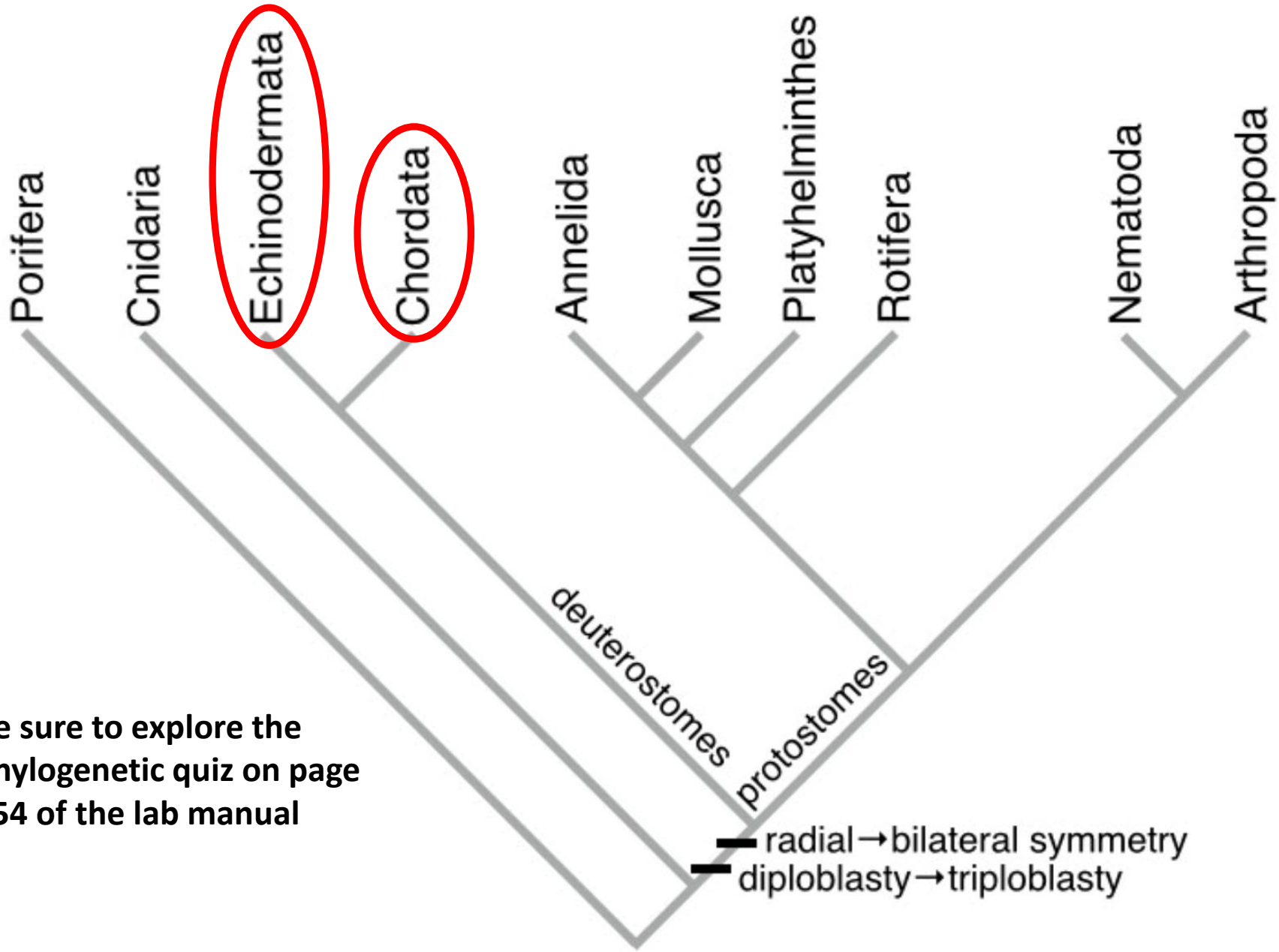
Week 12: Poecilia

Phyla Echinodermata and Chordata

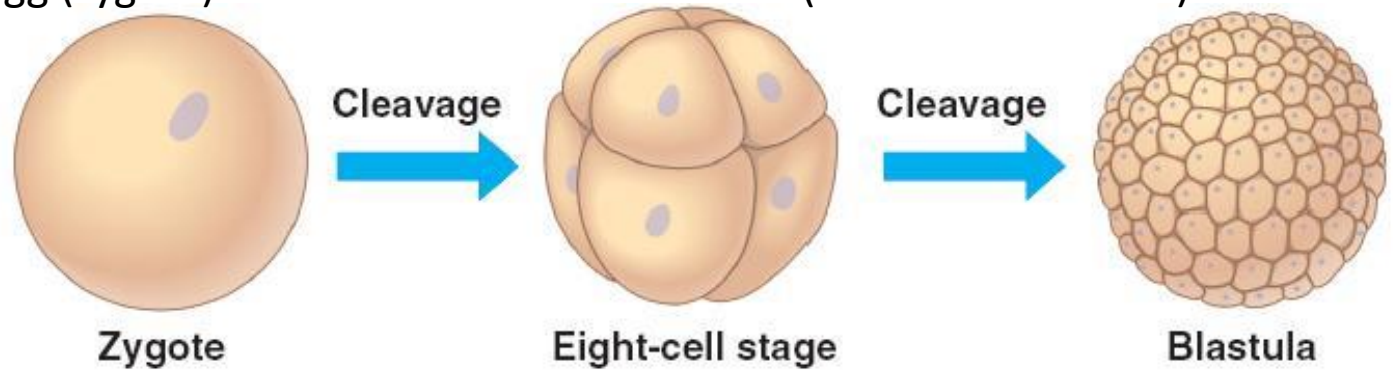


Be sure to explore the phylogenetic quiz on page 254 of the lab manual

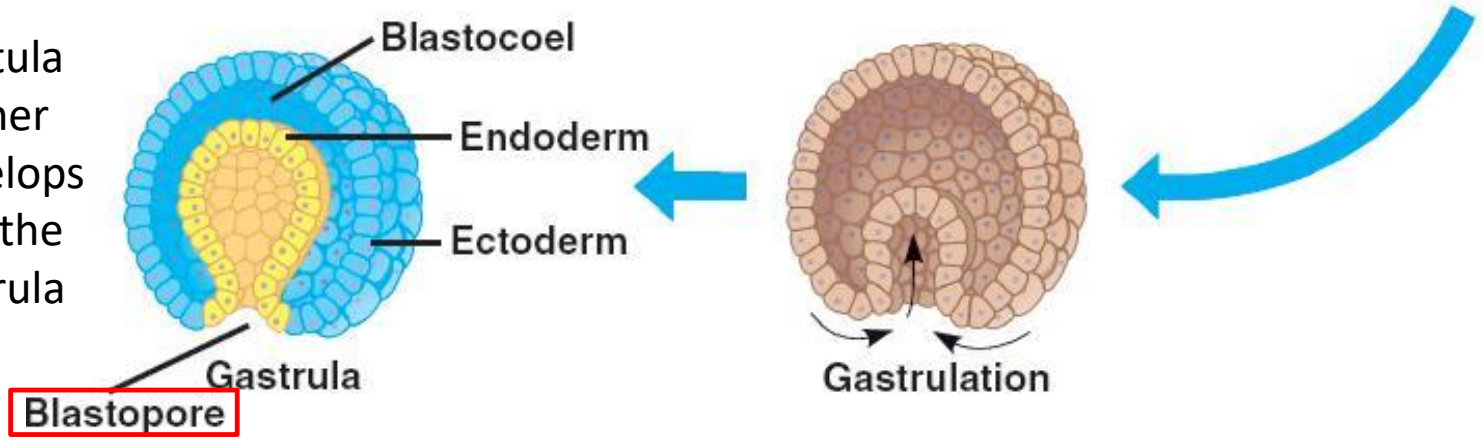
Remember this?

Development begins with the cleavage of the fertilized egg (zygote)

Resulting cells keep diving to form blastula (hollow ball of cells)



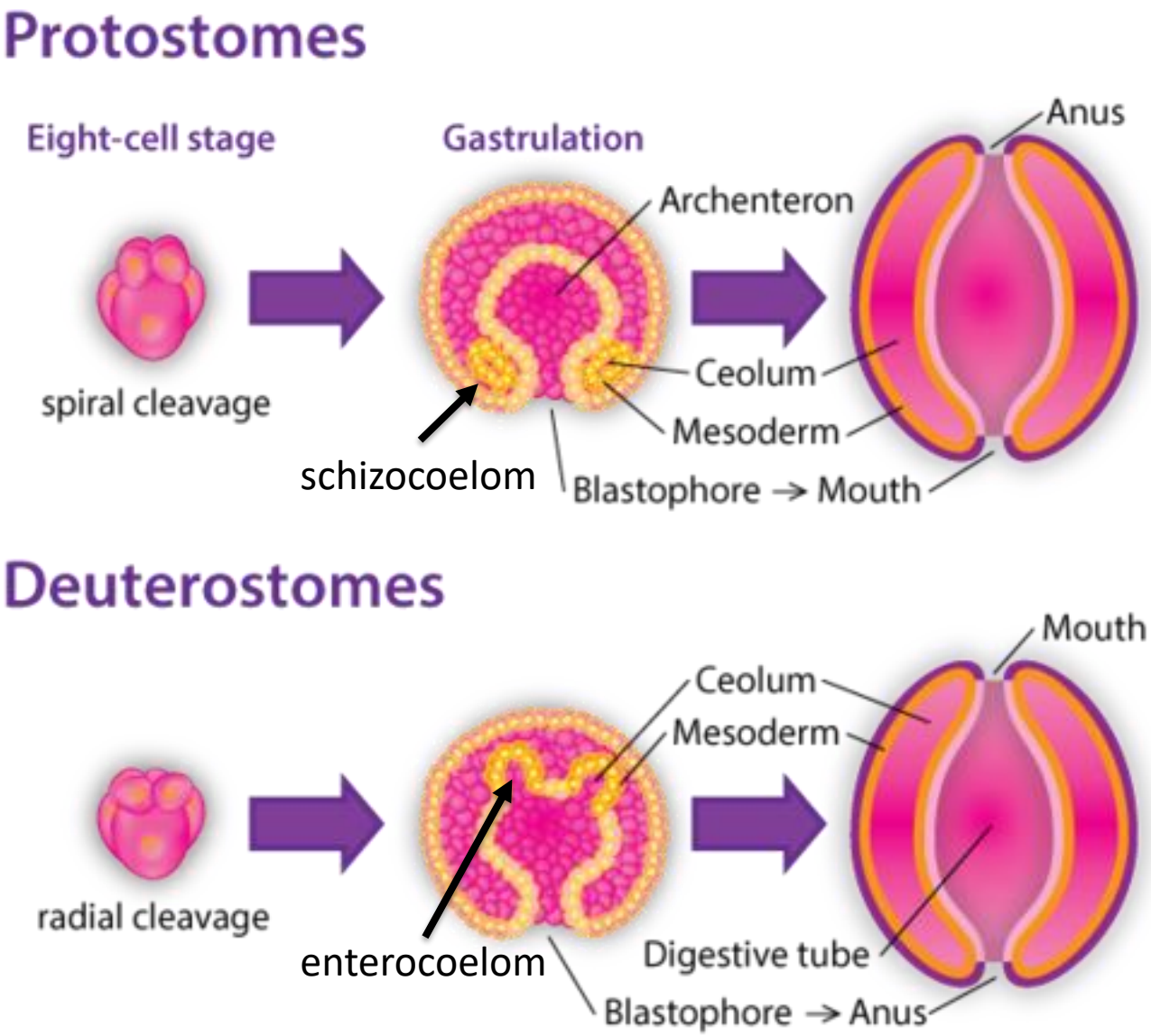
Blastula further develops into the gastrula



The cavity that forms in the gastrula is called the archenteron, and the opening of the cavity is called the blastopore

The archenteron develops into the adult digestive tract, and the blastopore either the mouth or anus

Fate of the Blastopore



Indeterminate Development

- In deuterostomes: fate of embryonic cells is not determined until later in development
- In protostomes: fate of embryonic cells is determined by the first cell division (**determinate development**)
- If you remove cells from an early deuterostome embryo, remaining cells can still make the whole organism

Phylum Echinodermata

- Pentaradial symmetry: All body parts repeated 5x
- Endoskeleton of $CaCO_3$
- Water vascular system
- Tube Feet

Five Classes

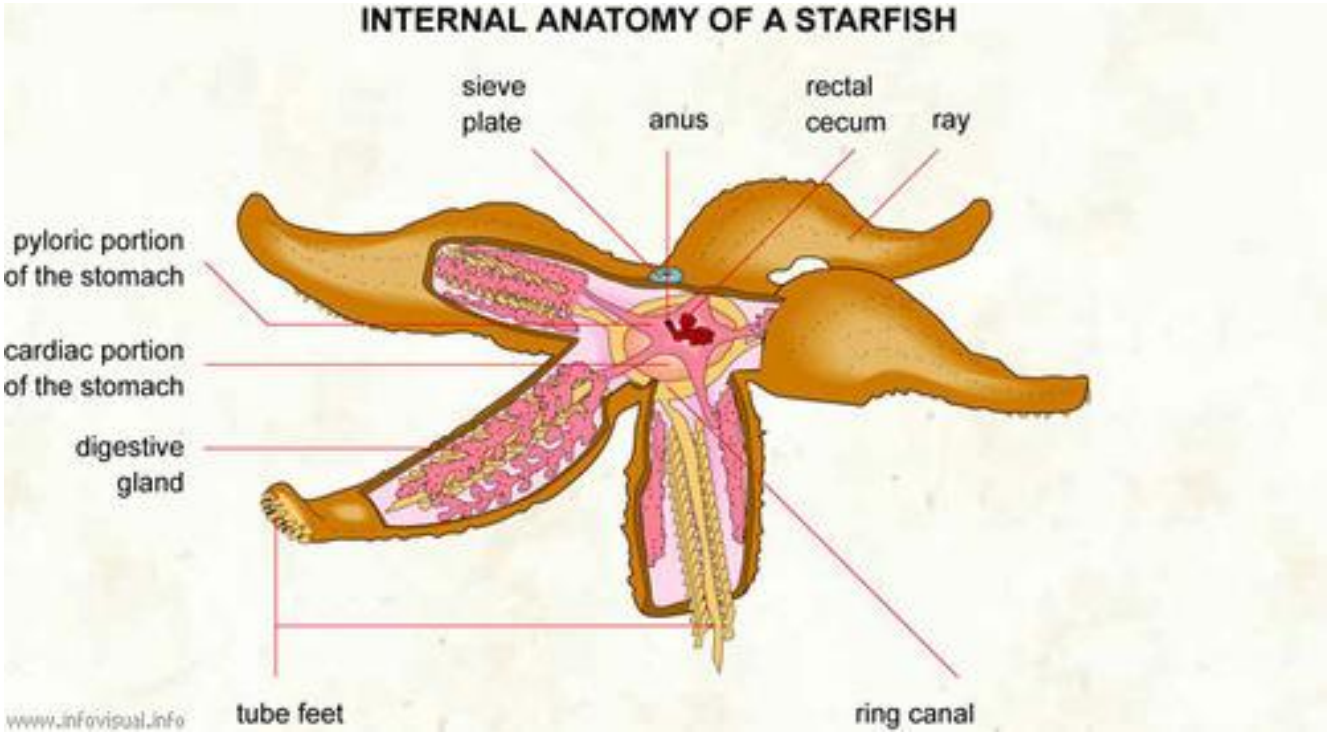
Asteroidea **Ophiuroidea** **Echinoidea** **Holothuroidea** **Crinoidea**





Echinoderm Body Plan

Echinoderms have a large coelom and has a **water-vascular system.** The water-vascular system is the the animal's circulatory system, but also allows **tube feet** to move, collect food, and respiration. The water-vascular system is **unique to echinoderms**



See more in the video on Canvas!

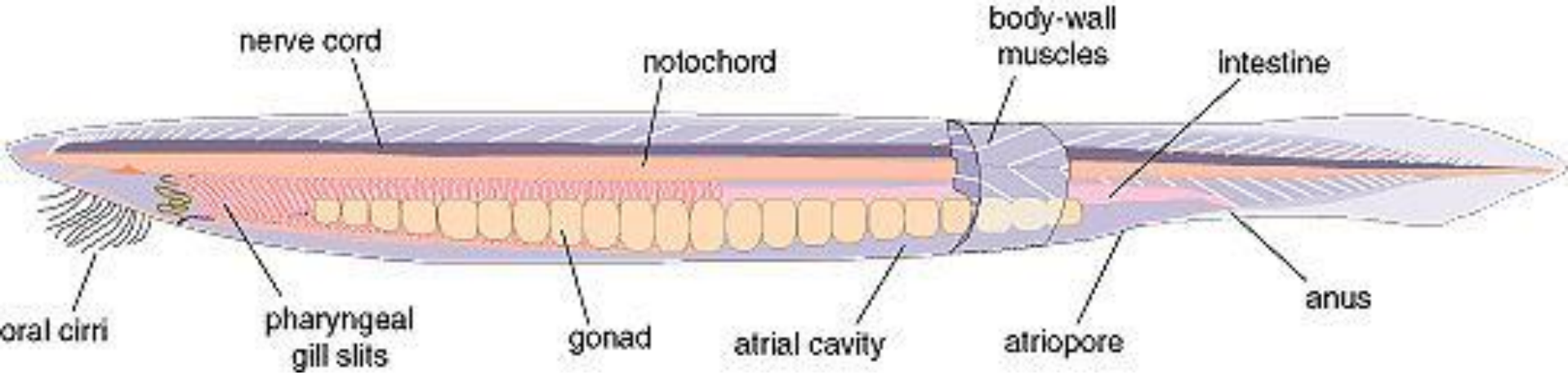
Phylum Chordata

- Bilateral symmetry
- Notochord
- Pharyngeal gill slits
- Post-anal tail



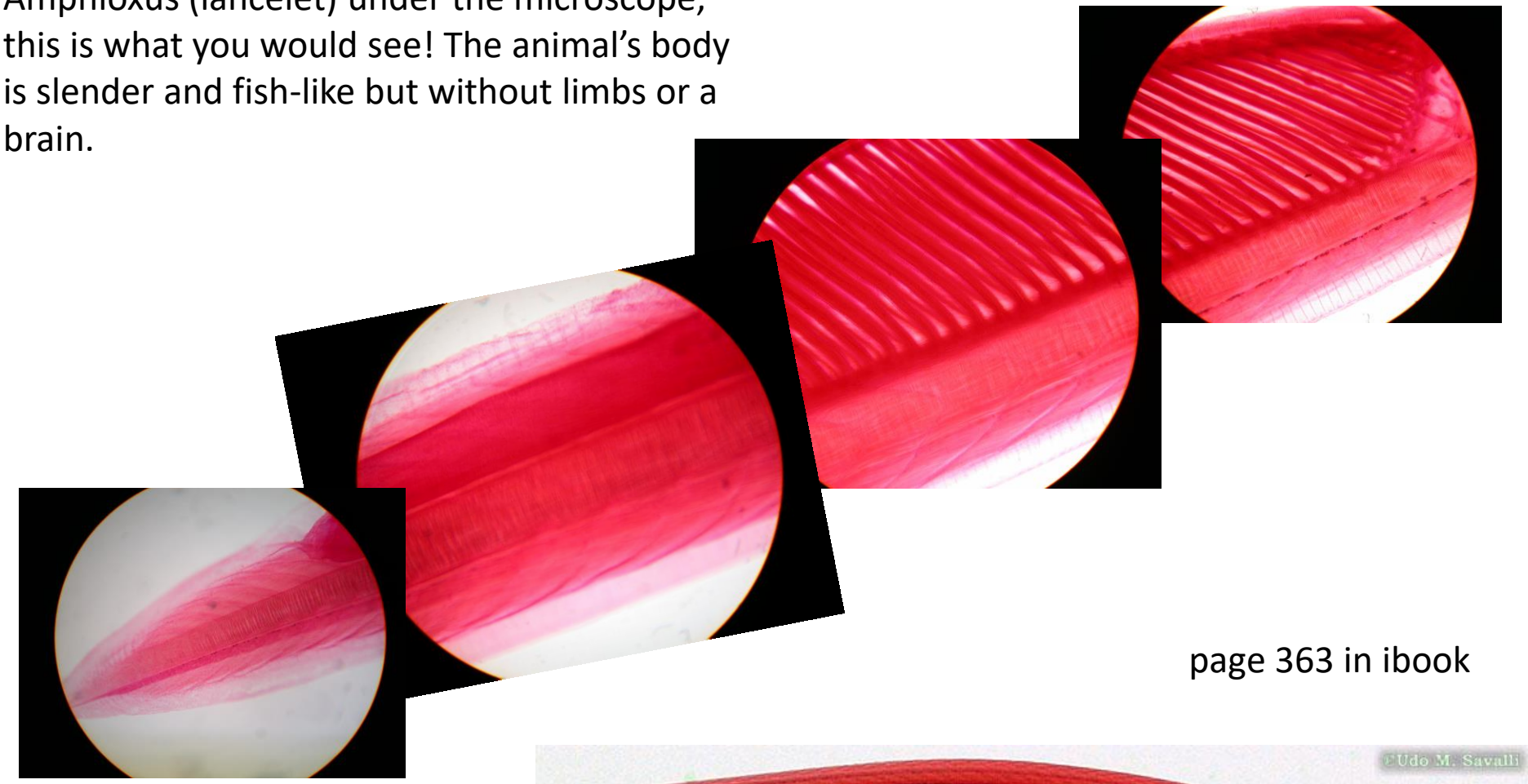



Subphylum Cephalochordata (Lancelets)

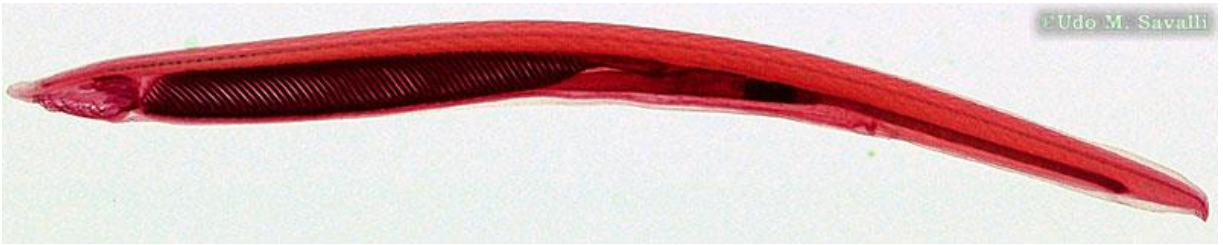


Amphioxus (common name for lancelet)

If you were looking at a wet mount of an Amphioxus (lancelet) under the microscope, this is what you would see! The animal's body is slender and fish-like but without limbs or a brain.



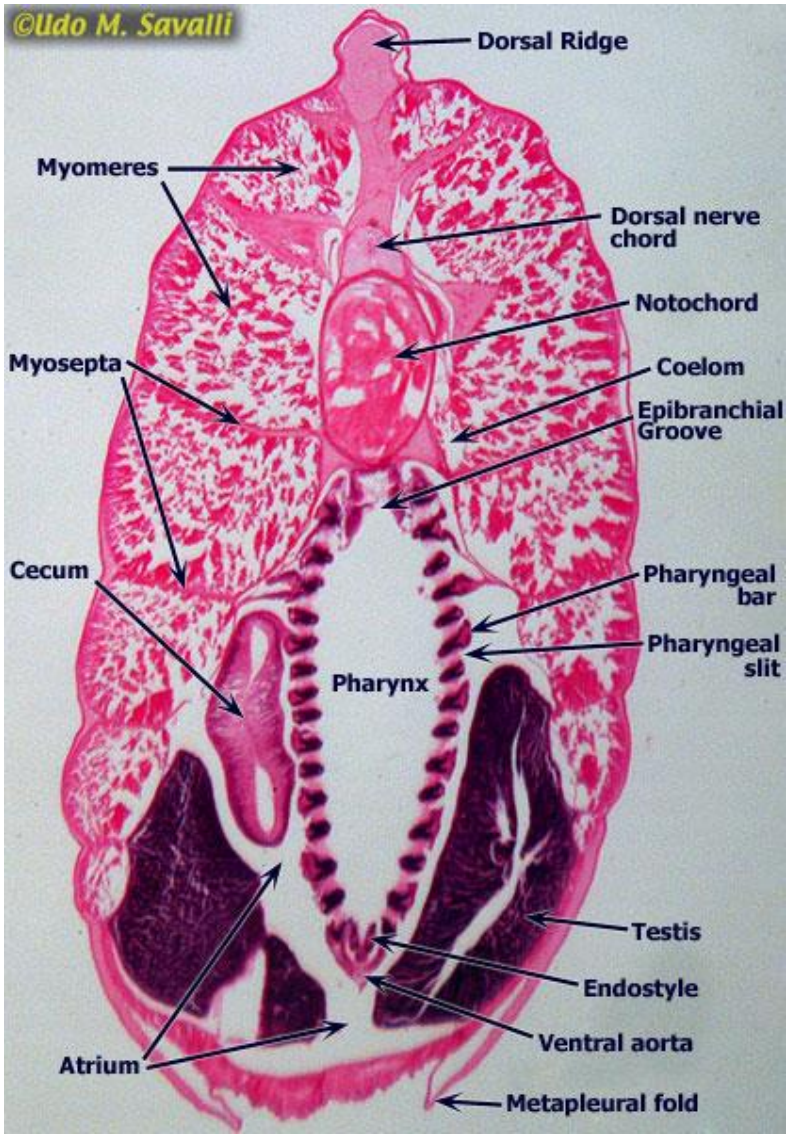
page 363 in ibook



Lancelet Anatomy slides

The mouth opens into a large pharynx, the walls of which are composed of many diagonally arranged cartilaginous gill bars between which are the pharyngeal slit.
The primary function of the pharynx is to collect food. It also serves as a respiratory organ, but for such small organisms that live in moving water, respiration through the skin is probably sufficient.

More Lancelet Anatomy

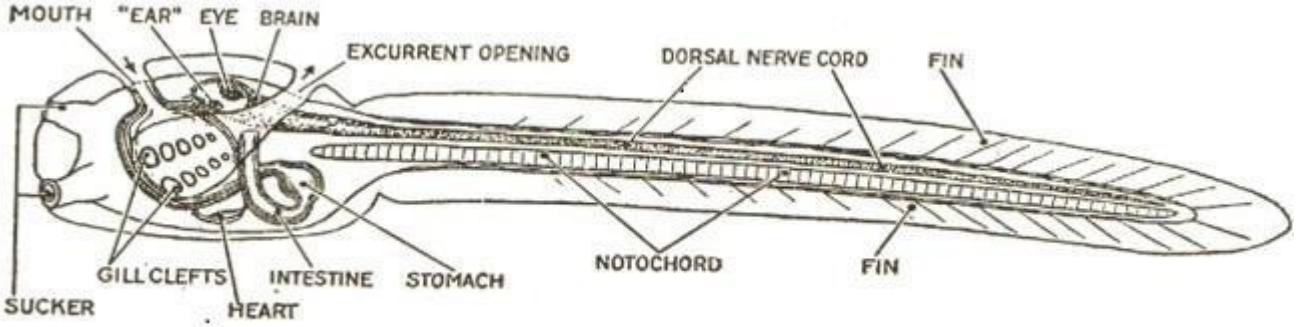


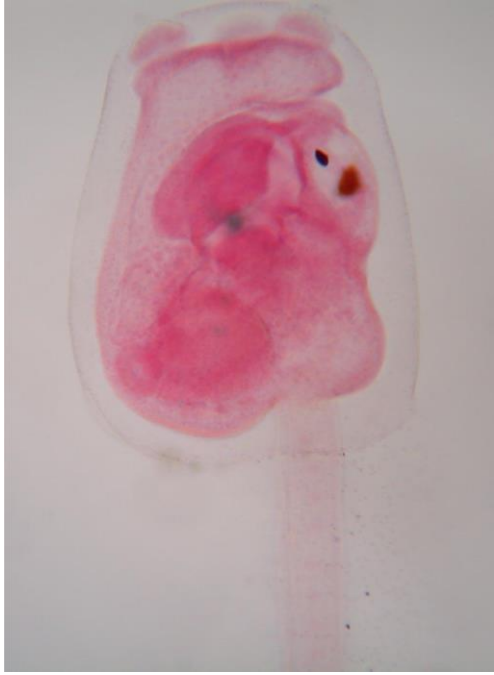
Subphylum Urochordata

Tunicates and sea squirts (3000 species described)

- Urochordates are commonly called either tunicates or sea squirts. Salps are also in this group.
- Pharyngeal gill slits of a tunicate: Feeding apparatus, secondarily has role in respiration
- The larvae are tadpole-like and motile, with all four chordate characteristics on display.
- In adults, the notochord and nerve cord disappear.

Tunicate Larvae

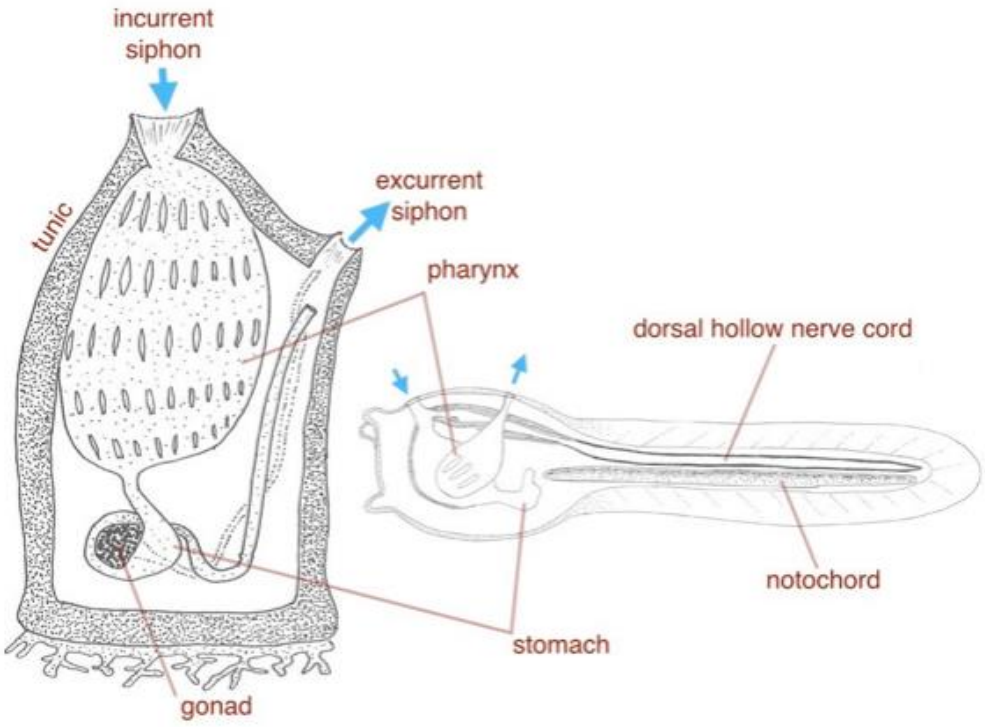


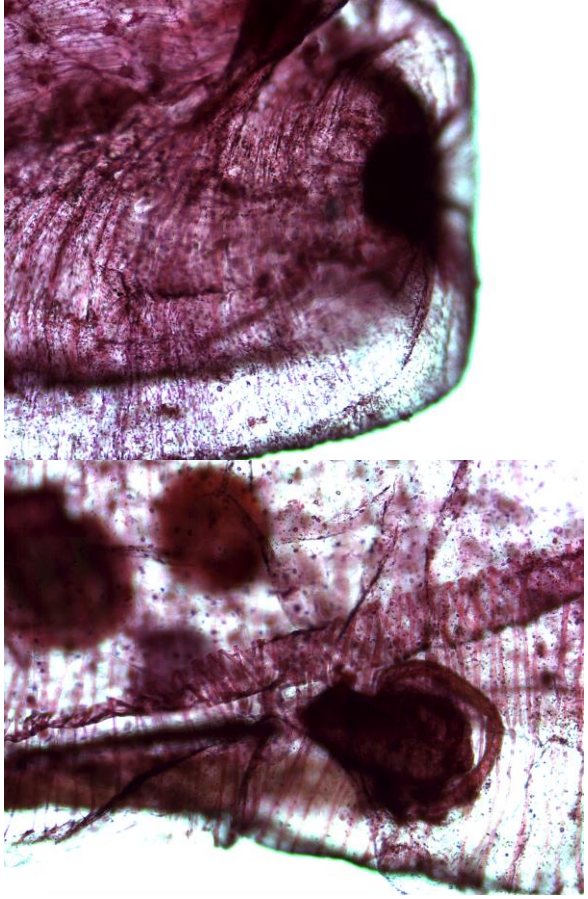


- The organism has a rotund body and a long, narrow, muscular tail
- Note that the notochord is restricted to the tail and does not extend into the body region; the name of the subphylum reflects this feature (uro, tail; chordata, pertaining to a notochord).
- Now look at the body and find a darkly pigmented spot, the sensory vesicle, consisting of a light-sensitive ocellus and a balancing organ called an otolith.
- Just anterior to the sensory vesicle identify the incurrent siphon, the opening though which water and particulate matter enter the animal. The siphon connects internally to a sieve-like pharynx, the wall of which is permeated by many gill slits. As water passes through the mouth, food particles are trapped within the pharynx but the water itself flows through the slits to exit the body through an excurrent siphon.
- Find the excurrent siphon just posterior to the sensory vesicle.

pg 365

Adult Tunicate



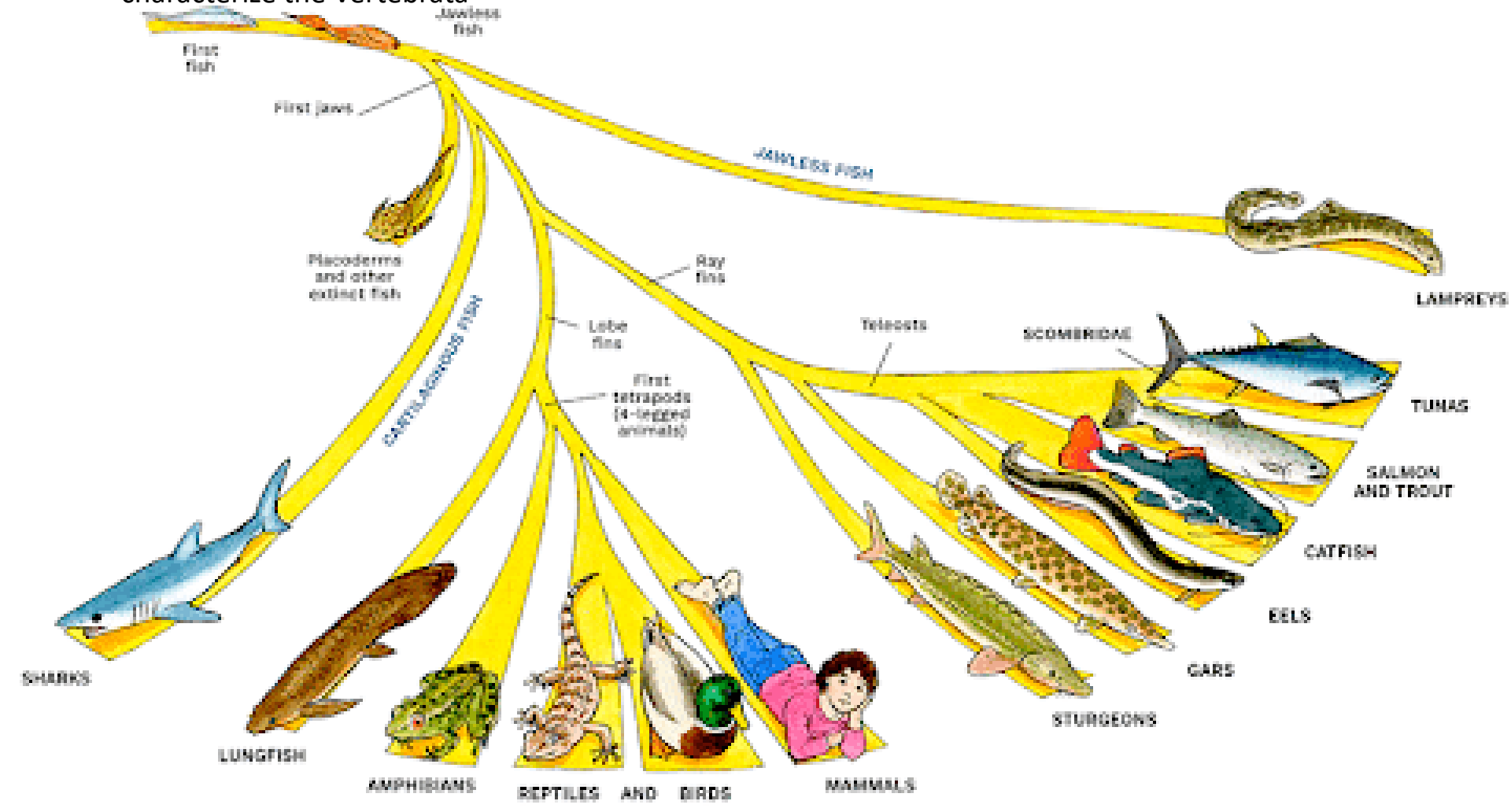


12.R.9 Typical tunicate. Left-adult. Right-larva. Drawing: J. Dole

- Note the thick, very tough outer covering, or tunic, that encloses the animal; it is because of this structure that these organisms are called “tunicates.” A major component of the tunic is cellulose, a polysaccharide more commonly made by plants than animals.
- Both larval and adult tunicates are filter feeders, the pharynx serving as the filter.

Subphylum Vertebrata

- Vertebrates have a vertebral column, or backbone, that serves as the primary support for the body. The vertebral column is composed of several repeated units called **vertebrae**. As development progresses, the vertebral column forms around the notochord, thereby incorporating it into their structure.
- The vertebrae form a protective bony encasement around the nerve cord
- The basal lineage of the Vertebrata are fish that lack jaws, appendages, and bones and lack a formal vertebrae. These obscure fishes points out the evolutionary accumulation of characters that we characterize the Vertebrata

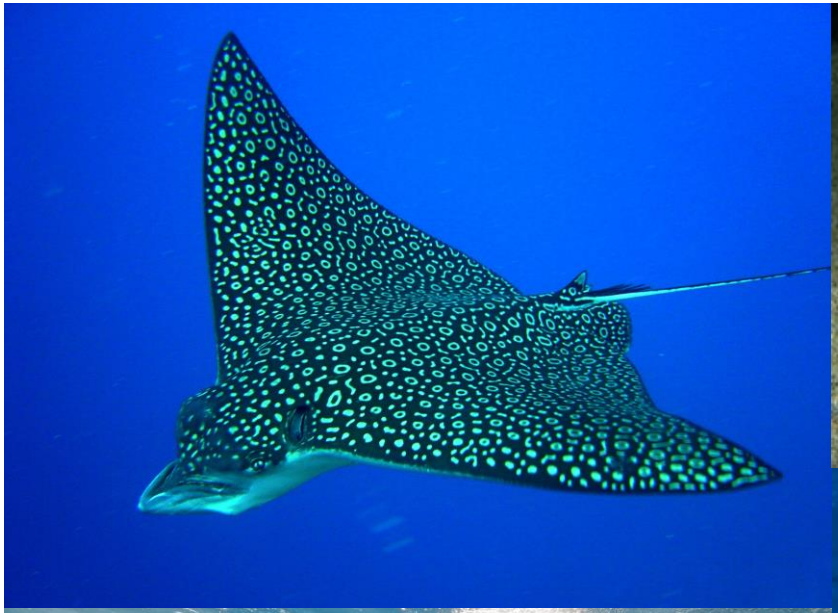


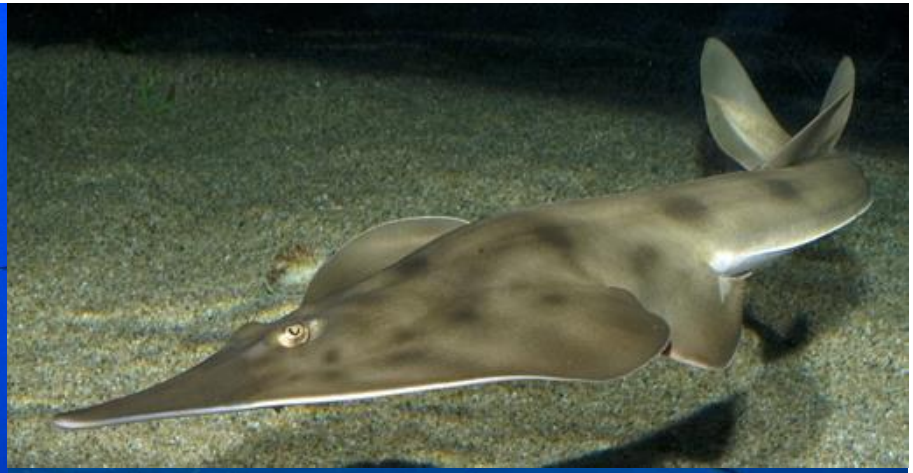
Class Cephalospidomorphi – **lamprey**

- Lamprey feed by attaching to the side of a fish and suck out blood
- Some species are anadromous – juveniles are born in freshwater, but then go out to the ocean, and only return to breed and die...Can you think of another type of organism that has this lifestyle? **SALMON!**

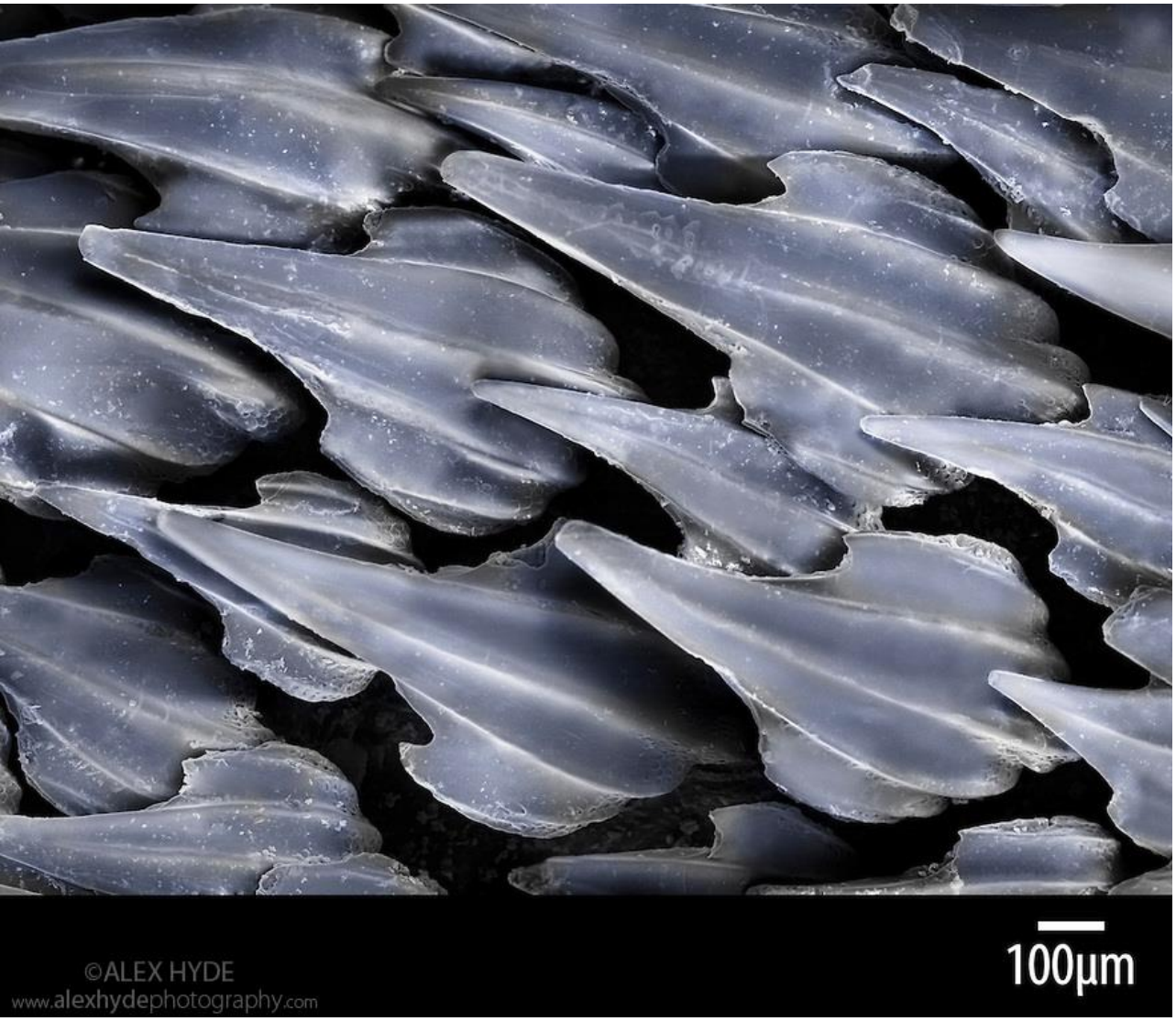
Class Chondrichthyes – cartilaginous fish

- Includes rays, skates, sharks, chimeras
- This class has skeletons formed of cartilage versus bone!





Shark skin



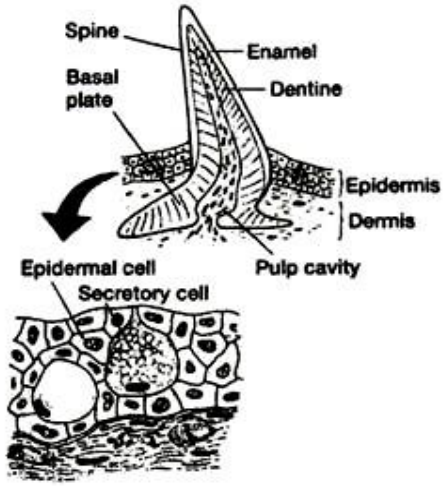
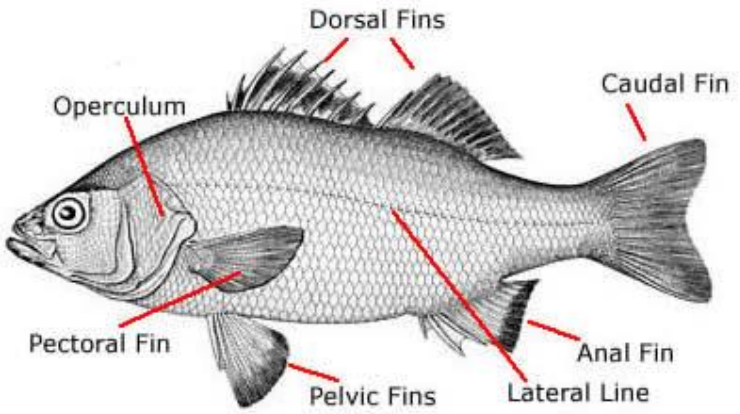


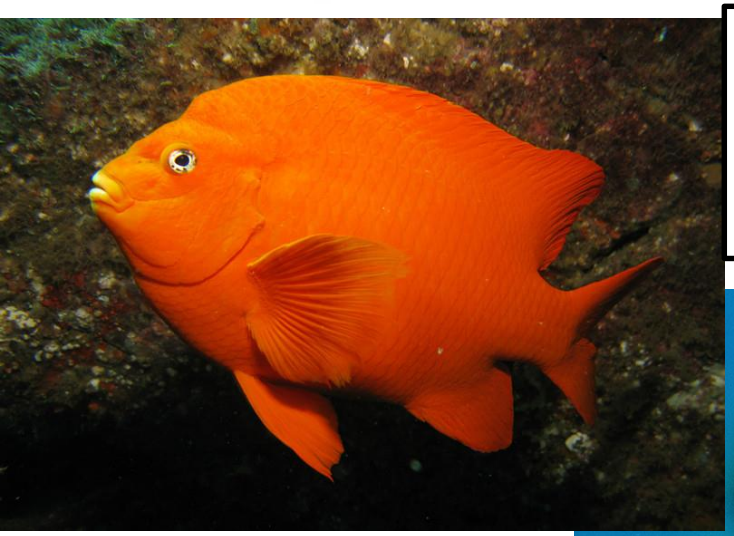
Fig. 2.9 : Shark skin — Section through a placoid scale. The projecting scale consists of enamel and dentin around a pulp cavity

Same with the epidermal scales of reptiles, this group has **placoid scales**, which means that the scales are replaced when lost or damaged

Feels like sandpaper!

Class **Actinopterygii** – ray-finned fish



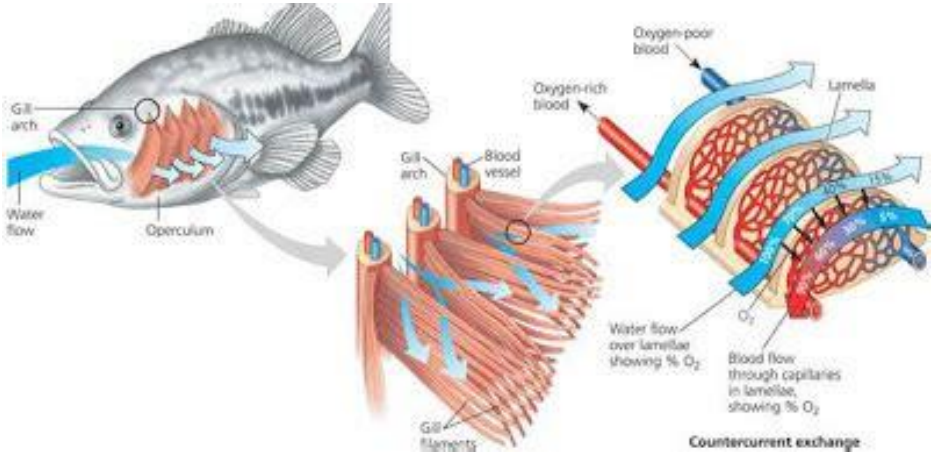


- Pharyngeal gill slits of a fish becomes gills!
- Ray-finned fishes are much more species-rich and abundant than any of the other fish classes with ~24,000 species

Characteristics of teleost fish

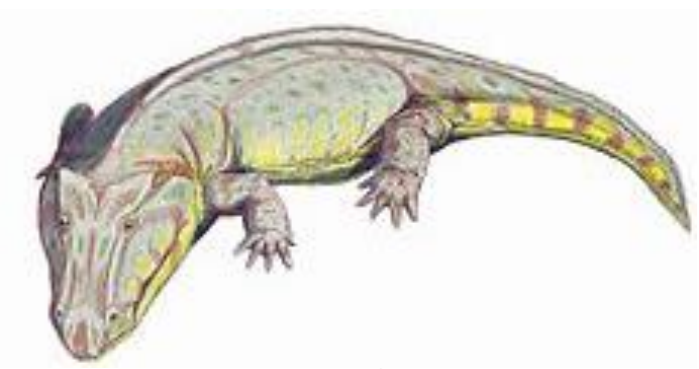
Operculum: bony covering that protects gills

Look at this baby sea bass "breathe"!
(courtesy of Monterey Bay Aquarium)



cycloid scales – overlapping scales; grow as the fish grows (**you can actually age a fish based on its scales!**) and cannot be replaced if lost/damaged

Swim bladder helps fish stay buoyant in the water



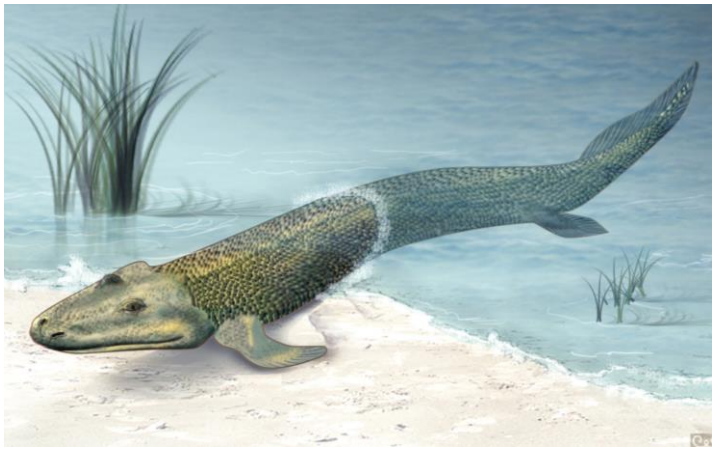
Tetrapods

Anamniotes:

- Class Amphibia

Amniotes:

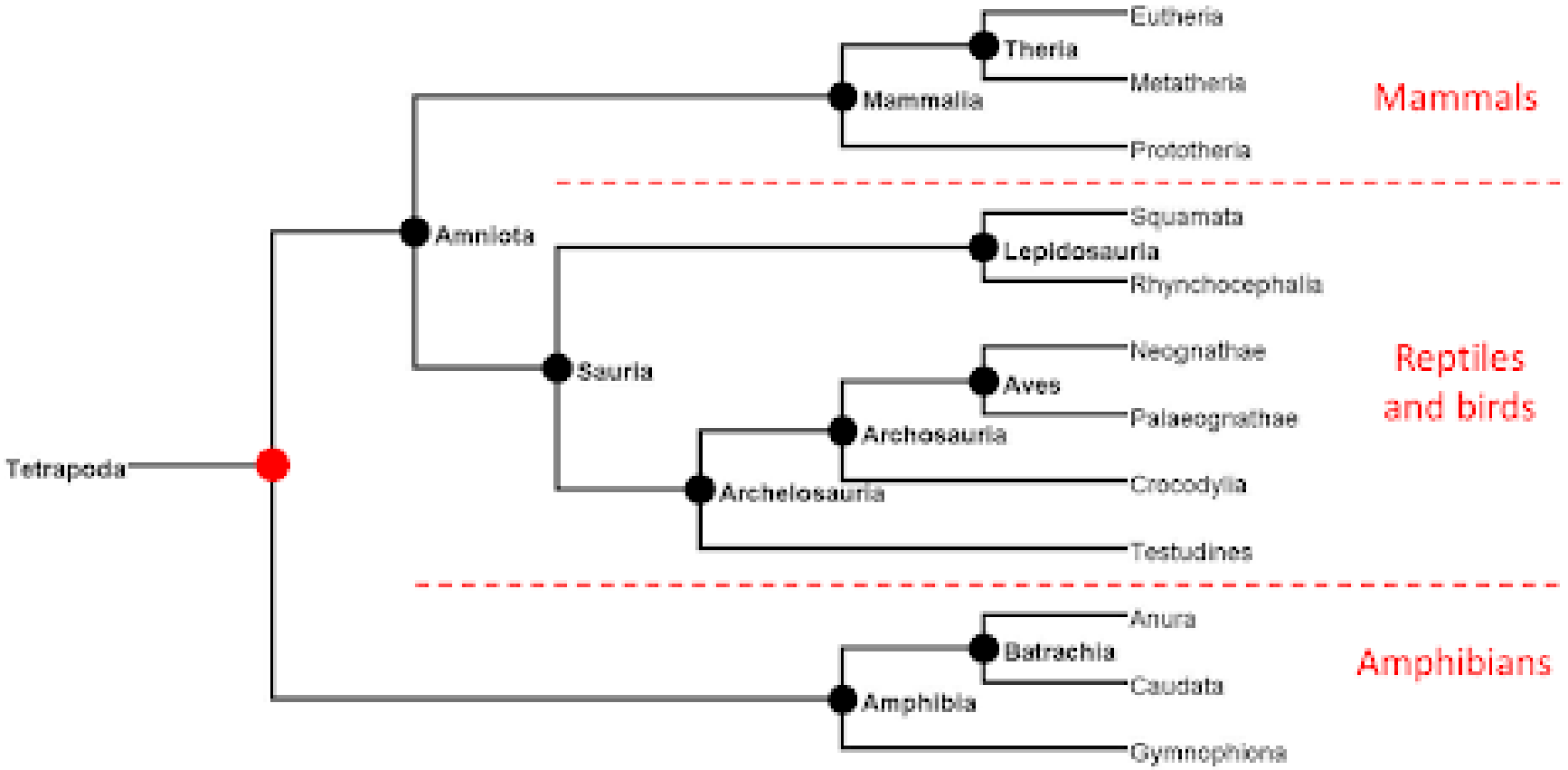
- Class Mammalia
- Class Reptilia
- Class Aves



Tiktaalik – intermediate between fish and amphibians

Terms to Understand:
Anamniotes: no shell over eggs and need water/moisture to lay eggs
Amniotes: have shell on eggs and lay eggs on land; amniotic membranes surrounding the developing embryo

Tetrapod Phylogenetic Tree



Tree from Open Tree of Life

Class Amphibia

- **Most basal, ancestral form of living tetrapods**
- **Frogs, toads, salamanders, newts, caecilians**
- **Porous skin covered in mucous**
- **Requires moisture to properly respirate**
- **Almost every life stage involves being on land and in water**
- **No shell on eggs, must be laid in water**

Which isn't native to California?

Class Amphibia

Which isn't native to California?

What's the difference?

- All newts are salamanders, but not all salamanders are newts
- All toads are frogs, but not all frogs are toads
- Newts have a lifestage ("eft stage") that allows them to travel on land to find other ponds (goal: increase heterogeneity), Salamanders do not
- Toads are typically burrowers and stay underground when it is not wet season
- Toads "hop" while frogs can be agile jumpers

Salamander

Newt

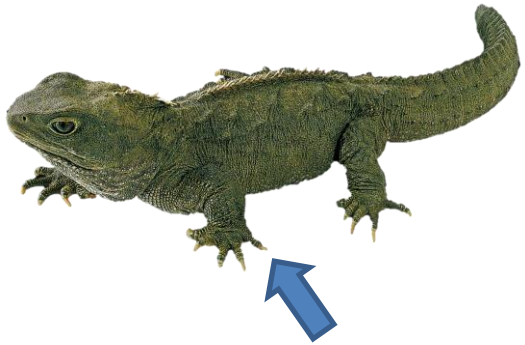
Class Mammalia

Synapomorphies:

- Homeothermic & Endothermic
- Produces hair
- Young fed by milk via mammary glands
- Most often demonstrates parental care

1) Notochord of a mammal: It becomes bone. Part of the vertebral column
2) Pharyngeal gill slits of a mammal: develops into the Eustachian tube, canal that regulates the pressure of the inner ear.

Class Reptilia



This is not a lizard! It's a Tuatara. Only found in New Zealand

- Includes: Turtle, lizards, tuataras, snakes, and alligators
- Epidermal scales, prevents desiccation
- Adapted to lay eggs on land (vs. Amphibians, who have to lay eggs in wet environments or in water)
- Poikilothermic (sometimes) & Ectothermic
- All reptiles on this slide besides the Tuataras can be found in North America

Class Aves

- Endothermic and Homeothermic
- Feathers (modified scales)
- More closely related to Crocodilians
- Your friendly neighborhood modern dinosaur

Fun fact: all of these birds can be found in California!

Choice Trials Experiment

Sexual Selection

- A type of natural selection that involves mate choice
- The more attractive the opposite sex is, the more likely they will mate, and the traits that made them attractive is passed down to offspring, then the cycle continues
- Their attractiveness can be a demonstration of their fitness like health or prowess, or other times it's not (e.g. peacocks who can't fly away from predators because tail feathers are too elaborate and deer who are hunted for big game)

Guppies and Mate Choice

- Males with showy tails are healthier and can possibly give more reproductive success.
  - Think about a male with a showy tail in an environment with a predator
  - The showy tail gives a disadvantage to the male from escaping predators, but if the male is able to still maintain a showy tail without getting eaten, they are seen as a “fit” mate for the female (lead to more offspring)

- Females that are larger can carry more offspring because body size is correlated with # of offspring. So males may choose the larger female because she will lead to more offspring

Now think about your **and write down** hypotheses...

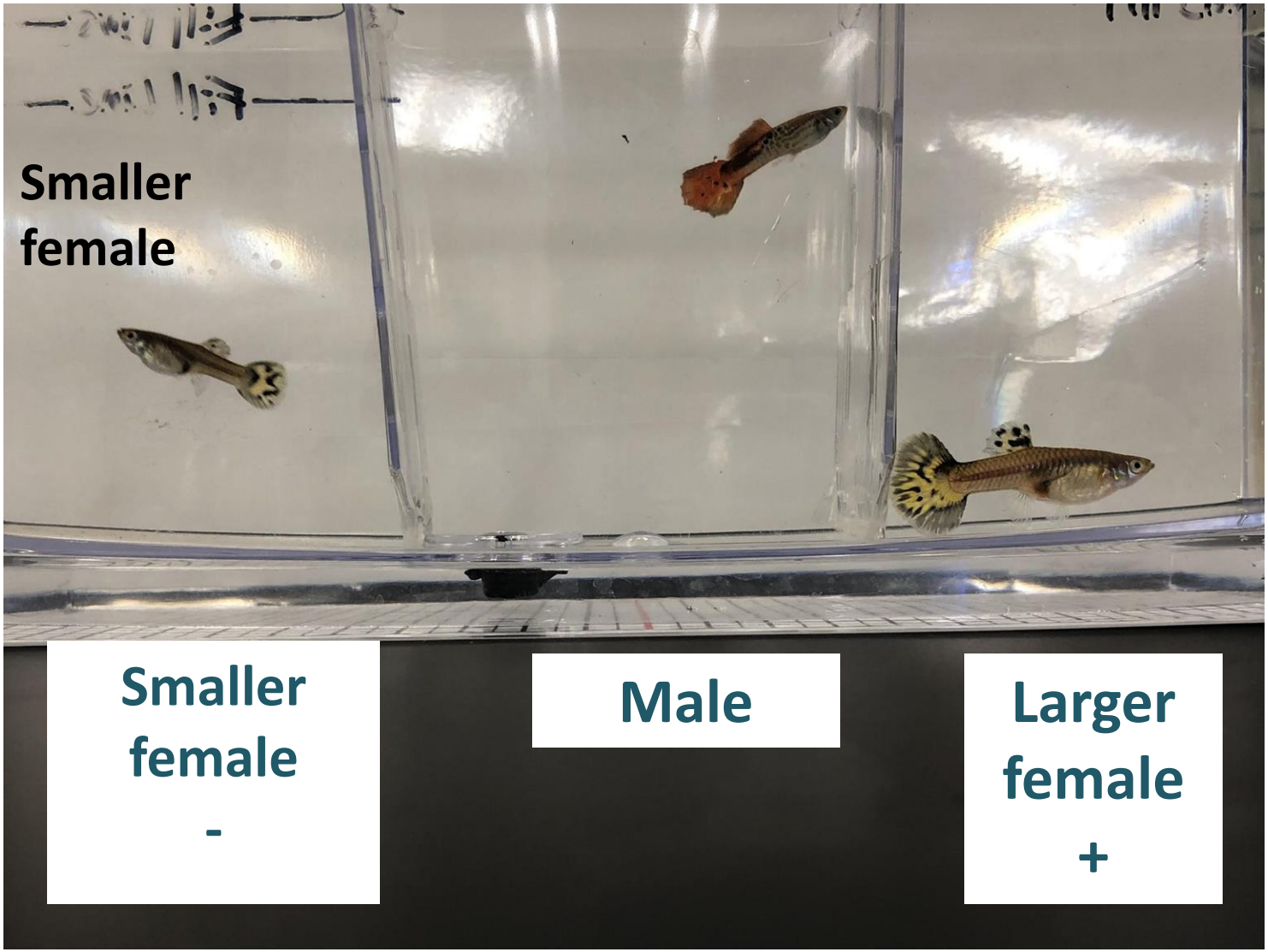
Based on the information provided on the previous slide, come up with hypotheses to the following questions:

- Do males prefer larger or smaller females?
- Do females prefer showy or less showy males?
- Do guppies represent an example of male and female sexual selection?

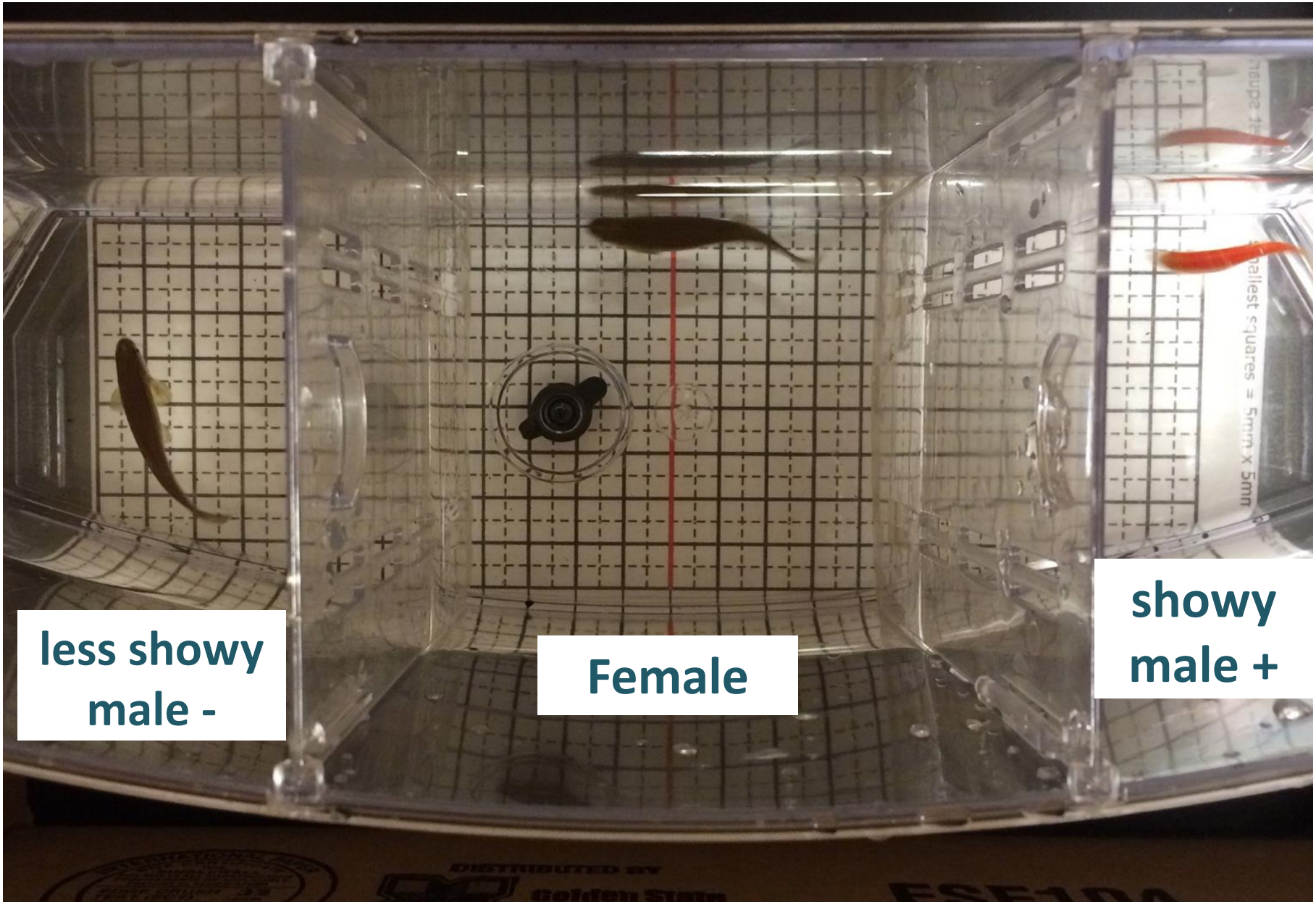
Methods

- Device was set on time-lapse and recorded video for 30 minutes
- For each minute after 5 mins (n= 25), students scored the frame
- **Scoring:** For each frame scored, students measured the distance from the red center line on the graph paper to the fish's eyes.
- If the fish was closer to the larger/showier neighbor, then give this number a + sign; if the focal fish was closer to its smaller/less showy neighbor, then give the number a – sign.
- Estimated the distance to the nearest half centimeter

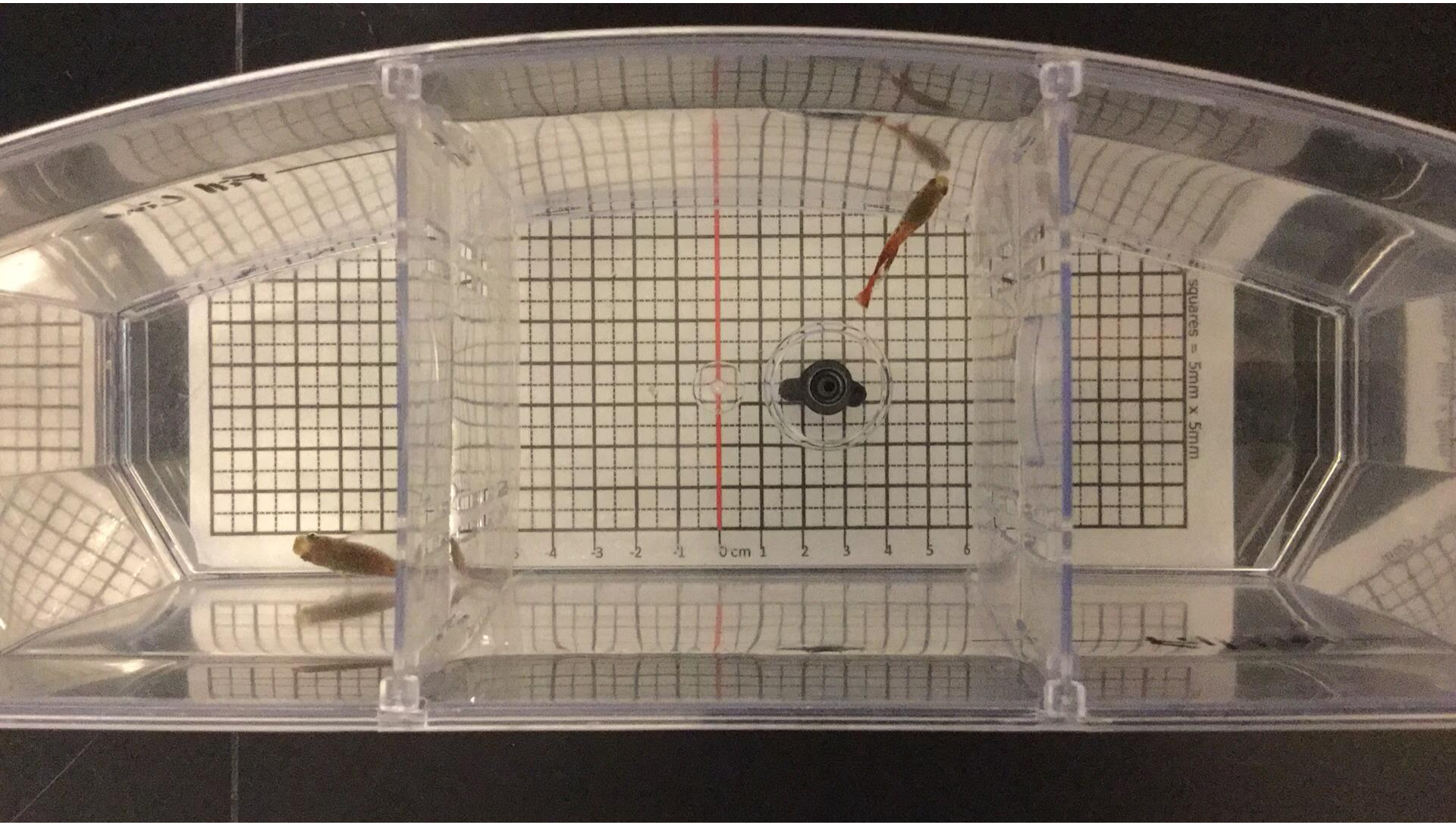
Male Preference Set-up

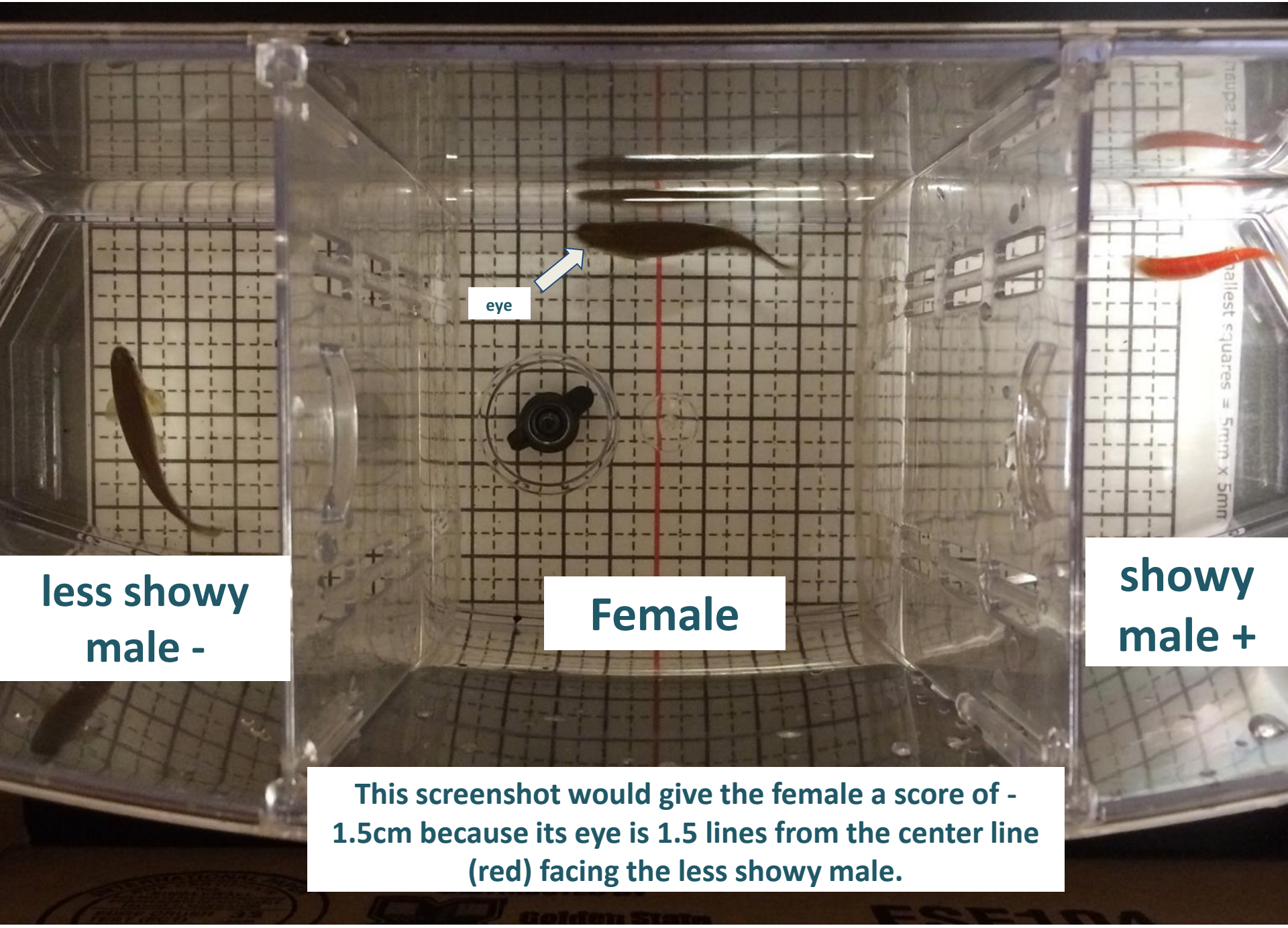


Female Preference Set-up



Example Timelapse




eye
less showy male -
Female
showy male +
This screenshot would give the female a score of -1.5cm because its eye is 1.5 lines from the center line (red) facing the less showy male.

Poecilia Report

- Find the report description on Canvas
- Using the class's pooled data, make a graph with **Confidence Limits** (2x SE) to determine if female and male fish showed a preference in our choice trial.
- Follow your instructor's directions on Canvas, but always make sure to: **state your hypotheses**, **explain what results are shown on your graph (what is significant)**, and **if your hypotheses were upheld by the experiment**