1. Explain how the **outer physical appearance**, **digestive system**, **circulatory system**, and **reproductive system** are *specifically* adapted for each animal’s environment. (Hint: think of evolution and adaptation). 12.5 points

Dogfish

* Physical appearance:
  + Dogfish have a streamlined body shape designed for moving quickly through aqueous environments, along with multiple pairs of fins.
  + Their skin has a lateral line and the head has nares for smell and eyes for sight, allowing the shark to sense changes in the water pressure, direction, detect odors in water, and see.
  + Spiracles let water flow over the gills while the shark is feeding.
  + Dogfish have an external reproductive system consistent with their aqueous environment.
* Digestive system:
  + The liver not only detoxifies waste and produces bile, but it also stores the oil that dogfish need to remain buoyant since they do not have a swim bladder.
  + Dogfish have a cloaca that handles both the excretion of waste and the release of sperm.
  + They have a spiral valve that increases the surface area of the small intestine.
  + The remainder of the system is similar in function to that of other vertebrates, consisting of an esophagus, intestine, accessory organs, colon, and stomach.
* Circulatory system:
  + In order for gas exchange to take place underwater, the dogfish needs to have gills that water can run over, exchange gas with de-oxygenated blood pumped by the 4-chamber heart, and then deliver that to the rest of the body.
  + Gill rakers prevent suspended food particles from entering and injuring the gills.
* Reproductive system:
  + Male sharks have a specialized reproductive system that carries sperm from the testes to the seminal vesicle, where it then exits via the cloaca and two claspers with dorsal grooves.
  + The female dogfish has a specific shell gland that coats the fertilized eggs and then continues to the uterus where they develop inside the mother and hatch inside.

Toad/Frog:

* Physical appearance:
  + Frogs have thin skin and lack hair to allow for gas exchange, as well as a nictitating membrane adapted for use when underwater.
  + For hearing, the frogs developed external tympanic membranes that allow for sounds detection both underwater and above ground.
  + The tongue is also specialized for catching insects.
* Digestive system:
  + The frog has a standard digestive system compared to other non-mammal vertebrates, with similar organs to the dogfish (except the spiral valve).
* Circulatory system:
  + 3-chambered heart paired with cutaneous respiration allows for more efficient circulation since frogs have evolved a relatively slow metabolism and therefore require less oxygen.
* Reproductive system:
  + In females, eggs coated in gelatinous substance are stored in the ovisac until they are released into the water to be fertilized, utilizing their surrounding environment.
  + In male frogs sperm moves from the testes to the ureter and out of the anus into the surrounding water.

Rat:

* Physical appearance:
  + Large whiskers help rats sense during night, since they have adapted to be nocturnal.
  + The nares that they have evolved for smell also help with sensing in darkness.
  + External pinnae are specially adapted to focus sound waves and pinpoint direction.
  + Adult rats also have incisors and molars to gnaw on food that they’ve adapted to with their omnivorous diet.
  + Body hair helps conserve heat, whereas the naked tail dissipates (as well as balance, since terrestrial animals do not have significant buoyancy to remain upright).
  + Rats walk with 4 limbs in what is called plantigrade motion, something that is adapted to the rough and uneven terrain.
* Digestive system:
  + The organs of the digestive system in rats are similar to those preceding, except that the rat has an anus specifically for excreting fecal matter instead of a cloaca.
* Circulatory system:
  + 4-chambered hearts are adapted to mammals higher metabolic rate and need of oxygen to function.
  + The diaphragm helps with terrestrial lung contraction since mammals do not have gills.
* Reproductive system:
  + Female rats carry fertilized eggs until giving a live birth. This is an adaptation to living fully on land since external eggs would dehydrate.
  + Unlike previous animals, the male rat has an external reproductive system in which the penis is used to discharge semen in complement.

Pig:

* Physical appearance:
  + The pig has similar external structures to the rat with body hair, tails, eyes, nose, and ears.
  + Pigs walk on their hooves in unguligrade motion, where two-digit hooves are better suited to balancing on rocky terrain.
  + The umbilical cord in mammals is used to receive oxygen and nutrients from the mothers blood, as well as eliminate waste since they are born living.
* Digestive system:
  + Pigs have a full digestive system from mouth to anus, suitable for the type of food that they eat.
* Circulatory system:
  + 4-chambered hearts are adapted to mammals higher metabolic rate and need of oxygen to function.
  + The diaphragm helps with terrestrial lung contraction since mammals do not have gills.
* Reproductive system:
  + Female pigs carry fertilized eggs until giving a live birth. This is an adaptation to living fully on land since external eggs would dehydrate.
  + The male pig has an external reproductive system in which the penis is used to discharge semen in complement.

**2.** Compare the frog and the Dogfish. How are they similar? How are they different? Explain why you think these differences occur? (Hint: Think of evolution and adaptation) 5 points

* Similarities:
  + Adapted for life underwater
  + Reproduce in eggs
  + Cloaca
  + Similar digestive system, bar the spiral valve
  + Gas exchange can occur underwater
* Differences:
  + Dogfish have gills for underwater respiration, whereas frogs breathe almost only through their skin underwater
  + The nerve sensors of the dogfish are concentrated on the lateral line
  + The liver of the dogfish also stores the oil it needs for buoyancy
  + Frogs have 3-chambered hearts compared to the 4-chambered heart of the dogfish
  + Spiral valve of the dogfish does not exist in the frog
  + Frogs hear through their tympanic membrane, whereas fish hear through other mechanisms

These differences likely arrived as vertebrates evolutionary transitioned from aquatic living to adapt to terrestrial life. Both have to be able to survive in water, but the frog also has to live on land, requiring unique adaptations that would not be necessary in the dogfish.

**3.** Compare the Rat and the Fetal Pig. How are they similar? How are they different? Explain why you think these differences occur? (Hint: Think of evolution and adaptation) 5 points

* Differences:
  + Rats have whiskers, whereas pigs do not
  + Pigs do not need the specific adaptations rats have for nocturnal living such as highly developed sense organs
  + Different terrains require different styles of locomotion, such as plantigrade vs unguligrade
* Similarities
  + Both have hair
  + Similar digestive tracts, as well as circulatory and reproductive systems

The differences that do occur mainly arise from adaptations to different environments and lifestyles, such as how the rat lives nocturnally, although they are similar internally since they are related evolutionarily.

**4.** Which of the five vertebrates are the most similar? Explain why. 5 points

I believe that the rat and the pig are the most similar. They are both mammals and are therefore more closely related genetically, and they also have similar morphological features like circulatory, digestive, and reproductive systems since they adapted to similar environments.

**5.** What did you think of this lab? What would you change in the future to make it more informative and/or fun? 2.5 points

This lab was pretty fun already, dissecting is always cool. Having to look at other peoples finished dissections wasn’t very informative for those animals, but that has obvious time constraints.