I. Cardiovascular health

A. the heart is a pump made out of muscle
   1. more than a gallon/minute (2,000 gallons/day)
   2. looks like an upside-down pear, about the size of your fist
   3. resides in the pericardial cavity
      a. behind breastbone
      b. center of chest between the lungs
   4. three layers of tissue
      a. epicardium = thin, outer layer
      b. myocardium = the middle layer, consisting of the heart muscle itself
      c. endocardium = inner layer
   5. four chambers
      a. atrium = upper chamber, receives blood from the veins
      b. ventricle = lower chamber
      c. connected by valves
      d. blood flows in one direction
   6. bloodflow
      a. unoxygenated blood enters the right atrium
      b. from right atrium into the right ventricle
      c. right ventricle pumps blood into lungs via the pulmonary artery
      d. oxygenated blood flows into the left atrium
      e. from left atrium into the left ventricle
         (1) left ventricle is an extremely powerful pump
         (2) blood is pumped through the aorta and to the rest of the body
      f. pumping is controlled by the nervous system
         (1) epinephrine and norepinephrine stimulate beating
         (2) these “stress hormones” are released from anger or fear

B. the circulatory system

1. network of blood vessels
   a. bring oxygen and nutrients to the organs and tissues and carry away wastes
   b. reaches every cell in the body
   c. carries hormones, antibodies, white blood cells
   d. approximately 100,000 miles long
2. three types of blood vessels
   a. arteries carry oxygenated blood from the heart
   b. capillaries are small vessels that bring blood directly to cells
   c. veins carry unoxygenated blood back to the heart
3. blood is the fluid that travels through the heart and the circulatory system
   a. plasma = yellowish liquid that carries other blood components
   b. erythrocytes = red blood cells
      (1) contain hemoglobin
      (2) carries oxygen
   c. leukocytes = white blood cells
      (1) part of the immune system
      (2) destroy invading microbes
d. platelets = small bodies that patch damage in the walls of blood vessels
   (1) form clots (along with clotting factors)
   (2) prevent us from bleeding to death

e. blood is continuously being synthesized
   (1) mostly in bone marrow
   (2) some WBC called lymphocytes are manufactured in the lymphatic system

C. cardiovascular disease
1. major forms are coronary heart disease (CHD), hypertension, rheumatic fever, congenital heart disease, and stroke
2. CHD
   a. blood flow to the heart is insufficient to supply oxygen and nutrients
   b. usually results from arteriosclerosis (hardening of the arteries)
3. atherosclerosis
   a. most common form of arteriosclerosis
   b. plaque (fatty deposits) build up inside arteries and restrict blood flow
   c. in CHD, plaques form in coronary arteries going to the heart
   d. if a blood clot (thrombus) forms, it can block the flow of blood to the heart, resulting in a heart attack
   e. if the blood flow to the brain is blocked, the result can be a stroke
4. myocardial infarction = medical term for heart attack
   a. infarct = area of dead or dying tissue
   b. heart muscle is dying from lack of blood (ischemia)
   c. brain death can occur within minutes if the heart doesn’t pump enough blood
5. CHD affects more than 20 million Americans, about 10% of the population
6. signs of a heart attack
   a. intense, prolonged chest pain, usually described as crushing, not sharp
      (1) like the heart is being squeezed
      (2) some heart attacks are not accompanied by chest pain
   b. pain extending from the chest to the left shoulder and arm, the back, sometimes the jaws and gums
   c. prolonged pain in the upper abdomen
   d. shortness of breath
   e. fainting or weakness
   f. heavy perspiration, nausea, or vomiting
   g. anxiety and fear
7. angina pectoris = “choke” “chest”
   a. angina = chest pain similar to but less severe than a heart attack
   b. pain is below the breastbone and may extend to the left jaw and shoulder, down the left arm
   c. can be mistaken for heartburn or indigestion
   d. symptom of restricted blood flow to heart
      (1) usually occurs during periods of exertion
      (2) can occur during sleep, exposure to cold, or strong emotion
   e. attacks can last several minutes and are usually relieved by rest
   f. nitroglycerine can open coronary arteries, increasing blood flow to heart
g. no lasting damage to heart
h. many, but not all, heart attacks are preceded by angina

8. hypertension = high blood pressure
   a. can lead to heart attacks, congestive heart failure, kidney damage, stroke, even blindness
   b. blood pressure
      (1) systolic pressure = when heart contracts
      (2) diastolic pressure = pressure when heart is between beats
      (3) normal = 120/80 mm Hg
      (4) hypertension = at least 140 systolic or 90 diastolic
   c. accelerates atherosclerosis
   d. damage can occur over a long period of time

9. congestive heart failure
   a. damage prevents heart from pumping out all the blood it receives
   b. blood backs up or pools in veins, lungs, or lower extremities
   c. can result from a congenital condition, loss of muscle (heart attack or disease), rheumatic fever, high blood pressure
   d. signs
      (1) edema (swelling) especially in ankles and legs
      (2) shortness of breath
      (3) loss of muscular endurance
   e. usually treatable
      (1) exercise to strengthen heart
      (2) proper diet
      (3) weight control
      (4) avoidance of alcoholic beverages
      (5) drugs
         (a) diuretics to decrease edema
         (b) digitalis increase heart contractions
         (c) vasodilators expand the arteries, making it easier to pump blood

10. rheumatic fever
    a. inflammatory disease accompanied by fever that can damage the heart or kidneys
    b. caused by an autoimmune reaction to Streptococcus
    c. heart valves may become inflamed, causing permanent damage

11. congenital heart defects
    a. the heart or connections between the heart, lungs, and blood vessels fail to develop normally
    b. most common type of birth defect
    c. cause is generally unknown, but some are due to a viral infection like rubella
    d. treatment usually requires surgery and may completely fix the problem

12. arrhythmias = abnormal heartbeat or rhythm
    a. common and usually unnoticed
    b. tachycardia = sudden acceleration of heartbeat to around 160 beats/minute
    c. ventricular fibrillation = ventricles contract irregularly and pump ineffectively
      (1) cause of most heart attack deaths
(2) can be stopped with a defibrillator
(3) ventricular fibrillation can trigger cardiac arrest where the heart stops beating completely
   (a) loss of consciousness
   (b) cessation of breathing
   (c) death
d. CPR (cardiopulmonary resuscitation) may restart the heartbeat of someone in cardiac arrest

13. stroke = cerebrovascular accident (CVA)
   a. occurs when blood flow to part of the brain is obstructed
   b. three types of strokes
      (1) cerebral thrombosis
         (a) most common
         (b) blood clot (thrombus) blocks a cerebral artery
         (c) enhanced by atherosclerosis
      (2) cerebral embolism
         (a) a blood clot or other particle forms in another part of the body, travels through the circulatory system, and lodges in an artery that serves the brain
         (b) emboli usually form in the heart from atrial fibrillation
      (3) hemorrhagic stroke
         (a) least common but most severe stroke
         (b) 50% death rate
         (c) a blood vessel in the brain ruptures, leaking blood into brain cavities
         (d) often linked to high blood pressure
            i) can occur with a head injury
            ii) could be due to a burst aneurysm (blood filled sac that balloons out from a weakened portion of an arterial wall)
c. typical effects of stroke are slurred speech, blurry vision, loss of feeling, sudden loss of consciousness, severe headaches

II. Diagnosis and treatment of cardiovascular disorders
A. diagnostic tests
   1. stethoscopes can detect heart irregularities
      a. heart murmurs occur when blood passes through a valve that’s normally closed
      b. irregular rhythms
   2. blood tests
      a. cholesterol
      b. thyroid hormones (overactive thyroid linked to some arrhythmias)
      c. sugar levels (high sugar may indicate diabetes, a major risk factor for CHD)
   3. electrocardiogram (ECG or EKG)
      a. heart’s electrical activity
      b. EKG reveals abnormal heart rhythms
      c. stress tests with physical activity while EKG monitored
d. Holter monitor = portable EKG worn 24 hours/day
   4. echocardiogram uses ultrasonic imaging to visualize heart
   5. radionuclide imaging allows viewing how blood flows through the heart
6. magnetic resonance imaging (MRI)  
a. uses magnets to generate a computerized image of body parts  
b. can detect heart damage from previous heart attacks or abnormalities in the blood vessels around the heart  
7. coronary angiography (angiogram)  
a. cardiac catheterization = catheter is inserted into heart through the aorta  
b. dye is injected into the heart to visualize plaque within coronary arteries  
8. electroencephalogram (EEG) measures brain waves and can reveal abnormal brain activity indicating damage  
9. computerized axial tomography scan (CAT scan)  
a. specialized X-ray machine that takes pictures from several angles and constructs a 3-D image  
b. can help determine if a stroke was caused by a thrombus or hemorrhage  
c. blood thinners are appropriate for clots but dangerous with hemorrhages  

B. treating heart disease  
1. medication  
a. thrombolytic agents (e.g., streptokinase) can dissolve blood clots  
b. beta-blockers reduce pumping demands on the heart  
c. vasodilators expand blood vessels, increasing flow to heart  
d. drugs to lower blood cholesterol  
2. coronary bypass  
a. a vein from another part of the body is used to bypass a clogged coronary artery  
b. bypass can eventually become clogged  
3. balloon angioplasty (percutaneous transluminal coronary angioplasty)  
a. a catheter is threaded to blockages  
b. a balloon is inflated to flatten the blockage against the artery wall  
c. in an atherectomy, blockages are surgically removed or cleared with a laser  
d. blockages commonly reoccur  
e. some procedures leave a stent in place  
4. transplants  
a. very risky due to nature of surgery and risk of rejection  
b. about 80% survival after one year  
5. pace maker  
a. electrical device about the size of a silver dollar  
b. transmits electrical impulses to maintain a normal heartbeat  

III. Risk factors  
A. uncontrollable  
1. age  
a. risk of CHD rises sharply with men after about 40  
b. slow rise with women until menopause, then a rapid increase  
c. stroke usually occurs after age 65  
2. gender  
a. men at greater risk than women  
b. risk seems to even out around age 65  
3. heredity
a. close male relative who had a heart attack before 55
b. female relative before 65

4. race/ethnicity
   a. African Americans are about 75% more likely to die from CHD than white Americans
   b. African Americans are about 60% more likely to suffer strokes than white Americans
      (1) linked to hypertension
      (2) may involve economic differences

B. controllable
   1. hypertension
   2. cholesterol
      a. LDL (low density lipoproteins) cling to artery walls
      b. HDL carries excess cholesterol to the liver for elimination
      c. values should be less than 200 mg/dL
         (1) HDL should be at least 35 mg/dL
         (2) LDL should not exceed 160 mg/dL
   3. triglycerides
      a. dietary fat in bloodstream
      b. risk of CHD with value of 250 mg/dL
         (1) increases risk of heart disease
         (2) associated with obesity and high cholesterol
   4. diabetes mellitus
      a. damages blood vessels
      b. accelerates atherosclerosis
      c. contributes to hypertension
   5. obesity
      a. associated with other risk factors
      b. “apples” at greater risk than “pears”
   6. smoking
      a. more than doubles the risk
      b. increases cholesterol while lowering HDL
      c. risk can be eliminated within two years of quitting
   7. inactivity
   8. personality (type A behavior)
   9. emotional arousal
      a. high levels of anger or anxiety can damage the cardiovascular system
      b. increased risk of hypertension
      c. mental stress can decrease blood flow to heart
   10. environmental stress
      a. regular routine helps
      b. calming surroundings