**Instructor’s Manual**

***to accompany***

***Martin’s Human Anatomy and Physiology***

***Laboratory Manual,* Main, Cat, and Fetal Pig Versions**

**Fourth Edition**

**Terry R. Martin**

***Kishwaukee College***

**Cynthia Prentice-Craver**

***Chemeketa Community College***

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**Laboratory Exercise 1**

**Scientific Method and Measurements**

**Pre-Lab Answers**

1. a 4. b 7. b
2. c 5. c 8. a
3. d 6. c

**Laboratory Assessments Answers**

Part A: Assessments

1. (experimental results)
2. (experimental results)
3. Answers will vary; however, many students will conclude that the data will support their original hypothesis.

Part B: Assessments

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. Answers will vary.
6. Answers will vary.

**Laboratory Exercise 2**

**Body Organization, Membranes, and Terminology**

**Pre-Lab Answers**

1. c 4. c 7. d 10. a
2. a 5. c 8. d
3. d 6. b 9. b

**Laboratory Assessments Answers**

Part A: Assessments

1. Matching:

1. a 4. a 7. c 10. a
2. d 5. b 8. e
3. a 6. c 9. d

2. Fig. 2.10:

1. Cranial; brain

2. Vertebral canal; spinal cord

3. Thoracic; lung

4. Abdominal; gallbladder

5. Pelvic; urethra

3. Fig. 2.11:

1. Parietal pericardium

2. Pericardial cavity

3. Visceral pericardium (epicardium)

Part B: Assessments

1. c 4. g 7. e 10. b
2. d 5. j 8. f 11. a
3. h 6. i 9. k

Part C: Assessments

1. Inferior 4. Anterior 7. Distal 10. Posterior
2. (Correct) 5. (Correct) 8. (Correct) 11. Deep
3. (Correct) 6. (Correct) 9. (Correct) 12. (Correct)

Part D: Assessments

Critical Thinking Assessment:

1. LUQ 4. RUQ
2. RLQ 5. LUQ or LLQ
3. any or all quadrants 6. LUQ

Part E: Assessments

Fig. 2.12:

1. Sagittal (median; midsagittal)
2. Frontal (coronal)
3. Transverse (horizontal)

Fig. 2.13 – Anterior view:

1. Cephalic 4. Sternal 7. Antecubital 10. Carpal 13. Crural

1. Otic 5. Pectoral 8. Antebrachial 11. Femoral 14. Tarsal
2. Cervical 6. Brachial 9. Inguinal 12. Patellar

Fig. 2.13 – Posterior view:

1. Occipital 4. Gluteal 7. Plantar

1. Otic 5. Manus
2. Lumbar 6. Popliteal

Critical Thinking Assessment:

A – Thoracic cavity; pleural cavity – Left lung

B – Abdominal cavity; abdominopelvic cavity – Liver; gallbladder; small intestine; large intestine

C – Pelvic cavity; abdominopelvic cavity – Small intestine; large intestine; left ureter

**Laboratory Exercise 3**

**Chemistry of Life**

**Pre-Lab Answers**

1. c 4. d 7. a
2. b 5. a 8. a
3. a 6. c

**Laboratory Assessments Answers**

Part A: Assessments

1. (experimental results)
2. (experimental results)
3. No
4. Various substances dissolved in tap water will influence the pH.
5. (experimental results)

Critical Thinking Assessment:

A person who has blood pH of 7.20 is below the normal range of blood pH which is 7.35-7.45; therefore, there would be an abnormally high amount of H+ concentration in the blood relative to what is normal, resulting in acidosis.

Part B: Assessments

1. (experimental results)
2. (experimental results)
3. (experimental results)
4. (experimental results)

Part C: Assessments

1. Answers will vary.
2. (experimental results)
3. Answers will vary depending upon the unknown compound selected.
4. Answers will vary.

Critical Thinking Assessment:

Answers may vary; however, albumin has the highest protein value along with the lowest amount of carbohydrates (starch and sugar).

**Laboratory Exercise 4**

**Care and Use of the Microscope**

**Pre-Lab Answers**

1. c 4. d 7. b
2. d 5. b 8. a
3. a 6. c

**Critical Thinking Activity Answer:**

Answers will vary depending upon the order of the three colored threads. However, the colored thread on the top will be in focus first, the middle one second, and the bottom one last as the student continues to turn the fine adjustment the same direction.

**Laboratory Assessments Answers**

Part A: Assessments

1. 100x
2. 1000x

Part B: Assessments

1. (sketch) 4. About 2.2 mm
2. About 4.5 mm (using a 4x (scanning) objective) 5. About 2,200 micrometers
3. About 4,500 micrometers

Part C: Assessments

1. (sketch) 5. Light intensity is decreased when high-power objective is used
2. About 1.7 mm (using a 10x (low-power) objective) 6. (sketch)
3. View is about 2.6 times greater than that of the 7. The image is upside down and reversed from right to left

low-power field of view 8. Left

1. Student is unable to see two adjacent mm lines on 9. Toward the observer

the scale in the high-power field of view

Part D: Assessments

1. Fig. 4.8:

1. Body tube 4. Rotating nosepiece 7. Condenser 10. Substage illuminator
2. Body 5. Objectives 8. Iris diaphragm lever
3. Mechanical stage 6. Stage 9. Adjustment knobs

control knobs

2. Matching:

1. f 4. a 7. d 10. e
2. i 5. h 8. b
3. c 6. J 9. g

Part E: Assessments

(sketches)

**Laboratory Exercise 5**

**Cell Structure and Function**

**Pre-Lab Answers**

1. b 4. c 7. b
2. a 5. a 8. b
3. d 6. c 9. a

**Critical Thinking Activity Answer:**

The outer body surface is the same tissue as inside the cheek, however outer surface cells are dead from drying out.

**Laboratory Assessments Answers**

Part A: Assessments

1. Fig. 5.4:
2. Ribosomes 5. Mitochondrion
3. Secretory vesicle 6. Rough endoplasmic reticulum
4. Golgi apparatus 7. Plasma membrane
5. Nucleolus
6. Matching:
7. a 4. l 7. c 10. e
8. g 5. i 8. b 11. h
9. k 6. f 9. d 12. j

Part B: Assessments

1. (sketch)
2. The wet mount cells look like shells or “ghosts.” The stained cells made the nucleus and other cellular components clearly visible.

Part C: Assessments

1. (sketches)
2. Students should notice cytoplasm, nucleus, nuclear envelope, and plasma membrane.
3. Answers will vary.
4. Answers will vary.

Part D: Assessments

Fig. 5.5:

1. Ribosomes (free) 6. Plasma membrane
2. Nuclear envelope 7. Mitochondria (cross section)
3. Endoplasmic reticulum 8. Nuclear envelope
4. Mitochondrion (cross section) 9. Nucleolus
5. Chromatin 10. Chromatin

11. Answers will vary.

**Laboratory Exercise 6**

**Movement Through Membranes**

**Pre-Lab Answers**

1. c 4. a 7. b
2. d 5. b 8. a
3. a 6. c

**Laboratory Assessments Answers**

Part A: Assessments

1. (experimental results)
2. (experimental results)
3. Answers will vary.
4. Some of the color of the tea in the bag diffused from the higher concentration inside the tea bag into the area of lower concentration into the hot water outside of tea bag.

Critical Thinking Assessment:

1. Yes
2. Yes
3. No

Part B: Assessments

1. Answers will vary.
2. The greater volume of fluid is in the thistle tube as a result of osmosis. The water is moving toward the area with the higher solute concentration.
3. Plain water has more water and less solute concentration than what is inside the cells of the carrot and celery pieces, so water will move into the carrot and celery making them more plump and crisp.

Critical Thinking Assessment:

1. Yes
2. No
3. Yes

Part C: Assessments

1. (sketches)
2. Tube 3 – There was a net movement of water out of the cells.
3. Tube 1 – There was a net movement of water into the cells.
4. Tube 2 – There was no net movement of water into or out of the cells.
5. (a) Isotonic; (b) Hypertonic; (c) Hypotonic

Critical Thinking Assessment:

If unusually large quantities of plain water are consumed in a very short period of time, our cells become exposed to this hypotonic solution that would then move into the cells, resulting in cells that swell and burst (lyse).

Part D: Assessments

1. Water, glucose, and starch passed through the filter paper.
2. The tests for glucose and starch were positive.
3. Gravity
4. Charcoal
5. Pores in the filter paper were too small.
6. Increase; A greater hydrostatic pressure would occur in the capillaries during exercise. This would increase the filtration of substances out of the capillaries into the tissues.

Critical Thinking Assessment:

1. No; This is an example of diffusion, not filtration, as oxygen molecules and carbon dioxide molecules move down their concentration gradients across the plasma membrane.
2. Yes; Hydrostatic pressure is force that is pushing substances through the wall of the blood capillary.
3. Yes; Water coming from the coffee maker is putting pressure on the noninstant coffee, pushing dissolved coffee through the pores of the filter paper.

*.*

**Laboratory Exercise 7**

**Cell Cycle**

**Pre-Lab Answers**

1. a 4. c 7. c 10. a
2. b 5. c 8. b
3. d 6. b 9. b

**Critical Thinking Activity Answer:**

Interphase. Even in rapidly dividing cells interphase is the most prevalent because it requires the longest period of time for growth and duplication of cell structures.

**Laboratory Assessments Answers**

Part A: Assessments

Table:

|  |  |
| --- | --- |
| **Stage** | **Major Events Occurring** |
| Interphase | DNA synthesis, growth, duplication of cytoplasmic structures, and normal metabolism take place. |
| Prophase | Nuclear envelope and nucleolus disperse; chromatin fibers condense, forming chromosomes (paired chromatids); centrioles move to opposite sides of the cell. |
| Metaphase | Chromosomes align along equator (midway) between centrioles. |
| Anaphase | Microtubules pull sister chromatids toward centrioles. |
| Telophase | Chromosomes elongate and become chromatin fibers; nuclear envelopes reassemble. |
| Cytokinesis | Cell membrane constricts, dividing cell into new cells (daughter cells). |

Part B: Assessments

(sketches)

Part C: Assessments

1. Each new cell contains identical chromosomes.
2. Mitosis is the division of the nucleus while cytokinesis is the division of the cytoplasm of the cell.

Part D: Assessments

* 1. Metaphase c. Prophase
  2. Telophase d. Anaphase



5 1

6 4

8 3

2 7

**Laboratory Exercise 8**

**Epithelial Tissues**

**Pre-Lab Answers**

1. a 4. b 7. a
2. d 5. c 8. a
3. b 6. a 9. b

**Laboratory Assessments Answers**

Part A: Assessments

(sketches)

Critical Thinking Assessment:

Any of the epithelial tissues with many layers will provide good protection. Cells with cilia also provide additional protection.

Part B: Assessments

Matching:

1. h 4. d 7. e 10. a 13. a
2. d 5. c 8. h 11. g
3. c 6. f 9. b 12. e

Part C: Assessments

Answers will vary.

Critical Thinking Assessment:

The simple cuboidal epithelial cells are all resting on the basement membrane and are therefore closest to the nutrient and waste removal source of blood vessels found in the connective tissue beneath (deep to) the basement membrane. In order for tissues to carry out mitosis to repair and heal from injury, a blood supply is crucial. The stratified squamous epithelial cells are layered, and it is only those cells closest to the basement membrane that are able to carry out mitosis.

**Laboratory Exercise 9**

**Connective Tissues**

**Pre-Lab Answers**

1. d 4. a 7. a
2. c 5. a 8. b
3. b 6. c 9. a

**Laboratory Assessments Answers**

Part A: Assessments

(sketches)

Part B: Assessments

Matching:

1. g 4. d 7. j 10. h 13. b
2. a 5. b 8. i 11. k 14. c
3. c 6. f 9. e 12. f

Part C: Assessments

Answers will vary.

Critical Thinking Assessment:

The spleen is composed of reticular connective tissue containing only short, thin reticular fibers that are widely scattered among the cells within a fluid-gel matrix.

Critical Thinking Assessment:

Hyaline cartilage is avascular, while bone (osseous) tissue is highly vascular; therefore, bone would heal more quickly than hyaline cartilage because the metabolically active cells would receive the nourishment and waste removal necessary to carry out their functions, which include mitosis to replace dead and damaged cells.

**Laboratory Exercise 10**

**Muscle and Nervous Tissues**

**Pre-Lab Answers**

1. a 4. b 7. a
2. d 5. b 8. b
3. c 6. a

**Laboratory Assessments Answers**

Part A: Assessments

(sketches)

Part B: Assessments

Matching:

1. b 4. a 7. c 10. b
2. a 5. c 8. a 11. c
3. d 6. b 9. d 12. d

Critical Thinking Assessment:

In muscle tissue, a fiber is a living muscle cell. The nervous tissue fibers are actually axons of neurons, also called nerve fibers, so they are part of the living cell.

**Laboratory Exercise 11**

**Integumentary System**

**Pre-Lab Answers**

1. c 4. d 7. b
2. a 5. b 8. a
3. b 6. d

Critical Thinking Activity:

Produced by melanocytes, melanin granules are concentrated in the deep layers of the epidermis where cells are living and carrying out cell division. Melanin is oriented on the superficial side of the nucleus of the keratinocytes to provide a protective shield of the nucleus as it absorbs the UV radiation of the sun. The absorption of the ultraviolet radiation wavelengths by melanin helps protect these living keratinocytes and also those living cells found in the deeper dermis and hypodermis where melanocytes are not found.

**Laboratory Assessments Answers**

Part A: Assessments

1. Fig. 11.6:
2. Hair shaft 5. Arrector pili muscle
3. Sweat pore 6. Epidermis
4. Hair root 7. Dermis
5. Sebaceous gland 8. Hypodermis
6. Matching:
7. g 4. h 7. d 10. k
8. l 5. c 8. j 11. e
9. a 6. i 9. f 12. b

Part B: Assessments

1. Answers will vary.

2. Answers will vary.

3. Cell divisions of keratinocytes occur within the hair bulb at the hair matrix. As the cells are forced toward the surface, they become parts of the hair as they keratinize and die.

4. Hair root

Part C: Assessments

1.

|  |  |  |  |
| --- | --- | --- | --- |
| **Layer** | **Location** | **Tissue(s)** | **Distinguishing Characteristics** |
| Epidermis | Superficial layer of skin | Stratified squamous epithelium | Contains strata; deepest strata carries out mitosis; avascular; deepest cells rest on basement membrane; superficial cells open to surface; contains mostly keratinocytes; contains melanocytes that secrete melanin granules. |
| Dermis | Deep layer of skin | Areolar connective tissue and dense irregular connective tissue | Thick, tough layer; contains hair follicles, glands, blood vessels (vascular), arrector pili muscle |
| Hypodermis | Beneath dermis, deep to skin | Adipose, some areolar | Stores energy; vascular |

2. Cells of the stratum basale are living and actively divide; cells of the stratum corneum are keratinized and dead, forming the surface layer of the skin.

3. Melanin is located primarily in the stratum basale of the epidermis.

4. The posterior forearm is darker because it is exposed to UV rays from the sun moreso than the anterior forearm. Exposure to UV rays stimulates more melanin granule production and synthesis from melanocytes to help protect the nucleus of developing keratinocytes.

5. The dermis contains abundant elastic and collagen fibers that give the dermis qualities of elasticity and strength.

6. The epidermis layer of thick skin includes the stratum lucidum. This increased thickness of the epidermis that this strata provides gives extra protection to areas of the hands and feet.

Part D: Assessments

1. Hair root

2. Dermis

3. Sebaceous glands are next to the hair follicles and secrete sebum into the follicles.

4. the hair follicles

5. Merocrine glands

Part E: Assessments

(sketch)

**Laboratory Exercise 12**

**Bone Structure and Classification**

**Pre-Lab Answers**

1. c 4. c 7. a
2. b 5. a 8. a
3. d 6. d 9. b

Critical Thinking Activity:

The closest supply of blood to an osteocyte is the central canal of an osteon. The plasma membranes and cytoplasm of osteocytes extend through tiny channels called canaliculi, reaching and forming gap junctions (intercellular junctions) between the plasma membranes of adjacent osteocytes. Within an osteon, those osteocytes closest to the blood supply transfer nutrients and remove wastes to/from osteocytes further away.

**Laboratory Assessments Answers**

Part A: Assessments

1. Flat 7. The diaphysis of a long bone is the shaft of the bone that provides leverage for
2. Short purposes of movement when muscles contract and pull on it. The epiphysis of a
3. Long long bone is an expanded portion at the ends that provides greater surface area
4. Irregular for tendons and ligaments to attach.
5. Sesamoid 8. Hyaline cartilage is also called articular cartilage because it is located on the ends
6. Flat of a long bone which is a joint surface. It lubricates the joint to reduce friction.

9. The periosteum is the tough outer sheath that covers the surface of bone, except

at the articular ends. Exposure of the articular cartilage to the lubricating synovial

fluid of the joint, and its function in preventing bone on bone contact is important

to the ease of movement and health of the joint.

Part B: Assessments

1. The periosteum is composed of dense irregular connective tissue and covers the outer surface of bone, except at the

articular ends of long bone. The endosteum is composed of reticular connective tissue and lines the hollow, internal

chambers of bone such as the medullary cavity of long bone.

2. Compact bone has osteons that look like onion-like rings closely packed together. Spongy bone has large spaces between

Thin bony plates called trabeculae, giving it a sponge-like appearance.

3. Compact bone provides strength and support in the shaft and bone surface regions. Spongy bone reduces the weight of

bone and provides spaces for red bone marrow.

4. The marrow in the medullary cavity of an adult is yellow marrow, but the marrow in the spaces of spongy bone of some

bones is red marrow.

5. The proximal epiphyses of a humerus and a femur retain functional red bone marrow in order to produce blood cells in

the adult skeleton.

Part C: Assessments

Fig. 12.9:

1. Red bone marrow 5. Epiphyseal line

2. Yellow bone marrow 6. Spongy bone

3. Periosteum 7. Articular cartilage

4. Compact bone

Fig. 12.10:

1. Epiphysis (distal) 4. Medullary cavity

2. Diaphysis 5. Compact bone

3. Epiphysis (proximal) 6. Spongy bone

Fig. 12.11

1. Trabeculae 5. Concentric lamella

2. Spongy bone 6. Osteon

3. Compact bone 7. Periosteum

4. Perforating canal

Fig. 12.12

1. Central canal

2. Lacuna (with osteocyte)

3. Canaliculi

**Laboratory Exercise 13**

**Organization of the Skeleton**

**Pre-Lab Answers**

1. a 4. b 7. d
2. d 5. b 8. c
3. c 6. a 9. b

Critical Thinking Activity:

The largest foramen in the skull is the foramen magnum.

The largest foramen in the skeleton is the obturator foramen.

**Laboratory Assessments Answers**

Part A: Assessments

Fig. 13.3 – Anterior View

1. Skull 4. Rib 7. Femur 10. Tarsals

2. Clavicle 5. Vertebra 8. Patella 11. Metatarsal

3. Sternum 6. Hip bone 9. Tibia

Fig. 13.3 – Posterior View

1. Scapula 4. Phalanges 7. Vertebra 10. Metacarpal

2. Humerus 5. Femur 8. Radius 11. Fibula

3. Ulna 6. Tibia 9. Sacrum

Part B: Assessments

1. Fig. 13.4

1. Hip bone 4. Fibula 7. Radius 10. Patella

2. Sternum 5. Ulna 8. Clavicle 11. Femur

3. Sacrum 6. Scapula 9. Humerus 12. Tibia

13. Rib

2. The sacrum, sternum, and rib are part of the axial skeleton.

Part C: Assessments

1. Matching:

1. c 4. d 7. f

1. e 5. g
2. a 6. b

2. Matching:

1. c 4. e 7. f

2. a 5. b

3. g 6. d

Part D: Assessments

1. Sutural 5. Coccyx 9. Sternum 13. Tarsals

2. Sesamoid 6. Sternum 10. Carpals 14. Phalanges

3. Skull 7. Twelve 11. Sacrum

4. Hyoid 8. Pectoral 12. Patella

**Laboratory Exercise 14**

**Skull**

**Pre-Lab Answers**

1. a 4. b 7. c 10. b
2. d 5. b 8. b
3. c 6. a 9. a

Critical Thinking Activity:

The cribriform plate of the ethmoid bone with numerous olfactory foramina is a weak location of the cranium. Excessive pressure on the cribriform pate could result in a skull fracture.

**Laboratory Assessments Answers**

Part A: Assessments

Fig. 14.10

1. Frontal bone 4. Infraorbital foramen 7. Middle nasal concha

2. Nasal bone 5. Maxilla 8. Inferior nasal concha

3. Zygomatic bone 6. Mandible 9. Mental foramen

Fig. 14.11

1. Parietal bone 6. External acoustic meatus 11. Zygomatic process (of temporal bone)

2. Squamous suture 7. Mastoid process 12. Zygomatic bone

3. Temporal bone 8. Mandibular condyle 13. Maxilla

4. Lambdoid suture 9. Coronal suture 14. Mental foramen

5. Occipital bone 10. Frontal bone 15. Mandible

Fig. 14.12

1. Maxilla 6. Incisive foramen 11. Foramen magnum

2. Zygomatic bone 7. Palatine process of maxilla

3. Sphenoid bone 8. Palatine bone

4. Temporal bone 9. Vomer bone

5. Occipital bone 10. Occipital condyle

Fig. 14.13

1. Frontal bone 5. Ethmoid bone

2. Temporal bone 6. Sphenoid bone

3. Parietal bone 7. Sella turcica

4. Occipital bone 8. Foramen magnum

Critical Thinking Assessment:

The bones and their features that compose the temporomandibular joint are the mandibular condyle (of the mandible bone) and the mandibular fossa (of the temporal bone).

Part B: Assessments

Matching:

1. d 4. f 7. f 10. e

2. a 5. c 8. a 11. f

3. a 6. f 9. c 12. b