Body Organization

LEARNING OBJECTIVES
- Identify the meaning of 10 or more terms relating to the organization of the body.
- Describe the properties of life.
- Label the structures of the cell, and describe the function of each.
- Describe the organization of the body from the smallest unit to the largest.
- Describe organs of the body in relation to the plane, region, or cavity of location.
- Describe five or more disorders resulting from variations or defects in cell organization.

KEY TERMS
- Autosomal (AW-toe-zome) Any chromosome except the X or Y
- Benign (bi-NINE) Self-limiting, not malignant
- Condition (kon-DISH-un) Change from normal function that cannot be cured
- Congenital (kon-JEN-i-tal) Referring to conditions that exist at birth regardless of cause
- Disease (di-ZEEZ) Interruption of normal function of the body, usually caused by microorganisms; can be treated
- Dominant (DOM-i-nant) Gene trait that appears when carried by only one in the pair of chromosomes
- Electrolyte (e-LEK-tra-lite) Substance that separates into ions in solution and is capable of conducting electricity
- Genotype (JEE-o-teen-o-tipe) Genetic pattern of an individual
- Heredity (he-RED-i-tee) Genetic transmission of trait or particular quality from parent to offspring
- Homeostasis (ho-me-o-STAY-asis) Tendency of an organism to maintain the "status quo" or the same internal environment
- Malignant (muh-LIG-nuh-nt) Characterized by uncontrolled growth, invasive, tending to produce death
- Mutation (myoo-TAY-shun) Permanent change in a gene or chromosome
KEY TERMS

Organism (OR-gah-nizm) Individual living thing, plant, or animal

Phenotype (FEE-no-type) Physical, biochemical, and physiological configuration of an individual determined by genes

Recessive (re-SESS-iv) Gene trait that does not appear unless carried by both members of a pair of chromosomes

Syndrome (SYN-drome) Set of symptoms that occur together

Body Organization Terminology*

Thalidomide was a sleeping pill prescribed in the 1950s that caused more than 3,000 children to be born with congenital birth defects. (Photograph courtesy of Dr. Clay Hildreth Vanston, in Demjanov T. Pathology for the Health Professions, ed 3, St. Louis, 2005, Saunders.)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Prefix</th>
<th>Root</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abduct</td>
<td>Draw away from the center</td>
<td>ab</td>
<td>duct</td>
<td></td>
</tr>
<tr>
<td>Adduct</td>
<td>Draw toward the center</td>
<td>ad</td>
<td>duct</td>
<td></td>
</tr>
<tr>
<td>Congenital</td>
<td>Born with</td>
<td>con</td>
<td>gen/it</td>
<td>al</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>Treatment by a chemical agent</td>
<td>chem/o</td>
<td>therapy</td>
<td></td>
</tr>
<tr>
<td>Cytoplasm</td>
<td>Nonorganelle material contained in cells</td>
<td>cyto/l</td>
<td>plasm</td>
<td></td>
</tr>
<tr>
<td>Dysfunction</td>
<td>Impairment of function</td>
<td>dys</td>
<td>function</td>
<td></td>
</tr>
<tr>
<td>Genetic</td>
<td>Pertaining to genes</td>
<td>gen/et</td>
<td>ic</td>
<td></td>
</tr>
<tr>
<td>Genotype</td>
<td>Genetic makeup of an organism</td>
<td>gen/o</td>
<td>type</td>
<td></td>
</tr>
<tr>
<td>Physiology</td>
<td>Study of function</td>
<td>physi</td>
<td>ology</td>
<td></td>
</tr>
<tr>
<td>Semipermeable</td>
<td>Allowing only some materials to enter and exit</td>
<td>semi</td>
<td>permeable</td>
<td></td>
</tr>
</tbody>
</table>

* A short transition syllable or vowel may be added to or deleted from the word parts to make the combining form.

Abbreviations of Body Organization

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;P</td>
<td>Anatomy and physiology</td>
</tr>
<tr>
<td>ant</td>
<td>Anterior</td>
</tr>
<tr>
<td>Ca²⁺</td>
<td>Calcium ion</td>
</tr>
<tr>
<td>CF</td>
<td>Chlorine ion</td>
</tr>
<tr>
<td>CVS</td>
<td>Chorionic villus sampling</td>
</tr>
<tr>
<td>DNA</td>
<td>Deoxyribonucleic acid</td>
</tr>
<tr>
<td>LUQ</td>
<td>Left upper quadrant</td>
</tr>
<tr>
<td>Na⁺</td>
<td>Sodium ion</td>
</tr>
<tr>
<td>Post</td>
<td>Posterior</td>
</tr>
<tr>
<td>RLQ</td>
<td>Right lower quadrant</td>
</tr>
</tbody>
</table>

Anatomy and Physiology

The human body, like all living organisms, has four basic properties of life:

- **Reception** is the ability of the organism to control its actions and respond to changes in the environment.
- **Metabolism** is the process of taking in and using nutrients to produce energy and growth.
- **Reproduction** is the ability to reproduce offspring to continue the species.
- **Organization** divides the organism into distinct parts to perform these functions.

The two major types of study of the human body are called anatomy and physiology. Anatomy is the study of body structures and their location. Body structures are organized on five levels:

- Cells are the smallest unit of life.
- Tissues are combinations of similar cells.
- Organs are collections of tissues working together to perform a function.
- Body systems consist of organs that work together to provide a major body function.
- Organisms are the beings that result when the body systems work together to maintain life.

**BRAIN BYTE**

The median age of all Americans in 2000 was 35.3 years of age. The number of Americans 65 and older was 35 million, or one in eight.

**Cell Structure**

The major structures, called organelles, of the cell are shown in Fig. 9-1. These structures include:

- The nucleus controls the activity of the cell and directs reproduction.
- The cytoplasm is a semifluid material that surrounds the cell parts and transports chemicals and nutrients within the cell.
- Mitochondria produce the energy used for cellular processes.
- The cell membrane surrounds the cell and controls which substances enter and leave the cell.
- Lysosomes help to break down, or digest, molecules.
- Ribosomes attached to the rough endoplasmic reticulum work to make protein for the cell structures.

**FIGURE 9-1** The structures of the cell. (From Patton KT, Thibodeau GA. Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)
The Golgi apparatus helps to transport proteins made by the ribosomes out of the cell by making glycoproteins.

The smooth endoplasmic reticulum makes fats (lipids), steroid hormones, and some carbohydrates.

Homeostasis is the tendency of a cell or the whole organism to maintain a state of balance. Homeostasis generally refers to maintaining constancy of the "internal milieu," or fluid surrounding the cells of the organisms. The composition of the tissue fluid that makes up this internal environment is kept constant despite changes in the external environment. Molecules pass into and out of the cell to maintain this balance. Some of the physiologic components of this state of balance include body temperature, gas exchange, pH values, water and ion balance, volume and pressure of fluids, waste removal, and nutrient intake (Table 9-1).

Electrolytes are compounds made of charged particles called ions. These ions can conduct electrical current in water or in the cytoplasm of the cell. A positive charge, or cation, creates an acid. A negative charge, or anion, creates a base. The pH of a fluid is a measurement of how much acid or base is present. Each body tissue has a normal pH. The cells do not function properly if the normal pH is not maintained for the area of the body (Fig. 9-2). Different electrolytes also have specific functions, as shown in Table 9-2.

**Tissue Types**

The body includes four main groups of tissue (Fig. 9-3).

- Epithelial tissue covers the body, forms glands, and lines the surfaces of cavities and organs.
- Connective tissue, formed by a protein, includes soft tissue such as fat and blood cells and hard tissues such as bones, ligaments, and cartilage.
- Muscle tissue, made of protein fibers, has the unique property of shortening in length to produce movement.
- Nervous tissue, composed largely of specialized cells called neurons, is found in the eyes, ears, brain, spinal cord, and peripheral nerves. Nervous tissue transmits communications.

**Body Systems**

The study of the functions of the body is called physiology. Functions are studied according to body systems. A body system is a group of related organs that together accomplish functions necessary to maintain and support life. The 12 body systems are as follows:

- The integumentary system covers the body and protects other body systems.
- The cardiovascular system transports oxygen and nutrients to all body parts and removes waste products.
- The circulatory system includes the blood and lymph that move throughout the body.
- The respiratory system exchanges gases between the air and blood.
- The muscular system allows the body to move and controls movements within the body.
- The skeletal system provides body support and protection.
- The digestive system processes food and eliminates food waste.
- The urinary system filters the blood and removes liquid wastes.

<table>
<thead>
<tr>
<th>TABLE 9-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Homeostasis and Body Systems</strong></td>
</tr>
<tr>
<td><strong>Body System</strong></td>
</tr>
<tr>
<td>Integumentary</td>
</tr>
<tr>
<td>Cardiovascular</td>
</tr>
<tr>
<td>Circulatory</td>
</tr>
<tr>
<td>Respiratory</td>
</tr>
<tr>
<td>Skeletal</td>
</tr>
<tr>
<td>Muscular</td>
</tr>
<tr>
<td>Urinary</td>
</tr>
<tr>
<td>Endocrine</td>
</tr>
<tr>
<td>Nervous</td>
</tr>
<tr>
<td>Sensory</td>
</tr>
<tr>
<td>Reproductive</td>
</tr>
</tbody>
</table>

FIGURE 9-2 The body's pH. The body must maintain normal pH levels to function properly.

TABLE 9-2
Electrolytes of the Body

<table>
<thead>
<tr>
<th>Ion</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cations ((^+))</td>
<td></td>
</tr>
<tr>
<td>Sodium (Na(^+))</td>
<td>Controls water distribution by increasing the ability of fluid to pass through the cell membrane</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>Maintains fluid balance, promotes growth of cells, nerve conduction, muscle contraction, and heart activity</td>
</tr>
<tr>
<td>Calcium (Ca(^{2+}))</td>
<td>Controls neuromuscular irritability, muscle contraction, and blood clotting; used to build bones and teeth</td>
</tr>
<tr>
<td>Magnesium (Mg(^{2+}))</td>
<td>Maintains neuromuscular system, activates enzymes, regulates level of phosphorus</td>
</tr>
<tr>
<td>Hydrogen (H(^+))</td>
<td>Needed for cell and enzyme functions, binding of oxygen to hemoglobin</td>
</tr>
<tr>
<td>Anions ((^-))</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate (HCO(_3^-))</td>
<td>Maintains acid-base balance</td>
</tr>
<tr>
<td>Hydrogen Sulfate (HPO(_4^{2-}))</td>
<td>Maintains fluid and acid-base balance</td>
</tr>
<tr>
<td>Chloride (Cl(^-))</td>
<td>Maintains fluid balance</td>
</tr>
<tr>
<td>Sulfate (SO(_4^{2-}))</td>
<td>Maintains fluid balance</td>
</tr>
</tbody>
</table>

- The endocrine system coordinates body activities through hormones.
- The nervous system regulates the environment and directs the activities of other body systems.
- The sensory system perceives the environment and sends messages to and from the brain.
- The reproductive system provides for human reproduction.

The following 12 chapters discuss the body systems in more detail.

**Describing the Body**

The anatomical position is the standard position of the body used to describe the location of its anatomy. The person is in an erect standing position with mouth closed and eyes and head facing forward. The feet are slightly apart with the toes facing forward. The arms are close to the body, and the palms are facing forward with the fingers extended (Fig. 9-4). From this position, the parts of body may be described in relation to each other.

**Body Planes**

Structures of the body can be located and described in relation to planes that divide the body (Fig. 9-5). Three planes are used to describe the body:

- The coronal or frontal plane separates the front and back of the body.
- The transverse plane divides the upper and lower body.
- The sagittal plane divides the body into right and left sides.

The location of organs is described in relation to these planes. For example, an organ or growth may be below (inferior) or above (superior) the transverse plane. It may be close to (medial) or away from (lateral) the sagittal plane. It may be in front of (anterior or ventral) or behind (posterior or dorsal) the coronal plane. Other terms for location include close to (proximal) or away from (distal) a point where one organ attaches to another.

**Body Cavities**

The human body has five cavities (Fig. 9-6):

- The thoracic cavity contains the lungs, heart, esophagus, trachea, and major blood vessels.
- The abdominal cavity contains the stomach, gallbladder, pancreas, intestines, liver, spleen, adrenal glands, and kidneys.
- The pelvic cavity contains the reproductive organs, bladder, and rectum.
- The cranial cavity contains the brain, ventricles, and some glands.
- The spinal cavity houses the spinal cord and nerves.
Cell Function

Cell Reproduction

Mitosis is the process by which a cell divides to reproduce, creating an identical copy with the same chromosomes. Each cell of an organism carries all of the genetic information of the organism. Humans have 46 chromosomes in each cell except the gametes (sperm and egg). With the exception of the sex chromosomes (X and Y), all of the chromosomes are paired and called homologous chromosomes.

In the process of meiosis, the cell divides into two parts, each with only one half of the chromosomes. Meiotic cell division is part of the reproduction process and results in the formation of sex cells (gametes). The combination of two gametes with chromosomes from different parents into one cell is called fertilization. The offspring inherits any abnormal gene found on the chromosome of either parent. Fig. 9-9 compares the processes of mitosis and meiosis.

Heredity

Heredity is the passing on of genetic information that determines the characteristics of an individual person. The arrangement of genetic material determines many characteristics, such as blood type, physical appearance, and gender. The hereditary information in the cell is found in the genes.

Genes are made up of chains of a molecule called deoxyribonucleic acid (DNA). The human genetic or DNA sequence (genome) has been completely "mapped" or identified, but the function of all of the genes has not yet been determined. There are almost three billion base pairs of DNA in the human genome on 46 chromosomes. Chromosomes are threadlike strands of DNA. The human genome or DNA sequence contains between 30,000 and 40,000 protein-coding genes that determine the person’s general human and individual traits. A microscopic
photograph (karyotype) of the 46 chromosomes in the cell shows the chromosome composition (Fig. 9-10).

The configuration of genetic information in the chromosome is called the genotype. The trait or appearance that results from the genotype is called the phenotype. The characteristic of a dominant gene appears even when only one gene is inherited. Traits caused by recessive genes appear only when the gene is inherited from both parents and is present on both paired chromosomes. When two genes are alike on the chromosome pair, the combination is called homozygous. When they differ, they are called heterozygous.

The genetic information carried by the chromosomes is responsible for the development of all body cells and the formation of tissues, organs, and body systems. Chapter 35 provides more information regarding biotechnology, the study of genetic manipulation.

TABLE 9-3
Causes of Genetic Disorders

<table>
<thead>
<tr>
<th>Variation</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single gene disorder</td>
<td>Mutation in a single gene (on one or both paired chromosomes)</td>
<td>Sickle cell anemia, cystic fibrosis, Tay-Sachs disease</td>
</tr>
<tr>
<td>Chromosomal disorder</td>
<td>Structural changes in chromosomes or excess/deficiency in number of genes</td>
<td>Down syndrome, Patau syndrome, Klinefelter syndrome</td>
</tr>
<tr>
<td>Multifactorial inheritance or polygenic disorder</td>
<td>Combination of genetic and environmental factors</td>
<td>Heart disease, breast cancer, diabetes, Alzheimer disease</td>
</tr>
</tbody>
</table>

**TABLE 9-3**

**CASE STUDY 9-2** A husband and wife ask you what the chances would be that they might have a child with cystic fibrosis. They each have a sibling with the disorder, so they know it runs in their family. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerdin

**CASE STUDY 9-3** A friend tells you that she is not going to have children because she does not want to have a baby with Down syndrome. She tells you she knows that Down syndrome runs in her family because she has a cousin with it. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerdin

Genetic Disorders

Abnormal genes or chromosomes cause many disorders, which are therefore called inherited, hereditary, or genetic disorders. Abnormalities may result when there is a mutation of one or more genes (Table 9-3). Researchers have identified more than 4000 disorders caused by gene variation. Not all people with the gene variant will develop the disorder. Most genetic disorders are multifactorial or caused by more than one factor or a combination of gene variations and environmental influences.

The National Center for Biotechnology Information has summarized more than 80 genetic disorders.

The terms **congenital** and **condition** are used to describe these disorders as opposed to the terms **contagious** and **disease**. An organism such as a virus or bacteria causes contagious diseases. Some genetic disorders affect only one body part or system, but others cause defects or symptoms in two or more body systems. When symptoms of a genetic disorder appear, the condition may be called a **syndrome**.

Common genetic disorders are included in the following body system chapters, according to the system primarily affected. The following are some of the most common genetic disorders:

- Cleft lip or palate (Chapter 10)
- Clubfoot (Chapter 14)
- Cystic fibrosis (Chapter 13)
- Down syndrome (Chapter 19)
- Huntington disease (Chapter 19)
- Klinefelter syndrome (Chapter 21)
- Neural tube defect (Chapter 19)
- Neurofibromatosis (Chapter 19)
- Phenylketonuria (Chapter 16)
- Sickle cell anemia (Chapter 12)
- Spina bifida (Chapter 19)
- Tay-Sachs disease (Chapter 16)
- Thalassemia (Chapter 12)

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**Cancer**

Cancer is the uncontrolled growth of abnormal cells that tend to spread (metastasize) and invade the tissue around them. Cancer is classified into five groups.

Carcinomas have cells that cover internal and external parts of the body. Leukemia is found in the blood but starts in the bone marrow. Sarcomas are found in connective tissue like bones, muscle, fat, and cartilage. Lymphomas start in lymph nodes and immune system tissues. Adenomas affect the thyroid, pituitary gland, adrenal gland, and other glandular tissues.

A new growth of cells or neoplasm may be benign or malignant. Malignant growths spread and destroy body tissue. Benign growths are usually not cancerous and do not spread. Cancer cells are able to grow rapidly because they create their own blood vessels to take the oxygen and nutrients from the body. Common sites for development of cancer include the lungs, breast, colon, uterus, oral cavity, and bone marrow. Many malignancies are curable if detected early. Warning signs of cancer vary with the area affected (Box 9-1).

Although the specific cause of cancer is not known, it results from a mistake or mutation in one single cell's division (Box 9-2). Cancer cells have properties similar to embryonic cells during fetal division. The DNA message that directs embryo cells to divide rapidly is chemically repressed when the fetal development is complete. In cancer this uncontrolled cell division begins again. It is theorized that this change is brought on by exposure to something that induces or starts it (carcinogen). More than 80% of the cancer cases are related to smoking or exposure to chemicals, radiation, and ultraviolet light such as the sun. Some
reactive oxygen may be a cause rather than a by-product of cancer.

BOX 9.2
Factors Associated with Cancer
- Age
- Bacterial infection
- Carcinogens
- Diet
- Environmental factors
- Genetic mutations
- Immune system problems
- Physical activity
- Viruses
- Weight

BOX 9.3
Inherited Cancers
- Breast
- Colonctal
- Cowden syndrome
- Melanoma
- Ovarian
- Prostate
- Retinoblastoma
- Von-Hippel-Lindau disease
- Wilms tumor
- Xeroderma pigmentosum

*Inheriting a gene mutation does not necessarily mean that the person will develop cancer in all types listed.

Issues and Innovations

Genetic Engineering
At least 4,000 disorders are known to result from single gene abnormalities. Research now shows that other disorders with no known cause, including some forms of retardation and cancer (Table 9.4), may also be genetically linked. Chromosomes also can be damaged by drugs, radiation, toxins, viruses, and other environmental agents. In all, approximately 1 of every 150 to 200 births involves a serious chromosomal defect.

Using advanced techniques, new procedures can now identify abnormal genes in the unborn fetus. Chromosomal microarray analysis (CMA) is a method of examining the chromosomes using a small sample of placental tissue at about the seventh to eighth week of pregnancy. Amniocentesis, a procedure that examines the fluid that surrounds the fetus in the uterus, can detect genetic defects in the 16th or 17th week of pregnancy. More than 200 disorders can be identified by amniocentesis. Some researchers are developing techniques to identify fetal disorders by using maternal blood samples that contain fetal cells. These fetal cells are present in the mother's blood after they have leaked through the placenta.

New approaches to cancer treatment resulting from this research may include agents that block the enzymes or that destroy the reactive oxygen in cancer cells. The body fights cancer by forming antibodies against the abnormal cells. It is believed that small groups of cancer cells develop in the body continually without detection. These "silent cancers" are successfully removed by the body's immune processes.

TABLE 9.4
Mapped Genetic Disorders
<table>
<thead>
<tr>
<th>Gene</th>
<th>Chromosome</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD3</td>
<td>X</td>
<td>Alzheimer disease, type 3</td>
</tr>
<tr>
<td>AD4</td>
<td>1</td>
<td>Alzheimer disease, type 4</td>
</tr>
<tr>
<td>SOD1</td>
<td>21</td>
<td>Amyotrophic lateral sclerosis</td>
</tr>
<tr>
<td>APOE</td>
<td>19</td>
<td>Apolipoprotein E</td>
</tr>
<tr>
<td>BRCA1</td>
<td>17</td>
<td>Breast cancer, type 1</td>
</tr>
<tr>
<td>BRCA2</td>
<td>13</td>
<td>Breast cancer, type 2</td>
</tr>
<tr>
<td>CFTR</td>
<td>7</td>
<td>Cystic fibrosis</td>
</tr>
<tr>
<td>DMD</td>
<td>X</td>
<td>Duchenne muscular dystrophy</td>
</tr>
<tr>
<td>HD</td>
<td>4</td>
<td>Huntington disease</td>
</tr>
<tr>
<td>IDDM1</td>
<td>6</td>
<td>Type 1 diabetes</td>
</tr>
<tr>
<td>CDKN2A</td>
<td>13</td>
<td>Malignant melanoma</td>
</tr>
<tr>
<td>NF1</td>
<td>22</td>
<td>Neurofibromatosis</td>
</tr>
<tr>
<td>OBI</td>
<td>7</td>
<td>Obesity</td>
</tr>
<tr>
<td>PTH</td>
<td>12</td>
<td>Phenytoin</td>
</tr>
<tr>
<td>DPC1</td>
<td>18</td>
<td>Suppressor of pancreatic cancer</td>
</tr>
<tr>
<td>FMR1</td>
<td>X</td>
<td>S-linked mental retardation</td>
</tr>
</tbody>
</table>

*In some cases the presence of the gene for a disorder does not guarantee that it will occur.

Preimplantation diagnosis combines the biotechnology of in vitro fertilization and genetic testing. In this procedure, embryos are created outside of the body in Petri dishes. A single cell sample is taken from the embryo when it has grown to eight cells in a process called embryo biopsy. The single cell is then examined for genetic defects. Only the embryos that are free from genetic error are then implanted.

Research teams are now investigating the possibility of correcting defective genes in humans. Gene splicing, the transplanting of genes, has been conducted successfully in "test-tube" animal embryos. Procedures are also being developed to implant a normal gene in a defective one by using a retrovirus to carry the normal gene into the cells of the affected individual after birth.

Genetic screening of potential parents can help determine the risk of a genetic disorder occurring. About 900 tests are available to find genetic disorders. Special counseling provides parents with information about their options before and after conception if a defect is expected or found. The couple's family medical and genetic histories are charted to determine the potential for chromosomal defects. All states test infants for phenylketonuria and congenital hypothyroidism.

Ethical decisions resulting from increased knowledge about genetics are a growing concern of health care workers now and in the future. Hospitals have ethics committees to decide what type of care should be given to infants born with genetic defects. Genetic research has raised ethical questions never before faced. Emergent techniques of genetic engineering will create new challenges and new ethical decisions. Chapter 35 provides more information regarding genetic engineering and biotechnology.

Cancer Treatments
Using the theory that the body's immune system can treat cancer, scientists are developing cancer vaccines. The Food and Drug Administration (FDA) has approved two types of cancer-prevention vaccines. These are vaccines against the hepatitis B and human papillomavirus types 16 and 18. The FDA has not approved any cancer treatment vaccine.

Immunotherapy involves using chemicals that are isolated from bacteria infected with the cancer, killed suspensions of bacteria, and some biological substances that harm tumors (Box 9.4). The biological substances include interferon, interleukin, tumor necrosis factors, and growth factors. Other scientists are researching the possibility of replacing the genetic message of cancerous cells that causes the rapid cell division to occur.

In some cases lasers are used to destroy cancerous cells. Fiberoptic technology, called photodynamic therapy, is used to place a destructive wavelength of light directly into the tumor. Hyperthermia, or an increase in temperature, is being used in combination with radiation to treat some tumors. The cells of the tumor can be raised to temperatures high enough to kill them without killing the surrounding body cells.
Summary

- The properties of life are reception, metabolism, reproduction, and organization.
- The structures of the cell include the nucleus, cytoplasm, and cell membrane.
- The organization of the body consists of cells that, when combined, make tissues. Tissues combine to make organs. Organs combine to make a body system. The combined body systems make an organism.
- The brain is located superior to the heart, which is anterior to the spinal cord.
- Five disorders resulting from defects in cell organization are cleft lip, clubfoot, cystic fibrosis, Down syndrome, and Huntington disease.

Critical Thinking

1. Investigate and compare the cost of at least three tests used to diagnose disorders relating to body organization.
2. Investigate at least five common medications used in treatment of body organization disorders.
3. List at least five health care occupations involved in the care of disorders of the body organization.
4. Investigate advanced techniques used in genetic engineering.
5. Investigate and write an essay about one type of cancer, its cause, signs and symptoms, and treatment.
6. Use the Internet to investigate and give an example of each of the following types of genetic disorders: point mutation, gene deletion, chromosomal aberration (missing or extra), trinucleotide repeat disorder.
7. Research and write a paragraph describing the origin of the name (epithet) of one genetic disorder.

Review Questions

1. Describe four properties of living organisms.
2. List the four units of organization of the body from the smallest to the largest.
3. Describe the structure and location of the four types of tissue of the body.
4. Complete the following phrases using directional terms to describe the location of each body part.
   - List the plane that is used to section the location.
   - The eyes are located _________ to the nose.
     Plane: _________
   - The head is located _________ to the neck.
     Plane: _________
   - The spine is located _________ to the sternum.
     Plane: _________
   - The stomach is located _________ to the heart.
     Plane: _________
   - The fingers are located _________ to the hand.
     Plane: _________
5. List one body organ or structure located in each of the following sections of the body:
   - right upper quadrant
   - epigastric region
   - thoracic cavity
   - spinal cavity
   - left upper quadrant
   - abdominal cavity
   - hypogastric region
   - right inguinal region
   - umbilical region
   - left lumbar region
6. Differentiate between the genotype and phenotype of an individual.
7. Identify three tests used to detect genetic abnormalities of a fetus.
8. Describe two areas of research dealing with correcting genetic defects.
9. Use the following terms in one or more sentences that correctly relate their meaning: autosome, dominant, genotype, phenotype, recessive.

STANDARDS AND ACCOUNTABILITY*

Foundation Standard 1: Academic Foundation
Health care professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in a health science program of study.

Accountability Criteria

1.1 Human Structure and Function
1.1.1 Classify the basic structural and functional organization of the human body (tissue, organ, and system).
1.1.2 Recognize body planes, directional terms, quadrants, and cavities.
1.1.3 Analyze the basic structure and function of the human body.

1.2 Diseases and Disorders
1.2.1 Describe common diseases and disorders of each body system (prevention, pathology, diagnosis, and treatment).
1.2.2 Recognize emerging diseases and disorders.
1.2.3 Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of diseases.

1.3 Medical Mathematics
1.3.1 Apply mathematical computations related to health care procedures (metric and household, conversions and measurements).
1.3.2 Analyze diagrams, charts, graphs, and tables to interpret health care results.
1.3.3 Record time using the 24-hour clock.


Explore the Web

Genetic Disorders
National Center for Biotechnology Information (NCBI)

Genetic and Rare Diseases Information Center (GARD)

National Institutes of Health
http://ghr.nlm.nih.gov/BrowseConditions

Genomic Science Project
http://www.orml.gov/sci/techresources/Human_Genome/posters/chromosome/diseaseindex.shtml#top

Test and Treatment Costs
National Cancer Institute
http://www.cancer.gov/aboutcancer/causesprevention/costofcancer

National Institutes of Health
http://ghr.nlm.nih.gov/handbook/testing/costresults

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