## KEY TERMS

abbreviations
prefix
suffix
word roots

# 5:1 INFORMATION Using Medical Abbreviations

As a health care worker, you will see many abbreviations. You will be expected to recognize the most common abbreviations. This section provides a basic list of these abbreviations.

**Abbreviations** are shortened forms of words, usually just letters. Common examples are AM, which means morning, and PM, which means afternoon or evening.

Abbreviations are used in many health fields. Sometimes they are used by themselves; other times, several abbreviations are combined to give orders or directions. Consider the following examples:

BR c̄ BRP, FFl qh, VS qid

NPO 8 PM, To Lab for CBC, BUN, and FBS

These examples are short forms for giving directions. The first example is interpreted as follows: bedrest with bathroom privileges, force fluids every hour, vital signs four times a day. The second example is interpreted as follows: nothing by mouth after eight o'clock in the evening, to the laboratory for a complete blood count, blood urea nitrogen, and fasting blood sugar. As these examples illustrate, it is much easier to write using abbreviations than it is to write the corresponding detailed messages.

A sample list of abbreviations and symbols follows. This list contains some of the most commonly used abbreviations. Different abbreviations may be used in different facilities and in different parts of the country. It is the responsibility of health care workers to learn the meanings of the abbreviations used in the agencies where they are employed.

NOTE: *There is a growing trend toward eliminating periods from most abbreviations. Although the following list does not show periods, you may work in an agency that chooses to use them. When in doubt, follow the policy of your agency.*

NOTE: Learn the abbreviations in the following way:

1. Use a set of index cards to make a set of flashcards of the abbreviations found on the abbreviation list. Print one abbreviation in big letters on each card. Put the abbreviation on the front of the card and the meaning on the back of the card.
2. Use the flashcards to study the abbreviations. A realistic goal is to learn all abbreviations for one letter per week. For example, learn all of the *A*s the first week, all of the *B*s the second week, all of the *C*s the third week, and so on until all are learned.
3. Prepare for weekly tests on the abbreviations. The tests will be cumulative. They will cover the letter of the week plus any letters learned in previous weeks.

## A

| | |
|---|---|
| @ | at |
| ā | before |
| A&D | admission and discharge |
| A&P | anterior and posterior, anatomy and physiology |
| āā | of each |
| Ab | abortion |
| abd | abdomen, abdominal |
| ABG | arterial blood gas |
| ac | before meals |
| ACTH | adrenocorticotrophic hormone |
| AD | right ear |
| ADH | antidiuretic hormone |
| ad lib | as desired |
| ADL | activities of daily living |
| adm | admission |
| AHA | American Hospital Association |

| | |
|---|---|
| AIDS | acquired immune deficiency syndrome |
| am, AM | morning, before noon |
| AMA | American Medical Association, against medical advice |
| amal | amalgam |
| amb | ambulate, walk |
| amt | amount |
| ANA | American Nurses' Association |
| ANS | autonomic nervous system |
| ant | anterior |
| AP | apical pulse |
| approx | approximately |
| aq, aqua | aqueous (water base) |
| ARC | AIDS-related complex |
| ART | accredited records technician |
| AS | left ear |
| as tol | as tolerated |
| ASA | aspirin (acetylsalicylic acid) |
| ASAP | as soon as possible |
| ASCVD | arteriosclerotic cardiovascular disease |
| ASHD | arteriosclerotic heart disease |
| AU | both ears |
| av | average |
| AV | arteriovenous, atrioventricular |
| A&W | alive and well |
| Ax | axilla, axillary, armpit |

## B

| | |
|---|---|
| Ba | barium |
| bacti | bacteriology |
| B&B | bowel and bladder training |
| BBB | bundle branch block |
| B&C | biopsy and conization |
| BE | barium enema |
| bid | twice a day |
| bil | bilateral |
| Bl | blood |
| Bl Wk | blood work |
| BM | bowel movement |
| BMR | basal metabolic rate |
| BP | blood pressure |
| BR | bed rest |
| BRP | bathroom privileges |
| BS | blood sugar |
| BSA | body surface area |
| BSC, bsc | bedside commode |
| BUN | blood urea nitrogen |
| Bx, bx | biopsy |

## C

| | |
|---|---|
| °C | degrees Celsius (Centigrade) |
| c̄, w/ | with |
| Ca | calcium |
| CA | cancer |
| cal | calorie |
| Cap | capsule |
| CAT | computerized axial tomography |
| Cath | catheter |
| CBC | complete blood count |
| CBET | certified biomedical equipment technician |
| CBR | complete bed rest |
| cc | cubic centimeter |
| CC | chief complaint |
| CCU | coronary care unit, critical care unit |
| CDA | certified dental assistant |
| CDC | Centers for Disease Control and Prevention |
| CEO | chief executive officer |
| CF | cystic fibrosis |
| CHD | coronary heart disease |
| CHF | congestive heart failure |
| CHO | carbohydrate |
| chol | cholesterol |
| CICU | cardiac intensive care unit |
| ck | check |
| Cl | chloride or chlorine |
| cl liq | clear liquids |
| cm | centimeter |
| CMA | certified medical assistant |
| CNP | certified nurse practitioner |
| CNS | central nervous system |
| co, c/o | complains of |
| CO | carbon monoxide, coronary occlusion |
| $CO_2$ | carbon dioxide |
| Comp | complete, compound |
| cont | continued |
| COPD | chronic obstructive pulmonary disease |
| COTA | certified occupational therapy assistant |
| CP | cerebral palsy |
| CPK | creatine phosphokinase (cardiac enzyme) |
| CPR | cardiopulmonary resuscitation |
| CPT | current procedure terminology |
| CRTT | certified respiratory therapy technician |

| | |
|---|---|
| CS | central supply or service |
| C&S | culture and sensitivity |
| CSF | cerebral spinal fluid |
| CSR | central supply room |
| CST | certified surgical technologist |
| CT | computerized tomography |
| Cu | copper |
| CVA | cerebral vascular accident (stroke) |
| Cx | cervix, complication, complaint |

## D

| | |
|---|---|
| d | day |
| D&C | dilatation and curettage |
| DA | dental assistant |
| DAT | diet as tolerated |
| DC | Doctor of Chiropractic |
| D/C, dc, disc | discontinue, discharge |
| DDS | Doctor of Dental Surgery |
| DEA | Drug Enforcement Agency |
| del | delivery |
| Dept | department |
| DH | dental hygienist |
| DHHS | Department of Health and Human Services |
| Diff | differential white blood cell count |
| dil | dilute, dissolve |
| DM | diabetes mellitus |
| DMD | Doctor of Dental Medicine |
| DMS | diagnostic medical sonography |
| DNA | deoxyribonucleic acid |
| DNR | do not resuscitate |
| DO | Doctor of Osteopathic Medicine |
| DOA | dead on arrival |
| DOB | date of birth |
| DOD | date of death |
| DON | director of nursing |
| DPM | Doctor of Podiatric Medicine |
| DPT | diphtheria, pertussis, tetanus |
| Dr | doctor |
| dr | dram, drainage |
| DRG | diagnostic related group |
| drg, drsg, dsg | dressing |
| D/S | dextrose in saline |
| DSD | dry sterile dressing |
| DTs | delirium tremors |
| DVM | Doctor of Veterinary Medicine |
| DW | distilled water |
| D/W | dextrose in water |
| Dx, dx | diagnosis |

## E

| | |
|---|---|
| ea | each |
| EBL | estimated blood loss |
| ECG, EKG | electrocardiogram |
| ED | emergency department |
| EEG | electroencephalogram |
| EENT | ear, eye, nose, throat |
| elix | elixir |
| EMG | electromyogram |
| EMS | emergency medical services |
| EMT | emergency medical technician |
| ENT | ear, nose, throat |
| EPA | Environmental Protection Agency |
| ER | emergency room |
| ESR | erythrocyte sedimentation rate |
| et, etiol | etiology (cause of disease) |
| Ex, exam | examination |
| Exc | excision |
| Exp | exploratory |
| ext | extract, extraction, external |

## F

| | |
|---|---|
| °F | degrees Fahrenheit |
| FBS | fasting blood sugar |
| FBW | fasting blood work |
| FC | Foley catheter |
| FDA | Food and Drug Administration |
| Fe | iron |
| FF, FFl | force fluids |
| FH, FHR | fetal heart rate |
| Fl, fl | fluid |
| Fr, Fx | fracture |
| FSH | follicle stimulating hormone |
| ft | foot |
| FUO | fever of unknown origin |

## G

| | |
|---|---|
| GA | gastric analysis |
| gal | gallon |
| GB | gallbladder |
| Gc | gonococcus, gonorrhea |
| GH | growth hormone |
| GI | gastrointestinal |
| Gm, g | gram |

| | |
|---|---|
| gr | grain |
| gt, gtt, gtts | drop, drops |
| GTT | glucose tolerance test |
| GU | genitourinary |
| Gyn | gynecology |

## H

| | |
|---|---|
| H | hydrogen |
| $H_2O$ | water |
| $H_2O_2$ | hydrogen peroxide |
| H, (h), hypo | hypodermic injection |
| HA | hearing aid, headache |
| HBP | high blood pressure |
| HBV | hepatitis B virus |
| HCG | human chorionic gonadotrophin hormone |
| HCl | hydrochloric acid |
| hct | hematocrit |
| HDL | high density lipoproteins (healthy type of cholesterol) |
| Hg | mercury |
| Hgb, Hb | hemoglobin |
| HHA | home health assistant/aide |
| HIV | human immunodeficiency virus (AIDS virus) |
| HMO | health maintenance organization |
| HOB | head of bed |
| HOH | hard of hearing |
| HOSA | Health Occupations Students of America |
| H&P | history and physical |
| Hr, hr, H, h | hour, hours |
| HS | hour of sleep (bedtime) |
| Ht | height |
| Hx, hx | history |
| hypo | hypodermic injection |
| Hyst | hysterectomy |

## I

| | |
|---|---|
| I&D | incision and drainage |
| I&O | intake and output |
| ICCU | intensive coronary care unit |
| ICD | international classification of diseases |
| ICU | intensive care unit |
| ID | intradermal |
| IDDM | insulin-dependent diabetes mellitus |
| IH | infectious hepatitis |
| IM | intramuscular |
| imp | impression |
| in | inch |
| inf | infusion, inferior, infection |
| ing | inguinal |
| inj | injection |
| int | internal, interior |
| IPPB | intermittent positive pressure breathing |
| irr, irrig | irrigation |
| Isol, isol | isolation |
| IT | inhalation therapy |
| IUD | intrauterine device |
| IV | intravenous |
| IVP | intravenous pyelogram |

## J

| | |
|---|---|
| jt | joint |

## K

| | |
|---|---|
| K | potassium |
| KCl | potassium chloride |
| Kg, kg | kilogram |
| KUB | kidney, ureter, bladder X-ray |

## L

| | |
|---|---|
| L | lumbar |
| L&D | labor and delivery |
| L&W | living and well |
| (L), lt, lft | left |
| L, l | liter (1,000 cc) |
| Lab | laboratory |
| Lap | laparotomy |
| lat | lateral |
| lb | pound |
| LCT | long-term care |
| LDH | lactose dehydrogenase (cardiac enzyme) |
| LDL | low density lipoprotein (unhealthy type of cholesterol) |
| lg | large |
| liq | liquid |
| LLQ | left lower quadrant |
| LMP | last menstrual period |

| | |
|---|---|
| LOC | laxative of choice, level of consciousness |
| LP | lumbar puncture |
| LPN | licensed practical nurse |
| LS | lumbar sacral |
| LUQ | left upper quadrant |
| LVN | licensed vocational nurse |

## M

| | |
|---|---|
| m | minim |
| MA | medical assistant |
| Mat | maternity |
| mcg | microgram |
| MD | Medical Doctor, muscular dystrophy, myocardial disease |
| Med | medical, medicine |
| mEq | milliequivalent |
| mg | milligram |
| Mg | magnesium |
| MI | myocardial infarction (heart attack) |
| min | minute |
| mL, ml | milliliter |
| MLT | medical laboratory technician |
| mm | millimeter |
| MN | midnight |
| mod | moderate |
| MOM | milk of magnesia |
| MRI | magnetic resonance imaging |
| MS | multiple sclerosis, mitral stenosis, muscular-skeletal |
| MT | medical technologist |

## N

| | |
|---|---|
| N | nitrogen |
| N/A | not applicable |
| Na | sodium |
| NA | nurse aide/assistant |
| NaCl | sodium chloride (salt) |
| NB | newborn |
| N/C | no complaints |
| neg | negative, none |
| Neur | neurology |
| NG, ng | nasogastric tube |
| NICU | neurological intensive care unit |
| NIDDM | non-insulin-dependent diabetes mellitus |
| NIH | National Institutes of Health |
| nil | none |
| no | number |
| NO | nursing office |
| noc, noct | at night, night |
| NP | nurse practitioner |
| NPN | nonprotein nitrogen |
| NPO | nothing by mouth |
| N/S, NS | normal saline |
| Nsy | nursery |
| N/V, N&V | nausea and vomiting |
| NVD | nausea, vomiting, diarrhea |
| NVS | neurological vital signs |

## O

| | |
|---|---|
| $O_2$ | oxygen |
| O&P | ova and parasites |
| Ob, Obs | obstetrics |
| OBRA | Omnibus Budget Reconciliation Act |
| od | overdose |
| OD | right eye, occular dextra, Doctor of Optometry |
| oint | ointment |
| OJ | orange juice |
| OOB | out of bed |
| OP | outpatient |
| OPD, OPC | outpatient department or clinic |
| opp | opposite |
| OR | operating room |
| Ord | orderly |
| Orth | orthopedics |
| os | mouth |
| OS | left eye, occular sinistra |
| OSHA | Occupational Safety and Health Administration |
| OT | occupational therapy/ therapist |
| OTC | over the counter |
| OU | each eye |
| OV | office visit |
| oz | ounce |

## P

| | |
|---|---|
| p̄ | after |
| P | pulse, phosphorus |
| PA | physician's assistant |
| PAC | premature atrial contraction |
| PAP | Papanicolaou test (smear) |

| | |
|---|---|
| para | number of pregnancies |
| Path | pathology |
| Pb | lead |
| PBI | protein bound iodine |
| pc | after meals |
| PCA | patient controlled analgesia |
| PCC | poison control center |
| PCP | patient care plan |
| PCT | patient/personal care technician |
| PDR | *Physicians' Desk Reference* |
| PE | physical exam, pulmonary edema |
| Peds | pediatrics |
| per | by, through |
| PET | positron emission tomography |
| pH | measure of acidity/alkalinity |
| Pharm | pharmacy |
| PI | present illness |
| PID | pelvic inflammatory disease |
| PKU | phenylketonuria |
| PM, pm | after noon |
| PMC | postmortem (after death) care |
| PMS | premenstrual syndrome |
| PNS | peripheral nervous system |
| po | by mouth |
| PO | phone order |
| post | posterior, after |
| post-op | after an operation |
| PP | postpartum (after delivery) |
| PPE | personal protective equipment |
| PPO | preferred provider organization |
| pre-op | before an operation |
| prep | prepare |
| prn | whenever necessary, as needed |
| Psy | psychology, psychiatry |
| pt | patient, pint (500 mL or cc) |
| Pt | prothrombin time |
| PT | physical therapy/therapist |
| PTT | partial thromboplastin time |
| PVC | premature ventricular contraction |
| PVD | peripheral vascular disease |
| Px | prognosis, physical exam |

## Q

| | |
|---|---|
| q, q̄ | every |
| qd | every day |
| qh | every hour |
| q2h | every 2 hours |
| q3h | every 3 hours |
| q4h | every 4 hours |
| qhs | every night at bedtime |
| qid | four times a day |
| qns | quantity not sufficient |
| qod | every other day |
| qs | quantity sufficient |
| qt | quart |

## R

| | |
|---|---|
| R | respiration, rectal |
| ®, Rt | right |
| Ra | radium |
| RBC | red blood cell |
| RDA | recommended daily allowance |
| REM | rapid eye movement |
| RHD | rheumatic heart disease |
| RLQ | right lower quadrant |
| RN | registered nurse |
| RNA | ribonucleic acid |
| R/O | rule out |
| RO | reality orientation |
| ROM | range of motion |
| RR | recovery room |
| RRT | registered respiratory therapist, registered radiologic technologist |
| RT | respiratory therapy/therapist |
| RUQ | right upper quadrant |
| Rx | prescription, take, treatment |

## S

| | |
|---|---|
| S | sacral |
| S&A | sugar and acetone |
| s̄, w/o | without |
| SA | sino atrial |
| sc, SC | subcutaneous |
| SGOT, SGPT | transaminase test |
| SICU | surgical intensive care unit |
| SIDS | sudden infant death syndrome |
| Sig | give the following directions |
| sm | small |
| SOB | short of breath |
| sol | solution |
| sos | if necessary |
| spec | specimen |

| | |
|---|---|
| SpGr, spgr | specific gravity |
| SPN | student practical nurse |
| spt | spirits, liquor |
| $\overline{ss}$ | one half |
| S/S, S&S | signs and symptoms |
| SSE | soap solution enema |
| staph | staphylococcus infection |
| stat | immediately, at once |
| STD | sexually transmitted disease |
| STH | somatotropic hormone |
| strep | streptococcus infection |
| supp | suppository |
| Surg | surgery, surgical |
| susp | suspension |
| Sx | symptom, sign |
| syp | syrup |

## T

| | |
|---|---|
| T&A | tonsillectomy and adenoidectomy |
| T, Temp | temperature |
| tab | tablet |
| TB | tuberculosis |
| tbsp | tablespoon |
| TCDB | turn, cough, deep breathe |
| TH | thyroid hormone |
| TIA | transient ischemic attack |
| tid | three times a day |
| TLC | tender loving care |
| TO | telephone order |
| tol | tolerated |
| TPN | total parenteral nutrition |
| TPR | temperature, pulse, respiration |
| tr, tinct | tincture |
| TSH | thyroid stimulating hormone |
| tsp | teaspoon |
| TUR | transurethral resection |
| TWE | tap water enema |
| tx | traction, treatment, transplant |

## U

| | |
|---|---|
| UA, U/A | urinalysis |
| ung | ointment |
| Ur, ur | urine |
| URI | upper respiratory infection |
| UTI | urinary tract infection |
| UV | ultraviolet |

## V

| | |
|---|---|
| Vag | vaginal |
| VD | venereal disease |
| VDM | Veterinarian Degree of Medicine |
| VDRL | serology for syphilis, Venereal Disease Research Laboratory |
| VICA | Vocational Industrial Clubs of America |
| VO | verbal order |
| Vol | volume |
| VS | vital signs (TPR & BP) |

## W

| | |
|---|---|
| WBC | white blood cell |
| WC | ward clerk/secretary |
| w/c | wheelchair |
| WHO | World Health Organization |
| WNL | within normal limits |
| W/P | whirlpool |
| wt | weight |

## X

| | |
|---|---|
| x | times (2× means do 2 times) |
| x-match | cross match |
| XR | X-ray |

## Y

| | |
|---|---|
| y/o | years old |
| YOB | year of birth |
| yr | year |

## Z

| | |
|---|---|
| Zn | zinc |

## MISCELLANEOUS SYMBOLS

| | |
|---|---|
| > | greater than |
| < | less than |
| ↑ | higher, elevate, or up |
| ↓ | lower or down |
| # | pound or number |
| ℥ | dram |
| ℥ | ounce |
| ' | foot or minute |
| " | inch or second |
| ° | degree |
| ♀ or F | female |
| ♂ or M | male |
| I or *i* or i̇ | one |
| II or *ii* or i̇i̇ | two |
| V | five |
| X | ten |
| L | fifty |
| C | one hundred |
| D | five hundred |
| M | one thousand |

**STUDENT:** *Go to the workbook and complete the assignment and evaluation sheets for 5:1, Using Medical Abbreviations.*

## 5:2 INFORMATION Interpreting Word Parts

Medical dictionaries have been written to include the many words used in health occupations. It would be impossible to memorize all such words. By breaking the words into parts, however, it is sometimes possible to figure out their meanings. This section provides basic information on doing just that.

A word is often a combination of different parts. The parts include prefixes, suffixes, and word roots (see figure 5-1).

A **prefix** can be defined as a syllable or word placed at the beginning of a word. A **suffix** can be defined as a syllable or word placed at the end of the word.

The meanings of prefixes and suffixes are set. For example, the suffix *itis* means "inflammation of." *Tonsillitis* means "an inflammation of the tonsils," and *appendicitis* means "an inflammation of the appendix." Note that the meaning of the suffix is usually placed first when the word is defined.

**Word roots** can be defined as main words or parts to which prefixes and suffixes can be added. In the example *appendicitis,* the word root is *appendix.* By adding the prefix *pseudo,* which means "false," and the suffix *itis,* which means "inflammation of," the word becomes *pseudoappendicitis.* This is interpreted as a "false inflammation of the appendix."

The prefix usually serves to further define the word root. The suffix usually describes what is happening to the word root.

When prefixes, suffixes, and/or word roots are joined together, vowels are frequently added. Common examples include a, e, i, ia, io, o, and u. These are listed in parentheses in the lists that follow. The vowels are not used if the word root or suffix begins with a vowel. For example, *encephal (o)* means brain. When it is combined with *itis* meaning inflammation of, the vowel is not used for *encephalitis.* When it is combined with *gram* meaning tracing or record, the vowel "o" is added for *encephalogram. Hepat (o)* means liver. When it is combined with *itis,* the vowel is not used for *hepatitis.* When it is combined with *megaly* meaning enlarged, the vowel "o" is added for *hepatomegaly.*

By learning basic prefixes, suffixes, and word roots, you will frequently be able to interpret the meaning of a word even when you have never before encountered the word. A list of common prefixes, suffixes, and word roots follows.

**NOTE:** Learn the prefixes, suffixes, and word roots in the following way:

1. Use a set of index cards to make flashcards of the word parts found on the prefix, suffix, and word root list. Place one prefix, suffix, or word root on each card. Put the word part on the front of the card and the meaning of the word part on the back of the card. Ensure that each is spelled correctly.

2. Use the flashcards to learn the meanings of the word parts. A realistic goal is to learn one letter per week. For example, learn all word parts starting with the letter *A* the first week, all of those starting with *B* the second week, all of those starting with *C* the third week, and so on until all are learned. Practice correct spelling of all of the word parts.

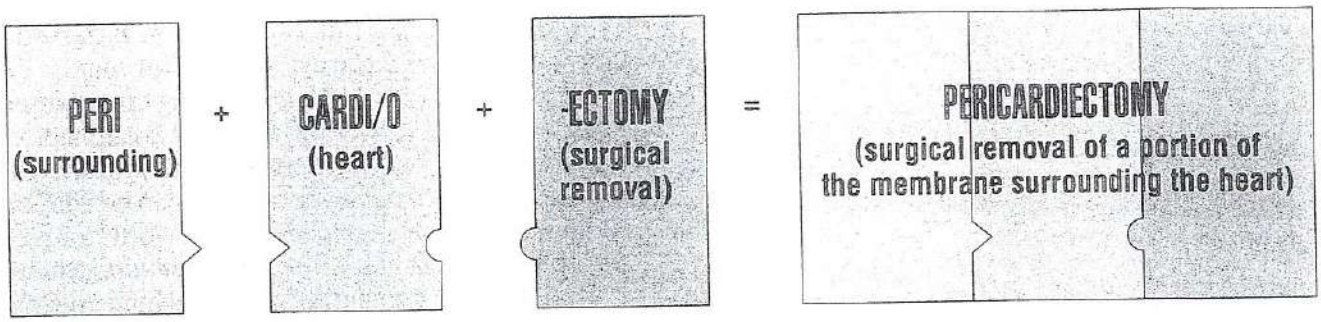



FIGURE 5-1 Prefixes, suffixes, and word roots can be used to interpret the meaning of a word.

3. Prepare for weekly tests on the word parts. The tests will be cumulative. They will cover the letter of the week plus any letters learned in previous weeks. Words will be presented that use the various word parts. In order to be considered correct, you must spell the words correctly.

## A

| | |
|---|---|
| a-, an- | without, lack of |
| ab- | from, away |
| -able | capable of |
| -ac, -ic | pertaining to |
| acr- (o) | extremities (arms and legs) |
| ad- | to, toward, near |
| aden- (o) | gland, glandular |
| adren- (o) | adrenal gland |
| aer- (o) | air |
| -al | like, similar, pertaining to |
| alba- | white |
| alges- (i, ia) | pain |
| -algia | pain |
| ambi- | both, both sides |
| an- (o, us) | anus (opening to rectum) |
| angi- (o) | vessel |
| ankyl- | crooked, looped, immovable, fixed |
| ante- (ro) | before, in front of, ahead of |
| anti- | against |
| append- (i, o) | appendix |
| arter- (io) | artery |
| arthr- (o) | joint |
| -ase | enzyme |
| -asis | condition of |
| -asthenia | weakness, lack of strength |
| ather- (o) | fatty, lipid |
| audi- (o) | sound, hearing |
| aur- | ear |
| auto- | self |

## B

| | |
|---|---|
| bi- (s) | twice, double, both |
| bio- | life |
| -blast | germ/embryonic cell |
| blephar- (o) | eyelid |
| brachi- | arm |
| brachy- | short |
| brady- | slow |
| bronch- (i, o) | air tubes in lungs |
| bucc- (a) | cheek |

## C

| | |
|---|---|
| calc- (u, ulus) | stone |
| carcin- (o) | cancer, malignancy |
| cardi- (a, o) | pertaining to heart |
| carp- (o) | wrist |
| -cele | swelling, tumor, cavity, hernia |
| cent- (i) | one hundred |
| -centesis | surgical puncture to remove fluid |
| cephal- (o) | head, pertaining to head |
| cerebro- | brain |
| cerv- (ic) | neck, neck of uterus |
| cheil- (o) | lip |
| chem- (o) | drug, chemical |
| chir- (o) | hand |
| chlor- (o) | green |
| chol- (e, o) | bile, gallbladder |
| chond- (i, r, ri) | cartilage |
| chrom- (o) | color |
| -cide | causing death |
| circum- | around, about |
| -cise | cut |
| -clysis | washing, irrigation |
| co- (n) | with, together |
| -coccus | round |

| | |
|---|---|
| -coele | chamber, enlarged space |
| col- (in, o) | colon, bowel, large intestine |
| colp- (i, o) | vagina |
| contra- | against, counter |
| cost- (a, i, o) | rib |
| crani- (o) | pertaining to the skull |
| -crine | secrete |
| cryo- | cold |
| crypt- | hidden |
| cut- | skin |
| cyan- (o) | blue |
| cyst- (i, o) | bladder, bag, sac |
| cyt- (e, o) | cell |

## D

| | |
|---|---|
| dacry- | tear duct, tear |
| dactyl- (o) | finger, toe |
| dec- (a, i) | ten |
| demi- | half |
| dent- (i, o) | tooth |
| derm- (a, at, o) | pertaining to skin |
| -desis | surgical union or fixation |
| dextr- (i, o) | to the right |
| di- (plo) | double, twice |
| dia- | through, between, part |
| dis- (ti, to) | separation, away from |
| dors- (i, o) | to the back, back |
| duoden- (o) | duodenum |
| dyni- (a, c) | pain |
| dys- | difficult, painful, bad |

## E

| | |
|---|---|
| e- (c) | without |
| -eal | pertaining to |
| ec- (ti, to) | outside, external |
| -ectasis | expansion, dilation, stretching |
| -ectomy | surgical removal of |
| electr- (o) | electrical |
| -emesis | vomit |
| -emia | blood |
| encephal- (o) | brain |
| endo- | within, innermost |
| enter- (i, o) | intestine |
| epi- | upon, over, upper |
| erythro- | red |
| -esis | condition of |
| -esthesia | sensation, perception, feel |
| eu- | well, easy, normal |
| ex- (o) | outside of, beyond |

## F

| | |
|---|---|
| faci- | face |
| -fascia | fibrous band |
| -ferous | producing |
| fibr- (a, i, o) | fiber, connective tissue |
| fore- | in front of |
| -form | having the form of, shape |
| -fuge | driving away, expelling |

## G

| | |
|---|---|
| galacto- | milk, galactose (milk sugar) |
| gast- (i, ro) | stomach |
| -genesis | development, production, creation |
| -genetic, -genic | origin, producing, causing |
| genito- | organs of reproduction |
| -genous | kind, type |
| geront- (o) | old age, elderly |
| gingiv- | gums, gingiva |
| gloss- (o) | tongue |
| gluc- (o) | sweetness, sugar, glucose |
| gly- (co) | sugar |
| -gram | tracing, picture, record |
| -graph | diagram, instrument for recording |
| gyn- (ec, o) | woman, female |

## H

| | |
|---|---|
| hem- (a, ato, o) | blood |
| hemi- | half |
| hepat- (o) | liver |
| herni- | rupture |
| hetero- | other, unlike, different |
| hist- (o) | tissue |
| hom- (eo, o) | same, like |
| hydro- | water |
| hyper- | excessive, high, over, increased, more than normal |
| hypno- | sleep |
| hypo- | decreased, deficient, low, under, less than normal |
| hyster- (o) | uterus |

## I

| | |
|---|---|
| -ia, -iasis | condition of, abnormal/ pathological state |
| -ic, -ac | pertaining to |
| idio- | peculiar to an individual, self-originating |
| ile- (o, um) | ileum |
| infra- | beneath, below |
| inter- | between, among |
| intra- | within, into, inside |
| -ism | condition, theory, state of being |
| iso- | equal, alike, same |
| -itis | inflammation, inflammation of |

## K

| | |
|---|---|
| kerat- (o) | cornea of eye |
| -kinesis, -kinetic | motion |

## L

| | |
|---|---|
| labi- (a, o) | lip |
| lacrima- | tears |
| lact- (o) | milk |
| lapar- (o) | abdomen, abdominal wall |
| laryng- (o) | larynx (voicebox) |
| latero- | side |
| -lepsy | seizure, convulsion |
| leuco-, leuko- | white |
| lingu- (a, o) | tongue |
| lip- (o) | fat, lipids |
| lith- (o) | stone, calculus |
| -logy | study of, science of |
| lymph- (o) | lymph tissue |
| -lys (is, o) | destruction, dissolving of |

## M

| | |
|---|---|
| macro- | large |
| mal- | bad, abnormal, disordered, poor |
| malac- (ia) | softening of a tissue |
| mamm- (o) | breast, mammary glands |
| -mania | insanity, mental disorder |
| mast- (o) | breast |
| med- (i) | middle, midline |
| -megaly, mega- | large, enlarged |
| melan- (o) | black |
| mening- (o) | membranes covering the brain and spinal cord |
| meno- | monthly, menstruation |
| mes- (o) | middle, midline |
| -meter | measuring instrument, measure |
| -metry | measurement |
| micro- | small |
| mono- | one, single |
| -mortem | death |
| muc- (o, us) | mucus, secretion of mucous membrane |
| multi- | many, much, a large amount |
| my- (o) | muscle |
| myc- (o) | fungus |
| myel- (o) | bone marrow, spinal cord |
| myring- (o) | eardrum, tympanic membrane |

## N

| | |
|---|---|
| narc- (o) | sleep, numb, stupor |
| nas- (o) | nose |
| -natal | birth |
| necr- (o) | death |
| neo- | new |
| neph- (r, ro) | kidney |
| neur- (o) | nerve, nervous system |
| noct- (i) | night, at night |
| non- | no, none |

## O

| | |
|---|---|
| ocul- (o) | eye |
| -ode, -oid | form, shape, like, resembling |
| odont- (o) | tooth |
| olig- (o) | few, less than normal, small |
| -ologist | person who does/studies |
| -ology | study of, science of |
| -oma | tumor, a swelling |
| onco- | mass, bulk, tumor |
| oophor- (o) | ovary, female egg cell |
| ophthalm- (o) | eye |
| -opia | vision |
| -opsy | to view |
| opt- (ic) | vision, eye |

| | |
|---|---|
| or- (o) | mouth |
| orch- (ido) | testicle, testes |
| -orrhea | flow, discharge |
| orth- (o) | normal, straight |
| ost- (e, eo) | bone |
| -oscopy | diagnostic examination |
| -osis | condition, state, process |
| ot- (o) | ear |
| -otic | pertaining to a condition |
| -otomy | cutting into |
| -ous | full of, containing, pertaining to, condition |
| ovi-, ovario- | egg, female sex gland, ovary |

## P

| | |
|---|---|
| pan- | all, complete, entire |
| pancreat- (o) | pancreas |
| para- | near, beside, beyond, abnormal, lower half of the body |
| -paresis | paralysis |
| -partum | birth, labor |
| path- (ia, o, y) | disease, abnormal condition |
| ped- (ia) | child |
| -penia | lack of, abnormal reduction in number, deficiency |
| pent- (a) | five |
| -pepsia, -pepsis | digestion |
| per- | through, by, excessive |
| peri- | around |
| -pexy | fixation |
| phag- (o) | eat, ingest |
| -phage, -phagia | to eat, consuming, swallow |
| pharyng- (o) | pharynx, throat |
| -phas, -phasia | speech |
| -philia, -philic | affinity for, attracted to |
| phleb- (o) | vein |
| -phobia | fear |
| phon- (o) | sound, voice |
| -phylaxis | protection, prevention |
| -plasty | surgical correction or repair |
| -plegia | paralysis |
| pleuro- | side, rib |
| -pnea | breathing |
| pneum- (o, on) | lung, pertaining to the lungs, air |
| pod- (e, o) | foot |
| poly- | many, much |
| post- | after, behind |
| pre- | before, in front of |
| pro- | in front of, forward |
| proct- (o) | rectum, rectal, anus |
| psora- | itch |
| pseudo- | false |
| psych- (i, o) | pertaining to the mind |
| -ptosis | drooping down, sagging, downward displacement |
| pulmon- (o) | lung |
| py- (o) | pus |
| pyel- (o) | renal pelvis of kidney |
| pyr- (o) | heat, fever |

## Q

| | |
|---|---|
| quad- (ra, ri) | four |

## R

| | |
|---|---|
| radi- (o) | X-rays, radiation |
| re- | back, again |
| rect- (o) | rectum |
| ren- (o) | kidney |
| retro- | backward, in back, behind |
| rhin- (o) | nose, pertaining to the nose |
| -rraphy | suture of, sewing up of a gap or defect |
| -rrhagia | sudden or excessive flow |
| -rrhea | flow, discharge |
| -rrhexis | rupture of, bursting |

## S

| | |
|---|---|
| salping- (i, o) | tube, fallopian tube |
| sanguin- (o) | blood |
| sarc- (o) | malignant (cancer) connective tissue |
| -sarcoma | tumor, cancer |
| scler- (o) | hardening |
| -sclerosis | dryness or hardness |
| -scope | examining instrument |
| -scopy | observation |
| -sect | cut |
| semi- | half, part |
| sep- (ti) | poison, rot, infection |
| sinistr- (o) | left |
| soma- (t) | body |
| son- (o) | sound |
| -spasm | involuntary contraction |

| | |
|---|---|
| sperm- (ato) | spermatozoa, male germ (sex) cell |
| splen- (o) | spleen |
| -stasis | stoppage, maintaining a constant level |
| steno- | contracted, narrow |
| stern- (o) | sternum, breast bone |
| stoma- (t) | mouth |
| -stomy | artificial opening |
| sub- | less, under, below |
| sup- (er, ra) | above, upon, over, higher in position |
| sym-, syn- | joined, fused, together |

## T

| | |
|---|---|
| tach- (o, y) | rapid, fast |
| ten- (do, o) | tendon |
| tetra- | four |
| -therapy | treatment |
| therm- (o, y) | heat |
| thorac- (o) | thorax, chest |
| thromb- (o) | clot, thrombus |
| thym- (o) | thymus gland |
| thyr- (o) | thyroid gland |
| -tome | instrument that cuts |
| -tox (ic) | poison |
| trach- (e, i, o) | trachea, windpipe |
| trans- | across, over, beyond |
| tri- | three |
| trich- (o) | hair |
| -trips (y) | crushing by rubbing or grinding |
| -trophy | nutrition, growth, development |
| tympan- (o) | eardrum, tympanic membrane |

## U

| | |
|---|---|
| ultra- | beyond, excess |
| uni- | one |
| ur- (o) | urine, urinary tract |
| ureter- (o) | ureter (tube from kidney to bladder) |
| urethr- (o) | urethra (tube from bladder to urinary meatus) |
| -uria | urine |
| uter- (o) | uterus, womb |

## V

| | |
|---|---|
| vas- (o) | vessel, duct |
| ven- (a) | vein |
| ventro- | to the front, abdomen |
| vertebr- (o) | spine, vertebrae |
| vesic- (o) | urinary bladder |
| viscer- (o) | internal organs |
| vit- (a) | necessary for life |

## X

| | |
|---|---|
| xanth- (o) | yellow |
| -xenia | strange, abnormal |

## Z

| | |
|---|---|
| zoo- | animal |
| zymo- | enzymes |

**STUDENT:** *Go to the workbook and complete the assignment and evaluation sheets for 5:2, Interpreting Word Parts.*

## UNIT 5 SUMMARY

**Medical abbreviations and terminology are used in all health care occupations and facilities. In order to communicate effectively, health care workers must be familiar with common abbreviations and terminology.**

**Medical abbreviations are shortened forms of words, usually just letters. Sometimes, they are used by themselves; other times, several abbreviations are combined to give orders or directions.**

**Medical terminology consists of the use of prefixes, suffixes, and word roots to create words. Entire dictionaries have been written to include the terminology used in health care. It would be impossible to memorize the meaning of every word. By learning common prefixes, suffixes, and word roots, however, a health care worker can break a word into parts and figure out the meaning of the word.**

# 6 : 1 Basic Structure of the Human Body

## Objectives

After completing this section, you should be able to:

- Label a diagram of the main parts of a cell
- Describe the basic function of each part of a cell
- Compare the four main types of tissue by describing the basic function of each type
- Explain the relationship between cells, tissues, organs, and systems
- Define, pronounce, and spell all the key terms

## KEY TERMS

**anatomy**
**cell**
**cell membrane**
**centrosome**
*(sen'-troh-sohm)*
**chromatin**
*(crow'-ma-tin)*
**connective tissue**
**cytoplasm**
*(sy'-toe-plaz-um)*
**dehydration**
**edema**
*(eh-dee'-mah)*
**endoplasmic reticulum**
*(en'-doe-plaz-mik re-tik'-you-lum)*
**epithelial tissue**
*(ep'-eh-thiel"-e-al tish'-u)*
**Golgi apparatus**
*(gawl'-jee ap-a-rat'-us)*
**lysosomes**
*(ly'-sah-soms)*
**meiosis**
*(my-o'-sis)*
**mitochondria**
*(my-toe-con'-dree-ah)*
**mitosis**
*(my-toe'-sis)*
**muscle tissue**
**nerve tissue**
**nucleolus**
*(new"-klee-oh'-lus)*
**nucleus**
**organ**
**organelles**
**pathophysiology**
**physiology**
*(fizz-ee-all'-oh-gee)*
**pinocytic vesicles**
**protoplasm**
*(pro'-toe-plaz-um)*
**system**
**tissue**

## RELATED HEALTH CAREERS

**NOTE:** A basic knowledge of human anatomy and physiology is essential for almost every health care provider. However, some health careers are related to specific body systems. As each body system is discussed, examples of related health careers are listed. The following health career categories require knowledge of the structure and function of the entire human body and will not be listed in specific body system units.

- Athletic Trainer
- Emergency Medical Careers
- Medical Laboratory Careers
- Medical Assistant
- Medical Illustrator
- Nursing Careers
- Pharmacy Careers
- Physician Assistant
- Physicians
- Surgical Technologist

# 6:1 INFORMATION

The human body is often described as an efficient, organized machine. When this machine does not function correctly, disease occurs. Before understanding the disease processes, however, the health worker must first understand the normal functioning of the body. A basic understanding of anatomy and physiology is therefore necessary. **Anatomy** is the study of the form and structure of an organism. **Physiology** is the study of the processes of living organisms, or why and how they work. **Pathophysiology** is the study of how disease occurs and the responses of living organisms to disease processes.

The basic substance of all life is **protoplasm**. This material makes up all living things. Although protoplasm is composed of ordinary elements such as carbon, oxygen, hydrogen, sulfur, nitrogen, and phosphorus, scientists are unable to combine such elements to create that characteristic called *life*.

## CELLS

Protoplasm forms the basic unit of structure and function in all living things: the **cell**. Cells are microscopic structures that carry on all the functions of life. They take in food and oxygen; produce heat and energy; move and adapt to their environment; eliminate wastes; perform special functions; and reproduce to create new, identical cells. The human body contains trillions of cells. These cells vary in shape and size and perform many different functions.

Most cells have the following basic parts (see figure 6-1):

- **Cell membrane**—the outer protective covering of the cell. It is semipermeable, which means that it allows certain substances to enter and leave the cell while preventing the passage of other substances.
- **Cytoplasm**—a semi-fluid inside the cell. It contains water, proteins, lipids (fats), carbohydrates, minerals, and salts. It is the site for all chemical reactions that take place in the cell. **Organelles**, or cell structures that help a cell to function, are located in the cytoplasm. The main organelles are the nucleus, mitochondria, ribosomes, lysosomes, centrioles, Golgi apparatus, and endoplasmic reticulum.
- **Nucleus**—a mass in the cytoplasm. It is often called the "brain" of the cell because it controls many cell activities and is important in cell division.
- **Nucleolus**—located inside the nucleus, and important in cell reproduction. Ribosomes, made of ribonucleic acid (RNA) and protein, are manufactured in the nucleolus. The ribosomes move from the nucleus to the cytoplasm, where they aid in the synthesis (production) of protein. They can exist freely in the cytoplasm or be attached to the endoplasmic reticulum.
- **Chromatin**—located in the nucleus and made of deoxyribonucleic acid (DNA) and protein. During cell reproduction, the chromatin condenses to form rod-like structures called chromosomes. A human cell has 46 chromosomes or 23 pairs. The chromosomes contain about 100,000 genes, which carry inherited characteristics. Each gene has a specific and unique sequence of approximately 1,000 base pairs of DNA; the DNA sequence carries the genetic coding that allows for exact duplication of the cell. Since the DNA sequence on genes is unique for each individual, it is sometimes used as an identification tool similar to fingerprints, but much more exact.
- **Centrosome**—located in the cytoplasm and near the nucleus. It contains two centrioles. During mitosis, or cell division, the centrioles separate. Thin cytoplasmic spindle fibers form between the centrioles and attach to the chromosomes. This creates an even division of the chromosomes in the two new cells.
- **Mitochondria**—rod-shaped organelles located throughout the cytoplasm. These are often called the "furnaces" or "powerhouses" of the cell because they break down carbohydrates, proteins, and fats to produce adenosine triphosphate (ATP), the major energy source of the cell.
- **Golgi apparatus**—a stack of membrane layers located in the cytoplasm. This structure produces, stores, and packages secretions for discharge from the cell. Cells of the salivary, gastric, and pancreatic glands have large numbers of Golgi apparatus.
- **Endoplasmic reticulum**—a fine network of tubular structures located in the cytoplasm. This network allows for the transport

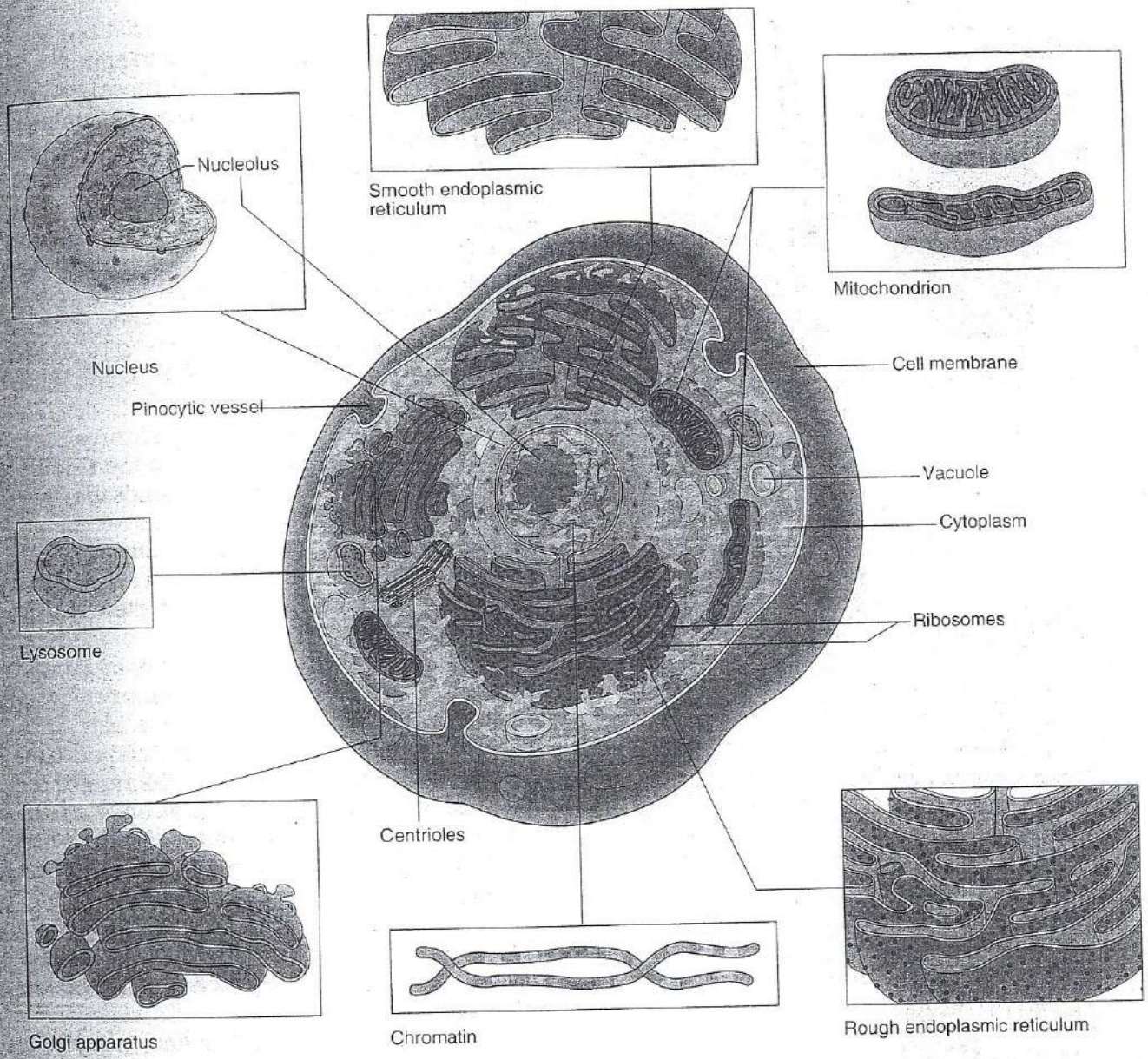



FIGURE 6-1 Basic parts of a cell.

of materials into and out of the nucleus, and also aids in the synthesis and storage of proteins. Rough endoplasmic reticulum contains ribosomes, which are the sites for protein synthesis (production). Smooth endoplasmic reticulum does not contain ribosomes and is not present in all cells. It assists with cholesterol synthesis, fat metabolism, and detoxification of drugs.

- **Lysosomes**—oval or round bodies found throughout the cytoplasm. These structures contain digestive enzymes that digest and destroy old cells, bacteria, and foreign materials, an important function of the body's immune system.
- **Pinocytic vesicles**—pocketlike folds in the cell membrane. These folds allow large molecules such as proteins and fats to enter the cell. When such molecules are inside the cell, the folds close to form vacuoles or bubbles in the cytoplasm.

## Cell Reproduction

Most cells reproduce by dividing into two identical cells. This process is called **mitosis**, a form of asexual reproduction (see figure 6-2). Skin cells, blood forming cells, and intestinal tract cells reproduce continuously. Muscle cells only reproduce every few years, but muscle tissue can be

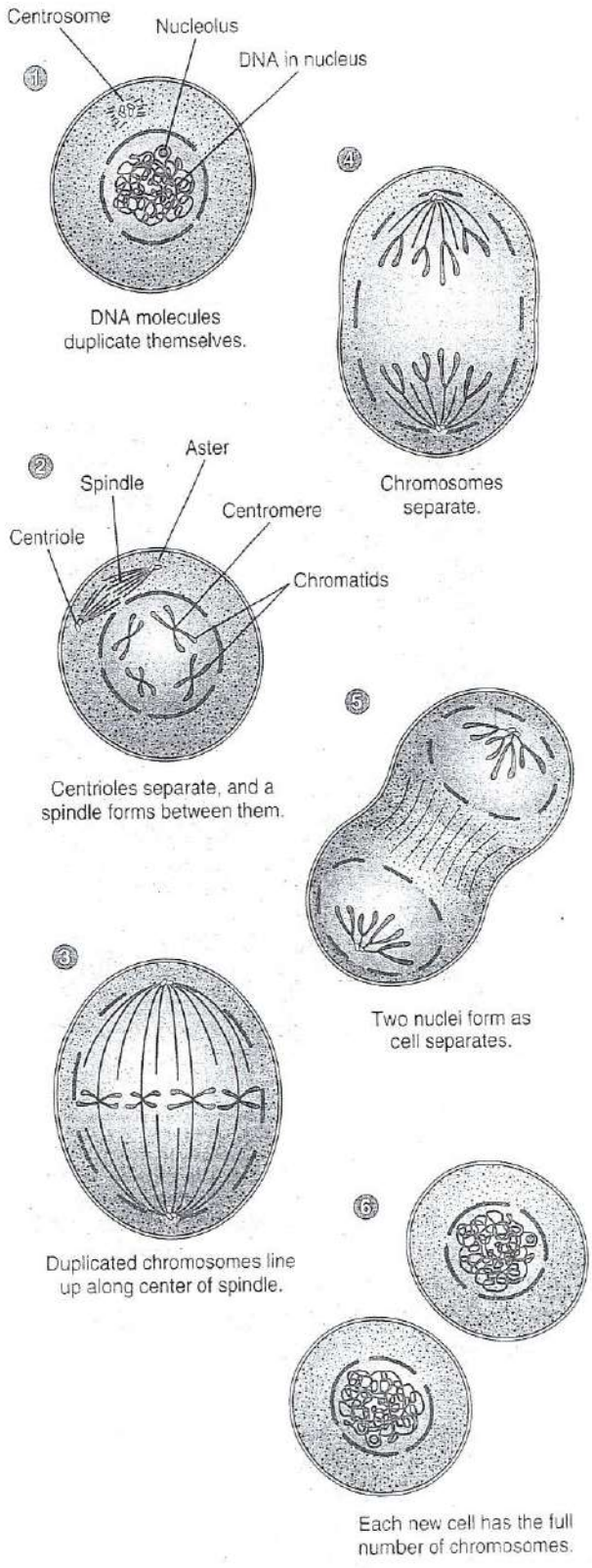



FIGURE 6-2 Mitosis is a form of asexual reproduction where a cell divides into two identical cells.

enlarged with exercise. Some specialized cells, such as nerve cells in the brain and spinal cord, do not reproduce after birth. If these cells are damaged or destroyed, others are not formed to replace them.

Prior to mitosis, the chromatin material in the nucleus condenses to form chromosomes, and an exact duplicate of each chromosome is made. Each chromosome then consists of two identical strands, called *chromatids*, joined together by a structure called a *centromere*. When mitosis begins, the two centrioles in the centrosome move to opposite ends of the cell. A spindle of threadlike fibers trails from the centrioles. The nuclear membrane disappears, and the pairs of duplicated chromosomes attach to the spindles at the center of the cell. The chromatids then split from their duplicated halves and move to opposite ends of the cell. Each end now has 46 chromosomes or 23 pairs. The cytoplasm divides, and a new cell membrane forms to create two new identical cells.

Sex cells (gametes) divide by a process known as **meiosis**. This process uses two separate cell divisions to produce four new cells. When female cells (ova) or male cells (spermatozoa or sperm) divide by meiosis, the number of chromosomes is reduced to 23, or one-half the number found in cells created by mitosis. When an ovum and sperm join to create a new life, the zygote, or new cell, has 46 chromosomes: 23 from the ovum and 23 from the sperm. Thus, the zygote has 46, or 23 pairs, of chromosomes, the normal number for all body cells except the sex cells.

Immediately after the ovum and sperm join to form a zygote, the zygote begins a period of rapid mitotic division. Within four to five days, the zygote is a hollow ball-like mass of cells called a *blastocyst*. Within this blastocyst are embryonic *stem cells*. These stem cells have the ability to transform themselves into any of the body's specialized cells and perform many different functions. A controversial area of research is now concentrated on these stem cells. Scientists are attempting to determine whether stem cells can be transplanted into the body and used to cure diseases such as diabetes mellitus, Parkinson's, heart disease, osteoporosis, and arthritis. The hope is that the stem cells can be programmed to produce new specialized cells that can replace a body's damaged cells and cure a disease. The controversy arises from the fact that a 4–5 day embryo, capable of creating a new life, is used

to obtain the cells. Right-to-life advocates are strongly opposed to stem cell research if the cells are obtained from embryos. Stem cells also exist in adult tissues, such as bone marrow and the liver. Adult stem cells, however, do not have the ability to evolve into every kind of cell; these stem cells evolve into more cells of their own kind. This controversy will continue as scientists expand stem cell research.

## TISSUE

Although most cells contain the same basic parts, cells vary greatly in shape, size, and special function. When cells of the same type join together for a common purpose, they form a **tissue**. Tissues are 60 percent to 99 percent water with various dissolved substances. This water is slightly salty in nature and is called *tissue fluid*. If there is an insufficient amount (not enough tissue fluid), a condition called **dehydration** occurs. When there is an excess amount (too much tissue fluid), a condition called **edema**, or swelling of the tissues, occurs.

There are four main groups of tissues: epithelial, connective, nerve, and muscle (see figure 6-3).

**Epithelial tissue** covers the surface of the body and is the main tissue in the skin. It forms the lining of the intestinal, respiratory, circulatory, and urinary tracts, as well as that of other body cavities. Epithelial tissue also forms the body glands where it specializes to produce specific secretions for the body.

**Connective tissue** is the supporting fabric of organs and other body parts. There are two main classes of connective tissue: soft and hard. Soft connective tissue includes adipose, or fatty, tissue (which stores fat as a food reserve [or source of energy], insulates the body, and acts as padding) and fibrous connective tissue, such as ligaments and tendons (which help hold body structures together). Hard connective tissue includes cartilage and bone. Cartilage is a tough, elastic material that is found between the bones of the spine and at the end of long bones. It acts as a shock absorber and allows for flexibility. It is also found in the nose, ears, and larynx, or "voice box," to provide form or shaping. Bone is similar to cartilage but has calcium salts, nerves, and blood vessels; it is frequently called *osseous tissue*. Bone helps form the rigid structure of the human body. Blood and lymph are classified as liquid connective tissue or *vascular tissue*. Blood carries nutrients and oxygen to the body cells and carries metabolic waste away from cells. Lymph transports tissue fluid, proteins, fats, and other materials from the tissues to the circulatory system.

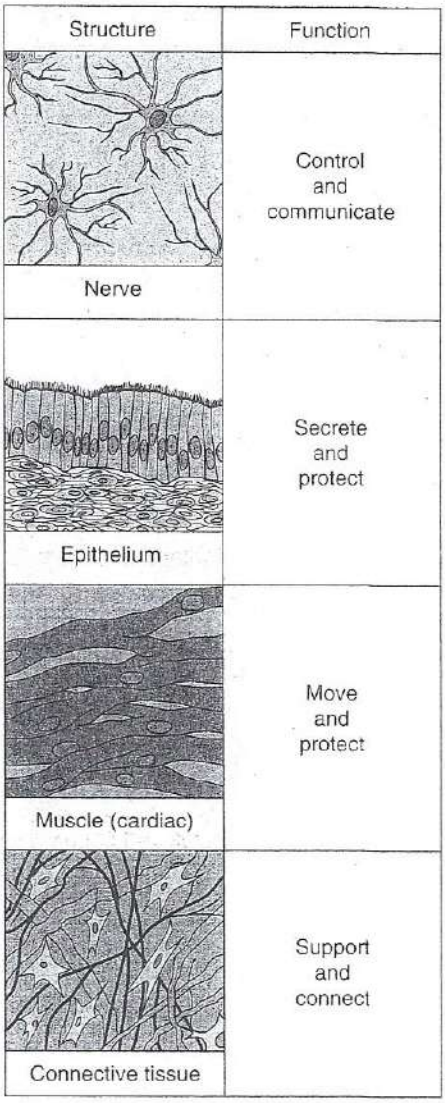



FIGURE 6-3 Four main groups of tissues and their functions.

**Nerve tissue** is made up of special cells called *neurons*. It controls and coordinates body activities by transmitting messages throughout the body. The nerves, brain, and spinal cord are composed of nerve tissue.

**Muscle tissue** produces power and movement by contraction of muscle fibers. There are three main types of muscle tissue: skeletal, cardiac, and visceral (smooth). Skeletal muscle attaches to the bones and provides for movement of the body. Cardiac muscle causes the heart to beat. Visceral

muscle is present in the walls of the respiratory, digestive, urinary tract, and blood vessels.

## ORGANS AND SYSTEMS

Two or more tissues joined together to perform a specific function are called an **organ**. Examples of organs include the heart, stomach, and lungs.

Organs and other body parts joined together to perform a particular function are called a **system**. The basic systems (discussed in more detail in succeeding sections) are the integumentary, skeletal, muscular, circulatory, lymphatic, nervous, respiratory, digestive, urinary (or excretory), endocrine, and reproductive. Their functions and main organs are shown in table 6-1.

In summary, cells combine to form tissues, tissues combine to form organs, and organs and

TABLE 6-1 Systems of the Body

| SYSTEM | FUNCTIONS | MAJOR ORGANS/STRUCTURES |
|---|---|---|
| Integumentary | Protects body from injury, infection, and dehydration; helps regulate body temperature; eliminates some wastes; produces vitamin D | Skin, sweat and oil glands, nails, and hair |
| Skeletal | Creates framework of body, protects internal organs, produces blood cells, acts as levers for muscles | Bones and cartilage |
| Muscular | Produces movement, protects internal organs, produces body heat, maintains posture | Skeletal, smooth, and cardiac muscles |
| Nervous | Coordinates and controls body activities | Nerves, brain, spinal cord |
| Special Senses | Allow body to react to environment by providing sight, hearing, taste, smell, and balance | Eye, ear, tongue, nose, general sense receptors |
| Circulatory | Carries oxygen and nutrients to body cells; carries waste products away from cells; helps produce cells to fight infection | Heart, blood vessels, blood, spleen |
| Lymphatic | Carries some tissue fluid and wastes to blood, assists with fighting infection | Lymph nodes, lymph vessels, spleen, tonsils, and thymus gland |
| Respiratory | Breathes in oxygen and eliminates carbon dioxide | Nose, pharynx, larynx, trachea, bronchi, lungs |
| Digestive | Digests food physically and chemically, transports food, absorbs nutrients, eliminates wastes | Mouth, salivary glands, pharynx, esophagus, stomach, intestine, liver, gallbladder, pancreas |
| Urinary | Filters blood to maintain fluid and electrolyte balance in the body, produces & eliminates urine | Kidneys, ureters, urinary bladder, urethra |
| Endocrine | Produces and secretes hormones to regulate body processes | Pituitary, thyroid, parathyroid, adrenal, and thymus glands; pancreas, ovaries, testes |
| Reproductive | Provides for reproduction | Male: Testes, epididymis, vas deferens, ejaculatory duct, seminal vesicles, prostate gland, penis, urethra<br>Female: Ovaries, fallopian tubes, uterus, vagina, breasts |

other body parts combine to form systems. These systems working together help create the miracle called the human body (see figure 6-4).

**STUDENT:** *Go to the workbook and complete the assignment sheet for 6:1, Basic Structure of the Human Body.*

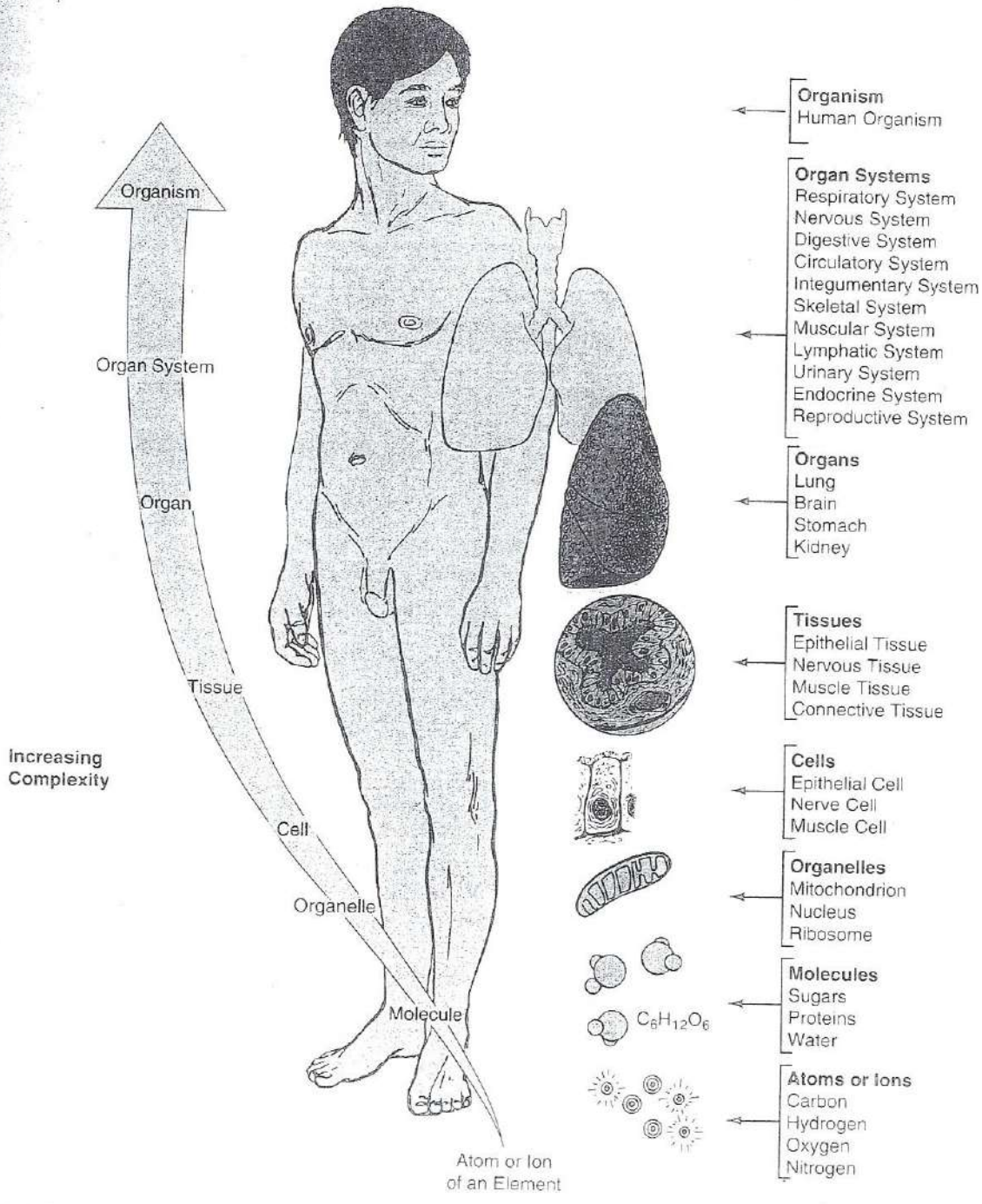



FIGURE 6-4 The levels of complexity in the human organism.

# 6:2 Body Planes, Directions, and Cavities

## Objectives

After completing this section, you should be able to:

- Label the names of the planes and the directional terms related to these planes on a diagram of the three planes of the body
- Label a diagram of the main body cavities
- Identify the main organs located in each body cavity
- Locate the nine abdominal regions
- Define, pronounce, and spell all the key terms

## KEY TERMS

**abdominal cavity**
**abdominal regions**
**anterior**
**body cavities**
**body planes**
**buccal cavity**
**caudal**
*(kaw'-doll)*
**cranial**
*(kray'-nee-al)*
**cranial cavity**
**distal**
**dorsal**
**dorsal cavity**
**frontal (coronal) plane**
**inferior**
**lateral**
*(lat'-eh-ral)*
**medial**
*(me'-dee-al)*
**midsagittal (median) plane**
*(mid-saj'-ih-tahl)*
**nasal cavity**
**orbital cavity**
**pelvic cavity**
**posterior**
**proximal**
*(prox'-ih-mahl)*
**spinal cavity**
**superior**
**thoracic cavity**
*(tho-rass'-ik)*
**transverse plane**
**ventral**
**ventral cavity**

## 6:2 INFORMATION

Because terms such as *south* and *east* would be difficult to apply to the human body, other directional terms have been developed. These terms are used to describe the relationship of one part of the body to another part.

### BODY PLANES

**Body planes** are imaginary lines drawn through the body at various parts to separate the body into sections. Directional terms are created by these planes. The three main body planes are the transverse, midsagittal, and frontal (see figure 6-5).

The **transverse plane** is a horizontal plane that divides the body into a top half and a bottom half. Body parts above other parts are termed **superior**, and body parts below other parts are termed **inferior**. For instance, the knee is superior to the ankle, but inferior to the hip. Two other directional terms related to this plane include **cranial**, which means body parts located near the head, and **caudal**, which means body parts located near the sacral region of the spinal column (also known as the "tail").

The **midsagittal**, or **median, plane** divides the body into right and left sides. Body parts close to the midline, or plane, are called **medial**, and body parts away from the midline are called **lateral**.

The **frontal**, or **coronal, plane** divides the body into a front section and a back section. Body parts in front of the plane, or on the front of the body, are called **ventral**, or **anterior**. Body parts on the back of the body are called **dorsal**, or **posterior**.

Two other directional terms are **proximal** and **distal**. These are used to describe the location of

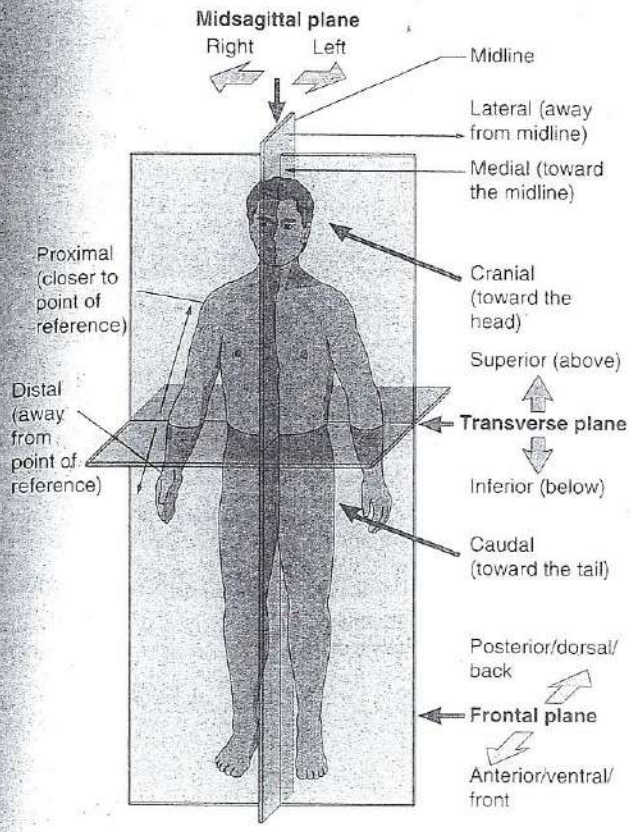



FIGURE 6-5 Body planes and directional terms.

the extremities (arms and legs) in relation to the main trunk of the body, generally called the *point of reference*. Body parts close to the point of reference are called proximal, and body parts distant from the point of reference are called distal. For example, in describing the relationship of the wrist and elbow to the shoulder (or point of reference), the wrist is distal and the elbow is proximal to the shoulder.

## BODY CAVITIES

**Body cavities** are spaces within the body that contain vital organs. There are two main body cavities; the dorsal, or posterior, cavity and the ventral, or anterior, cavity (see figure 6-6).

The **dorsal cavity** is one long, continuous cavity located on the back of the body. It is divided into two sections: the **cranial cavity**, which contains the brain, and the **spinal cavity**, which contains the spinal cord.

The **ventral cavities** are larger than the dorsal cavities. The ventral cavity is separated into two distinct cavities by the dome-shaped muscle called the *diaphragm*, which is important for respiration (breathing). The **thoracic cavity** is located in the chest and contains the esophagus, trachea, bronchi, lungs, heart, and large blood vessels. The **abdominal cavity**, or abdominopelvic cavity, is divided into an upper part and a lower part. The upper abdominal cavity contains the stomach, small intestine, most of the large intestine, appendix, liver, gallbladder, pancreas, and spleen. The lower abdominal cavity, or **pelvic cavity**, contains the urinary bladder, the reproductive organs, and the last part of the large intestine.

Three small cavities are the **orbital cavity** (for the eyes), the **nasal cavity** (for the nose structures), and the **buccal cavity**, or mouth (for the teeth and tongue).

## ABDOMINAL REGIONS

The abdominal cavity is so large that it is divided into regions or sections. One method of division is into quadrants, or four sections. As shown in figure 6-7, this results in a right upper quadrant (RUQ), left upper quadrant (LUQ), right lower quadrant (RLQ), and left lower quadrant (LLQ). Another method of division is into nine **abdominal regions** (see figure 6-8). The center regions are the epigastric (above the stomach), umbilical (near the umbilicus, or belly button), and hypogastric, or pelvic (below the stomach). On either side of the center the regions are the hypochondriac (below the ribs), lumbar (near the large bones of the spinal cord), and iliac, or inguinal (near the groin).

The terms relating to body planes, directions, and cavities are used frequently in the study of human anatomy.

STUDENT: *Go to the workbook and complete the assignment sheet for 6:2, Body Planes, Directions, and Cavities.*

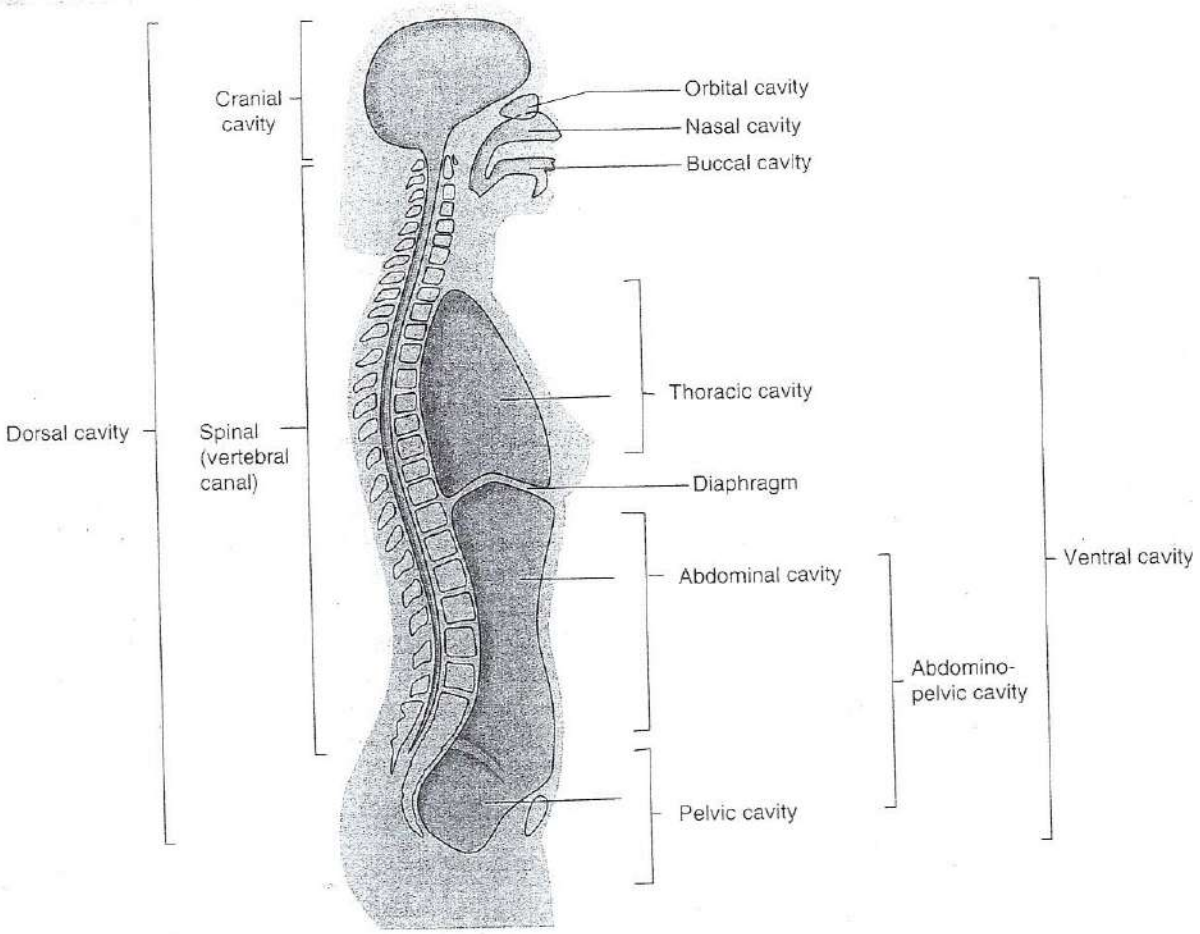



FIGURE 6-6 Body cavities.

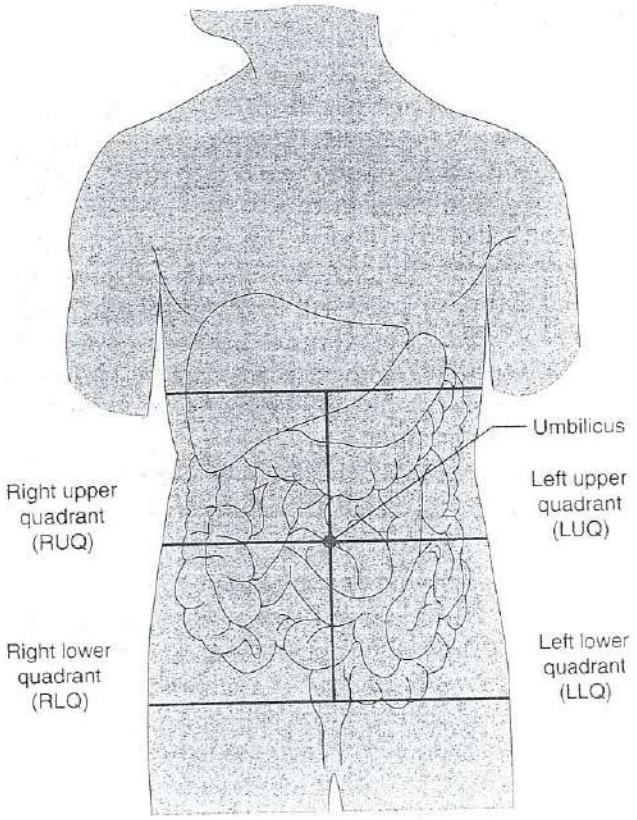



FIGURE 6-7 Abdominal quadrants.

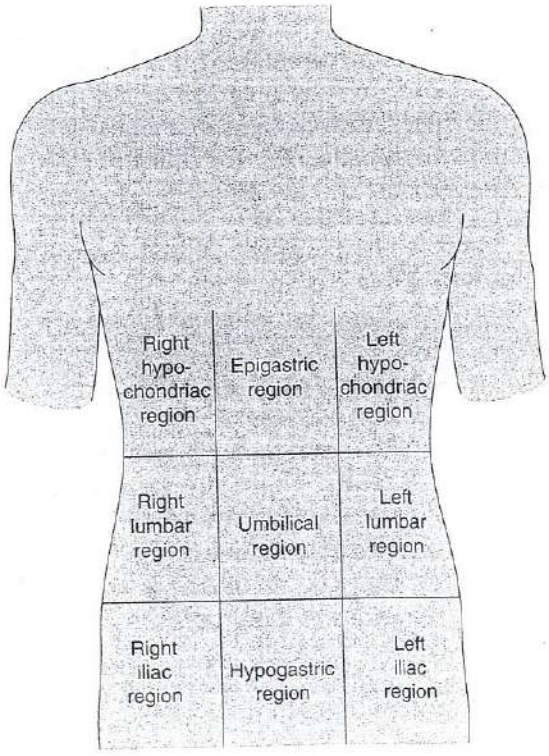



FIGURE 6-8 Nine abdominal regions.

# 6:3 Integumentary System

## Objectives

After completing this section, you should be able to:

- Label a diagram of a cross section of the skin
- Differentiate between the two types of skin glands
- List six functions of the skin
- Provide the correct names for three abnormal colors of the skin and identify the cause of each abnormal color
- Describe at least four skin eruptions
- Describe at least four diseases of the integumentary system
- Define, pronounce, and spell all the key terms

## KEY TERMS

**albino**
**alopecia**
**constrict** *(kun-strict')*
**crusts**
**cyanosis** *(sy"-eh-noh'-sis)*
**dermis**
**dilate** *(die'-late)*
**epidermis** *(eh-pih-der'-mis)*
**erythema** *(err-ih-thee'-ma)*
**integumentary system** *(in-teg-u-men'-tah-ree)*
**jaundice** *(jawn'-diss)*
**macules** *(mack'-youlz)*
**papules** *(pap'-youlz)*
**pustules** *(pus'-tyoulz)*
**sebaceous glands** *(seh-bay'-shus)*
**subcutaneous fascia (hypodermis)** *(sub-q-tay'-nee-us fash'-ee-ah)*
**sudoriferous glands** *(sue-de-rif'-eh-rus)*
**ulcer**
**vesicles** *(ves'-i-kulz)*
**wheals**

## RELATED HEALTH CAREERS

- Allergist
- Dermatologist
- Plastic Surgeon

## 6:3 INFORMATION

The **integumentary system**, or skin, has been called both a membrane, because it covers the body, and an organ, because it contains several kinds of tissues. Most anatomy courses, however, refer to it as a system because it has organs and other parts that work together to perform a particular function.

Three main layers of tissue make up the skin (see figure 6-9):

**Epidermis**—the outermost layer of skin. This layer is actually made of five smaller layers but no blood vessels or nerve cells. Two main layers are the *stratum corneum*, the outermost layer, and the *stratum germinativum*, the innermost layer. The cells of the stratum corneum are constantly shed and replaced by new cells from the stratum germinativum.

**Dermis**—also called *corium*, or "true skin." This layer has a framework of elastic connective tissue and contains blood vessels; lymph vessels; nerves; involuntary muscle; sweat and oil glands; and hair follicles. The top of the dermis is covered with papillae, which fit into ridges on the stratum germinativum of the epidermis. These ridges form lines, or striations, on the skin. Because the pattern of

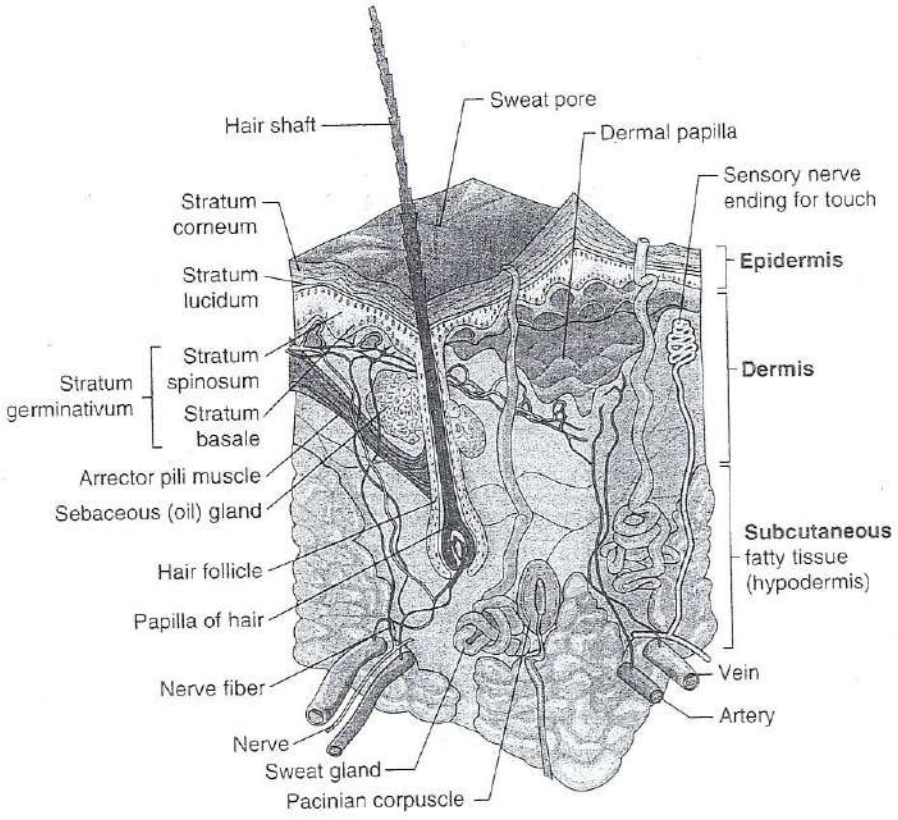



FIGURE 6-9 Cross-section of skin.

ridges is unique to each individual, fingerprints and footprints are often used as methods of identification.

- **Subcutaneous fascia** or **hypodermis**—the innermost layer. It is made of elastic and fibrous connective tissue and adipose (fatty) tissue, and connects the skin to underlying muscles.

The integumentary system has two main types of glands: sudoriferous and sebaceous. The **sudoriferous glands** (sweat glands) are coiled tubes that extend through the dermis and open on the surface of the skin at pores. The sweat, or perspiration, eliminated by these glands contains water, salts, and some body wastes. The **sebaceous glands** are oil glands that usually open onto hair follicles. They produce sebum, an oil that keeps the skin and hair from becoming dry and brittle. Because sebum is an antibacterial and antifungal secretion, it also helps prevent infections. When an oil gland becomes plugged, the accumulation of dirt and oil results in a blackhead or pimple.

Two other parts of the integumentary system are the hair and nails. Each hair consists of a root (which grows in a hollow tube, called a *follicle*) and a hair shaft. Hair helps protect the body and covers all body surfaces except for the palms of the hands and the soles of the foot. Due to genetics, males (and some females) may experience **alopecia** or baldness, a permanent loss of hair on the scalp. Nails protect the fingers and toes from injury. They are made of dead, keratinized epidermal epithelial cells packed closely together to form a thick, dense surface. They are formed in the nail bed. If lost, nails will regrow if the nail bed is not damaged.

## FUNCTIONS

The integumentary system performs the following important functions:

- *Protection*—It serves as a barrier to the sun's ultraviolet rays and the invasion of pathogens, or germs. It also holds moisture in and prevents deeper tissues from drying out.
- *Sensory perception*—The nerves in the skin help the body respond to pain, pressure, temperature (heat and cold), and touch sensations, figure 6-10.
- *Body temperature regulation*—The blood vessels in the skin help the body retain or lose heat. When the blood vessels **dilate** (get

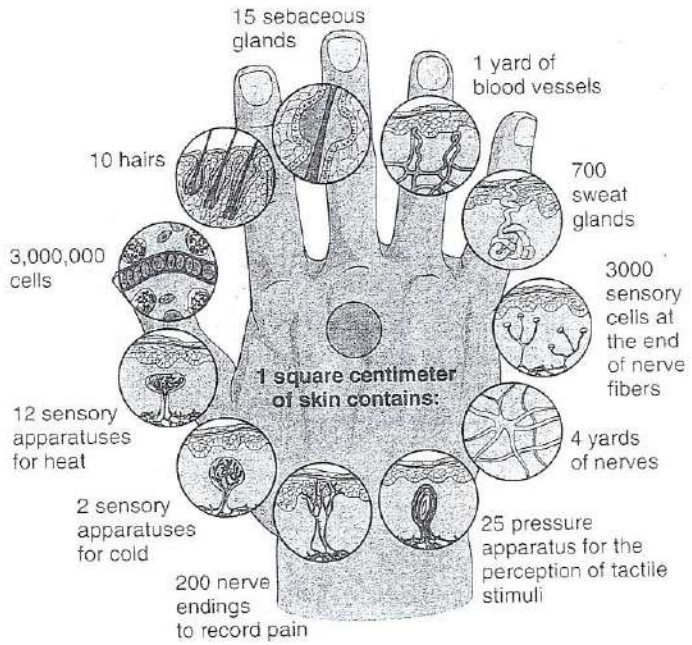



**FIGURE 6-10** The nerves in the skin allow the body to respond to many different sensations.

larger), excess heat from the blood can escape through the skin. When the blood vessels **constrict** (get smaller), the heat is retained in the body. The sudoriferous glands also help cool the body through evaporation of perspiration.

- *Storage*—The skin has tissues for temporary storage of fat, glucose (sugar), water, vitamins, and salts. Adipose (fatty) tissue in the subcutaneous fascia is a source of energy.
- *Absorption*—Certain substances can be absorbed through the skin, such as motion sickness or heart disease medications and nicotine patches to help stop smoking. The medications are placed on sticky patches and applied to the skin. This is called a transdermal medication.
- *Excretion*—The skin helps the body eliminate salt, a minute amount of waste, and excess water and heat through perspiration.
- *Production*—The skin helps in the production of vitamin D by using ultraviolet rays from the sun to form an initial molecule of vitamin D that matures in the liver.

## PIGMENTATION

Basic skin color is inherited and is determined by pigments in the epidermis of the skin. Melanin, a brownish-black pigment, can lead to a black, brown, or yellow skin tint, depending on racial origin. Melanin can also absorb ultraviolet light to tan the skin. Small concentrated areas of melanin pigment form freckles. Carotene, a yellowish-red pigment, also helps determine skin color. A person with an absence of color pigments is an **albino**. An albino's skin has a pinkish tint and the hair is pale yellow or white. The person's eyes also lack pigment and are red in color and very sensitive to light.

Abnormal colors of the skin can indicate disease. **Erythema** is a reddish color of the skin that can be caused by either burns or a congestion of blood in the vessels. **Jaundice**, a yellow discoloration of the skin, can indicate bile in the blood as a result of liver or gallbladder disease. Jaundice also occurs in conjunction with certain diseases that involve the destruction of red blood cells. **Cyanosis** is a bluish discoloration of the skin caused by insufficient oxygen. It can be associated with heart, lung, and circulatory diseases or disorders. Chronic poisoning may cause a gray or brown skin discoloration.

## SKIN ERUPTIONS

Skin eruptions can also indicate disease. The most common eruptions include:

- **Macules**: (macular rash) flat spots on the skin, such as freckles.

- **Papules**: (papular rash) firm, raised areas such as pimples and the eruptions seen in some stages of chickenpox and syphilis.
- **Vesicles**: blisters, or fluid-filled sacs, such as those seen in chickenpox.
- **Pustules**: pus-filled sacs such as those seen in acne, or pimples.
- **Crusts**: areas of dried pus and blood, commonly called "scabs."
- **Wheals**: itchy, elevated areas with an irregular shape; hives and insect bites are examples.
- **Ulcer**: a deep loss of skin surface that may extend into the dermis; may cause periodic bleeding and the formation of scars.

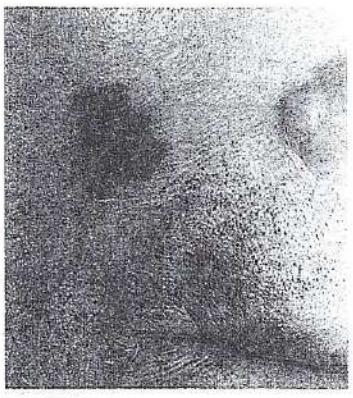


FIGURE 6-11 Melanoma is the most dangerous form of skin cancer. *(Courtesy of Robert A. Silverman, MD, Pediatric Dermatology, Georgetown University)*

## DISEASES AND ABNORMAL CONDITIONS

*Acne vulgaris* is an inflammation of the sebaceous glands. Although the cause is unknown, acne usually occurs at adolescence. Hormonal changes and increased secretion of sebum are probably underlying causes. Symptoms include papules, pustules, and blackheads. These occur when the hair follicles become blocked with dirt, cosmetics, excess oil, and/or bacteria. Treatment methods include frequent, thorough skin washing; avoiding creams and heavy makeup; antibiotic or vitamin A ointments; oral antibiotics; and/or ultraviolet light treatments.

*Athlete's foot* is a contagious fungal infection that usually affects the feet. The skin itches, blisters, and cracks into open sores. Treatment involves applying an antifungal medication and keeping the area clean and dry.

*Cancer of the skin* occurs in different forms such as basal cell carcinoma, squamous cell carcinoma, and malignant melanoma, figure 6-11. Frequently, skin cancer develops from a mole or nevus that changes in color, shape, size, or texture. Bleeding or itching of a mole can also indicate cancer. Exposure to the sun, prolonged use of tanning beds, irritating chemicals, or radiation are the usual causes of skin cancer. Treatment involves surgical removal of the cancer and/or radiation.

*Dermatitis*, an inflammation of the skin, can be caused by any substance that irritates the skin. It is frequently an allergic reaction to detergents, cosmetics, pollen, or certain foods. One

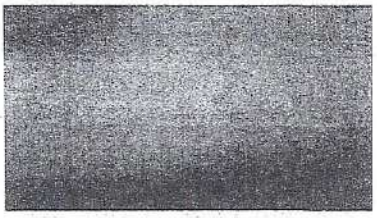


FIGURE 6-12 A contact dermatitis caused by contact with poison oak. *(Courtesy of the Centers for Disease Control and Prevention)*

example of contact dermatitis is the irritation caused by contact with poison ivy, poison sumac, or poison oak (see figure 6-12). Symptoms include dry skin, erythema, itching, edema, macular-papular rashes, and scaling. Treatment is directed at eliminating the cause, especially in the case of allergens. Anti-inflammatory ointments, antihistamines, and/or steroids are also used in treatment.

*Eczema* is a noncontagious, inflammatory skin disorder caused by an allergen or irritant. Diet, cosmetics, soaps, medications, and emotional stress can all cause eczema. Symptoms include dryness, erythema, edema, itching, vesicles, crusts, and scaling. Treatment involves removing the irritant and applying corticosteroids to reduce the inflammatory response.

*Impetigo* is a highly contagious skin infection usually caused by streptococci or staphylococci organisms. Symptoms include erythema, oozing vesicles, pustules, and the formation of a yellow crust. Lesions should be washed with soap and water and kept dry. Antibiotics, both topical and oral, are also used in treatment.

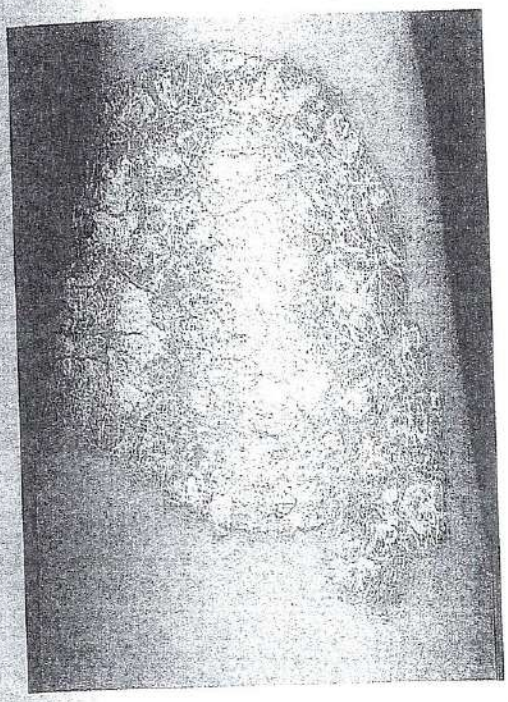


FIGURE 6-13 Psoriasis is characterized by white or silver scales. *(Courtesy of Robert A. Silverman, MD, Pediatric Dermatology, Georgetown University)*

*Psoriasis* is a chronic, noncontagious, inherited skin disease (see figure 6-13). Symptoms include thick, red areas covered with white or silver scales. Although there is no cure, treatment methods include coal/tar or cortisone ointments; ultraviolet light; and/or scale removal.

*Ringworm* is a highly contagious fungus infection of the skin or scalp. The characteristic symptom is the formation of a flat or raised circular area with a clear central area surrounded by an itchy, scaly, or crusty outer ring. Antifungal medications, both oral and topical, are used in treatment.

*Verrucae,* or warts, are caused by a viral infection of the skin. A rough, hard, elevated, rounded surface forms on the skin. Some warts disappear spontaneously, but others must be removed with electricity, liquid nitrogen, acid, chemicals, or laser.

**STUDENT:** *Go to the workbook and complete the assignment sheet for 6:3, Integumentary System.*

## 6:4 Skeletal System

### Objectives

After completing this section, you should be able to:

- List five functions of bones
- Label the parts of a bone on a diagram of a long bone
- Name the two divisions of the skeletal system and the main groups of bones in each division
- Identify the main bones of the skeleton
- Compare the three classifications of joints by describing the type of motion allowed by each
- Give one example of each joint classification
- Describe at least four diseases of the skeletal system
- Define, pronounce, and spell all the key terms

### KEY TERMS

appendicular skeleton *(ap-pen-dick'-u-lar)*
axial skeleton
carpals
clavicles *(klav'-ih-kulz)*
cranium
diaphysis *(dy-af'-eh-sis)*
endosteum *(en-dos'-tee-um)*
epiphysis *(ih-pif'-eh-sis)*
femur *(fee'-mur)*
fibula *(fib'-you-la)*
fontanels
foramina *(for-ahm'-e-nah)*
humerus *(hue'-mer-us)*
joints
ligaments
medullary canal *(med'-hue-lair-ee)*

(continued)

*(Key Terms Continued)*

**metacarpals**
*(met-ah-car'-pulz)*
**metatarsals**
*(met-ah-tar'-sulz)*
**os coxae**
*(ahs cock'-see)*
**patella**
*(pa-tell'-ah)*
**periosteum**
*(per-ee-os'-tee-um)*
**phalanges**
*(fa-lan'-jeez)*
**radius**
**red marrow**
**ribs**
**scapula**
**sinuses**
*(sigh'-nuss-ez)*
**skeletal system**
**sternum**
**sutures**
**tarsals**
**tibia**
**ulna**
**vertebrae**
*(vur'-teh-bray)*
**yellow marrow**

## RELATED HEALTH CAREERS

- Athletic Trainer
- Chiropractor
- Orthopedist
- Osteopathic physician
- Physiatrist
- Physical Therapist
- Podiatrist
- Prosthetist
- Radiologic Technologist
- Sports Medicine

## 6:4 INFORMATION

The **skeletal system** is made of organs called *bones.* An adult human has 206 bones. These bones work as a system to perform the following functions:

- *Framework*—The bones form a framework to support the body's muscles, fat, and skin.
- *Protection*—Bones surround vital organs to protect them. Examples include the skull, which surrounds the brain, and the ribs, which protect the heart and lungs.
- *Levers*—Muscles attach to bones to help provide movement.
- *Production of blood cells*—Bones help produce red and white blood cells and platelets, a process called *hemopoiesis* or *hematopoiesis.*
- *Storage*—Bones store most of the calcium supply of the body.

Bones vary in shape and size depending on their locations within the body. Bones of the extremities (arms and legs) are called *long bones.* The basic parts of these bones are shown in figure 6-14. The long shaft is called the **diaphysis**, and the two extremities, or ends, are each called an **epiphysis**. The **medullary canal** is a cavity in the diaphysis. It is filled with **yellow marrow**, which is mainly fat cells. The **endosteum** is a membrane that lines the medullary canal and keeps the yellow marrow intact. It also produces some bone growth. **Red marrow** is found in certain bones such as the vertebrae, ribs, sternum, and cranium, and in the proximal ends of the humerus and femur. It produces red blood cells (erythrocytes), platelets (thrombocytes), and some white blood cells (leukocytes). Because bone marrow is important in the manufacture of blood cells and is involved with the body's immune response, the red marrow is used to diagnose blood diseases and is sometimes transplanted in people with defective immune systems. The outside of bone is covered with a tough membrane, called the **periosteum**, which contains blood vessels, lymph vessels, and *osteoblasts,* special cells that form new bone tissue. The periosteum is necessary for bone growth, repair, and nutrition. A thin layer of articular cartilage covers the epiphysis and acts as a shock absorber when two bones meet to form a joint.

The skeletal system is divided into two sections: the axial skeleton and the appendicular skeleton. The **axial skeleton** forms the main trunk of the body and is composed of the skull,

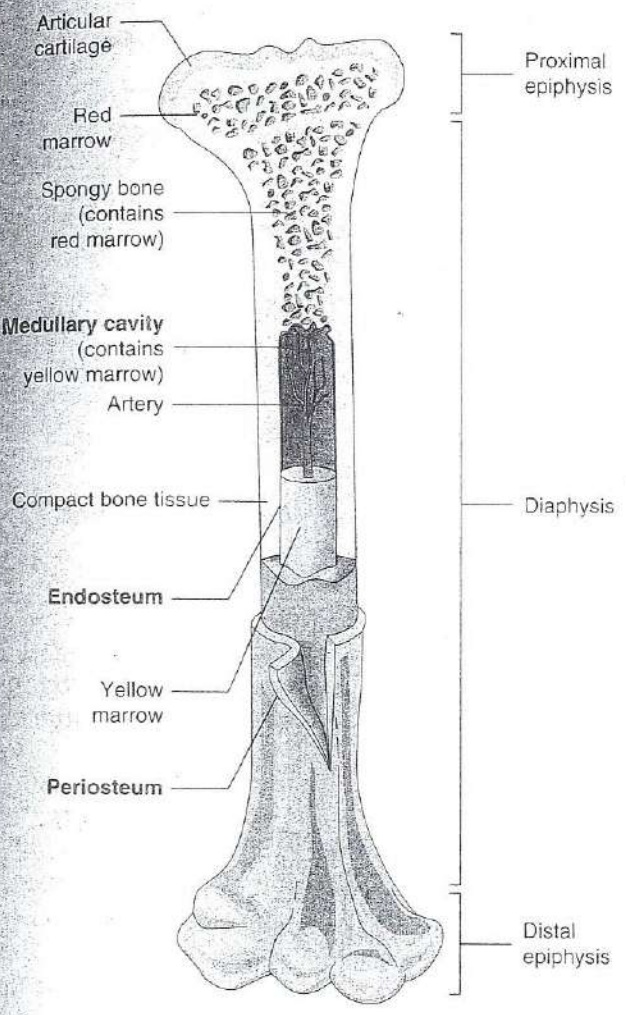
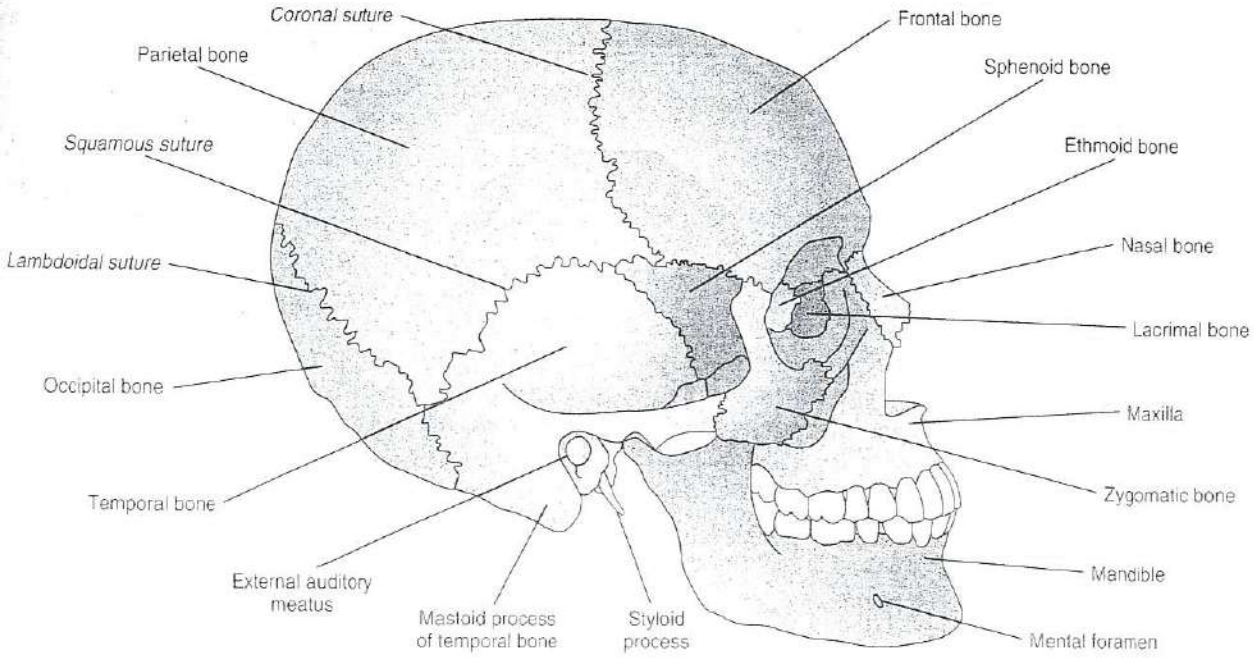



FIGURE 6-14 Anatomical parts of a long bone.

spinal column, ribs, and breastbone. The **appendicular skeleton** forms the extremities and is composed of the shoulder girdle, arm bones, pelvic girdle, and leg bones.

The skull is composed of the cranial and facial bones (see figure 6-15). The **cranium** is the spherical structure that surrounds and protects the brain. It is made of eight bones: one frontal, two parietal, two temporal, one occipital, one ethmoid, and one sphenoid. At birth, the cranium is not solid bone. Spaces called **fontanels**, or "soft spots," allow for the enlargement of the skull as brain growth occurs. The fontanels are made of membrane and cartilage and turn into solid bone by approximately 18 months of age. There are 14 facial bones: one mandible (lower jaw), two maxilla (upper jaw), two zygomatic (cheek), two lacrimal (inner aspect of eyes), five nasal, and two palatine (hard palate or roof of the mouth). **Sutures** are areas where the cranial bones have joined together. **Sinuses** are air spaces in the bones of the skull that act as resonating chambers for the voice. They are lined with mucous membranes. **Foramina** are openings in bones that allow nerves and blood vessels to enter or leave the bone.

The spinal column is made of 26 bones called **vertebrae** (see figure 6-16). These bones protect the spinal cord and provide support for the head and trunk. They include seven cervical (neck), twelve thoracic (chest), five lumbar




Bones of the skull.

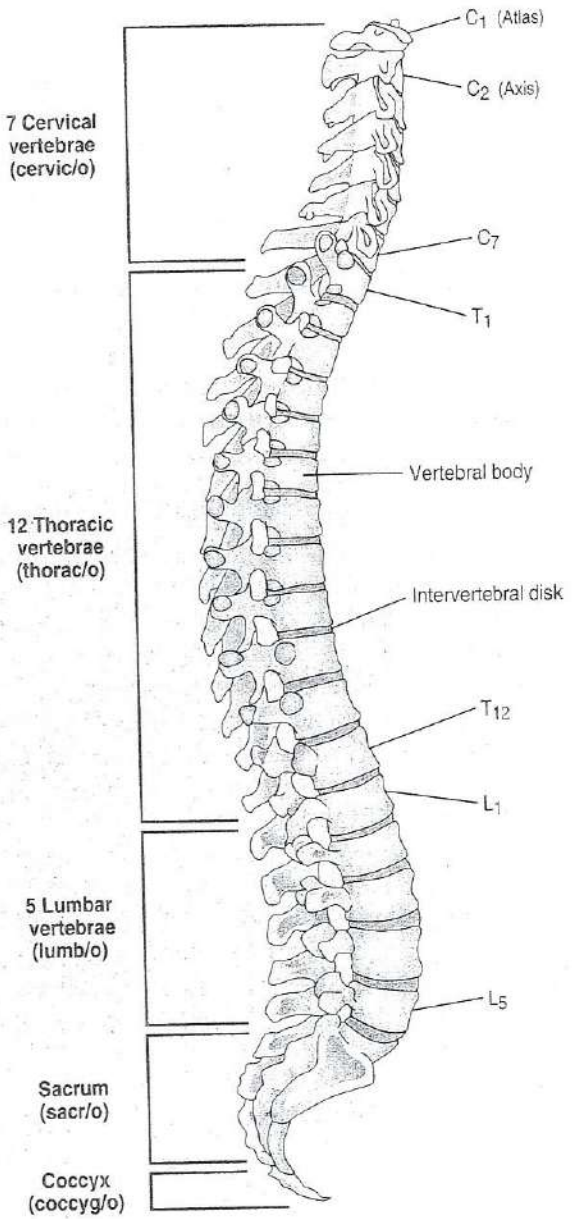



FIGURE 6-16 Lateral view of the vertebral, or spinal, column.

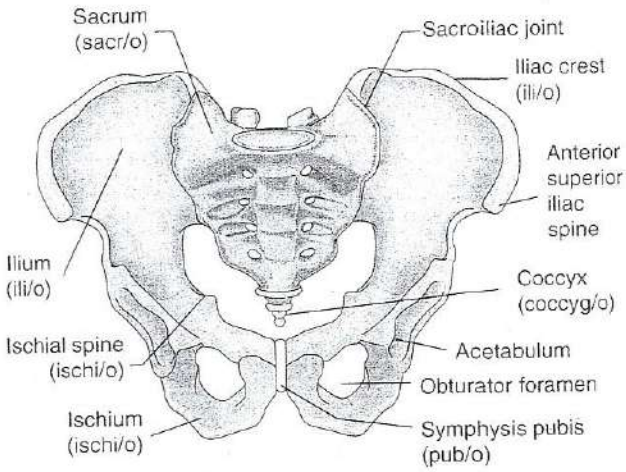



FIGURE 6-17 Anterior view of the pelvic girdle.

(waist), one sacrum (back of pelvic girdle), and one coccyx (tailbone). Pads of cartilage tissue, called *intervertebral disks,* separate the vertebrae. The disks act as shock absorbers and permit bending and twisting movements of the vertebral column.

There are 12 pairs of **ribs**, or costae. They attach to the thoracic vertebrae on the dorsal surface of the body. The first seven pairs are called *true ribs* because they attach directly to the sternum, or breastbone, on the front of the body. The next five pairs are called *false ribs*. The first three pairs of false ribs attach to the cartilage of the rib above. The last two pairs of false ribs are called *floating ribs* because they have no attachment on the front of the body.

The **sternum** or breastbone is the last bone of the axial skeleton. It consists of three parts: the manubrium (upper region), the gladiolus (body), and the xiphoid process (a small piece of cartilage at the bottom). The two collarbones, or clavicles, are attached to the manubrium by ligaments. The ribs are attached to the sternum with costal cartilages to form a "cage" that protects the heart and lungs.

The shoulder, or pectoral, girdle is made of two **clavicles** (collarbones) and two **scapulas** (shoulder bones). The scapulas provide for attachment of the upper arm bones.

Bones of each arm include one **humerus** (upper arm), one **radius** (lower arm on thumb side), one **ulna** (larger bone of lower arm with a projection called the *olecranon process* at its upper end, forming the elbow), eight **carpals** (wrist), five **metacarpals** (palm of the hand), and fourteen **phalanges** (fingers).

The pelvic girdle is made of two **os coxae** (coxal, or hip, bones), which join with the sacrum on the dorsal part of the body (see figure 6-17). On the ventral part of the body, the os coxae join together at a joint called the *symphysis pubis.* Each os coxae is made of three fused sections: the ilium, the ischium, and the pubis. The pelvic girdle contains two recessed areas, or sockets. These sockets, called *acetabula,* provide for the attachment of the leg bones. An opening between the ischium and pubis, called the *obturator foramen,*

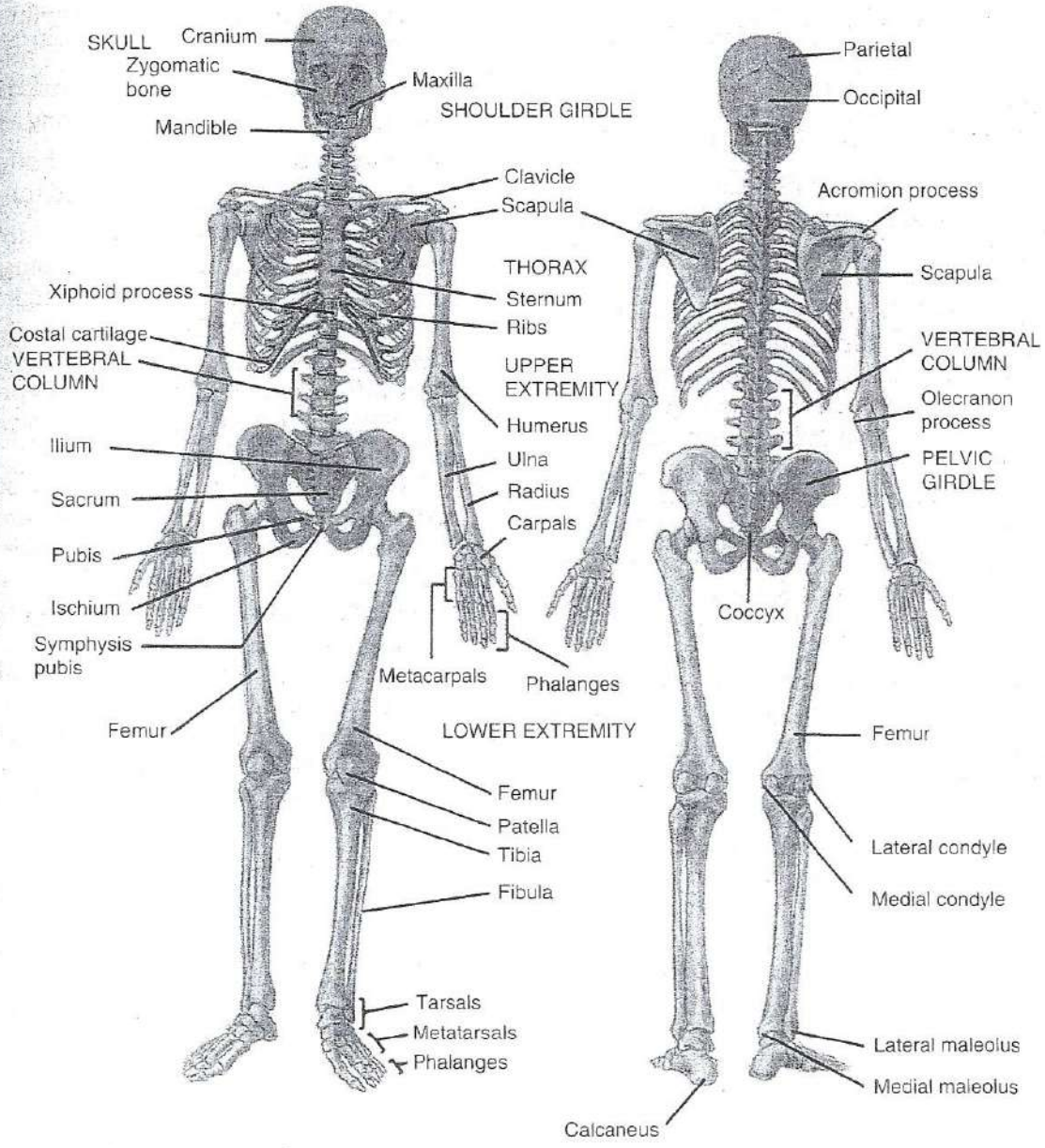



FIGURE 6-18 Bones of the skeleton.

allows for the passage of nerves and blood vessels to and from the legs.

Each leg consists of one **femur** (thigh); one **patella** (kneecap); one **tibia** and one **fibula** (lower leg); seven **tarsals** (ankle); five **metatarsals** (instep of foot); and fourteen **phalanges** (toes). The heel is formed by the large tarsal bone called the *calcaneous*. The bones of the skeleton are shown in figure 6-18.

**Joints** are areas where two or more bones join together. Connective tissue bands, called **ligaments**, help hold long bones together at joints. There are three main types of joints:

- *Diarthrosis:* freely movable; examples include the ball-and-socket joints of the shoulder and hip, or the hinge joints of the elbow and knee
- *Amphiarthrosis:* slightly movable; an example is the attachment of the ribs to the thoracic vertebrae
- *Synarthrosis:* immovable; an example is the cranium

## DISEASES AND ABNORMAL CONDITIONS

*Arthritis* is actually a group of diseases involving inflammation of the joints. Two main types are osteoarthritis and rheumatoid arthritis. Osteoarthritis, the most common form, is a chronic disease that usually occurs as a result of aging. It frequently affects the hips and knees. Symptoms include joint pain, stiffness, aching, and limited range of motion. Although there is no cure, rest, applications of heat and cold, aspirin and anti-inflammatory medications, injection of steroids into the joints, and special exercises are used to relieve the symptoms. Rheumatoid arthritis is a chronic, inflammatory disease affecting the connective tissues and joints. It is three times more common in women than in men and onset often occurs between the ages of 35 and 45. Progressive attacks can cause scar tissue formation and atrophy of bone and muscle tissue, which result in permanent deformity and immobility. Early treatment is important to reduce pain and limit damage to joints. Rest, prescribed exercise, anti-inflammatory medications such as aspirin, and careful use of steroids are the main forms of treatment. Surgery, or arthroplasty, to replace damaged joints, such as those in the hips and knees, is sometimes performed when severe joint damage has occurred.

*Bursitis* is an inflammation of the bursae, small, fluid-filled sacs surrounding the joints. It frequently affects the shoulders, elbows, hips, or knees. Symptoms include severe pain, limited movement, and fluid accumulation in the joint. Treatment consists of administering pain medications; injecting steroids and anesthetics into the affected joint; rest; aspirating (withdrawing fluid with a needle) the joint; and physical therapy to preserve joint motion.

A *fracture* is a crack or break in a bone. Types of fractures, shown in figure 6-19, include:

- *Greenstick:* bone is bent and splits, causing a crack or incomplete break; common in children
- *Simple* or *closed:* complete break of the bone with no damage to the skin
- *Compound* or *open:* bone breaks and ruptures through the skin; creates an increased chance of infection
- *Impacted:* broken bone ends jam into each other
- *Comminuted:* bone fragments or splinters into more than two pieces
- *Spiral:* bone twists resulting in one or more breaks; common in skiing and skating accidents
- *Depressed:* a broken piece of skull bone moves inward; common with severe head injuries
- *Colles:* breaking and dislocation of the distal radius that causes a characteristic bulge at the wrist; caused by falling on an outstretched hand

Before a fracture can heal, the bone must be put back into its proper alignment. This process is called *reduction. Closed reduction* involves positioning the bone in correct alignment, usually with traction, and applying a cast or splint to maintain the position until the fracture heals. *Open reduction* involves surgical repair of the bone. In some cases, special pins, plates, or other devices are surgically implanted to maintain correct position of the bone.

A *dislocation* is when a bone is forcibly displaced from a joint. It frequently occurs in shoulders, fingers, knees, and hips. After the dislocation is reduced (the bone is replaced in the joint), the dislocation is immobilized with a splint, a cast, or traction.

A *sprain* is when a twisting action tears the ligaments at a joint. The wrists and ankles are common sites for sprains. Symptoms include pain, swelling, discoloration, and limited movement. Treatment methods include rest; elevation; immobilization with an elastic bandage or splint; and/or cold applications.

*Osteomyelitis* is a bone inflammation usually caused by a pathogenic organism. The infectious organisms cause the formation of an abscess within the bone and an accumulation of pus in the medullary canal. Symptoms include pain at the site, swelling, chills, and fever. Antibiotics are used to treat the infection.

*Osteoporosis*, or increased porosity or softening of the bones, is a metabolic disorder caused by a hormone deficiency (especially estrogen in females), prolonged lack of calcium in the diet, and a sedentary lifestyle. The loss of calcium and phosphate from the bones causes the bones to become porous, brittle, and prone to fracture. Bone density tests lead to early detection and preventative treatment for osteoporosis. Treatment methods include increased intake of calcium and vitamin D; medications to increase bone mass; exercise; and/or estrogen replacement.

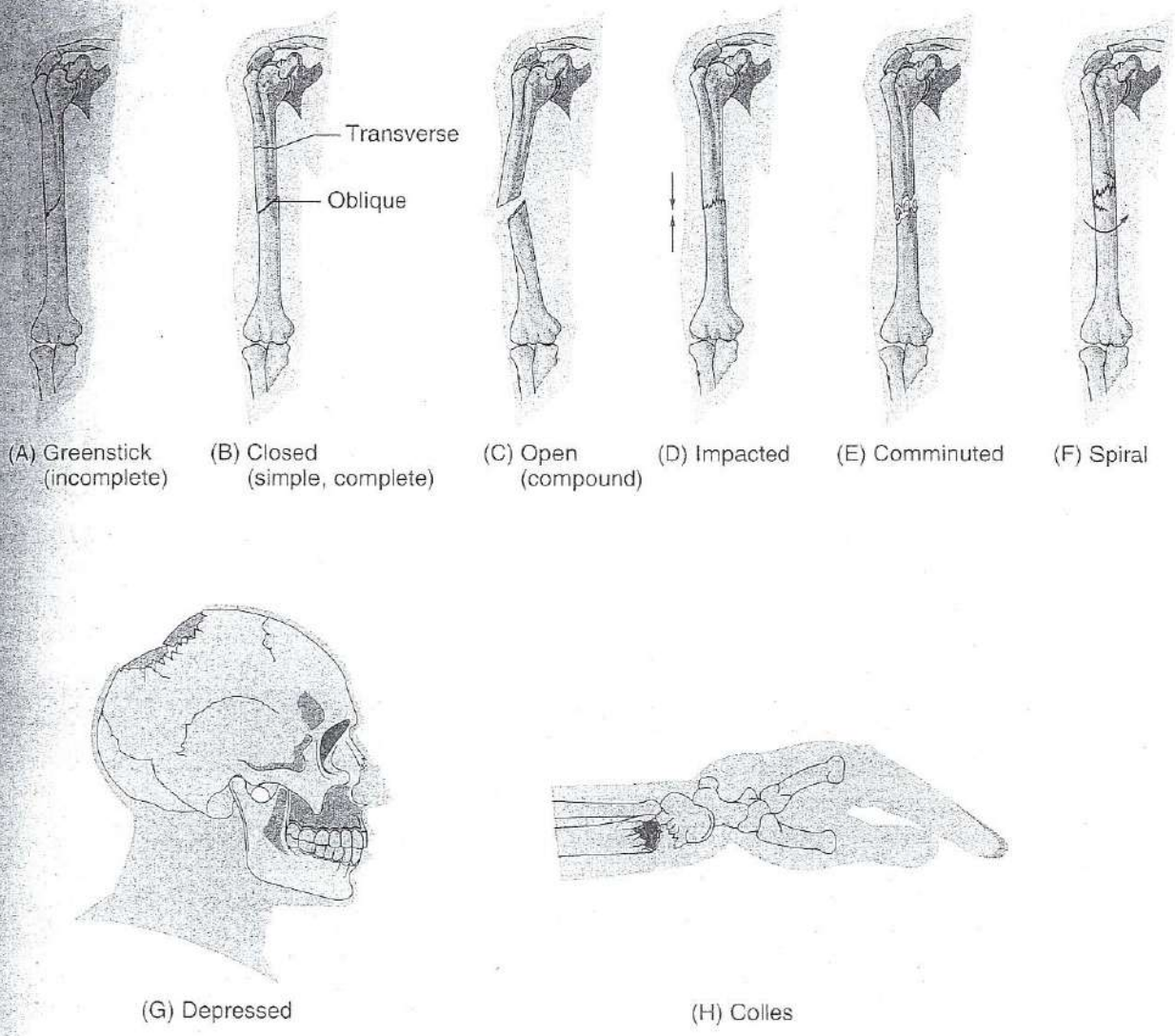



**FIGURE 6-19** Types of fractures.

A *ruptured disk*, also called a herniated or slipped disk, occurs when an intervertebral disk (pad of cartilage separating the vertebrae) ruptures or protrudes out of place and causes pressure on the spinal nerve. The most common site is at the lumbar–sacral area, but a ruptured disk can occur anywhere on the spinal column. Symptoms include severe pain, muscle spasm, impaired movement, and/or numbness. Pain, anti-inflammatory, and muscle relaxant medications may be used as initial forms of treatment. Other treatments include rest, traction, physical therapy, massage therapy, chiropractic treatment, and/or heat or cold applications. A laminectomy, surgical removal of the protruding disk, may be necessary in severe cases that do not respond to conservative treatment.

Abnormal curvatures of the spinal column include *kyphosis, scoliosis,* and *lordosis* (see figure 6-20). Kyphosis, or "hunchback," is a rounded bowing of the back at the thoracic area. Scoliosis is a side-to-side, or lateral, curvature of the spine. Lordosis, or "swayback," is an abnormal inward curvature of the lumbar region. Poor posture, congenital (at birth) defects, structural defects of the vertebrae, malnutrition, and degeneration of the vertebrae can all be causes of these defects. Therapeutic exercises, firm mattresses, and/or braces are the main forms of treatment. Severe deformities may require surgical repair.

STUDENT: *Go to the workbook and complete the assignment sheet for 6:4, Skeletal System.*

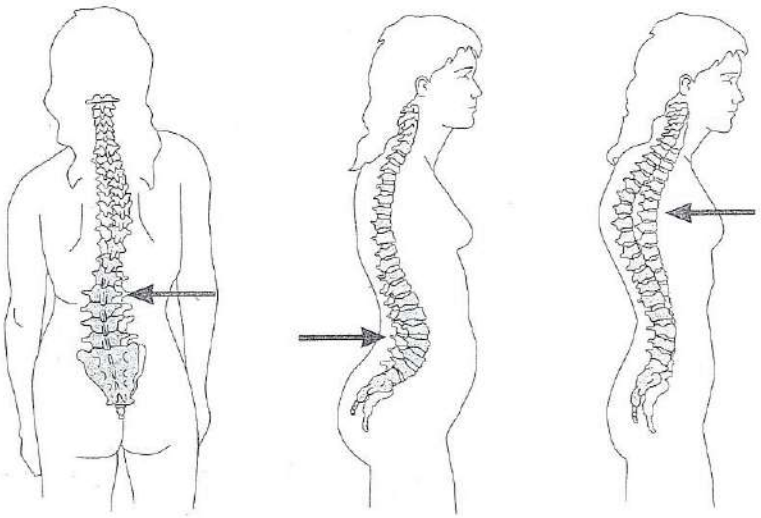



FIGURE 6-20 Abnormal curvatures of the spinal column.

# 6:5 Muscular System

## Objectives

After completing this section, you should be able to:

- Compare the three main kinds of muscle by describing the action of each
- Differentiate between voluntary muscle and involuntary muscle
- List at least three functions of muscles
- Describe the two main ways muscles attach to bones
- Demonstrate the five major movements performed by muscles
- Describe at least three diseases of the muscular system
- Define, pronounce, and spell all the key terms

## KEY TERMS

**abduction** *(ab-duck'-shun)*
**adduction** *(ad-duck'-shun)*
**cardiac muscle**
**circumduction**
**contract** *(con-trackt')*
**contractibility**
**contracture** *(con-track'-shur)*
**elasticity**
**excitability**
**extensibility**
**extension**
**fascia** *(fash'-ee"-ah)*
**flexion** *(flek'-shun)*
**insertion**
**involuntary**
**muscle tone**
**muscular system**
**origin**
**rotation**
**skeletal muscle**
**tendons**
**visceral (smooth) muscle**
**voluntary**

## RELATED HEALTH CAREERS

- Athletic Trainer
- Chiropractor
- Doctor of Osteopathic Medicine
- Massage Therapist
- Myologist
- Orthopedist
- Physiatrist
- Physical Therapist
- Podiatrist
- Prosthetist
- Sports Medicine Physician

## 6:5 INFORMATION

Over 600 muscles make up the system known as the **muscular system**. Muscles are bundles of muscle fibers held together by connective tissue. All muscles have certain properties or characteristics:

- **excitability**: irritability, the ability to respond to a stimulus such as a nerve impulse
- **contractibility**: muscle fibers that are stimulated by nerves **contract**, or become short and thick, which causes movement
- **extensibility**: the ability to be stretched
- **elasticity**: allows the muscle to return to its original shape after it has contracted or stretched

There are three main kinds of muscle: cardiac, visceral, and skeletal (see figure 6-21). **Cardiac muscle** forms the walls of the heart and contracts to circulate blood. **Visceral**, or **smooth, muscle** is found in the internal organs of the body such as those of the digestive and respiratory systems, and the blood vessels and eyes. Visceral muscle contracts to cause movement in these organs. Cardiac muscle and visceral muscle are **involuntary**, meaning they function without conscious thought or control. **Skeletal muscle** is attached to bones and causes body movement. Skeletal muscle is **voluntary** because a person has control over its action. Because cardiac muscle and visceral muscle are discussed in sections on other systems, the following concentrates on skeletal muscle.

Skeletal muscles perform four important functions:

- attach to bones to provide voluntary movement
- produce heat and energy for the body
- help maintain posture
- protect internal organs

Skeletal muscles attach to bones in different ways. Some attach by **tendons**, strong, tough connective-tissue cords. An example is the gastrocnemius muscle on the calf of the leg, which attaches to the heelbone by the Achilles tendon. Other muscles attach by **fascia**, a tough, sheet-like membrane that covers and protects the tissue. Examples include the deep muscles of the trunk and back, which are surrounded by the lumbodorsal fascia. When a muscle attaches to a bone, the end that does not move is called the **origin**. The end that moves when the muscle contracts is called the **insertion**.

A variety of different actions or movements performed by muscles are shown in figure 6-22 and are described as follows:

- **Adduction**—moving a body part toward the midline
- **Abduction**—moving a body part away from the midline
- **Flexion**—decreasing the angle between two bones, or bending a body part
- **Extension**—increasing the angle between two bones, or straightening a body part
- **Rotation**—turning a body part around its own axis; for example, turning the head from side to side
- **Circumduction**—moving in a circle at a joint, or moving one end of a body part in a circle while the other end remains stationary, such as swinging arm in a circle

The major muscles of the body are shown in figure 6-23; the locations and actions of the major muscles are noted in table 6-2.

Muscles are partially contracted at all times, even when not in use. This state of partial contraction is called **muscle tone** and is sometimes described as a state of readiness to act. Loss of

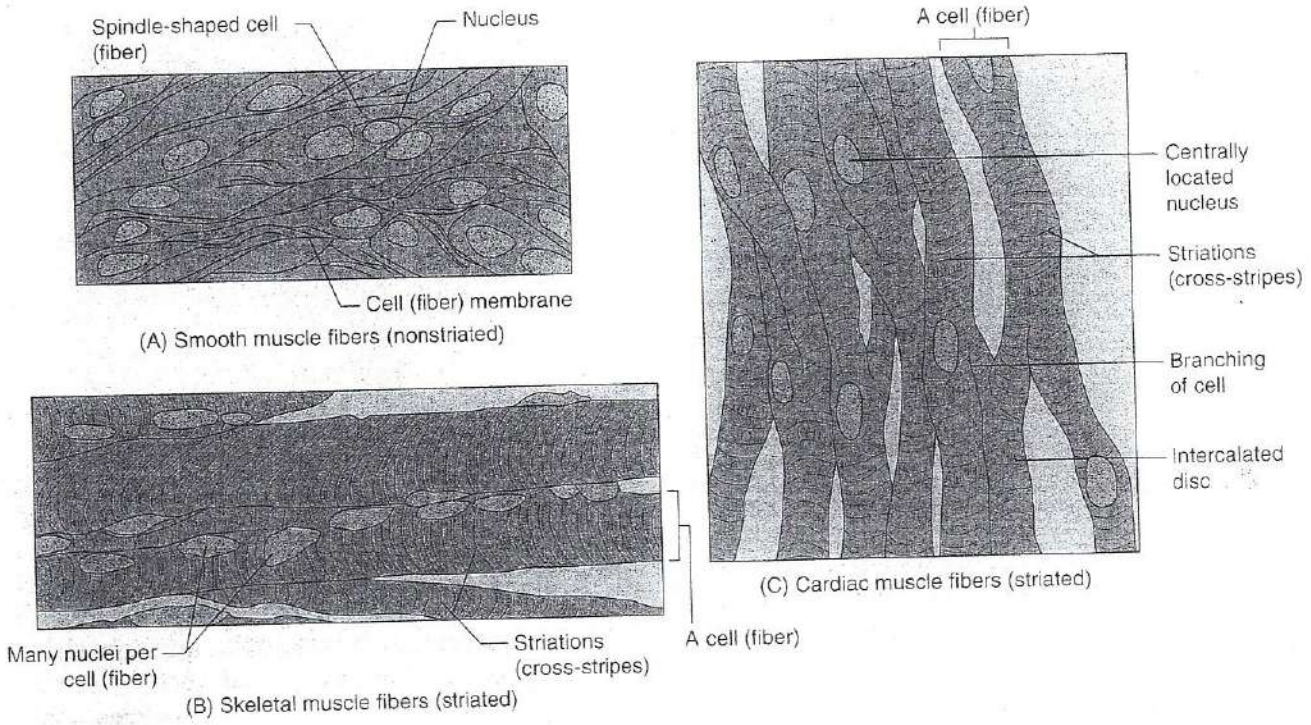



FIGURE 6-21 Three main kinds of muscle.

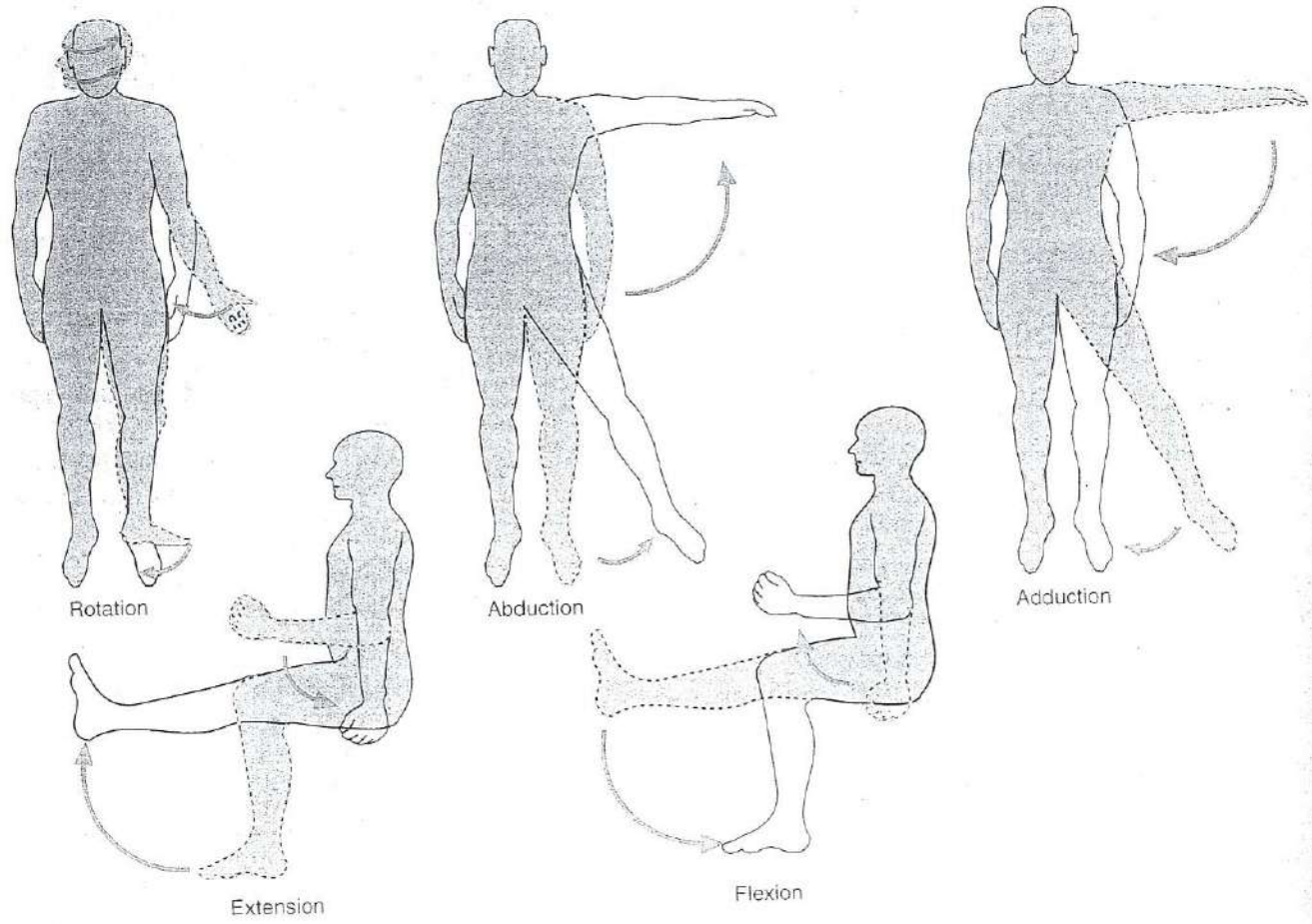



FIGURE 6-22 Types of muscle movement.

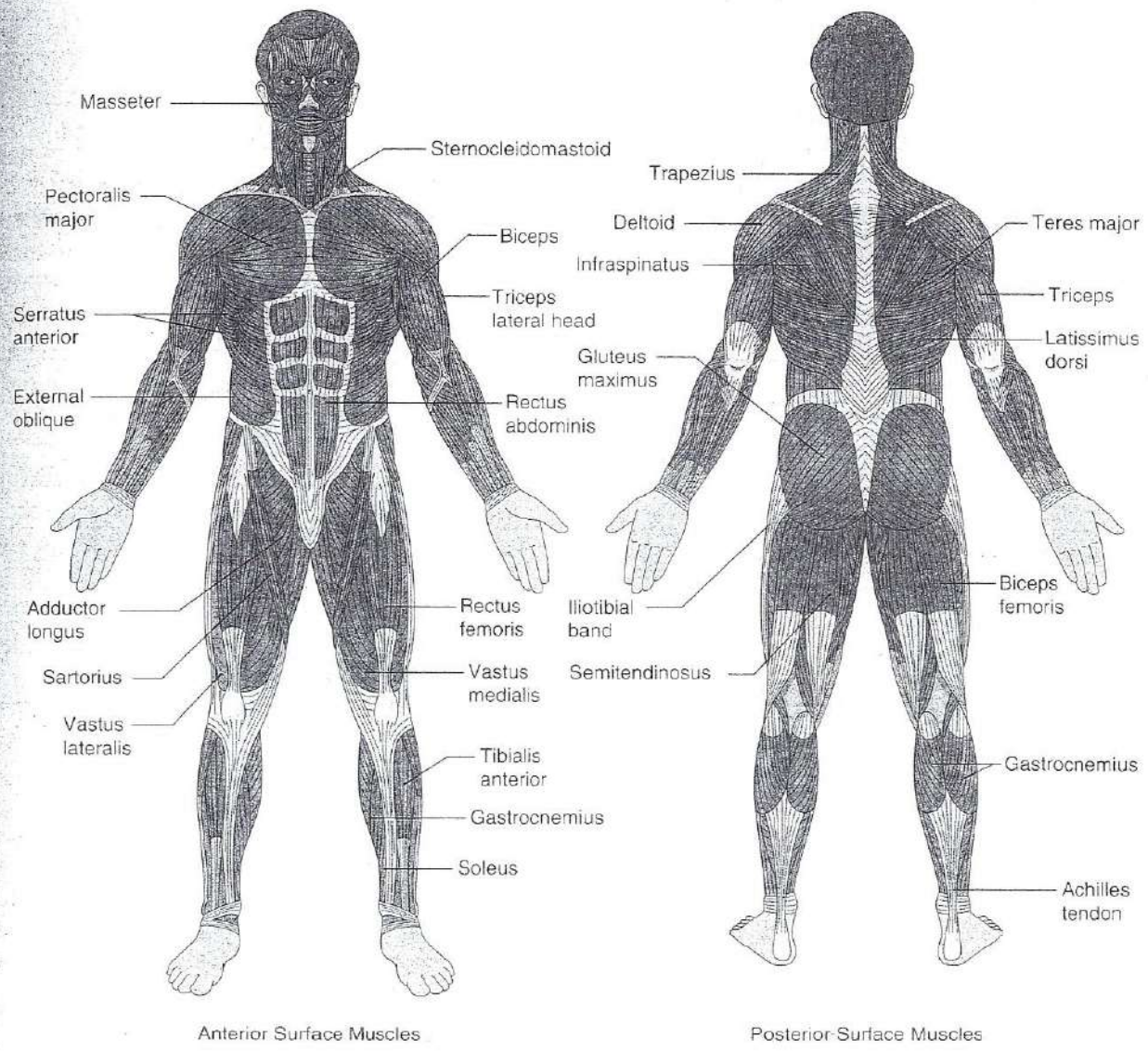



FIGURE 6-23 Major muscles of the body.

muscle tone can occur in severe illness such as paralysis. When muscles are not used for a long period of time, they can *atrophy* (shrink in size and lose strength). Lack of use can also result in a **contracture**, a severe tightening of a flexor muscle resulting in bending of a joint. Foot drop is a common contracture, but the fingers, wrists, knees, and other joints can also be affected.

## DISEASES AND ABNORMAL CONDITIONS

*Fibromyalgia* is chronic, widespread pain in specific muscle sites. Other symptoms include muscle stiffness, numbness or tingling in the arms or legs, fatigue, sleep disturbances, headaches, and depression. The cause is unknown, but stress, weather, and poor physical fitness affect the condition. Treatment is directed toward pain relief and includes physical therapy, massage, exercise, stress reduction, and medication to relax muscles and relieve pain.

*Muscular dystrophy* is actually a group of inherited diseases that lead to chronic, progressive muscle atrophy. Muscular dystrophy usually appears in early childhood; most types result in total disability and early death. Although there is no cure, physical therapy is used to slow the progress of the disease.

*Myasthenia gravis* is a chronic condition where nerve impulses are not properly transmitted to the muscles. This leads to progressive muscular weakness and paralysis. If the condition affects the respiratory muscles, it can be fatal. While the cause is unknown, myasthenia gravis is thought to be an

TABLE 6-2 Locations and Functions of Major Muscles of the Body

| MUSCLE | LOCATION | FUNCTION |
|---|---|---|
| Sternocleidomastoid | Side of neck | Turns and flexes head |
| Trapezius | Upper back and neck | Extends head, moves shoulder |
| Deltoid | Shoulder | Abducts arm, injection site |
| Biceps brachii | Upper arm | Flexes lower arm |
| Triceps brachii | Upper arm | Extends lower arm |
| Pectoralis major | Upper chest | Adducts and flexes upper arm |
| Intercostals | Between ribs | Moves ribs for breathing |
| Rectus abdominus | Ribs to pubis (pelvis) | Compresses abdomen |
| Latissimus dorsi | Spine around to chest | Extends and adducts upper arm |
| Gluteus maximus | Buttocks | Extends thigh, injection site |
| Sartorius | Front of thigh | Abducts thigh, flexes leg |
| Quadriceps femoris | Front of thigh | Extends leg |
| Tibialis anterior | Front of lower leg | Flexes and inverts foot |
| Gastrocnemius | Back of lower leg | Flexes sole of the foot |

autoimmune disease, with antibodies attacking the body's own tissues. There is no cure, and treatment is supportive.

*Muscle spasms,* or cramps, are sudden, painful, involuntary muscle contractions. They usually occur in the legs or feet and may result from overexertion, low electrolyte levels, or poor circulation. Gentle pressure and stretching of the muscle are used to relieve the spasm.

A *strain* is an overstretching of or injury to a muscle and/or tendon. Frequent sites include the back, arms, and legs. Prolonged or sudden muscle exertion is usually the cause. Symptoms include myalgia (muscle pain), swelling, and limited movement. Treatment methods include rest; muscle relaxants or pain medications; elevating the extremity; and alternating hot and cold applications.

**STUDENT:** *Go to the workbook and complete the assignment sheet for 6:5, Muscular System.*

## 6:6 Nervous System

### Objectives

After completing this section, you should be able to:

- Identify the four main parts of a neuron
- Name the two main divisions of the nervous system
- Describe the function of each of the five main parts of the brain
- Explain three functions of the spinal cord
- Name the three meninges
- Describe the circulation and function of cerebrospinal fluid
- Contrast the actions of the sympathetic and parasympathetic nervous systems
- Describe at least five diseases of the nervous system
- Define, pronounce, and spell all the key terms

## KEY TERMS

autonomic nervous system
brain
central nervous system
cerebellum
*(seh"-reh-bell'-um)*
cerebrospinal fluid
*(seh-ree"-broh-spy'-nal fluid)*
cerebrum
*(seh-ree'-brum)*
diencephalon
hypothalamus
medulla oblongata
*(meh-due'-la ob-lawn-got'-ah)*
meninges (singular: meninx)
*(meh-nin'-jeez)*
midbrain
nerves
nervous system
neuron
*(nur'-on)*
parasympathetic
*(par"-ah-sim"-pah-thet'-ik)*
peripheral nervous system
*(peh-rif'-eh-ral)*
pons
*(ponz)*
spinal cord
sympathetic
thalamus
ventricles

## RELATED HEALTH CAREERS

- Acupressurist
- Acupuncturist
- Anesthesiologist
- Chiropractor
- Diagnostic Imager
- Doctor of Osteopathic Medicine
- Electroencephalographic Technologist
- Electroneurodiagnostic Technologist
- Mental Health Technicians
- Neurologist
- Neurosurgeon
- Physical Therapist
- Polysomnographic Technologist
- Psychiatrist
- Psychologist

## 6:6 INFORMATION

The **nervous system** is a complex, highly organized system that coordinates all the activities of the body. This system enables the body to respond and adapt to changes that occur both inside and outside the body.

The basic structural unit of the nervous system is the **neuron**, or nerve cell (see figure 6-24). It consists of a cell body containing a nucleus; nerve fibers, called *dendrites* (which carry impulses toward the cell body); and a single nerve fiber, called an *axon* (which carries impulses away from the cell body). Many axons have a lipid (fat) covering called a *myelin sheath,* which increases the rate of impulse transmission and insulates and maintains the axon. The axon of one neuron lies close to the dendrites of many other neurons. The spaces between them are known as *synapses.* Impulses coming from one axon "jump" the synapse to get to the dendrite of another neuron, which will carry the impulse in the right direction. Special chemicals, called *neurotransmitters,* located at the end of each axon allow the nerve impulses to pass from one neuron to another. In this way, impulses can follow many different routes.

**Nerves** are a combination of many nerve fibers located outside the brain and spinal cord. *Afferent,* or sensory, nerves carry messages from all parts of the body to the brain and spinal cord. *Efferent,* or motor, nerves carry messages from the brain and spinal cord to the muscles and glands. *Associative,* or *internuncial,* nerves carry both sensory and motor messages.

There are two main divisions to the nervous system: the central nervous system and the peripheral nervous system. The **central nervous system** consists of the brain and spinal cord. The **peripheral nervous system** consists of the nerves. A separate division of the peripheral nervous system is the **autonomic nervous system**. This system controls involuntary body functions.

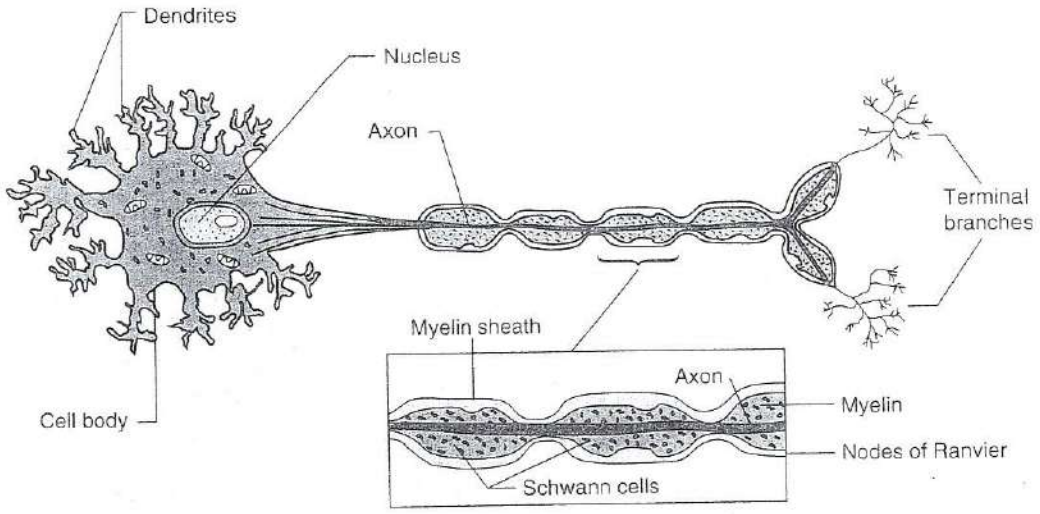



FIGURE 6-24 A neuron, the basic structural unit of the nervous system.

## CENTRAL NERVOUS SYSTEM

The **brain** is a mass of nerve tissue well protected by membranes and the cranium, or skull (see figure 6-25). The main sections include:

- **Cerebrum**—the largest and highest section of the brain. The outer part is arranged in folds, called *convolutions*, and separated into lobes. The lobes include the frontal, parietal, temporal, and occipital, named from the skull bones that surround them, figure 6-26. The cerebrum is responsible for reasoning, thought, memory, speech, sensation, sight, smell, hearing, and voluntary body movement.
- **Cerebellum**—the section below the back of the cerebrum. It is responsible for muscle coordination; balance and posture; and muscle tone.

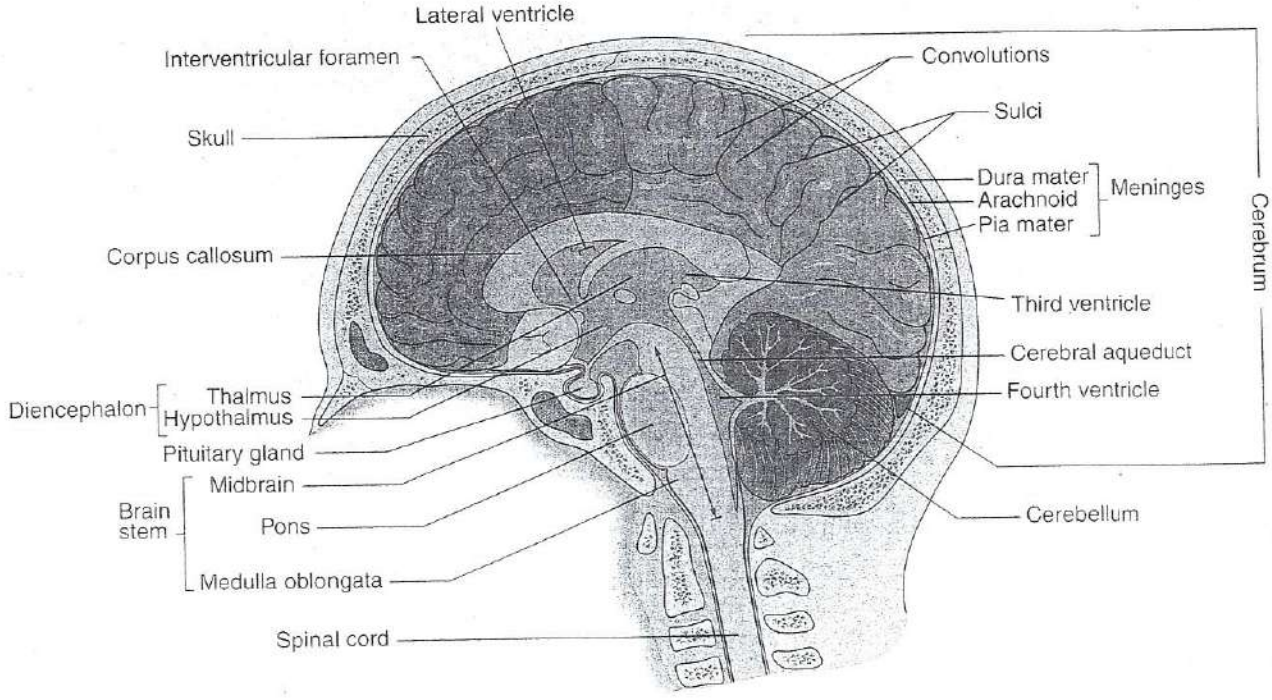



FIGURE 6-25 The brain and spinal cord.