Teach Aquaculture Curriculum: Anatomy of a Fish[1]

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*This is Activity 1 in a series of 25 in the Teach Aquaculture curriculum. The introduction to this series is available at*https://edis.ifas.ufl.edu/FA173.

Abstract

About 50% of all seafood consumed in the world is produced in aquaculture systems, and about 50% of these products are fish (freshwater, marine, and brackish). As demand for seafood grows, the global aquaculture industry will need to expand. In this lesson, students will observe and/or participate in a dissection of a fish, either by using a dissection guide, a virtual dissection on the computer, or an actual dissection of a preserved or fresh fish. Students will learn to distinguish between the three main types of fishes, will complete a live or virtual dissection of a fish, and will identify the external anatomy of a fish and describe the function of important external features. They will be able to identify the major internal organs of a fish and their functions related to swimming, digestion, and respiration.

Objectives

Students will be able to:

1. Categorize types of fishes and provide examples.
2. Describe basic biology of fish species common to aquaculture.
3. Identify and explain the primary functions of key anatomical features of fish species common to aquaculture.

Grade Level

5–12

Subject Area

Biology, Anatomy

Time

Preparation: 10 minutes

Activity: 45—60 minutes

Clean-up: 10 minutes

Student Performance Standards (Sunshine State Standards)

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02.02 Demonstrate proper safety precautions and use of personal protective equipment (SC.912.L.14.6, SC.912.L.16.10; SC.912.L.17.12, 14, 15, 16; MA.012.A.2.1, 2).

06.04 Compare basic internal and external anatomy of animals (LA.910.1.6.1, 2, 3, 4, 5; SC.912.L.14.11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 28, 29, 31, 32, 33, 34, 36, 40, 41, 42, 43, 45, 46, 47,48, 51; SC.912.L.15.6, 7).

10.03 List examples of aquatic crops and animals (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.912.L.17.9).

11.01 List and explain the meaning of morphology, anatomy, and physiology (LA.910.1.6.1, 2, 3, 4, 5; SC.912.L.14.7).

11.02 List and describe the physiology of aquatic animals (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.7.L.17.1; SC.912.L. 18. 7, 8, 9).

11.05 Identify and describe the external and internal anatomy of fish (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.912.L.14.11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 28, 29, 31, 32, 33, 34, 36, 40, 41, 42, 43, 45, 46, 47,48, 51).

12.01 Recognize and observe safety practices necessary in carrying out aquaculture activities (LA.910.1.6.1, 2, 3, 4, 5).

Interest Approach

Have the students list some of the different types of fish they have consumed or caught and ask them if they think they were produced in aquaculture. Remind them that some fish caught in the wild are cultured and stocked at a small size for stock enhancement for anglers. Discuss aquarium fish and if they think fish sold in pet stores were produced in aquaculture. You may not know for sure, but it will get them thinking about different purposes of aquaculture. Ask them to identify an example of a bony, cartilaginous, and jawless fish.

Student Materials

1. *Introduction to the Biology of Fish* section

2. Dissection equipment (or computer access for virtual dissection)

Student Instructions

1. Read the *Introduction to the Biology of Fish* section for homework in preparation for this laboratory.

2. Observe a live fish in an aquarium (if one is available).

3. Identify some of the key anatomical features.

4. Once assigned to a group, prepare the table for a live dissection (or prepare your worksheets for a virtual dissection).

5. Identify and label the external anatomical features and their functions on your worksheet or in your lab notebook.

6. Follow the teacher's instructions for identifying the internal anatomy and the proper way to prepare your dissection.

7. Identify the internal organs and their functions in response to swimming, digestion, and respiration.

Teacher Instructions

Preparations

1. Access drawings and diagrams on the websites listed in *Support Materials*.

2. Consult your school or district rules regarding dissections and disposal of dissected fish. For further information visit http://www.nsta.org/about/positions/animals.aspx

3. Obtain your fresh or preserved fish specimens, one or more per group and a large enough size for easy dissection (>4 inches).

4. Divide your class into small groups (2–4 per group if possible).

5. Prepare one dissection kit, pan, and set of clean-up materials per group.

6. Give students a copy of the *Introduction to the Biology of Fish* section and have them read this as homework, or discuss the different types of fishes in classroom lectures prior to the dissection.

Activity

1. Once students are in their groups, ask them to identify the external anatomy (possibly draw on the board).

2. Ask the students to label and/or draw each step of the dissection and identify major organs and their uses.

Post Work/Clean-Up

1. When students are finished with the dissection, have them fold all materials into their paper towels and set aside a separate trashcan for dissection materials.

2. Remind each group to thoroughly rinse and sanitize dissection equipment (water and mild bleach solution or other sanitizing agent). Have them dry the equipment and return it to the kit. Make sure that they rinse and dry their tray as well.

3. Dispose of dissection material appropriately (in a dumpster outside, for instance) and immediately.

4. Wipe all dissection stations with a sanitizer (mild bleach solution).

Anticipated Results

1. Students will identify the external anatomy of a fish and describe the functions of important external features.

2. Students will know the major internal organs of a fish and their functions related to swimming, digestion, and respiration.

3. Students will demonstrate dissection skills (for live dissections).

Support Materials

1. *Introduction to the Biology of Fish* section

2. *Biology of Cultured Fish* presentation http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/2general_biology.php

3. *Aquariums in the Classroom* presentation http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/1introduction.php

4. Fish Terminology: http://australianmuseum.net.au/Glossary-of-fish-terms

5. Black, K.D. and A.D. Pickening. 1998. Biology of Farmed Fish, 1 Ed. Blackwell Publishing. 415 pp. ISBN-10: 0849397316.

6. Popma, T. and M. Masser. 1999. Tilapia: Life history and biology. SRAC Publication No. 283. http://srac.tamu.edu or http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/2general_biology.php

7. About Fishes: http://australianmuseum.net.au/Fishes

8. General Fish References: https://specifyportal.floridamuseum.ufl.edu/fishes/

Explanation of Concepts

1. Anatomy of vertebrates

2. Dissection skills

3. Relationship of structure and function

Support Materials

Introduction to the Biology of Fish

Fish are aquatic vertebrates that use gills to obtain oxygen from fresh or seawater. There are three main groups: the bony fishes or Osteichthyes, like goldfish, cod, and tuna; the cartilaginous fishes or Chondrichthyes, like sharks and rays; and the jawless fishes or Agnatha, for instance, hagfishes and lampreys. Fishes of some form are found in virtually every body of water in the world except for the very salty water of the Dead Sea and some hot springs. Of the 30,000 fish species, approximately 2,500 live in freshwater. The world's largest fish is the whale shark (*Rhincodon typus*), more than 20 m/66 ft long; the smallest is the dwarf pygmy goby (*Pandakapygmaea*), 7.5–9.9 mm long. The study of fishes is called ichthyology.

The bony fishes constitute the majority of living fishes (about 25,000 species). In this type of fish, the skeleton is bone, mobile fins control movement, and the body is usually covered with scales. A single flap covers the gills. Many have a swim bladder with which the fish adjusts its buoyancy. Most bony fishes are ray-finned fishes, but a few, including lungfishes and coelacanths, are fleshy-finned.

The cartilaginous fish are efficient hunters. There are fewer than 600 known species of sharks and rays. The skeleton is cartilage, the mouth is generally beneath the head, the nose is large and sensitive, and there is a series of open gill slits along the neck region. They have no swim-bladder. They rely to some degree on a large, lipid-laden (oily) liver to provide some lift, but in order to remain fully buoyant, they must keep swimming. Some types of cartilaginous fishes, such as sharks, retain the shape they had millions of years ago.

Jawless fish have a body plan like that of some of the earliest vertebrates that existed before true fishes with jaws evolved. Jawless fish have a notochord instead of a true backbone. One type of jawless fish, the lamprey, attaches itself to the fishes on which it feeds by a sucker-like rasping mouth.

Hagfishes, another jawless fish, are entirely marine, very slimy, and feed on carrion and injured fishes.

All aquatic species may be classified in terms of their salinity tolerance as either: saltwater, brackish water, or freshwater species. Salinity requirements may differ for a given species at different stages of its life cycle. Species adapted to a narrow range of salinities are described as *stenohaline*. Species that are able to tolerate a wide range of salinities are described as *euryhaline*. To observe how fish have adapted to different salinities, it's helpful to understand a few key concepts. *Osmosis* is the net movement of a solvent across a permeable membrane from the side with the lower concentration to the side with the higher concentration. For fish we can think of the body fluids as one solution, the surrounding water as the other solution, and the skin separating the two solutions as the membrane. (In most organisms the gills are the primary membranes where osmosis occurs.) *Osmoregulation* is the process that keeps a fish's internal fluids from becoming too diluted by water or too concentrated: an important consideration for an organism that lives its whole life surrounded by water! It is the active regulation of the *osmotic pressure* of an organism's fluids to keep the organism's water content constant (maintain *homeostasis*). Osmoregulation in marine fish is different from osmoregulation in freshwater fish. The body fluids of saltwater species are *hypotonic* (dilute) relative to the surrounding water, so these species tend to lose water to the environment. Osmoregulation in saltwater species requires intake of water and excretion of excess salts. Osmoregulation in freshwater species involves excretion of water and active uptake and retention of salts. The ionic composition of the body fluids of freshwater species is *hypertonic* (more concentrated) to the surrounding water, so these species tend to accumulate water from the environment.

Table 1.

Material	Store	Estimated Cost
LIVE DISSECTION		
Dissection kit	Carolina Biological Supply www.carolina.com	$16 and up
Fish dissection guide (Perch)	www.tobinslab.com	$1.99
Dissection pan	Carolina Biological Supply	$15.50 and up
Fish (preserved or fresh)	Preserved–Carolina Biological Supply Fresh-local markets	$ 1.95 and up
Paper towels	Walmart, grocery store	$2 and up
Mixed mild bleach solution	Walmart	$2 and up
Hand sanitizer	Walmart, grocery store	$3 and up
VIRTUAL DISSECTION		
Carolina BioLab software	Carolina Biological Supply	$80 and up
Virtual dissection	http://australianmuseum.net.au/Fishes	
Classroom dissection	http://www.sf.adfg.state.ak.us/Education/index.cfm/FA/dissect.dissection	