Title: A Tree Made Out of Fish

Grade Level Middle School (6-8)

Subject: Systematics and Evolutionary Studies

Connection to Cruise
During the ICEFISH cruise, scientists will collect fish from the sub-Antarctic region and use molecular, cellular (cytological), and morphological data from these fish to complete a family tree. The scientists are interested in a particular group of fish called Notothenioids (no-toe-thee-knee-oids). One question they would like to answer is just how closely related are the sub-Antarctic Notothenioids to the Antarctic Notothenioids they have already studied in previous expeditions.

Background
Years before Darwin began his work on the mechanisms of evolution, a Swedish scientist named Linnaeus was trying to make sense of how organisms were related to each other. He noticed that many organisms had similar features and shapes. He would take these similar looking organisms and group them into categories based on their common anatomical features. For example, everything that had fins were called fish, everything that had a beak was grouped with the birds. What Darwin suggested after studying organisms in the Galapagos and elsewhere was that organisms that look similar but not identical today probably had a common ancestor sometime in the past, and that natural selection had driven the evolution of that common ancestor into two or more specialized species.

To this day, scientists rely on the physical features (morphology) of organisms to classify them into taxonomic groups and build family trees. Not only does the family tree relate existing organisms to each other, it helps connect them to their common ancestors in the past. Starting in the last half of the 20th century, scientists also started to look closely at the molecular and cellular (cytological) similarities of organisms to help understand their taxonomical relationships. Rapid improvements in technology have helped advance this part of science that has, in turn, advanced our understanding of systematics and evolutionary studies.

Objective
Students will be able to create a family tree of hypothetical fishes from the following worksheet. They should be able to describe common morphological characteristics for each of the groups they investigate and explain why they grouped the individual fish.

Time
1 45-minute periods

Materials
Field Guide to local or regional fishes (marine or freshwater)
Hypothetical Fish Worksheets (provided)
Handout of general fish anatomy
Transparent tape or glue
Blank paper
Scissors

Advanced Preparation
Students will need to have a general understanding of the taxonomic classification system with particular attention to the Fishes. They should also have a general understanding of external fish anatomy (e.g. tail vs pectoral fins, dorsal fin).

Teachers should prepare for the activity by becoming familiar with general fish anatomy. Teachers should make several copies of the worksheets of hypothetical fish and have copies of pictures of real local/regional fish to show the students.

Activity

The class should be broken up into teams of two students. Students will use the scissors to first cut out the individual hypothetical fish from the worksheet. They will then work as a team to create at least three groups (Families) of fish by gluing or taping them to a blank sheet of paper. Students will then want to present their finings to the rest of the class and explain their reasoning for grouping the fish.

Notes for working with the Hypothetical Fish Worksheets: There are a total of five worksheets included in this exercise. The first Worksheet is titled “Random” at the bottom and is the sheet that should be handed out to the students. No other worksheet should be handed out until after the entire activity is completed. The worksheet titled “by eye color” was created for teachers to show that eye color is not the best characteristic to group the fish. The worksheet titled “correct” is the correct way (at least one correct way) to group the fish. It groups the fish using the highest number of shared anatomical features (5) and is based on the following features:

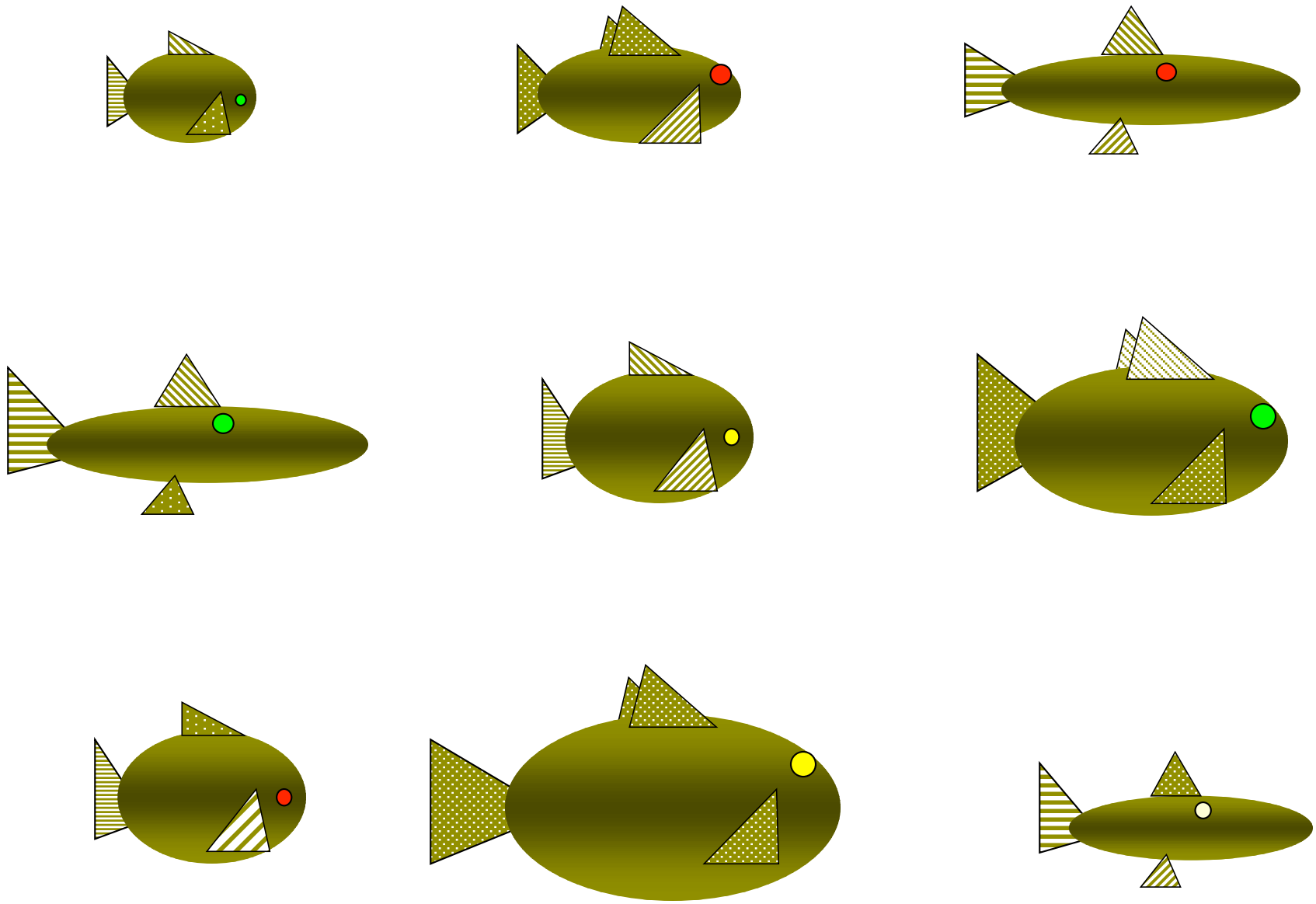
Dorsal fin shape (but not color)
Body shape (but not size)
Eye position (but not color)
Pectoral fin position (but not color)
Tail fin pattern (but not shape)

The last two worksheets are hypothetical family trees of these fish with an additional group of ancestral fish with no eyes. The second sheet has text describing the evolutionary adaptations for each group.

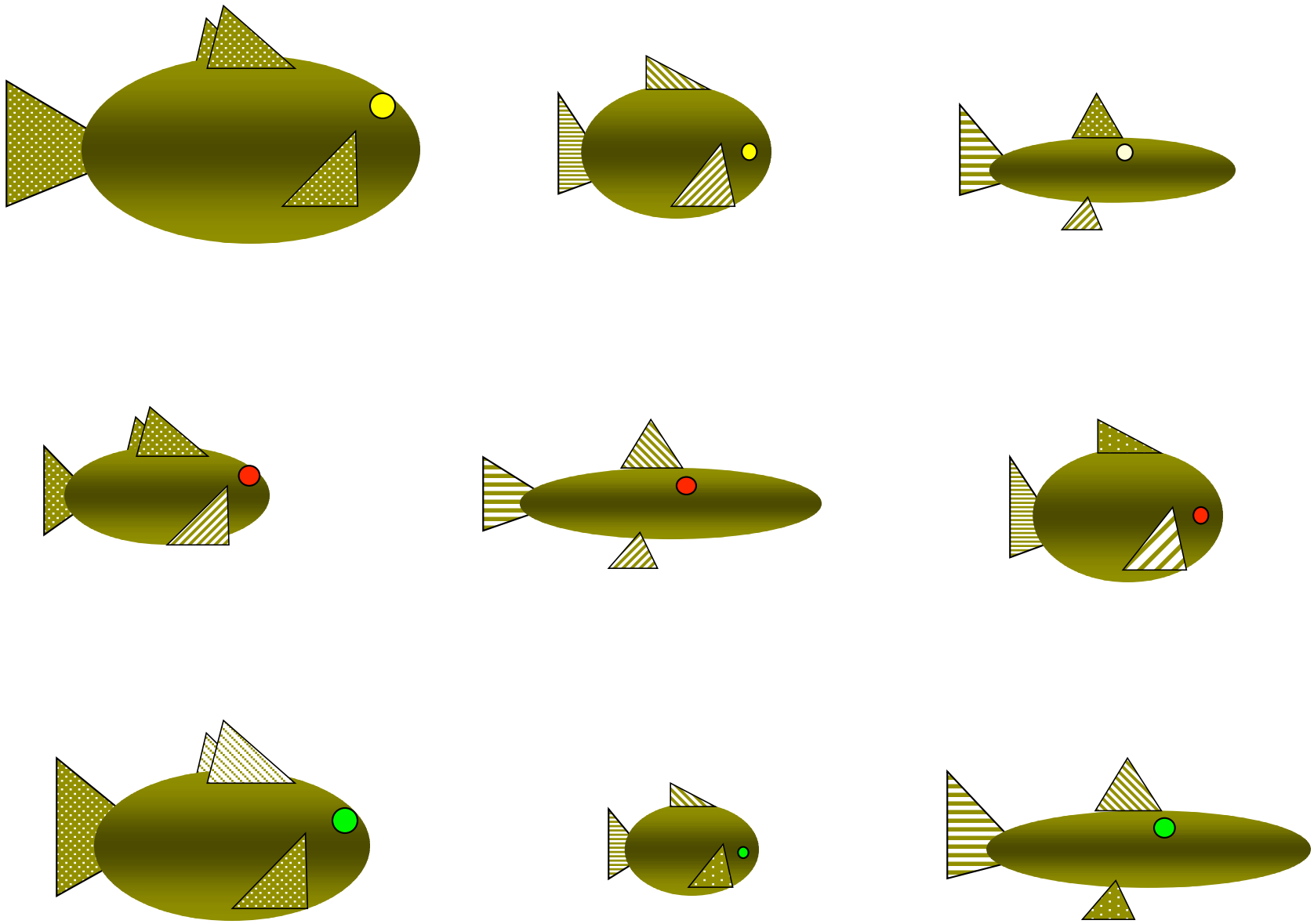
During subsequent classes, students can research the phylogenetic relationships of their local/regional fishes and generate a family tree. Students should then communicate with other participating groups around the world to share their findings and create a larger, more developed tree.

Synthesis
Teachers will want to assess students understanding of the concepts used in the activity by testing their understanding of anatomic and taxonomic terminology. Throughout the process, students should be encouraged to explain their reasoning for placing fish in their prospective groups.

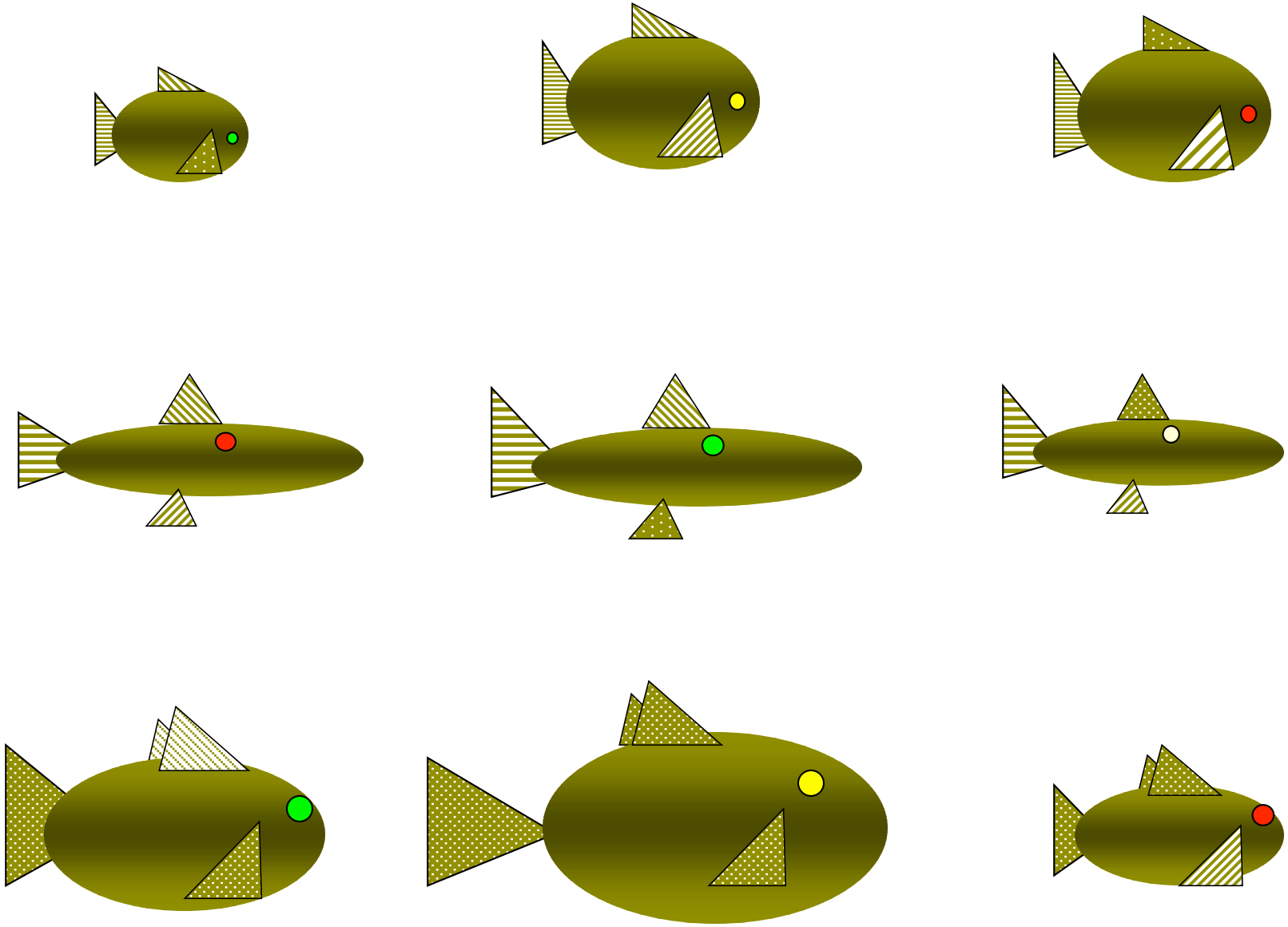
Extended Investigations
Students can create their own hypothetical fish, name them using binomial nomenclature, and explain their lifestyles. Based on their physical features. During subsequent classes, students can also research the phylogenetic relationships of their local/regional fishes and generate a family tree. Students should then communicate with other participating groups around the world to share their findings and create a larger, more developed tree.



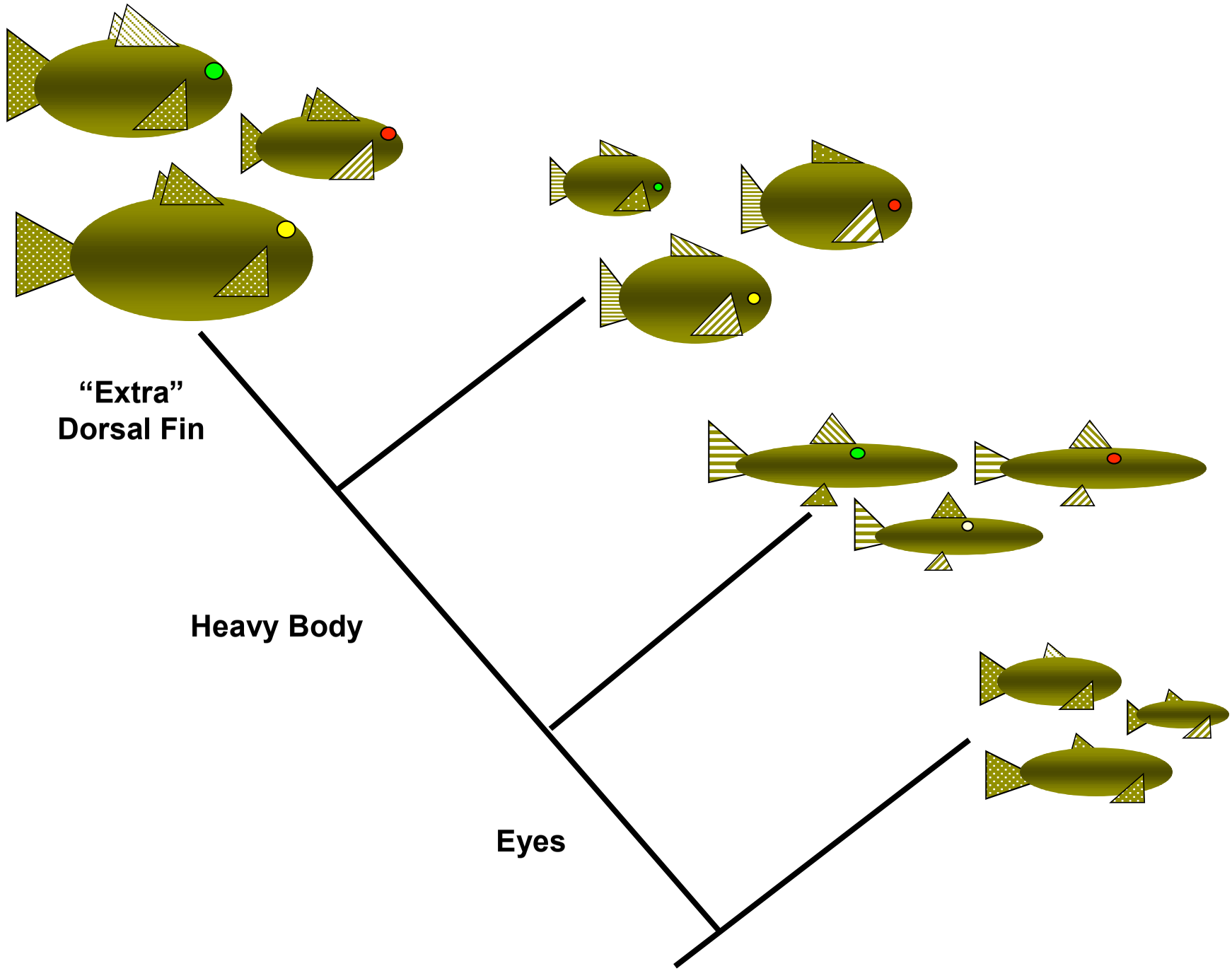
Random



By Eye Color



Correct


"Extra"
Dorsal Fin
Heavy Body
Eyes