

Title: A Tree Made Out of Fish**Grade Level** High School (9-12)**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 draw a phylogenetic tree of common local/regional fishes, starting with Order (Perciformes) and following it down to individual Families using field guides and web-based research. They should be able to describe major morphological characteristics for each of the Families they investigate. They will then share their collective findings with participating students from other regions.

Important Note: Students should cite the source of data or images used to create their tree.

Time

2 – 4 45-minute periods

Materials

Field Guide to local or regional fishes (marine or freshwater)
Access to the web (optional)
Handout of general fish anatomy
Photocopier
Transparent tape
Drawing paper and pencils

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. pelvic vs pectoral fins, operculum, lateral line) and be able to describe their relative anatomical positions using terms such as posterior, demersal, dorsal, etc.

Teachers should prepare for the activity by becoming comfortable with the common families of fish in their region, using the field guide of their choice. They can also identify pertinent websites related to the fish in their region.

Activity

From a local/regional fish guide, teachers should identify the most common Families of fishes and select two or three fish from at least three of the described Families. It will be helpful to select Families of fish that look distinctly different from other Families, but all should be of the Order Perciformes. Teachers may add as many individual species from different Families as time and resources provide.

Once the teacher has selected their fishes, they should make enlarged copies of the fish pictures from the field guide using a photocopier. Note: It is recommended that teachers try to create a family tree out of the fish you have selected first before having the students try the activity.

The class should be broken up into teams of two or three students. Copies of the enlarged fish pictures from the field guide should be handed out to each of the teams, making sure the names of the fish are not shown. Teams should apply their knowledge of classification and fish anatomy to sort the fish into their proper Families. The students should only have about 10-20 minutes to develop their groupings. Teams should then take turns presenting their results to the rest of the class and explain their reasoning. Students can illustrate their results on a black/whiteboard by taping the pictures on the board and then drawing lines and circles to create Families and the relationships to other Families (which are more closely related) the groups. At the end of the exercise, the teacher has the option to reveal the correct groupings of fish into Families, or the teacher may use remaining class time for students to use field guides or web-resources to correctly group their fishes into the correct Families.

During subsequent classes, students should 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

Teachers may incorporate art into the activity by having students make scientific drawings of the fish species that include labels. Students may even wish to create a large collaborative artwork such as a mural, mobile, or diorama.