

Chapter Seven

Protection, Support, and Movement:

What can go wrong?



Day One:

Today, your child should complete their reading and practice problems for the week.

Below are the supplies for this week's lab:

One clothespin (a tennis ball can also be used)

Large bowl of ice water

Timer or clock with second hand

National Science Education Standards covered this week:

12CLS5.1 All matter tends toward more disorganized states. Living systems require a continuous input of energy to maintain their chemical and physical organizations. With death, and the cessation of energy input, living systems rapidly disintegrate.

Definitions

aerobic respiration	conversion of sugar to ATP at times when oxygen is in abundance
anaerobic respiration	conversion of sugar to ATP at times when oxygen is limited
arthritis	a group of disorders which affect synovial joints
ATP (adenosine triphosphate)	compound created by cells which acts as the main chemical fuel for all bodily processes
blisters	fluid-filled pocket between the epidermis and the dermis/hypodermis; caused by burning or friction
edema	swelling of tissues; caused by a buildup of fluid within areas that are inflamed
estrogen	chemical which helps to maintain bone mass and regulates the organs and tissues within the female reproductive system
first-degree burns	burns which damage only the epidermis
inflammation	first stage of tissue repair; identified by swelling, redness, excessive warmth, and pain in the area that contains the damaged tissues
lactic acid	produced by muscle fibers during exercise which interfere with the ability of calcium ions to produce muscle contraction
muscle cramp	situation in which a muscle contracts with such force it stays contracted and no other muscle acts to stretch it back into place
muscle spasms	a strong and painful involuntary contraction of muscles
osteoarthritis	a type of arthritis commonly affects the larger, well-worn joints such as the hips and knees
osteoporosis	condition in which bones become abnormally thin and brittle; caused by the excessive activity of osteoclasts
pathogens	harmful agents that invade the body

regeneration	second stage of tissue repair in which the body attempts to restore homeostasis by replacing/repairing damaged tissues back to their normal functions
rheumatoid arthritis	a type of arthritis caused by the inflammation of tissues within the synovial joints
scars	a large amount of connective tissue that replaces cut layers of epidermis resulting from a cut into the lower dermis/hypodermis layer
scoliosis	disorder causing abnormal curvature of the spine and lateral (side) bending of the backbone
second-degree burns	burns which damage the epidermis and the upper region of the dermis
third-degree burns	heat from these burns destroys all layers of the skin, including blood vessels and nerve endings

Sample questions to ask your child after completing the weekly reading.

What causes the noticeable symptom of swelling when a tissue becomes inflamed?

A buildup of fluid known as edema typically forms within inflamed tissues. This causes the symptom of swelling to occur.

Why do scars look differently than its surrounding tissues?

When a cut is made very deep into the dermis/hypodermis layers of the skin, dense connective tissues can form to fill the wound that has been created. Instead of new epidermal tissues being created from the stratum basale, these connective tissues do not appear the same as its neighboring tissue.

Why is it impossible to regenerate new skin cells in areas that have received third-degree burns?

The vascular layers of skin are completely damaged within a third-degree burn. Without the stratum basale or a stable blood supply, new tissues cannot be formed.

Both a pulled muscle and muscle fatigue can cause discomfort. What is the main differences between these two conditions?

Muscle fatigue occurs during anaerobic respiration such as during a period of intense physical activity when oxygen is being used extensively. The buildup of lactic acid from this process interferes with the muscles from contracting. A pulled muscle takes place when the muscle fibers have been stretched too far, causing them to tear apart. This results in bruised and/or swollen areas with moderated amounts of pain several hours or days after the activity.

Day Two:

Your child should check their work on the practice worksheets today with the answer key on the next page.

In addition, your child should read the lab activity and start collecting all of the necessary materials!

Answer Key for Practice Problems

Vocabulary Review

- | | | |
|-------------------------|---------------------------------|------------------------|
| 1) arthritis | 8) estrogen | 15) blisters |
| 2) scars | 9) ATP (adenosine triphosphate) | 16) pathogens |
| 3) muscle spasms | 10) osteoporosis | 17) third-degree burns |
| 4) rheumatoid arthritis | 11) aerobic respiration | 18) lactic acid |
| 5) osteoarthritis | 12) anaerobic respiration | 19) regeneration |
| 6) first-degree burns | 13) scoliosis | 20) muscle cramp |
| 7) second-degree burns | 14) inflammation | |

Multiple Choice and True/False

- | | | |
|------|------|------|
| 1) B | 3) F | 5) F |
| 2) C | 4) T | 6) T |

Application Questions

In Experiment A, the students could use aerobic respiration as they started to run in place since they were allowed to take in oxygen. When they stopped, their respiration rate was increased as their bodies needed to replenish the oxygen used for their run. In Experiment B nearly all of the student's respiration came from anaerobic respiration because the students held their breath while running in place. It can be assumed that any reserve of oxygen remaining within the student's body was used up quickly before anaerobic respiration began to function. Therefore, the students within Experiment B required more oxygen to replenish the volume that was used during their run. Consequentially, the rate of respiration for the students in Experiment B would be much higher and extend for a greater period of time than students in Experiment A.

Day Three: Lab Activity

Your child should have already read through this lab and has been reviewing all of this week's vocabulary words.

Collect your supplies for the lab:

One clothespin (a tennis ball can also be used)

Large bowl of ice water

Timer or clock with second hand

Putting your life on the "clothes" line

Maybe I need to start working out...

The buildup of lactic acid through muscle fatigue will be generated in this activity.

Materials:

One clothespin (a tennis ball can also be used)

Large bowl of ice water

Timer or clock with second hand

Procedure:

Part One:

- 1) Hold the clothespin or tennis ball in your dominant hand. Squeeze either of the items as quickly and firmly as possible for 20 seconds. You will need to record the number of times you squeeze the item.
- 2) Immediately repeat this procedure nine more times, recording the total number of squeezes each time.
- 3) Repeat all ten trials once again using the non-dominant hand and record your results.
- 4) Graph your data.

Part Two:

- 1) Fill a large bowl with water and ice. Allow the container to rest for at least 15 minutes to allow the temperature of the water to approach the freezing point.
- 2) Count the maximum number of times you can make a fist with your non-dominant hand in 20 seconds. Record this amount.
- 3) Submerge this hand into the ice water for 30-45 seconds.
- 4) Remove the hand from the ice water and immediately count how many times you can make a fist in 20 seconds. Again, record this amount.

Explanation:

In the first part of this activity, the muscles in your hand become fatigued throughout the duration of the experiment. It is very likely that the number of squeezes decreased steadily throughout the trials. What is happening within the muscles of your hand was stated in this week's reading:

Muscle cells are very efficient at breaking down sugar into a chemical known as ATP (adenosine triphosphate) which is the main source of chemical energy needed for muscle fibers to contract. Typically, oxygen is present during the conversion of sugar to ATP (aerobic respiration); however, when oxygen is limited (anaerobic respiration) such as during a period of intense physical activity when oxygen is being used extensively, a waste product is created (lactic acid), which interferes the process of muscle contraction and causes your muscles to become fatigued.

Simply put, as your hand used up its supply of oxygen gas to provide the necessary energy needed to squeeze the clothespin, your cells began undergoing anaerobic respiration in order to generate the necessary energy for the hand's movement. This form of respiration generates the waste product lactic acid. Unfortunately, the buildup of lactic acid prevents muscle cells from contracting. Therefore, the number of squeezes began to decrease.

The same effect occurs when you remove heat from the cells within your hand. Cold temperatures cause muscle cells to work slower, thereby slowing the rate of contraction. In addition, the lowered temperature also lowers the rate in which nerve impulses can travel. This also slows down the ability of your hand to move as well.

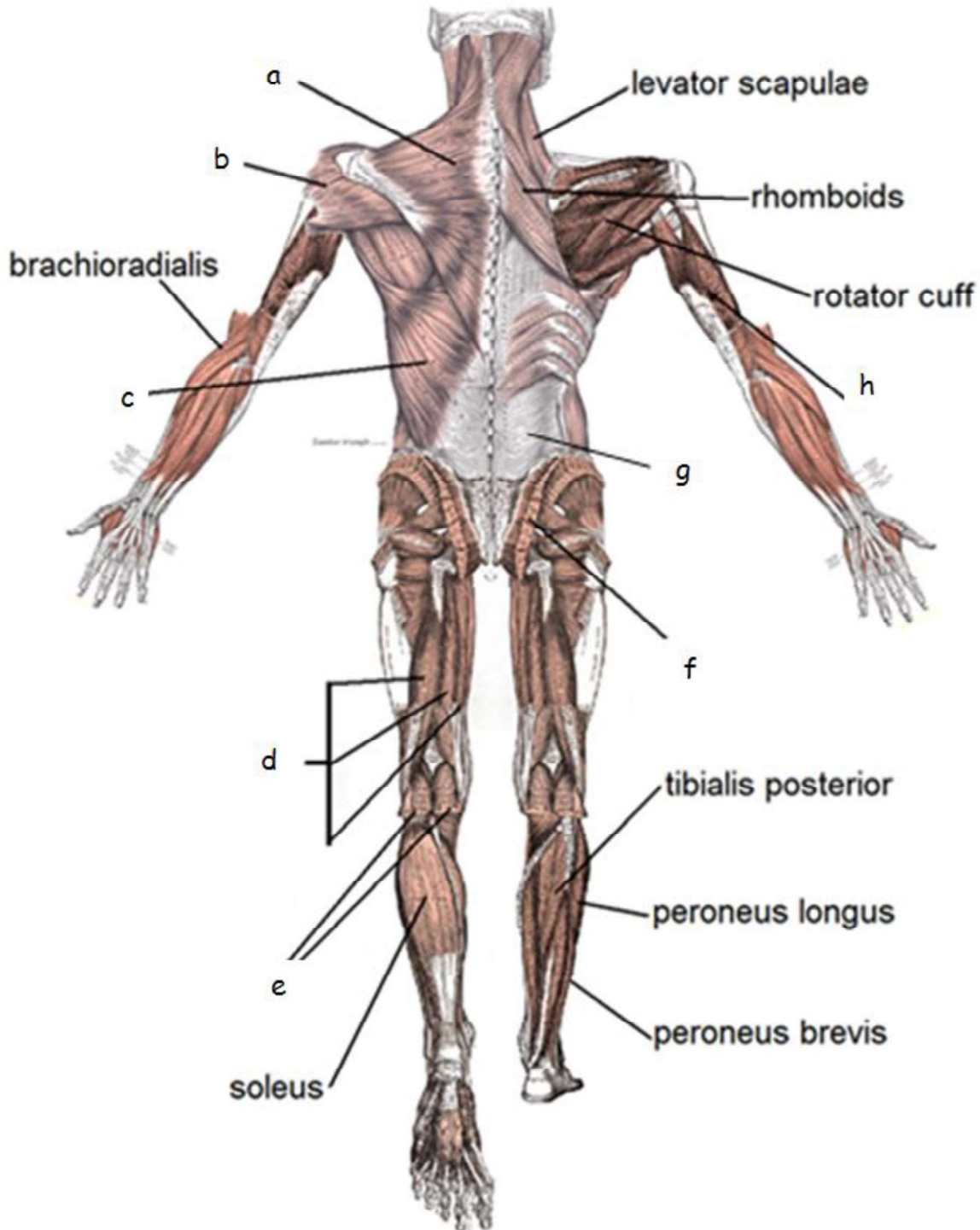
Unit Quiz (Weeks 5-7)

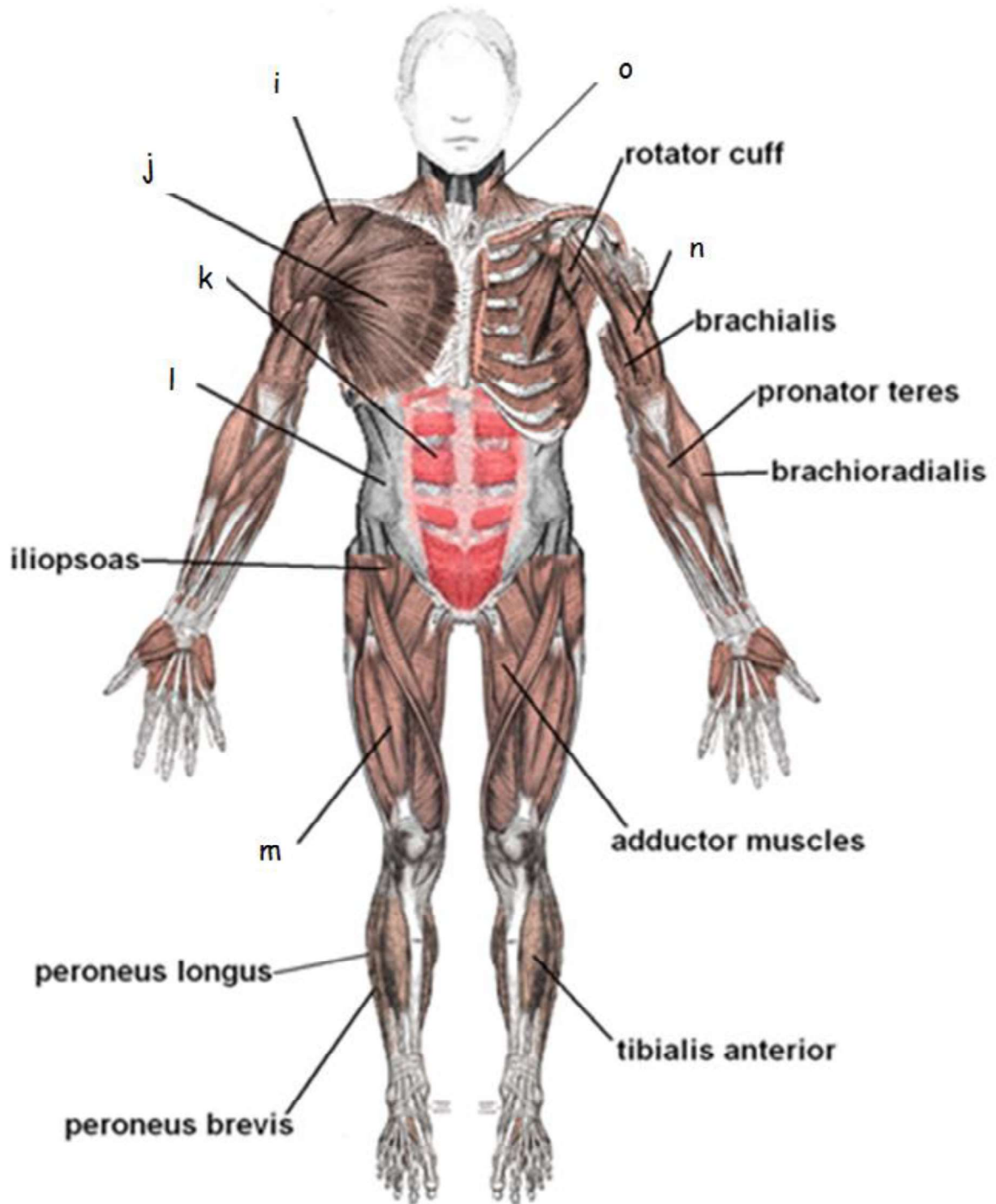
Three of the following four statements are false. Identify each of them and explain why they are false.

- 1) **True or False:** Skeletal muscle is considered involuntary because it is the only type of muscle tissue that is under the control of an individual's thought process.
- 2) **True or False:** The neurotransmitter used by the nervous system to activate skeletal muscle cells is acetylcholine.
- 3) **True or False:** The epimysium covers individual muscle fibers.
- 4) **True or False:** Thick filaments are made of a protein called actin.

5) After your second anatomy and physiology quiz, you dropped to one knee, tipped your head back, raised one arm over your head, clenched your fist, pumped your arm up and down, and yelled "Yes!" Use the proper terms (flexion/extension) to describe the movements undertaken by the various joints of your knees, hip, neck, fingers, elbows, and shoulders.

6) Correctly identify the following structures within the following images. Use the words from the word bank below:





WORD BANK: hamstrings, gluteals, gastrocnemius, biceps, deltoid, trapezius, quadriceps, sternocleidomastoid, deltoid, erector spinae, pectoralis major, latissimus dorsi, triceps, obliques, rectus abdominus

a)

b)

c)

d)

e)

f)

g)

h)

i)

j)

k)

l)

m)

n)

o)

Unit Quiz Answer Key

- 1) F - skeletal muscle tissue is under the control of an individual's thought process and is considered voluntary
- 2) T
- 3) F - the endomysium protects individual muscle fibers while the epimysium protects the entire skeletal muscle
- 4) F - thick filaments are made up of the protein myosin while thin filaments are made from actin
- 5) Flex the knees, flex the hip (on the side with knee up), hyperextend the neck, flex fingers, and flex and extend at elbow and shoulder.
- 6) Word match from picture:
 - a) trapezius
 - b) deltoid
 - c) latissimus dorsi
 - d) hamstrings
 - e) gastrocnemius
 - f) gluteals
 - g) erector spinae
 - h) triceps
 - i) deltoid
 - j) pectoralis major
 - k) rectus abdominus
 - l) obliques
 - m) quadriceps
 - n) biceps
 - o) sternocleidomastoid

Test: Units 1-3

Chapters 1-7

Match the following vocabulary terms with their correct definition:

avascular
 axial skeleton
 basement membrane
 bulb
 cartilage
 cell membrane
 columnar
connective tissue
proper
 contracts
 dermis/hypodermis
 diffusion
 epidermis
 epithelial
 esophagus
 extremities
 false ribs

genitalia
 hypothalamus
 integumentary system
 irregular bones
 keratin
 ligaments
 lumbar curvature
 lumen
 melanin
 muscle fibers
 nervous tissue
 neuroglia
 neurons
 organelles
 planes of reference
 root
 sebaceous glands

sebum
 semipermeable
 sensory receptors
 shaft
 smooth muscle
 spinal cord
 stratum basale
 striated tissue
 sudoriferous glands
 synovial joints
 tendons
 thoracic curvature
 trichosiderin
 vascular
 vasoconstriction
 vasodilation
 vitamin D

- 1) _____ a set of three planes (imaginary flat surfaces) passing through the body used to identify specific locations in, on, and around the body
- 2) _____ property of the cell membrane which regulates the substances allowed in and out of the cell
- 3) _____ protective covering which surrounds a cell
- 4) _____ protein produced and used by the epidermis of the skin which provides a protective barrier against infection
- 5) _____ responsible for creating and sending nerve impulses throughout the body
- 6) _____ responsible for sending the nerve impulses throughout the body
- 7) _____ responsible for slow, involuntary movements of the internal organs
- 8) _____ skin cells which are much taller than they are wide
- 9) _____ specialized structures within a cell
- 10) _____ supporting cells: help to support the neurons throughout the body
- 11) _____ the inside spaces of a tubular structures such as the esophagus
- 12) _____ the movement of any substance from an area of high concentration to an area of low concentration
- 13) _____ the muscular tube which carries your food to the stomach
- 14) _____ tissue which covers the outside of the body, outer surfaces of organs, body cavities, and various glands
- 15) _____ tissues which contain visual stripes on its surface when viewed under a microscope
- 16) _____ to shorten
- 17) _____ type of connective tissue responsible for protection of bones and flexibility of joints; not as rigid as bone tissue but less flexible than muscle tissue

- 18) _____ type of connective tissue which includes tendons, ligaments and fat tissue; strong and flexible tissue which allows the body to hold onto fluids, absorb waste material, and stores fat
- 19) _____ very long and threadlike cells which make up skeletal muscle
- 20) _____ a brown-black pigment responsible for absorbing harmful ultraviolet light within the skin
- 21) _____ a gland in our brain which acts like a thermostat for the body
- 22) _____ a system consisting of the skin, hair, nails, and glands within the skin
- 23) _____ a vascular "anchor" for an individual hair follicle
- 24) _____ acidic chemical secreted by sebaceous glands near hair follicles to the surface of the skin; used to protect, lubricate, and waterproof the skin
- 25) _____ being regularly supplied with nutrients from the blood
- 26) _____ chemical created within the stratum basale through exposure to the sun; responsible for the absorption of calcium and phosphorus
- 27) _____ connective tissue which attaches the stratum basale to the dermis
- 28) _____ enlarged base at the end of a single hair which contains its root
- 29) _____ internal layer of skin; interior to the epidermis
- 30) _____ iron-containing pigment within red-haired individuals
- 31) _____ not being supplied with nutrients from the blood
- 32) _____ oil-producing glands
- 33) _____ receptors within the skin that respond to various stimuli such as touch, pressure, temperature, and pain
- 34) _____ sex organs

- 35) _____ sub-layer of tissue attached to the dermis with the help of the basement membrane
- 36) _____ sweat-producing glands
- 37) _____ the outermost and visible layer of skin
- 38) _____ thickening of blood vessel walls
- 39) _____ visible portion of the hair
- 40) _____ widening the internal diameter of blood vessels
- 41) _____ 8th-10th pairs of ribs which are attached to the seventh pair of ribs
- 42) _____ a large bundle of nerve fibers protected within the vertebral column
- 43) _____ a section of the spinal cord which contains five vertebrae and carries most of the weight of the human body
- 44) _____ a section of the spinal cord which contains twelve vertebrae and is attached to the ribs
- 45) _____ a type of connective tissue proper which connects bones to other bones
- 46) _____ a type of connective tissue proper which connects muscles to bones
- 47) _____ all freely moving joints in the human body such as those found in the shoulders, knees, elbows, wrists, etc.
- 48) _____ arms and legs
- 49) _____ bones having many different shapes; examples include the jawbone and kneecap
- 50) _____ bones which are responsible for protecting the head, neck, and trunk of the body

Choose the correct answer in the following questions:

51) Which of the following directional terms have the same meaning:

- a) superior and caudal
- b) anterior and dorsal
- c) inferior and superior
- d) anterior and ventral

52) The system that takes in oxygen and releases carbon dioxide from the body is the:

- a) muscular system
- b) respiratory system
- c) urinary system
- d) cardiovascular system
- e) reproductive system

53) Which of the following is NOT a form of connective tissue:

- a) skeletal muscle
- b) cartilage
- c) bone
- d) adipose
- e) blood

54) Which type of tissue utilizes electric currents:

- a) nervous tissue
- b) connective tissue
- c) muscle tissue
- d) dense tissue
- e) epithelial tissue

55) The tailbone is known as the:

- a) pubis
- b) sacrum
- c) coccyx
- d) patella
- e) ischium

56) True or False: Most homeostatic control mechanisms are negative feedback reactions.

57) True or False: *Proximal* means farther away from the trunk of the body.

58) True or False: The epidermis is made up of stratified squamous epithelium.

59) True or False: Hair is produced by the hair bulb and is composed primarily of dead keratin-rich cells.

60) True or False: Melanin is found in the uppermost layer of skin and helps prevent water loss.

61) True or False: The spinal cord passes through the body of each vertebra.

62) True or False: Hematopoiesis refers to the formation of blood cells within the red bone marrow.

63) True or False: There are seven cervical, twelve thoracic, and five lumbar vertebrae.

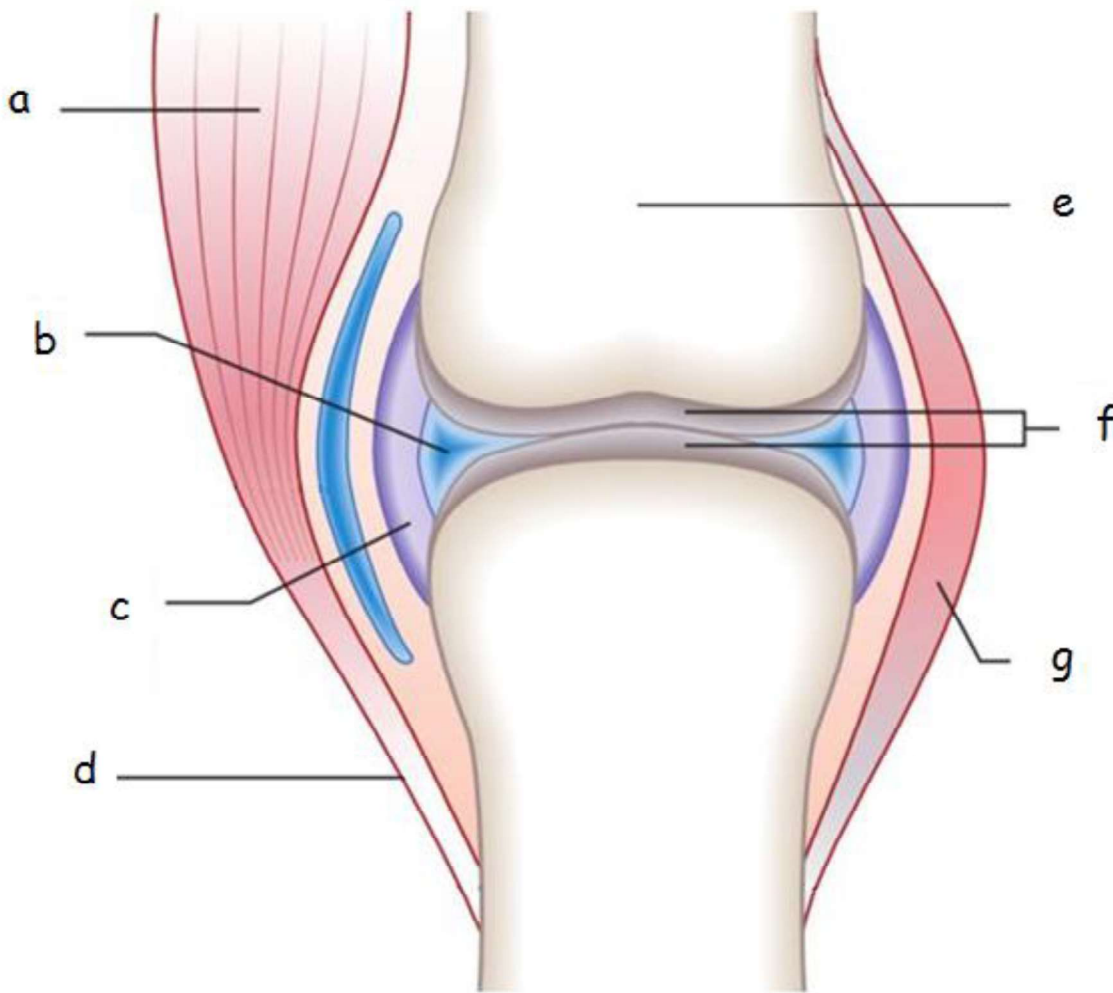
64) The skin of infants is more easily penetrated and injured by abrasion than that of adults. Based on your knowledge of epithelium, why do you believe this to be true?

65) You are playing outside one day and slide your hand across the wooden hand rail. You pull your hand back quickly as you feel a small pinch and look to find a tiny sliver of wood stuck inside your skin. There is no visible bleeding. What type of tissue have you pierced? (Be specific.) How do you know?

66) There's a special fun-house mirror that hides either the right or left half your body and doubles the image of your other side. In the mirror, you can appear to do amazing things such as lifting both legs off the ground simultaneously. A different mirror in the next room divides your body at the waist and shows your reflection with two heads, four arms and no legs. Along what planes of reference are these mirrors dividing your body?

67) When closure of the epiphyseal plate occurs, the cartilage of the plate is replaced by bone. Do you believe this will occur from the epiphyseal side of the plate or the diaphyseal side?

68) Correctly identify the following structures within the following image. Use the words from the word bank below:



WORD BANK: tendon, epiphysis, synovial fluid, hyaline cartilage, ligament, synovial fluid lining, muscle

a)

e)

b)

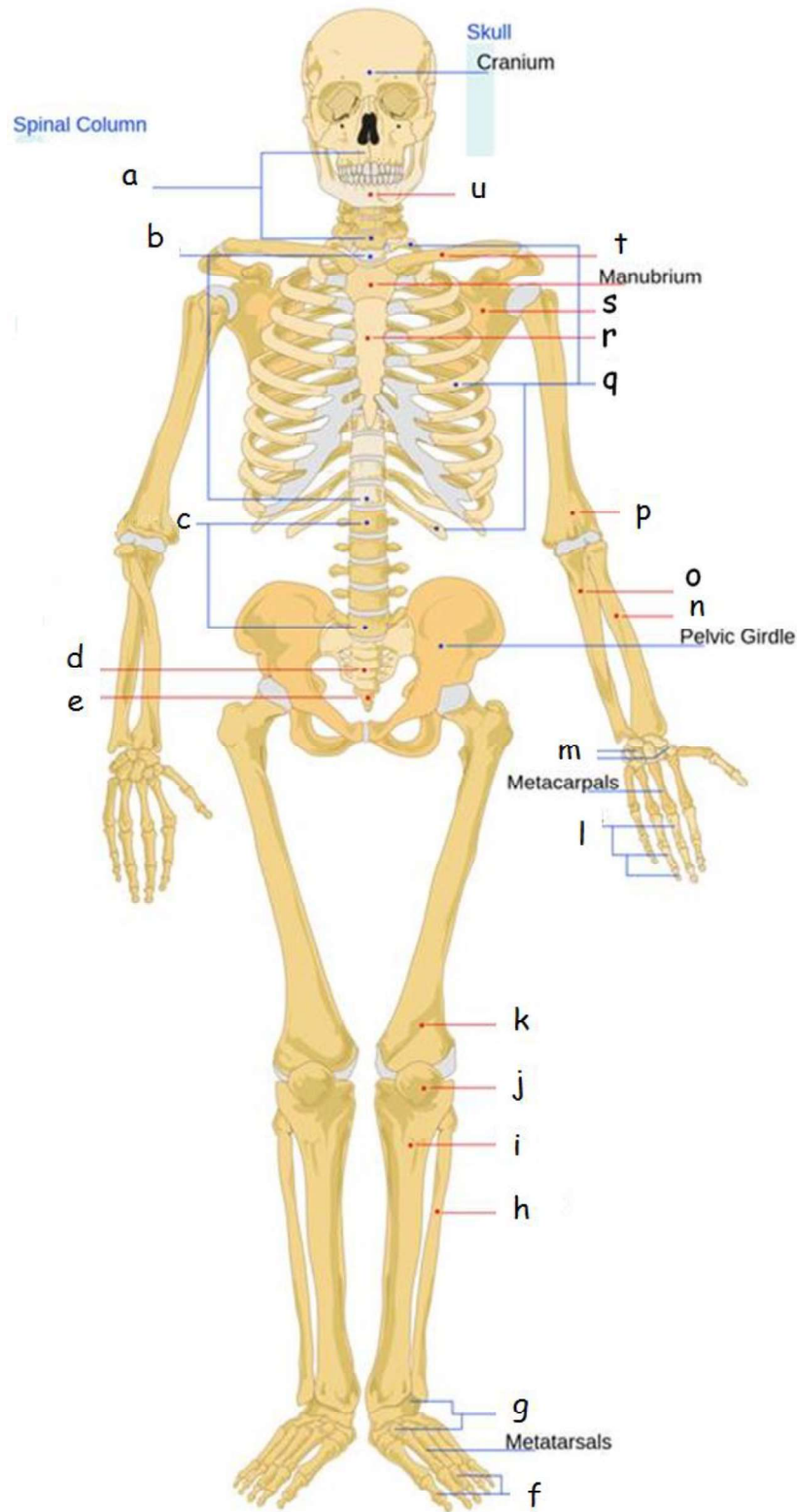
f)

c)

g)

d)

69) Correctly identify the following structures within the following image. Use the words from the word bank below:



WORD BANK: tarsals, sacrum, thoracic vertebrae, scapula, sternum, femur, phalanges, coccyx, clavicle, lumbar vertebrae, mandible, patella, phalanges, humerus, ulna, radius, ribs, tibia, fibula, cervical vertebrae, carpals

- | | |
|----|----|
| a) | l) |
| b) | m) |
| c) | n) |
| d) | o) |
| e) | p) |
| f) | q) |
| g) | r) |
| h) | s) |
| i) | t) |
| j) | u) |
| k) | |

Test: Answer Key

Vocabulary Matching:

- 1) planes of reference
- 2) semipermeable
- 3) cell membrane
- 4) keratin
- 5) nervous tissue
- 6) neurons (nerve cells)
- 7) smooth muscle
- 8) columnar
- 9) organelles
- 10) neuroglia
- 11) lumen
- 12) diffusion
- 13) esophagus
- 14) epithelial
- 15) striated tissue
- 16) contracts
- 17) cartilage
- 18) connective tissue proper
- 19) muscle fibers
- 20) melanin
- 21) hypothalamus
- 22) integumentary system
- 23) root
- 24) sebum
- 25) vascular
- 26) vitamin D
- 27) basement membrane
- 28) bulb
- 29) dermis/hypodermis
- 30) trichosiderin
- 31) avascular
- 32) sebaceous glands
- 33) sensory receptors
- 34) genitalia
- 35) stratum basale
- 36) sudoriferous glands
- 37) epidermis
- 38) vasoconstriction
- 39) shaft
- 40) vasodilation
- 41) false ribs
- 42) spinal cord
- 43) lumbar curvature (small of the back)
- 44) thoracic (chest) curvature
- 45) ligaments
- 46) tendons
- 47) synovial joints
- 48) extremities
- 49) irregular bones
- 50) axial skeleton

- | | |
|-------|-------|
| 51) d | 58) T |
| 52) b | 59) T |
| 53) a | 60) F |
| 54) a | 61) F |
| 55) c | 62) T |
| 56) T | 63) T |
| 57) F | |

- 64) The outermost layers of the skin consists of many rows of flat, dead epithelial cells. These layers are continuously shed and replaced throughout our lives. In infants, there are fewer rows of cells, resulting in skin that's more easily damaged than the skin of adults.
- 65) The splinter is likely stuck through the keratinized, stratified squamous layer of the skin. There is no bleeding because the epithelium is avascular.
- 66) The sagittal plane divides the body into equal right and left halves. The transverse plane divides the top half from the bottom half of the body.
- 67) Replacement of cartilage of the epiphyseal plate by bone normally occurs on the diaphyseal side of the plate. Since new cartilage from the growth plate is normally pushed towards the outer edge of the epiphyses where it eventually is transformed into bone, the "base" of the growth plate (the area nearest the diaphysis) must first be replaced by bone. This reduces the growth plate's ability to continually produce new cartilage. Replacement of cartilage with bone continues from the diaphyseal side until all of the cartilage of the plate is eventually converted into bone.

68) Matching words from image:

- a) muscle
- b) synovial fluid
- c) synovial fluid lining
- d) tendon
- e) epiphysis
- f) hyaline cartilage
- g) ligament

69) Matching words from image:

- | | | |
|--------------------------|--------------|-------------|
| a) cervical
vertebrae | f) phalanges | n) radius |
| b) thoracic
vertebrae | g) tarsals | o) ulna |
| c) lumbar
vertebrae | h) fibula | p) humerus |
| d) sacrum | i) tibia | q) ribs |
| e) coccyx | j) patella | r) sternum |
| | k) femur | s) scapula |
| | l) phalanges | t) clavicle |
| | m) carpals | u) mandible |