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The Normal Physiological Aspects of Aging as They Relate to Nurse Aid Care

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THE NORMAL PHYSIOLOGICAL ASPECTS OF AGING AS THEY RELATE TO NURSE AID CARE

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An Abstract Presented to the Faculty of the Graduate School
of Lindenwood College in Partial Fulfillment of the
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ABSTRACT: The education of caregivers is essential to proper care. The retention of nurse aids in long-term care of the elderly can be enhanced by specific instruction in the physical aspects of aging as it relates to the required care. The educational level of nurse aids may not give them the perspective needed to interpret the changes they see taking place in the elderly. This paper provides some of that additional perspective.

Aging changes begin at the cellular level. Cell tasks are specific and functional. Aging effects changes in cell function and response with subsequent visible and experienced signs and symptoms of aging. Anatomical and physiological age-related changes are the subsequent result of the overall, ongoing aging process. The body systems are interrelated and interdependent. Skin and hair require a change in the aid care as they become dry and thin. The musculoskeletal system changes result in a loss of strength and height, and includes some visual changes, all of which require special aid attention. The nervous system changes result in a slowing of the response time to stimuli. The endocrine system oversees many of the age related changes. The endocrine system as well as the respiratory and circulatory systems, have few functions that the nurse aid can directly influence, yet the changes require knowledgeable aid care. The digestive and urinary systems are two of the systems most apparently affected as we age and aid knowledge of the changes can be of great assistance to the elderly. The reproductive system slowly undergoes changes in both the male and female. Aid awareness of these changes will yield better care for the elderly.

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Dedication

This labor is dedicated to the joy of learning and the utilization of knowledge. My gratitude is extended to instructors that have shared their excitement of life and love of learning.

To supportive parents that encourage learning, to daughters and their families that have gone without visits and phone calls because Mom had papers and homework to do, to friends that understand and to both family and friends that have encouraged and waited while I grew a little more, I dedicate this work.

Thank you.

M.

Acknowledgement

This project could not have been completed with such ease and expediency without the assistance of my husband, Thomas Ardean Edgar. His ruthless editing and pointed questions helped hone these pages while his knowledge of computers made it easy and his patience when I was unbearable, made it all come together. Thanks, Tom.

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Preface

This thesis started initially to be directed toward the nurse aid, for better understanding of physiological age-related changes people undergo as they age. Having chosen a topic I so dearly love, I must admit I succumbed to the topic. The writing is presented by body systems. Each chapter starts with normal physiology. The first chapter is cell physiology. With proper presentation, the cell is understandable and the concept and awareness of its functioning is important to the understanding of systems physiology. The intention was to present enough normal physiology for the age-related changes to be defined and displayed as the wondrous changes they are. In so doing, I became excited about some interesting items that had nothing to do with the age changes. Since I found them so very interesting and exciting I included them in the hope the information would spark excitement in others. The writing developed into a form that will be best used by professionals as a complete format to use in the instruction of nurse aids about physiological age-related changes. No attempt was made to address the social, emotional, spiritual or financial aspects of aging. The weight of this volume notwithstanding, there have been aspects of physiology that have been ignored since they do not relate to the aging process.

The second portion of this paper is what I refer to as the "linear" for no apparent reason other than it is not in sentence structure but is a line-by-line description of nurse aid actions and corresponding age-related rational for these actions. The attempt was made to set it out for ease of readability and reference.

Not all aid tasks are addressed. The aid tasks pertaining to the age-related changes have been presented. I make no pretense that all the tasks an aid would do relative to the physiology of aging have been included. Enough have been included for the thinking aid to become aware of the rationale for their actions regarding the aging changes.

The last section is another love of mine. In medicine, the words truly have meaning. If a new word is presented, break it apart and the understanding will be made easy and apparent. I have included word elements that will assist and hopefully make understanding easier. Attempts to define and explain the word by another means other than the one found in the text were sought. This was done to further explain beyond the text for the enjoyment of learning and the practicality of understanding. I gave thought to writing in nonmedical terms. The aid that has worked any length of time can and does hear and use some of the terminology used in this paper. The idea of the paper is to add to the knowledge the aid has and to encourage learning and growth.

It is my firm belief that presented with the joy and love I feel for this work, anyone, aid or novice, could understand, learn, enjoy and grow in this knowledge.

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INTRODUCTION

A resident swoons at how the doctor treats him so wonderfully, and the nurse seethes. The nurse feels she did the work; after all, all the physician did was visit the resident for a few minutes and write an unreadable note. The nurse tells the resident the problem will be addressed, writes a care plan and assigns tasks. The nurse feels she has the resident, the physician, and the problem in control. The aid seethes. The aid carries out the order, answers the call-light, listens to the resident and feels under-appreciated, over-used and definitely underpaid.

Physicians and nurses have continuing education classes for updating their body of knowledge. Their accumulation of continuing education units is required in some states. The aid has onsite inservices given by the staff of the institution. Some institutions and states require nurse aids be inserviced on an on-going basis. These inservices, often reiterate the basics such as how to give a shower or include reminder techniques on how to take vital signs. Aids voice a disgruntled slow moan and a collective 'they are talking down to us again' attitude. The type of inservices aids request directly correlates with the type of residents for which they have responsibility.

Aids have basic care instruction with 75 didactic hours, 100 hours actual training in giving the care, and a competence test prior to certification. While the geriatric resident is the primary focus of nurse assistants working in a long-term care facility, the normal aging process and the care a geriatric resident requires are just touched on in the aid's initial instruction. The 655 page Missouri State instructional manual suggested for long-term care nurse assistant training, would require covering nine pages per hour to complete. The pace is daunting. The content of some parts of the instruction is skimmed because other parts require more time. The elder's health changes are primarily disease based in the instructional material the aid receives. Some instructional material covers normal aging better than others, albeit minimally. The aids have a need for, and a right to, better understanding of the normal aging process. Having a knowledge of the normal aging process allows better recognition of the changes that are abnormal. The need for this project is rooted in the need for continuing education of aids in the normal aging process. The aid needs to be treated, addressed and cherished for the professional she/he is.

Objective

The plan is to address each physical system, how it normally changes with age, and what the impact is on aid care. Current literature (within the last five years), both book and published articles, will be used as reference. Applicable current aid instruction will be included in the works cited. The information will be presented in in-depth narrative and quick reference lineal form. A glossary will be developed as the chapters' progress. The focus will be the gerontological reasoning for the aid care. A review of a few of the aid manuals yielded a surprise in the depth of anatomy and physiology that is taught to the aids. This will be understood as basic and built upon in this aid directed presentation.

Goal

The goal of this writing is to have a developed, understandable delineation of the normal aging process that first line care givers can use to render care to the elderly. It is not meant to cover the diseases nor care of the ill elderly. All elderly, ill or healthy, have a need to understand, and have their carers understand, their normal physiological age related changes.

Anticipated Outline

The systems to be addressed will include the following.

Integument, Hair

Musculoskeletal System

- Muscular System/Skeletal System
- Bones, Joints, Muscles

Nervous System

- Central Nervous System
- Peripheral Nervous System

Senses

- Vision
- Hearing
- Taste
- Smell
- Touch

Respiratory System

Circulatory System

Digestive System

Urinary System

Reproductive System

Endocrine System

The "How come" and "Why" of aging is exciting and interesting, as well as necessary and beneficial for the care giver to possess. It enables delivery of informed care to the elderly.

TOPIC JUSTIFICATION

Health care service delivery has changed in the last twenty years. When the need for care was greater than the pool of qualified nurses could provide, aids were given the task of delivering the nonglamorous hands-on care. This was team nursing. The Registered Nurse (RN) lead the team. Health care tasks requiring a nurse's knowledge or training, were provided by the less educated Licensed Practical Nurse (LPN) and over seen by the RN. The Nurse Aid (NA), who was less educated than the LPN, and lower paid, did the actual bedside care. In the '70's the focus of care turned to primary care in acute care settings. The attitude then was that the care should be delivered by the individual with the education. In primary care, the RN was the team. She not only had the primary responsibility for the care, but also performed the actual tasks. She emptied the bedpans, gave bedbaths and made the beds, besides charting and interacting with the physician and hospital administration.

The financial aspect of medical care cannot be ignored. Cost is definitely a factor. The team approach to medical care is more cost effective than primary care and had never been eliminated in long term care facilities (LTC). Staffing an acute care center with a staff of RN's is not cost effective.

About the same time primary nursing was phased out, custodial care, which had long been the norm, was replaced with emphases on rehabilitative care. Rehabilitative care aims to restore to the resident their maximal physical and psychological fitness and independent living. The health care team focuses, organizes and carries out the rehabilitative effort with the resident. The health care team consists of many members and their presence on the team is mandated to accomplish the rehabilitative care. The team consists of one or more physicians, nurses, RNs, LPNs, NAs, dietitians, physical therapists, occupational therapists, activity therapists, social workers and more. Even the role of the barber and beautician cannot be ignored in making an institutionalized individual feel and look better. The complete team is now required in LTC facilities. Every one of the team members has their body of knowledge and each must be professionally qualified to be allowed to function on the team.

Each team member has a well-defined role. It is notable that the hands of the degreed members of the team remain clean and dry as the team operates. Within the team, increasing financial rewards follow the dry hands and education. It has been interesting to sit in seminars and listen to physicians that are involved in gerontology relate that because the elderly are their medical focus, they are looked down upon by their peers. They have said that it is a real struggle to be seen by the community as a real doctor, with skills and expertise on a par with other physicians. They relate they are viewed as physicians that cannot quite make the grade and are therefore relegated to the nursing home set. It is a very real problem that the geriatric physician faces. Being nonvalued or undervalued by peers takes its toll even on physicians. Again, however there is a real tendency to equate the value of a role on the team with the level of the financial reimbursement and the educational level of the person holding it. This translates to not thinking of the beautician or barber as a team member and thinking of the nurse aid as the least valued member of the team. Nurse aids carry out the team's collective voice in an attempt to reach the team goal. Being overworked, under appreciated, and low paid takes its toll on the nurse aid resulting in a high turnover rate. The turnover cycle begins as the NA seeks a facility or position that values and recognizes her contribution to the team. The estimated turnover rate for the NA's in LTC facilities is 40 to 74% annually (Waxman, Carner and Berkenstock 503). This is not just a problem for the personnel department and the team, but also has an impact on the residents that live in the LTC facility. The attachments and emotional bonds built as a result of the resident-aid partnership are torn apart when a trusted and valued carer leaves. The cost of replacement is emotional as well as financial, and takes its toll on the facility and resident.

The turnover of NA's is positively correlated with the aid's perception of control. The tighter the administrative control, the greater the supervision, the more formal the structure, the higher is the turnover rate of nursing personnel (Waxman, Carner and Berkenstock 508).

Finding a position is not a problem for the NA. There are open positions for NA's that seem to go unfilled. For the new NA, the glamour of being in the medical profession soon evaporates. Various approaches to solving the NA turnover problem have been addressed. Changing the organizational milieu, allowing the NA to participate in the problem-solving process, allowing some flexibility in daily coping tasks, talking among peers, sharing the emotional load, finding one's personal stress reliever and continual reviewing and upgrading of the educational and knowledge level of the nursing staff, all have the potential for decreasing burnout (Heine 16-7).

The requirement for certification of an individual as a nurse assistant in the State of Missouri includes 75 didactic hours and 100 on-the-job training hours. Competency is verified by a written test and a practicum test.

> "The program shall consist of a basic course consisting of a minimum of seventy-five classroom hours of training on basic nursing skill, fire safety and disaster training, resident safety and rights, social and psychological problems of residents, and the methods of handling and caring for mentally confused residents such as those with Alzheimer's disease and related disorders; one hundred hours of supervised on-the-job training (Clinical practice); a final examination; and, following the basic course, continuing inservice training...(Blunt 1993)."

Geriatric physicians are getting together and learning about their chosen field at the same time they are elevating the geriatric field to a specialty area. The NA is being educated on a continuing basis as required. Depending on the facility and its staff, NA's are inserviced in the same basic nursing skills that they were taught initially.

In some LTC facilities, the NA is valued and is retained by the facility by being wooed with further education, the successful completion of which results in a percentage salary increase. Genesis Health Ventures, based in Kennett Square, Pennsylvania, has a program called Geriatric Nursing Assistant Specialist Program (GNAS). It is an education incentive program for the NA. Their numbers are impressive. A total of 533 employees graduated from the program as of May 1991. Over the next three years and two months, 94 percent remained with

Genesis Health Ventures, with 5% of the total group having gone on for additional education (Cover letter Genesis Health Ventures). Swope Ridge Geriatric Center (SRGC) in Kansas City, Missouri, is making a proactive choice in NA retention by adopting the GNAS program.

> "The overall program objectives are:
> - to increase the skills and knowledge of direct care personnel
> - to allow for more autonomous decision making on the part of the GNAS graduates
> - to allow GNAS graduates to assume an expanded role within SRGC
> - to reduce job turn over through increased financial incentives and improved employee morale
> - to improve the care of SRGC residents as a result of the preceding objectives."
>
> (Swope Ridge Geriatric Center)

The curriculum of GNAS program includes anatomy, physical assessments and pharmacology. The course is offered in the local Kansas City Community College. It is granted to applicants based on eligibility criteria and financed by SRGC through grant or foundation funding. Successful completion results in an increase in pay for the aid. Carol Smith, Director of Education for SRGC, wrote that of their successful graduates through September of 1992, they continue to enjoy a retention rate of 88 percent as of December 1993 (Letter dated December 28, 1993). In a phone conversation with Ms. Smith, she could not praise enough the increased incentive and focus shown by the individual participants and the quality of care they render as a result of the special education and attention. They have become very strong and valued participants of the team.

The classes include: exploration of the nursing center, staff and residents;

functional assessment; vital signs and fluid balance; cognitive status; death and dying; common diseases of the elderly and advanced skills (Module Descriptions, Genesis Health Ventures).

Specifics of the Genesis program could not be discussed with Ms. Smith because it is copyrighted and protected. She did say it does not include the normal physiological aspects of aging. However, she indicates the need for in-depth organized education with focus on the normal aspects of aging.

Everyone needs to feel they are valued and able to make a contribution in their field of choice. All gerontological health care professionals, at any level of education, need to be recognized for their efforts in the health care of the elderly. Consistent quality care is needed and required. Steps that will decrease the aid turnover rate will be advantageous financially and medically to the institution and to the resident.

CELL PHYSIOLOGY

Aging is an ongoing individual process. We all do it but at different rates. Our various body systems and system components' age at different rates also. We have all met people that do not look their age. We may observe someone of a given chronological age doing a task that is considered extraordinary for a person of that age, like the one finger push up Jack LaLane does for the television cameras where the typical view of a person's activity at that age is relaxing in a recliner.

The Cell

To have a better understanding of the physiology of aging, a cursory introduction to cell physiology is in order.

> The basic building block of all living organisms is the cell. Cells have a cell membrane, which is it's outer covering and helps it hold its shape. The cell's control center is the cell nucleus; it is in the center of the cell. Cytoplasm surrounds the nucleus and extends to the cell membrane. Within the cytoplasm are many structures, all with their own task to do. Collectively, they are called organelles.
>
> They include:
>
> Ribosomes: involved in protein synthesis for use inside and outside of the cell.
>
> Mitochondria: function in the metabolism and cellular respiration of the cell; they produce energy.

Lysosome: a membrane-bound vesicle that can digest, by means of hydrolytic enzymes, its contents into simpler molecules that then enter the cytoplasm.

Nucleolus: is composed largely of Ribonucleic Acid (RNA) for ribosome formation.

Endoplasmic reticulum: tubular canals continuous with the nuclear envelope. They branch throughout the cytoplasm creating a transportation system by means of its vesicles. It is called rough when studded with ribosomes and it synthesizes protein. It is called smooth when it is without ribosomes and it synthesizes lipid and carbohydrate synthesis.

The nucleus is the largest organelle in a cell and contains 46 thread like structures called chromosomes. Chromosomes are the genetic material or the deoxyribonucleic acid (DNA) of the body. DNA are the genes that control our physically inherited traits. It is the genetic material that replicates and directs protein synthesis in cells. The nucleus also contains RNA. DNA, with the help of RNA, assists in protein synthesis within the cytoplasm.

Cells come in different types because they have different tasks. Cells of the same type join together to form a tissue. Different tissues make up an organ. Various organs make up an organ system. Lastly, organ systems make up an organism.

Tissue Types

There four types of tissue: epithelial tissue, connective tissue, muscle tissue and nerve tissue.

Epithelial Tissue

Epithelial tissue covers the outside of our body and most of our inner cavities. It lines our nose, mouth, respiratory tract, stomach, and intestines. Our skin, hair, nails and glands are made of epithelial tissue. Epithelial tissue comes in different shapes according to the task it must perform. It can be single or multi-layered, ciliated and/or secretory. In its various forms it can provide filtration, diffusion, osmosis, secretion, absorption, protection and movement.

Connective Tissue

Connective tissue binds organs and structures, provides support, protects, insulates and stores fat. It transports gases, nutrients and wastes, fights infection; and provides blood clotting throughout the body. Connective tissue includes bone, blood and cartilage. Blood is unlike other types of connective tissue in that it is not made by the cells.

Muscular Tissue

Muscular tissue allows the body to move by bending and stretching. There are three types of muscle tissue; skeletal, smooth and cardiac. Skeletal muscular tissue is attached to the skeleton and is under voluntary control. Smooth muscular tissue controls the action of the stomach, intestines, blood vessels and other body organs and is involuntarily controlled. The third muscle group is cardiac muscle. It is involuntary and is only found in the heart.

Nerve Tissue

Nerve tissue is found in the brain and spinal cord. It receives and carries impulses to the brain and back to the body parts.

(Mader 1992; Sorrentino 1992)

AGE-RELATED CHANGES IN CELL PHYSIOLOGY

Age-related changes affect all cells, organs, and systems (Chirst and Hohloch 48). The changes are initially quite apparent. Babies grow and develop at an alarming rate. The milestones such as tooth development and initiation of locomotion, crawling and walking are anticipated and treasured. Later, the grade level in school is looked upon as verification of age progression. With a few more years, tasks such as driving, drinking and voting are looked at as rites of aging. Every age milestone is marked with privilege. The time comes when the milestones grow few and far between; having children ceases and active employment ceases. The toll of the ravages of time begin to display themselves Aging does not cease until life itself ceases.

All systems have changes that are manifested with aging. These are not disease driven changes but are the results of the normal physiology of aging. The physiologic decline occurs independent of disease; however, it does make the elderly more susceptible to disease.

THE INTEGUMENT

Skin

One of the most apparent and important organs of the body is the skin. It is what we and others see and it envelops and protects all the other organs of the body. For health care workers knowing the physiology of the skin is important. Understanding what is normal as well as normal changes that occur with aging, provides the health care worker with a basis to evaluate the skin and its appendages.

The skin is the body's first line of defense against disease. It is a barrier organ (Kurban and Kurban 30). The skin is the body's largest organ, and measures about 21 square feet in an average adult (Mader 59; Silverberg and Silverberg 131). The skin has many functions in addition to protection including absorption, secretion, excretion, thermoregulation, accumulation, sensory perception, immunity and the manufacture of pigment cells (pigmentogenesis) (Cerimele, Celleno and Serri 13). It is 15% of the total body weight, provides a protective shield against bacteria and viruses, and absorbs shocks that might otherwise damage the bones and the internal organs (Corr and Corr 72; Mader 58). Skin functions are reduced by 50% after middle age (Cerimele, Celleno and Serri 13). The skin is also one of the first places where we notice signs of aging , specifically atrophy, wrinkling, sagging and laxity (Lapiere 5; Perlumutter and Hall 36). It becomes thin and semitransparent, does not regenerate as fast, and is prone to dryness and pruritus, (an intense, chronic itching) (Silverberg and Silverberg

131). Itching skin, pruritus, and chapping are common problems with the elderly (Kurban and Kurban 40; Perlmutter and Hall 86). Vitamin A deficiency, excessive bathing, urticaria (hives or rash that itch), a reaction to alkalizing effect of soap on dry skin, drug reaction or various degenerative diseases may be the culprit (Kurban and Kurban 40; Perlmutter and Hall 86). It also becomes rough and scaly in appearance and texture with the slowing of cell replacement (Perlumutter and Hall 36; Silverberg and Silverberg 132). Cellular changes are dramatically apparent in the fat deposits that insidiously accumulate on the cheeks, belly, buttocks, thighs and elsewhere, while simultaneously, some muscles atrophy and arthritis develops (Montagna and Carlisle 61).

Cell replacement takes about 20-21 days in the 18 to 50 year old (Perlumutter and Hall 36). Replacement slows to about every 25 days after age 50, to 31 days in the 6th decade and to 37 days in the 7th decade (Perlumutter and Hall 36). According to the Silverberg's, cells replicate every 42 days by the time we are in our thirties and continue to take longer with each additional decade (Silverberg and Silverberg 132). Either way, as we age we slow down, even on the cellular level.

Human skin is not only skin deep. In fact, it is among the body's most complex organs. Of its three main layers, only the paper-thin epidermis is normally visible (Mader 58). The epidermis is the outer, thinner layer of the skin. It is completely cellular and itself has four layers, the lowest of which has basal cells, melanocytes, where melanin is produced, and Langerhans cells which are important in the development of delayed hypersensitivity (Kurban and Kurban 30; Silverberg and Silverberg 131). It also contains keratinocytes and the stratum corneum, a nonliving keratinous layer (Kurban and Kurban 30). It is made up of stratified squamous epithelium, which is produced continually by a bottom layer of cells called basal cells(Mader 59). As new cells are formed, they are continually migrating upward and gradually flattening (Mader 59; Silverberg and Silverberg 131). They lose their nucleus, harden and are shed (Mader 59; Silverberg and Silverberg 131).

"The sweat glands do double duty, helping to eliminate wastes and to cool the body. On a hot day, the skin can release up to 2,500 Kcalories of heat (Mader 58)." In the aged skin sweat glands decrease in number and those that continue to function secrete less sweat (Perlmutter and Hall 86). This can increase the susceptability of the aged to heat stroke due to impaired heat loss through evaporation of sweat and decrease the source of body odor due to decreased apocrine sweat glands in the armpits and genital area (Perlmutter and Hall 86).

The hardening of the skin is caused by cellular production of a waterproof protein called keratin (Mader 59). Over much of the body, keratinization is minimal, but the palm of the hand and the sole of the foot have a particularly thick outer layer of dead keratinized cells arranged in spiral and concentric patterns (Mader 59). We call these patterns fingerprints and footprints (Mader 59). Eventually, cells die and are sloughed off (Mader 58).

"The specialized cells in the epidermis called melanocytes produce melanin, the pigment responsible for skin color ...(Mader 59)." Melanin is produced in the epidermis' lowest layer in an attempt to protect itself from the damaging effects of ultraviolet radiation from sunlight (Mader 59). In the aged, the sluggish regeneration of melanocytes causes clumping irregularly which produces a mottled appearance of the skin (Silverberg and Silverberg 132). The number of the enzymatic active melanocytes decrease in the elderly either by loss of the cell or by just ceasing to produce pigment (Montagna and Carlisle 61; Silverberg and Silverberg 131). This leaves the elderly vulnerable to the effects of the sun.

Beneath the epidermis is the dermis, and below that is the subcutaneous layer. "In a square inch of skin, you will find 20 blood vessels; 65 hairs and muscles; 78 nerves; 78 sensors for heat, 13 for cold, 160-65 for pressure; 100 sebaceous glands; 650 sweat glands; 1,300 nerve endings; and 19,500,000 cells (Mader 58)." The epidermis and dermis are separated by an undulating network of ridges (Silverberg and Silverberg 131). The epidermal thickness remains constant throughout life but the dermis atrophies and its thickness may decrease by as much as 20% in elderly persons (Silverberg and Silverberg 131). This accounts for the paper-thin, almost translucent quality of older skin, and predisposes the easy separation contributing to increase skin fragility (Kurban and Kurban 30; Silverberg and Silverberg 131).

Cross-linkage stiffens elastic fibers and collagen in the deep skin layers, making the skin less pliable (Perlmutter and Hall 86). As the process of aging continues the skin becomes thinner and drier, while fat deposits directly beneath the skin diminish, and muscles decrease in size. (Perlmutter and Hall 86). This progressive atrophy of the dermis leads to folds and wrinkles of the aging skin (Lapiere 5). Over all, the major changes of the aged skin include dryness, which is really roughness, wrinkling, laxity, uneven pigmentation, and an onset of a variety of proliferative lesions (Silverberg and Silverberg 131). The inevitable occurs, the skin sags (Corr and Corr 73; Perlmutter and Hall 86).

The number of Langerhans cells, which are thought to have a role in the immune response, decrease by about 50% in the elderly (Montagna and Carlisle 61; Silverberg and Silverberg 132). This decrease effects the immunoresponsiveness in the skin of the elderly thereby slowing their rate of tissue healing (Corr and Corr 72; Silverberg and Silverberg 132).

The dermis is a layer of fibrous connective tissue that is deeper and thicker than the epidermis (Mader 59; Silverberg and Silverberg 131). It is composed of proteins, mucopolysaccharides, and several cell types and contains elastic fibers, collagen fibers, blood vessels, nerves, muscle and reticulo-endothelial cells (Kurban and Kurban 30; Mader 59; Silverberg and Silverberg 131). "The collagen fibers form bundles that interlace with each other and, for the most part, run parallel to the skin surface.(Mader 59)."

There are several types of structures in the dermis. The hair, except for the root, is formed of dead, hardened epidermal cells; the root is alive and resides in a hair follicle found in the dermis. Each follicle has one or more oil (sebaceous) glands that secrete sebum, an oily substance that lubricates the hair and the skin..(Mader 58)".

"A smooth muscle called the arrector pili muscle is attached to the hair follicle in such a way that when contracted, the muscle causes the hair to "stand on end." (Mader 59)

Sweat (sudoriferous) glands are quite numerous and are present in all regions of the skin (Mader 59). A sweat gland begins as a coiled tubule within the dermis, but then it straightens out near its opening (Mader 59). Some sweat glands open into hair follicles, and others open onto the surface of the skin (Mader 59). Decreased eccrine sweat production makes body temperature difficult to regulate.

"Small sense organs are present in the dermis. There are different sense organs for touch, pressure, pain, and temperature. The fingertips contain the most touch receptors, and these add to our ability to use our fingers for delicate tasks (Mader 59)."

"The dermis also contains nerve fibers and blood vessels (Mader 59)." The cells and blood vessels of the dermis decrease in number with advancing age (Silverberg and Silverberg 132). Capillaries become fragile resulting in the bruises under the skin surface known as senile prupura (Corr and Corr 73). Sensory perception is reduced, decreasing pain sensation; as a result of the loss of nerve fibers.

Reduced sebum production leaves the skin dry, rough and itchy (Corr and Corr 73; Silverberg and Silverberg 132). The sebum quantity cannot be changed with the use of skin care products (Raab 39). The oil produced by the sebaceous glands help keep the skin looking young. Oil-producing glands begin to atrophy in women after menopause and because of this their skin starts to demonstrate signs of aging about ten years before men (Perlmutter and Hall 85). The physiological cell atrophy is delayed in men compared to women with men's skin remaining thicker and oilier postponing wrinkles (Perlmutter and Hall 85). Daily shaving scrapes old cells from the top layer of skin thereby speeding the growth of the new cells from lower skin layers which may help keep men's skin looking young (Perlmutter and Hall 85).

Cell changes result in the most common bothersome pathologic changes in the aged skin, xerosis and pruritus (Silverberg and Silverberg 133). Xerosis, is dry. skin. It is the most common cause of pruritus or itching in the elderly (Silverberg and Silverberg 133). It is almost universally found in persons over age 60, primarily on the lower legs, but can be seen over the entire body surface (Kurban and Kurban 40; Silverberg and Silverberg 133). It is a progressive dryness of the skin especially during the winter months and as a result of frequent bathing (Kurban ana Kurban 40). Adding to the cause of Xerosis are the age related changes of the epidermis which include development of wrinkles (Raab 40; Silverberg and Silverberg 133). Wrinkles are an irregular surface area. They thereby increase the amount of surface area from which to loose moisture. Wrinkles subsequently decrease protection from rapid water evaporation increasing dryness of the skin (Raab 40; Silverberg and Silverberg 133).

The subcutaneous layer, which lies below the dermis, is composed of loose connective tissue, including adipose or fat tissue. Adipose tissue separates the skin from the underlying layer of tissue or fascia and muscle and helps to insulate the body from the inside (Corr and Corr 72; Mader 59; Silverberg and Silverberg 131). The fat distribution for men under 50 is primarily between skin and muscle tissue, but in his 60's and 70's the fat infiltrates in and between muscles (Perlmutter and Hall 86). Weight gain for men continues until mid-fifties while weight gain for women continues until they reach their mid-sixties (Perlmutter and Hall 88). At later ages, both sexes tend to lose weight (Perlmutter and Hall 88).

Muscle death and atrophy is age related and with it comes decreased muscle strength, tone, flexibility and speed of movement (Perlmutter and Hall 86-8). At about age thirty, muscle strength begins to decline. Muscle cells cannot replace themselves (Perlmutter and Hall 86). Losses in the strength of leg and trunk muscles progresses faster than those of arm muscles at a rate of 10 to 20% until about 70 years of age (Perlmutter and Hall 88). Beginning about age 39, muscle mass begins to shrink (Perlmutter and Hall 86). The muscle fibers decrease in number and diameter and are replaced with fat (Perlmutter and Hall 86). Over age 70, strength ebbs until only 50% of earlier strength remains (Perlmutter and Hall 88). Half of this age-related decline may be due to reduced physical activity (Perlmutter and Hall 88).

Skin Lesions and Growths

Age spots or liver spots are common in aged Caucasians with fair skin.

These spots are caused by the pigment-containing cells in the skin decreasing in number with age and are encouraged by exposure to sun. (Perlmutter and Hall 86). These pigment-containing cells decrease in number but increase in size and sometimes cluster on the hands, forearms, or face resulting in a dark area or spot (Perlmutter and Hall 86).

Keratoses, are not a result of the aging process but do enlarge and have additional permanent growths in the aged and so are associated with aging process (Perlmutter and Hall 86). They are warty growths that may be dry and light-colored or greasy and dark-colored, located anywhere on the body (Perlmutter and Hall 86). Seborrheic Keratosis start to appear around the 5th decade and gradually increase in number (Kurban and Kurban 33). They are a benign overgrowth of horny tissue that look like superficial stuck-on dark brown growths (Kurban and Kurban 33). Five to 20 mm in diameter, with a convoluted surface, they usually develop on the trunk and face (Kurban and Kurban 33). Except for cosmetic purposes special care or treatment is not needed, then destructive means are appropriate (Kurban and Kurban 33).

Skin tags, harmless and related to hormone levels, are small pendulous skin growths which often appear on the chest, neck, eyelids, and armpits of older women (Perlmutter and Hall 86) and men.

Cherry angioma is another normal aging skin formation (Kirban and Kurban 41). They are asymptomatic bright red, dome-shaped papules, occuring mainly over the trunk (Kurban and Kurban 41). They appear in the fourth decade and gradually increase in number thereafter (Kurban and Kurban 41). No treatment or special care is needed but they can be excised if desired (Kurban and Kurban 41).

AGE-RELATED CHANGES OF THE SKIN

A summary of the age related skin changes includes thinning of the skin, loss of elasticity, deepening of expression lines, and a smooth, unblemished surface as the results of flattening of dermal-epidermal junction and effacement of rete ridges, decreased melanocytes, decreased Langerhans' cells, dermal atrophy, decreased area of superficial vascular plexuses, and progressive loss of elastic tissue in the papillary dermis (Kurban and Kurban 35). The overall appearance is smooth, even if it has angiomas with a dry scaly, itchy and wrinkled surface and thin epidermis.(Raab 38).

HAIR

Hair is considered an appendage of the skin (Sorrentino 52). Except for the palms of the hands and the soles of the feet the entire body is covered with hair (Sorrentino 53). In many mammals hair is of vital importance in thermal insulation (Messenger 4S). Human hair, however, is social and sexual in communication both visually and in dispersing scents secreted by skin glands (Messenger 4S). Humans, when compared to other mammals, are relatively hairless and our hair is not necessary for the survival of our species (Messenger 4S). Those that suffer from alopecia universalis, or total hair loss, however may not feel that way. Hair does have functional tasks. The hair of the nose, eyes, and ears protects these organs from dust, insects, and other foreign objects (Messenger 4S; Sorrentino 52). These are the hairs that start to change texture, become stiff and turn gray in the nares of both men and women at about age forty. Older men also develop coarse hairs on their ears. Hair follicle development depends on a series of messages between the dermis and the epidermis (Messenger 4S). The dynamics of the hair growth cycle vary between different species, between different body sites in the same species, and between different follicle types in the same body site (Messenger 5S). Hair growth slows down with aging by as much as 50% and it loses it's pigmentation, turning gray (Corr and Corr 73; Silverberg and Silverberg 132). We, like other animals, have seasonal variation of hair growth although it is seldom sufficient to be noticeable (Messenger 5S).

Androgens are steroid hormones, mainly androsterone and testosterone. They are produced by both the male and female (Miller and Keane). Humans show androgen-induced changes in hair growth (Messenger 6S). Androgens alter the size of the hair follicle and the diameter of the hair fiber and modify the duration of the hair growth cycle (Messenger 7S). Men castrated before the age of puberty neither grow beards nor go bald unless they are treated with testosterone (Messenger 6S). Castration of older men prevents the progression of balding but does not reverse it (Messenger 6S). Beard growth is partially reversed by castration, the reversibility being greatest in those who are castrated at an early age (Messenger 6S).

AGE-RELATED CHANGES IN HAIR

The aged have fewer hair follicles by number with the scalp having a noticeable decrease in hair follicles but their structure remains unchanged (Montagna and Carlisle 61, 67). By middle age, both men and women have some scalp hair loss (Perlmutter and Hall 84). Hair density has decreased by 25% by age 50 (Perlmutter and Hall 83). With age, more hair follicles everywhere on the body are in the telogen stage or resting phase of growth (Montagna and Carlisle 67). They rest longer and take longer to develop in the growth phase. Not all body hairs thin (Montagna and Carisle 67). Chest hair in men begins to decline at about 50 years of age while the axillary hair does not decline until about 40 and then more so in women than men (Montagna and Carlisle 67). The pattern of hair growth undergoes age-related changes (Christ and Hohloch 38). Hair growth in men decreases on the scalp while hair growth on the ears and eyebrows increase; beard growth remains unchanged (Christ and Hohloch 38; Perlmutter and Hall 83). Hair growth in women after menopause becomes sparse in the axillary and pubic region and may even disappear while facial hair growth is common in Caucasian women (Christ and Hohloch 38; Perlmutter and Hall 83).

Aging and gray hair go hand in hand (Ortonne 22). Onset may differ but no race or sex is spared (Ortonne 22). Melanocytes give color or pigmentation to hair and skin. The progressing or total loss of the melanocytes by the hair bulb results in gray hair (Cerimele, Celleno and Serri 14; Ortonne 21). Graying of the hair begins with the slowing of pigment production in the hair follicles (Perlmutter and Hall 83). Onset of graying is genetically determined although it is not unusual to have graying hair begin in the twenties or early thirties it usually begins in the late fourth or early fifth decade (Ortonne 22; Perlmutter and Hall 83). The sequence of graying begins with the head hair, then the beard and body hair, with the hairs of the chest, pubic and axillary regions possibly retaining their pigment even into old age (Ortonne 22). The pattern of graying scalp hair usually begins at the temples, then slowly progresses to the top of the head, then to the remainder of the scalp (Ortonne 22). Except for a few cases of reported reversal of graying, it is usually irreversible (Ortonne 22) unless bottle products are used.

Maintaining independence is a prime team goal in working with the elderly. Encouraging and fostering self care is not abandoment of a task. In fact it may take more time and more effort on the part of the aid. AM and PM care have special grooming tasks that need to be completed. If the residents can do for themselves, then allow for the time in your work schedule. Preparing for the day's activities and then again preparing for the night's rest, is a major energy expenditure activity for both the aid and resident.

Good grooming is important. Hair care is part of AM and PM care. Some men like to grow a beard or mustache. Keeping facial hair trimmed is usually the task of the barber. The barber should also cut the hairs in the nares and on the ears of men when he cuts the hair. Some women like their legs and underarms shaved on a regular basis. Keeping a man shaved is the task of the aid. Hair cuts may be less frequent as we age due to the slowing of hair growth. Since seasonal hair loss is barely noticeable it would be appropriate to be concerned over noticeable hair loss or thinning since it can be indicative of an underlying illness or medication reaction.

Plucking hair has also been used as a way to get rid of unwanted hair. Plucking hairs in the resting cell cycle state advances the onset of new growth (Messenger 5S). Since plucking hairs encourages new growth and leaves an opportunity for infection; plucking of the nares and ear hair should be avoided. Women, too, need the coarse hair in their nares clipped. There are inexpensive battery powered clippers especially for this task. It would be dangerous to tweeze, or clip with sharp pointed scissors.

Graying hair does not require special treatment. The decreased oil production does require less frequent washing however. The intervals for hair washing depend on the condition and need of the hair and scalp. Too frequent washing can further dry the hair and scalp while too infrequent washing can leave the resident disheveled and malodorous. Hair tensile strength and shaft diameters decrease with aging. This, along with the decrease in the sensations of the touch, pressure, pain and temperature receptors all necessitate gentle handling when caring for the hair and scalp of the elderly individual. Gently massaging the scalp while avoiding scratching is invigorating, and stimulating, and can make hair washing a pleasure. Burns can occur without awareness due to decreased touch, pain, pressure and temperature receptors; therefore precautions must be taken to protect the resident. Avoid water that is hot. Curling irons and blow dryers need to be used with caution.

Hair thinning or balding in both men and women may be difficult to adjust to. Tact and finesse is necessary when giving care to women who have facial hair and need to be shaved or clipped regularly. Acceptance by self and others is important to everyone's self-esteem.

Nails and Their Age-Related Changes

Nails are also considered appendages of the skin (Sorrentino 53). They protect the tips of fingers and toes and help fingers pick up and handle small objects (Sorrentino 53). The nail growth (Silverberg and Silverberg 132) and strength decrease with age (Christ and Hohloch 38). Longitudinal nail ridges become more numerous and prominent with aging (Christ and Hohloch 38). With advancing age growth of nails decreases by as much as 50% (Corr and Corr 73; Silverberg and Silverberg 132). Drying of the nails also occurs with aging.

Good aid care includes good nail care. Caution must be practiced when giving nail care because of the decreased sensation to pressure and pain. Frequent hand washing of resident and staff is necessary for acceptable hygiene. Hand and foot soaks are not only soothing and comforting, but in addition make nail care easier. Nail care is definitely easier after bathing or showering. The nail is not as brittle after soaking. Nails that are kept short and well groomed will prevent splitting and tearing. Nail clippers and emery boards usually will be the only equipment needed. The diabetic's nail care remains the responsibility of the nurse.

MUSCULOSKELETAL SYSTEM

We are all seen from the outside. Our external appearance is the first impression we make. Our physical stature, how we stand, how we walk, is in large part determined by our muscle tone and our skeleton framework. The framework over which skin is draped is called a skeleton. The skeleton is made up of 206 bones that are held together with muscles, tendons and cartilage. The muscles also provide form and function to the body. To understand the changes brought on by aging, the normal physiology need to be explored. Changes in the composition of the musculosketal system are a normal physiological aspect of aging (Perlmutter and Hall 88). They happen throughtout life while growing to maturity and continue after maturity as a degenerative process. All changes start at the smallest level and can proceed to affect the total system.

The skeletal system and the muscular system are so related to each other the single term musculoskeletal system, is used to refer to them (Badasch and Cheseboro 288). Musculoskeletal refers to the combined work of both systems (Badasch and Cheseboro 288). The musculoskeletal system is made up of a boney skeleton which is held together by muscle and connective tissue, such as tendons, ligaments and cartilage (Burke and Walsh 258; Sorrentino 53). The skeleton provides structure and allows movement (Burke and Walsh 258; Medcom 5). The type of muscle that moves the skeleton and provides motion and form are the voluntary skeletal muscles. To allow specific types of motion between particular skeletal members there are three types of joints; the hinge, the pivot, and the ball and socket (Mader 221). The system includes fluid filled sacks that allow ease of movement at joints which are called synovial membranes and the fluid they contain is called synovial fluid (Mader 221). To understand the changes resulting from the aging process, it is necessary to know the cellular structure and make up of the skeletal system and the muscles that move it.

Connective Tissue

The 206 bones are held together, in part, by connective tissue which binds the structure together, provides support and protection, fills spaces, stores fat, and forms blood (Mader 54). There are five types of connective tissue; (1) loose connective tissue, (2) fibrous connective tissue, (3) cartilage, (4) bone and (5) blood (Mader 54). Loose connective tissue, which is found primarily beneath epithelial layers, binds structures and includes fibroblasts. Fibroblast cells are widely spaced and are separated by jellylike substance (Mader 54). This jellylike matrix has either white collagen fibers, which provide flexibility and strength or yellow elastic fibers, which are not as strong as collagen but are more flexible (Mader 54). Adipose tissue is a connective tissue that insulates the body and stores fat (Mader 54).

Fibrous connective tissue binds body parts (Mader 54). Tendons, which connect muscles to bones and ligaments which connect bones to other bones at joints are two types of fibrous connective tissue (Burke and Walsh 259; Mader 54; Sorrentino 55). Fibrous connective tissue contains tightly packed collagenous fibers (Mader 54). The blood supply of the tendons and ligaments is poor and therefore these tissues take a long time to heal when injured (Mader 54).

Cartilage is another type of connective tissue. The cells of cartilage are in small chambers separated by matrix that is an intercellular substance that is solid yet flexible (Mader 54). Direct blood supply to cartilage is lacking and therefore it too heals very slowly (Mader 54). There are three types of cartilage, each with a different matrix (Mader 54). Hyaline cartilage is found in the nose, at the ends of long bones and the ribs, and in the supporting rings of the windpipe (Mader 55). Elastic cartilage is found in the auricle of the ear (Mader 55). Fibrocartilage is found between the vertebrae in the backbone and wedges of fibrocartilage are found in the knee joint (Mader 55).

The most rigid connective tissue is bone (Mader 55). The matrix of bone is made of calcium salts that are around protein fibers (Mader 55). Bone compressional strength is provided by calcium (Burke and Walsh 259). Bones provide storage areas for inorganic calcium and phosphorus salts (Mader 215). Bones also provide attachment sites for tendons and muscles (Mader 215). The 206 bones in the body are grouped into four types: (1) long bones that bear the body weight; (2) short bones which facilitate ease of movement; (3) flat bones that protect; and (4) irregular bones that allow various degrees of movement and flexibility (Sorrentino 55). Bones are hard, rigid, and made of living cells (Sorrentino 55). They are covered by a membrane called periosteum (Sorrentino 55). Periosteum contains blood vessels that supply the bone cells with oxygen and food (Sorrentino 55). With all of this, bone is not solid. Compact bone forms the shaft of long bone and contains canals that have nerve fibers and blood vessels running through them (Mader 55). These vessles feed the bone and allow for renewal of the cells (Mader 55). The ends of long bones are spongy bone (Mader 55). Spongy bone are bony bars and plates arranged with irregular spaces (Mader 55). Spongy bone is designed for lightness, strength, and stress (Mader 55). The end of spongy bone is surrounded by cartilage (Mader 215).

Many of the bones also have other functions. Flat bones, located in the skull, ribs and the breast bone produce red blood cells and protect their contents (Mader 215; Sorrentino 55). Spongy bone is often filled with red marrow which produces red blood cells (Mader 216). Long bones have a central core cavity and usually contain yellow marrow that is a fat-storage tissue (Mader 216).

Bone cells are continually being broken down and generated (Burke and Walsh 258; Corcoran 537; Mader 216). Bone is a living tissue, made of living cells and is always being replaced (Burke and Walsh 258; Mader 217; Perlmutter and Hall 88; Sorrentino 55). Bone growth is controlled by growth hormones, sex hormones, physical activity and weight bearing (Burke and Walsh 258; Corcoran 537; Mader 216). While calcium loss from bone begins immediately after bed confinement, more gradual calcium loss accompanies the decreased activity level of the aged or those with chronic illness (Corcoran 537). Ten percent of the skeleton is remodeled each year during young adulthood (Perlmutter and Hall 88). The formation and resorption of bone is about equal between the ages of 30 and 50 (Burke and Walsh 259). After that time, resorption gradually becomes greater than formation, thus extracting calcium and destroying the bone's organic matrix, thereby diminishing bone mass (Burke and Walsh 259; Christ and Hohloch 45). This process is faster and therefore greater in women than in men (Burke and Walsh 259). There are a number of reasons for this among which is the fact that women usually have smaller skeletal build than men to start with. Women have noticeable acceleration of bone loss with the cessation of menses (Burke and Walsh 259). This accelerated rate continues for five to ten years, in women (Perlmutter and Hall 88). It then slows while men's bone loss is slow but steady (Perlmutter and Hall 88). "Both aging and disuse change the body composition and metabolism in similar ways: a) decreased lean body mass, b) increased body fat, c) calcium loss, d) decreased cortical thickness of bone, e) decreased glucose tolerance, f) lowered mean body temperature, and g) diminished serum androgen levels resulting in decreased spermatogenesis and libido (Corcoran 538)."

The skull has eight bones which, except for the jawbone, are essentially a single unit in the adult. The skull contains sinuses which are air spaces (Mader 217). These air spaces minimize the weight of the head and provide resonant sound to the voice (Mader 217).

The spine or vertebral column extends from the skull to the pelvis and serves as the backbone for the body (Mader 218). It is composed of intervertebral disks of firbrocartilage that are located between vertebral disks of bone (Mader 218). It is the area of initial, and significant loss of bone mass due to aging (Burke and Walsh 259). This loss of bone mass leads to compression fractures of the vertebral column (Burke and Walsh 259). The outside of the bones also deteriorates with age and becomes brittle, leading to fractures (Burke and Walsh 259; Sorrentino 98). Much of our perception of the aged is due to the effects of age on these structures. The typical aged person is thought to be stooped forward, with their head tilted backward and their knees, hips, and elbows flexed (Christ and Hohloch 37).

The pectoral girdle and pelvic girdle along with their extremities compose the appendicular skeleton (Mader 218). Each has special capabilities. The pectoral girdle and upper limbs are specialized for flexibility, whereas the pelvic girdle and lower limbs are specialized for strength (Mader 218). They undergo altered body proportions in aging that include a decrease in shoulder width, and an increase in diameter of the chest, pelvic, and abdominal areas (Christ and Hohloch 37; Perlmutter and Hall 88). Loss of calcium, cartilage and muscle contributes to these structural changes (Christ and Hohloch 37; Medcom 5; Perlmutter and Hall 88). The intervertebral distances narrow and vertebrae become thinner, shortening the trunk, while the center of gravity moves from the hips to the upper torso affecting the ability to walk and maintain balance (Christ and Hohloch 37; Medcom 5; Perlmutter and Hall 88).

Joints

A joint is the point of articulation between bones (Burke and Walsh 259). Joints are categorized according to the amount of movement they allow (Mader 220). The three types of movement are; 1) immovable, i.e., skull bones; 2) slightly movable, i.e., vertebrae; or 3) freely movable i.e., the knee (Mader 220). Joints that are freely movable have a synovial capsule between two bones that allow for pain free ease of movement (Mader 220; Sorrentino 55). Synovial fluid, secreted by the synovial membrane, lubricates the joint for smooth movement (Burke and Walsh 259; Sorrentino 55). Hinge joints permit movement in only one direction whereas ball-and-socket joints permit movement in all directions and even rotational movement (Mader 221; Sorrentino 55). Ball-and-socket joints are junctures where the end of one bone forms a pocket that fits over the rounded end of another bone allowing movement in all directions; for example, the hips and shoulders (Sorrentino 55). The pivot joint, allows turning from side to side, like the movement of the head (Sorrentino 55). The problems of arthritis are centered in the synovial joint (Mader 222). In rheumatoid arthritis the synovial membrane is inflamed and thickened (Mader 222). Osteoarthritis is a disintegration of the cartilage at the ends of bones so that the bones become rough and irregular (Mader 222).

Muscles

Bones give the body structure but muscles give it form and motion. Muscles move body parts, maintain posture, and produce body heat (Sorrentino 55). There are more than 500 muscles in the body which are grouped into three types: voluntary muscles, which can be consciously controlled; involuntary muscles, or smooth muscles, i.e., stomach, intestines, blood vessels, and other organs, and cardiac muscle which is only found in the heart (Sorrentino 55). As mentioned earlier, muscles are attached to bones by tendons. To provide motion, muscles shorten and pull by contraction, they then relax (Mader 22). They cannot push (Mader 222). This activity on the part of the muscle burns food for energy and produces heat (Sorrentino 55). Increasing the food energy burn increases the heat; this is how shivering heats the body (Sorrentino 55). The combined fibers that form a muscle are always in various states of contraction or relaxation. If all the fibers in the supporting muscle groups were to relax at one time, the body would collapse (Mader 225).

"Characteristics of Skeletal Muscle:

- weight: 40% of total body weight
- total number of muscles in body: over 600
- number of fibers (cells in a muscle): a few hundred to over a million
- size of muscle cell: 10-100um diameter; up to 20 cm long
- size of filaments: thick = 15nm diameter; thin = 5 nm diameter
- time of contraction: fast fiber = 10 msec; slow fiber = 100 msec
- time for contraction-relaxation cycle: 0.15 second"

(Mader 225).

AGE-RELATED CHANGES IN THE MUSCULOSKELETAL SYSTEM

When muscle cells are lost, they do not regenerate (Christ and Hohloch 45). With disuse, muscles gradually atrophy thereby decreasing in size and strength (Burke and Walsh 259). The remaining muscle cells atrophy with age. The subsequent decrease in total the muscle mass yields a decrease in the proportion of muscle weight to bone weight (Christ and Hohloch 45). As the size of the motor unit or muscle decreases, the muscle strength declines 10 to 20 percent (Christ and Hohloch 45). A muscle is only as strong as it needs to be for the task for which it is used (Corcoran 537). "A partially used muscle exerting less than 20 percent of its maximum force will begin to atrophy, whereas regular exertion at 20 to 30 percent of maximum force will preserve a muscle's strength (Corcoran 537)." In general, however, muscle mass, power, strength, and endurance all decline with age (Smith and Gilligan 46). Changes can eventually result in loss of height, loss of strength, decrease in mobility and decrease in range of motion in the legs, arms, and neck (Lewis 5; Medcom 5; Sorrentino 98).

Although increasing age results in a decline in the functions of the components of the musculoskeletal system, the decline can be minimized by taking appropriate measures. One of the most helpful measures is exercise. Exercise has many benefits (Mader 225). Two benefits of exercise are increase in endurance and the strength of muscles (Mader 225). Continued use of muscles slows the loss of muscle components and subsequent loss of strength and mobility as well (Burke and Walsh 259). It also slows bone loss (Burke and Walsh 259). Decreased muscle and bone strength are in direct response to decreased activity (Lewis 5). A caveat is that muscle function depends on other systems including the neurological system (Burke and Walsh 259). Changes in one body system have far reaching effects in the other systems.

"The body's adaptability to exercise remains unimpaired with aging (Burke and Walsh 259)." "Use it, or lose it," is most applicable when muscles are involved. "Endurance is measured by the length of time the muscle can work before fatiguing, and strength is the force a muscle can exert against a resistance (Mader 225)" A regular exercise program brings about physiological changes that build endurance (Mader 225). Safe exercise can keep the muscles and bones fit (Medcom 5). Almost every organ and organ system deteriorates with nonuse (Corcoran 536) One of the signs of deterioration is the contracture. A contracture is any decrease in the normal range of motion (ROM) of a moving part of the body (Corcoran 536). Contractures may begin to form within eight hours of nonuse (Corcoran 536).

> "Aside from improved endurance and strength, an exercise program also helps many other organs of the body. Cardiac muscle enlarges, and the heart can work harder than before. The resting heart rate decreases. Lung and diffusion capacity increase. Body fat decreases, but bone density increases so that breakage is less apt to occur. Fat and cholesterol blood levels decrease along with blood pressure. An exercise program lowers the risk of a heart attack (Mader 225)."

Active people have lower colon, brain, kidney, and reproductive cancers as well as a lower rate of leukemia than people that are not active (Mader 227). "...Half of the functional decline between ages 30 and 70 could be prevented if we simply used our body more. Bone density, nerve function, and kidney efficiency, as well as overall strength and flexibility, largely can be preserved into our later years simply by keeping up an active life (Mader 227)."

To stay fit, seniors 55 and up are encouraged to:

- do "moderate exercise three times a week
- plan a daily walk
- do daily stretching exercises
- learn a new sport: golf, fishing, ballroom dancing
- try low-impact aerobics
- before undertaking new exercises, consult your doctor" (Mader 227).

Osteoporosis

Osteoporosis is common occurrence in 30% of women and 15% of men over the age of 60 (Burke and Walsh 260). The percentage rate for the occurrence of osteoporosis in current cohorts over the age of 65 is 65% of women and 21% of men (Perlmutter and Hall 88). Due to the intestine's decreased ability to absorb calcium with age, some degree of osteoporosis is a normal age-related change (Christ and Hohloch 92). It is characterized by collapse of the vertebral bodies and the susceptibility to fracture of some long bones (Burke and Walsh 260). Risk factors for osteoporosis include: a) increased age, b) heredity, c) premenopausal ovariectomy, d) corticosteroid use, e) extreme immobility, f) inactivity, g) poor nutritional status, h) being a thin, white female, i) a low-calcium diet, j) cigarette smoking, k) moderate alcohol consumption, and l) estrogen deficiency (Burke and Walsh 261; Christ and Hohloch 92; Medcom 5; Perlmutter and Hall 89). Estrogen deficiency is thought to cause accelerated bone loss (Burke and Walsh 261; Christ and Hohloch 92). Vitamin D is needed for the body to use calcium. If there is a low level of Vitamin C or of Vitamin D, the other is also low. Both are needed for healthy bones (Christ and Hohloch 92). Bone loss starts at about 40 years of age, with loss exceeding the formation of bone, leading to demineralization (Christ and Hohloch 45, 92). Contributory factors include the level of bone mass at maturity, gender, diet, and mobility (Burke and Walsh 260; Christ and Hohloch 45). Bed rest leads to osteoporosis even in healthy young individuals (Burke and Walsh 262; Perlmutter and Hall 89). Skeletal mass is less in women than in men. Females at

18 years of age have 20% less mass than males and also lose bone mass at a more rapid rate after cessation of menses and thereafter at an accelerated rate for next 5 to 8 years (Burke and Walsh 260; Christ and Hohloch 92). This rapid rate of bone loss is in the spongy bone, which is the supportive strand of connective tissue in bone (Burke and Walsh 260; Christ and Hohloch 45). This loss of bone is associated with compression fractures of the spine (Burke and Walsh 260). A slower rate of bone loss is demonstrated by the cortical bone or outer portion of the bone as evidenced in the femur (Burke and Walsh 260; Christ and Hohloch 45). This loss of cortical bone results in thinning bone of the spinal vertebral body leading to decreased height, increased risk of compression fractures of the spine, and decrease in bone strength (Burke and Walsh 260). Cardiac and respiratory problems can result from compression of the heart, lungs, and nerves with decreased thoracic mobility that is caused by advanced osteoporosis, vertebral compression fractures and kyphosis (Christ and Hohloch 92). The prevention of osteoporosis includes supplements of calcium, estrogen therapy and exercise; primarily weight-bearing activities like walking (Perlmutter and Hall 89). Remaining active is of prime importance in preventing osteoporosis and in maintaining a positive outlook on life.

Osteoarthritis

Osteoarthritis is the most common arthritis found in the elderly (Burke and Walsh 262). The changes start to develop between ages 20 and 30 with cartilage erosion (Christ and Hohloch 45). Twenty-five percent of those over the age of 50 develop cervical osteoarthritis (Christ and Hohloch 46). Fifty percent of those over 65 and 75% of those over the age of 80 have arthritis (Lewis 5). It is a disease of the joints with deterioration of the cartilage and formation of new bone at the bone surface (Burke and Walsh 262). The signs and symptoms of osteoarthritis are: 1) pain with first movement of a joint that is relieved with rest, 2) morning stiffness which lasts for a few minutes, 3) pain and weakness following activity, 4) tenderness is usually present, 5) swelling may be present, and 6) crepitus, a grating sensation, is always present (Burke and Walsh 262; Lewis 5). As the disease progresses, there may be a limitation of motion and weight-bearing joints may weaken (Burke and Walsh 262). The knuckles may become enlarged due to the new bone being laid down (Burke and Walsh 263). This disease is the number one cause of disability and limitation of activity in those over 75 years of age and the most common joint disease among Caucasians (Burke and Walsh 263). Treatment consists of symptomatic relief and prevention of further destruction of the joints (Burke and Walsh 263). Decrease high impact assaults on the knees, lose weight if overweight, and exercise, with rest as needed, to maintain flexibility (Burke and Walsh 263). A good rule of thumb when exercising is that if it hurts, don't.

Feet

The elderly have foot problems that are primarily the result of footwear and habit (Burke and Walsh 265). High heel shoes with pointed and hard soles, and tight stockings interfere with normal gait (Burke and Walsh 265). This combination can shorten tendons, debilitate muscles and shift ligaments causing corns, hammer toes and hallus valgus (bunions) (Burke and Walsh 265). All of this can hamper an elderly person's mobility and cause pain (Burke and Walsh 265). Shoes should not apply pressure to any (inflamed) area, and should allow a healthy gait (Burke and Walsh 266). Orthotics are appropriate, and again, exercise is good for the foot.

Bones and muscles must last a life time. They degenerate if we do nothing and serve well the more use we make of them. Degeneration with aging is, as shall be seen over and over again, not entirely controllable nor is it reversable to any great degree.

NERVOUS SYSTEM

The nervous system controls, directs, and coordinates body functions (Badasch and Cheseboro 291; Sorrentino 55). The nervous system along with the endocrine system assists in the adaptation to our internal and external environment. "The internal environment consists of blood and tissue fluid that bathes the cells (Madder 62)". The external environment is everything outside of the body. The aging of the nervous system is critical since it coordinates all the body systems (Perlmutter and Hall 108; Woodruff and Birren 254).

The big fear of aging is that we will become confused, disoriented and unable to care for ourselves (Perlmutter and Hall 108). These and other symptoms have, in the past, often been characterized by the term senility. The development of senility is not a normal age related occurrence and happens to a relatively small proportion of the elderly (Perlmutter and Hall 108).

Uncertainty exists about the effect of the aging process on the neurological system. It is agreed that there are changes, but specifically what the changes are or how these changes relate to the cognitive process is not certain (Burke and Walsh 357; Perlmutter and Hall 108). Most studies to date have been conducted on individual's brains that during life demonstrated loss or who were institutionalized for some reason. Recent studies have earnestly tried to limit the studied population to individuals that have not demonstrated mental aberrances, that have been healthy and have not been candidates for institutions. These recent studies are demonstrating that aging has wide variations of normalcy. They are proving that even with some physiological changes, mentation and behaviors are not necessarily affected. The normal process of aging results in physical changes in the brain that may affect the cognitive abilities of some elderly individuals (Burke and Walsh 356; Woodruff and Birren 255). It was thought that the brain atrophies (Burke and Walsh 357). Current studies show that selected, restricted areas of the brain atrophy, rather than the entire brain (Burke and Walsh 357). It appears to shrink over the years but definitely decreases in weight with increased space between the brain and the skull, and with expansion of the ventricles (the fluid-filled spaces deep within the brain) (Christ and Hohloch 43; Perlmutter and Hall 109; Woodruff and Birren 254). The atrophy may be as much as 7 percent (Christ and Hohloch 43). It is difficult to separate the normal effects of aging on the brain from the effects of nutrition. The cardiovascular status, respiratory function, cancer, organic brain disease and the use of alcohol and drugs, all can have a large effect on the brain (Perlmutter and Hall 109). Two of the factors associated with the brain for which there is no change with aging, are the metabolic rate of glucose and oxygen usage. (Perlmutter and Hall 113). Neurons die, maybe daily, but this loss has little effect on the brain function (Perlmutter and Hall 109). Neurons do not regenerate; loss is permanent and inevitable (Christ and Hohloch 43). Neurons are lost especially in regions of the brain that coordinate voluntary muscle activity (Perlmutter and Hall 118). The rate of cerebral blood flow does diminish with age, (Christ and Hohloch 43) possibly a result of arteriosclerosis, or atherosclerosis (Perlmutter and Hall 113; Woodruff and Birren 255). With all that has been said however, environmental stimulation seems to encourage the development of new connections between neurons in the older brain, just as it does in brains of the young (Perlmutter and Hall 111).

Until the early 60's, the intellectual capacity is fairly stable. For some there may be a decrease of some abilities through the mid-70's, but by 80, a decrease of abilities is the norm for most individuals (Woodruff and Birren 255). The decrement of intelligence may be the result of normal pathology, especially severe cardiovascular disease alone or combined with emotional or social deprivation (Woodruff and Birren 256).

As was mentioned earlier, study results from the healthy aged have been obtained recently. "When studies are limited to carefully screened, mentally normal adults, there seems to be no significant decrease in brain weight or ventricular expansion (Perlmutter and Hall 109)." "Changes appear with age in the cell bodies of the brain. Dense granules surrounded by fluid-filled cavities, called vacuoles, may appear after the age of 60. Senile plaques, dark clumps of dead and dying neuralfibers, may also appear in older brains, and at least a few seem inevitable once people are more than 90 years old. Neurofibrillary tangles, twisted bundles of paired helical filaments made up of various proteins, are also found in small numbers. All these changes (vacuoles, senile plaques, and neurofibrillary tangles), while sparse in the normal aging brain, are found in great numbers in diseased brains. In the normal aged brain, for example, neurofibrillary tangles are primarily confined to a portion of the temporal lobe...(Perlmutter and Hall 112)."

Plaques and tangles may be present with and without dementia (Christ and Hohloch 44).

There are two divisions in the nervous systems: the central nervous system (CNS) and the peripheral nervous system (PNS) (Burke and Walsh 356; Mader 189; Sorrentino 55). There is a portion over which we have control and there is an autonomic portion, over which we have no control.

Nerve Physiology

The basic working cellular structure in the nervous system is the nerve cell or neuron (Sorrentino 58). Nerve function is to transport messages to and from the brain (Sorrentino 58). The transportation of stimuli is by electrical and chemical conduction along neurons (Badasch and Chesebro 292). The neuron is a specialized conducting cell (Burke and Walsh 357) that has three parts: a dendrite, a cell body, and an axon (Mader 189). Dendrites conduct impulses to the cell body (Mader 57; Sorrentino 58). The cell body contains most of the cytoplasm, the nucleus, and other organelles of the neuron (Mader 57). The axon conducts impulses away from the cell body (Mader 57; Sorrentino 58). There is usually only one axon to a neuron (Sorrentino 58). The neuron can be as long as 2 to 3 feet in length or as short as a few inches (Sorrentino 58). When the axons and dendrites are long they are called nerve fibers (Mader 57; Sorrentino 58). There are three types of neurons: sensory, motor, and interneuron (Mader 189).

"A sensory neuron takes a message from a receptor, a sense organ, to the CNS and has a long dendrite and a short axon (Badasch and Chesebro 293; Mader

189). A motor neuron takes a message away from the CNS to an effector, a muscle fiber or a gland, and has short dendrites and a long axon (Badasch and Chesebro 293; Mader 189). Because motor neurons cause muscle fibers and glands to react, they are said to innervate these structures (Mader 189). Mixed nerve type consists of both long dendrites of sensory neurons and long axons of motor neurons (Mader 196). Mixed nerves carry messages to the CNS via dendrites and away from the CNS in axons (Mader 196).

The interneuron is contained completely within the CNS and conveys messages between parts of the system (Mader 189). It has short dendrites and a long or a short axon (Mader 190). Sensation is experienced when the impulse is conducted from the sense organ to the spinal cord and the brain (Mader 57). When the conduction of an impulse is away from the spinal cord and brain to the muscle it causes a response in function (Mader 57). The neuronal dendrite and axon are sometimes called fibers or processes (Mader 190). Nerves are easily damaged and take a long time to heal (Sorrentino 58). The long fibers are protected by a wrapping that enhances conduction, provides protection and serves as insulation (Mader 190; Sorrentino 58). This wrapping is called a myelin sheath and has a white glistening appearance (Mader 190).

The age-related change most affecting neurons is the shrinkage of large neurons (Burke and Walsh 357; Perlmutter and Hall 111). To compensate for the shrinkage of the large neurons, there is thought to be dendrite formation that allows some of the neuronal pathways experiencing loss to continue to function

(Burke and Walsh 357; Perlmutter and Hall 111).

Central Nervous System

The central nervous system includes the brain and the spinal cord (Badasch and Chesebro 292; Mader 201; Perlmutter and Hall 108; Sorrentino 55, 59). It is well protected by bone in the skull and vertebrae down the spine (Mader 201; Sorrentino 59). The CNS receives sensory information and initiates motor control (Mader 202).

Brain

There are three main portions of the brain; the cerebrum, the cerebellum, and the brainstem (Burke and Walsh 357; Sorrentino 59). The conscious brain is in the cerebrum (Mader 202; Sorrentino 59). It is the largest portion of the brain (Mader 202; Sorrentino 59). The cerebrum is responsible for consciousness, and higher mental processes of interpretation of stimuli and voluntary initiation of movements (Burke and Walsh 357; Mader 203; Sorrentino 59).

Cerebellum

The cerebellum integrates impulses from higher cerebral centers to control balance and complex muscular movements (Mader 203). The system that controls movement is altered by the aging process (Light 820).

Cerebrum

Sections of the cerebrum function in the capacity of storage or control. For example, the left half of the brain is the verbal half, while the right half of the brain is the visual or spatial relation, artistic half (Mader 205). Usually the two halves of the brain share information or compliment each other. The frontal lobes' function is to control movements of the voluntary skeletal muscles and association areas that carry on higher intellectual processes such as concentration, planning, complex problem solving, and judging the consequences of behavior (Mader 205). The parietal lobes consist of two basic areas, one of which is responsible for the sensations of temperature, touch, pressure, and pain called the sensory area and the other which aids in the understanding of speech and using words that express thoughts and feelings (Mader 205). Temporal lobes are responsible for the sensory areas of hearing and smelling (Mader 205). The occipital lobes' are responsible for vision and association function in combining visual images with other sensory experiences (Mader 205).

Cerebral Cortex

The cerebral cortex is the outside of the cerebrum and controls the highest functions of the brain (Sorrentino 59). Some of the functions controlled by the cerebral cortex are reasoning, memory, the conscious, speech, voluntary muscle movement, vision, hearing, and sensation (Sorrentino 59). In the elderly confusion may occur, memory is often shorter, and forgetfulness increases (Sorrentino 100). The reason may be because of the physiological changes. Blood flow is reduced to the brain, and there is progressive loss of brain cells (Sorrentino 100). The neuronal loss is most pronounced in the cerebral cortex, which loses about 20% of its neurons (Christ and Hohloch 43). All of these may result in personality and mental function changes (Badasch and Chesebro 302; Sorrentino 100). Affective functioning or change of mood may be a normal part of the aging process; however, it is not normal or healthy to develop symptoms of depression (Burke and Walsh 358). Depression can affect sleep and cause tiredness (Perlmutter and Hall 116). As the brain ages, its capacity to process, store, and retrieve information efficiently, decreases (Burke and Walsh 358). This is demonstrated in memory, the first area of cognition to be affected (Burke and Walsh 358). By the age of 50 there is a significant decline in tests of memory, such as learning and recalling new information compared with those of younger individuals (Burke and Walsh 358). By the mid 60's perceptual ability declines as does the ability to divide attention among different stimuli (Burke and Walsh 358). By 70 years of age, a significant change in linguistic ability and capacity for abstract thinking occurs (Burke and Walsh 358). It needs be remembered that these may be normal signs of aging but there is a wide variation among individuals (Burke and Walsh 358).

The unconscious brain contains many tracks that relay messages to and from the spinal cord (Mader 202). The unconscious brain includes areas that control the internal organs (Mader 202). The areas of the unconscious brain are the medulla oblongata, the hypothalamus, the thalamus, and the cerebellum (Mader 203). "The medulla oblongata and the hypothalamus both are concerned with control of the internal organs...The thalamus receives sensory impulses from other parts of the CNS and channels only certain of these to the cerebrum...The cerebellum controls balance and complex muscular movements (Burke and Walsh

357; Mader 203; Sorrentino 59)."

Brainstem

Between the brain and the spinal cord is the brainstem (Sorrentino 59). The brainstem serves as a connector to the different sections of the brain and as a transmitter of impulses between the brain and spinal cord (Burke and Walsh 357). The brain stem includes the midbrain, pons, and the medulla (Burke and Walsh 357; Sorrentino 50).

Peripheral Nervous Sustem

The other major division of the nervous system is the peripheral nervous system. The peripheral nervous system involves 12 pairs of cranial nerves and 31 paired spinal nerves (Burke and Walsh 257; Sorrentino 59). The twelve pairs of cranial nerves include sensory, motor and mixed nerves (Mader 197). Even though the brain is part of the CNS, the cranial nerves are part of the PNS (Mader 197). All but one are concerned with the head, neck and facial regions of the body (Mader 197). The peripheral nervous system conducts impulses for the sense organs (Sorrentino 60). The five organs and their senses are the eye, for sight; the ear, for hearing; the tongue, for taste; the nose, for smell; and the skin, for touch (Badasch Chesebro 293; Sorrentino 60).

Taste and Smell

The sensation receptors for taste are in the tongue and are called taste buds (Sorrentino 60). The sense of taste and smell are related (Badasch and Chesebro 300). The taste buds on the tongue are specialized for bitter, sweet, sour, and salty (Badasch and Chesebro 300). There is a 50 percent loss of taste functioning as a consequence of aging (Badasch and Chesebro 300). In the elderly, taste and smell become dulled, causing a decrease in appetite with possible affected nutritional status (Badasch and Chesebro 300; Sorrentino 99). There is evidence that the taste function may have only subtle changes with aging, whereas there are dramatic alterations in the olfactory sense in the elderly (Ship and Weiffenbach M26). Decline in the smell identification is part of the aging process (Ship and Weiffenbach M30). There are other possible contributing factors for decrease in the olfactory sense besides aging (Ship and Weiffenbach M30). Aging diminishes the sense of smell but does not extinguish it altogether (Burke and Walsh 110). Gender differences contribute to the variations, with women's olfactory function being superior across the human life span (Ship and Weiffenbach). Changes in the ability to smell can be related to poor oral hygiene, periodontal disease, dental caries, oral mucosal problems, and improperly fitting dentures as well as mouth movements, swallowing and spitting, all of which are related to aging (Ship and Weiffenbach M30).

Touch

As was discussed in the chapter on skin, the sense of touch and sensitivity to pain is reduced in the elderly. There is an impaired sensitivity to tactile stimuli with aging (Woodward 63). Factors associated with aging itself rather than changes in the mechanical properties of the skin are the cause for the loss of sensitivity (Woodward 67). These causative factors may be viscoelastic properties of the skin, changes in the nervous system that affect speed, quantity, or quality of information processing, which leads to fine tactile discrimination (Woodward 67).

Vision

The sensation receptor for vision is in the eye (Sorrentino 60). The eye has three layers (Sorrentino 60). First is the outer layer, the white of the eye, called the sclera (Sorrentino 60). Next is the choriod that includes the blood vessels, the cilliary muscle and the iris that gives it color (Sorrentino). The pupil is the black part of the eye. It is the opening through which light enters the eye. The pupil constricts in bright light and dilates in dim light to allow the proper amount of light to get to the vision receptors (Sorrentino 60). The retina contains the receptors for vision and the nerve fibers of the optic nerve (Sorrentino 60). The light passes through the cornea that is transparent and lies over the eye (Sorrentino 60). The lens, which is behind the pupil, reflects the light to the retina which in turn carries the message to the brain by way of the optic nerve (Sorrentino 60). The vitreous body lies behind the lens and helps the eye keep its shape (Sorrentino 60). The aqueous chamber separates the cornea from the lens and is filled with aqueous humor that helps the cornea keep its shape and position (Sorrentino 60).

Eyesight changes with age (Badasch and Chesebro 295). As it ages, the eye needs more light to see clearly so that night driving may become difficult. The eyes take longer to adjust to changes from dark to light and from light to dark as well (Badasch and Chesebro 295). Small print, small items, and things at a distance are harder to see (Badasch and Chesebro 295). Corrective lenses, such as eyeglasses or contact lenses, are usually required to accommodate these changes (Badasch and Chesebro 295; Woodruff and Birren 256).

The external area around the eye demonstrates age related changes. Loss of orbital fat, loss of elastic tissue, and a decrease in muscle becomes obvious (Burke and Walsh 88). The periorbital area darkens, wrinkles or "crow's feet" are seen and sometimes the outer eyebrows are lost (Burke and Walsh 88). Xanthomas, which are lipid deposits, usually yellow in color, can be found at the inner portion of the eye lid (Burke and Walsh 88). The eye lids may have specific age related changes. When the lid margin turns inward it is called senile entropion (Burke and Walsh 88). When the eyelid margin turns outward it is called senile ectropion (Burke and Walsh 88). These changes do not affect vision but can be unattractive and be a source of physical irritation (Burke and Walsh 88). The senile entropion can cause the lashes to rest against the conjunctiva resulting in ocular irritation while senile ectropion exposes the conjunctiva causing inflammation of the affected eye (Burke and Walsh 88). The eye itself has age related changes. The cornea tends to flatten reducing the refractory power (Burke and Walsh 88). The cornea, which assists in protection of the eye, loses its sensitivity and therefore has a diminished ability to protect the eye (Burke and Walsh 89). The eye is not immune to fatty deposits. The sclera may become yellow due to the fatty deposits (Burke and Walsh 89). The pupil no longer dilates and constricts as it once did. The pupil becomes smaller, and response to light lessens due to loss of range of dilation and constriction (Burke and Walsh 89).

The retina of the aged receives only 1/3 the light that it did when it was younger (Burke and Walsh 89). Blue-green distinctions develop in the aged due to difficulty in color perceptions (Burke and Walsh 89). The lens loses elasticity and increases in density (Burke and Walsh 89). Lens change makes the aged eye highly susceptible to glare taking sun glasses from a luxury to a necessity (Burke and Walsh 89). Opacities, or floaters, in the vitreous humor, are normal but may indicate retinal detachment and therefore require physician observation (Burke and Walsh 89). The aged commonly have a grayish-yellow ring around the iris (Burke and Walsh 89). It is called arcus senilis and is caused by fatty invasion of the corneal margin (Burke and Walsh 89). Tears are the eyes natural protective device (Burke and Walsh 89). They are diminished in the aged eye predisposing it to more infections of the conjunctiva (Burke and Walsh 89). The most frequent age related change is the primary loss of flexibility of the lens and results in the loss of range of accommodation for near vision or presbyopia (Burke and Walsh 89).

Hearing and Balance

The ear has two functions, hearing and balance (Sorrentino 60). It has three divisions; the external ear, the middle ear, and the inner ear (Sorrentino 60). The external ear is sometimes called the pinna or the auricle (Sorrentino 62). Sound waves are guided through the auricle into the one inch long auditory canal (Sorrentino 62). The auditory canal extends to the ear drum, or tympanic membrane, which separates the external and middle ear (Sorrentino 62). The auditory canal has many glands that secrete a waxy substance called cerumen

(Sorrentino 62). The middle ear contains the Eustachian tube and three small bones called ossicles (Sorrentino 62). The Eustachian tube connects the middle ear and the throat (Sorrentino 62). Ossicles amplify sound from the eardrum and transmit it to the inner ear (Sorrentino 62). The ossicles are the malleus, the incus and the stapes (Sorrentino 62). The malleus looks like a hammer, the incus looks like an anvil and the stapes looks like a stirrup (Sorrentino 62). The inner ear includes the semicircular canals and the cochlea (Sorrentino 62). The cochlea looks like a shell and contains fluid and cilia that carry sound waves from the middle ear to the auditory nerve (Burke and Walsh 101; Mader 248; Sorrentino 62). The age-related loss of these cilia is thought to be the primary source of hearing loss in the elderly (Burke and Walsh 102). From the cochlea the message is then carried to the brain (Sorrentino 62). The three semicircular canals are involved in balance (Sorrentino 62). They send the head and body position and changes in position to the brain (Sorrentino 62).

Hearing is often affected as the system ages (Badasch and Chesebro 298). There is 90 percent hearing impairment in the population over the age of 80 years of age (Burke and Walsh 100). The loss usually begins in the third decade and seems to peak between the 4th and 5th decade. Usually it is the high frequency sounds that are the most troublesome. Discrimination of consonants is problematic for the aged (Burke and Walsh 102).

The five senses are only portion of the PNS. The PNS also includes the 31 pairs of spinal nerves (Mader 197; Sorrentino 59). These nerves are protected by the spinal column and are about 18 inches long (Sorrentino 59). The spinal nerves come out of the spinal cord by two short roots that lie within the vertebral column (Mader 197). The brain and the spinal nerves are also protected by three layers of connective tissue called meninges (Sorrentino 59). The three layers have fluid between them to protect the CNS (Sorrentino 59).

Somatic Nervous System

Somatic means pertaining to the body (1). The somatic nervous system is a subdivision of the peripheral nervous system and as such includes all nerves that are throughout the body (Sorrentino 55). "They serve the musculoskeletal system and the exterior sense organs, including those in the skin (Mader 198)." When environmental stimuli trigger the external sense organs a nerve impulse is initiated (Mader 198). The messages in the external world are picked up by our senses and are transported to our brain for interpretation. A considerable number of the messages we do not need to pay attention to, they are automatic responses. "Reflexes are automatic, involuntary responses to changes occurring inside or outside the body (Mader 198)."

Autonomic Nervous System

The autonomic nervous system is part of the PNS (Mader 199). It is composed of motor neurons that control the internal organs and smooth muscle automatically, usually without need for conscious intervention (Mader 199; Perlmutter and Hall 113). There are two divisions of the autonomic nervous system: the sympathetic and parasympathetic system (Burke and Walsh 257;

Mader 199). "The sympathetic nervous system causes those responses we associate with 'fight or flight' (Mader 201)." The sympathetic can be thought to speed things up while the parasympathetic system can be thought to slow things down (Sorrentino 60). The parasympathetic system innervates the internal responses associated with relaxation (Mader 201). With age some of the responses controlled by the autonomic nervous system slow or become weaker, so that it takes longer for the body to adapt to a change in condition (Perlmutter and Hall 113). There are those that believe that the changes in the autonomic nervous system due to aging may be involved in the development of hypertension (Perlmutter and Hall 113).

Sleep

The impulses that travel throughout the nervous systems are electrical. They can be monitored, observed and plotted. There are normal electrical ranges for all activities; for thinking, relaxing, meditation, and even sleeping. The electrical patterns associated with sleep have been studied in depth. Five times during an eight hour sleep session the brain waves become slower and larger corresponding with rapid eye movement (Mader 205). The elderly need for sleep does not change. The total daily sleep needed remains the same (Burke and Walsh 336). However, the quality and continuity of sleep change with the elderly getting less deep sleep, more frequent awakenings and earlier awakenings (Burke and Walsh 336). The aged rarely remain asleep all night without waking (Perlmutter and Hall 115). "The circadian (or daily) rhythm of sleep and waking does not disappear in older adults; instead its amplitude seems to be reduced, so that sleep becomes fragmented and waking hours are punctuated by periods of drowsiness (Perlmutter and Hall 115)." Most aged get 7 to 8 hours of sleep in a 24 hour period, albeit their night's sleep is interrupted (Perlmutter and Hall 113). The elderly usually nap during the day (Perlmutter and Hall 113; Sorrentino 100). The fatigue is related to the loss of energy and decreased brain blood flow (Sorrentino 100). It can also be attributed to the interrupted night's sleep. There are sleep differences between the sexes which exist from puberty (Perlmutter and Hall 115). Men spend a larger part of the night in non-rapid eye movement (REM) sleep, and their sleep consists of more light sleep than is the case for women (Perlmutter and Hall 115). During non-REM sleep, the heart rate and respiration become slow and regular and the muscles become relaxed (Perlmutter and Hall 115). Young-old age men wake more often at night than women until in their eighties when this sex difference disappears (Perlmutter and Hall 115). The cause of frequent waking could be a number of things including the need to urinate.

Insomnia is a big problem in the elderly. Insomnia in the elderly can be the result of many different things. They need to be investigated and addressed as the causative factor of the loss of sleep. Some of the possible causes for insomnia are: the medications they take, psychiatric disorders, physical disorders, such as waking to urinate (nocturia), incontinence, difficult breathing (dyspnea), endocrine problems (DM, hyperthyroid) coughing, gastric reflux and sleep disorders, which include sleep apnea syndrome and periodic leg movements during sleep (Morley).

Pain and environmental factors such as noise and stress may contribute to insomnia (Morley).

Over the age of sixty, one third of healthy adults develop sleep apnea (Perlmutter and Hall 116). Sleep apnea is a condition where breathing stops for at least 10 seconds, during which time the carbon dioxide levels rise, causing the person to wake and resume breathing (Morley; Perlmutter and Hall 116). This condition can be a great contributor to tiredness and lack of sleep. The prevalence of sleep apnea of 5 episodes per night is as high as 24 percent of the independent living elderly and 42 percent of the nursing home bound elderly (Morley). The contributing factors of sleep apnea include hypertension, obesity, stroke, daytime sleepiness, snoring, hypothyroidism and depression (Morley). Nocturnal myoclonus, where a sleeper's leg muscles twitch or jerk every 20 to 40 seconds over long stretches of time, happen in about one third of adults over 65 and cause sleep loss (Perlmutter and Hall 116). The depressed complain of lack of sleep (Perlmutter and Hall 116). Sleep loss can also be caused by excessive consumption of caffeine or alcohol or by use of sleeping pills (Perlmutter and Hall 116). Sleeplessness can be treated by eliminating sleeping medication and limiting time in bed, so that the bed is used only for sleeping and only during specific hours (Perlmutter and Hall 116). A good nights' rest can be encouraged by exercising during the day, by stopping smoking, by avoiding daytime napping and by maintaining reasonable weight (Morley). Further suggestions include eating moderately, and avoiding alcohol, caffeine, and other fluids after dinner (Morley).

Hot milk is a suggestion that may assist sleep (Morley). Medication review is in order as insomnia is a side effect of many medications (Morley). Use the bed for sleep or for sex only (Morley). The use of earplugs or window shades can help prevent sleep interruptions (Morley). Two more ways to get a good nights' sleep is to remain active during the day, and have something to look forward to the next day. The creature comfort assurance of a warm and comfortable sleeping environment goes a long way to assure a good night rest.

AGE-RELATED CHANGES IN THE NERVOUS SYSTEM

The age related changes in the nervous system are numerous. During a physical exam, an elderly person may demonstrate a decrease of sensation to vibrations, particularly in the legs, less brisk deep-tendon reflexes, and the ankle reflex is often absent entirely (Burke and Walsh 358). There is a decrease ability to gaze upward, a slowed response time to tasks and an increase in time needed to recover from physical exertion, all of which are attributed to the aging process (Burke and Walsh 358). Additionally, temperature perception is altered along with an increase in the pain threshold (Woodruff and Birren 256). The elderly have a deminished awareness of the environmental stimuli around them (Woodruff and Birren 256).

"Sensory losses associated with the aging process obviously affect the stimulus identification stage of information processing. The decline of sensory receptor function is commonly believed to account for most of the sensory processing difficulty observed with aging. Central nervous system alteration for stimulus recognition and sensory encoding, however, appears to be more responsible for the sensory processing slowdown than the sensory transducer changes (Light 822)." "Improved sensory information processing in older adults is possible when significant stimuli are made clear, intense, and with a high contrast between the signal and the background...A partial explanation for the difficulties observed in response selection by older individuals is the notable decline of their abilities to anticipate signals or to shift selective attention when signals and response requirements changed (Light 822)."

Dizziness, confusion, forgetfulness and fatigue may occur in the aged due to reduced blood flow to the brain (Sorrentino 100).

The result of aging in the autonomic nervous system is seen in the decline in the body's ability to respond to stress (Perlmutter and Hall 113). Environmental stress may include the room temperature to which the aged may have adjustment difficulty. This is why the elderly are more prone to heat stroke in the summer and hypothermia during the winter (Perlmutter 113).

The ability to respond is slowed in the aged (Sorrentino 100; Woodruff and Birren 254). "Age-related deterioration of movement response speed, in reaction to an environmental stimulus, is generally accepted by researchers in aging to be determined more by CNS processes than by peripheral processes such as nerve conduction velocity, muscle contractile speed, or synaptic transmission delays (Light 822)."

"The loss of neurons in the hypothalamus (sensitive to osmolality) may contribute to the deceased awareness of thirst and dehydration among the elderly. Dehydration can have other troublesome consequences such as confusion and constipation (Woodruff and Birren 254)." The hypothalamus becomes less affective in regulating the body's heat production and heat loss as well (Christ and Hohloch 44). There are age-related changes associated with the PNS. There is a decrease in deep tendon reflex; 15 percent decrease in the conduction in the PNS because of (a)a decrease in the number of dendrites, (b) changes in the synapses slowing nerve impulse conduction, (c) thereby slowing reaction time (Christ and Hohloch 44). There is a decrease in the function of both the autonomic and sympathetic nervous systems (Christ and Hohloch 44).

The elderly have as many demonstrated differences from one another in their age related changes as they did in their youth. Because one ages and undergoes changes does not mean we become a homogeneous group of senile aged, incapable of self determination and self care. Wide variations of normal and functional exist. Most of the aged do not become as far removed from the able-bodied, mentally alert ideal as we have been led to believe.

THE RESPIRATORY SYSTEM

According to the medical dictionary respiration is the exchange of oxygen and carbon dioxide between the atmosphere and the body cells, including inspiration and expiration, diffusion of oxygen from the pulmonary alveoli to the blood and of carbon dioxide from the blood to the alveoli, and the transport of oxygen to and carbon dioxide from the body cells (Miller and Keane 1296).

The respiratory system controls the ability to be physically active (Medcom 9). It is required for the life of the cell as well as our continued existence. Breathing is accomplished by a phenomenon called diffusion. Diffusion is the movement of molecules from an area of greater concentration to an area of lesser concentration. Diffusion takes place across a semipermeable membrane. The elements of respiration are oxygen (O2) and carbon dioxide (CO2).

Respiratory Physiology

Breathing is accomplished when the plural space is enlarged causing a partial vacuum or a negative gradient down which the oxygen rich air flows. Room air is 21 percent oxygen. Breathing, is on the cellular level and is also the entrance and exit of air into and out of the lungs, that occurs about 14 to 20 times per minute (Mader 150). The exchange of gases O2 and CO2 between air and blood is called external respiration (Mader 150). The internal respiration is the exchange of O2 and CO2 between blood and the tissue fluid (Mader 150).

During both inspiration (inhalation) and expiration (exhalation), air flows to or from the lungs through a series of cavities, tubes and openings. The respiratory system is divided into the upper respiratory tract and the lower respiratory tract (Burke and Walsh 224). The upper respiratory tract includes the nasal cavity, pharynx and the larynx. The lower respiratory tract includes the trachea, bronchi, bronchioles, alveoli, lungs, pleura and the respiratory membrane.

Nose

The nose has two external nares or nostrils that are narrow canals with convoluted side walls (Mader 151). A vertical partition, called the nasal septum divides the two nares (Burke and Walsh 224; Mader 151). The nares have six main functions: conduction of air, filtration, temperature control, humidification of inhaled air, voice resonance, and olfaction (Burke and Walsh 224). Filtration is the job of the coarse hairs and cilia in the region of the nostrils and by cilia alone in the rest of the nose and the windpipe (Mader 150). The hairs and cilia of the nose act as a screening device (Mader 150). In the trachea, cilia beat upward, carrying mucus, dust, and on occasional bit of food that erroneously made its way into the breathing tube (Mader 150). These items can then be swallowed or expectorated. Heat given off by blood vessels lying close to the surface of the lining of the air passages warms air as it is inhaled and cools the air as it is exhaled (Mader 150). The air is moistened by the wet surface of these passages on the way in and air loses moisture on the way out (Mader 150-1). As the gas (air) cools, it deposits its moisture on the lining of the windpipe and the nose (Mader 151). The nose may even drip because of this condensation (Mader 151). The air has so much moisture that on a cold day the expiration condenses and forms a small cloud

(Mader 151). Olfactory epithelium covers an area from the tip of the nasal cavity to just under the brain (Weiffenbach and Bartoshuk 545). The olfactory receptor cells located in that epithelium are actually the dendrites of the olfactory neurons (Weiffenbach and Bartoshuk 545). The dendrites are shaped like knobs with projecting cilia (Weiffenbach and Bartoshuk 545). The olfactory neurons therefore provide a direct connection from the nose to the brain that may act as a conduit for viruses or toxins (Weiffenbach and Bartoshuk 546). Food vapors go up from the back of the mouth into the nasal cavity where they stimulate olfactory receptors (Weiffenbach and Bartoshuk 544).

Tear glands empty into the nasal cavities which can cause the nose to run during tearing (Mader 151).

The nasal cavities also communicate with the cranial sinuses. Sinuses are air-filled spaces in the skull that are lined with mucous membrane.

Pharynx

The pharynx, in the back of the throat is divided into three sections: the nasopharynx, (upper section) oropharynx, (middle section) and the laryngopharynx, (lowest section) (Burke and Walsh 224). The pharynx is a long, tubelike structure (Burke and Walsh 224). Air taken in by either the mouth or nares enters the pharynx (Mader 151). It serves as a passageway for air to travel to the trachea and for food to travel to the esophagus, it also aids in the formation of vocal sound (Burke and Walsh 224).

Larynx

The larynx lies at the top of the trachea and below the root of the tongue (Mader 151). The larynx is a muscular and cartilaginous structure that is lined with mucous membrane. It has nine cartilages that are held together by muscles and ligaments. It is a major structure in the upper respiratory tract and connects the pharynx with the trachea (Burke and Walsh 224). The glottis is the true vocal cord of the larynx or voice box. At the edges of the glottis, and embedded in mucous membrane, are elastic ligaments called vocal cords (Mader 152). They stretch from the back to the front of the larynx at the sides of the glottis (Mader 152). They vibrate when air is expelled passed them through the glottis, producing sound (Mader 152). The pitch of the sound depends on the length, thickness, and degree of elasticity of the vocal cords and the tension at which they are held (Mader 153). The volume or intensity, depends on the amplitude of the vibrations, or the degree to which vocal cords vibrate (Mader 153).

Epiglottis

The epiglottis is a flap or lid located at the base of the tongue. It closes the larynx by covering it during swallowing to prevent passage of food or drink into the larynx and trachea (Miller and Keane 507). A cough is the back up system if food or other substance gains entrance into the larynx (Mader 152).

Lower Respiratory Tract

The lower respiratory tract has a front and back portion. The back part is the esophagus. The front part is the trachea or windpipe. The trachea is a tubelike structure extending from the cartilage of the larynx to where the trachea divides into the left and right main bronchi (Burke and Walsh 224). It has C-shaped cartilaginous rings that hold it open (Mader 154). The trachea is lined with ciliated mucous membrane that usually keep the windpipe free of debris including accumulated mucous (Mader 154). It is about four inches long and 3/5 of an inch wide.

Trachea

The trachea divides into the right and left bronchi that enter the right and left lungs (Mader 154). They then subdivide further into smaller passages called bronchioles (Mader 154). As the airway divides and divides again the passageways become narrower, their walls become thinner and the cartilage is no longer present (Mader 154). Each bronchiole ends in an elongated cul-de-sac type space consisting of a multitude of air pockets or sacs called alveoli which make up the lungs. The alveoli are grape like clusters of small thin-walled air sacs where the gas exchange occurs (Burke and Walsh 225).

Alveolus

There are three layers that make up the alveolus. There is an interstitial space between the alveolar epithelium, a capillary membrane and two layers in the capillary membrane. While there is only one layer of squamous epithelium surrounding the blood capillaries, the gas exchange occurs between the air in the alveoli and blood in the capillaries (Mader 154). The total surface area of the alveoli is about 40 times that of the surface of the skin (Mader 154).

Air, rich in oxygen, is carried to the alveoli to be exchanged with the deoxygenated blood brought in a mass of capillaries to the exchange site by the branches of the pulmonary artery of the heart (Mader 154). Four pulmonary veins then take the oxygenated blood into the left atrium of the heart (Mader 154).

Lungs

The lungs extend from the shoulders at the apex, or top, to the diaphragm on the base, or bottom, and from rib cage to rib cage side to side. There is a right and left lung. The right lung has three lobes or sections. The left lung has two lobes allowing space for the heart to lie between the two lungs. The lungs are elastic cone-shaped organs for gas exchange. The space between the two lungs is called the mediastinum (Burke and Walsh 225). It not only separates the two lungs but also allows space for the heart and its accompanying structures, the aorta, venae cavae, pulmonary vessels, esophagus, part of the trachea and bronchi, and the thymus gland (Burke and Walsh 225).

The pleura is a double walled sac that encloses each lung (Burke and Walsh 225). The side next to the viscera, is called the visceral pleura and it adheres firmly to the lungs (Burke and Walsh 225). The parietal pleura is the other portion of the double wall sac. Parietal means pertaining to the wall of a cavity hence the name parietal pleura since it lines the walls of the thoracic cavity. The pleural cavity is filled with pleural fluid that is secreted by the pleura and acts as a lubricant, reducing friction between the two layers during the movements of respiration (Burke and Walsh 225).

Respiration

The process of respiration includes ventilation, diffusion or external respiration and gas transport or internal respiration (Burke and Walsh 227). Ventilation is the manner in which air is drawn into the lungs (inspiration) and expelled out of the lungs (expiration) (Burke and Walsh 227; Mader 155). Never is there a portion of the respiratory system that is without air in it, from the pharynx to the alveoli (Mader 155). Without air in the lungs they would collapse and inspiration would be impossible. The act of breathing is the result of muscular contractions. These contractions cause air volume change within the lungs resulting in inspiration followed by the relaxation of those muscles and exhalation. The diaphragm is the major muscle of inspiration and accounts for almost 80 percent of the labor of breathing (Burke and Walsh 227). Muscles elevate the ribs increasing the front to back diameter of the thorax while, if necessary, the accessory muscles raise the clavicles, upper ribs and sternum (Burke and Walsh 227). Expiration is a relaxation of the inspiratory muscles and is a passive action (Burke and Walsh 227). Expiration involves the relaxation of the diaphragm, the pressing up of the abdominal organs against the diaphragm, and the rib cage moving down and inward causing the air to be pushed out (Mader 157). This normal quiet breathing is under the control of the central nervous system, primarily the medullary respiratory center in the medulla oblongata (Burke and Walsh 227). Respirations can also regulated deliberately through the motor areas of the cerebral cortex (Burke and Walsh 227).

Diffusion is gas moving from an area of greater pressure to one of lesser pressure. It is required that the pressure in the lungs and thorax be less than atmospheric pressure for this phenomenon to occur. With the contraction of the respiratory muscles the pressure of the gas (at end inspiration in the alveoli, the $O2$ is low and the $CO2$ is high) compared to the air around us (room has high $O2$ and low $CO2$) is less causing the gas to enter the lungs. This is because a gas will flow down gradient. The air flows into the vacancy in the lungs and respiratory system while at the alveoli level the $O2$ flows through the alveolar-capillary membrane into the venous system to be taken to the heart and the $CO2$ flows down gradient into the avoli to be expelled via the respiratory tract. Very little pressure change is required to move air into and out of the lungs (Burke and Walsh 228). The gas exchange flows until equilibrium is attained (Burke and Walsh 228). Respiratory diffusion, or external respiration, is the actual transfer of oxygen into and the carbon dioxide out of the blood (Burke and Walsh 228).

The chemical exchange can be affected by the elasticity of the lung tissue (resistance), the size of the large air passages, and the compliance of the chest wall (Burke and Walsh 228).. Surfactant is secreted by the epithelial cells in the alveoli and contributes to the lung elasticity (Burke and Walsh 228). Respiration is also under the influence of chemical control from the central and peripheral chemoreceptors that trigger the respiratory centers to change the rate and depth of respiration (Burke and Walsh 228). Alveolar ventilation is the most important portion of gas exchange. If the alveoli are not open for any reason as in collapse, filled with mucous as in pneumonia, or fluid filled, true ventilation does not take place (Burke and Walsh 228).

Internal respiration begins after diffusion and takes place on the cellular level (Burke and Walsh 228). Oxygen moves into the cells, and CO2 leaves the cells to enter the blood stream (Burke and Walsh 228). "Diffusion of oxygen out of the blood into the tissues occurs because the oxygen concentration of tissue fluid is low--cells continuously use up oxygen in cellular respiration (Mader 161)". "Diffusion of carbon dioxide into blood from the tissues occurs because carbon dioxide concentration of tissue fluid is high. Carbon dioxide is produced continuously by cells, and it collects in tissue fluid (Mader 161)".

The respiratory system always has air in it. The amount of air moved in and out with each respiration is called the tidal volume usually, about 500 ml (Mader 157). This is with a normal breath. When we inhale as much as we possibly can the total volume of air that can be moved in and out during a single breath is called the vital capacity (Mader 157).This can increase inspiration by as much as 3,100 ml of air (Mader 157). This is the inspiratory reserve volume (Mader 157). The forced increased expiration can measure approximately 1,400 ml of air and is called the expiratory reserve volume (Mader 157). The vital capacity is the sum of tidal, inspiratory reserve, and expiratory reserve volumes (Mader 157). Even after very deep breathing about 1,000 ml of air remains in the lungs this is called residual volume and is no longer useful for gas exchange (Mader 157). Dead air is the air that never reaches the lungs and instead fills the conducting airways (Mader 157).

AGE-RELATED CHANGES OF RESPIRATORY SYSTEM

The physiological changes in the respiratory system that occur with age are quite extensive. The greatest change happens after age 70 (Christ and Hohloch 39). In comparison to a 20 year old, the typical 75 to 80 year old has only 50 percent of their lung capacity (Christ and Hohloch 39; Mader 331). This results in difficult breathing with activity or stress (Christ and Hohloch 39; Sorrentino 99). There is no functional change apparent at rest (Sorrentino 99). Growing inelasticity of lung tissue means decreased ventilation (Mader 331; Sorrentino 98). This loss of elasticity of the lung tissue, combined with the large air passages, and the resistance of the chest wall affects respiration and can change the work of breathing (Burke and Walsh 228). Since the entire vital capacity is rarely used these effects are not noticed unless there is an increased demand for O2 (Mader 331). In the aged lung there is a homogeneous enlargement of the alveolar airspaces, that occurs without fibrosis or destruction of the alveolar walls (Verbeken et al. 800).

Olfactory

The olfactory sense declines with age. Olfactory loss is primarily the result of upper respiratory infections, head trauma, and nasal symptoms (Weiffenbach and Bartoshuk 545). Both head trauma and exposure to upper respiratory infections are of special relevance to aging. Losses due to head trauma are often permanent and damage to the chemical senses due to repeated infection may well cumulate over the years (Weiffenbach and Bartoshuk 545). The loss is often related to disease (Perlmutter and Hall 201). Basal cells provide the source for the replacement of olfactory cells (Weiffenbach and Bartoshuk 546). The olfactory receptor cells live for only about five to eight weeks and then die and are replaced with new cells (Perlmutter and Hall 200). Since basal cells may not continue to replace olfactory neurons at the same pace throughout life this may be a cause for the age-associated loss of olfaction (Weiffenbach and Bartoshuk 546). There may be more lost than replaced. The layers of cells in the olfactory bulbs that receive input from the receptor cells show some thinning with aging (Perlmutter and Hall 200). There is a dramatic decline in the sensitivity to olfactory abilities with age (Weiffenbach and Bartoshuk 548). The olfactory and taste senses are interrelated but the decline of olfactory intensity is greater than for taste intensity (Weiffenbach and Bartoshuk 548). Yet, as with other age-related changes, there is a wide range of abilities within the aged population.

Lung

Physiologically the lungs become less able to expand and contract with age, therefore the O_2, CO_2 exchange becomes more difficult (Badasch and Chesebro 259). This leaves more air trapped in the lungs (Badasch and Chesebro 259).

Breathing capacity of the lungs decreases and the aged expend 10 percent more energy to breathe causing rapid fatigue (Medcom 9). Shortness of breath is associated with aging (Perlmutter and Hall 94). The inability to deep breathe and cough can lead to serious illness (Medcom 9). Among the influences the aged have on their respiratory decline are the cumulative effects of pollution, smoking, occupational exposure to harmful air or vapors and lung disease (Medcom 9). These things can cause permanent damage that can easily be mistaken for primary signs of aging (Perlmutter and Hall 96). They can however, be secondary signs of aging (Perlmutter and Hall 96).

Alveoli

Age changes include the fusion or blending of alveoli (atrophy and loss of elasticity between them), sclerosis of the bronchi and supporting tissues and degeneration of the bronchial epithelium and mucous glands (Corr and Corr 55). The cartilage in the trachea and large bronchi increase in diameter and calcify resulting in increased dead space (Burke and Walsh 229). The dead space this creates decreases the amount of oxygenated air that can reach the alveoli for gas exchange (Burke and Walsh 229). The functional respiratory surface of the alveoli deteriorates even though the total number of alveoli remain the same throughout life (Burke and Walsh 230; Perlmutter and Hall 94). The aged respiratory system has larger alveoli and dilated bronchioles with a decreased air exchange surface for external respiration to take place (Burke and Walsh 230). Collagen in the walls of the alveoli develops cross-linkages decreasing the elasticity and thus decreasing the ability to expand and contract with each breath (Burke and Walsh 229; Perlmutter and Hall 94). The total lung volume remains unchanged but vital capacity is diminished starting in our twentieth year (Corr and Corr 55; Perlmutter and Hall 94). Between the ages of 25 and 85 there is a 40 percent decrease in vital capacity

(Perlmutter and Hall 94). The O2 diffusion is impaired and the respiratory efficiency is reduced; as are the sensitivity and efficiency of self-cleansing mechanisms (Corr and Corr 55).

Other systems impinge on the respiratory system. Degeneration of the intervertebral discs may be seen clinically in the progression of kyphosis and scoliosis (Burke and Walsh 229). Osteoporosis of the thoracic vertebrae and rib cage can result in and increasing rigidity of the chest wall (Burke and Walsh 229; Corr and Corr 55; Perlmutter and Hall 94). Osteoporosis of the ribs and vertebrae, along with calcification of the costal cartilages result in increased stiffness or rigidity, decreased rib mobility and reduced compliance of the chest wall (Burke and Walsh 229). There is reduced elasticity and calcification of the rib cartilage, and weakness of intercostal and accessory muscles of respiration (Christ and Hohloch 39; Corr and Corr 55; Perlmutter and Hall 94; Sorrentino 98). These changes impair the functional reserve respiratory capacity that is normally only a problem with illness (Christ and Hohloch 39; Corr and Corr 55; Perlmutter and Hall 94; Sorrentino 98). The compliance changes little because the rise to be expected from diminished elastic recoil is offset by the increased lung stiffness (fibrosis) and loss of flexibility in the chest wall (Burke and Walsh 230; Corr and Corr 55). Chest structures such as the skeletal muscles, connective tissue, and smooth muscle become more rigid with age (Christ and Hohloch 38). The strength of the inspiratory and expiratory muscle strength declines causing reductions in ventilaton and vital capacity (Burke and Walsh 229; Christ and

Hohloch 38). The muscle fibers become smaller and fewer in number affecting respiration (Perlmutter and Hall 94). The muscles between the ribs, the accessory muscle attached to the first two ribs, and the diaphragm are used more for expiration than previously (Christ and Hohloch 38). The elderly may use their accessory abdominal muscles since their thoracic muscles have weakened with age (Burke and Walsh 229). While the diaphragm does not lose mass it does contribute to the change in the thoracic cage volume (Burke and Walsh 229). Increased abdominal pressure and body position greatly affect the breathing patterns of the frail elderly now that these areas are used for adequate respiration (Burke and Walsh 229). The curve in the upper back or kyphosis decreases the chest expansion (Christ and Hohloch 39). The front to back dimensions of the chest increases due to degeneration of the intervertebral discs (Burke and Walsh 229; Christ and Hohloch 39). This age related change may result in kyphosis and scoliosis or even, in severe cases, may ultimately have the pelvic bones support the rib cage (Burke and Walsh 229). All of these physiological changes will limit the movement of the thorax (Burke and Walsh 229). The cough mechanism is less effective due to inadequate force from the anatomic changes of the chest and decreased muscle strength (Burke and Walsh 231; Christ and Hohloch 39; Sorrentino 99).

Inspiratory reserve volume decreases while the expiratory reserve volume increases by as much as 50 percent due to the loss of elastic recoil (Burke and Walsh 230; Christ and Hohloch 39). By the age of 60 there is a 30 percent loss of maximal oxygen uptake (Perlmutter and Hall 96). The total lung capacity and tidal volume remain unchanged however, the lungs become rigid and the alveoli decrease in number and size (Christ and Hohloch 39).

The vessels that are involved in the external and internal respiration undergo changes. The vessels' muscle components become fibrous and less able to distend for accommodation in their task. The pulmonary artery diameter increases and thickens, subsequently causing an increase in pressure and vascular resistance (Burke and Walsh 230). The mucosal seat of the alveolar-capillary membrane thickens and affects the surface available for diffusion of gases (Burke and Walsh 230). The number of capillaries decline, resulting in decreased alveolar vascularity (Burke and Walsh 230). All of this together diminishes the cardiac output and causes a decrease in the pulmonary capillary blood volume (Burke and Walsh 230).

The respiratory cilia decrease with age (Burke and Walsh 231). This combined with the decreased cough forcefulness impairs the effective clearing of the large air passages (Burke and Walsh 231). Mucus plugging of the small air ducts is more common with aging (Burke and Walsh 231). The secretory immunoglobulin, that neutralizes viruses of the nasal and respiratory mucosal surfaces are less efficient in the aged (Burke and Walsh 231).

The cells that generate surfactant may decrease leaving the elderly susceptible to alveolar collapse and higher incidence of lung disease (Burke and Walsh 230).

The respiratory fluids decrease by about 39 percent affecting the mucous membranes and respiratory tract secretions by drying the airways and increasing the risk of mucus obstruction and infection (Christ and Hohloch 39).

Elastin and collagen components of the lung tissue and pulmonary blood vessels change leading to decreased diffusion activity (Christ and Hohloch 39). The decreases occur in the tensile strength, flexibility, and recoil during expiration (Christ and Hohloch 39). The capillaries that do the gas exchange are thickened and reduced in number leading to a decrease in diffusion (Christ and Hohloch 39). The top and bottom portions of the lungs perform poorly in the aged (Christ and Hohloch 39).

The receptors that control respiratory rate and depth undergo changes with aging (Burke and Walsh 231). When oxygen is low usually the respiratory rate and depth change to accommodate, but in the older person these adaptations may not trigger or may be slow to respond (Burke and Walsh 231).

Exercise is proving to be a great restorer of abilities as well as a preventive action to be taken to avoid the loss of function. This holds true for oxygen consumption. Four months of aerobic exercise for a group over 60 years of age demonstrated a 10 to 15 percent improvement in peak oxygen consumption plus other benefits (Blumenthal et al. 633). While regular exercises increase maximal oxygen uptake it is unclear if exercise improves lung elasticity (Perlmutter and Hall 96).

As in all age-related physiological changes, the changes vary with the individual. The changes can not be avoided entirely. They usually happen slowly along with the aging process, and accommodations are made. The changes, while not looked forward to, are a normal part of aging.

CARDIOVASCULAR SYSTEM

At the heart of all the body systems is the cardiovascular system. This system, also known as the circulatory system, has contact with and affects all other systems. All the other systems, in turn then, can have impact on the cardiovascular system. There is a fine line, that at times is difficult to separate, between the normal aging process of the cardiovascular system and changes related to disease (Burke and Walsh 201; Perlmutter and Hall 90). "The function of the cardiovascular system is influenced primarily by three interrelated factors: the inner workings and condition of the heart, the condition of the peripheral circulatory system, and extrinsic factors such as blood volume, nervous system, and level of physical exertion (Burke and Walsh 199)." The cells of the heart, arteries, veins and capillaries cannot divide and reproduce; therefore the cardiovascular system eventually wears out (Perlmutter and Hall 90). Its deterioration is associated with age (Perlmutter and Hall 90).

The circulatory system is made up of the blood, heart, blood vessels and lymph vessels (Miller and Keane 311). The muscles that make up the heart are cardiac muscles (Mader 56). Cardiac muscle combines the features of both smooth muscle and skeletal muscle yet it is neither, remaining uniquely cardiac muscle (Mader 56). The heart is the pump that circulates blood throughout the body through the blood vessels (Sorrentino 62). The average adult has about five quarts of blood (Miller and Keane 311). This entire amount makes one complete circuit through the body in one minute (Miller and Keane 311). In 24 hours, 7200 quarts of blood pass through the heart (Miller and Keane 311). In a life time the heart may beat 3 billion times (Perlmutter and Hall 90).

Blood

Blood carries important items to and from the cells. The main function of the heart is to circulate the blood that carries food and oxygen to the cells and removes waste products from the cells (Burke and Walsh 198; Sorrentino 62). The circulatory system also produces and carries cells that defend the body from disease-causing germs (Sorrentino 62). Blood and the blood vessels assist in the regulation of body temperature (Sorrentino 62). "Heat from muscle activity is carried by the blood to other body parts (Sorrentino 62)." The blood vessels in the skin dilate if the body needs to be cooled and constrict if heat needs to be retained in the body (Sorrentino 62).

There are many parts that make up the blood. Two of the parts are the blood cells and a liquid called plasma (Sorrentino 62). Three primary types of suspended particles in blood are red blood cells, white blood cells and platelets. Plasma is mostly water and serves as the vehicle that carries the blood cells to the other cells of the body (Sorrentino 62). Plasma also carries food (proteins, fats, and carbohydrates), hormones and chemicals that are needed by the body cells for proper functioning (Sorrentino 62). The plasma also carries waste products away from the cells (Sorrentino 62).

Red blood cells are called erythrocytes (Sorrentino 62). An erythrocyte, when it is mature, is a biconcave disk without a nucleus and is about 7.7

micrometers in diameter (Miller and Keane 515). It consists mainly of hemoglobin and a supporting framework (Miller and Keane 515). Erythrocytes are made in the red bone marrow in the adult (Miller and Keane 515). Initially they have a nucleus (Mader 120). The nucleus is lost and the erythrocytes acquire hemoglobin before they are released from the bone marrow (Mader 120). This red blood cell has many functions including transportation of oxygen and carbon dioxide (Miller and Keane 515). The average life span of an erythrocyte is 120 days (Miller and Keane 516). By the time they are removed from the system they have traveled quite a distance. The body maintains a relatively constant number of erythrocytes. Erythrocytes give blood its red color because of a substance in the cell called hemoglobin (Sorrentino 62). Hemoglobin has affinity for carrying oxygen. As the blood circulates through the lungs the hemoglobin picks up oxygen (Sorrentino 62). When it carries the oxygen it is bright red in color. This blood is called arterial blood and is about 97 percent saturated with oxygen (Miller and Keane 671). The blood circulates throughout the body releasing the oxygen and picking up the carbon dioxide waste product (Sorrentino 62). Then, when the hemoglobin has delivered the oxygen and picked up the carbon monoxide, the color of the blood becomes darker (Miller and Keane 671). This blood is now only about 20 to 70 percent oxygenated and is called venous blood (Miller and Keane 671).

"There are about 25 trillion red blood cells in the body. About 4 1/2 to 5 million are in a cubic milliliter of blood (the size of a tiny drop). These cells live for 3 to 4 months. They are destroyed by the liver and spleen as they wear out.

About one million new red blood cells are produced every second (Sorrentino 62)."

"White blood cells, called leukocytes, are colorless. They protect the body against infection. There are 5,000 to 10,000 white blood cells in a cubic milliliter of blood. At the first sign of infection, white blood cells rush to the site of the infection and begin to multiply rapidly. White blood cells are also produced by the bone marrow. They live about 9 days (Sorrentino 62)." There are many different types of leukocytes. They act by moving through blood vessel walls to reach the site of injury or infection (Miller and Keane 843). White blood cells differ from red blood cells in that they are usually larger, have a nucleus, lack hemoglobin, and appear white in color (Mader 124).

"Platelets (thrombocytes) are necessary for the clotting of blood. They are also produced by the bone marrow. There are about 200,000 to 400,000 platelets in a cubic milliliter of blood. A platelet survives for about 4 days (Sorrentino 62)." Platelets are the smallest of the formed elements in blood (Miller and Keane 1170). Thrombocytes are disk-shaped, non-nucleated with a very fragile membrane (Miller and Keane 1170). They adhere to uneven or damaged surfaces with the task of coagulation and clotting of the blood (Miller and Keane 1170). At any given time 1/3 of the total blood platelets can be found in the spleen while the remaining two-thirds are in the circulating blood (Miller and Keane 1170).

Heart

The task of pumping the blood through the blood vessels to the cells is the function of the heart. This hollow cone shaped, muscular organ lies slightly to the left of the midline of the chest (Burke and Walsh 198; Mader 96; Miller and Keane 654). The ribs, the sternum, and the vertebral column provide a bread-basket-like enclosure for the heart (Burke and Walsh 198). It is the size of the fist. It has three layers (Burke and Walsh 198; Sorrentino 62). The outer layer is the pericardium; it is a thin double wall sac covering the heart, protecting it from infection (Burke and Walsh 198; Sorrentino 62). The pericardium contains a small amount of fluid that reduces friction that occurs during the normal cardiac cycle (Burke and Walsh 198). The myocardium is the second layer. This layer is the thick muscular portion of the heart. The endocardium is the inner layer. It is the membrane lining the inner surface of the heart (Sorrentino 62). The heart itself is not nourished from within. It is fed by the coronary arteries that come from the aorta (Mader 101).

"The heart has four chambers. Upper chambers receive blood and are called the atria. The right atrium receives blood from body tissues. The left atrium receives blood from the lungs. The lower chambers are called ventricles. Ventricles pump blood. The right ventricle pumps blood to the lungs for oxygen. The left ventricle pumps blood to all parts of the body (Sorrentino 62)." The muscle walls of the atria are thinner than the ventricles. The atria are large receiving chambers while the ventricles are smaller and have thick muscular walls for pumping blood out of the heart. Between these four chambers there are trap doors or valves that prevent back flow of blood and secure the chamber so the pressure of the contraction will allow the chamber muscles to force the blood out of the chamber. The valves are special and have individual names. They are the tricuspid valve that is located between the right atrium and the right ventricle and the mitral or bicuspid valve that is between the left atrium and left ventricle.

There are two phases of heart action: systole and diastole (Mader 98; Sorrentino 63). During diastole, the resting phase, heart chambers expand, filling with blood (Burke and Walsh 198; Mader 98; Sorrentino 63). During systole, the working phase, the heart contracts forcing blood into the aorta and pulmonary artery (Burke and Walsh 198; Mader 98; Sorrentino 63). As the atria contract, the ventricles relax and vice versa (Mader 98). All the chambers rest together for 0.40 second (Mader 98). "Blood is pumped through the blood vessels when the heart contracts (Sorrentino 63)." "Blood enters the right atrium from the body and then passes into the right ventricle, where it is pumped into the lungs. It returns from the lungs into the left atrium. It enters the left ventricle and then is pumped to the body via the aorta (Miller and Keane 656)." Deoxygenated blood never mixes with oxygenated blood (Mader 97). Blood must pass through the lungs to pass from the right side to the left side of the heart (Mader 97).

All contraction of the cardiac muscle is controlled by electrical stimulus. There is one main initiating center for this stimulus. It is located in the upper dorsal wall of the right atrium (Mader 98). A stimulus is initiated in the atrium then travels down the electrical pathways to trigger the second major location in the base of the right atrium, which causes contraction of the ventricles. This 0.85

second travel time delay allows the atria to contract followed by the contraction of the ventricles (Mader 98). This electrical activity can be measured accurately with the electrocardiogram.

The autonomic nervous system is the primary regulator of the heart rate (Mader 101). The parasympathetic system promotes function associated with normal activities while the sympathetic system is associated with the times of stress (Mader 101). Decreased efficiency in the sympathetic nervous system accounts for most of the changes in the heart's response to stress, such as the longer time required for each contraction (Perlmutter and Hall 91).

Blood Vessels

Blood vessels are the conduit through which blood flows to body tissues and cells. There are three types of blood vessels: arteries, capillaries, and veins (Mader 94; Sorrentino 63). Arteries are three layered vessels that carry oxygenated blood to the body tissues and cells. The aorta is the largest artery (Sorrentino 63). It receives blood directly from the left ventricle then branches into other arteries that carry blood to all parts of the body (Sorrentino 63). The arteries continue to branch into smaller diameter parts within the tissues (Sorrentino 63). The smallest branch of an artery that can be seen is an arteriole (Mader 95; Sorrentino 63). Arterioles connect with blood vessels called capillaries (Sorrentino 63). Capillaries are very tiny, microscopic, one layer thick, vessels (Mader 95; Sorrentino 63). Capillaries are the semipermeable membrane for interchange of various substances between the blood and tissue fluid (Miller and

Keane 245). "At the arterial end, the blood pressure within the capillary is higher than the pressure in the surrounding tissues, and the blood fluid and some dissolved solid substances pass outward through the capillary wall. At the venous end of the capillary, the pressure within the tissues is higher causing waste material and fluids from the tissues to pass into the capillary, and to be carried away for disposal (Miller and Keane 245)." Veins, like arteries, have three layers, an inner, a middle, and outer, but the layers are not so thick and they collapse when the vessel is cut (Miller and Keane 1597). They return blood to the heart (Sorrentino 63). "Many veins, especially the superficial, have valves formed of reduplication of their lining membrane (Miller and Keane 1597)." They are connected to the capillaries by venules that are small veins (Sorrentino 63). Venules begin branching together to form veins (Sorrentino 63). As the many branches of veins come together they merge into two main veins, the inferior venae cavae and the superior venae cavae (Sorrentino 63). The inferior venae cavae carries blood from the legs and trunk while the superior venae cavae carries blood from the head and arms back to the heart (Sorrentino 63). "At any given time, more than half of the total blood volume is in the veins and the venules (Mader 96)."

The avenue the blood follows is: venous blood, poor in oxygen, empties into the right atrium--> through the tricuspid valve into the right ventricle-->right ventricle pumps blood into the lungs to pick up oxygen--> oxygen-rich blood from lungs into the left atrium--> through mitral valve into left ventricle--> left ventricle to aorta--> aorta to other smaller arteries that carry blood throughout the body--

>arteriole takes arterial blood to the cell capillaries-->cells and capillaries exchange oxygen and nutrients for carbon dioxide and waste products-->capillaries connect with venules-->venules form veins-->veins join to form inferior venae cavae and superior venae cavae returning blood to the right atrium-->to start the cycle all over (Sorrentino 64).

While this is the course the blood takes, the heart does not pump the blood back to the heart. The veins and returning vessels are surrounded by and imbedded in the muscles of the body. As the muscles of the body move, they propel the blood beyond valves located in the vessels. The valves then shut preventing backflow until the next surge of blood. This one way push forces the return of the blood to the heart. The movement of the diaphragm and the muscles that expand the chest cavity provide the large venae cavaes with the force needed to return the blood to the heart.

The blood being forced into the arteries causes their elastic walls to swell, then, with the surge over, to recoil, providing the sensation of the pulse whenever the left ventricle contracts (Mader 101). The normal pulse or heart rate for the aged is 70 with a maximum of no faster than 125 times per minute (Mader 104; Perlmutter and Hall 91).

Blood pressure is the pressure of the blood against the wall of a blood vessel (Mader 104). The systolic blood pressure is due to the ejection of blood from the heart (Mader 104). The diastolic blood pressure is the result of the ventricles relaxing (Mader 104).

AGE-RELATED CHANGES OF THE CARDIOVASCULAR SYSTEM

The aging process affects the heart, however, it remains difficult to separate the normal aging from disease process. In normal aging, the inside layer of the heart thickens (Christ and Hohloch 39). Fat infiltration occurs with a decrease in connective tissue in the heart (Christ and Hohloch 39; Perlmutter and Hall 90). The color of the cardiac cells even changes with age (Christ and Hohloch 40). The heart pumps with less force, becoming less efficient (Sorrentino 98). This loss of efficiency may be the result of cellular changes in the heart muscle, calcified and thickened muscle fibers, loss of muscle fibers, and a loss of elasticity in the heart valves (Burke and Walsh 199; Medcom). The elasticity of the heart muscle decreases causing rigidity; and the valves become thick and rigid (Christ and Hohloch 39; Burke and Walsh 199; Perlmutter and Hall 90). Other structures become calcified and thicken as well, affecting the cardiovascular system (Burke and Walsh 199). "The mitral and aortic valves are most affected, due to their exposure to high pressures in the vascular system (Burke and Walsh 199)." Collagen and lipid increase contributing to stiffness of the muscles of the heart (Burke and Walsh 199). Arteries narrow, become rigid and are less elastic, which is the most common change in the cardiovascular system (Burke and Walsh 199; Medcom 8; Sorrentino 98). Less blood can flow through the narrowed arteries preventing the circulation of needed oxygen (Perlmutter and Hall 91; Sorrentino 98). These changes require the heart to work harder (Christ and Hohloch 40; Sorrentino 98).

At rest there may be no problems, but with exercise, activity, excitement and illness the body's need for oxygen and nutrients' increases (Sorrentino 98). The heart may be unable to meet these needs (Sorrentino 98). There is an increase in resistance that results in an increase in the blood pressure (Christ and Hohloch 40; Mader 330; Perlmutter and Hall 91). A healthy adult can expect a rise in their blood pressure from 120/80 at age 25 to 160/90 at age 65 (Medcom 8). This varies greatly between the sexes and among individuals in the elderly population. It is, however, more prevalent in affluent societies (Perlmutter and Hall 93).

Heart size shrinks due to a decrease in the size of the cardiac muscle cell and the reduction of demands placed on it by a sedentary life-style (Mader 330; Perlmutter and Hall 90). The loss of muscle cell leads to loss of cardiac muscle strength and reduced cardiac output (Burke and Walsh 200; Christ and Hohloch 39, Mader 330; Perlmutter and Hall 90). The left ventricle becomes about 25 percent thicker (Christ and Hohloch 39) due to its pumping against the increased resistance of the narrowed vascular system. All of these changes in the aging cardiovascular system make the heart work harder to accomplish less (Woodruff and Birren 257). There are only two ways for the heart to pump more blood when needed. One is to increase the heart rate which is an option that is limited in the aged heart. The other way is to increase the amount pumped with each contraction. This is what the heart attempts to do by 1) the further thickening of the thick heart muscle in the left ventricle (Christ and Hohloch 39), 2) delay in diastolic filling time allowing more blood to be collected and therefore having more blood available to be pumped out of the heart (Burke and Walsh 200). "Heart rate increase can double or triple the amount of blood pumped each minute even though the maximum possible output with each contraction declines (Mader 330)."

The heart beat or contraction is under electrical control. The aged heart has changes in the electrical amplitude and conduction (Christ and Hohloch 40). The strength of the electrical impulse is decreased and transmission is slowed down due to the major electrical trigger point that becomes infiltrated by fat and connective tissue (Burke and Walsh 199). The reduced functional reserve capacity of the normal aging cardiovascular system reduces its effectiveness at handling stress (Burke and Walsh 200; Medcom 8). "The stroke-volume and cardiac output decrease by about 1 percent each year between ages 19 and 86 (Christ and Hohloch 40)." The resting heart rate remains unchanged with age; there is, however, a decrease in the maximum heart rate that can be achieved with exercise (Burke and Walsh 200; Christ and Hohloch 40). The absence of an increase in the heart rate can obscure the presence of disease conditions (Medcom 8). An individual's baseline heart rate does not change nor does the cardiac output change in older adults who are free of cardiovascular disease (Perlmutter and Hall 90).

While disease is not the focus of this paper, the average heart undergoes changes that resemble cardiac disease. The differences between the cardiac changes related to disease verses normal aging becomes quite blurred and is currently undergoing study for clarification. Meanwhile, the average older adult has cardiac changes that are typical of the entire cohort probably related to diet and lifestyle. The typical pulse rate is decreased and has a wide range: from 44 to 108 beats per minute (Medcom 8). A rapid heart rate is poorly tolerated in the aged (Christ and Hohloch 40). Exercise, emotions, and fever may cause a rapid normal heart beat that may lead to cardiac irregularities or heart failure (Christ and Hohloch 40).

Between the ages of 75 to 80 the heart pumping efficiency is 70 percent of what it was at the age of twenty (Mader 331). The decline may be as much as 40 percent by age 65 (Medcom 8). Blood flow to the vessels of the heart itself is reduced by one-third by age 60 (Medcom 8). The ability of the vessel to stretch decreases about 50 percent by age 80 (Christ and Hohloch 40). "Blood vessels may become less able to respond quickly to changes in body position, failing to maintain sufficient blood supply to all parts of the body. This can lead to dizziness when standing up from a lying position. The older person should sit up straight and allow the body to adjust for a few seconds before standing up (Medcom 8)." Thickened connective tissue in blood vessels leads to their being less distensible (Burke and Walsh 200). Fragmentation of elastin and calcification develops within the vessels and contributes to increased vascular rigidity (Burke and Walsh 200). The superficial vessels become more prominent (Christ and Hohloch 40).

Large arteries and the aorta also develop thick walls (Burke and Walsh 200). Fibrosis and sclerosis develop due to the calcium deposits in the artery walls (Christ and Hohloch 40). All of this thickening of the passageways increases the resistance in the system thereby increasing the blood pressure, and making the system less sensitive to the pressure changes. The arterial elasticity declines, in aging, causing an increased peripheral resistance (Christ and Hohloch 40). The aorta and carotid artery become tortuous (Christ and Hohloch 40).

The capillary membrane thickens with aging (Christ and Hohloch 40). The valves in the veins become less efficient which may lead to varicose veins or stasis ulcers (Christ and Hohloch 40). The veins too become dilated, stretched, and tortuous (Christ and Hohloch 40).

The altered blood flow distribution and increased resistance cause major physiologic changes, such as arteriosclerosis, hypertension, and diminished tissue circulation (Christ and Hohloch 40; Woodruff and Birren 257). Other organs are affected by the cardiac pressure decrease. Blood flow to all the organs is decreased (Christ and Hohloch 40). The brain and heart arteries receive a larger blood volume than other organs and structures (Christ and Hohloch 40). The heart's blood flow decreases by about 35 percent between the ages of 20 and 60 (Christ and Hohloch 40). The liver does not metabolize drugs as efficiently as before due to the reduced blood flow thus resulting in an increased level of drug in the blood. This high level of circulating drug volume can and often does result in drug toxicity. Because of the liver changes, a reduced dosage of medication can be therapeutic in the aged.

Life-style influences cardiovascular function (Burke and Walsh 201). There are a number of things that can be done to have a healthy heart for a life time. Along with picking the correct parental genes, avoid exposure to pollution, do not smoke or chew tobacco, eat a healthy diet, and avoid stressful living. "Researchers have found that putting young, well-conditioned men to bed for three weeks decreases their cardiac output by 26 percent, their maximum breathing capacity by 30 percent, and their oxygen consumption by 30 percent. Solely from disuse, their respiratory and circulatory systems, in effect, temporarily 'aged' nearly 30 years in three weeks (Perlmutter and Hall 140)." Exercise is associated with a decrease in cardiovascular disease, decreased death from cancer, a decrease in the amount of sleep needed and a 35 percent decreased risk of a heart attack (Perlmutter and Hall 140). Strenuous exercise decreases the chance of heart attack by 50 percent (Perlmutter and Hall 140). Although exercise may not prevent a heart attack, it reduces the risk and may ensure recovery and delay death (Woodruff and Birren 257). Ample exercise has a positive effect on the cardiovascular system including a lower resting heart rate, an increase in the efficiency of the heart, lungs and blood vessels, a reduction in hypertension, a reduction in blood cholesterol and an increase in serum high density lipoproteins, a reduction in serum glucose and triglycerides and reduced stored fat (Woodruff and Birren 257). Exercise also increases the feeling of well being, improves self-esteem, improves mental health, provides energy, and relieves anxiety (Perlmutter and Hall 140).

The focus of this paper is the normal physiological aspects of aging. A mention of a few of the cardiovascular disorders or complications from cardiovascular disorders that may affect the elderly are listed here: hypertension, hypotension, stroke, transient ischemic attacks, heart attack, kidney failure, blindness, coronary artery disease, angina pectoris, atherosclerosis, arteriosclerosis, valvular heart disease, arrhythmia's and conduction disorders, peripheral vascular disease, varicose veins, chronic venous insufficiency, stasis ulcers and congestive heart failure. Cardiovascular disease is the leading cause of death for men over the age of 40 and women over the age of 65 in the United States (Perlmutter and Hall 90). Fifty percent of all deaths in the United States are attributable to cardiovascular disease (Mader 105).

Cardiovascular changes start in our youth with the full impact felt in our old age. There are many things we can do for ourselves to minimize the adverse effects of age related cardiovascular changes, primarily, eat right and exercise. The results of so called 'good' eating, while momentarily satisfying, will be paid for far into the future. The lack of exercise and non-use of our muscles that our modern lifestyle tends to promote, is to our detriment. However, the cardiovascular changes that are seen in the normal aging process are not altogether preventable even with correct eating and exercise. The circulatory system does age, grow old and wear out.

DIGESTIVE SYSTEM

The digestive system can be perceived as the most important system, especially as it encompasses our favorite pastime, eating. The digestive system is also called the gastrointestinal system (GI tract), gut, or the alimentary system or canal. It is one continuous tube from the mouth to the anus. The various sections of the GI tract have different names and different specialized functions. The main parts of the digestive system are the mouth, salivary glands, throat or pharynx, epiglottis, esophagus, stomach, small intestine, large intestine, rectum, and anus with accessory organs teeth, tongue, liver, gallbladder, and pancreas (Badasch and Cheseboro 168; Sorrentino 76).

Digestion takes place in the GI tract. It is accomplished by digestive enzymes secreted into the gut by glands both in the gut and by glands located outside the gut but that secrete their enzymes into the gut, facilitating digestion (Mader 69). The digestive system has as its ultimate task the transformation of food into usable soluble molecules that can be transported to and absorbed at the cellular level and to eliminate waste (Mader 69). The meat, potatoes, and butter we eat become the amino acids from the meat protein, the sugars from the potatoe carbohydrate, and the glycerol and fatty acids from the butter, all of which nourishes the cell (Mader 69). The portion of our intake that cannot be digested into small molecules is expelled from the gut as fecal waste material (Mader 69).

The journey of a morsel of food starts as it passes the lips. From the inside of the lips to the anus the GI tract is lined with mucous membrane. "Healthy, intact oral mucous membrane allows the individual to speak, chew, taste, and maintain a normal physical appearance (Burke and Walsh 156)." The oral mucosa is moist, smooth and pink (Burke and Walsh 157). The gums, which are the tissue around the teeth, should also be moist, smooth and pink and in addition the gums should fit tight around the teeth (Burke and Walsh 157).

Taste

Eating is appreciated through both the olfactory (smell) and taste receptors. The olfactory sense is activated both before foods enters the mouth and after it is in the mouth by way of the oral route up to the nose (Murphy 3; Weiffenbach and Bartoshuk 545). Taste is the function of the taste buds which are located on the tongue (Mader 69). "Two facts about taste receptor cells are of special importance. First, there is a synapse between the taste receptor cell and the sensory axon that carries taste information to the brain. This is very different from olfaction, in which there is no synapse and the receptor cell is actually the dendrite of an olfactory neuron. Secondly, the taste receptor cells live only days before they are replaced by new cells (Weiffenbach and Bartoshuk 546)." Receptors for scent and those of taste are positioned in an oval around the edges of the tongue (Weiffenbach and Bartoshuk 544). There are only four simple taste sensations, salt, sweet, sour, and bitter (Murphy 3; Sorrentino 67; Weiffenbach and Bartoshuk 544).

Mouth

The mouth contains the initial means for digestion. Teeth chew food into swallowing size pieces. Teeth are small bonelike structures in the jaws (Miller and Keane 1504). They are for biting, cutting, grinding and chewing of food and to assist in shaping sounds and in the forming of words in speech (Miller and Keane 1504; Sorrentino 67). The physical makeup of a tooth includes a crown and a root (Mader 69). The crown is covered by a layer of enamel; it is the hardest substance in the body (Mader 69; Miller and Keane 1504). Enamel is made of calcium compounds and is related to the epithelial tissue of the skin (Mader 69; Miller and Keane 1504). The root is below the gum line and is covered with a bonelike covering called cementum (Miller and Keane 1504). Beneath the enamel and the cementum, located in the center of the tooth and root is dentin which makes up the main body of the tooth (Miller and Keane 1504). Within the dentin, is the dental pulp, a soft, sensitive tissue that contains nerves and blood and lymph vessles (Mader 69; Miller and Keane 1504). "The cementum, dentin, and pulp are formed from connective tissue (Miller and Keane 1504)."

The roof of the mouth separates the air passages from the oral cavity (Mader 71). The front of the mouth roof is the hard palate and the back is the soft palate (Mader 71). The hard palate is made of a number of bones while the soft palate is muscle (Mader 71). The soft palate ends in the uvula (Mader 71). The uvula is the suspended piece of tissue that can be seen in the back of the throat. When a swallow occurs, the uvula elevates along with the soft palate to close off the nasalpharyngeal area allowing the bolus of food to be directed to the esophagus.

Salivary Glands

The mouth has three large pairs of salivary glands (Mader 71; Miller and Keane 1326). These glands release saliva that contains an enzyme which acts on starch and begins the process of food digestion (Mader 71). The major salivary glands are located outside of the mouth with openings in the mouth. The parotid glands are at the sides of the face immediately below and in front of the ears (Mader 71). They open on the inner surface of the cheek (Mader 71). The sublingual glands are beneath the tongue and the submandibular glands are beneath the lower jaw and open under the tongue (Mader 71). Smaller salivary glands are located in the cheeks and tongue (Miller and Keane 1326). Saliva has many functions which include moistening the mouth, lubricating food for easier swallowing, and providing the enzyme (Ptyalin) necessary to begin food digestion (Miller and Keane 1326; Sorrentino 67). These glands are under the control of the nervous system (Miller and Keane 1326). Within 2 to 3 seconds after being stimulated by sight, smell, or taste of food, the salivary glands respond with saliva (Miller and Keane 1326). These glands produce about 3 pints of saliva daily (Miller and Keane 1326).

Tongue

The tongue is a muscular organ that is slightly rough on the top side and smooth with prominent veins on the bottom side (Burke and Walsh 157). It has taste buds, the organs of taste, on its surface (Miller and Keane 1502). It is strong and provides movement of food in the mouth enabling the teeth to pulverize the oral contents. It then forms the pulverized food into a bolus for swallowing (Mader 71).

Pharynx

The pharynx, or throat, is the region between the mouth and the esophagus (Mader 71). It is a 5 inch long tube made of muscle and membrane (musculo-membranous) leading to the stomach connecting the nasal cavities (nasopharynx), mouth (oropharynx), larynx (laryngopharynx), and esophagus (Mader 71; Miller and Keane 1144).

Esophagus

The esophagus is a muscular tube usually 10 to 12 inches in length (Miller and Keane 519; Sorrentino 67). It also is a tube made of muscle and membrane (musculo-membranous) extending from the pharynx to the stomach (Miller and Keane 519; Sorrentino 67). The layers that comprise the esophagus are the same throughout the gut; consisting of an outer fibrous coat, a muscular layer, a submucous layer, and an inner mucous membrane (Miller and Keane 519). With swallowing, the soft palate and uvula move upward and close the nasopharynx while the epiglottis closes off the larynx allowing an unobstructed path to the stomach. Swallowing is the beginning of a peristalsis movement. This rhythmic contraction is initiated with swallowing and is picked up by the esophagus carrying the bolus to the stomach (Mader 72). The esophagus ends where it meets the stomach at a sphincter aptly called the esophogeal sphincter (Mader 73). "Sphincters are muscles that encircle tubes and act as valves; tubes close when sphincters contract, and they open when sphincters relax, allowing the bolus to pass into the stomach (Mader 73)."

Stomach

The stomach is a thick-walled, muscular, curved, J-shaped saclike organ that lies on the left side of the body beneath the diaphragm (Mader 73; Miller and Keane 1416; Sorrentino 67). "The stomach consists of four coats: an outer serous coat; a muscular coat, made up of longitudinal, circular, and oblique muscle fibers; a submucous coat; and a mucous coat or membrane forming the inner lining. The muscle fibers slide over one another, reducing the thickness of the stomach wall while increasing its area. When empty, the stomach has practically no cavity at all, since its walls are pressed tightly together. When full, the average stomach holds about 1 1/2 quarts (Miller and Keane 1416)." Peristalsis mixes the partially digested food with stomach secretions and ingested liquid until it is the consistency of thick soup, called chyme (Mader 73; Miller and Keane 1416; Sorrentino 67). The contractions (peristalsis) then gradually push the chyme into the small intestine (Mader 73; Miller and Keane 1416; Sorrentino 67). This process takes one to six hours depending on the food eaten, with carbohydrates leaving the stomach more rapidly than proteins and proteins more rapidly than fats (Miller and Keane 1416). "The mucous membrane lining the stomach contains innumerable gastric glands; their secretion gastric juice, contains enzymes, mucin, and hydrochloric acid. Enzymes help to split the food molecules into smaller parts during digestion...Hydrochloric acid aids in dissolving the food before the enzymes begin working on it (Miller and Keane 1416)." Gastric juice also contains pepsin, a digestive enzyme that digests protein (Mader 73). "The high acidity of the stomach (about pH2) is beneficial because it kills most bacteria present in food

(Mader 73)." The chyme leaves the stomach in small amounts through the pyloric sphincter and passes into the small intestine (Mader 73).

Small Intestine

The small intestine is small in diameter only, as it is about twenty feet long (Miller and Keane 785; Sorrentino 67). It has three parts: the duodenum is the first ten inches and is connected to the stomach, the jejunum is after the duodenum, and the ileum is the last section of the small intestine (Miller and Keane 785). Narrow tubes or channels called ducts, carry secretions from the gallbladder and the pancreas and unite to form the common duct that enters into the duodenum (Mader 74). The secretions from the gallbladder and pancreas chemically and mechanically break down the chyme, absorb nutrient molecules, and transport undigested material to the large intestine (Mader 74). The small intestine has villi that look like tightly tufted soft carpet. Each tuft or villi has microscopic villi on it (Mader 74). The villi produce an intestinal digestive juice that contains enzymes for the completion of digestion (Mader 74; Miller and Keane 785). The villi also provide absorption of water and nutrients through their walls into the circulatory and lymphatic systems (Mader 75; Miller and Keane 785; Sorrentino 67).

Large Intestine

The large intestine is larger in diameter than the small intestine but is only five feet long (Mader 75; Miller and Keane 785). It too has a number of parts: the cecum, to which the appendix is attached, the colon, which itself has parts (the ascending, the transverse, the descending, and the sigmoid colon), the rectum and the anus (Mader 75; Miller and Keane 785). The large intestine absorbs water and salts, and forms the indigestible parts of the food and waste into formed, fairly solid feces (Mader 75; Miller and Keane 785; Sorrentino 67). Peristalsis then pushes it down into the rectum for evacuation out the anus (Mader 75; Miller and Keane 785; Sorrentino 67). The stimulus to evacuate the contents of the bowel comes from the colon and the rectum (Mader 75). Feces also contain bile pigments, heavy metals, and large quantities of bacteria (Mader 785). "The large intestine normally contains a large number of normally noninfectious bacteria that live off any substances that were not digested earlier. When they break this material down, they give off odorous molecules that cause the characteristic odor of feces. Some of the vitamins, amino acids, and other growth factors produced by these bacteria are absorbed by the gut lining. In this way, the bacteria perform a service to us (Mader 75)."

Liver/Pancreas/Gallbladder

Other organs that assist in digestion are the pancreas, the liver and the gallbladder (Mader 76). The pancreas secretes enzymes into the small intestine (Mader 76). These enzymes digest all types of food; proteins, carbohydrates, and fats (Mader 76). The pancreas also produces the hormones insulin and glucagon and secretes them directly into the blood (Mader 266). While insulin promotes storage of nutrients, it also helps to lower the blood glucose level (Mader 266). Glucagon is secreted between eating periods, and works just the opposite of insulin, stimulating the breakdown of stored nutrients and causing the blood sugar level to rise (Mader 266).

Liver

The liver has many functions, it:

- Destroys old red blood cells and converts hemoglobin to the breakdown products
- Manufactures and secretes bile
- Stores glucose as glycogen after eating and when it is needed converts glycogen to glucose
- Produces urea from the breakdown of amino acids
- Makes and breaks down fats and temporarily stores fatty acids
- Makes blood proteins, assists in regulating blood volume
- Detoxifies the blood by removing and metabolizing poisonous substances
- Provides storage and filtration of blood
- Breaksdown heme (Mader 76; Miller and Keane 856).

Gallbladder

The gallbladder stores the bile manufactured in the liver, removes water from it and delivers it as needed into the small intestine where it emulsifies fats (Mader 76; Miller and Keane 856).

AGE-RELATED CHANGES OF THE DIGESTIVE SYSTEM

With aging in the GI tract, there is atrophy of mucosa, intestinal glands, and the muscularis which can lead to prolonged GI transit time (constipation), and alteration in intestinal secretion, motility, and absorption (Corr and Corr 54).

Peristalsis is slower and weaker contributing to constipation. "The longer the solid waste remains in the large intestine, the more water is absorbed from it and the more solid it becomes (Badasch and Chesebro 170)."

The aged digestive system finds it more difficult to digest certain kinds of foods and spices (Badasch and Chesebro 170).

Oral Mucosa

Atrophy of the oral mucosa and underlying connective tissue with a decreased ability in mastication is an age related change in the elderly (Burke and Walsh 286). Oral mucous membrane disturbances can be the cause of pain and suffering in the elderly (Burke and Walsh 157). A good diet containing the necessary minerals and vitamins is important since malnutrition is a leading cause of oral mucous-membrane problems (Burke and Walsh 161; Miller and Keane 610) "Changes in the oral mucous membrane during aging include loss of dentition, decreased salivary secretion, atrophy of oral tissues, gum diseases and degenerative changes in the masticatory apparatus (Burke and Walsh 157)." "Decreased salivary production leads to dry mouth and difficulty swallowing and chewing. The atrophy of oral tissues leads to a reduction in host resistance, rendering the elderly more susceptible to infections and oral cancer (Burke and Walsh 157)."

Taste

Three-fourths of the taste buds may be lost by age 70; the tongue becomes smooth, and there is a loss of the threadlike elevations covering most of the tongue surface (Burke and Walsh 157; Murphy 4). Taste and olfactory sensations are mediated by touch, and sensitivity to touch declines with age (Weiffenbach and Bartoshuk 544). These changes can lead to loss of appetite and less interest in food (Badasch and Chesebro 170; Sorrentino 99; Woodruff and Birren 257). The elder individual may be less willing to eat (Badasch and Chesebro 171). The taste quality of one of the four sensations may be affected while others remain intact since they are "differentially vulnerable to declines with aging" (Weiffenbach and Bartoshuk 544). There is an age-related decline in threshold sensitivity to taste (Weiffenbacha and Bartoshuk 548). It is quality-specific rather than across the board (Weiffenbach and Bartoshuk 548). The salty and bitter taste threshold increases more with age than the sweet and sour threshold (Murphy 4). An increased threshold means that it takes more to trigger the taste sensation, hence the tendency to use more salt and to increase the bitter flavor of foods. Eating habits may change due to difficulty with chewing or swallowing or a loss of appetite caused by diminished sense of taste and smell (Medcom 9). Dentures can also affect the taste of the food (Burke and Walsh 286). Across-the-board deterioration of taste is not a consequence of normal aging and needs serious attention as it is due to serious pathologic conditions of the nervous system (Weiffenbach and Bartoshuk 550).

Teeth

One half of all retired persons are endentulous or without teeth (Burke and Walsh 157). Tooth loss usually results from long-term neglect rather than aging (Mader 332). The protective tooth enamel thins, and the dentin becomes translucent in normal aging (Burke and Walsh 157; Christ and Hohloch 40). Teeth may become more brittle (Burke and Walsh 286; Christ and Hohloch 40). Broken off carious teeth, cysts, dental infections, fissures (deep skin groves in the corner of the mouth), oral ulcers and an increased potential for infection of the parotid glands, are all aging related changes (Corr and Corr). Dental caries are the most common disease in the United States. They occur when the bacteria in the mouth metabolize sugar and give off acids that corrode the tooth (Corr and Corr 54; Mader 69). Limiting sweets and regular frequent tooth brushing and flossing help prevent tooth decay (Mader 71). Oral disorders have an impact on the elderly, limiting the ability to chew, eat and communicate and also have an impact on their appearance (Locker and Slade 830). It would seem that oral disorders could even be considered a disability. With more elderly keeping their teeth into old-old age, new attitudes in dentistry are needed for the care of the elderly with teeth (Kamen 2; Locker and Slade 830). Keeping teeth longer increases the risk of dental disease and necessities continued oral maintenance of teeth (Kamen 2).

The alternative to keeping one's own teeth are dentures. Dentures are not maintainence free either nor do they last a life time. The life expectancy for a denture plate is five years. They need to be replaced if teeth fall out, the plate chips, cracks or breaks, the fit is no longer tight, or if irritation of the oral mucosa develops. They need professional cleaning and assessment on a regular basis due to physiological changes of the aging person and the aging of the appliance. Plaque can build up on dentures and must be professionally removed. The endentulous mouth needs professional assessment for an annual cancer check and to check for other oral disorders in addition to assessment of the dental plate.

Regular care of the endentulous tissue is required, including removing the dentures overnight to allow the tissues to rest from the pressure of the appliance. The plate needs to be brushed and must be soaked overnight in water to prevent warping due to dryness.

Gingival recession exposes the cementum, lending the cementum susceptible to plaque build up and caries (Corr and Corr 54; Kamen 3). The changes that occur in the mouth when it has been without teeth for 18 months are permanent making subsequent adaptation to dentures unsuccessful (personal conversation with Dr. Scherff). The changes in dentention include decreased saliva or the thickening of the saliva, tooth erosion, abrasion halitosis, stress on the remaining teeth, excessive bone resorption, muscular imbalances, malocclusion of the jaw and temporomandibular arthritis (Burke and Walsh 157). The combination of the loss of teeth and loss of tissue mass (gums shrink) in the mouth leads to poorly fitting dentures (Badasch and Chesebro 170). As early as the fourth decade there may be a resorption of bone in the jaw leading to loosening of teeth, increased infections in teeth and gums, and eventual loss of teeth (Burke and Walsh 286). Jaw bone resorption and changes in gum structure also result in ill fitting dentures that can result in poor nutrition (Burke and Walsh 286). There is a lack of correlation between advanced age and deteriorating oral health status which demonstrates that periodontal disease, decay, and the loss of natural teeth in late life are not an unavoidable age-related physiological change (Christ and Hohloch 40; Jette, Feldman and Douglass 1107; Kamen 1). Therefore the converse must apply. The declining oral health of the elderly is a result of neglect of care and lack of treatment of dental caries and/or periodontal disease (Jette, Feldman and Douglass 1102). While all of this is true, there is an association between increased severity of periodontal disease and increasing age (Kamen 1, 4). Good oral hygiene should yield healthy periodontal tissue (Kamen 1).

Physical disabilities are part of the reason the aged do not receive the needed oral health care (Jette, Feldman and Douglass 1102). They may not be able to do self care due to physical or mental limitations. The elderly may not be able to physically go to the dentist. Few elderly have dental insurance to cover the cost of oral care. They also often have limited funds for maintenance of their oral health. Good oral care notwithstanding, there is a small number of elderly in which specific teeth and specific sites are prone to dental caries (Kamen 3).

Periodontitis (the inflammation of the tissues supporting the teeth) is caused by poor oral care, specifically by residual food, bacteria, and calcium deposits in spaces between the gum and lower part of the tooth crown (Miller and Keane 1132). Oral bone loss is one result of periodontitis (Jeffcoat and Chesnut 49). Bone loss also results in loss of teeth and increased chances of residual or remaining ridge resorption (Jeffcoat and Chesnut 49). This and the atrophic changes in the jaw lead to problems of adaptation to dentures and altered alignment of bite (Corr and Corr 54; Kamen 3). Systemic osteoporosis, age and estrogen deprivation are factors in alveolar (the sockets in the jaw for the teeth) bone loss and subsequent tooth loss (Jeffcoat and Chesnut 50). The residual ridge resorption and loss of teeth may result in severe mandibular atrophy (Jeffcoat and Chesnut 50). Ridge resorption may be caused by ill-fitting dentures and make wearing dentures difficult or impossible (Jeffcoat and Chesnut 49).

Gum

Gum disease is the greatest oral mucous membrane impairment in the frail elderly (Burke and Walsh 157). It is more prevalent in the elderly (Mader 71). It can lead to gingivitis, an overgrowth of gingival tissue, halitosis, and periodontal disease (Burke and Walsh 157). Plaque can cause gingivitis leading to the gums becoming darker, edematous, and soft, and bleeding easily (Burke and Walsh 160). Gingivitis is best prevented by regular, frequent brushing and flossing of the teeth and implementation of a proper vigorous oral hygiene plan (Burke and Walsh 160; Miller and Keane 610). Periodontitis begins with inflammation of the gums (gingivitis) that spreads to the periodontal membrane lining the tooth socket (Mader 71). It can result in loss of bone and loosening of the teeth to such a degree that extensive dental work may be required in an attempt to save the teeth (Mader 71). The best preventive is brushing and flossing to keep the mouth free of food particles and debris.

Saliva

As early as the fifth decade there is a decrease in the salivary secretion, slowing digestion of starch (Burke and Walsh 286; and Christ and Hohloch 40). It is associated with changes in taste thresholds (Burke and Walsh 286; Christ and Hohloch 40). Saliva secretion reduction or impairment of the swallowing mechanism are associated with aging (Medcom 9). There is a reduction in the amount of saliva and digestive juices and they are released more slowly (Badasch and Chesebro 170; Mader 332). "This causes the digestive process to be slower and less efficient (Badasch and Chesebro 170)."

The loss of moist saliva increases the rate of dental caries. In the normal moist mouth it may take 15 to 18 months to develop a dental carie. In a dry mouth with thick saliva, a dental carie may develop in as little as 2 1/2 months. Dry mouth, known as "xerostomia, can lead to a decrease in chewing (masticatory) function, an increase in oral mucositis, a decrease in the denture-wearing abilities of the patient, and an increase in dental caries (Scherff 40)." Saliva thickens, making it more difficult to swallow (Sorrentino 99). Oral care should be done every two hours in the case of thick tenacious oral mucus (Burke and Walsh 164). Mechanical debridement of the mouth with a solution of one part hydrogen peroxide to four parts normal saline may be helpful (Burke and Walsh 164). The medication regimen should be checked for possible causes of thick oral secretions. Sugar-free lemon drops may increase saliva production while artificial saliva products may also relieve symptoms (Burke and Walsh 164). Adequate hydration cannot be emphasized enough, remembering the elderly's decreased thirst perception. Regular fluoride dentifrice and fluoride mouthwash can be used to prevent further oral mucous membrane damage (Burke and Walsh 164).

Mouth

The elderly person is at risk for inadequate food intake and poor nutrition due to oral changes, associated loss of appetite and difficulties chewing food (Burke and Walsh 287). Muscle loss results in a decline in the biting force (Christ and Hohloch 40). Neurologically there is a decrease in the gag reflex in the elderly (Christ and Hohloch 41).

Epiglottis

The epiglottis weakens with age and cannot completely close, causing choking with some foods (Badasch and Chesebro 171). Dysphagia (difficulty swallowing), esophageal reflux, and esophageal pouches that collect food and/or fluid, either holding or causing a pause in the travels to the stomach, are increased in the aged physiology (Corr and Corr).

Esophagus

The major esophageal age related change is smooth-muscle weakness that can result in delayed emptying, possible esophageal dilation and increased risk of aspiration (Burke and Walsh 287; Christ and Hohloch 41). The sphincter at the lower end of the esophagus may become weak, allowing back splashes of secretions from the stomach which cause burning irritation and inflamation of the esophagus called esophagitis (Burke and Walsh 287; Perlmutter and Hall 96). This lower esophageal sphincter also can fail to relax thereby not allowing its contents to empty into the stomach (Perlmutter and Hall 96).

Hiatal hernia is a frequent age-related difficulty (Christ and Hohloch 41; Corr and Corr). A hernia is the abnormal protrusion of part of an organ or tissue through the structures that normally contain it (Miller and Keane 683). They are named after the location or organ where it is located. The hiatal hernia, then, is the protrusion of a structure, often a portion of the stomach, through the esophageal hiatus of the diaphragm (Miller and Keane 684).

The lower section of the esophagus may have a prolonged spastic contraction with increased nonperistaltic contractions that are not sufficient to move contents along the tract (Burke and Walsh 287). Diminished eating pleasure, due to an unpleasant feeling of fullness in the chest under the sternum (breast bone), may be the result of delayed emptying of the esophagus caused by the weakened muscle (Burke and Walsh 287).

Stomach

The muscle at the opening to the stomach becomes weaker with age and may not seal completely (Badasch and Chesebro 171). This allows the contents of the stomach to leak back into the esophagus. The combined action of partly digested food and digestive juices on the esophagus can cause a burning feeling and pain (Badasch and Chesebro 171). Stomach muscle changes, fat tissue accumulation and smooth muscle thinning results in delayed in gastric emptying and difficulty in managing large food quantities (Christ and Hohloch 41). Yet it has not been proved that there are changes in gastric motility and emptying as we age (Burke and Walsh 287). There is risk of impaired digestion and absorption of iron, vitamin B12, and protein, diminished levels of hydrochloric acid, gastric mucus, and pepsin (Burke and Walsh 287). The decrease in pepsin and hydrochloric acid secretion causes only minimal functional changes, while the diminished absorption of calcium and vitamins B1 and B2 still remains adequate (Christ and Hohloch 41). The decrease in the hydrochloric acid may result in defective absorption of iron and vitamins, and lead to pernicious anemia (Corr and Corr 55). From age 50, the secretion of hydrochloric acid steadily decreases with the result that there is a small number of those over the age of 70 who develop atrophic gastritis (Perlmutter and Hall 98). The glands that line the stomach and produce mucous and the digestive enzyme, pepsin, are destroyed by chronic inflammation caused by aspirin, alcohol, bile salts and acids, not by normal aging (Perlmutter and Hall 98).

Small Intestine

While the intestines begin their aging process before age 30, due to their large reserve, they maintain their ability to function as well as ever in the healthy aged (Perlmutter and Hall 98). The cell replacement in the intestine takes twice as long in the aged (Christ and Hohloch 41). There is a decrease in digestive juices (Mader 332; Sorrentino 99; Woodruff and Birren 257). Changes associated with decreased function and atrophy of the small intestine may affect protein, fat, and carbohydrate absorption, as well as potential malabsorption of other nutrients, such as calcium and vitamin D (Burke and Walsh 287). With all of these changes there is no indication of absorption reduction in the digestive tract (Mader 332). The nutrient absorption may not be as efficient (Christ and Hohloch 41). In some elderly, the absorption of B6, B12 and calcium may not be what it once was (Perlmutter and Hall 98).

Large Intestine

There is a reduction of smooth wall muscle in the large intestine and loss of tone in its remaining muscles (Christ and Hohloch 41; Perlmutter and Hall 98). Besides weakened musculature, there is a decrease in the peristalsis and diminished nerve sensation (Christ and Hohloch 41; Woodruff and Birren 257). This would not have enough influence to cause the problems in the aged. Combined, however, with decreased fluid intake, lack of fiber and lack of exercise, the result is constipation (Christ and Hohloch 41; Perlmutter and Hall 98).

Colon

Age-related changes in the colon's role in the digestive process and storage activities are atrophy of the mucosa, and a decrease in the musculature (Burke and Walsh 287). Diverticulitis, (a condition in which irregular pouches develop along the walls of the large intestine) is rarely seen in those under 30, while in the aged, it occurs more often and may be due to a lifetime low-residue diet (Corr and Corr 55).

Anus

The muscle at the anus becomes weaker and there is a decrease in the external sphincter reflex (Christ and Hohloch 41). "It is more difficult to control the flow of stool from the rectum. The weaker the muscle becomes, the greater the leakage of stool from the rectum (Badasch and Chesebro 171)." This muscle weakness is a great contributor to the embarrassing escaping flatulence that occurs.

Liver

The liver begins its age-related changes between the fifth and sixth decade with cell structure changes (Perlmutter and Hall 98). There is a reduction in size, weight, and function of the liver between 60 and 90 years of age (Burke and Walsh 287). It becomes sluggish in response to stimuli that provoke enzyme production and those enzymes are less concentrated (Christ and Hohloch 41; Perlmutter and Hall 98). The decrease number of hepatic cells results in a reduced ability to metabolize drugs and hormones and reduces alcohol tolerance (Burke and Walsh

287). The livers' ability to synthesize protein decreases (Christ and Hohloch 41). Although the liver undergoes all of these losses, it retains an adequate reserve function in the healthy elder (Burke and Walsh 288; Christ and Hohloch 41).

Pancreas

Even with all the physiological changes that the pancreas undergoes, including dilation of the ducts at the head, body, and tail of the pancreas, fatty infiltration, fibrosis, arteriolar sclerosis and other changes, function is not affected (Burke and Walsh 288). The pancreatic enzymes, trypsin, amylase, and lipase decrease in volume and concentration, resulting in poor tolerance of high-fat meals and poor absorption of fat-soluble vitamins (Christ and Hohloch 42). The concentration of enzymes nonetheless remains sufficient to maintain digestive function (Christ and Hohloch 42). The elderly's ability to dispose of glucose efficiently progresses with aging, the cause of which is still unclear (Perlmutter and Hall 103). The glucose level of the elderly remains high long after a load enters the bloodstream (Perlmutter and Hall 103). While half of the aged past age 65 show decreased glucose tolerance, less than 10 percent have any signs of diabetes (Perlmutter and Hall 103).

Gallbladder

The gallbladder walls thicken and shrink with age but its function to store bile is unimpaired (Perlmutter and Hall 98). Emptying of the gallbladder becomes more difficult, bile becomes thicker and there is less of it (Christ and Hohloch 41). There is a tendency to develop gallstones in approximately 40 percent of those over age 80 (Christ and Hohloch 41). With aging, bile can become supersaturated with cholesterol (Perlmutter and Hall 98).

"Many of the digestive complaints of the elderly are the result of their life-style or the diseases of secondary aging (Perlmutter and Hall 96)." As with some other physiological age-related changes it is difficult to separate true age-related changes from those due to decreased activity levels, long-term dietary habits, and side effect of medications (Burke and Walsh 287). As has been previously asserted, attention to diet, drugs, and exercise can minimize some of the functional age-related disorders (constipation, hiatal hernia, diverticulosis etc.) (Woodruff and Birren 257).

If it can ever be said that an army moves on its stomach then the army of older adults move on the quality and condition of their GI tract from their mouth to their anus. Nutrition on a plate has never kept anyone healthy or well fed. Eating consists of ingestion, digestion and elimination, all of which must act in unison for good health. The individual may be compartmentalized psychosocially, but the digestive tract must act in total for a healthy happy individual.

URINARY SYSTEM

The urinary system is quite a sophisticated system. It includes the kidneys, ureters, urinary bladder and urethra (Mader 174). These organs are under the control of the spinal cord, the brain, and the autonomic and somatic nervous systems (Burke and Walsh 313). The main purpose of the urinary system is the removal of liquid waste from the body, and to regulate salt, glucose, and the alkaline levels of the blood (Badasch and Chesebro 421; Perlmutter and Hall 100). To oversimplify the functions of the urinary system, the kidneys produce urine, ureters transport urine, the urinary bladder store's urine while the urethra eliminates urine from the body (Mader 173).

Kidneys

There are two kidneys. They are bean-shaped organs about the size of a fist, located at waist level, in the back flank area, one toward each side of the body (Badasch and Chesebro 422). Kidneys filter blood, excrete the end-products of body metabolism as urine, and regulate the concentrations of hydrogen, sodium, potassium, phosphate, and other ions in the fluid outside the cells (Miller and Keane 813). The average adult kidney is about 4 inches long, 2 inches wide, 1 inch thick, and weighs 4 to 6 ounces (Miller and Keane 813).

The kidney has many filtering segments. There are over one million microscopic filtering nephrons in the kidney (Miller and Keane 813; Sorrentino 67). The nephron has many different filtering structures including: the Bowman's capsule, the proximal convoluted tubule, the loop of Henle, the distal convoluted tubule, and the collecting duct (Mader 175). For filtration to take place, the fluid must be brought to the kidney and past the specialized filtering areas. The kidney is one of the three areas of the body that contains the smallest vessels, the other areas are the eye and the brain. This dense vascular bed of exceptionally small vessels allows for filtration, absorption, and reabsorption to take place efficiently. The blood is brought to the kidney nephron, past the filtration areas for pressure filtration, selective reabsorption, and tubular excretion (Mader 176).

> "Blood arrives at the kidney by way of the renal artery, and is distributed through arterioles into many millions of capillaries which lead into the nephrons. Fluids and dissolved salts in the blood pass through the walls of the capillaries and are collected within the central capsule of each nephron. The glomerulus, a tuft of capillaries within the capsule, acts as a semipermeable membrane permitting a protein-free ultrafiltrate of plasma to pass through. This filtrate is forced into hairpin-shaped collecting channels in the nephrons, called tubules. Capillaries in the walls of the tubules reabsorb the water and the salts required by the body and deliver them to a system of small kidney veins which, in turn, carry them into the renal vein and return them to the general circulation. Excess water and other waste materials remain in the tubules as urine. The urine contains, besides water, a quantity of urea, uric acid, yellow pigments, amino acids, and trace metals. The urine moves through a system of ducts into a collecting funnel (renal pelvis) in each kidney, whence it is led into the two ureters. (Miller and Keane 813)."
>
> "About 1 1/2 quarts (1500cc) of urine are excreted daily by the average adult. Ordinarily it draws off from the blood about 180 quarts of fluid daily, and usually returns 98 to 99 percent of the water plus the useful dissolved salts, according to the body's changing needs (Miller and Keane 814)." The kidney maintains the body's acid-base balance and regulates the sodium-water balance (Miller and Keane 814).

While the kidney controls the amount of fluid and the number of ions that are removed or retained by the body, it is done in response to hormones. Primarily the antidiuretic hormone from the posterior pituitary directs the kidneys in the maintenance of blood volume (Mader 180). The hormone aldosterone is secreted by the adrenal cortex and primarily maintains sodium and potassium balance (Mader 181). The kidneys control the narrow window of acceptable blood pH (Mader 180). This is done by reabsorption and excretion of sodium, hydrogen, ammonia, bicarbonate, potassium and magnesium as needed (Madder 180).

Ureters

Each kidney has a muscular tube called a ureter that drains urine from the kidney into the bladder by peristaltic contractions (Badasch and Chesebro 422; Mader 173; Sorrentino 69). It is a fibromuscular tube, 10 to 18 inches in length that rhythmically forces the urine along, emptying it in spurts into the bladder (Miller and Keane 1559; Sorrentino 69)

Bladder

The lower urinary tract includes the bladder, the detrusor muscles surrounding the bladder, the urethra, and the internal and external sphincters (Burke and Walsh 313). The pelvic floor muscles are important in bladder control in that they support both the bladder and the urethra (Burke and Walsh 314). The bladder is a holding container for the urine. It is a hollow, membranous, round muscular saclike organ at the end of the ureters in the lower part of the abdominal cavity that expands as it fills with urine (Badasch and Chesebro 422; Mader 173; Sorrentino 69). The urinary bladder can hold up to 600 cc of urine (Mader 173). The sympathetic nervous system maintains the bladder relaxation and urethral contraction (Burke and Walsh 313). The parasympathetic nervous system controls the contraction of the bladder for expulsion of urine (Burke and Walsh 313). Two ureters, one from each kidney, squirt urine into the bladder and the bladder empties through one tube, the urethra.

Urethra

The urethra is the drain through which urine from the bladder exits the body through the urethral meatus (Badasch and Chesebro 422; Sorrentino 69). The external sphincter, which controls elimination of urine from the bladder, is controlled by the somatic nervous system (Burke and Walsh 314). In the female the urethra is about 2.5cm long and in the male it is about 15 cm long (Mader 173).

"There is no connection between the genital and urinary systems in females whereas there is a connection in males (Mader 173)."

The brain mediates urination, also known as micturition (Burke and Walsh 314). "The cerebral cortex appears to inhibit the loss of urine, whereas the brainstem facilitates urination (Burke and Walsh 314)." As the urinary bladder fills with urine, stretch receptors send nerve impulses to the spinal cord when there is approximately 300cc of urine in the bladder (Mader 174). Nerve impulses leaving the cord then cause the urinary bladder to contract and the sphincters to relax so that urination is possible (Mader 174). The cerebral cortex can control this reflex, which is the process used in adults to delay urination, until a suitable time (Burke and Walsh 314; Mader 174).

Urine is the vehicle by which the body rids itself of excess water, several different types of waste products and the surplus of the products that are necessary for bodily functioning (Miller and Keane 1563). A list of waste products would include: urea, uric acid, ammonia, and creatinine (Miller and Keane 1563). Items such as sodium, potassium, calcium, magnesium, chloride, phosphate, and sulfate are chemicals that may be found in excess in the body (Miller and Keane 1563). When they are in excess the kidneys then flush them out (Miller and Keane 1563).

AGE-RELATED CHANGES OF THE URINARY SYSTEM

Kidneys

The kidney begins to shrink in the third decade due to reduced renal tissue growth (Christ and Hohloch 42; Perlmutter and Hall 100). By age 80 it may be only 30 percent of its original weight (Perlmutter and Hall 100). "The kidney undergoes age-related changes including loss of nephrons (kidney tubule, the functional unit) so that in an average life span, about one half of the birth number remain (Woodruff and Birren 257)." Of the remaining functional units, more than 30 percent are abnormal (Perlmutter and Hall 100). The filtration rate falls steadily from age 21 until by the age of 90 it has declined 35 to 50 percent (Perlmutter 100). "Stress can easily precipitate kidney failure in an elder (Woodruff and Birren 257)." It also requires more time to assure homeostasis in bodily functions (Woodruff and Birren 257). The sodium-conserving ability of the kidney decreases, while the acid-base disturbances take longer for the kidney to correct (Christ and Hohloch 42). Renal blood flow, glomerular filtration, and tubular rates decrease with aging: this decrease in blood flow may be as much as 53 percent (Christ and Hohloch 42; Medcom 10; Woodruff and Birren 258). The renal arteries undergo sclerotic and fibrotic changes in the elderly (Woodruff and Birren 258). With age-related diseases as atherosclerosis, there is further decrease in renal function (Christ and Hohloch 42). The passage of blood through the kidneys and the reabsorption of glucose from the tubular fluid is slower in the aged (Perlmutter and Hall 100). The older kidney does not concentrate urine as well as it once did, especially at night, due to changes in tubular function (Christ and Hohloch 42; Perlmutter and Hall 100).

Dehydration is a serious problem in the elderly. It is responsible for significant morbidity and mortality rate among the elderly (Burke and Walsh 298). Thirst in the elderly is reduced, reducing their desire to drink adequate amounts of fluid. Dehydration can be seen as either a lack of body fluid in comparison to the solutes or an excessive amount of solutes compared to the amount of body fluid. This can be predominately influenced by fluid intake and urinary excretion. The body loses fluid through excretion by sweat, respiration and the renal system. Age changes can contribute to dehydration and high blood sodium through a decrease in total body water, an altered sense of thirst, a lowered ability of the kidneys to concentrate urine, and a decrease in the effectiveness of the antidiuretic hormone (ADH) (Burke and Walsh 299). Other conditions that may contribute to dehydration include: hypertension, congestive heart failure, renal disease, infections, fever, diarrhea, and central nervous system disorders that diminish the thirst sensation (Burke and Walsh 299). Drugs, physical, mental, and psychosocial disorders, and the self-imposed deliberate fluid restriction to avoid incontinence, all contribute to potential dehydration (Burke and Walsh 299). Dehydration leads to changes in skin, neurological status, cardiopulmonary status, genitourinary functioning and blood laboratory values (Walsh and Burke 299). The best treatment for dehydration is prevention. Once dehydration has occurred, the ingestion of fluids is necessary. Primarily water, but juices are also appropriate to replenish fluids. Avoid coffee, tea, sweetened drinks and colas as they have a tendency to cause the body further loss of water, as they are diuretics (Burke and Walsh 299). The decreased kidney function resulting from normal age-related changes, allows poisonous substances to build up in the blood, and concentration of urine due to lack of fluid intake (Sorrentino 98).

The changes in the renal system can cause medications to remain in and active in the system longer, thereby becoming toxic to the elder. "Adverse affects of medication should be monitored closely in the elderly (Medcom 10). Even with these major anatomical changes the kidney continues to work reasonably efficiently (Perlmutter and Hall 100)." Renal function is sufficient at 50 percent (Christ and Hohloch 42).

Bladder

Nocturia, which is going to the bathroom frequently during the night, increases with age. The elderly have a need to void every two hours while awake and at least once during the night because of diminished bladder capacity (Perlmutter and Hall 100). There may be a need to void 30 minutes after going to bed because the recumbent position increases renal function (Christ and Hohloch

43). The bladder's reduced capacity to expand and contract due to shrinkage is related to muscle weakness and changes in connective tissue, rendering the need for the aged bladder to be emptied frequently (Perlmutter and Hall 100). Urinary tract infections are common in the aged due to urinary stasis, retention, and obstruction, (Christ and Hohloch 99) among other things. This can be the reason for frequent, urgent, or burning micturition. Emptying the bladder becomes a problem in aging due to weakening of the bladder and perineal muscles and changes in the sensation to void (Christ and Hohloch 43). These changes may lead to retention of large volumes of urine (Christ and Hohloch 43). Bladder capacity decreases by half in the aged (Christ and Hohloch 42). The signal for the bladder to empty is felt in the elderly when the bladder is full. Before this age-related change, the bladder signaled when it was half full (Perlmutter and Hall 100). This last minute signal comes with a need for immediate response or it comes too late to be answered (Perlmutter and Hall 100).

Incontinence is the inability to control the elimination of feces or urine. It is not a normal age-related happening. There are, however, some age-related changes that may lend themselves to incontinence. For men, benign prostate hypertrophy (BPH), which is a non-cancerous enlargement of the prostate gland, increases with age and often leads to urinary incontinence, urinary frequency, urgency, decreased force of the urinary stream and hesitancy in initiating urine flow (Burke and Walsh 314). In men, an enlarged prostate gland or a weakened bladder may cause frequent urination or dribbling, as will a urinary tract infection

(Christ and Hohloch 43). In women, the normal age-related estrogen decrease causes changes in the squamous epithelium of the urethral and vaginal wall, a decrease in vaginal muscular tone, a weakened pelvic diaphragm from childbirth and vascular profusion changes, all of which contribute to urinary incontinence (Burke and Walsh 314; Christ and Hohloch 43). The incontinence could possibly be accompanied by urgency and frequency, as could a urinary tract infection. Incontinence is categorized as transitory or persistent (Burke and Walsh 314). There are four types of incontinence: stress, urge, overflow, and functional. Since incontinence per se is not a normal age-related happening, it will not be addressed here. Suffice it to say, these types of incontinence are treatable and should not be considered normal. Incontinence is not acceptable in the aged and should not be considered or treated as such. That it is not a normal part of aging does not negate the fact that urinary incontinence is the most common reason elderly are placed in long-term facilities.

The renal system is complex and not addressed in its totality here. The renal system is a body system in which the age-related changes have potential for a significant health impact.

REPRODUCTIVE SYSTEM

The reproductive system is for the reproducing of a species. The human reproductive system is more than the female and male organs of reproduction. It is governed by the hormone releasing endocrine system (Perlmutter and Hall 104). The endocrine system, consisting of the hypothalamus, anterior pituitary, and adrenal cortex, all play a major hormonal role in the reproductive system of both female and male. The major hormones, testosterone, estrogen and progesterone, are found in both male and female but in differing amounts. The brain acts as the major regulator, with hormones that are secreted in the hypothalamus controlling the functions of the pituitary (Kolodny et al. 26).

Reproduction is accomplished through sexual functions. Sexuality is not just the physical or biological reproductive elements and act, but encompasses the manner in which individuals use their roles, relationships, values, customs, maleness or femaleness (Miller and Keane 1358). The sexuality experienced in men and women refer to a broad concept including the physical, psychological, social, emotional, and spiritual makeup of an individual (Miller and Keane 1358).

There are no known age limits to sexual activity, and there is nothing in the biology of aging that automatically shuts down sexual function (Burke and Walsh 116). The physiology of human sexuality undergoes many changes while growing old. The functions and actions modify their role in the age-related changes.

Human sexual physiology, functions and actions are regulated and modified by hormones. The organs and the hormones undergo age-related changes in the male and female.

It is obvious in age-related reproductive changes, the changes are the physiological adjustment toward non-reproduction.

THE FEMALE REPRODUCTIVE SYSTEM

The human female sex produces the egg and bears the young (Miller and Keane 546; Morris 483). The female anatomical reproductive system includes the vulva, vagina, uterus, fallopian tubes, ovaries, and breasts.

Vulva

The external female genital organs are known collectively as the vulva (Mader 283; Sorrentino 72). The vulva consists of the mons pubis, the labia's majora, labia's minora, clitoris, and vestibule (Mader 284). The mons pubis is a hair covered, well padded, rounded, fleshy, prominence that is over the bony symphysis pubis (Mader 284; Miller and Keane 932; Sorrentino 72). The labia's majora are two large, hair-covered folds of skin that extend back from the mons pubis (Mader 283; Sorrentino 72). They are composed of a large amount of fat tissue and a thin layer of smooth muscle (similar to the muscle fibers present in the male scrotum) (Kolodny et al. 9). The labia's majora have many sweat and sebaceous glands (Kolodny et al. 9). Between the labia's majora are two small folds of skin known as the labia's minora (Mader 284). The labia's minora have a center of vascular, spongy connective tissue without fat cells; their surfaces are composed of stratified squamous epithelium with large sebaceous glands (Kolodny et al. 9). Both labia extend forward forming a foreskin encircling the clitoris

(Mader 284). The clitoris is a small, pea-shaped glans of erectile tissue that contains sense receptors for sexual stimulation (Mader 284; Sorrentino 72). It is composed of two small erectile cavernous bodies enclosed in a fibrous membrane surface and ending in a glans or head (Kolodny et al. 9). The clitoris is just like the male penis and is richly endowed with free nerve endings whose sole function is as a receptor and transducer for erotic sensation in the female (Kolodny et al. 10). A vestibule is a space or cavity at the entrance to another structure which in this case is the vagina (Miller and Keane 1605). The vestibule of the vagina houses the urethra (Mader 284; Miller and Keane 1605).

Vagina

The vagina is a sheathlike canal from the external genitalia to the cervix (Miller and Keane 1570). It is a potential space rather than a balloonlike opening (Kolodny et al. 10). It is about 3 inches long and makes a 45 degree angle with the small of the back (Mader 283; Miller and Keane 1570). It has a mucous lining that lies in folds that is the major source of vaginal lubrication (Kolodny et al. 10; Mader 283). The vaginal walls are fibromuscular, capable of contraction and expansion; and can accommodate to the passage of a baby or a penis (Kolodny et al. 10; Mader 283). A cervix is a part of an organ resembling a neck (Bolander and Bolander 37). The cervix of the uterus projects into the vagina (Kolodny et al. 10; Sorrentino 72). The vaginal entrance is just behind the urethra (Sorrentino 72). It receives the penis during copulation (Sorrentino 72).

Uterus

The uterus is a thick-walled, hollow, muscular organ about the size and shape of an inverted pear (Mader 283; Sorrentino 71). It is located above and tips over the urinary bladder and in front of the rectum, in the center of the pelvic cavity (Mader 283; Sorrentino 71). The top of the uterus is called the fundus (Sorrentino 71). The uterus is approximately 5 cm wide but can stretch to over 30 cm during gestation (Mader 283). The lining of the uterus is called the endometrium (Sorrentino 71). It contains many blood vessels and builds and sloughs on a cyclic basis if impregnation of a fertilized egg does not occur (Sorrentino 71). On the sides at the top of the uterus are the fallopian tubes.

Fallopian Tubes

The fallopian tubes, or oviducts, or uterine tubes extend from the end of the uterus on each side to the ovaries (Kolodny et al. 12; Mader 283; Sorrentino 71). They do not touch the ovaries nor are they connected to the ovaries. The fallopian tubes are tipped with fingerlike projections called fimbriae that sweep over the ovary at the time of ovulation (Kolodny et al. 12; Mader 283). In addition, the fallopian tubes are lined with cilia that sweep gently encouraging the ova or egg into it (Kolodny et al. 12; Mader 283). The tubes also have muscular contractions that propel the recently released ova toward the uterus (Kolodny et al. 12; Mader 283).

Ovary

The female gonadal organ is the ovary (Miller and Keane 1083). There are two and they are located in the abdomen, one on either side of the uterus (Miller and Keane 1083; Sorrentino 71). The ovaries produce hormones and affect the reproductive process (Miller and Keane 1083). The hormones they produce are estrogen and progesterone (Miller and Keane 1083). The ovaries are the size of walnuts and shaped like almonds (Miller and Keane 1083; Sorrentino 71). The ovary has many follicles (Mader 282). The follicles house the immature ovum or oocyte before its first maturational division (Mader 282; Miller and Keane 1061). The second division occurs with one half surviving and the other half disintegrating (Mader 282). This secondary oocyte or egg is surrounded with increasing fluid in the cavity until pressure increases to the point that the follicle wall balloons out on the surface of the ovary and bursts, releasing the secondary oocyte (Mader 283). The release of an ova or egg occurs once a month and is called ovulation (Sorrentino 71). The now empty follicle becomes the corpus luteum, a glandlike structure releasing the female sex hormones estrogen and progesterone (Mader 283; Sorrentino 71). The corpus luteum continues for the first three to six months of a pregnancy or if not impregnated will degenerate after about 10 days (Mader 283).

It is interesting to note "the female is born with as many as 2 million follicles, but the number is reduced to 300,000 - 400,000 by the time of puberty. Only a small number of follicles (about 400) ever mature because a female usually produces only one egg per month during her reproductive years" (Mader 282)

The route the microscopic ovum travels is: ovary, fallopian tube, uterus, cervix, vagina, external genitalia.

Breasts

The breasts are considered part of the reproductive system because they secrete milk after childbirth (Sorrentino 72). They are glandular and adipose tissue in nature (Sorrentino 72).

THE MALE REPRODUCTIVE SYSTEM

The male anatomical reproductive system includes the penis, testes, prostate, seminal vesicles and vas deferens. Also addressed are the seminal fluid and sperm that are important in reproduction.

Penis

"The penis is the copulatory organ of males. The penis has a long shaft and an enlarged tip called the glans penis. At birth, the glans penis is covered by a layer of skin called the foreskin, or prepuce, which enables it to expand freely during erection (Miller and Keane 1126). Gradually, over a period of 5-10 years, the foreskin separates from the penis and may be retracted (Mader 278). During this time there is a natural shedding of cells between the foreskin and penis (Mader 278). The cells, along with an oil secretion that begins at puberty, are called smegma and make it easy for the penis to expand and retract past the foreskin (Mader 278; Miller and Keane 1126). In the child, no special cleansing method is needed to wash away smegma, but in the adult, the foreskin can be retracted to do so (Mader 278).

The male penis is an organ that serves both the genital and urinary systems. It has three cylindrical bodies of erectile tissue, the paired corpora cavernosa and the single corpus spongiosum (Kolodny et al. 12; Miller and Keane 1126). The corpora cavernosa masses lie alongside each other and end behind the head of the penis (Miller and Keane 1126). The corpus spongiosum lies underneath the corpora cavernosa (Miller and Keane 1126). This latter mass contains the urethra (Miller and Keane 1126). The penis terminates in an oval or cone-shaped body, the glans penis, which contains the exterior opening of the urethra (Miller and Keane 1126). During sexual excitement, vasocongestion within the spongy tissue of the penis fills with blood, causing the penis to become hard and erect allowing it to be inserted into the vagina (Kolodny et al. 13; Sorrentino 71). Parasympathetic impulses dilate the arteries of the penis, while the veins are compressed passively so that blood flows into the erectile tissue under pressure (Mader 280). The rate of arterial inflow of blood is matched by the rate of venous return, maintaining the erection (Kolodny et al. 13). Flacidity occurs as a result of the venous outflow exceeding arterial input (Kolodny et al. 13).

Testes

The male gonads, also called testicles, are paired, egg-shaped glands situated in the scrotum; outside of the abdominal cavity (Mader 275; Miller and Keane 1473; Sorrentino 70). The scrotum is made of skin and muscle, and holds the testes suspended between the thighs (Sorrentino 70). The walls of the testes are made of fibrous connective tissue and are divided into lobules (Mader 275). Each lobule has one to three seminiferous tubules that are tightly coiled and have a combined length of 250m. (Mader 275). The testes produce the spermatozoa, the male reproductive cells, which are ejaculated into the female vagina during coitus (Miller and Keane 1473). They also produce the male sex hormone, testosterone, which is responsible for the secondary sex characters of the male (Miller and Keane 1473). The mature sperm is microscopic in size and looks like a translucent tadpole (Miller and Keane 1393). It has three parts: a head, a middle piece, and a tail (Mader 276). The tail is typical of cilia and flagella, the middle piece contains energy-producing mitochondria, and the head contains the 23 chromosomes within a nucleus (Mader 276). The nucleus tip is covered by a cap called the acrosome, that is believed to contain enzymes needed for fertilization (Mader 276). While the testis produce sperm, they mature in the epididymis, which is a tightly coiled tubule on top and to the side of the testis, about 5-6m (17 ft) long (Mader 278; Sorrentino 70). The sperm take two to four days to mature during which time they develop their swimming ability (Mader 278). Each epididymis joins a vas (ductus) deferens, that enters the abdominal cavity where it curves around the bladder and empties into the urethra (Mader 278). Sperm are stored in the first part of the vas deferens, leaving through the urethra only with ejaculation (Mader 278). The vas deferens eventually join a seminal vesicle (Sorrentino 70). Spermatic cords are made of fibrous connective tissue and muscle fibers that enclose the vas deferens, the blood vessels, and the nerves (Mader 278).

Seminal-Fluid

Seminal fluid carries the sperm out of the body at the time of ejaculation (Mader 278; Sorrentino 70). Seminal fluid is the combination of secretions from three types of glands; the seminal vesicles, the prostate gland, and the Cowper's glands (Mader 278). The seminal vesicles are located at the base of the bladder and have a duct that joins the vas deferens (Mader 278). The prostate gland is a doughnut-shaped, chestnut size gland surrounding the upper portion of the urethra just below the bladder (Kolodny et al. 14; Mader 278; Sorrentino 70). Behind the prostate is the rectum providing easy accessability for palpable examination (Kolodny et al. 14). The prostate secretes fluid containing sugar fructose that serves as an energy source needed by the swimming sperm (Mader 278; Sorrentino 70). The pea-size Cowper's glands are behind the prostate on either side of the urethra (Mader 278). "Each component of seminal fluid seems to have a particular function. Sperm are more viable in a basic solution, and seminal fluid, which is milky in appearance, has a slightly basic pH (about 7.5). Seminal fluid also contains prostaglandins, chemicals that cause the uterus to contract." (Mader 278)

The male produces several hundred million sperm per day continually throughout his life (Mader 276). A single discharge (about a teaspoonful of semen on the average) may contain more than 250 million spermatozoa (Miller and Keane 1393). The route the sperm travels is: testes, epididymis, vas deferens, seminal vesicles, ejaculatory duct, prostate gland, urethra.

AGE-RELATED CHANGES OF THE FEMALE REPRODUCTIVE SYSTEM

Age thirty brings with it the first of a gradual decline in reproductive capability due to a combination of diminishing fertility and a higher rate of spontaneous abortion or miscarriage (Kolodny et al. 79). Disturbances of the menstrual cycle increase with age along with a normal cessation of the fertility and the hormonal cycling that 'typify the second through the fifth decades' (Kolodny et al. 79). Menopause seems to be under the control of hormonal secretions that make changes within the female reproductive system (Kolodny et al. 80). Changes in women's reproductive physiology are hormonally directed. The combination of a decrease in estrogen production, and the neurological and circulatory elements that interact both at the cellular and at the systems level produce age-related changes (Masters, Johnson and Kolodny 469). The pituitary gonadotropins no longer influence subsequent hormonal release in the ovaries with a resultant lowering of the estrogen and progesterone levels (Kolodny et al. 80). The effect of the hormonal changes causes the cessation of the menarche that is menopause. Menopause is experienced in women in varying degrees of awareness. Some women complete the process, that takes years, without awareness any changes are taking place. In others the hormonal changes have enormous side effects. Some of the side effects include the physical symptoms of vasomotor instability ("hot flashes"), atrophic changes in the breasts, genitals, and skin and the psychological symptoms that range from irritability to depression (Kolodny et al. 80). "It is not clear to what extent these symptoms occur because of the changing state of hormone equilibrium, the existence of a relative or absolute estrogen deficiency, or the psychosocial programming that leads many women to expect such symptoms to accompany the menopause (Kolodny et al. 80)." There is no verifiable correlation between the estrogen levels and the postmenopausal symptoms (Kolodny et al. 80). Estrogen deprivation does cause some physiological changes including atrophy of vaginal mucosa along with diminished vaginal lubrication (Kolodny et al. 80). This can result in painful or difficult intercourse (dyspareunia), which can be treated with oral estrogen or topical application of estrogen creams (Kolodny et al. 80). The lining of the vagina becomes thinner and less elastic, sometimes appearing to be only tissue-paper thin (Masters, Johnson and Kolodny 469). When this occurs the vagina is especially fragile and may have a tendency to bleed or become easily irritated or infected leading to painful intercourse (Masters, Johnson and Kolodny 469). Ovaries become smaller and fibrotic, breast tissue decreases, the uterus and cervix become smaller, their mucus secretion stops, and muscle weakening may lead to uterine prolapse (Christ and Hohloch 43). The vagina changes to a paler color due to decreased vascularity (Masters, Johnson and Kolodny 469). The vagina becomes narrower and shorter, the epithelial lining atrophies, secretions become more alkaline, elasticity decreases and the risk of atrophic vaginitis increases (Christ and Hohloch 43). The external genitals become less pronounced (Mader 332) due to the loss of fat in the labia majoria and the loss or thinning of hair in the pubic area. There is no change in clitoral sensitivity (Masters, Johnson and Kolodny 470). The sexually inactive postmenopausal woman may experience actual shrinkage in size of the vaginal barrel and the loss of elasticity to the walls of the vagina (Kolodny et al. 81). Decreased tissue elasticity is an age-related change and when combined with estrogen deficiency results in changes in the breast tissue (Kolodny et al. 81). Breasts droop with age even if they maintain the ability for lactation (Kolodny et al. 81).

Estrogen replacement therapy (ERT) has pluses and minus. It prevents deterioration of protein synthesis in the skin and improves microcirculation in the skin lessening epidermal atrophy and preserving skin elasticity (Kolodny et al. 81). Moreover, it delays or prevents development of postmenopausal osteoporosis in women (Kolodny et al. 81). ERT decreases the risk of coronary heart disease by 40 to 50 percent in postmenopausal women (Masters, Johnson and Kolodny 471). ERT is speculated to increase the amount of 'good' cholesterol and lower 'bad' cholesterol in the blood stream (Masters, Johnson and Kolodny 471). ERT controls hot flashes, night sweats and it has been reported to enhance the overall sense of well being (Masters, Johnson and Kolodny 471). Risks of ERT include endometrial carcinoma, and should be used with caution in women that have impaired liver function, history of or familial history of breast cancer or endometrial cancer, and history of thromboembolic disease or cerebrovascular disorders (Kolodny et al. 82).

AGE-RELATED CHANGES OF THE MALE REPRODUCTIVE SYSTEM

Since the reproductive system is under the control of the hormonal system and there are age-related changes in hormone production, there are corresponding age-related effects in the reproductive system. "The primary mechanism underlying the various physiologic changes in male sexual responsivity seen with aging is a gradual decline in gonadal function....At the same time, there is a gradual reduction in production of testosterone and related androgens...Aging leads to changes in the central control of testicular function - that is, changes in the hypothalamus and pituitary gland that affect the secretion of luteinizing hormone (LH), which in turn modulates androgen production at the testicular level. (Masters, Johnson and Kolodny 468)".

Spermotogenesis diminishes from the fifth decade on but remains sufficient until the ninth decade (Kolodny et al. 82; Mader 332). Testosterone and related androgens gradually decline but from age 60 on there is no pronounced decrease in this sex steroid hormone level in men (Kolodny et al. 82; Masters, Johnson and Kolodny 468). The gradual decline in gonadal function is the underlying cause of physiological changes in men (Masters, Johnson and Kolodny 468).

Testes

Testicles become smaller, testosterone production decreases, sperm count falls, seminal fluid becomes less viscous, and the prostate gland enlarges (Christ and Hohloch 43). In older men, the prostate can enlarge and squeeze off the urethra, making urination painful and difficult, while in advanced years the prostate may atrophy (Christ and Hohloch 43; Mader 278).

A male climacteric is seen in about 5 percent of men over the age of 60 (Kolodny et al. 82; Masters, Johnson and Kolodny 468). The symptoms are linked with testosterone deficiencies and are varied including: listlessness, weight loss or poor appetite, or both; depressed libido, usually accompanied by loss of potency; impotence, impaired ability to concentrate; weakness, fatigue and irritability (Kolodny et al. 82; Masters, Johnson and Kolodny 468).

There is a noticeable reduced volume of ejaculate which may be related to changes in the prostate gland and nerve supply to the genital area (Kolodny et al. 83). There is a decreased amount of semen produced (Masters, Johnson and Kolodny 466). There is less of a need to ejaculate at each coital experience past the sixth decade due partly because of the reduced fluid volume, and partly due to the changes in intensity of neuromuscular signals to and responses in the prostate gland (Kolodny et al. 83).

The often heard platitude that the sex roles reverse in old age seems to be true. Menopause has little effect on the sexual response in the female (Kolodny et al. 83). Sexual activity in the male begins to decrease in the late teenage years or early twenties and declines steadily into old age while the female has a less prominent decline in sexual activity with aging (Kolodny et al. 84).

The age-related change in the reproductive system is one that is dealt with on a very personal and intimate level. Changes are quite apparent to the individual just as the physical changes such as wrinkles are apparent to others. The adjustment is dependent upon prior satisfactory adjustment to one's sexuality, and one's self. The biggest incumberances to satisfactory adjustment are one's health and the availability of a partner. Sex can be and is an enjoyable driving force all throughout life.

THE FEMALE SEXUAL RESPONSE CYCLE

PHASE	NORMAL PATTERN	AGE-RELATED CHANGES
DESIRE PHASE	No specific physical changes	
EXCITEMENT PHASE	Physical or psychic in origin, short or long in duration	
	Appearance of vaginal lubrication, produced by vasocongestion in the walls of the vagina leading to a transudation of fluid	Vaginal lubrication is decreased and requires a longer time to develop
	Expansion of the inner two-thirds of the vaginal barrel	Vagina is less expansive during sexual stimulation Vaginal ballooning delayed
	Color of vaginal wall becomes darker	
	Elevation of the cervix and the body of the uterus	
	Flattening and elevation of the labia majora	Elevation of labia majora decreased

	Inner lips of the vagina thicken Clitoris increases in size due to vasocongestion although a true erection does not occur Erection of the nipples, may not be simultaneous Surface venous patterns of the breast become more visible Increase in the size of the breasts may be present Late in the excitement phase areolae begin to become engorged Sex flush appears Heart rate and blood pressure increase General neuromuscular tension increases	Labia minora vasocongestion decreased The clitoris continues to respond as it once did The response may not be seen The vasocongestive increase in breast size may be reduced or absent after menopause

PLATEAU PHASE	Marked increase in sexual tension above the unaroused levels Duration varies widely A short plateau phase may precede particularly intense orgasms in females Prominent vasocongestion in the outer third of the vagina, called the orgasmic platform Cervix and uterus elevate further The vasocongestion causes the vagina to narrow (this is the reason why the size of the penis is relatively unimportant to the physical stimulation received by the female during intercourse, there is actually a 'gripping' action of the outer portion of	

	the vagina around the penis) The inner two-thirds of the vagina undergoes minor additional lengthening and expansion in size Increase in elevation of the uterus Rate of vaginal lubrication often slows The shaft and glans of the clitoris retract against the pubic symphysis, without loss of clitoral sensation Vasocongestion occurs in the labia Lips of the vagina become more swollen and change color Areolae begin to become engorged masking the nipple erection that is still present Increases in breast size during the plateau phase are	 Vaginal barrel does not elongate or widen

	less in women who have previously nursed; in women who have not breast-fed, breast size of 20 to 25 percent above baseline is not uncommon	
	In late excitement phase, a rash resembling measles may develop in 50 to 75 percent of females	
	This ‘sex flush’ begins in the epigastrium spreading rapidly over the breasts and anterior chest wall, may be on other parts of the body and may intensify	Sex flush is seen less frequently and has a more limited distribution in older women
	Also generalized myotonia, tachycardia, hyperventilation, and an increase in blood pressure	Generalized myotonia is decreased
	Further increase in neuromuscular tension	Levels of muscle tension decreased
	Visual and auditory acuity are diminished	

ORGASM	It is postulated orgasm is triggered by neural reflex arc when the orgasmic threshold level has been reached or exceeded	Aging does not decrease libido or the capacity to be orgasmic if general health remains good
	Simultaneous rhythmic contractions of the uterus, the orgasmic platform (outer third of the vagina), and the rectal sphincter, beginning at 0.8 second intervals, then diminishing in intensity, duration, and regularity	Painful uterine contractions can occur during orgasm in aging women Postmenopausal women have fewer involuntary contractions of the outer portion of the vagina with orgasm
	Orgasm is a total body response	Orgasm may not be as intense over age 60
	Significant changes in the brain as well as changes in rates and types of brain wave activity	
	Sex flush, if present, reaches maximum color and spread	

	Involuntary contraction of rectal sphincter Contractions of peripheral muscle groups Peak respiration, blood pressure and heartbeat rates General loss of voluntary muscular control; may be cramplike spasm of muscle groups in the face, hands, and feet Females do not ejaculate	
RESOLUTION PHASE	Females have potential to be multiorgasmic Females do not have a refractory period Orgasmic platform disappears as the muscular contractions of orgasm pump blood away from these tissues	

	Clitoris returns to normal position within 5-10 seconds after orgasm	
	Uterus moves back into the true pelvis	
	Vagina begins to shorten in both width and length	Rapid shrinking of vaginal balloon
	Vaginal return to resting color may take 10-15 minutes	
	Orgasmic platform disappears	
	Vaginal lips return to normal thickness, position, and color	
	Areola returns to normal size quickly; nipple erection disappears more slowly	Delayed areolae detumescence
	Rapid disappearance of sex flush	
	Irregular neuromuscular tension may continue, as	Possible urinary urgency immediately postcoitus

	shown by involuntary twitches or contractions of isolated muscle groups Heart rate, respiratory rate, and blood pressure return to baseline levels General sense of relaxation is usually prominent Visual and auditory acuity return to usual levels	Increased complaints of dysuria

THE MALE SEXUAL RESPONSE CYCLE

PHASE	NORMAL PATTERN	AGE-RELATED CHANGES
DESIRE PHASE	No specific physical changes	
EXCITEMENT PHASE	Penile erection is usual and the result of vasocongestive changes within the spongelike tissue of the penis	Penile erection typically takes a longer time and more direct stimulation is needed in the aged male to achieve erection, taking minutes instead of seconds

	Scrotum changes with vasocongestion producing a smoothing out of skin ridges on the scrotal sac Scrotum flattens due to internal thickening of the scrotal integument Testes partially elevated toward the perineum by shortening of the spermatic cords, mediated by the cremasteric muscles Late in this phase the testes increase slightly in size as a result of vasocongestion Nipple erection can occur or can be absent with or without direct physical stimulation Heart rate increases, blood pressure rises modestly and there is a generalized increase in neuromuscular	There is a modest decrease in the firmness of the erection found in men over age 60 There may be less tactile sensitivity in the erect penis Sex flush is less frequent

	tension throughout the body General neuromuscular tension increase	
PLATEAU PHASE	Rigidity of erection increases Head of penis enlarges modestly Marked increase in sexual tension above the unaroused levels Duration of plateau phase varies widely A short plateau phase maybe exceptionally brief in males with premature ejaculation In late excitement phase, a rash resembling measles may develop in a small percent of males This 'sex flush' begins in the epigastrium spreading	

	rapidly over the breasts and anterior chest wall, may be on other parts of the body Also generalized myotonia, tachycardia, hyperventilation, increase in blood pressure Minor increase in the diameter of the proximal portion of the glans penis Frequently a visible deepening in color due to venous stasis Vasocongestion further increases the size of the testes with increments of 50 to 100 percent of baseline volume	
	As sexual tension mounts toward orgasm, the testes continue not only the process of elevation initiated	Testicular elevation diminishes Scrotal wall vasocongestion is reduced

	in the excitement phase but also a process of anterior rotation so that the posterior testicular surfaces rest in firm contact with the perineum Small amounts of fluid from the urethra may be present Heart rate and blood pressure increase further, breathing may become more shallow and rapid Further increase in neuromuscular tension Visual and auditory acuity are diminished	
ORGASM	It is postulated orgasm is triggered by neural reflex arc when the orgasmic threshold level has been	

	reached or exceeded Orgasm is a total body response Sex flush, if present, reaches maximum color and spread Significant changes in the brain, as well as changes in rates and types of brain wave activity Contractions of peripheral muscle groups General loss of voluntary muscular control; may be cramplike spasm of muscle groups in the face, hands, and feet Peak respiration, blood pressure and heartbeat rates	
	Accessory sex organs begin a series of contractions that cause seminal fluid to pool in the prostatic	Sensation of ejaculatory inevitability diminished

	urethra, "ejaculatory inevitability" becomes evident Internal sphincter of the neck of the urinary bladder is tightly closed during ejaculation Rhythmic contractions of the prostate, the perineal muscles, and the shaft of the penis combine to assist ejaculatory propulsion	Intensity of the ejaculatory experience is diminished in aging men possibly due to the less vigorous rhythmic contractions by the prostate and a less powerful rush of ejaculatory fluid from the penis Reduction in the intensity of the orgasm and altered sense of ejaculation, possibly due to neuromuscular changes
RESOLUTION PHASE	Refractory period, during which further ejaculation is impossible, although partial or full erection may sometimes be maintained	The refractory period lengthens with increasing age

	Duration of refractory period may be for a few minutes or many hours	
	The erection diminishes in two stages: prompt loss of erection due to penile contractions during orgasm quickly reduces vasocongestion Second stage of detumescence corresponding to a slower process of return to normal vascular flow Testes decrease in size and descend into the scrotum unless sexual stimulation is continued Scrotum loosens and scrotal folds reappear Loss of nipple erection Rapid disappearance of the sex flush Irregular neuromuscular tension may continue	Rapid penile detumescence

	Heart rate, respiratory rate, and blood pressure return to baseline levels General sense of relaxation is usually prominent Visual and auditory acuity return to usual levels	

The chart information was compiled and taken from the text in Textbook of Human Sexuality for Nurses. Kolodny et al. (1979). from Heterosexuality. Masters, Johnson and Kolodny.(1994). and Gerontologic Nursing Care of the Frail Elderly. Burke and Walsh (1992).

ENDOCRINE SYSTEM

The endocrine system is a system of glands. These glands produce and release hormones that affect other glands, other hormones and subsequently body systems and functioning. "Hormones are chemical messengers that influence the metabolism of the cell either directly or indirectly, depending on the hormone type (Mader 256)." The system is a series of smooth functioning negative-feed-back loops. The endocrine glands are located throughout the body. They are an all powerful team that releases their production in a regular diurnal or circadian rhythm except for the female reproductive hormones that cycle monthly (Burke and Walsh 168). "In conjunction with the neurological system, the endocrine system maintains the body's ability to regulate its response to the internal and external environment. The endocrine system (a) regulates the body's response to stress and injury; (b) maintains growth, development, and reproduction; (c) adjusts ionic homeostasis; and (d) modulates and maintains energy metabolism (Burke and Walsh 168)." Studies being done are learning new things about the endocrine system.

The major glands of the endocrine system will be addressed. "In addition, though the exact relationship between human hormones and human behavior remains largely unknown, and the wide variations in individual behaviors make it difficult to ascertain those relationships, scientists continue to be intrigued by the study of endocrinology and human behavior (Burke and Walsh 168)." "There is evidence that the endocrine system plays a role in the etiology of depression at all ages. High levels of cortisone, changes in estrogen and prolactin levels in women, and abnormal thyroid and other endocrine disorders are all associated with behavioral changes and depressive symptoms (Burke and Walsh 374)."

Glands

There are two types of glands over all, exocrine and endocrine. Exo- is a word element meaning outside of or outward (Miller and Keane 531). The exocrine glands secrete their hormones by way of ducts out of the body; for example, tears are secreted from the lacrimal glands and sweat is excreted from the sweat (sudoriparous) glands (Miller and Keane 1462, 1442, 531). Endo-is a word element meaning inside or within (Morris 431). The endocrine glands are ductless and secrete their hormones within the body directly into the blood stream (Mader 255). The endocrine system works on the negative feed back principle. Negative feedback simply reduces the output of a system, for example, the action of heat on a thermostat to limit the output of a furnace (Morris 879). "The major endocrine glands are the hypothalamus, pituitary, thyroid, parathyroid, adrenal glands, pancreas, and the gonads (ovaries and testes) (Miller and Keane 492)".

All the hormones target their own specific body part or parts known as target organs (Mader 255). Hormones also regulate other glands in the body (Sorrentino 75). It is thought that more than glands generate and secrete hormones. The heart is thought to produce a hormone called atrial natriuretic hormone (Mader 265). It causes natriuresis, the excretion of sodium, ridding the body of excess sodium, thereby lowering the blood volume and blood pressure

(Mader 265).

Hormones

Hormones are substances that are produced by a gland that help to regulate the functions of other glands and organs of the body (Badasch and Chesebro 446). Glands produce digestive juices from the gallbladder, pancreas, and salivary glands (Badasch and Chesebro 446). Perspiration fluid from sweat glands, oils from sebaceous glands in the skin, milk from breasts, which are mammary glands, and tears from the lacrimal glands in the eyes (Badasch and Chesebro 446) are all examples of the glandular production of the exocrine glands.

"Hormone includes all types of chemical messengers (Mader 271)." There are two different chemical actions of hormones; direct and indirect. The direct chemical action of a hormone acts by entering the cell and causing an action (Mader 256). Steroid hormones, the sex hormones, act in this manner. The indirect chemical acting hormone may have as many as three levels of hormone releasing stimulation before an action takes place. These hormones do not enter cells but cause action from outside the cell. The final chemical stimulates the enzymes of the cell to carry out their normal function (Mader 256).

Hypothalamus

The hypothalamus instructs the pituitary. "The hypothalamus is a region of the brain that regulates the internal environment (Mader 258)." It has four regions that activate, control, and integrate many of the involuntary functions of living (Miller and Keane 736). Some functions influenced are: the peripheral autonomic mechanisms, endocrine activity, and many bodily functions: for example, a general regulation of water balance, body temperature, sleep, thirst, and hunger, and the development of secondary sex characteristics (Miller and Keane 736). Some of the major hypothalamic factors are; thyroid-stimulating hormone releasing hormone (TRH), which activates the release of the thyroid-stimulating hormone (TSH) from the anterior lobe of the pituitary gland; corticotropin-releasing factor (CRF); growth hormone releasing factor (GHRF); and prolactin-inhibiting factor (PIF) and others (Miller and Keane 736). The hormone oxytocin is made in the hypothalamus and stored in the posterior pituitary (Mader 259). It is involved in sexuality.

Pituitary

In the leadership role is the pituitary gland (Sorrentino 75). It is about the size of a cherry and is located at the base of the brain behind the eyes (Sorrentino 75). The front half or anterior lobe and the back half or posterior lobe differ in function and origin (Miller and Keane 1160). The anterior pituitary originates from epithelial tissue and secretes six important hormones which are: growth hormone (GH), thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), prolactin, follicle-stimulating hormone (FSH), and luteinizing hormone (LH) (Miller and Keane 1160). There is a middle lobe in the pituitary, called the pars intermedia, that secretes melanocyte-stimulating hormone (MSH) (Miller and Keane 1160). GH affects metabolism, and tissue growth, promotes tissue repair and is affected by obesity and sex (Perlmutter and Hall 103). "Most of the hormones of the anterior lobe are tropic hormones, which regulate the growth, development, and proper functioning of other endocrine glands and are of vital importance to the growth, maturation, and reproduction of the individual (Miller and Keane 1160)." Tropic is itself a rootword element meaning turning toward; changing; tending to turn or change (Miller and Keane 1532). The anterior pituitary gland controls other glands which in turn direct functioning. "The secretion of anterior pituitary hormones is controlled by releasing and inhibiting hormones (negative feedback) produced by the hypothalamus. Information that is gathered by the nervous system about the well-being of an individual is collected in the hypothalamus and used to control the secretion of hormones by the pituitary gland (Miller and Keane 1160)." While the hypothalamus produces hormones that control the anterior pituitary, the anterior pituitary produces hormones that control the thyroid, the adrenal cortex and the gonads (Mader 261). The communication between the anterior pituitary and the hypothalamus is relatively easy as they are attached to each other by the hypophyseal stalk (Miller and Keane 1160). In the hypothalamic-hypophyseal portal system, the hypothalamic venules connect directly with the capillaries of the anterior pituitary (Miller and Keane 1160).

The posterior lobe of the pituitary originates from neural tissue and stores and secretes two hormones, oxytocin and antidiuretic hormone (ADH) which are released in response to neural stimulation (Miller and Keane 1160).

Thyroid

The thyroid is the largest endocrine gland (Miller and Keane 1494). It is situated in the front and sides of the neck and produces hormones that are necessary to maintain normal growth and metabolism (Mader 262; Miller and Keane 1494). In addition, it also stores and uses iodine in its production of thyroglogulin, the storage form of thyroxin (Mader 262; Miller and Keane 1494). The thyroid influences many metabolic processes, stimulates cellular production of heat, stimulates protein synthesis, regulates many aspects of carbohydrate metabolism; stimulates lipid synthesis, mobilization, and degradation; stimulates the synthesis of coenzymes from vitamins and may affect the response of tissues to epinephrine and norepinephrine (Miller and Keane 1494). Thyroxin increases metabolic rate of most of the cells of the body (Mader 262). The thyroid also produces calcitonin, the hormone that helps regulate the calcium level in the blood and opposes the action of the parathyroid hormone (Mader 263).

Parathyroid

The parathyroid glands are in the posterior surface of the thyroid (Mader 263; Miller and Keane 1112). The parathyroid hormone (PTH) stimulates the absorption of calcium from the gut, acts on the kidneys to excrete phosphate and reabsorb filtered calcium from the urine thereby retaining calcium and stimulates the demineralization of bone (Mader 263; Miller and Keane 1113). PTH secretion is by closed-loop feedback involving calcium levels; high calcium level inhibits PTH; low calcium level stimulates PTH (Mader 264; Miller and Keane 1113). The thyroid also secretes calcitonin which has the opposite effect of PTH (Mader 264). Calcitonin and vitamin D, along with PTH, regulate the level of calcium in the blood (Mader 264; Miller and Keane 1113).

Adrenal

The adrenal glands are located on top of the kidneys (Mader 264). They have an outer portion or cortex and an inner portion or medulla (Mader 264; Miller and Keane 30). The adrenal medulla secretes norepinephrine and epinephrine in response to the sympathetic nervous system (Miller and Keane 30). The fight or flight response initiated by the sympathetic nervous system is maintained by the adrenal gland secretion of both epinephrine, also known as adrenalin, and by norepinephrine (Mader 264). The fight or flight response includes blood glucose level and metabolic rate increases, increased breathing and heart rate, constriction of blood vessels in the intestine and dilation of blood vessels in the muscles (Mader 264).

The adrenal cortex generates in excess of 30 different kinds of steroids (Mader 265; Miller and Keane 31). The steroids are grouped in three major divisions; glucocorticoids, mineralocorticoids, and androgens (Mader 265; Miller and Keane 31). "In males, the adrenal cortex is a source of female sex hormones, and in females, it is a source of male hormones (Mader 265)." Glucocorticoids are synthesized from cholesterol produced by the adrenal cortex whose function is to increase the glucose level in the blood (Miller and Keane 31). Mineralocorticoids are essential in maintaining adequate fluid volume in the fluid compartments of the cell and vessels, normal cardiac output, and adequate levels of blood pressure (Miller and Keane 925). The major mineralocorticoid hormone, aldosterone, targets the kidney in the maintenance of sodium and potassium balance through a complicated multiple step interaction that causes resorption of sodium and secretion of potassium in the renal tubules (Mader 265; Miller and Keane 925).

Pancreas

The pancreas lies across the abdomen from the left to right with the greater bulk of it on the left side. It has exocrine glands that produce and secrete digestive juices that eventually arrive in the small intestine through the pancreatic duct and the common duct (Mader 266). The pancreas also has endocrine glands that produce and secrete the hormones insulin and glucagon directly into the blood (Mader 266). The islets of Langerhans are located on the surface of the pancreas and are endocrine in nature (Miller and Keane 1099). There are three types of island cells: alpha cells that secrete glucagon which elevates blood sugar, beta cells that secrete insulin which affects metabolism of carbohydrates, proteins, and fats; and delta cells that secrete somatostatin that can inhibit the secretion of both glucagon and insulin and may control metabolic processes (Miller and Keane 1099). Insulin promotes storage of nutrients for later use and helps lower the glucose level (Mader 266). Glucagon is secreted between eating periods and breaks down the stored nutrients for usage, causing the blood sugar level to rise (Mader 266). Insulin and glucagon keep an acceptable level of glucose in the blood.

Gonads

The gonads are endocrine glands that produce hormones. Androgens are any steroid hormone that produces male characteristics (Miller and Keane 74). The testes produce testosterone which is the primary male sex hormone (Mader 267). The ovaries produce estrogen and progesterone, the female sex hormones (Mader 267). Males have some female hormones and females have some male hormones. Adrenal glands produce androgens and small amounts of estrogens in both sexes while the ovaries produce some androgens in the females (Miller and Keane 74; Perlmutter and Hall 102).

Thymus

The thymus lies in the upper chest under the breast bone. It functions in an immunologic role throughout life (Miller and Keane 1492). The thymus has lobules in which the T lymphocytes develop (Mader 134). T lymphocytes are responsible for cellular immunity (Miller and Keane 869). The thymus secretes the hormone thymosin whose function is to cause pre-T cells to develop into T cells (Mader 135).

Pineal

The pineal gland produces the hormone melatonin primarily at night (Mader 268). It is located in the brain and is thought to be involved in regulating sleep-awake cycles and human sexual development (Mader 268).

AGE-RELATED CHANGES OF THE ENDOCRINE SYSTEM

With increased age comes decreased hormones (Badasch and Chesebro 446). Body organs and glands change in response to the lack of hormones. Some of the changes are bothersome and clinically significant while others are quite insignificant (Burke and Walhs 168). Still others may not be recognized (Burke and Walsh 168).

Pituitary

The structure of the pituitary shows the signs of aging. There are increases in the connective tissues, and a change in the way various cell types are distributed throughout the gland (Perlmutter and Hall 102). The blood supply, that since puberty has been slowly decreasing, is now significant (Perlmutter and Hall 102). There is a decrease secretion of growth hormone during sleep in the aged (Burke and Walsh 169). GH is affected by sex and obesity (Perlmutter and Hall 102). It is low in about one third of the elderly population with women and the obese elderly having higher levels of GH (Perlmutter and Hall 102). Aged men with very low levels of GH that receive injections of GH display a slowing of the aging of skin, bone, and muscle (Perlmutter and Hall 102). TSH and ACTH levels remain adequate in the aged (Perlmutter and Hall 102). These hormones yield the continued ability of the aged to have an adequate response to stress (Perlmutter and Hall 102).

Thyroid

Too little thyroid hormone can cause slowed mental functioning, loss of energy, and slowed physical movement and must not be attributed to “old age” or expected signs of growing older (Burke and Walsh 170). The thyroid’s structure is affected in aging, demonstrating a slight volume increase (Perlmutter and Hall 103). There is no change in functioning despite the appearance of collagen fibers and the decline of hormone production (Perlmutter and Hall 103). The decrease in thyroid production is related to the increased time it takes to degrade thyroid hormones within the body tissue due to slowed activity and reduced oxygen consumption (Perlmutter and Hall 103).

Adrenal

The adrenal glands undergo marked changes with aging; lipofuscin and collagen increase, blood vessels enlarge and some bleeding occurs (Perlmutter and Hall 103). The adrenal cortex weight decreases and more and more cells become abnormal (Perlmutter and Hall 103). Adrenal hormones decline with age due to their slower rate of metabolism but remain within acceptable levels (Perlmutter and Hall 103). Steroid levels that regulate fat and carbohydrate metabolism remain constant in healthy adults (Perlmutter and Hall 103). Glucocorticoids decrease, cortisol rate decreases 25 percent, and urinary excretion rate of glucocorticoids decreases 25 percent, neither of which cause ill effects (Christ and Hohloch 45). Aldosterone has a 50 percent decrease, as does the urinary excretion of the 17 ketosteroids (Christ and Hohloch 45). Dispite hormone changes affecting the sodium and chloride balance there is little change of these electrolyte levels in the blood (Perlmutter and Hall 103). "The decline in production of adrenal hormones is apparently due to the slower rate at which these hormones are metabolized with age (Perlmutter and Hall 103)."

Pancreas

The glucose level remains elevated longer in the elderly even though insulin can still be secreted by the pancreas (Burke and Walsh 170). Aging brings with it insulin insensitivity that is not well understood (Burke and Walsh 170). "Recent research suggests that reduced insulin uptake is associated with the appearance of tangled polypeptide fibers within the pancreas, although it is not certain these fibers cause the decreased uptake or simply speed its progress (Perlmutter and Hall 103)." The ability to dispose of glucose declines with aging while the release of insulin is delayed with smaller amounts released (Perlmutter and Hall 103). Insulin sensitivity seems to be the problem in the aged, not the aging of the pancreas (Perlmutter and Hall 103). However, the question remains if it is a normal age-related occurrence or a disorder (Perlmutter and Hall 103).

Gonads

Due to the changes in the female hormones, skin loses elasticity, causing wrinkles, underarm hair and pubic hair lessens, and stiff whiskerlike hair appears and becomes more prone to irritation and infection (Badasch and Chesebro 447). In men, the hormonal changes result in the skin loosing elasticity, causing wrinkles, nasal hair, ear hair, and eyebrows become longer and whiskerlike, needing frequent trimming (Badasch and Chesebro 447). "The major difference between hormone production in younger and older men may be a smoothing out of daily rhythms of hormone release; young men show a morning peak in testosterone levels that does not appear among older men (Perlmutter and Hall 105)." Low testosterone levels may be the result of diminished sexual activity, not the other way around (Perlmutter and Hall 105). Testosterone levels are not decreased in healthy older men who socialize with women (Perlmutter and Hall 105). Sperm count does not decrease in number but their motility may slow in the elderly (Perlmutter and Hall 105). In the fourth decade, cells in the prostate gland begin to age, collagen replaces muscle tissue, and blood supply to the gland diminishes (Perlmutter and Hall 106). Prostate cell growth enlarges the gland so that in the fifth and sixth decade the prostate may be 40 percent heavier than earlier and by the seventh decade it has doubled in size (Perlmutter and Hall 106). This age-related glandular change may interfere with bladder function and may require surgical removal (Perlmutter and Hall 106). Tissues and blood vessels of the penis harden and lose elasticity, affecting the speed and firmness of erection (Perlmutter and Hall 106). By the sixth decade the angle of erection has gone from 45 degrees to 90 degrees, but barring interference with penile blood or nerve supply, no further change will occur (Perlmutter and Hall 106).

In her fourth decade, a women's reproductive aging begins (Perlmutter and Hall 106). Her ovaries fail to respond promptly to hormonal stimulation leading to a drop in estrogen production and subsequently fewer ova are released (Perlmutter and Hall 106). Fertility declines, menstrual periods become irregular, cycles lengthen, and the ovaries gradually begin to shut down (Perlmutter and Hall 108). When all has stopped, menopause has been attained (Perlmutter and Hall 108). "With menopause, estrogen levels drop sharply, since the body's primary source of female hormones is now the conversion of androgens produced by the adrenal gland. But the pituitary gland continues to release FSH and LH, so that by two years after menopause, blood levels of FSH are 18 times higher than they were before the climacteric, and LH levels are three times higher (Perlmutter and Hall 108)." With less estrogen, the atrophying vagina shortens, and narrows, and tissues in the vaginal walls become thinner and less expansive (Perlmutter and Hall 108). Vaginal atrophy is reduced with continued sexual activity and is accompanied by higher estrogen levels (Perlmutter and Hall 108).

Thymus

The thymus, with its immunologic role, decreases functioning even though it continues to function adequately with age (Miller and Keane 1492). It becomes smaller and fatty with aging (Mader 268).

The major age-related hormonal changes have been addressed here. There are few changes that affect the elderly in a way that nurse aid's may be of assistance. The ways an aid may function have already been addressed in the linear or in the chapter pertaining to the body system affected. The linear is therefore without major entries related to the hormone system.

Hormones can't be seen but their effects can be seen and felt. From energy levels to appetite, to how our food digests, to how sexy we feel, we are governed by hormones. The age-related changes are apparent to the aging person and to the bystander. No matter what, age marches on and affects everyone of us. The endocrine system is a system in and of itself. However, it can be seen that all systems are integrated to function as whole. The physiological changes caused by the endocrine system are observed in the other systems.

PRIMARY ENDOCRINE GLANDS

ENDOCRINE GLAND	HORMONE	TARGET ORGAN	CHIEF FUNCTION	AGE -RELATED CHANGE
HYPO-THALAMUS	Releasing hormones Release-inhibiting hormones	anterior pituitary	• regulate anterior pituitary hormones	
ANTERIOR PITUITARY	Growth hormone (GH)	bone	• growth of bones, muscles, and other organs except the brain • enhances protein synthesis • increases utilization of fats and conserves carbohydrate by decreasing utilization of glucose	Decreased secretion during sleep The vascular network decreases Connective tissue increases

			• increases retention of nitrogen	No change in hormone concentration or secretion
	Thyroid-stimulating hormone (TSH)	thyroid gland	• controls rate of manufacture and release of T3 and T4 from the thyroid gland • controls the rate of the body's metabolic processes	Decreased sensitivity No change in hormone concentration or secretion
	Adrenocorticotropic hormone (ACTH)	adrenal gland adrenal cortex	• increases the making and release of cortisol • secondarily secretes aldosterone and the sex hormones	No change in hormone concentration or secretion

	Prolactin	ovaries breasts	• maintains corpus luteum and progesterone secretion • stimulates milk secretion	
	Follicle-stimulating hormone (FSH)	ovaries testes	• stimulates development of ovarian follicles and estrogen secretion • stimulates production of sperm	Increased levels in postmenopausal women but unchanged in men
	Luteinizing hormone (LH)	ovaries testes	• maturation of ovarian follicles • ovulation • progesterone secretion • stimulation of Leydig cells of testes • testosterone secretion	Increased levels

INTERMEDIATE PART	Melanocyte-stimulating hormone (MSH)	melanocyte skin cells	• increases skin pigmentation	
POSTERIOR PITUITARY	Vasopressin, antidiuretic hormone (ADH)	distal and convoluted tubules and collecting ducts of the kidney	• water conservation by decreasing urinary output • elevates blood pressure in relatively high doses	Increased secretion
	Oxytocin (OT)	uterus breasts	• contraction of the uterus • sperm transport during coitus • secretion in response to sexual stimulation • increases secretion of milk	

THYROID	Thyroxine (T4) Triiodothyronine (T3)	all tissues	• increases metabolic rate e.g., increase respiratory rate and utilization of oxygen, production of body heat, gluconeogenesis, strength and force of heart rate, and enhance muscle tone • helps regulate growth and development	Metabolic rate slows T3 blood level state decreases 10 to 20 % Fibrosis and follicular distention occur with functional changes
	Calcitonin	bones kidneys gut	• lowers blood calcium level	
PARATHYROID GLANDS	Parathyroid hormone (PTH)	bones kidneys	• maintains constant serum level of calcium	Some structural changes

		gut		Atrophy and degeneration minimal
ADRENAL CORTEX	Glucocorticoids (cortisol)	all tissues	• raise blood glucose level by impairing utilization of glucose • stimulate breakdown of protein • increase hepatic output of glucose	Cortisol secretion rate drops about 25 % Urinary excretion rate of glucocorticoids drops about 25 % Both without adverse effects
	Mineralocorticoids (aldosterone)	kidneys	• stimulate kidneys to reabsorb sodium and to excrete potassium	Blood level and urinary excretion of aldosterone decrease about 50 %

	Sex hormones	sex organs skin muscles bones	• stimulate development of secondary sex characteristics (particularly in male)	
ADRENAL MEDULLA	Norepinephrine Epinephrine	cardiac and other muscles	• stimulate fight or flight reactions • elevate blood glucose and blood lipids, raise blood pressure	Increased
GONADS TESTES	Androgens (testosterone)	sex organs skin muscles bones	• stimulate spermatogenesis • develop and maintain secondary male sex characteristics in fetus • stimulate descent of testes into scrotum • stimulate protein production	Decreased sperm production

			• responsible for masculinization	
OVARIES	Progesterone	sex organs skin muscles bones	• prepares mammary tissue for lactation • prepares endometrium for implantation of the fertilized ovum • decreases frequency of uterine contractions • promotes secretory changes in mucosal lining of uterine tubes for nutrition of fertilized ovum • develop and maintain secondary female sex characteristics	Capacity for reproduction ceases Progesterone production by the ovaries, testes, and adrenal cortex declines after the reproductive period ends Metabolic clearance rate and production rate of testosterone

				decline Ovary continues to secrete testosterone after menopause
	Estrogen		• cause proliferation and growth of sexual organs and other reproductive tissues • induce proliferative phase of the menstrual cycle	Decreased estrogen production ceases with menopause causing atrophy of ovaries, uterus, and vagina and ends reproductive capacity

PLACENTA	Human chorionic gonadotropin (hCG) Human placental lactogen (hPL)		• maintains corpus luteum and stimulates progesterone secretion • acts in combination with prolactin to induce lactation • promotes growth and acts as an insulin antagonist	
PANCREAS Beta cells	Insulin	liver muscles adipose tissue	• lowers blood glucose level • promotes formation of glycogen, proteins, and fats • promotes uptake, storage, and use of glucose, especially by liver, muscles, and fat tissue • increases transport of glucose into	Glucose tolerance declines Insulin release and peripheral sensitivity decrease

			cells and their usage of glucose • causes active transport of many amino acids into cells • promotes protein synthesis and inhibits breakdown of proteins • slows down rate of glucose generation • works with GH	
Alpha cells	Glucagon	liver muscles adipose tissue	• raises blood glucose level • promotes the breakdown of glycogen, proteins, and fats • causes glycogen breakdown in the liver with the subsequent release of	Unknown if aging affects glucagon

			glucose, which raises blood glucose level • increases rate of glucose generation which causes continued elevated glucose in the blood	
Delta cells	Somatostatin		• inhibits secretion of both insulin and glucagon; also secreted by hypothalamus as growth hormone-inhibiting hormone	
THYMUS	Thymosins	T lymphocytes	• stimulates maturation of T lymphocytes	
PINEAL GLAND	Melatonin	circadian rhythms	• involved in circadian and circannual rhythms	

			• possibly involved in maturation of sex organs	

Compiled from tables and text Burke and Walsh 169. Christ and Hohloch 44-45. Mader 256. Miller and Keane 494, 1161.

THE NORMAL PHYSIOLOGICAL ASPECTS OF AGING AS THEY RELATE TO NURSE AID CARE

BODY SYSTEM	NURSE AID ACTION	GERIATRIC PHYSIOLOGICAL RATIONAL
SKIN	Observe for breaks in the skin	• skin is the body's first line of defense against disease • the skin becomes thin due to loss of body fat and therefore more susceptible to tearing
	Avoid giving daily baths and showers	• decrease in oil and sweat glands causes dry skin • partial baths are usually taken with full bath or shower two to three times a week, use only mild soap • often soap is not used on the arms, legs, back, chest, and abdomen • lanolin-based lotion or a bath oil can be used to prevent drying and itching

	Observe for dry skin	• reduced sebum production leaves the skin dry, rough and itchy • rapid evaporation of water from the skin due to increased exposed surface area (wrinkles) contributes to dry skin • washing removes oil as well as sweat and debris • dry skin causes scratching which may open the skin leaving it susceptible to bacterial invasion and infection • women's skin is dryer than a man's because the oil-producing glands begin to atrophy after menopause and men's skin become dry about ten years later • the removal of the dead cells with daily shaving may contribute to new growth of cells from lower skin layers thereby maintaining men's facial skin oilier and without wrinkles • Vitamin A deficiency, excessive bathing, drug reaction call can

		foster dry skin
	Use lanolin-based lotion or bath oil applied to moist skin	• reduces further moisture loss • moisture cannot be inserted into the skin but a moisturizer can help prevent further loss of moisture and relieve itching • comforts the elderly itching from Xerosis
	Avoid the use of soaps	• the alkalizing effect of soaps dry the skin • dry skin is easily damaged and causes itching
	Avoid the use of lengthy hot showers	• hot showers remove even more oil from the skin • hot showers contribute to Xerosis
	Observe for signs and symptoms of being cold or hot Appropriate dress for temperature,	• loss of muscle and fatty tissues beneath the skin increases sensitivity to cold, while decreasing the body's ability to keep itself warm

	comfort and season Provide sweaters, lap blankets, socks, and extra blankets for warmth	• loss of sweat glands and the decrease sweat production of those glands that remain, limit the body's ability to cool itself • thinning of hair shaft and decrease in hair density, decreases thermal insulation
	Avoid the use of hot water bottles, heating pads, etc.	• loss of temperature sensing cells increases risk of burns
	Frequently reposition bedfast or sedentary residents	• loss of pressure sensing cells increase the risk of pressure sores • loss of pain cells increases the risk of tissue breakdown • loss of blood vessels in the dermis coupled with fragile capillaries increases the risk of tissue breakdown • Langerhans cells decrease by 50% affecting the immunoresponsiveness I the skin, slowing the rate of tissue healing

	Protect the skin of the elderly with sun screen, clothing and avoid the direct sun	• loss of ability to produce melanin leaves the elderly grossly vulnerable to the effects of the sun • many medications increase the potential and severity of sunburn • enzymatic active melanocytes decrease either by loss of the cell or by cessation of pigment production • increased exposure to the sun's rays increases the possibility of skin cancer
	Frequently wash the hands of the resident Wash residents face daily and prn	• good hygiene is necessary throughout life
	Pat the skin dry	• skin is thin, fragile, easily torn and prone to chapping
	All physical contact must be of a gentle	• capillaries become fragile resulting in bruises known as senile

	nature	pupura
HAIR		
	Comb and brush the head hair Maintain good grooming	• looking good contributes to feeling good
	Clip the hair in the nares, of both men and women using the appropriate appliance Clip the hair on the ears of the men Shave or clip the facial hair of women providing privacy and using sensitivity	• while the hair of the nose and ears protects these organs from dust, insects and other foreign objects, good grooming removes unsightly visible hairs • the hairs that grow in the nares and on the ears of the elderly are stiff and irritate causing scratching and possible skin irritation • plucking or tweezing hairs encourages rapid regrowth if the hair is in the resting cell cycle state and bulb remains intact

		• plucking or tweezing leaves the follicle open to infection • due to the close proximity of the nose to the brain, never pluck nares hair; only clip it with appropriate appliance • the olfactory receptor cells are actually the dendrites of the olfactory neurons • olfactory neurons provide a direct connection from the nose to the brain that may act as a conduit for viruses or toxins • maintain self esteem with good grooming • sharp scissors are dangerous to use in trimming these hairs
	Gently wash the elderly person's hair as needed for dirt, oil and odor	• hair thins with age and decreases in density • decrease of sebaceous glands on the scalp causes drying, flaking and itching • too frequent washing can further dry the hair

		• gentle message can be invigorating and stimulating, making hair washing a pleasure • hair tensile strength and shaft diameter decrease with age
	Observe for hair loss	• gradual loss of hair is normal, where seasonal hair loss is barely noticeable • noticeable hair loss may be due to illness, disease process or medication side effect
	Use cream rinse or detangler after washing	• hair tensile strength and shaft diameters decrease with aging making it easy to break off
	Wash thick coarse hair of people of color every week or two applying hair cream or dressing to the hair	• people of color may have hair that is extremely dry and it may tangle easily • the scalp of people of color may be very dry

	Use hot appliances for hair care with caution	• the loss of receptor sites decreases the sensations of touch, pressure, pain and temperature necessitating cautious care
NAILS	Do thorough nail care on a regular and prn basis	• nails become dry and brittle with age • dry nails tear easily • soaking finger and toe nails makes cutting the nails easier • nails develop longitudinal nail ridges which may split • nail growth decreases by as much as 50% in the elderly • nails protect the tips of the fingers and toes • frequent nail polish application and removal dries the nail
SKIN LESIONS AND GROWTHS		

	Note any changes in skin lesions, weight or weight distribution Be aware of the normal lesions and growths in the elderly	• Cherry angiomas are normal, asymptomatic bright red, dome-shaped papules, occurring mainly over the trunk starting in the fourth decade • fat initially slowly gathers in prescribed areas as one ages then in the late 60's or 70's weight may begin to diminish • skin tags are normal small pendulous skin growths which occur on the chest, neck, eyelids and armpits • keratoses are normal warty growths that may be dry, light-colored or greasy and dark-colored anywhere on the body • seborrheic keratosis are normal benign overgrowth of horny tissue that look like superficial stuck-on dark brown growths usually on the trunk and face • Lentigo senilis/liver spots, are pigment-containing clusters of

		cells on hands forearms, or face; sometimes called age spots

MUSCULOSKELETAL SYSTEM

SKELETON BONE		
	Limit unnecessary bedrest	• prolonged bedrest can cause contractures • muscles atrophy 15% per week of inactivity • bedrest is a contributing factor in Osteoporosis
	Allow and encourage bathroom privileges or bed side commode Stand the resident every two hours for at least one minute Encourage walking and ROM exercises	• exercise is a major preventative for contractures and Osteoporosis • contractures begin after only eight hours of immobility • calcium loss from bone begins immediately after bed confinement • calcium loss accompanies decreased activity level • disuse changes the body composition and metabolism, i.e.,

	Physical and Occupational therapy as needed Turn and move the resident confined to bed gently and carefully Support joints in positioning	decreased cortical thickness of bone, decreased glucose tolerance, lowered mean body temperature, diminished serum androgen level • muscle cells that are lost do not regenerate • with disuse, there is muscle atrophy which leads to muscle weakness • almost every organ and organ system deteriorates with nonuse • decreased bone strength is in direct response to decreased activity the goal of resident care is their highest level of function
	Encourage exercise Encourage to be as active as possible	• a treatment plan for the frail elderly person that does not provide for exercise, or for activities, is neglectful • not providing or allowing the exercises called for in the treatment plan is neglectful • lack of appropriate care contributes to the loss of strength and the

		loss of emotional spirit that leads to a loss of mobility • decreased muscle and bone strength is in direct response to decreased activity • safe exercise can keep muscles and bones fit • muscle rigidity is not an acceptable part of aging; it is caused by inactivity and inappropriate care • exercise improves endurance and strength, enlarges cardiac muscle, decreases the resting heart rate, increases lung capacity, burns body fat, lowers fat and cholesterol blood levels, lowers blood pressure • continued use of muscles slows the loss of muscle components and subsequent loss of strength and mobility • exercise slows bone loss

		• active people have lower colon, brain, kidney, reproductive cancers and a lower rate of leukemia • exercise helps preserve bone density, nerve function, kidney efficiency, overall strength and flexibility
	Encourage frequent ROM exercises, passive and active	• exercises can help slow down the rate of changes • exercise promotes greater flexibility, muscular coordination, balance and mobility
	Encourage stretching exercises	• exercises need to follow normal body movements • assist in preventing contractures • decreases the discomfort of sitting or laying • promotes greater flexibility, muscular coordination, balance and mobility

	Encourage residents are to wear sturdy shoes with non-skid soles Encourage residents to use assistive devices as needed and ordered	• appropriate assistive devices like canes, walkers and sturdy non-skid shoes help prevent injury • such safety measures attempt to prevent falls
	Shoes must be of appropriate fit without pressure on areas of the foot	• inappropriate fitting shoes can disrupt the normal gait causing falls and injury
	Encourage a diet high in protein, calcium and vitamins	• Vitamin D (sunshine vitamin) is needed for the body to utilize calcium • calcium is lost from the bone for a number of reasons including: extended bedrest, after menopause, lack of Vitamin D, and due to the function of the intestine
	Measure the height of the resident first thing	• loss of height needs to be documented, reported and cause

	in the morning on a regular basis or at regular intervals per facility requirement	determined • loss of height may be a symptom and sign of a disease process • the elderly can have compression fractures of the spine with subsequent loss in height • muscle atrophy can result in loss of height • the intervertebral distances narrow and vertebrae become thinner, shortening the trunk
	Prevent injuries	• the blood supply of tendons and ligaments is poor and therefore these tissues take a long time to heal when injured • with some age related changes the center of gravity moves from the hips to the upper torso affecting the ability to walk and maintain balance • as muscle cells are lost, they do not regenerate; also muscle cells

		atrophy -- both cause a decrease in the total muscle mass that leads to weakness

NERVOUS SYSTEM

NERVOUS SYSTEM		
	Avoid supposing all mental changes in the elderly are normal and are a result of senility	• senility is not a normal age related occurrence and happens to a relatively small proportion of the elderly • it is difficult to separate the normal effects of aging from the effects of nutrition, cardiovascular difficulties, respiratory function, cancer, organic brain disease, the use of alcohol and drugs • dehydration can result in confusion • the normal process of aging results in physical changes in the brain

		that may affect the cognitive abilities of some elderly • in the old-old, there may be a 20% loss of neurons in the cerebral cortex which may lead to personality and mental function changes • by age 50 there is a significant decline in tests of memory, such as learning and recalling new information compared with those of younger individuals (according to some authors and not others)
	Encourage the elderly to think for themselves and make decisions for themselves Encourage social interaction Engage the elderly in relevant conversation	• use it or loose it is applicable • it is their right • environmental stimulation seems to encourage the development of new connections between neurons in the brain • emotional or social deprivation may result in a reduction of intelligence

	Allow the aged to do as much for themselves as possible (staffing may seemingly not lend itself to this necessity) Being patient is a requirement Do not take from the elderly what they can do for themselves Encourage exercise Encourage participation in the formal and informal activity programs provided by the facility and by the family	• the ability to respond is slowed in the aged • there is a decrease in deep tendon reflex; a 15 percent decrease in the conduction in the PNS because of (a) a decrease in the number of dendrites, (b) changes in the synapses slowing nerve impulse conduction, (c) thereby slowing reaction time • there is a decrease in the function of both the autonomic and sympathetic nervous systems with aging • functional task practice is one way to improve or maintain adequate functional speed • repetition of a task improves movement and response time for that task • older individuals are capable of improving movement performance and response times with practice, just as are other age groups

		• slowdown with aging results from lack of appropriate movement practice and failure to receive reinforcement for activity • lengthening response time is age-related and not a result of lack of motivation • practice leads to movement speed improvement yet practice alone will not suffice to reduce the age difference related to peripheral mechanisms of neuromuscular control • physical conditioning not only improves the functioning of the body periphery, it also has positive effect on central reactive capacity • chronic exercise appears not only to improve movement-time ability, but also to contribute to the maintenance of psychomotor speed over the life span • fluid intelligence (i.e., the capacity for abstract reasoning) is related

		to physical fitness and age, the better the fitness the higher the cognitive ability
	Protect the aged from injury	• nerves are easily damaged and take a long time to heal • there is a slowing in reaction time • there is a decrease in the function of the autonomic and sympathetic nervous systems • there is a decline in the body's ability to respond to stress (stress can be as simple as the environmental temperature) • with age, the autonomic nervous system slows or becomes weaker with the result the body takes longer to adapt to a change in condition • by the mid 60's perceptual ability declines • the elderly rarely remain asleep all night without waking

		• the sense of touch and sensitivity to pain is reduced in the elderly
	Encourage the elderly to drink fluids	• the loss of neurons in the hypothalamus may contribute to the decreased awareness of thirst and dehydration • dehydration can lead to confusion and constipation
	Protect the elderly from heat loss Protect the elderly from excessive heat production	• the hypothalamus becomes less effective in regulating the body's heat production and heat loss necessitating environmental measures be used to regulate heat loss and heat preservation • dress the elder person according to their need • the elderly are prone to heat stroke in the summer and hypothermia during the winter
	Observe the sleep pattern of the elderly	• the elderly need less sleep • the elderly rarely remain asleep all night without waking

		• sleep becomes fragmented with waking hours punctuated by periods of drowsiness necessitating naps • this fatigue is related to loss of energy, decreased blood flow and possibly boredom • sleep differences exist between the sexes from puberty on • young-old men wake more often at night until in their 80's when this sex difference disappears • frequent waking may be due to the need to urinate • sleep apnea is present in 1/3 over the age of sixty • sleepers leg, nocturnal myoclonus, happens in 1/3 of adults over age 65 and causes loss of sleep • depression can cause loss of sleep or too much sleep • sleep loss can be caused by excessive consumption of caffeine or

		alcohol or by use of sleeping pills • limit the time in bed • use the bed only for sleeping and sex • maintain a comfortable environment for sleeping
	Be aware of the environmental stimuli present while you interact with the elderly (TV, noise, shower stimulation and noise, children, etc.) Teaching needs to be done in a quiet, uncluttered, and calm environment	• by the mid 60's perceptual ability declines as does the ability to divide attention among different stimuli • by age 70 there is a significant change in linguistic ability and capacity for abstract thinking • sensory overload in the elderly is all too easy • environmental stimuli must be considered when competing for the focused attention of the elderly • competition can be from busy, noisy and environmentally cluttered areas

	Encourage appropriate eating and drinking	• in the elderly, taste and smell become dulled, causing a decrease in appetite with possible affected nutritional status • there is a 50 percent loss of taste functioning as a consequence of aging • the thirst sensation is decreased in the elderly leading to possible dehydration
	Provide assistance as needed and protect from harm due to age related vision changes Provide adequate light for good vision Control glare from windows with the use of drapes and/or shades Avoid shiny surfaces, as shiny waxed floor Use night lights in the bathroom and bedroom	• eyesight changes with age • the eye needs more light to see clearly it receives only 1/3 of the light it did when it was younger • night driving becomes difficult • perception falters • small print, small items, and things at a distance are harder to see

		• eyes take longer to adjust to changes from dark to light and from light to dark • adequate lighting is needed for vision • vision is altered due to the cornea flattening changing the refractory power • sensitivity of the cornea decreases lessening its ability to protect the eye • corrective lenses are usually required • glasses must be stored with the lens up to protect from scratching • lenses must be cleansed regularly, since dirty lenses prevent proper vision and pose safety concerns • glasses must be kept in good repair • the proper adjustment of temples and nose pads must be assured to

		provide good vision and for safety concerns, especially with bifocals and trifocals • there is a decreased ability to gaze upward • glare becomes a severe adaptive problem for the elderly • the pupil no longer dilates and constricts as it once did • floaters may be frightening • floaters can be seen and be interrupted as "seeing something" that others cannot see; they are not hallucinations • eye lashes rubbing against the conjunctiva can result in eye irritation and inflammation (senile entropion) • when the eyelid margin turns inward it may be a source of physical irritation (senile ectropion) • tears, which are a protective agent, are decreased

	Maintain good communication Have the person's attention before beginning to speak Face the person to whom your are speaking Avoid standing in the glare of bright sun or other lights Lower the pitch of your voice Speak clearly and slowly Avoid background noise Use other means of communication if unable to communicate verbally	• hearing is often affected with aging • hearing loss usually begins in the third decade and seems to peak between the fourth and fifth decade • the hearing loss related to age change is usually in the high frequency sound range • discrimination of consonants is difficult • there is an age related decrease in the cochlea of fluid and cilia that carry sound waves
	Protect from injury related to dizziness	• the semicircular canals and the cochlea form the inner ear which controls balance; the inner ear undergoes age-related changes that

		affect balance
	Protect from possible harm due to decreased olfactory sense Observe for the loss of olfactory sense Observe for loss of appetite Observe for an increased appetite for salty foods and sweets	• there are dramatic alterations in the sense of smell • there may be lack of awareness of the odor of natural gas • there may be a lack of awareness of personal body odor • loss of olfactory sense can be related to poor oral hygiene, periodontal disease, dental caries, and oral mucosal problems • olfactory receptor cells live for only five to eight weeks, then die and are replaced, this replacement slows in the aged, resulting in loss of olfaction • olfactory loss is primarily the result of upper respiratory infections, head trauma, nasal symptoms and or other diseases • be aware that due to decreasing olfactory sense the aged have an increase appetite for salty foods and sweets

		• taste and olfactory sensations are regulated by touch since touch declines with age there is a decline in taste and smell

RESPIRATORY SYSTEM

LUNGS		
RESPIRATION	Take measures to promote normal breathing	• heavy bed linens should not cover the chest • turning, repositioning, and deep breathing help prevent respiratory complications that may result from bed rest • breathing is usually easier in semi-Fowler's position • the individual should be as active as possible
	Observe for normal respirations	• the typical 75 to 80 year old has only 50 percent of the lung capacity of a 20 year old • decreased breathing capacity increases by 10 percent the energy

		needed to breathe, causing fatigue • strength of the inspiratory and expiratory muscle declines causing reductions in ventilation and vital capacity • the elderly may use their accessory abdominal muscles as their thoracic muscles have weakened with age • by age 60 there is a 30 percent loss of maximal oxygen uptake
	Encourage good chest expansion Position for adequate respiration and chest expansion Proper positioning allows for good chest expansion and adequate respiration	• inelasticity of lung tissue means decreased ventilation • inelasticity, large air passages and resistance of the chest wall can make breathing work and use precious energy, proving to be very tiring • throughout the alveolar airspaces there is enlargement, decreasing the available O2 • lungs become less able to expand and contract with age

		increasing dead air space, decreasing available air for respiration • tracheal cartilage calcify and large bronchi increase in diameter increasing dead space thereby decreasing available air for respiration • the inability to deep breathe and cough can lead to serious illness • reduced elasticity and calcification of the rib cartilage, weakness of intercostal and accessory muscles of respiration impair the functional reserve respiratory capacity which is normally only a problem with illness • respiratory cilia decrease, the cells that generate surfactant may decrease, respiratory fluids decrease; all affect respiratory ability and increas the incidence of respiratory illness • the mucosal seat of the alveolar-capillary membrane thickens and

		affects the surface available for diffusion of gases; the number of capillaries decline, resulting in decreased alveolar vascularity causing decreased respiratory diffusion of gas • kyphosis, scoliosis, and calcification of the costal cartilages increase rigidity of the chest wall reducing compliance of the chest wall for adequate respiration • the cough is less effective due to inadequate force from the anatomic changes of the chest and decreased muscle strength increased abdominal pressure and body position greatly affect the breathing patterns of the frail elderly
	Observe for and assist in the prevention of stress and activity related respiratory difficulty	• exercise is proving to be a great restorer of abilities • exercise assists the body in maintaining good functioning • regular exercises increase maximal oxygen uptake

	Encourage and support exercise as tolerated Allow the activity pace to be set by the elder person	• difficulty breathing increases with activity and stress while there is no apparent change with rest • the respiratory control centers do not function as well nor as fast in the elderly

CARDIOVASCULAR SYSTEM

HEART		
	Allow rest periods during the day Plan daily activities to avoid overexertion Do not allow the old-old to walk long distances, climb many stairs, or carry heavy objects Arrange personal care items, the television,	• the heart is a less efficient pump as it grows old • the heart becomes larger and pumps with less force • arteries narrow and are less elastic, decreasing blood flow through narrowed arteries, which makes the heart pump harder • the resident experiences reduced energy and confusion due to slow blood flow to the brain and other parts of the body

	telephone, and other frequently used items in convenient locations	• the exchange of nutrients and oxygen between body parts and blood vessels is less efficient
	Encourage daily exercise as tolerated Provide active or passive range-of-motion exercises, especially if confined in bed	• daily exercise as tolerated helps to stimulate circulation • exercise helps prevent the formation of blood clots in the leg veins
	Report irregular heart beat Report a pulse over 100 and under 60	• the electrical conduction of the heart may not be as regular • for adults the normal heart rate range is 70-80 • a rapid heart rate is poorly tolerated and may lead to cardiac irregularities or heart failure
	As routine, take the blood pressure after supine for 5 to 10 minutes and then immediately on sitting and record both	• arteries become clogged and narrow causing a rise in blood pressure • hypertension can be the result of increased resistance in the

	Report a blood pressure reading that is over 140/90	circulatory system • the circulatory system does not accommodate postural changes as well as it once did
	Encourage the resident to rise from a sitting or laying position slowly	• the circulatory system does not accommodate postural changes as it once did • blood flow is slower to the brain and other parts of the body • orthostatic hypotension can be a cause of falls and injury • the resident experiences reduced energy and confusion due to slow blood flow to the brain and other parts of the body
	Encourage, provide and monitor a healthy diet	• diet, as well as exercise, contribute to a healthy heart

GASTROINTESTINAL TRACT

GI SYSTEM		
OLFACTORY SENSE	Inquire for food preferences Assist with set up for meals Provide eating utensils appropriate to needs Report across-the-board deterioration of taste	• foods selected should be familiar and liked • food served should be served in an attractive manner • eating habits change due to difficulty with chewing or swallowing or a loss of appetite caused by diminished sense of taste and smell • across-the-board deterioration of taste can be due to serious pathologic conditions of the nervous system
	Monitor food and fluid intake for amount and adequacy Weigh monthly, observing weight loss or increase	• flavor enhancement of food results in increased food intake and improved immune status • three-fourths of the taste buds may be lost by age 70 • there are changes in the tongue with it becoming smooth,

	Report a weight change of five pounds or more	subsequent to loss of the elevations • touch is instrumental to taste and smell; touch declines with age reducing taste and smell • declining ability to taste and smell leads to decreased appetite and loss of interest in food • there is a decline in the amount of food flavor sensation requiring an increase in flavor to have flavor sensation • dentures can affect the taste of food
TEETH	Provide frequent (QID) oral care with proper implements; brush, rinse and floss Provide regular dental checkups Observe for and listen for complaints of oral discomfort	• good oral hygiene includes professional control of plaque and calculus • oral caries are the most common disease in the United States • neglect is the primary cause of tooth loss • declining oral health can be a result of neglect

	Limit sweets	• oral care is done to prevent mouth odors and infections, to increase comfort, and to make food taste better • tooth enamel thins, dentin becomes translucent, teeth become more brittle • normal age-related changes include: broken carious teeth, cysts, dental infections, lip and tongue fissures, oral ulcers, and increased potential for infection of the parotid glands • proper, vigorous oral hygiene can prevent gingivitis • regular fluoride dentifrice and fluoride mouthwash can be used
	Brush dentures as frequently as teeth Wash dentures in cold water Wash dentures over soft material to prevent breakage if they slip	• dentures will warp if hot water is used • dentures can break if dropped • dentures are expensive and are not easily replaced • dentures need replacing if the teeth fall out or chip, if the plate

	Wear gloves to brush dentures Remove and soak dentures overnight Discard the soak water from the dentures in the morning Oral care is performed on edentulous residents also Observe for proper denture fit Listen for complaints of denture discomfort Provide oral care on a regular basis (QID) Arrange an annual dental oral cancer screening	chips, cracks or breaks, if the fit is no longer tight or if irritation of the oral mucosa develops • the life expectancy of dentures is five years • dentures need professional cleaning to remove plaque • the edentulous mouth needs oral care on a regular basis • if a mouth is without teeth or dentures for 18 months it will not adjust to teeth due to the permanent change accommodation • the combination of lost teeth and lost tissue mass results in poorly fitting dentures • poor fitting dentures can result in poor nutrition • declining oral health can be a result of neglect • jaw bone resorption and changes in gum structure also result in ill fitting dentures

ORAL MUCOSA	Report all complaints pertaining to the mouth Report inflammation of the tissues supporting the teeth (periodontitis)	• oral mucosa atrophies making chewing less efficient • oral mucous membrane disturbances can result in pain and suffering • loss of oral tissues results in decreased host resistance thereby increasing the chance of infections and oral cancer • periodontitis is caused by poor oral care, specifically by residual food, bacteria, and calcium deposits in spaces between the gum and lower part of the tooth crown that can lead to oral bone loss • bone loss can result in loss of teeth • tooth loss can result in mandibular atrophy • ridge resorption can make denture wearing impossible • regular fluoride dentifrice and fluoride mouthwash can be used

		to prevent further oral mucous membrane damage
MOUTH	Observe and report dry mouth, ropy saliva, difficulty chewing or swallowing Report halitosis that is not relieved by good oral care Report complaints pertaining to the teeth and oral mocosa Inquire of the nurse if the resident is on any medications that can cause dry mouth Provide and encourage 1500cc to 2000cc of fluid per day (if not contraindicated) Do oral care every two (2) hours when there is dry mouth or thick ropy saliva	• in the fifth decade there is a decrease in salivary secretion, slowing digestion of starch • decreased salivary production leads to dry mouth, difficulty swallowing and chewing • decreased salivary production is associated with changes in taste threshold • saliva and digestive juices are reduced and released more slowly causing the digestive process to be slower and less efficient • the loss of moist saliva increases the rate of dental caries from 15/18 months to as little as 2 1/2 months • dry mouth (xerostomia) can lead to decreased chewing function, increased oral mucositis, decrease in the ability to wear dentures

	Use mechanical debridement of the mouth (toothbrush, washcloth over the finger) with one part hydrogen peroxide to four parts normal saline to cleanse a mouth with dry or thick mucous	and an increase in dental caries • thickened saliva makes it more difficult to swallow • Xerostomia (dry mouth) can be a side effect of some medications • adequate hydration cannot be emphasized enough for good all around health • the dentition changes lead to erosion, abrasion, halitosis, stress on the remaining teeth, excessive bone resorption, muscular imbalances, malocclusion of the jaw and temporomandibular arthritis • physical and/or mental disabilities are part of the reason the aged do not receive the needed oral health care (it is assumed they can do their own oral care and they may not be able to, can

		not, do or not do it/to maintain independence they refuse to allow so personal a care as oral care/they may not have the physical, mental or financial capabilities to go to the dentist) • the elderly are at risk for inadequate food intake and poor nutrition due to oral changes, associated loss of appetite and difficulties chewing food • malnutrition is a leading cause of oral mucous-membrane problems
	Know how to do the Heimlich maneuver Immediately report any time you have to do the Heimlich maneuver Report all difficulty swallowing Report all choking	• muscle loss results in decline in biting force • neurologically, there is a decrease in the gag reflex in the elderly

	Report all gurgling with the ingestion of fluids Report all coughing immediately following the ingestion of liquids	
GUMS	Observe for plaque build up, and receding gums Listen for complaints of tooth pain or gum pain Observe for and report gum bleeding Provide or make sure good oral care is provided Keep the mouth free of food particles and debris by frequent brushing and flossing	• gingival recession exposes the cementum, leads to plaque build up on the cementum and results in caries • a mouth that has been edentulous for 18 months has undergone permanent changes preventing accommodation to dental plates • gum disease is the greatest mucous membrane impairment in the frail elderly • gum disease can lead to gingivitis, an overgrowth of gingival tissue, halitosis and periodontal disease • plaque can cause gingivitis leading to gums becoming darker,

		edematous, and soft, and bleeding easily • the best preventive for periodontitis is brushing and flossing to keep the mouth free of food particles and debris
EPIGLOTTIS, ESOPHAGUS, STOMACH	Know how to do the Heimlich maneuver Immediately report any time you have to do the Heimlich maneuver Report all difficulty swallowing Report all choking Report all gurgling with the ingestion of fluids Report all coughing immediately following the ingestion of liquids Report all complaints of burning in the chest	• the epiglottis weakens with age and does not completely close, causing choking with some foods • with age, there is difficulty swallowing, esophageal reflux, esophageal pouches that collect food and/or fluid, either holding or causing just a pause in food traveling to the stomach • the esophagus has smooth-muscle weakness resulting in delayed emptying, possible dilation and increased risk of aspiration • the sphincter at the lower end of the esophagus may become weak, allowing back splashes of secretions from the stomach causing burning irritation and inflammation of the esophagus

	after eating Maintain the elderly an upright position two (2) hours after eating Serve six (6) meals a day to those that cannot tolerate three (3) big meals	• the sphincter at the lower end of the esophagus may fail to relax thereby not allow its contents to empty into the stomach • Hiatal hernia is a frequent difficulty in the aged • the lower esophagus may have prolonged spastic contractions that are not sufficient to move contents along the tract • there may be feeling of fullness in the chest under the sternum due to delayed emptying of the esophagus caused by the weakened muscle • the muscle at the opening to the stomach becomes weaker with age and may not seal completely allowing contents to leak back into the esophagus • the combined action of partly digested food and digestive juices on the esophagus can cause a burning feeling and pain

		• delayed gastric emptying and difficulty in managing large food quantities is caused by fat tissue accumulation and smooth muscle thinning
LARGE INTESTINE, SMALL INTESTINE, COLON, ANUS	Serve five to six small meals per day with the heaviest meal at midday rather than in the evening Serve plenty of fluids (1200cc to 1500cc minimum per day) Encourage exercise as tolerated Perform peri-care as frequently as needed keeping the skin clean and dry Use sensitivity when working with the incontinent elder	• there is a decrease of smooth wall muscle in the large intestine and loss of tone in the remaining intestinal muscles • there is a decrease in the peristalsis and diminished nerve sensation in the large intestine • combine the decreased smooth wall muscle, loss of tone, decrease in peristalsis, diminished nerve sensation with decreased fluid intake, lack of fiber and lack of exercise and constipation results • right foods and adequate exercise help the digestive process • constipation is a real problem with aging

	Provide privacy and confidentiality with incontinence Allow privacy and time on the comode at the same time daily for bowel evacuation	• there is atrophy of mucosa, intestinal glands, and the muscles of the digestive system which can lead to prolonged GI transit time • there is alteration in intestinal secretion, motility, and absorption • peristalsis is slower and weaker • the aged digestive system finds it more difficult to digest certain kinds of foods and spices • the colon has atrophy of mucosa and decrease in musculature • the anal muscle becomes weaker resulting in fecal incontinence and the spontaneous passage of flatulence
LIVER	Observe and report all exaggerated, delayed or extended responses to medications or other ingestables	• with age, the liver has a decreased size, weight, and function with sluggish response to stimulation producing less, and more concentrated, enzymes • decreased ability to metabolize drugs and hormones and

		reduced alcohol tolerance • decreased ability to synthesize protein
PANCREAS	Avoid serving dry, fried or fatty foods Be aware that the glucose level remains elevated longer in the elderly	• pancreatic enzymes, trypsin, amylase, and lipase decrease in volume and concentration, resulting in poor tolerance of high-fat meals and poor absorption of fat-soluble vitamins • the glucose level of the elderly remains high long after glucose enters the bloodstream
GALL-BLADDER	Present and maintain the diet as ordered Observe for and report pain to the nurse (gallstone in the duct is very painful)	• the gallbladder walls thicken and shrink making emptying more difficult • bile becomes thicker and there is less of it • the development of gallstones increases in approximately 40 percent of those over the age of 80

		• bile can become supersaturated with cholesterol

URINARY SYSTEM

KIDNEYS	Toilet frequently and as soon as requested Report accurate I and O Report absence of elimination Report decreased fluid ingestion Report abnormal blood pressure and heart rate Report frequent, malodorous, or scant voiding Report sudden mental status changes Encourage fluids Have drinking water readily available	• the kidney looses nephrons with age • filtration rate falls to about one half by age 90 • the kidney takes longer to do its task • the kidney has a decreased ability to conserve sodium • renal blood flow is decreased thereby decreasing functioning • the kidney does not concentrate urine as well as it once did • there is a decrease in the effectiveness of the antidiuretic hormone in the aged • dehydration can be serious and life threatening in the elderly • coffee, tea, sweetened drinks and colas are diuretics • decreased kidney function allows poisonous substances to build

	Offer drinks with snacks Avoid offering coffee, tea, sweetened drinks and colas	up in the system • the elderly have a need to void every two hours while awake and at least once during the night
BLADDER	Toilet frequently Report thin, weak, intermittent urinary stream in men Report difficulty starting a urinary stream Report urinary dribbling Report frequent, malodorous, scant amount, burning on urination, or discomfort on urination	• emptying the bladder becomes a problem in aging due to weakening of the bladder and perineal muscles and changes in the sensation to void • bladder changes may lead to retention of large volumes of urine • bladder capacity decreases by half in the aged • the aged bladder's signal to empty triggers when it is full • the aged bladder may not signal at all to empty • the bladder signal to empty must be addressed as immediately as possible due to the inability to control its emptying • there may be a need to void 30 minutes after going to bed

		because recumbent position increases renal function • benign prostate hypertrophy in males increases with age and can cause urinary incontinence, urinary frequency, urgency, decreased force and hesitancy in initiating urine flow • an enlarged prostate gland or a weakened bladder may cause frequent urination or dribbling, or a urinary tract infection • in females, incontinence may be the result of changes in the urethral and vaginal wall, decrease in vaginal muscular tone, a weakened pelvic diaphragm, or vascular circulation changes • a urinary tract infection and incontinence can both be accompanied by urgency and frequency • INCONTINENCE IS NOT A NORMAL AGE-RELATED CHANGE AND NEEDS INVESTIGATION AND

		TREATMENT

REPRODUCTIVE SYSTEM

SEXUALITY	Allow expression of sexuality	• sexuality is the way each person shows their female or male qualities: for example: hairstyles, style of clothing, type of walk and gestures, voice tones and speaking style, sexual habits, hobbies and interests
	Provide and allow privacy for sexual needs Draw the privacy curtain or move the resident to a private place Knock or announce yourself before entering allowing time for response Do not judge the resident because of the form of the sexual activity or means used	• sexual expression includes caressing, touching, mental imaging, masturbation, sharing, being physically intimate • participation in sexual activities is normal and healthy • hugs given by staff to residents may be the only touch they receive that is not related to their personal care • touch can be therapeutic and help maintain contact and reduce anxiety for the elderly

	Do not make fun of the resident's form of sexual expression Do not talk to other residents or health care workers about a residents chosen sexual expression Report sexual activities in which an individual is an unwilling partcipant Report sexual advances by a resident towards you Never make sexual advances toward a resident Allow and support activities that permit the mingling of female and male members	• expression of sexual feelings may add pleasure to their lives, reduce the amount of inappropriate sexual expression, and provide relief from anxiety • holding hands with an elder, giving compliments on appearance may affirm an older person's sexuality

	Give hugs, touch, hold hands with and compliment the elderly	
	Monitor and report a male resident that has difficulty starting a urinary stream , maintaining one, or has pain on urination Arrange an annual prostate exam for males over 50	• the urinary urethra passes through the prostate gland which may enalrge and block urine flow • the prostate enlarges with age • the prostate can be palpated thru the rectum by digital exam • a blood test (Prostate Specific Antigen) can determine if prostate cancer is present • prostate cancer is the most preventable cancer
	Report: listlessness, weight loss, poor appetite, depressed libido, impotence, inpaired ability to concentrate, weakness, fatigue, irritability	• these are the signs and symptoms of the male climacteric

	Practice universal precautions	• sexually transmitted diseases can be transmitted with intimate contact • some sexually transmitted diseases can be transmitted years after acquiring them
	Report itching of the vulva Report if resident volunteers her sexual experience was painful Report vaginal bleeding in women that are postmenopausal Report any evulsion of the contents of the uterus through the vulva	• the vagina thins and may be dry • there can be chronic inflammation due to hormonal changes • the vagina may be dry and require artificial lubrication to prevent painful sexual intercourse • bleeding could be the result of thin vaginal walls • bleeding could be the result of disease or cancer • vaginal bleeding on a cyclic basis can be the result of hormonal replacement if both estrogen and progesterone are taken

		• a prolapsed uterus is possible due to weak abdominal muscles
	In the uncircumsized male, retract the foreskin, cleanse the penis and return the foreskin in position	• smegma collects, causing odor, and is a contributor to infections • not returning the foreskin to its place can cause swelling of the glans penis and possibly require emergency surgery to relieve
	Accept the elder person as they are and for whom they are Encourage, allow, and assist the elderly to look their best at all times Report signs and symptoms of depression Make sure residents dress appropriately for the time of day in attractive clean clothing individual to them All women should wear bras that fit unless	• the body undergoes many physically observable changes that may not be welcomed or accepted: breasts sag, gluteals sag, facial and abdominal skin seemingly hangs, testes hang lower

	they determine they do not want to wear a bra at all	

ENDOCRINE SYSTEM

THYROID	Accurately weigh and record the resident's weight each month, and compare to the preceeding month's weight	• thyroid hormones assist in the metabolism of fats and carbohydrates • thryroid hormones drive oxygen usage • thyroid hormones encourages heat production by the body cells
	Encourage exercise within the resident's physical limits	• production of the thyroid decreases with age • production of thyroid hormone is decreased because the hormone takes longer to degrade in the body tissue since activity slows and oxygen consumption is reduced

GLOSSARY

ABDOMEN, area of body between thorax and pelvis. (1)

ABSORPTION, the act of taking up; to take up by soaking up. (1, 3)

ABSTRACT, a thought process that is oriented toward the development of an idea without application to, or association with, a particular instance. This type of thinking is independent of time and space. (3) theoretical; not applied or practical, not easily understood. (5)

ACCESSORY, supplementary or affording aid to another similar and generally more important thing. (3)

ACID, a solution in which the pH is less than 7; a substance that contributes or liberates hydrogen ions in a solution. (2)

ACID-BASE BALANCE, a state of equilibrium between acidity and alkalinity of the body fluids; also called hydrogen ion (H+) balance because, by definition, an acid is a substance capable of giving up a hydrogen ion during a chemical exchange, and a base is a substance that can accept it. (3)

ACROSOME, a caplike, membrane-bound structure covering the anterior portion of the head of a spermatozoon; it contains enzymes involved in penetration of the ovum. (3)

ACTH, see adrenocorticotropic hormone.

ADH, see antidiuretic hormone.

ADIPOSE TISSUE, fatty tissue. (3)

ADIPOSE, pertaining to fat accumulations in cells; fatty. (1, 3)

ADRENAL CORTEX, the adrenal cortex synthesizes and secretes more than 30 different steroids. In humans, the adrenal gland is the result of fusion of two organs, one forming the inner core or medulla, and the other forming an outer shell, or cortex. (3) the outer, firm layer comprising the larger part of the adrenal gland it secretes various hormones. (3)

ADRENAL GLAND, a small endocrine gland situated on top of the kidney. (3)

ADRENAL, near the kidney; of or produced by the adrenal glands. (3)

ADRENOCORTICOTROPIC HORMONE (ACTH), hormone secreted by the anterior lobe of the pituitary gland that stimulates activity in the adrenal cortex. (2)

AFFERENT NEURON, neurons that receive stimuli from the outside environment and transmit them toward the brain; sensory neuron. (3)

ALDOSTERONE, a hormone secreted by the adrenal cortex that functions in regulating sodium and potassium concentrations of the blood. (2) the main mineralocorticoid hormone secreted by the adrenal cortex, the principal biological activity of which is the regulation of electrolyte and water balance by promoting the retention of sodium (and, therefore, of water) and the excretion of potassium; the retention of water induces an increase in plasma volume and an increase in blood pressure. (3)

ALIMENTARY, pertaining to nutrition and digestion. (1)

ALKALI, any one of a class of compounds capable of neutralizing acids; play a vital role in maintaining the normal functioning of the body chemistry. (3)

ALKALI, any one of a class of compounds such as sodium hydroxide that form salts with acids and soaps with fats; a base, or substance capable of neutralizing acids. Alkalis play a vital role in maintaining the normal functioning of the body chemistry. (3)

ALKALINE, having the reactions of an alkali. (3)

ALOPECIA, loss of hair; baldness. (1, 3)

ALVEOLI, saclike structures that are the air sacs of a lung. (2)

AMINO ACID, one of a group of organic compounds containing both an amino and a carboxyl radical which are the building blocks of protein. (1) a unit of protein that takes its name from the fact that it contains an amino group (NH2 and an acid group (COOH). (2)

AMMONIA, a colorless alkaline gas, NH3, with a pungent odor and acrid taste, and soluble in water. (3)

AMPLITUDE, greatness of size; largeness, fullness; wideness or breadth of range or extent. (3)

ANDROGEN, any steroid hormone that promotes male characteristics. (3)

ANGINA PECTORIS, acute pain in the chest resulting from decreased blood supply to the heart muscle (myocardial ischemia). (3)

ANH, see atrial natriuretic hormone.

ANTERIOR, situated at or directed toward the front; opposite of posterior. (3)

ANTERO-, word element meaning infront of. (3)

ANTIDIURETIC HORMONE (ADH), hormone released from the posterior lobe of the pituitary gland that enhances the conservation of water by the kidneys. (2)

ANUS, outlet of the digestive tube. (2) the opening of the rectum on the body surface. (3)

AORTA, major artery that receives blood from the left lower portion (ventricle) of the heart. (2)

APEX, used to indicate the uppermost part of a body organ. (1) the pointed end of a cone-shaped part. (3)

APNEA, cessation of breathing; frequent and prolonged episodes in which breathing stops during sleep. (3)

APPENDICULAR SKELETON, pertaining to the limbs (3); portion of the skeleton forming the upper extremities, pectoral girdle, lower extremities, and pelvic girdle. (2)

APPENDIX, a small, tubular appendage that extends outward from the cecum of the large intestine. (2)

AQUEOUS HUMOR, the fluid produced in the eye, occupying the front and back chambers. (3) watery transparent liquid produced by the iris, ciliary bodies, and cornea that circulates throughout the anterior and posterior chambers of the eye. (1)

AQUEOUS, containing water. (1) watery; prepared with water. (3)

ARCUS SENILIS, the white ring that appears around the edge of the cornea, seen in aged persons due to lipoid degeneration. (1)

AREOLA, (pl. areolae) a narrow zone surrounding a central area, e.g., the darkened area surrounding the nipple of the mammary gland. (3)

ARRECTOR PILI, or ARRECTORES PILORUM, involuntary muscle fibers contracting under the influence of cold or fright and raising the hair follicles resulting in "goose-flesh". (1)

ARRHYTHMIA, a disturbance of rhythm in the heartbeat. (1)

ARTERIOLE, a branch from an artery that leads into a capillary. (2)

ARTERIOSCLEROSIS, a thickening or hardening and loss of elasticity of the blood vessels and arteries. (1) hardening of the arteries. (4)

ARTERY, a vessel that takes blood away from the heart; characteristically possessing thick elastic walls. (2)

ARTICULATION, a joint; the place of union or junction between two or more bones of the skeleton. (3)

ASPIRATION, the inspiration into the airway of foreign material; the withdrawal of fluid by an aspirator. (3)

ATHEROSCLEROSIS, a specific form of arteriosclerosis, fat cells narrow blood vessels reducing the blood flow. (4) localized accumulations of deposits of lipids within the inner surfaces of blood vessels, one of the causes of arterial occlusion. (1) an extremely common form of arteriosclerosis in which deposits of yellowing plaques containing cholesterol, other lipoid material, and lipophages are formed within the inner lining of large and medium-sized arteries. (3)

ATRIA, chambers; particularly the upper chambers of the heart that lie above the ventricles. (2)

ATRIAL NATRIURETIC HORMONE, a hormone produced in the cardiac atrium; an inhibitor of renin secretion and thus of the production of angiotensin, and a stimulator of aldosterone release. Its effect is increased excretion of water and sodium and a lowering of blood pressure. (3)

ATROPHY, degeneration of the body or of an organ or part (1); wasting; decrease in size of a normally developed organ or tissue. (3)

AUDI(O)- word element meaning hearing. (3)

AUDITORY CANAL, a tube in the outer ear that leads to the tympanic membrane. (2)

AURICLE, the flap of the ear (3); the external ear.(1)

AUTONOMIC NERVOUS SYSTEM, the branch of the nervous system that works without conscious control. (3) spontaneous control of involuntary bodily functions as part of the nervous system that innervates glands, smooth muscle tissue, blood vessels, and the heart. (1)

AUTONOMIC, not subject to voluntary control. (3)

AXON, process of a neuron that conducts nerve impulses away from the cell body. (2)

AXON, process of a neuron that conducts nerve impulses away from the cell body. (2)

BACTERIA, (pl. of bacterium); a single-celled microorganism that lacks a true nucleus and organelles such as a mitochondria, chloroblasts and lysosomes but has ribosomes, DNA and respiratory system. (1, 2, 3)

BASAL, pertaining to the lowest possible level. (3)

BASE, a solution in which pH is greater than 7; a substance that contributes or liberates hydroxide ions in a solution; alkaline; opposite of acidic. Also, in genetics the chemicals adenine, guanine, cytosine, thymine, and uracil that are found in DNA and RNA. (2) the lowest part or foundation of anything. (3)

BENIGN, not malignant; not recurrent; favorable for recovery. (3)

BICARBONATE, any salt containing the HCO3- anion; the bicarbonate of the blood plasma, an important parameter of acid-base balance measured in blood gas analysis. (3)

BICONCAVE, having two concave surfaces. (3)

BICUSPID, having two cusps. (3)

BILE, a secretion of the liver that is temporarily stored in the gallbladder before being released into the small intestine where it emulsifies fat. (2)

BLADDER, collecting sac for urine; a reservoir. (1)

BLINDNESS, inability to see partially or totally; visual impairment as a result of disease, irritation, or accident. (1)

BLOOD PRESSURE, the pressure of the blood against a blood vessel. (2)

BOLUS, a pill-shaped mass. (1) a rounded mass of food or pharmaceutical preparaton ready to be swallowed, or such a mass passing through the gastrointestinal tract. (3)

BOWMAN'S CAPSULE, double-walled cup that surrounds the glomerulus at the beginning of the kidney tubule. (2)

BRAINSTEM, the stemlike portion of the brain connecting the cerebral hemispheres with the spinal cord, and comprising the pons, medulla oblongata, and midbrain. (3)

BRONCHI, the two major divisions of the trachea leading to the lungs. (2)

BRONCHIOLES, the smallest branch of the bronchi within the lungs. (1) one of the successively smaller channels into which the segmental bronchi divide. (3)

BUNION, inflammation and thickening of the synovial membrane of the joint of the great toe resulting from chronic inflammation. (1)

CALCIFY, to make stony or chalky by deposition of calcium salts. (5)

CALCITONIN, hormone secreted by the thyroid gland that helps to regulate the level of blood calcium. (2)

CAPILLARIES, microscopic vessels located in the tissues connecting arterioles to venules through the thin walls of which molecules either exit or enter the blood. (2)

CARBOHYDRATE, a compound in food that are important and immediate source of energy for the body. (3)

CARBON DIOXIDE, CO_2; an odorless, colorless gas, formed in the tissues and eliminated by the lungs. (3) fond in the atmosphere as a colorless, odorless non-combustible gas necessary to all plant life. (2)

CARDIAC OUTPUT, the amount of blood pumped out of the heart into the body. (3)

CARDIOVASCULAR, pertaining to the heart and blood vessels. (1)

CARTILAGE, specialized, fibrous, dense connective tissue, usually part of the skeleton, that is composed of cells in a flexible basic material. (2, 3)

CAVERNOUS, pertaining to a hollow, or containing hollow spaces. (3)

CECUM, a pouchlike formation at the beginning of the large intestine and bears at its lower end the vermiform appendix; any blind sac. (1)

CELL BODY, portion of a nerve cell that includes a cytoplasmic mass and a nucleus and from which the nerve fibers extend. (2)

CELL MEMBRANE, a membrane that surrounds the cytoplasm of cells and regulates the passage of molecules into and out of the cell. (2)

CELL NUCLEUS, a spheroid body within a cell, contained in a double membrane, (the nuclear envelope), and containing the chromosomes and one or more nucleoli. (3)

CELL, the basic structure of all living things. (1)

CEMENTUM, thin layer of bony tissue deposited by cementoblasts which form the dentine or outer surface of the root of a tooth. (1)

CENTRAL NERVOUS SYSTEM, the brain and spinal cord. (2) including nerves and end organs that control voluntary action; voluntary nervous system. (1)

CEREBELLUM, back portion of the brain that controls voluntary muscular movements, equilibrium, and posture. (1)

CEREBRAL CORTEX, the convoluted layer of gray matter covering the cerebral hemispheres, which govern thought, reasoning, memory, sensation, and voluntary movement. (3)

CEREBRUM, the main portion of the brain that is responsible for consciousness. (2) the main portion of the brain, occupying the upper part of the cranial cavity; its two cerebral hemispheres, united by the corpus callosum, form the largest part of the central nervous system in man. (3)

CERUMEN, earwax. (1) a waxy secretion of the glands of the external ear. (3)

CERVIX, neck, the front portion of the neck, or a constricted part of an organ. (3)

CHOLESTEROL, fatty, steroid alcohol found in animal tissues, occurring in egg yolk, oils, fats, and organ tissues; constitutes the largest portion of gallstones; most of the cholesterol is synthesized in the liver, and it is important to bodily metabolism. (1)

CHORIOD, the vascular coat of the eye between the sclera and retina. (1) the middle, vascular coat of the eye, between the sclera and the retina; the vascular, pigmented middle layer of the wall of the eye. (2) It contains an abundant supply of blood vessels and a large amount of brown pigment that serves to reduce reflection or diffusion of light when it falls on the retina. (3)

CHYME, the liquid mixture of partially digested food and gastric juices formed during digestion and found in the stomach and small intestine after a meal. (1) the semifluid, homogeneous, creamy or gruellike material produced by action of the gastric juice on ingested food and discharged into the duodenum. (3)

CILIA, hairlike projections that arise from cells that can move either in an undulating fashion, like a whip, or stiffly, like an oar. (1, 3)

CILIARY BODY, consists of ciliary processes and ciliary muscle that extends from the iris base to the choroid. (1) the thickened part of the vascular tunic of the eye, connecting choroid and iris, made up of the ciliary muscle and the ciliary processes; these processes radiate from the ciliary muscle and give attachment to ligaments supporting the lens of the eye. (3)

CILIARY MUSCLE, a muscle that controls the curvature of the lens of the eye. (2)

CILIARY, pertaining to or resembling cilia; used particularly regarding certain eye structures, as the ciliary body or muscle. (3)

CIRCADIAN RHYTHM, the regular recurrences of certain phenomena in cycles of approximately 24 hours, e.g., biologic activities that occur at about the same time each day (or night) regardless of constant darkness or other conditions of illumination. (3)

CIRCADIAN, denoting a period of about 24 hours. (3)

CIRCULATORY SYSTEM, the major system concerned with the movement of blood and lymph; it consists of the heart, blood vessels, and lymph vessels. (3)

CLAVICLE, a slender, rodlike bone located at the base of the neck that runs between the sternum and the shoulders. (2)

CLIMACTERIC, menopause; cessation of a woman's reproductive period; corresponding period in a male characterized by decreased sexual activity. (1)

CLITORIS, small pea-shaped glans of erectile tissue containing sense receptors for sexual stimulation in the female. (2) an organ of the female genitalia; an erectile structure located beneath the anterior part of the vulva. (1)

CM, centimeter, a unit of measurement; one hundredth of a meter, or approximately 0.3937 inch; abbreviated cm. (3)

CO2, see carbon dioxide

COCHLEA, a spiral tube forming part of the inner ear, shaped like a snail shell, which is the essential organ of hearing. (3)

COGNITION, that operation of the mind process by which we become aware of objects of thought and perception, including all aspects of perceiving, thinking, and remembering. (3)

COITUS, sexual union by vagina between male and female; usually applied to the mating process in human beings. (3)

COLLAGEN, a substance composed of white fibers of connective tissue found in the skin, tendons, cartilage, and bone; a body protein composed of connective tissue fibers. (1, 3)

COLLECTING DUCT, a tube that receives urine from several distal convoluted tubules. (2)

COLON, the section of large intestine between the cecum and the rectum. (2) large intestine. (4)

COMPLIANCE, the quality of yielding to pressure or force without disruption, or an expression of the measure of ability to do so. (3)

CONCENTRATION, increase in strength by evaporation; the ratio of mass or volume of a solute to the mass or volume of the solution or solvent. (3)

CONFUSED, disturbance in orientation to time, place, or person; a psychological evaluation pertaining to a disordered consciousness. (1)

CONGESTIVE HEART FAILURE, (CHF) that which occurs as a result of impaired pumping capability of the heart and is associated with abnormal retention of water and sodium; a broad term denoting conditions in which the heart's pumping capability is impaired. (3)

CONJUNCTIVA, mucous membranes lining the eyelids and covering the front surface of the eyeball. (1)

CONNECTIVE TISSUE, a fibrous type of body tissue with varied functions. The connective tissue system supports and connects internal organs, forms bones and the walls of blood vessels, attaches muscles to bones, and replaces tissues of other types following injury. (3)

CONSTIPATION, a condition in which waste matter in the bowel is too hard to pass easily, or in which bowel movements are so infrequent that discomfort and other symptoms interfere with one's usual daily activities and sense of well-being. (3)

CONTRACTURE, shortening of muscle. (4)

CONVOLUTED, exhibiting convolutions; coiled; twisted; intricate; complicated. (5)

CONVOLUTION, a tortuous irregularity or elevation caused by the infolding of a structure upon itself. (3)

COPULATION, sexual union or coitus; usually applied to animals lower than humans. (3)

CORNEA, the transparent membrane covering the iris and pupil of the eye. (1)

CORONARY ARTERIES, two large arteries that branch from the ascending aorta and supply all of the heart muscle with blood. (3)

CORPORA CAVERNOSA, either of the two columns of erectile tissue forming the body of the penis or clitoris. (3)

CORPUS LUTEUM, a body, yellow in color, that forms in the ovary from a follicle that has discharged its egg. (2)

CORPUS SPONGIOSUM, a column of erectile tissue forming the urethral surface of the penis, in which the urethra is found. (3)

CORTEX, outer shell, an outer layer of an organ or other structure, as distinguished form its inner substance. (3) outer layer of an organ such as the cortex of the cerebrum, adrenal gland, or kidney. (2)

CORTI-, word element meaning cortex. (3)

CORTICAL, an outer layer as the outer layer of a bone or organs as distinguished from its inner substance. (3)

CORTICOTROPIN, adrenocorticotropic hormone; see ACT. (3)

CORTISOL, a glucocorticoid secreted by the adrenal cortex. (2)

COSTA, rib. (1)

COWPER'S GLANDS, two small structures located below the prostrate gland in males. (2)

CRANIAL NERVE, nerve that arises from the brain. (2)

CRANIAL, pertaining to the cranium or skull. (1)

CREMASTERIC, a genital muscle that elevates the testis. (3)

CREPITUS, a crackling or grating sound. (1)

CROWN, the topmost part of an organ or structure, e.g., the top of the head, or tooth. (3)

CUBIC CENTIMETER, cc; measurement in the metric system; 30cc = 1 oz. (4)

CYCLIC, pertaining to cycles. (3)

CYTOPLASM, the protoplasm of a cell surrounding the nucleus. (3)

DE- word element meaning reversal. (5)

DEBRIDEMENT, the removal of foreign matter or dead tissue from a wound. (1) the removal of all foreign material and all contaminated and devitalized tissues from or adjacent to a traumatic or infected lesion until surrounding healthy tissue is exposed. (3)

DECREMENT, the act or process or decreasing or becoming gradually less; waste. (5)

DEHYDRATION, removal of water from the body or a tissue; or the condition that results from undue loss of water. (3)

DEMENTIA, mental deterioration; organic loss of intellectual functioning. (1)

DENDRITE, process of a neuron, typically branched, that conducts nerve impulses toward the cell body. (2)

DENTIN, the chief substance of the teeth, surrounding the tooth pulp and covered by enamel on the crown and by cementum on the roots. (3)

DEOXYRIBONUCLEIC ACID (DNA), the genetic material that codes for the structure of all the proteins of the cell. (3)

DEPRESSION, a lowering or decrease of functional activity; in psychiatry, a morbid sadness, dejection, or melancholy, distinguished from grief, which is realistic and proportionate to a personal loss. (3) a morbid sadness, melancholy, or lack of hope. (1)

DERMIS, the thick skin layer that lies beneath the epidermis. (2)

DETOXIFICATION, reduction of the toxic properties of a substance; treatment designed to assist in recovery from the toxic effects of a drug. Metabolic detoxification, reduction of the toxic properties of a substance by chemical changes induced in the body, producing a compound which is less poisonous or more readily eliminated. (3)

DETRUSOR MUSCLE, a general term for a body part, e.g., a muscle that pushes down. (3)

DETUMESCENCE, contraction following expansion, especially restoration of a swollen organ or part to normal size. (5)

DIABETES MELLITUS, condition characterized by a high blood glucose level and the appearance of glucose in the urine due to a deficiency of insulin. (2)

DIAPHRAGM, a sheet of muscle that separates the chest cavity from the abdominal cavity. (2)

DIASTOLE, relaxation of heart chambers. (2)

DIFFUSE, not definitely limited or localized; to pass solutes through or to spread widely through a tissue or substance. (1)

DIFFUSION, the process of becoming diffused; widely spread. (1)

DIGESTION, the act or process of converting food into chemical substances that can be absorbed into the blood and utilized by the body tissue. (3)

DIGESTIVE SYSTEM, the system responsible for the conversion of food to substances useable by the body which includes the mouth, pharynx, esophagus, stomach, small intestine, large intestine, and accessory glands. (1)

DISORIENTED, the loss of proper bearings, or a state of mental confusion as to time, place, or identity. (3)

DISTAL CONVOLUTED TUBULE, the highly coiled region of a nephron that is distant from Bowman's capsule because it occurs after the loop of Henle. (2)

DISTAL, farthest point from the medial line or center of the body. (1)

DIURNAL, pertaining to or occurring in a day or each day; daily; occurring or active during the daytime rather than at night. (5)

DIVERTICULITIS, inflammation of a diverticulum, especially inflammation involving diverticula of the colon. (3)

DIVERTICULUM, intestinal pouch or sac formed by hernial protrusion of the mucous membrane through a defect in the muscular coat of the intestine. (3)

DM, see diabetes mellitus.

DUCT, a narrow tube or channel which serves to convey secretions from a gland. (1)

DUODENUM, the first 12 inches of the small intestine. (4)

DYS-,word element meaning bad; difficult; disordered. (3)

DYSPAREUNIA, difficult or painful coitus in women. (3)

DYSPHAGIA, difficulty in swallowing. (1, 3)

DYSPNEA, difficult and labored breathing; shortness of breath, which may be accompanied by pain. (1)

DYSURIA, painful or difficult urination. (3)

EDEMA, the accumulation of excess fluid in a fluid compartment. (3) swelling of body tissues due to an excessive accumulation of fluid in connective tissue or a serous cavity. (1)

EDEMATOUS, pertaining to edema. (1)

EDENTULOUS, without teeth. (3)

EFFECTOR, an organ that produces an effect, such as contraction or secretion, in response to nerve stimulation. (3)

EJACULATION, forcible, sudden expulsion; especially expulsion of semen from the male urethra, a reflex action that occurs a result of sexual stimulation. (3)

EJACULATORY DUCT, the duct formed by union of the ductus deferens and the duct of the seminal vesicles, opening into the prostatic urethra. (3) contains fluid that nourishes the male sex cells. (4)

ELASTIC, capable of resuming normal shape after distortion. (3)

ELASTIN, material forming the main constituent of yellow elastic tissue found in tendons and cartilage. (1)

END(O)-word element meaning within; inward. (3)

END-STAGE RENAL DISEASE, a period in which serum creatinine and blood urea nitrogen levels continue to rise and there is impairment of all body systems. (3)

ENDOCARDIAL, situated or occurring within the heart. (3)

ENDOCARDIUM, the lining membrane of the cavities of the heart and the connective tissue bed on which it lies. (3)

ENDOCRINE GLAND, a gland that secretes hormones directly into the blood or body fluids. (2)

ENDOCRINE, secreting internally; pertaining to internal secretions; hormonal. (3)

ENDOMETRIUM, the lining of the uterus that becomes thickened and vascular during the uterine cycle. (2)

ENDOPLASMIC RETICULUM, a complex system of tubules, vesicles, and sacs in cells; sometimes having attached ribosomes. (2)

ENGORGE, to congest or fill to excess as with blood or other fluid. (5)

ENZYMATIC, of, relating to, caused by, or of the nature of an enzyme. (3)

ENZYME, a protein catalyst that speeds up a specific reaction or a specific type of reaction. (2) any protein that acts as a catalyst, increasing the rate at which a chemical reaction occurs. (3)

EPIDERMIS, the outermost and nonvascular layer of the skin. (3)

EPIDIDYMIS, long tube that stores sperm until it is released from the body. (4) coiled tubules next to the testes where sperm mature and may be stored for a short time. (2)

EPIGASTRIUM, the upper and middle region of the abdomen, located over the pit of the stomach or belly. (1; 3)

EPIGLOTTIS, a structure that covers the glottis during the process of swallowing. (2) flap of skin that closes the windpipe when food or water is swallowed so that nothing enters the lungs. (4)

EPINEPHRINE, a hormone produced by the medulla of the adrenal glands; also called adrenaline, aids in the regulation of the sympathetic branch of the autonomic nervous system. (3)

EPITHELIAL TISSUE, a type of tissue that lines cavities and covers the external surface of the body. (2)

EPITHELIUM, the cellular covering of internal and external surfaces of the body, including the lining of vessels and other small cavities. (3)

EQUILIBRIUM, a state of balance between opposing forces or influences. In the body, equilibrium may be chemical or physical. A state of chemical equilibrium is reached when the body tissues contain the proper proportions of various salts and water. Physical equilibrium, such as the state of balance required for walking, standing, or sitting, is achieved by a very complex interplay of opposing sets of muscles. The labyrinth of the inner ear contains the semicircular canals, or organs of balance, and relays to the brain information about the body's position and also the direction of body motions. (3)

ERECTILE, capable of erection. (3)

ERECTION, the condition of becoming rigid and elevated, as erectile, tissue when filled with blood; applied especially to the swelling and rigidity that occur in the penis as a result of sexual or other types of stimulation. (3)

EROTIC, charged with sexual feeling; pertaining to sexual desire. (3)

ERYTHROCYTES, non-nucleated, hemoglobin containing blood cells capable of carrying oxygen; the red blood cell. (2)

-ESIS, word element meaning state; condition. (3)

ESO- word element meaning within.. (3)

ESOPHAGUS, a tube that transports food from the mouth to the stomach. (2) passage starting at the end of pharynx and ending at the top of the stomach. (4)

ESTROGEN, a generic term for estrus-producing compounds; the female sex hormones. (3) an estrogenic hormone produced by the ovarian follicle and other structures, responsible for the development of secondary female characteristics and changes in the epithelium of the vagina and the endothelium of the uterus. (1)

EUSTACHIAN TUBE, the auditory tube that connects the middle ear with the pharynx. (1)

EXCRETION, the elimination of waste materials from the body. (1) the act, process, or function of excreting. Ordinarily, what is meant by excretion is the evacuation of feces. Technically, excretion can refer to the expulsion of any matter, whether from a single cell or from the entire body, or to the matter excreted. (3) the act, process, or function of excreting. (3)

EXO-, work element meaning away from; without; outside; sometimes used to denote completely. (3)

EXOCRINE GLAND, secreting externally; particular glands with ducts whose secretions are deposited into cavities, such as salivary glands. (2)

EXOCRINE, secreting externally via a duct; denoting such a gland or its secretion. (3)

EXPIRATORY RESERVE VOLUME, the expired difference between the tidal volume and the vital capacity. usually measures approximately 1,400 ml of air. (2)

EXTERNAL RESPIRATION, exchange of oxygen and carbon dioxide between air and blood in the alveoli of the lungs. (2)

EXTRINSIC, originating externally. (1)

FALLOPIAN TUBES, two tubes through which ova move from ovaries to the uterus. (4)

FATIGUE, a state of increased discomfort and decreased efficiency resulting from prolonged exertion; loss of power or capacity to respond to stimulation. A normal reaction to intense physical exertion, emotional strain, or lack of rest. (3)

FATTY ACID, an organic molecule having a long chain of carbon atoms and ending in an acidic group. (2) an organic compound of carbon, hydrogen, and oxygen that combines with glycerol to form fat. (3)

FECES, excreta, stools; waste products of the body discharged through the anus. (1) body waste discharged from the intestine; called also stool, excreta, or excrement. (3)

FIBER, an elongated threadlike structure. (3)

FIBROBLASTS, a cell from which connective tissue is developed. (1)

FIBROCARTILAGE, cartilage with a matrix of strong collagenous fibers. (2)

FIBROSIS, formation of fibrous tissue. (3) an abnormal fibrous tissue formation. (1)

FIBROSIS, formation of fibrous tissue; fibroid degeneration. adj., FIBROTIC. (3)

FIBROUS CONNECTIVE TISSUE, tissue composed mainly of closely packed collagenous fibers and found in tendons and ligaments. (2)

FILAMENT, a delicate fiber or thread. (2)

FILTRATE, a liquid that has passed through a filter. (3)

FILTRATION, passage of water and solutes through a filter or through a material that prevents passage of certain molecules. (1, 3)

FIMBRIA, fringe, border, or edge; a fringelike structure. (3)

FIMBRIAE OF UTERINE TUBE, the numerous divergent fringelike processes. (3)

FLACCID, absence of muscular tone; relaxed; flabby. (1)

FLANK, the side of the body between the ribs and the flaring portion of the hip bone. (3)

FLATULENCE, excessive formation of gasses in the stomach or intestine. (3)

FLATUS, gas or air in the gastrointestinal tract; gas or air expelled through the anus. (3)

FOLLICLE, a sac or pouchlike depression or cavity. (3)

FOLLICLE-STIMULATING HORMONE (FSH), hormone secreted by the anterior pituitary gland that stimulates the development of an ovarian follicle in a female or the production of sperm cells in a male. (2)

FORESKIN, the fold of skin or prepuce which covers the glans of the penis. (1)

FRAGMENTED, to have been broken into pieces. (3)

FSH, see follicle-stimulating hormone.

FUNDUS, referring to the base part of body of a hollow organ; the part most remote from its opening. (1)

FUSION, the merging or coherence of adjacent parts or bodies. (3)

GALLBLADDER, the pear-shaped organ located below the liver, serves as a storage place for bile. (3)

GASTROINTESTINAL, pertaining to the stomach and the intestines. (1)

GERIATRIC, the branch of health care dealing with the problems of aging and diseases of the elderly. (3)

GERONTOLOGY, the science of the aging process in all its aspects, social as well as biological. (3)

GESTATION, period of fetal development in the womb. (1)

GH, see growth hormone.

GINGIVA, the part of the oral mucosa covering the tooth-bearing border of the jaw; the gum. (3)

GINGIVITIS, a general term for inflammation of the gums. (3)

GLANS, bulbous end of the penis; head of the clitoris; gland. (1)

GLOMERULUS, a cluster; for example, the cluster of capillaries surrounded by Bowman's capsule in a kidney tubule. (2)

GLOTTIS, slitlike opening in the larynx between the vocal cords. (2) an opening at the upper part of the trachea and between the vocal cords responsible for the modulation of the voice; the vocal apparatus of the larynx. (1)

GLUCAGON, a hormone secreted by the alpha cells of the islets of Langerhans in the pancreas that causes the release of glucose from glycogen. (2)

GLUCO-, word element meaning glucose. (3)

GLUCOSE, an end product in the metabolism of carbohydrates and the chief source of energy for the body. (1) the most common six-carbon sugar. (2)

GONAD, female or male reproductive gland, the ovary in the female and the testis in the male. (3) an organ that produces sex cells; the ovary, which produces eggs, and the testis, which produces sperm. (2)

GONADOTROPIIC HORMONE, a type of hormone that regulates the activity of the ovaries and testes; principally FSH and LH. (2)

GRADIENT, a rate of inclination; slope. an ascending or descending part; the maximum rate at which a variable physical quantity changes in value per unit change in position. (5) rate in increase or decrease of a variable value, or its representative curve. (3)

GRANULE, a small particle or grain; a small pill made of sucrose. (3) a very small grain-like body or structure. (1)

GROWTH HORMONE (GH), a substance that stimulates growth, especially a secretion of the anterior lobe of the pituitary gland that directly influences protein, carbohydrate, and lipid metabolism and controls the rate of skeletal and interior organs within the cavities of the body. (3, 1) a hormone released by the anterior lobe of the pituitary gland that promotes the growth of the organism; somatotropin. (2)

HALITOSIS, foul or offensive breath. (1)

HALLUS VALGUS, great toe displacement toward other toes of the foot. (1)

HALLUS, great toe. (3)

HARD PALATE, front portion of the roof of the mouth that contains several bones. (2)

hCG, see human chorionic gonadotropic hormone.

HEART ATTACK, (myocardial infarct) occurs when a portion of the heart muscle dies because of a lack of oxygen. (2)

HEART, muscular organ located in thoracic cavity responsible for maintenance of blood circulation. (2)

HEAT EXHAUSTION, a condition caused by prolonged exposure to high temperatures combined with fatigue; characterized by dizziness, faintness, nausea, sweating, and general weakness. (1)

HEAT STROKE, a condition due to excessive exposure to high temperatures or the sun, occurs especially with those who are debilitated or who have been drinking alcoholic beverages, resulting in symptoms of dizziness, nausea, weakness, spot before the eyes, ringing in the ears, reddened and dry skin, rapid pulse, and collapse. (1)

HELICAL FILAMENTS, filaments shaped like a helix. (3)

HEME, the iron-containing portion of a hemoglobin molecule. (2)

HEMOGLOBIN, a red, iron-containing pigment in blood that combines with and transports oxygen. (2)

HIATAL HERNIA, a protrusion of part of the stomach upward through the esophageal hiatus of the diaphragm. (1)

HOMEOSTASIS, the constancy of conditions, particularly the environment of the body's cells; constant temperature, blood pressure, pH, and other body conditions. (2) the tendency of biological systems to maintain relatively constant conditions in the internal environment while continuously interacting with and adjusting to changes originating within or outside the system. (3)

HOMOGENEOUS, having the same quality or uniformity throughout; belonging to the same kind or type. (1)

HORMONE, a chemical messenger produced in small amounts in one body region that is transported to another body region. (2)

HUMAN CHORIONIC GONADOTROPIC HORMONE (HCG), a gonadotropic hormone produced by the chorion that functions to maintain the uterine lining. (2)

HYALINE CARTILAGE, the typical smooth, translucent cartilage which covers bone surfaces that articulate with other bones. (1)

HYDROCHLORIC ACID, a normal constituent of gastric juice in man and other animals. (3) found in gastric juices in the stomach in a diluted and neutralized form which converts pepsinogen into pepsin. (1)

HYDROGEN, a chemical element. (3)

HYDROLYTIC ENZYMES, describes an enzyme action in which a substance upon which an enzyme acts is broken down by the addition of water. (2, 3)

HYPERKALEMIA, abnormally high potassium concentration in the blood, most often due to defective renal excretion, as in kidney disease, severe and extensive burns, intestinal obstruction. (3)

HYPERTENSION, high blood pressure; above 140/90. (4)

HYPERVENTILATION, an increased or forced respiration which results in carbon dioxide depletion with accompanied symptoms of lowered blood pressure, vasoconstriction, and faintness. (1)

HYPOTENSION, low blood pressure; below 90/60. (4)

HYPOTHALAMUS, a region of the brain that helps maintain relatively constant conditions in the internal environment while continuously interacting with and adjusting to changes originating within or outside the system. (3)

HYPOTHERMIA, low body temperature. (3)

IMMUNOGLOBULIN, major components of what is called the humoral immune response system; synthesized by lymphocytes and plasma cells and found in the serum and in other body fluids and tissues, including the urine, spinal fluid, lymph nodes, and spleen.

IMMUNORESPONSIVE, the capacity to react immunologically. (3)

IMPOTENCE, the inability of male to copulate. (1)

IMPREGNATION, the fertilization of an ovum. (1)

INCOMPETENT, not able to function properly. (3)

INCONTINENCE, unable to control the elimination of feces or urine. (1)

INCUS, the middle of three ossicles in the ear that is shaped like an anvil. (1)

INNERVATE, the supply of nerves to an organ or part of the body; to stimulate through the nerves. (1)

INTER-, word element meaning between. (3)

INTERMEDIA, in anatomy, denoting a structure lying between a lateral and a median structure. (3)

INTERNAL RESPIRATION, exchange between blood and tissue fluid. (2)

INTERSTITIAL, pertaining to or situated between parts or in the interspaces of a tissue. (3)

INTESTINAL TRACT, the small and large intestines in continuity. The long, coiled tube of the intestine is the part of the digestive system where most of the digestion of food takes place. (3)

INTESTINE, a long tubelike organ between the stomach and the anus; consists of small intestine and large intestine. (4)

INVOLUNTARY, performed independently of the will. (3)

ION, an atom or group of atoms having a positive (cation) or negative (anion) electric charge by virtue of having gained or lost an electron. substances forming ions are electrolytes. (3) an atom or group of atoms carrying a positive or negative charge. (2)

IRIS, a muscular ring that surrounds the pupil and regulates the passage of light through this opening. (2)

-ITIS, word element, meaning inflammation.

JOINT, a junction or union between two bones; an articulation between two bones or cartilage. (1)

KERATIN, a hard and waterproofing protein present in skin, hair, nails, and horny formations. (1)

KERATINOUS, containing, or of the nature of, keratin. (3) a nonliving layer of cells.

KERATOSIS, any growth of horny tissue development of the skin. (1)

KIDNEY FAILURE, inability of the kidney to excrete metabolites at normal plasma levels under normal loading, or inability to retain electrolytes when intake is normal; in the acute form, marked by uremia and usually by oliguria, with hyperkalemia and pulmonary edema. (3)

KIDNEY, organ in the urinary system that concentrates and excetes urine. (2)

KYPHOSIS, an abnormally increased forward curvature of the spine; a hunchback one of the most common causes is osteoporosis accompanied by vertebral fractures. (3)

LABIA MAJORA, two large, hair-covered folds of skin that extend back from the mons pubis. (2) two folds of adipose tissue covered with pigmented skin and hair on the outer surface and free from hair on the inner surface which lie on either side of the vaginal opening. (1)

LABIA MINORA, located between the labia's majora, two folds of skin with a center of vascular, spongy connective tissue without fat cells; surfaces are composed of stratified squamous epithelium with large sebaceous glands. (2)

two thin folds of mucous membrane located within the labia majora on either side of the vaginal opening. (1)

LACTATION, secretion of milk; breast feeding. (1)

LANGERHANS CELLS, located in the epidermis they have a role in the immune response.

LARGE INTESTINE, the last major portion of the gut consisting of the cecum, colon, rectum, and anal canal. (2)

LARYNGOPHARYNX, the lower part of the pharynx which extends into the larynx and esophagus. (1)

LARYNX, the enlarged upper portion of the trachea or organ of voice, composed of nine cartilage's and the vocal cords. (1) structure that contains the vocal cords, voice box. (2)

LENS, a clear, membranelike structure found in the eye behind the iris. The lens brings objects into focus. (2)

LEUKOCYTE, refers to several types of colorless, nucleated blood cells that, among other functions, resist infection; white blood cells. (2)

LH, see luteinizing hormone.

LIBIDO, sexual drive; innate drives and instincts that motivate human behavior; the energy force associated with pleasure seeking and sexual instinct. (1)

LIGAMENT, a strong fibrous hand of connecting tissue which binds the articular ends of bones to limit motion or to hold body organs in place. (1)

LINGUISTIC, of or belonging to language. (5)

LINGUO-, word element, tongue. (3)

LIPID, any group of fats which are water-insoluble (will not dissolve in water). (1)

LIPOFUSCIN, a yellow to brown granular, iron-negative lipid pigment found particularly in muscle, heart, liver, and nerve cells; it is the product of cellular wear and tear, accumulating in lysosomes with age. (3)

LIVER, a large organ in the abdominal cavity that has many functions vital to continued existence such as production of blood proteins and detoxification of harmful substances. (2)

LOBE, the globular part of an organ with well-defined boundaries. (1) a more or less well defined portion of an organ or gland. (3)

LOOPE OF HENLE, that part of a nephron in the kidney that lies between the proximal convoluted tubule and the distal convoluted tubule; consists of a descending portion and ascending portion; concerned with reabsorption of water. (2)

LOOSE CONNECTIVE TISSUE, tissue composed mainly of fibroblasts that are separated by collagen and elastin fibers and found beneath epithelium. (2)

LOWER RESPIRATORY TRACT, includes the trachea, bronchi, bronchioles, alveoli, lungs, pleura, respiratory membrane. (2)

LUNG, one of two cone-shaped structures which function as respiratory organs responsible for providing oxygen for the body and discharging waste products. (1)

LUTEINIZING HORMONE (LH), hormone produced by the anterior pituitary gland that stimulates the development of the corpus luteum in females and the production of testosterone in males. (2)

LYMPH, a transparent, usually slightly yellow, often opalescent liquid found within the lymphatic vessels, and collected from tissues in all parts of the body and returned to the blood via the lymphatic system. When plasma, without its solid particles and some of its dissolved substances, seeps through the capillary walls and circulates among the body tissues, it is known as tissue fluid. When this fluid is drained from the tissues and collected by the lymphatic system, it is called lymph. (3)

LYMPHATIC SYSTEM, vascular system that takes up excess tissue fluid and transports it to the bloodstream. (2)

LYSOSOME, one of the minute bodies occurring in many types of cells, containing various hydrolytic enzymes and normally involved in the process of localized intracellular digestion. (3)

MAGNESIUM, a mineral element found in soft body tissue, muscle, bone and teeth; essential to the proper functioning of the body. (1) a chemical element; Its salts are essential in nutrition, being required for the activity of many enzymes. (3)

MALLEUS, the largest of the three ossicles of the ear; called also hammer. (3)

MALOCCLUSION, imperfect closure or meeting of opposing teeth caused by abnormal growth of the upper or lower jaw. (1)

MANDIBLE, the horseshoe-shaped bone forming the lower jaw. (3)

MASTICATION, chewing of food. (1)

MASTICATORY, pertaining to mastication; a substance chewed to promote salivary secretion. (1)

MATRIX, the intercellular substance of a tissue, as bone matrix, or the tissue from which a structure develops, as hair or nail matrix. (3)

MEAN, an average; a numerical value intermediate between two extremes. (3)

MEATUS, an opening or passage. (3)

MEDIAL, pertaining to or situated toward the midline. (3)

MEDIAN, situated in the median plane or in the midline of a body or structure. (3)

MEDIASTINUM, a median septum or partition; the mass of tissues and organs separating the sternum in front and the vertebral column behind, containing the heart and its large vessels, trachea, esophagus, thymus, lymph nodes, and other structures and tissues. (3)

MEDULLA OBLONGATA, the lowest portion of the brain that is concerned with the control of internal organs. (2)

MEDULLA, the inner portion of an organ; for example the adrenal medulla. (2) the central or inner portion of an organ. (3)

MELANIN the pigment responsible for the color of skin, hair, etc. (3)

MELANOCYTE, any clear cell of the epidermis that makes the pigment melanin. (3)

MELANOCYTE-STIMULATING HORMONE (MSH), a peptide from the anterior pituitary that influences the formation or deposition of melanin in the body. (3)

MENARCHE, the onset of menses, normally between ages 10-17. (1)

MENINGES, protective membranous coverings about the central nervous system. (2)

MENOPAUSE, in the female, when monthly flow of blood from uterus (menstruation) stops. (4) the cessation of the menses; climacteric, or change of life for women between ages 45-50. (1)

METABOLIC, pertaining to metabolism. (1)

METABOLISM, the sum of the physical and chemical processes by which living organized substance is built up and maintained, and by which large molecules are broken down into smaller molecules to make energy available to the organism. (3)

METABOLIZE, subject to or be transformed by metabolism. (3)

MICROMETER, one millionth meter; equivalent to 1 micron. (3)

MICRON, measurement of a unit of length equal to one millionth of a meter. (1)

MICTURITION, urination. (3)

MIDBRAIN, the short part of the brain stem that contains the nerve pathways and relay centers of the third and fourth cranial nerves; for example the visual reflexes, such as moving the head and eyes. (3)

MINERALOCORTICOID HORMONE, any of a group of hormones elaborated by the cortex of the adrenal gland, so called because of their effects on sodium, chloride, and potassium concentrations in the fluid outside of the cell. They are essential to the maintenance of adequate fluid volume. (3)

MISCARRIAGE, spontaneous abortion; referring to the interruption of pregnancy usually between the fourth month and viability. (1)

MITOCHONDRIA, small, spherical to rod-shaped, membrane-bounded cytoplasmic organelles that are the principal sites of energy production; contains DNA, RNA, and ribosomes; they replicate independently and make some of their own proteins. (3)

MITRAL VALVE, the left atrioventricular valve, the valve between the left atrium and the left ventricle of the heart; it is composed of two cusps, front and back; also called the bicuspid valve. (3)

MITRAL, pertaining to the bicuspid valve in the heart that prevents the blood in the left ventricle flowing back to the left auricle. (1) shaped like a miter; pertaining to the mitral valve. (3)

MODULATION, the normal capacity of cell adaptability to its environment. (3)

MOLECULE, smallest unit of a chemical compound that still has the properties of that compound. (2)

MONS PUBIS, a hair covered, well padded, rounded, fleshy, prominence that is over the bony symphysis pubis. (3)

MOTOR NEURON, a neuron having a motor function; an efferent neuron conveying motor impulses. (3)

MOUTH, an opening, especially the oral cavity, which forms the beginning of the digestive system and in which the chewing of food takes place. (3)

MSEC (or MS), millisecond. (3)

MS (or MSEC), millisecond. (3)

MSH, see melanocyte-stimulating hormone.

MUCOPOLYSACCHARIDE , any of a group of polysaccharides that contain hexosamine, that may or may not be combined with protein and that, dispersed in water, form many of the mucins. (3)

MULTI-LAYERED, more than one layer either of same or different structure or material.

MUSCLE TISSUE, a bundle of long slender cells, or fibers, that have the power to contract and hence to produce movement. (3)

MUSCULARIS, relating to muscle, specifically a muscular layer or coat. (3)

MUSCULO-MEMBRANOUS, pertaining to muscle and membrane. (3)

MUSCULOSKELETAL, pertaining to the muscle and skeleton. (3)

MYELIN, the whitish fatlike substance that surrounds the axon of myelinated nerve fibers. (1)

MYOCARDIUM, the thickest and middle layer of the wall of the heart, or muscle of the heart. (1)

MYOCLONUS, shocklike contractions of part of a muscle, an entire muscle, or a group of muscles.

MYOTONIA, any disorder involving continuous tension, (tonic spasm) of muscle. (3)

NANOSECOND, one billionth second abbreviated ns or nsec. (3)

NARES, (plural of naris); the nostrils; the external openings of the nasal cavity. (3)

NASOPHARYNGEAL, pertaining to the nose and pharynx. (1)

NASOPHARYNX, that portion of the pharynx situated above the partition that separates the nasal and oral cavities in the roof of the mouth. (1) the part of the pharynx above the soft palate. (3)

NATRIURESIS, the excretion of abnormal amounts of sodium in the urine. (3)

NEGATIVE-FEED-BACK, causes the controller to respond in a manner that opposes a deviation from the normal level. It is, therefore, a corrective action that returns a factor within the system to a normal range. (3) feedback that reduces the output of a system, for example, the action of heat on a thermostat to limit the output of a furnace. (5)

NEPHRON, the structural and functional unit of the kidney, each nephron being capable of forming urine by itself. The nephron consists of the renal corpuscle, the proximal convoluted tubule, the descending and ascending limbs of the loop of Henle, the distal convoluted tubule, and the collecting tubule. (3)

NERVE FIBERS, an elongated thread-like process, or axon, which conducts impulses. (1)

NERVE TISSUE, a macroscopic white cordlike structure of the body, comprising a collection of nerve fibers that convey impulses from the brain and spinal cord and some other body region. (1, 3)

NEURAL, pertaining to a nerve or nerves; the nervous system. (1)

NEURALFIBERS, fibers that are of the nervous system.

NEUROENDOCRINE TRANSDUCER, a neuron, that on stimulation secretes a hormone, thereby translating neural information into hormonal information. (3)

NEURON, nerve cell that characteristically has three parts: dendrite, cell body, axon. (2)

NM, nuclear magneton, abbreviated nm. (5)

NOCTURAL, of, suitable to, or occurring at night. (5)

NOCTURIA, excessive urination at night, (1)

NOREPIEPHRINE, excitatory neurotransmitter active in the peripheral and central nervous systems. (2)

NOSTRILS, see nares.

NUCLEOLUS, a small rounded body within the cell nucleus in which the synthesis of RNA takes place. (1)

NUCLEUS, a large organelle containing the chromosomes and acting as a control center for the cell. (2)

O-is a joining letter that combines words and portions of words

O2, see oxygen.

OBLIQUE, a slanting or diagonal direction; involvement of two muscles of the eye, the abdomen, the head, and the ears which run at an angle, not laterally. (1)

OCULAR, pertaining to the eye; concerned with the eye or vision. (1)

-OID, word element meaning steroid. (3)

OLFACTORY, referring to the sense of smell. (1)

OLIGURIA, insufficiency in the amount of urine produced. (1)

OOCYTE, an immature ovum. (3)

OPACITIES, the quality or state of being opaque. (3)

OPAQUE, impenetrable by light, neither transparent nor translucent, not reflecting light, without luster; dull. (5)

OPTIC CERVE, the second crainal nerve; it is purely sensory and is concerned with carrying impulses for the sense of sight. (3)

ORBITAL, concerning the orbit of the eye. (1)

ORGAN, a structure composed of two or more tissues functioning as a unit. (2)

ORGANELLE, specialized structures within cells, such as the nucleus, mitochondria, endoplasmic reticulum. (2)

ORGANISM, an individual animal or plant. (3)

ORGASM, the apex and culmination of sexual excitement. (3)

OROPHARYNX, the space between the partition that separates the nasal and oral cavities in the roof of the mouth and the upper epiglottis. (1)

ORTHOSIS, an orthopedic appliance or apparatus used to support, aligh, prevent, or correct deformities or to imporve function of movable parts of the body; brace; splint. (3)

ORTHOTIC, serving to protect or to restore or improve function; pertaining to the use or application of an orthosis.(3)

OSMOSIS, the movement or diffusion of a solution through a selectively permeable, or a semipermeable membrane from an area of higher density to an area of lesser density. (1)

OSSICLES, a small bone, especially one of those in the middle ear: incus, malleus, and stapes. (3)

OSTEOPOROSIS, a decreased mass per unit volume of normally mineralized bone compared to age and sex-matched controls. (3)

OVA, female sex cells. (4)

OVARY, the female gonad; either of the sex glands in the female in which the ova are formed. (3) produce the female sex cells (ova). (4)

OVIDUCTS, uterine tube; a passage through which ova leave the maternal body or pass to an organ communicating with the exterior of the body. (3)

OVULATION, the discharge of the mature egg from the follicle within the ovary. (2)

OXYGEN, (O_2); an odorless, colorless gas essential to respiration of most plants and animals, which constitutes approximately 20% of the atmosphere's total volume, and is necessary to support combustion. (1)

OXYTOCIN, a hypothalamic hormone stored in and released from the posterior pituitary. It acts as a powerful stimulant to the pregnant uterus, especially toward the end of gestation. (3) hormone released by the posterior pituitary that causes contraction of the uterus and milk letdown. (2)

PANCREAS, an elongated, flattened organ in the abdominal cavity that secretes digestive enzymes into the duodenum and produces hormones, notably insulin. (2)

PARASYMPATHETIC NERVOUS SYSTEM, a subdivision of the autonomic nervous system. Some of the effects of the parasympathetic system are: constriction of pupils, slowing of heart rate, contraction of smooth muscles, increased glandular secretions, and the ocnstriction of bronchioles. (1)

PARATHYROID HORMONE, (PTH) a hormone secreted by the parathyroid glands that affect the level of calcium and phosphate in the blood. (2)

PARATHYROID, one of four tiny endocrine glands, pea-size, located on the lower back portion of the thyroid gland that secretes the hormone parathormone responsible for calcium-phosphorous metabolism. (1)

PARIETAL LOBE, area of the cerebrum responsible for sensations involving temperature, touch, pressure, and pain, as wellas speech. (2)

PAROTID, the largest of the three main pairs of salivary glands, located on either side of the face, just below and in front of the ears. (3)

PARS, a division or part. (3)

PASSIVE, receiving or subjected to an action without responding or initiating an action in return; not participating, acting or operating. (5) unable to do for self; unable to move own muscles. (4)

PECTORAL GIRDLE, portionof the skeleton that provides support and attachment for the arms. (2)

PELVIC GIRDLE, portion of the skeleton to which the legs are attached. (2)

PENIS, male copulatory organ (2) contains passageways for sperm and urine. (4)

PEPTIDE BOND, the bond that joins two amino acids. (2)

PERCEPTION, the conscious mental registration of a sensory stimulus. (3)

PERICARDIUM, the sac that envelops the heart and the roots of the great blood vessels. (1)

PERINEUM, the pelvic floor and associated structures occupying the pelvic outlet. (3)

PERIODONTITIS, inflammation of the periodontium. (1)

PERIODONTIUM, the surrounding supportive tissues around a tooth, including the bone and gum. (1)

PERIORBITAL, around the eye socket. (3)

PERIOSTEUM, the fibrous mambrane whichforms a covering of bones containing numerous blood vessels for nouorishment, and a supporting structure for the attachment of muscles, and ligaments. (1)

PERIPHERAL NERVOUS SYSTEM, (PNS), nerves and ganglia that lie outside the brain and spinal cord. (2)

PERIPHERAL VASCULAR DISEASE, (PVD), any disorder affecting blood flow through the veins and arteries distal to the heart. (3)

PERIPHERAL, pertaining to, located on, or comprising the periphery. (5) pertaining to the outer surface. (1) the outermost part or region within a precise boundary; the region or area immediately beyond a precise boundary. (5)

PERISTALSIS, normal contraction and relaxation of the hollow tubes of the alimentary canal which slowly moves the contents along for variable distances. (1)

PHARYNX, the membraneous tube that connects the mouth and the esophagus. (1) throat. (4) a common passageway (throat) for both food intake and air movement. (2)

PHOSPHATE, any salt or ester of phosphoric acid. Phosphates are widely distributed in the body, the largest amounts being in the bones and teeth. They are continually excreted in the urine and feces and must be replaced in the diet. Inorganic phosphates function as buffer salts to maintain the acid-base balance in blood, saliva, urine, and other body fluids. (3)

PHYSIOLOGY, the science concerned with the functions of the living organism, its organs, and its parts; the science of the functioning of all structures in the human body. (1)

PIGMENTOGENESIS the making of pigment cells.

PINEAL GLAND, a gland either at the skin surface (fish, amphibians) or in the brain, producing melatonin. (2)

PINNA, outer, funnellike structure of the ear that picks up sound waves. (2)

PITUITARY GLAND, anterior portion produces six types of hormones and is controlled by hypothalamic-releasing and release-inhibiting hormones; posterior portion is connected by a stalk to the hypothalamus. (2)

PLASMA, the liquid part of the blood or lymph; cell protoplasm outside the nucleus. (1) the fluid portion of the blood in which corpuscles are suspended. (3)

PLATELET, a minute disk-shaped structure found in the blood, important in clotting of the blood. (1)

PLATITUDE, a trite remark or statement; lack of originality; triteness. (5)

PLEURA, a serous membrane lining the walls of the thorax and enclosing the lungs. (1) either of two membranous sacs, each of which lines one side of the thoracic cavity and envelops the contiguous lung, reducing the friction of respiratory movements to a minimum. (5)

PLEURAL SPACE, the two layers enclosing a potential space, the pleural cavity (3) contains pleura fluid to allow frictionless movement of the lungs.

POLYPEPTIDE, a molecule composed of many amino acids linked together by peptide bonds. (2)

POLYSACCHARIDE, is a carbohydrate that contains a large number of one unit sugars. (3)

PONS, any slip of tissue connecting two parts of an organ. (3) a broad band of nerve fibers in the brain which connects the lobes of the cerebrum, medulla, and cerebellum. (1)

POST-word element meaning after; behind. (3)

POSTERIOR PITUITARY, the posterior lobe of the pituitary gland; the neurohypophysis. (3)

POSTERIOR, directed toward or situated at the back; opposite of anterior. (3)

POSTULATE, to assume the truth or reality of with no proof, especially as a basis of an argument. (5)

POTASSIUM, a mineral element which is the main cation of intracellular fluid in the body. It functions with sodium and chloride to regulate osmotic pressure and acid-base balance; in combination with calcium and magnesium ions, it is essential for normal muscle excitability, especially the heart muscle; and it is necessary in the conduction of nerve impulses. (1)

PREGNANT, with child; having a developing embryo or fetus within the uterus. (3)

PREPUCE, foreskin. (3)

PRESBYOPIA, farsightedness due to aging. (4)

PRIMARY CARE, the sole responsibility for nursing care by one professional individual.

PRIMARY, being a fundamental, or basic part; being or standing first in a list, series or sequence. (5)

PRN, pro re nata, according to circumstances; on an as needed basis. (3)

PROCESS, a prominence or projection. (3) a part extending or projecting from an organ or organism; an appendage. (5)

PROGESTERONE, a steroid sex hormone that is the principal progestational hormone. (3)

PROLACTIN, a hormone secreted by the anterior pituitary that stimulates the production of milk from the mammary glands. (2)

PROSTAGLANDIN, any of a group of naturally occurring, chemically related, fatty acids that stimulate contractility of the uterine and other smooth muscles and have the ability to lower blood pressure, regulate acid secretion of the stomach, regulate body temperature and platelet aggregation, and control inflammation and vascular permeability. (3)

PROSTATE, a gland in the male that surrounds the neck of the bladder and the urethra. (3) produces most of the seminal fluid. (2)

PROTEIN, any of a group of complex organic compounds that contain carbon, hydrogen, oxygen, nitrogen, and sulfur. (1); basic building blocks for body cells, nutrients needed for growth. (4)

PROXIMAL CONVOLUTED TUBULE, highly coiled region of a nephron near Bowman's capsule. (2)

PROXIMAL, nearest to the point of reference. (1)

PRURITUS, an intense, chronic itching due to dry skin. (1)

PTH, see parathyroid hormone.

PULMONARY ARTERY, an artery in which blood travels directly from the heart to the lungs. (5) the large artery originating from the superior surface of the right ventricle of the heart and passing diagonally upward to the left across the route of the aorta. The pulmonary trunk divides between the fifth and sixth thoracic vertebrae, forming the right pulmonary artery, which enters the right lung, and left pulmonary artery, which enters the left lung. (3) the only artery in the body that carries deoxygenated blood.

PULMONARY VEIN, one of four veins in which blood travels directly from the lungs to the heart. (5) the large vein (right and left branches) that carries oxygenated blood from the lungs to the left atrium of the heart. (3)

PULMONARY VESSELS, vessels of or pertaining to the lungs.

PULP, the soft part of an organ; referring to dental pulp in the interior of a tooth. (1)

PULSE, vibration felt in arterial walls due to expansion of the aorta following ventricle contraction. (2)

PUPIL, an opening in the center of the iris of the eye. (2)

PURPURA, a condition of the skin marked by purple or livid spots caused by tiny hemorrhages that invade the tissues. (1)

REABSORPTION, the act or process of absorbing again, as the absorption by the kidneys of substances (glucose, proteins, sodium, etc.) already secreted into the renal tubules. resorption. (3)

RECEPTOR, a molecule on the surface or within a cell that recognizes and binds with specific molecules, producing some effect in the cell. (3)

RECEPTOR, a sense organ specialized to receive information from the environment; a structure found in the membrane of cells that combines with a specific chemical in a lock-and-key manner. (2)

RECTUM, the lower portion of the large intestine between the sigmoid flexure and the anal canal. (1) last six inches of the intestines. (4)

RECUMBENT, lying down. (3)

REFLEX, an inborn autonomic response to a stimulus that is dependent on the existence of fixed neural pathways. (2) a reflected action, or an involuntary response to a stimulus, such as a movement. (1)

REFLUX, a backward flow; regurgitation. (1)

REFRACTORY, not readily yielding to treatment; not responding to a stimulus. (3)

REHABILITATIVE CARE, the care process of restoring to health or activity after a disabling injury or illness. (1, 3)

RENAL FAILURE, inability of the kidney to maintain normal function. Impairment of kidney function affects most of the body's systems because of its important role in maintaining fluid balance, regulating the electrochemical composition of body fluids, providing constant protection against acid-base imbalance, and controlling blood pressure. (3)

RENAL PELVIS, the funnel-shaped expansion of the upper end of the ureter into which the renal calices open; it is usually the renal sinus, but under certain conditions, a large part of it may be outside the kidney. (3)

REPLICATION, the process of duplicating or reproducing (3); in a cell the duplication of DNA; occurs when the cell is not dividing.(2)

RESERVE VOLUME, the extra amount of air that can be inhailed (inspiratory reserve volume) and expired (expiratory reserve volume) with deep breathing. (2)

RESIDUAL VOLUME, the air that remains in the lungs after very deep breathing, the air is no longer useful for gas exchange purposes, about 1,000ml of air. (2) the amount of air that remains in the lungs aftr the most forceful expiration about 1,200 ml. (2)

RESISTANCE, opposition, or counteracting force; in studies of respiration, an expression of the opposition to flow of air produced by the tissues of the air passages, in terms of pressure resistance, the opposition to blood flow in the vascular bed: the pressure drop across the bed divided by the blood flow, conventionally expressed in peripheral resistance units. (3)

RESORPTION, the breaking down and the making of a substance, as of bone; reabsorption. (3)

RETICULOENDOTHELIAL CELLS, found throughout the body these cells have various tasks ie. blood cell formation and destruction, storage of fatty materials, metabolism of iron and pigment, and play a role in inflammation and immunity, some can ingest and destroy unwanted foreign material. (3)

RETINA, the innermost coat of the eyeball which receives images formed by the lens, and transmits these images to the brain by the optic nerve. (1)

RIB, a bone or cartilage that forms the chest cavity and protects certain vital organs. (1)

RIBONUCLEIC ACID, (RNA), which is a nucleic acid containing ribose found in cytoplasm in all cells; controls cellular protein synthesis and replaces DNA as a carrier of genetic codes in some viruses. (1, 3)

RIBOSOME, a large particle containing RNA and protein present in the cytoplasm of cells. (1)

ROOT, that portion of an organ, such as a tooth, hair, or nail, that is buried in the tissues, or by which it arises from another structure, or the part of a nerve that is next to the center to which it is connected.(3)

SALIVA, the slightly acid fluid secreted by the glands of the mouth that serves as the first digestive enzyme, ptyalin. (1)

SALIVARY GLANDS, glands in the mouth that make saliva. (4) The major ones are the three pairs of glands known as the parotid, submaxillary, and sublingual glands. There are other smaller salivary glands within the cheeks and tongue. (3)

SALIVARY, pertaining to saliva. (1)

SALT, sodium chloride, or common salt; any compound of a base and an acid. (3)

SCLERA, white fibrousouter layer of the eyeball. (2)

SCLEROSIS, a hardiening of tissur or a part, due to excessive growth of fibrous connective tissue. (1)

SCLEROTIC, pertaining to the sclera of the eye; affected with or pertaining to sclerosis. (3)

SCLEROUS, hard; indurated; bony. (3)

SCOLIOSIS, a lateral curvature of the spine. (1)

SCROTUM, sacs that house the testes where developing male sex cells (sperm) are produced. (4)

SEBACEOUS GLANDS, one of the thousands of minute glands in the skin that secrete an oily, colorless, odorless fluid (sebum) through the hair follicles. (3)

SEBACEOUS, pertaining to or secreting sebum. (3)

SEBUM, the oily secretion of the sebaceous glands. (3)

SECONDARY, one step removed from the first; of the second rank; not primary; inferior; minor; lesser. (5)

SECRETION, the cellular process of elaborating a specific product. (3)

SECRETORY, pertaining to secretion; a secretory organ or gland ie. sebaceous gland makes oil; salivary glands make saliva. (1, 3)

SEMEN, fluid discharged at ejaculation from the male, consisting of spermatozoa in their nutrient plasma, secretions from the prostate, seminal vesicles, and various other glands, epithelial cells, and minor constituents. (3)

SEMICIRCULAR CANALS, tubular structures within the inner ear that contain the receptors responsible maintaining equilibrium. (2, 3)

SEMINAL FLUID, a fluid produced by various glands situated along the male reproductive tract. (2)

SEMINAL VESICLES, a convoluted saclike structure attached to the vas deferens near the base on the bladder in males. (2)

SEMINIFEROUS (TUBULES), producing or carrying semen. (3)

SEMIPERMEABLE MEMBRANE, permitting passage only of certain molecules. (3)

SEMIPERMEABLE, permeable only to certain molecules, as a membrane that permits passage of a solvent but not the solute. (1)

SENILE ECTROPION, inversion, or the turning inward, as of the margin of an eyelid manifested in old age. (3)

SENILE PLAQUES, microscopic lesions composed of fragmented axon terminals and dendrites surrounding a core of a starchlike substance, which substance renders the terminals and dendrites nonfunctioning. (3)

SENILE, pertaining to old age (1) (no longer used to refer to the elderly).

SENILITY, old age; a pronounced loss of mental, physical, or emotional control in aged people, caused byphysical or mental deterioration or a combination of the two. (3)

SENSORY NEURON, a neurons that receive stimuli from the outside environment and transmit them toward the brain; afferent neuron. (3)

SEPTUM, any mixed matter with saliva that is expectorated through the mouth. (1)

SEROUS, pertaining to serum; thin and watery, like serum; producing or containing serum. (3)

SERUM, the clear portion of any animal or plant fluid that remains after the solid elements have been separated out. (3)

SLOUGHS, to cast off or shed; necrotic (dead) matter separated from living tissue. (1)

SMEGMA, a cheesy secretion of sebaceous glands, consisting of epithelial cells found under the labia minora and the foreskin. (1)

SOFT PALATE, entirely muscular back portion of the roof of the mouth. (2)

SOLUTE, the substance that is dissolved in a liquid (solvent) to form a solution. (3)

SOLUTE, the substance that is dissolved in a liquid (solvent) to form a solution. (3)

SOMATIC, pertaining to or characteristic of the body (soma). (3)

SPERM, the male germ cell, which unites with an ovum in sexual reproduction to produce a new individual. (3)

SPERMATIC, pertaining to the spermatozoa or to semen. (3)

SPERMATOGENESIS, production of sperm in males. (2); the formation of mature spermatozoa. (1)

SPERMATOGENESIS, the formation of mature spermatozoa. (1)

SPERMATOZOON, (pl. spermatozoa) a mature male germ cell, the specific output of the testes, which impregnates the ovum in sexual reproduction. (3)

SPHINCTER, a muscle that surrounds a tube and closes or opens the tube by contracting and relaxing. (2)

SPINAL, pertaining to a spine or to the vertebral column. (3)

SPONTANEOUS ABORTION, abortion occurring naturally. (3)

STAPES, the innermost of the three ossicles of the ear; called also stirrup. (3)

STASIS, stoppage of the flow of blood, urine, or the contents of the intestines due to illness, or disease. (1)

STERNUM, the breast bone to which the ribs are attached at the outer edges. (2) the narrow, flat bone in the midline of the thorax; breastbone. (1)

STERNUM, the narrow, flat bone in the median line of the thorax; breastbone. (1)

STIMULI, plural of stimulus. (3)

STIMULUS, any agent, act, or influence that produces functional or trophic reaction in a receptor or an irritable tissue. (3)

STOMACH, organ that holds food until it is broken down enough to move into the duodenum. (4) the curved, muscular, saclike structure that is an enlargement of the alimentary canal between the esophagus and the small intestine; also called gaster. (3)

STRATIFIED SQUAMOUS EPITHELIUM, layers of flat scaly cells found lining various organs; for example, the lungs and blood vessels. (1, 2, 3) produced by basal cells. (2)

STRATUM CORNEUM, the outer horny layer of the epidermis, consisting of cells that are dead and shedding. (1, 3)

STROKE, a sudden and severe attack. (3) a sudden attack or affliction, such as apoplexy or paralysis. (1) (Cerebrovascular accident) occurs when a portion of the brain dies due to a lack of oxygen. (2)

STROKE-VOLUME, the quantity of blood ejected from a ventricle at each beat of the heart. (3)

SUB- word element under, less than. (3)

SUBCUTANEOUS, beneath the skin. (1)

SUBLINGUAL, situated beneath the tongue. (1)

SUBMANDIBULAR, below the mandible. (3)

SUBMUCOUS, situated beneath a mucous membrane. (3)

SUDORIFEROUS, conveying or producing sweat; secretion of perspiration. (1)

SUDORIPAROUS, conveying sweat; sudoriferous. (3)

SURFACTANT, a surface-active agent, such as soap or a synthetic detergent. In pulmonary physiology, a mixture of phospholipids secreted by the great alveolar cells into the alveoli and respiratory air passsages, which reduces the surface tension of pulmonary fluids and thus contributes to the elastic properties of pulmonary tissue. (3)

SWALLOWING, the taking in of a substance through the mouth and pharynx and into the esophagus. It is a combination of a voluntary act and a series of reflex actions. (3)

SYMPATHETIC NERVOUS SYSTEM, that part of the autonomic nervous system that generally caouses effects associated with emergency situations. (2)

SYN- word element, union; association. (3)

SYNAPSE, the junction between the processes of two neurons or between a neuron and an effector organ, where neural impulses are transmitted by chemical means. (3)

SYNOVIAL FLUID, the transparent viscid fluid secreted by the synovial membrane and found in joint cavities, bursae, and tendon sheaths. (2)

SYNOVIAL MEMBRANE, the inner of the two layers of the articular capsule of a synovial joint; composed of loose connective tissue and having a free smooth surface that lines the joint cavity; it secretes the synovia. (2)

SYNOVIAL, of, pertaining to, or secreting synovia. (3)

SYNTHESIS, the process which involves the formation of a complex substance from a simpler compound. (1)

SYSTOLE, contraction of the heart chambers, particularly the left ventricle. (2)

TACHYCARDIA, an abnormal rapid heart rate, usually between 160-190 beats per minute. (1)

TASTE BUD, organ containing the receptors associated with the sense of taste. (2)

TEAM NURSING, a group of professionals organized to do a task together, usually Registered Nurse, Licensed Practical Nurse, and Nurse Aid.

TELOGEN STAGE, the resting phase of the hair cycle; the hair becomes clubhair and does not grow further. (3)

TEMPORAL LOBE, area of the cerebrum responsible for hearing and smelling, the interpretation of sensory experience and memory. (2)

TEMPORAL, pertaining to the temple. (3)

TEMPOROMANDIBULAR, pertaining to the temporal bone and mandible. (3)

TENDON, a cord or band of strong white fibrous tissue that connects a muscle to a bone. (3)

TENSION, the act of stretching or the condition of being stretched or strained. (3)

TESTICLE, one of two oval-shaped glands of reproduction in the male; testis. (1)

TESTIS, pl. testes; the male gonad; either of the paired, egg-shaped glands normally situated in the scrotum; called also testicle. (3) the male gonads, the organs that produce sperm and testosterone. (2)

TESTOSTERONE, the most potent of the androgens. (2)

THALAMUS, a mass of gray matter located at the base of the cerebrum, it receives sensory information and selectively passes it to the cerebrum. (2)

THERMOREGULATION, heat regulation. (3)

THORAX, the part of the body between the neck and abdomen; the chest. It is separated from the abdomen by the diaphragm. The walls of the thorax are formed by the 12 pairs of ribs, attached to the sides of the spine and curving toward the front. The upper seven ribs are attached to the sternum, the next three connect with cartilage below and the last two (the floating ribs) are unattached in the front. The principal organs in the thoracic cavity are the heart with its major blood vessels, and the lungs with the bronchi, which bring in the body's air supply. The trachea enters the thorax to connect with the lungs, and the esophagus travels through it to connect with the stomach below the diaphragm. (3)

THROMBOCYTE, a blood platelet which aids in coagulation. (1)

THROMBOEMBOLISM, an embolism carried by the blood from the site of origin to block another vessel. (1)

THYMUS, a ductless glandlike body lying in the upper mediastinum beneath the sternum, which reaches its maximum development during puberty and continues to play an immunologic role throughout life, even through its function declines with age.(3) a lymphatic organ that lies in the neck and chest area and is absolutely necessary to the development of immunity. (2)

THYROID, resembling a shield. (3)

THYROID-STIMULATING HORMONE (TSH), hormone that causes the thyroid to produce thyroxin. (2)

THYROID-STIMULATING HORMONE RELEASING HORMONE (TRH), acts on the pituitary gland and brings about the release of thyroid-stimulating hormone. (3)

THYROXIN, the hormone produced by the thyroid that speeds up the metabolic rate. (2)

TIA see transient ischemic attack.

TIDAL VOLUME, the amcount of air moved in and out with each normal breath, usually about 500 ml. (2)

TISSUE, a group or layer of similarly specialized cells that together perform certain special functions. (3)

TOOTH, one of the small, bonelike structures of the jaws for the biting and mastication of food; the teeth also assist in shaping sounds and forming words in speech. (3)

TORTUOUS, full of many twists and turns. (1)

TOXIN, a poison, especially a protein or conjugated protein produced by certain animals, some higher plants, and pathogenic bacteria. (3)

TRABECULA, a small beam or supporting structure; used in anatomic nomenclature to designate various firbomuscular bands or cords providing support in various organs, as heart, penis, and spleen. (3)

TRACHEA, the winpipe; the membranous tube extending from the larynx to the bronchi. (1)

TRANSDUCER, a device that translates one physical quantity to another, for example pressure or temperature to an electrical signal. (3)

TRANSIENT ISCHEMIC ATTACK, (TIA); a sudden episode of temporary or passing symptoms typically due to diminished blood flow through the brain. (3)

TRANSUDATION, passage of serum or other body fluid through a membrane or tissue surface. (3)

TRICUSPID VALVE, the valve that guards the opening between the right atrium and right ventricle. (3)

TRICUSPID, having three cusps, as a tooth having three points or cusps; the tricuspid valve of the heart. (1)

TROPIC-,root element meaning turning toward; changing; tending to turn or change. (3)

TSH, see thyroid-stimulating hormone.

TUBULE, a small tube. (3)

TUMESCENCE, swell up; be swollen. (5)

TYMPANIC MEMBRANE, a thin, semitransparent membrane, nearly oval in shape, that stretches across the ear canal separating the tympanum (middle ear) from the external acoustic meatus (outter ear); also called the eardrum. (3) a membrane located between the external and middle ear; the eardrum. (2)

TYMPANIC, pertaining to the tympanum; bell-like resonant. (1; 3)

ULTRAFILTRATE, products of the ultrafiltration process.

ULTRAFILTRATION, filtration through a filter capable of removing colloidal particles from a dispersion medium, as in filtration of plasma at the capillary membrane. (3)

UNCONSCIOUS, insensible; incapable of responding to sensory stimuli and of having subjective experiences; the part of the mind that is not readily accessible to conscious awareness by ordinary means but whose existence may be manifested in symptom formation, in dreams, or under the influence of drugs. (3)

UPPER RESPIRATORY TRACT, includes the nasal cavity, pharynx and the larynx. (2)

UREA, the diamide of carbonic acid which is found in urine, blood, and lymph, and is the chief nitrogenous end-product of protein metabolism in the body. (1) primary nitrogenous human waste derived from amino acid breakdown. (2)

UREMIA, a toxic condition produced by excessive byproducts of protein metabolism in the blood, causing symptoms of nausea, vomiting, vertigo, convulsions, dimness of vision, and coma. (1)

URETER, tube from the kidney that takes urine to the bladder. (2)

URETHRA, tube that takes urine from the bladder to outside. (2)

URIC ACID, waste product of nucleotide breakdown. (2) a crystalline acid found in urine occurring as an end-product of purine metabolism. (1)

UTERINE PROLAPSE, downward displacement of the uterus so that the cervix is within the vaginal opening, the cervix is outside the opening, or the entire uterus is outside the opening. (3)

UTERINE, pertaining to the uterus. (3)

UTERUS, a thick-walled hollow, muscular organ about the size and shape of an inverted pear. (2)

UVULA, small tissue projection extending from the middle of the soft palate in the throat. (1)

VACUOLE, a clear space within the cell protoplasm filled with air or fluid. (1)

VACUUM, a space exhausted of its air or gaseous content. (1)

VAGINA, in the female a sheathlike canal that extends from the external genitalia to the cervix. (3) receives the male penis during copulation.

VALVULAR, pertaining to, affecting or of the nature of a valve. (3)

VARICOSE VEINS, swollen, distended, and knotted veins, usually in the subcutaneous tissues of the leg. (3)

VAS DEFERENS, the excretory duct of the testis, which unites with the excretory duct of the seminal vesicle to form the ejaculatory duct; also called ductus deferens. (3)

VEIN, a blood vessel that takes blood to the heart. (2)

VENAE CAVAE, pertaining to either of two large veins that empties into the right atrium of the heart. (1) two large veins, i.e., superior vena cava and inferior vena cava, that return deoxygenated blood to the right atrium of the heart. (2)

VENTILATION, breathing; the process of moving air into and out of the lungs. (2)

VENTRICLE, a cavity in an organ such as the ventricles of the heart or the ventricles of the brain. (2)

VENULE, type of blood vessel that takes blood from capillaries to veins. (2)

VERTEBRAL COLUMN. the backbone of vertebrates through which the spinal cord passes. (2)

VERTEBRAL, pertaining to a vertebra or the vertebrae; spinal column. (1)

VESICLE, a small bladder or sac containing liquid; a small blister. (3)

VESTIBULE, a space or cavity at the entrance to another structure. (3)

VILLI, fingerlike projections that line the small intestine and function in absorption. (2)

VIRUS, any member of a unique class of infectious agents, which were originally distinguished by their smallness. (3)

VISCERA, the interior organs within the cavities of the body, especially the abdomin and the thorax. (5)

VISCOUS, sticky or gummy, having a high degree of viscosity. (3)

VITAL CAPACITY, the total volume of air that can be moved in and out during a single deep breath. usually about 3,100 ml of air about the tidal volume. (2)

VITREOUS BODY, transparent jelly-like mass that fills the vitreous chamber; vitreous humor. (1)

VITREOUS HUMOR, the substance that occupies the space between the lens and retina of the eye. (2)

VOLUNTARY, accomplished in accordance with the will. (3)

XANTHOMA, a papule, nodule, or plaque in the skin due to lipid deposits usually yellow, but may be brown, reddish, or cream in color, range in size from tiny pinheads to large nodules, shape may be round, flat, or irregular. often found around the eyes, joints, neck, on the palms or over tendons. Can be found throughout the body in bones, heart, blood vessels, liver, and other organs. may indicate underlying disease. (3)

XEROSIS, abnormal dryness. (3)

XEROSTOMIA, dryness of the mouth from salivary gland dysfunction. (3) is often a side effect of medication.

1. Bolander, Alyce and Donald O. Bolander. The New Webster's Medical Dictionary. The Lewtan Corporation. Hartford, Connecticut. 1992.

2. Mader, Sylvia S., Human Biology. 3rd ed. Wm. C. Brown, Dubuque, Iowa. 1992.

3. Miller, Benjamin Frank, Claire Brackman Keane. Encyclopedia & Dictionary of Medicine, Nursing, & Allied Health. 5th ed. Saunders, Philadelphia, Pennsylvania. 1992.

4. Badasch, Shirley A., Doreen Chesebro. Essentials for the Nursing Assistant in Long-Term Care. Delmar, New York. 1990.

5. Morris, William, Editor. The American Heritage Dictionary of the English Language. Houghton Mifflin. Boston. 1979.

BIBLIOGRAPHY

Badasch, Shirley A., and Doreen Cheseboro. Essentials for the Nursing Assistant in Long-Term Care. Delmar, Albany, New York (1990).

Blumenthal, J. A., C. F. Emery, D. J. Madden, R. E. Coleman, M. W. Riddle, S. Schniebolk, F. R. Cobb, M. J. Sullivan, M. B. Higginbotham. "Effects of Exercise Training on Cardiorespiratory Function in Men and Women Older Than 60 Years of Age". American Journal of Cardiology. 67.7 (1991) March 15. 633-9.

Blunt, Roy D. Secretary of State. "Title 13 Department of Social Services, Division 15 Division of Aging, Chapter 13 Training Program for Nursing Assistants". Code of State Regulations. 13 CSR 15-13 (1993): 3.

Bolander, Alyce, and Donald O. Bolander. ed. The New Webster's Medical Dictionary. Lewtan Line, Hartford, Connecticut. (1992).

Burke, Mary M., Mary B. Walsh. Gerontologic Nursing: Care of the Frail Elderly. Mosby Year Book. St. Louis. (1992).

Cerimele, D., L. Celleno and F. Serri. "Physiological Changes in Aging Skin". British Journal of Dermatology. 122.35 (1990): 13-20.

Christ, Mary Ann and Faith J. Hohloch. Gerontologic Nursing. 2nd ed. Springhouse, Pennsylvania. 1993.

Corcoran, Paul J., "Use It or Lose It-The Hazards of Bed Rest and Inactivity" Rehabilitation Medicine-Adding Life to Years. Special Issue. The Western Journal of Medicine. 154 (1991): 536-8.

Corr, Donna M., and Charles A. Corr. Nursing Care in an Aging Society. Springer, New York. (1990).

Felicetta, J. V., "Age-Related Changes in Calcium Metabolism. Why They Occur and What Can Be Done." Postgraduate Medicine. 85.4 (1989): March 85+.

Genesis Health Ventures. Geriatric Nursing Assistant Specialist Program.

Heine, Christine A. "Burnout Among Nursing Home Personnel". Journal of Gerontological Nursing. 12.3 (1986): 14-8.

Jeffcoat, Marjorie K., and Charles H. Chesnut III. "Systemic Osteoporosis and Oral Bone Loss: Evidence Shows Increased Risk Factors." Journal of the American Dental Association. 124 (1993): 49-56.

Jette, Alan M., Henry A. Feldman, and Chester Douglass. "Oral Disease and Physical Disability in Community-Dwelling Older Persons". The American Geriatrics Society. 41.10 (1993): 1102-1108.

Kamen, Paul R., "Dentistry's Challenge for the Future: Periodontal Disease in the Older Patient". Focus on Adult Oral Health. 1.3 (1993): December 1-7.

Kolodny, Robert C., William H. Masters, Virginia E. Johnson, and Mae A. Biggs. Textbook of Human Sexuality for Nurses. Little, Brown and Company, Boston. (1979). [*]

Kurban, Ramsay S., and Amal K. Kurban. "Common Skin Disorders of Aging: Diagnosis and Treatment". Geriatrics. 48.4 (1993): April 30-42.

Lapiere, C. M. "The Aging Dermis; The Main Cause for the Appearance of 'Old' Skin". British Journal of Dermatology. 122.35 (1990): 5-11.

Lewis, Carole B. Improving Movilityin Older Persons: A Manual for Geriatric Specialists. Aspen. Rockville, Maryland (1989).

Light, Kathye E., "Information Processing for Motor Performance in Aging Adults". Physical Therapy. 70:12 (1990): December 820-26.

Locker, David., and Gary Slade. "Oral Health and the Quality of Life Among Older Adults: The Oral Health Impact Profile." Scientific Journal. 59.10 (1993): October 830-833.

Mader, Sylvia S. Human Biology. 3rd ed. Wm. C. Brown Publishers: Dubuque, Iowa. 1992.

Masters, William H., Virginia E. Johnson, and Robert C. Kolodny. Heterosexuality. HarperCollins, New York. (1994).

Medcom Trainex "The Natural Process of Aging" Gerontology M120. Medcom/Trainex Garden Grove, California (1993).

Messenger, Andrew G., "The Control of Hair Growth: An Overview" The Journal of Investigative Dermatology. 101.1 (1993): Supplement July 4S-9S.

Miller, Benjamin Frank, and Claire Brackman Keane. Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health. 5th ed. Saunders: Philadelphia, 1992.

[*] 1979 was the last year this book was published.

Montagna W., and K. Carlisle. "Structural Changes in Aging Skin". British Journal of Dermatology. 122.35 (1990): 61-70.

Morley, John E., from a talk at the Fifth Annual Saint Louis University Symposium for Medical Directors in Nursing Homes. December 1993.

Morris, William, ed. The American Heritage Dictionary of the English Language. Houghton Mifflin. Boston. 1979.

Murphy, Claire. "Nutrition and Chemosensory Perception in the Elderly". Critical Reviews in Food Science and Nutrition. 33.1 (1993): 3-15.

Ortonne, Jean-Paul. "Pigmentary Changes of the Ageing Skin". British Journal of Dermatology. 122.35 (1990): 21-8.

Perlmutter, Marion, and Elizabeth Hall. Adult Development and Aging. Second Edition. Wiley &Sons. New York 1992.

Raab, W. P. "The Skin Surface and Stratum Corneum". British Journal of Dermatology. 122.35 (1990): 37-41.

Roach, K. E., and T. P. Miles. "Normal Hip and Knee Active Range of Motion: The Relationship to Age". Physical Therapy. 71.9 (1991): September 656-65.

Scherff, Lisa A. "A Guide for the Nondentist in Assessing Oral Health in Skilled Nursing Facilities". Nursing Home Medicine. 1.2 (1993) May/June 36+.

Ship, Johathan A., and James M. Weiffenbach. "Age, Gender, Medical Treatment and Medication Effects on Smell Identification". Journal of Gerontology: Medical Sciences. 48.1 (1993): M26-M32.

Silverberg, Nancy and Larry Silverberg. "Aging and the Skin". Postgraduate Medicine. 86.1 (1989): July 131-44.

Sorrentino, Sheila A. Mosby's Testbook for Nursing Assistants. Mosby Year Book: St. Louis. 1992.

Swope Ridge Geriatric Center Enhancing Quality Of Life for Home Residents Through a Comprehensive Staff Development, Employee Assistence, and Career Ladder Program.

Verbeken, E. K., M. Cauberghs, I. Mertens, J. Clement, J. M. Lauweryns, K. P. Van de Woestiine. "The Senile Lung. Comparison with Normal and Emphysematous Lungs. 2. Functional Aspects." Chest. 101.3 (1992) March 800-9.

Wasman, Howard M., Erwin A. Carner and Gale Berkenstock. "Job Turnover and Job Satisfaction Among Nursing Home Aides". The Gerontologist. 24.5 (1984): 503-9.

Weiffenbach, James M., and Linda M. Bartoshuk. "Taste and Smell". Clinics in Geriatric Medicine. 8.3 (1992) 543-55.

Woodruff, Diana S., and James E. Birren. Aging: Scientific Perspectives and Social Issues. 2nd ed. Brooks/Cole. Monterey, California. (1983).

Woodward, Katherine L., "The Relationship Between Skin Compliance, Age, Gender, and Tactile Discriminative Thresholds in Humans". Somatosensory and Motor Research. 10.1 (1993): 63-7.