

Topic 8: Body Systems – 8d. Respiratory/Circulatory Systems

8d2. Goldfish Tail Circulation Lab

Resources: Campbell et al. *Biology: Exploring Life*. Prentice Hall, p. 655.
Campbell et al. *Biology: Concepts and Connections*. Pearson, pp. 470-472.
Miller and Levine. *Biology*. Prentice Hall, p. 947.

Building on: Cell Structure and function
Diffusion and osmosis
Homeostasis

Links to Chemistry: Chemical reactions
Respiration reactions
Gas laws

Links to Physics: Conservation of energy
Flow rates
Pressure

Stories: Students will assume that fish out of water cannot survive, just as they could not survive underwater. However, the key to the fish's gas exchange (and yours) is to keep their gills wet. This is also a good time to talk about the percentage of oxygen in the air (about 20% at sea level) versus dissolved oxygen in water (usually 1% or less). Fish being ectothermic (cold-blooded) do not have the same oxygen requirements as humans, which are endothermic. Furthermore, fish—goldfish in particular—can store oxygen within their swim bladders. This is why goldfish can survive in outdoor ponds or with bowls without an aeration pump; they simply “gulp” a bit of air from above the surface of the water and they can use that oxygen for later.

Lab Instructions and Materials for the Teacher:

Buy medium-sized feeder goldfish at a local pet store; they usually sell for about 10¢ each. Set up two tanks: one for fish to be used by the students and one to allow the fish to recover. These tanks can be rotated from one class period to the next.

If the cotton gets into the fish's gills, it can cause a problem, so I will sometimes wrap the cotton in cheesecloth to contain the fibers better than cotton alone. Some fish “stress coat” (also available at the pet store) will allow the fish to recover even better.

Keep water from accumulating in the bottom of the Petri dish, or else the fish's swimming reflex will be triggered and they will flip their tail, violently trying to swim! The trick is to keep the cotton wet, but not the dish.

Goldfish Tail Circulation Lab

Materials:

Medium-sized goldfish

2 halves of a microscope slide

Dip net

Medicine dropper/dropper bottle w/H₂O

Half of a Petri dish

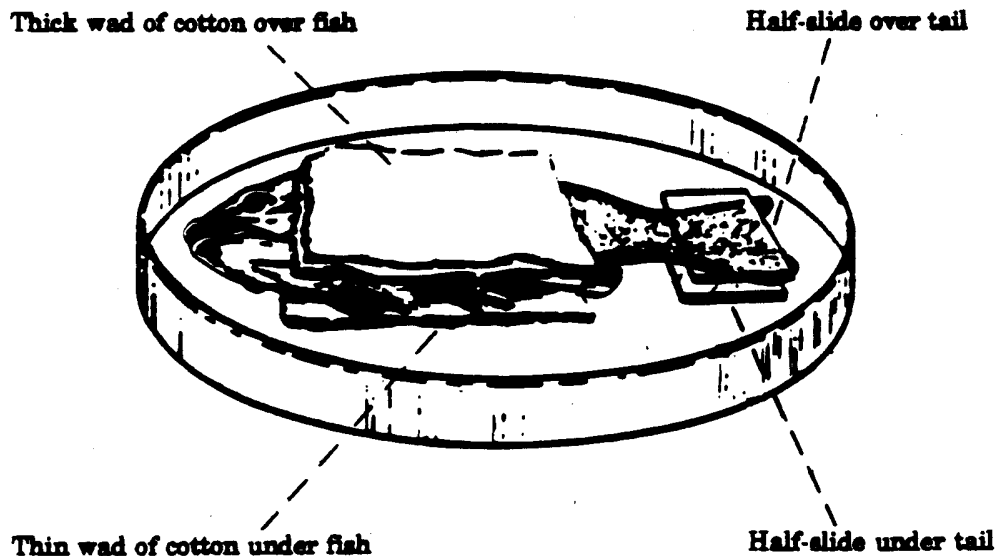
Compound microscope

2 wads of cotton (1 thick/1 thin)

Procedure:

1. Soak a thin wad of cotton in water and spread it toward one end of the bottom of a Petri dish. At the other end, place a clean half-slide. Soak a thick wad of cotton in water and have it ready for the next step.
2. Using a net, remove a fish from the water. Place the fish in the Petri dish with its head and body peacefully laying on the wet cotton. Its tail should lie on the half-slide.
3. Now place the thick, soaked wad of cotton over the body of the fish. Place another half-slide over the tail. The setup should look like the figure below (except you very likely have the fish head also covered in cotton, so he can't stare at you. ☺)

If the fish flips its tail out, as it may, just put it back between the glass slides. Remember to keep the cotton wet.



4. Remove the clips from the stage of your microscope. Place the Petri dish on the stage so that the fish's tail is over the hold in the stage.

Analysis:

Focus on the tail. Then move the dish around until you find a part of the tail in which you clearly see flowing blood. The smallest of the blood vessels you can see here are capillaries. (RBC's will be going through in single file.) Look for a small artery (arteriole) at a point where it divides. The two forks of this division are the capillaries.

1. Does blood flow more rapidly in the capillaries or in the arteries?
2. The small objects moving through the capillaries are red blood cells. What is their shape? Draw one here:
3. How many red blood cells can pass side by side through the capillaries?
4. Formulate a hypothesis to account for any advantage in having red blood cells pass through the capillaries as they do.

Trace a capillary in the direction of the blood flow until it joins with another to form a slightly larger vessel, a small vein called a venule.

5. Does the blood move more rapidly or less rapidly after it flows from the capillaries into a vein?
6. Why is it an advantage that the capillaries have thin walls?
7. Would you expect much exchange between red blood cells and body cells in arteries or veins? Why or why not?

8. Draw and label the five vessels listed below in your microscope's field of view (make sure they are in sequence!), and with arrows, show the direction that the blood is flowing. Remember, this is a microscopic view!

Artery → Arteriole → Capillary → Venule → Vein

Continue to draw more vessels so that your illustration looks like what you saw under the microscope; you do not label anymore vessels.

- Label the head and tail outside the field of view.
- Color the illustration with shades of orange and red.

Title _____

