

**SOLUTIONS TO THE STUDY GUIDE FOR MODULE #13**

1. a. Vertebrae – Segments of bone or some other hard substance that are arranged into a backbone
- b. Notochord – A rod of tough, flexible material that runs the length of a creature's body, providing the majority of its support
- c. Endoskeleton – A skeleton on the inside of a creature's body, typically composed of bone or cartilage
- d. Bone marrow – A soft tissue inside the bone that produces blood cells
- e. Axial skeleton – The portion of the skeleton that supports and protects the head, neck, and trunk
- f. Appendicular skeleton – The portion of the skeleton that attaches to the axial skeleton and has the limbs attached to it
- g. Closed circulatory system – A circulatory system in which the oxygen-carrying blood cells never leave the blood vessels
- h. Arteries – Blood vessels that carry blood away from the heart
- i. Capillaries – Tiny, thin-walled blood vessels that allow the exchange of gases and nutrients between the blood and the cells of the body
- j. Veins – Blood vessels that carry blood back to the heart
- k. Olfactory lobes – The lobes of the brain that receive signals from the receptors in the nose
- l. Cerebrum – The lobes of the brain that integrate sensory information and coordinate the creature's response to that information
- m. Optic lobes – The lobes of the brain that receive signals from the receptors in the eyes
- n. Cerebellum – The lobe that controls involuntary actions and refines muscle movement
- o. Medulla oblongata – The lobes that coordinate vital functions, such as those of the circulatory and respiratory systems, and transport signals from the brain to the spinal cord
- p. Internal fertilization – The process by which the male places sperm inside the female's body, where the eggs are fertilized
- q. External fertilization – The process by which the female lays eggs and the male fertilizes them once they are outside of the female
- r. Oviparous development – Development that occurs in an egg that is hatched outside the female's body

- s. Ovoviviparous development – Development that occurs in an egg that is hatched inside the female’s body
  - t. Viviparous development – Development that occurs inside the female, allowing the offspring to gain nutrients and vital substances from the mother through a placenta
  - u. Anadromous – A life cycle in which creatures are hatched in fresh water, migrate to salt water as adults, and then go back to fresh water in order to reproduce
  - v. Bile – A mixture of salts and phospholipids that aids in the breakdown of fat
  - w. Atrium – A heart chamber that receives blood
  - x. Ventricle – A heart chamber from which blood is pumped out
  - y. Ectothermic – Lacking an internal mechanism for regulating body heat
  - z. Hibernation – A state of extremely low metabolism and respiration, accompanied by lower-than-normal body temperatures
2. a. Class Amphibia b. Class Chondrichthyes c. Subphylum Cephalochordata d. Class Osteichthyes e. Subphylum Urochordata f. Class Agnatha
3. In addition to the other common features of members of phylum Chordata, they all go through metamorphosis from larva to adult.
  4. Bone is made of collagen fibers that have been hardened with calcium, while cartilage is not hardened. Thus, cartilage is more flexible and weaker than bone.
  5. Capillaries have thin walls to allow for the diffusion of gases. Thus, this is, most likely, a capillary.
  6. Red blood cells carry oxygen in the blood.
  7. Hemoglobin gives red blood cells their color.
  8. The cerebellum refines muscle movement. A creature that has uncoordinated, jerky muscle movements has a small cerebellum. Thus, an amphibian has a small cerebellum.
  9. Vertebrates have enlarged lobes if the creature has a particular aptitude for the function controlled by the lobe. Since owls have good eyesight, their optic lobes are enlarged.
  10. Fertilization is internal, because the female takes the sperm in to form the zygote, which is then encased in the egg. Development is oviparous, because the egg hatches externally.
  11. The stronger the skeleton, the less flexible it is. Lampreys and rays both have cartilaginous skeletons, but the salmon is a bony fish. Thus, the salmon’s skeleton is less flexible.
  12. Atlantic salmon and many lamprey are anadromous.

13. The shark's most sensitive means of finding prey is its electrical field sensor.
14. The lateral line senses vibrations in the water. This alerts fish and sharks to movements in the water. Typically, sharks investigate the vibrations as possible food sources, while most bony fish swim away from them in fear.
15. In both sharks and bony fish, the dorsal fins are used for balance in the water. In bony fish, the anterior dorsal fin is also a defensive weapon, because it is hard and sharp.
16. Rays have thin, whiplike tails, while skates have thicker, fleshy tails.
17. a. esophagus b. brain c. spinal cord d. stomach e. air bladder f. kidney g. gonad h. anus  
i. intestine j. pyloric ceca k. gall bladder l. liver m. heart n. gills

18.

Organ	Basic Function
Gills	Exchange of carbon dioxide and oxygen between the water and the blood
Heart	Pumps blood
Liver	Makes bile for the digestion of fats and does many other chemical tasks
Gall bladder	Concentrates bile
Pyloric ceca	Secretes digestive enzymes and chemicals that break down food in stomach
Intestine	Digests food
Gonad	Reproduction
Anus	Expelling of undigested food
Brain	Controls nervous system
Esophagus	Sends food to stomach
Stomach	Stores and breaks down food
Spinal cord	Sends messages from brain to other parts of the body and vice-versa
Kidney	Cleans blood of waste products
Air bladder	Allows fish to change depths and float in water

19. a. anterior cardinal vein b. efferent brachial arteries c. dorsal aorta d. kidney  
e. posterior cardinal vein f. atrium g. ventricle h. ventral aorta i. afferent brachial arteries j. gills

20.

Arteries	Veins	Neither
Efferent brachial arteries	Anterior cardinal vein	Atrium
Dorsal aorta	Posterior cardinal vein	Ventricle
Ventral aorta		Gills
Afferent brachial arteries		Kidney

21. Their endoskeleton is made mostly of bone.

Their skin is smooth with many capillaries and pigments. Amphibians do not have scales.

They usually have two pairs of limbs with webbed feet.

They have as many as four organs of respiration.

They have a three-chambered heart.

They are oviparous with external fertilization.

22. Frogs have smooth, wet skin and live near water. Toads have dry, warty skin and need not live near water.

23. The major respiratory organ for most amphibians is the skin.