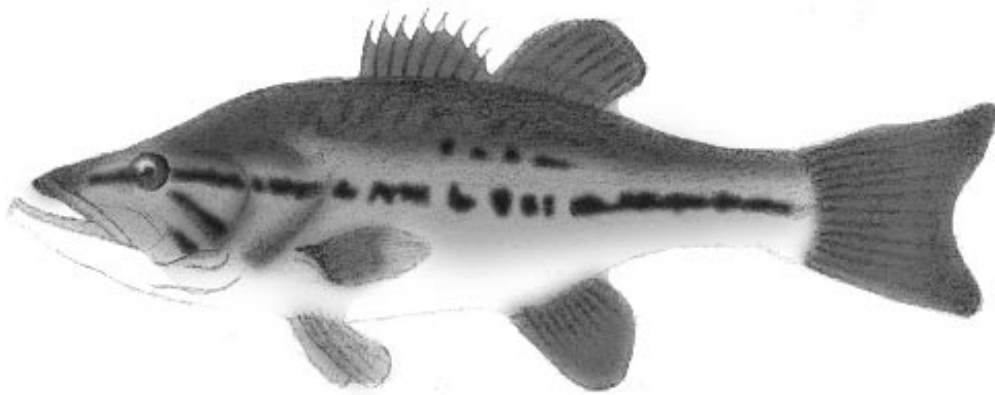


Features of Fish

Instructor's
Manual



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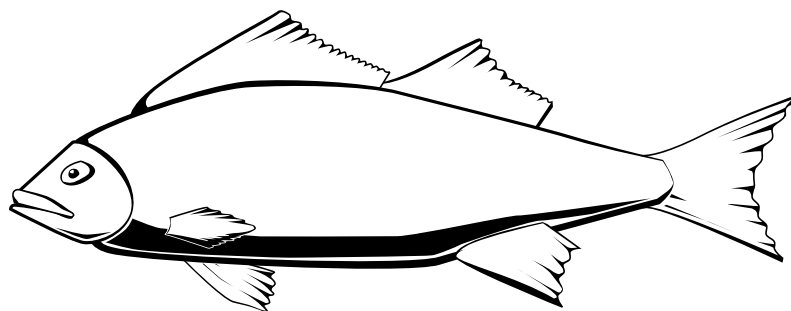


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Student Learning Objectives

Upon viewing the video and completing the enclosed activities, students will be able to do the following:

- List examples of animals in the phylum Chordata.
- Explain four characteristics common to chordates including the presence of:
 - dorsal hollow nerve cord
 - notochord
 - pharyngeal gill slits
 - postanal tail
- Define the term ectothermic and list some examples of ectothermic animals.
- Describe some of the characteristics of fishes that enable them to be so well adapted to life in water. Examples of adaptations include the presence of overlapping scales, a swim bladder, the presence of gills, and well-developed sensory organs.
- Explain the function of gills in fishes. Identify the location of gills on a fish.
- Create a diagram outlining the life cycle of a fish. The diagram should include illustrations of eggs, immature fish, and adult fish.
- Understand that anadromous fish spend part of their lives at sea, but return to freshwater to lay their eggs. State an example of an anadromous fish.
- List examples of fish in the class Agnatha including lampreys and hagfishes. Describe their distinguishing characteristics.
- Explain the main characteristics of Chondrichthyes - the cartilaginous fishes.
- Cite some examples of cartilaginous fishes such as sharks, skates, and rays. Explain how they are similar and different from each other.
- Understand and describe some of the important characteristics of Osteichthyes - the bony fishes.
- Differentiate between the major groups of bony fishes: lobe-finned fishes, lung-fishes, and ray-finned fishes.

Assessment

Preliminary Assessment (p. 14-15):

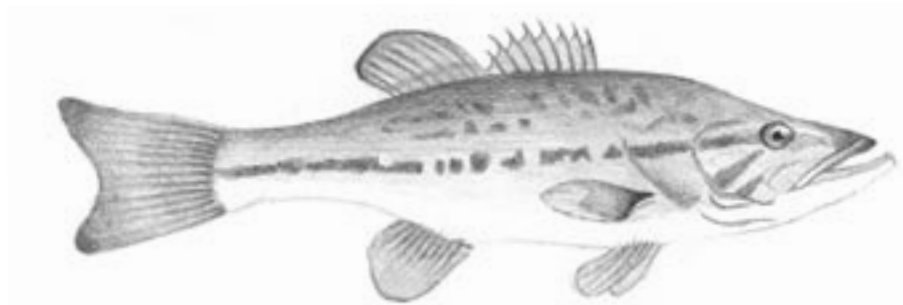
The Preliminary Assessment is an assessment tool designed to gain an understanding of students' preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Post Assessment (p. 16-17):

The Post Assessment can be utilized as an assessment tool following student completion of the program and student activities. The results of the Post Assessment can be compared against the results of the Preliminary Assessment to assess student progress.

Video Review (p. 18):

The Video Review can be used as an assessment tool or as a student activity. There are two sections. The first part contains questions displayed during the program. The second part consists of a ten-question video assessment to be answered at the end of the video.



Introducing the Program

Before you show the video program to your students, do the following short activity. Have students write the name of a specific type of fish on a piece of scrap paper. Next, have them write the name of an animal they think is a fish but are not exactly sure if it is or not. Explain to students that fish are the most abundant vertebrates on the planet. In fact, there are over 24,000 known species of fish.

Next, have each student write the names of their two fish on the board. After all students have written the names of their fish on the board, ask them which examples are clearly not fish. Ask students the following question: “What makes a fish a fish?” Discuss the fact that fish live in water, many (but not all) have scales, and most have fins to help them swim. Fish also have gills enabling them to carry out respiration in water. Based on these criteria, decide which organisms are not fish.

After eliminating the non-fish from the list, tell students their next challenge is to group the fish based on common characteristics. As a class discuss what some of the common characteristics should be, whether it be body shape, presence of certain physical features, or internal structures. Upon agreeing on a classification system, place the fish into several groups. Discuss the various problems encountered while categorizing the fish. Tell students to pay close attention to the video program to learn how fish are categorized by scientists, and how fish are well adapted to their life in water. Following the video program revisit the fish classification system developed by the class, and discuss how it might be changed or improved.

Program Viewing Suggestions

The student master “Video Review” (p. 19) is provided for distribution to students. You may choose to have your students complete this master while viewing the program or do so upon its conclusion.

The program is approximately 20 minutes in length and includes a ten-question video assessment. Answers are not provided to the Video Assessment in the video, but are included in this guide on page 13. You may choose to grade student assessments as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.

Video Script: Features of Fish

1. Do you enjoy fishing in lakes, streams, or the ocean?
2. Perhaps fish is one of your favorite foods.
3. Or, maybe you like to go to the aquarium where you can see a wide variety of fish in all sorts of shapes, sizes, and colors.
4. What exactly are fish?
5. What are some of their characteristics?
6. How are they similar and different from other vertebrate animals?
7. And, why are they important?
8. During the next few minutes we are going to explore these questions and others,...
9. ...as we investigate the fascinating features of fish.
- 10. Graphic Transition – What is a Fish?**
- 11. You Decide!** What do an alligator, a trout, a salamander, a pelican, and a human being all have in common?
12. That's right, all these animals possess a backbone. They are collectively referred to as vertebrates.
13. Reptiles, fishes, amphibians, birds, and mammals are in the phylum Chordata.
14. At some point in their lives, all chordates share four main characteristics: a dorsal hollow nerve cord, a notochord, pharyngeal gill slits, and a postanal tail.
15. Many of these characteristics change as chordates develop throughout their lives.
16. For example, in the early stages of human development gill slits are present, but they disappear as the organism develops.
17. Most chordates also have an internal skeleton, or endoskeleton, that resides inside the organism and supports the body as it grows.
18. Vertebrates are chordates that have a distinct head, skull, and bone segments called vertebrae that make up the backbone.
19. If you run your fingers down the back of your neck, you can feel your spinal column. It's composed of individual vertebrae.
20. There are several distinct classes of vertebrates. Some of these include fishes, amphibians, reptiles, birds, and mammals.
21. During the next few minutes we will focus on the characteristics of jawless fishes, cartilaginous fishes, and bony fishes.
22. Even though these groups of organisms are quite different from each other, we will collectively refer to these classes as fishes.
23. As you know, fishes are adapted for living in water.
24. All but a few fishes are ectothermic, which means they do not necessarily maintain a constant body temperature,...
25. ...as do birds and mammals.
26. This means that the internal body temperature of ectotherms such as amphibians, reptiles,...
27. ...and fishes fluctuate according to the temperature of the external environment.
28. Let's take a closer look at some of the structures and adaptations of fishes.

Video Script: Features of Fish

29. Graphic Transition – Structures and Adaptations of Fishes

30. Fishes are the oldest vertebrate group.
31. They are the most numerous vertebrates on the planet, with over 24,000 known species.
32. Why are fishes so prominent? Because they have been so successful adapting to their aquatic environment and occupying a wide range of habitats.
33. For example, their body form and structure enables many fishes to swim efficiently with great speed.
34. **You Observe!** Describe the shape of this fish.
35. This fish has a streamlined, torpedo shape. It's a shape that helps reduce friction as the fish darts through the water.
36. Most fishes have overlapping scales that cover and protect the skin.
37. The scales are coated with a slippery mucus which also helps reduce friction.
38. Most fishes also possess a structure called a swim bladder that enables them to move up and down in the water.
39. Many fish have well developed senses including keen vision, and a well-developed sense of smell.
40. The olfactory lobe in some fishes, such as sharks, enables them to smell food from great distances.
41. Adult salmon amazingly use their olfactory lobe to smell and return to the stream where they were born to lay their eggs.
42. Most fishes also have a well-developed set of sensory organs called the lateral line system. This helps the fish detect vibrations and changes in water pressure.
43. The lateral line appears as a slight groove running from head to tail.
44. To successfully live in the aquatic environment, fish use structures called gills that capture oxygen gas from water and give off waste carbon dioxide gas.
45. Gills are respiratory organs consisting of layers of thin, feathery tissue richly supplied with blood vessels.
46. Water enters the mouth of a fish and passes through the gills where gas exchange occurs.
47. The water then exits through gill flaps.
48. These are just a few of the adaptations fish possess making them so well suited for life in the water.
49. **Graphic Transition – Life Cycle of Fishes**
50. Perhaps you have heard of, or even eaten a delicacy called caviar.
51. **You Decide!** What is caviar?
52. Caviar consists of fish eggs, often from salmon or a type of fish called sturgeon.
53. The life cycle of most fish begins with the laying of eggs by the female,...
54. ...although some fishes, such as sharks, bare live young.
55. Eggs are fertilized externally or internally by the male.
56. It is not unusual for some species of fishes to lay thousands of eggs, of which only a small percentage hatch,...

Video Script: Features of Fish

57. ... with even fewer surviving until adulthood. With a few exceptions, parents generally do not care for the eggs or for the young.
58. While most fish spend their lives in one general location, like the bass in this lake,...
59. ...some species of fish, such as salmon, migrate great distances.
60. Salmon are usually anadromous, meaning they spend part of their lives at sea but return to fresh water to spawn.
61. Amazingly, many species of salmon travel hundreds or even thousands of kilometers from the ocean upstream to the stream where they were spawned. They do this to lay their own eggs guided by the characteristic odor of the stream.
- 62. Graphic Transition – Jawless Fishes**
63. Did you know there are more kinds of fish than all other kinds of water and land vertebrates put together?
64. They vary greatly in shape, color, and size.
65. Fish live almost anywhere there is water.
66. Scientists who study fish, called ichthyologists, have identified and classified over 25,000 different species of fish. There are several major groupings of extinct and living fishes.
67. The jawless fishes in the class Agnatha, first appeared over 500 million years ago, and for more than 100 million years were the only vertebrates.
68. These snake-like fish include present-day lampreys, and hagfishes.
- 69. You Observe!** What makes this fish look unusual?
70. That's right, it does not have a characteristic head with jaws.
71. These jawless fish have a skeleton made of cartilage and are considered to be the most primitive of all vertebrates.
72. Besides not having a jaw, they also lack the paired fins and scales that other fish possess.
73. There are only about 40 species of lampreys, and about 60 species of hagfishes.
74. Most lampreys are parasitic. That means they obtain food by attaching their round sucker-like mouths to the bodies of other fishes.
75. The lampreys then suck the blood and body fluids of the fish for nourishment.
76. Hagfishes, another type of jawless fish, are scavengers feeding off dead fishes or large invertebrates.
- 77. Graphic Transition – Cartilaginous Fishes**
78. The waters here off the Florida coast are inhabited with some of the oldest, and at times most dangerous fishes – the cartilaginous fishes.
79. Cartilaginous fish, belonging to the class chondrichthyes, include sharks, rays and skates.
80. Nearly all members of this class of which there are over 850 species, live in the ocean. Their ancestors date back hundreds of millions of years.
81. The common characteristic of these organisms is a skeleton made of a durable but strong material called cartilage.
- 82. You Compare!** Compare the shape of this shark to that of this fish.

Video Script: Features of Fish

83. The shark has a streamlined, torpedo-shaped body compared to the flattened wing-like body of the skate. Sharks use their sleek bodies for swiftly catching prey, while the bodies of skates and rays are adapted to life on the seafloor.
84. Unlike jawless fishes, cartilaginous fish have movable lower and upper jaws.
85. In some shark species, the strong jaws are lined with several rows of razor-sharp teeth.
86. Rays and skates have flattened, wing-like bodies with whip-like tails that often include sharp, poisonous barbs.
87. A shark's body is adapted for powerful, fast swimming, thrashing its way through the water with its strong tail.
88. Most sharks are carnivorous, preying on fish, and other marine organisms.
89. Some however, such as the basking shark and whale shark are filter feeders, meaning they eat microscopic plants and animals.
90. Sharks obtain oxygen as water passes through their mouth and over their gills as they swim.
91. They possess well-developed sense organs, including a keen ability to detect vibrations and smells, enabling them to find food and avoid predators.
- 92. Graphic Transition – Bony Fishes**
93. If you have recently eaten fish, most likely it was a bony fish belonging to the class osteichthyes.
94. Osteichthyes are the largest class of vertebrates consisting of over thousands of species.
95. Osteichthyes are a very diverse group that is abundant in both saltwater and freshwater.
96. Most members of this group have bony skeletons, paired fins, swim bladders, a highly developed lateral line system, and overlapping scales.
97. The major groups of bony fishes include lobe-finned fishes, lungfishes, and ray-finned fishes.
98. Lobe-finned fishes, once thought to be extinct, were discovered when an example of a coelacanth was caught in 1938. Coelacanths are the only living examples of lobe-finned fishes.
99. Lungfishes, a close relative of the coelacanth, possess lung-like structures that enable them to breathe outside of water during periods of drought.
100. You are probably most familiar with examples of ray-finned fishes. Common examples include salmon, perch, tuna, trout, and swordfish to name just a few.
101. Ray-finned fishes are the largest group of bony fishes.
102. They possess fan-like fins supported by rays of thin bones.
103. They vary greatly in form and behavior and are widely distributed throughout the Earth's waters.
104. Their origins are traced back to the Devonian Period, and their evolution is widely supported in the fossil record.
105. Modern day ray-finned fishes have proliferated into thousands of species.
106. Common characteristics include dorsal fins, paired pelvic fins, well-developed eyes, and other well-developed sensory organs.

Video Script: Features of Fish

107. Graphic Transition – Video Review

108. During the past few minutes we have explored some of the fascinating features of fishes.
109. We began by highlighting some of the common characteristics of fishes including the fact that they live in water, are ectothermic, they have scales, as well as swim bladders, and use gills for gas exchange.
110. These features make fishes especially well suited for their lives in water.
111. We then briefly reviewed the general life cycles of fishes.
112. Some of the characteristics of the major groups of fishes were then explored.
113. We took an in-depth look at agnathans – the jawless fishes.
114. The features of chondrichthyes, the cartilaginous fishes were discussed.
115. Last, the characteristics of osteichthyes, the most abundant and diverse group of fishes were explored.

Graphic Transition – Video Assessment

Fill in the correct word to complete the sentence.

1. ____ are chordates that have a spinal column.
2. ____ are the oldest and most abundant vertebrates.
3. Fishes are ____ meaning they do not necessarily maintain a constant body temperature.
4. Most fishes are covered with overlapping ____.
5. A swim ____ enables fish to move up and down in the water.
6. ____ are respiratory organs used for gas exchange.
7. Agnathans are fish that lack ____.
8. ____ fish spend part of their lives at sea and part in freshwater
9. Chondrichthyes are often referred to as ____ fishes.
10. Salmon, trout, and tuna are examples of fish in the category called ____.

Answer Key to Student Assessments

Preliminary Assessment (p. 15-16)

1. c - backbone
2. a - endoskeleton
3. d - ectothermic
4. a - scales
5. c - swim bladder
6. b - gills
7. b - lateral line system
8. a - eggs
9. d - anadromous
10. b - ichthyologists
11. c - jaws
12. b - lampreys
13. a - cartilage
14. d - osteichthyes
15. c - trout
16. Most fishes are water-dwelling, ectothermic vertebrates that possess scales, fins, a swim bladder, and gills through which respiration occurs.
17. The lateral line system appears as a slight groove running from head to tail. It helps fish detect vibrations and changes in water pressure.
18. Most fish hatch from eggs laid by the female. Eggs are fertilized by the male. With a few exceptions, parents generally do not care for the eggs or the young.
19. Agnathans, of which there are about 100 species are jawless fishes. They have a skeleton made of cartilage. They also lack paired fins and scales.
20. Cartilaginous fishes have a skeleton made of cartilage whereas bony fishes have a skeleton made mainly of bone. Most cartilaginous fish live in saltwater while many bony fish live in freshwater.

Video Review (p. 19)

1. All of these animals possess a backbone. These animals are collectively referred to as vertebrates.
2. The shape of this fish has a streamlined, torpedo shape that helps reduce friction as it darts through the water.
3. Caviar consists of fish eggs, often from salmon or sturgeon.
4. This fish is unusual because it does not have a characteristic head with jaws. It is a jawless fish with a skeleton made of cartilage.
5. The shark has a streamlined, torpedo-shaped body which allows the shark to swiftly catch prey. The skate has a flattened, wing-like body that is adapted for life on the seafloor.

Video Assessment (p. 19)

- | | |
|----------------|------------------|
| 1. vertebrates | 6. gills |
| 2. fishes | 7. jaws |
| 3. ectothermic | 8. anadromous |
| 4. scales | 9. cartilaginous |
| 5. bladder | 10. osteichthyes |

Post Assessment (p. 17-18)

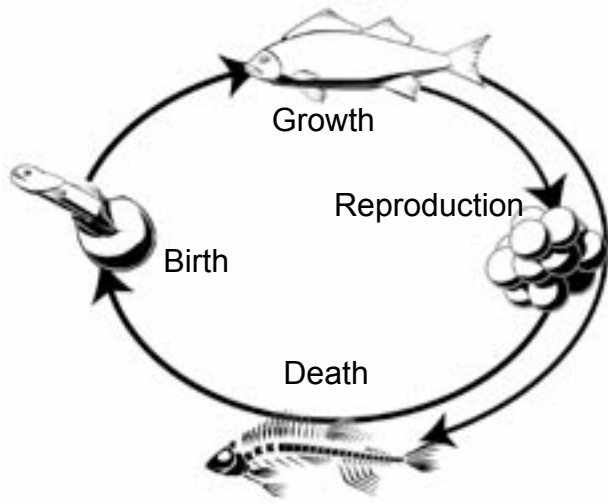
1. a - eggs
2. b - ichthyologists
3. b - lampreys
4. d - osteichthyes
5. d - anadromous
6. c - jaws
7. a - cartilage
8. c - trout
9. a - endoskeleton
10. a - scales
11. b - gills
12. c - backbone
13. d - ectothermic
14. c - swim bladder
15. b - lateral line system
16. Most fish hatch from eggs laid by the female. Eggs are fertilized by the male. With a few exceptions, parents generally do not care for the eggs or the young.
17. Cartilaginous fishes have a skeleton made of cartilage whereas bony fishes have a skeleton made mainly of bone. Most cartilaginous fish live in saltwater while many bony fish live in freshwater.
18. Agnathans, of which there are about 100 species are jawless fishes. They have a skeleton made of cartilage. They also lack paired fins and scales.
19. The lateral line system appears as a slight groove running from head to tail. It helps fish detect vibrations and changes in water pressure.
20. Most fishes are water-dwelling, ectothermic vertebrates that possess scales, fins, a swim bladder, and gills through which respiration occurs.

Features of Fish Vocabulary

1. h - agnathans
2. n - lungfishes
3. g - ichthyologist
4. k - osteichthyes
5. d - olfactory lobe
6. l - lateral line system
7. j - chondrichthyes
8. o - ray-finned fishes
9. b - scales
10. m - coelacanth
11. f - anadromous
12. e - gills
13. c - swim bladder
14. i - lampreys
15. a - ectothermic

Answer Key to Student Activities

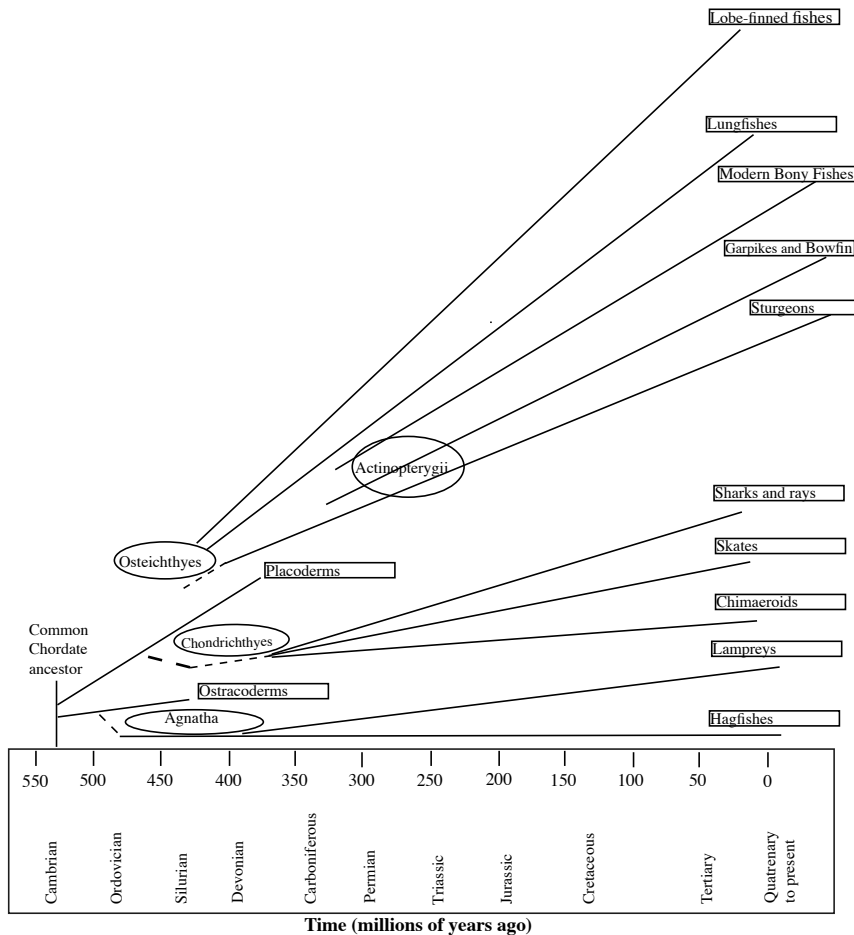
Life Cycle of a Fish (p. 21-22)



Migration of the Eels (p. 25)

1. Eels are a type of fish that have a scaleless, snake-like body. They can be found in saltwater and freshwater. Eels range in size from 5 centimeters to 3.75 meters.
2. For centuries scientists observed large numbers of adult eels swimming down rivers toward the ocean and no adults were ever observed returning to the streams. Instead, in the spring the much smaller eels returned. Scientists assumed the adult eels left to spawn and the young eels returned. However, the location of the spawning grounds was a mystery and this intrigued the scientists.
3. The tiny eel larvae drift on ocean currents for two years to reach the middle of the Atlantic ocean. At the end of the third year, they reach the coastal waters of Europe. Here larvae undergo metamorphosis changing into a smaller juvenile form, looking much like adult eels. The males remain in the coastal waters while the females migrate to freshwater tributaries. After eight to fifteen years the females join the males to return to the ancestral breeding grounds to spawn.

Evolution of Fish (p. 23-24)



Preliminary Assessment

Name: _____

Directions: Circle the best answer for each of the following:

1. An adult alligator, trout, salamander and human being all have the following feature(s) in common:
 - a. scales
 - b. hair
 - c. backbone
 - d. fins
2. Chordates possess the following type of skeleton:
 - a. endoskeleton
 - b. cartilaginous skeleton
 - c. exoskeleton
 - d. body armor
3. Most fish do not maintain a constant body temperature and are described as being:
 - a. anadromous
 - b. endothermic
 - c. warm-blooded
 - d. ectothermic
4. The following structures cover and protect the bodies of fishes:
 - a. scales
 - b. incisions
 - c. skin tissue
 - d. bones
5. This structure enables fish to move up and down in the water:
 - a. liver
 - b. spleen
 - c. swim bladder
 - d. buoyancy device
6. The respiratory organs utilized by fish to inhale oxygen and give off carbon dioxide are called:
 - a. lungs
 - b. gills
 - c. gas regulators
 - d. respirators
7. This well-developed sense organ(s) enables fish to sense vibrations and changes in water pressure:
 - a. nose
 - b. lateral line system
 - c. ears
 - d. echolocaters
8. The life cycle of most fish begins with them emerging from:
 - a. eggs
 - b. live from the mother
 - c. sperm cells
 - d. spores
9. Fish that spend part of their lives at sea, but return to freshwater to spawn are said to be:
 - a. nocturnal
 - b. bilateral
 - c. diurnal
 - d. anadromous
10. Scientists that study fish are referred to as:
 - a. endocrinologists
 - b. ichthyologists
 - c. entomologists
 - d. ornithologists
11. Agnathans consist of a group of fishes that are most noted for lacking this characteristic:
 - a. cartilaginous skeleton
 - b. eyes
 - c. jaws
 - d. tail
12. Which type of fish is parasitic, obtaining food by attaching a sucker-like mouth to the bodies of other fish?
 - a. sharks
 - b. lampreys
 - c. skates
 - d. salmon
13. The skeleton of fish in the class Chondrichthyes is composed primarily of the following material:
 - a. cartilage
 - b. bone
 - c. muscle fiber
 - d. chitin
14. The largest class of vertebrates are bony fishes in the class called:
 - a. Agnatha
 - b. Reptilia
 - c. Tuatara
 - d. Osteichthyes
15. Which of the following is an example of a ray-finned fish?
 - a. shark
 - b. lamprey
 - c. trout
 - d. coelacanth

Preliminary Assessment

Name: _____

Directions: Answer the following using complete sentences

16. Describe some characteristics common to most fishes.

17. What is the function of the lateral line system and where is it located?

18. How do fish begin their life cycle?

19. What are Agnathans? Describe them.

20. What are two differences between cartilaginous fishes and bony fishes?

Post Assessment

Name: _____

Directions: Circle the best answer for each of the following:



1. The life cycle of most fish begins with them emerging from:

- a. eggs
- b. live from the mother
- c. sperm cells
- d. spores

2. Scientists that study fish are referred to as:

- a. endocrinologists
- b. ichthyologists
- c. entomologists
- d. ornithologists

3. Which type of fish is parasitic, obtaining food by attaching a sucker-like mouth to the bodies of other fish?

- a. sharks
- b. lampreys
- c. skates
- d. salmon

4. The largest class of vertebrates are bony fishes in the class called:

- a. Agnatha
- b. Reptilia
- c. Tuatara
- d. Osteichthyes



5. Fish that spend part of their lives at sea, but return to freshwater to spawn are said to be:

- a. nocturnal
- b. bilateral
- c. diurnal
- d. anadromous

6. Agnathans consist of a group of fishes that are most noted for lacking this characteristic:

- a. cartilaginous skeleton
- b. eyes
- c. jaws
- d. tail

7. The skeleton of fish in the class Chondrichthyes is composed primarily of the following material:

- a. cartilage
- b. bone
- c. muscle fiber
- d. chitin



8. Which of the following is an example of a ray-finned fish?

- a. shark
- b. lamprey
- c. trout
- d. coelacanth

9. Chordates possess the following type of skeleton:

- a. endoskeleton
- b. cartilaginous skeleton
- c. exoskeleton
- d. body armor

10. The following structures cover and protect the bodies of fishes:

- a. scales
- b. incisions
- c. skin tissue
- d. bones

11. The respiratory organs utilized by fish to inhale oxygen and give off carbon dioxide are called:

- a. lungs
- b. gills
- c. gas regulators
- d. respirators

12. An adult alligator, trout, salamander and human being all have the following feature(s) in common:

- a. scales
- b. hair
- c. backbone
- d. fins

13. Most fish do not maintain a constant body temperature and are described as being:

- a. anadromous
- b. endothermic
- c. warm-blooded
- d. ectothermic

14. This structure enables fish to move up and down in the water:

- a. liver
- b. spleen
- c. swim bladder
- d. buoyancy device

15. This well-developed sense organ(s) enables fish to sense vibrations and changes in water pressure:

- a. nose
- b. lateral line system
- c. ears
- d. echolocaters

Video Review

Name: _____

Directions: Answer these questions as you watch the video:

1. **You Decide!**

What do an alligator, a trout, a salamander, a pelican, and a human being all have in common?

2. **You Observe!**

Describe the shape of this fish.

3. **You Decide!**

What is caviar?

4. **You Observe!**

What makes this fish look unusual?

5. **You Compare!**

Compare the shape of this shark to that of this fish.

Video Assessment

Directions: After you watch the video, fill in the blank to complete the sentence.

- _____ are chordates that have a spinal column.
- _____ are the oldest and most abundant vertebrates.
- Fishes are _____ meaning they do not necessarily maintain a constant body temperature.
- Most fishes are covered with overlapping _____.
- A swim _____ enables fish to move up and down in the water.
- _____ are respiratory organs used for gas exchange.
- Agnathans are fish that lack _____.
- _____ fish spend part of their lives at sea and part in freshwater.
- Chondrichthyes are often referred to as _____ fishes.
- Salmon, trout, and tuna are examples of fish in the category called _____.

Features of Fish Vocabulary

Name: _____

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

____ 1) aaannhgst _____

____ 2) hfuegsnils _____

____ 3) tlshoiocigtyh _____

____ 4) hheesscottyi _____

____ 5) latrocyof oebL _____

____ 6) taalrle ieln myests _____

____ 7) dtciershnocyhh _____

____ 8) ary ndnfei sshief _____

____ 9) lcssea _____

____ 10) alocechant _____

____ 11) ooaaumnsrd _____

____ 12) islgl _____

____ 13) ismw dbedral _____

____ 14) yarpblem _____

____ 15) tteecciromh _____

a. Refers to the internal body temperature of an animal that fluctuates according to the temperature of the external environment.

b. Hard overlapping tissues that cover the bodies of most fishes.

c. An inflatable structure(s) inside fishes enabling them to move up and down in the water.

d. A portion of the brain that is related to the sense of smell.

e. Respiratory organs that enable fish to carry out gas exchange in water.

f. Refers to fish that spend part of their lives at sea and part of their lives in freshwater.

g. A scientist that studies fish.

h. A group of fishes that do not possess jaws.

i. Parasitic jawless fishes that commonly attach their sucker-like mouths to living fish to obtain nourishment.

j. A group of cartilaginous fishes that includes skates, sharks, and rays.

k. The largest group of fishes; they have a bony skeleton and paired fins.

l. A slight groove running from head to tail that helps fish detect vibrations and changes in water pressure.

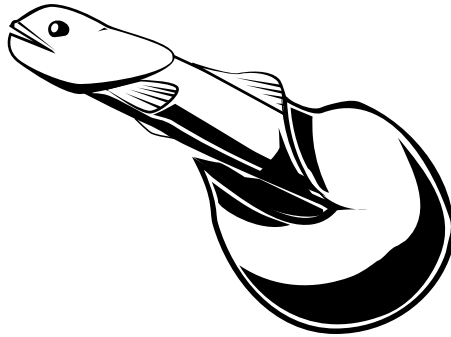
m. The only known living species of lobe-finned fish.

n. A group of fishes that possess lung-like structures enabling them to breathe outside of water during periods of drought.

o. The largest group of bony fishes; possess fan-like fins supported by rays of thin bones.

Life Cycle of a Fish

Name: _____



Background:

Have you ever heard of or eaten a delicacy called caviar? Believe it or not, caviar consists of the eggs of fish. It is eaten throughout the world. Sometimes referred to as roe, caviar is derived from the eggs of salmon, sturgeon, or other types of fish. The life cycle of most fish begins with the laying of eggs by the female. Living things go through a series of changes in their lives referred to as a life cycle. The term “cycle” is used to describe the circular or repeating pattern of the life stages of an animal. Every organism, including fish has their own unique life cycle with the four general stages: birth, growth, reproduction, and death.

Although some fishes, such as sharks bear live young, most lay eggs. Eggs are either fertilized internally or externally by the male. An egg is successfully fertilized when sperm from the male fuses with the egg. It is not unusual for some species of fishes to lay thousands of eggs.

Of the thousands of eggs laid by the female fish, only a small percentage hatch. Many eggs are lost to predators or drift into inhospitable environments. Over time the fish embryo develops within the egg. In days or weeks the fish larva emerges from the egg. In many cases the larva still possess a yolk sac that provides nourishment. Once the yolk supply has been exhausted the larva must obtain its own food to survive and continue growing. With few exceptions parents generally do not care for the eggs or for the young.

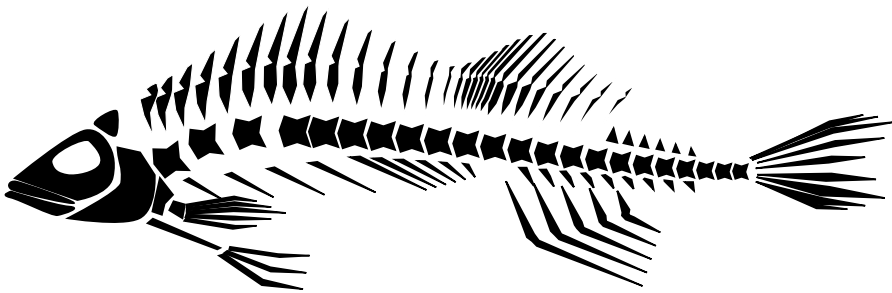
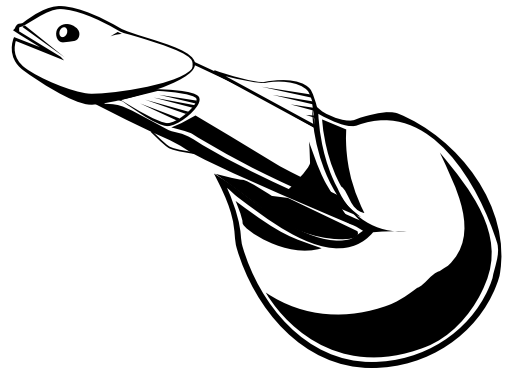
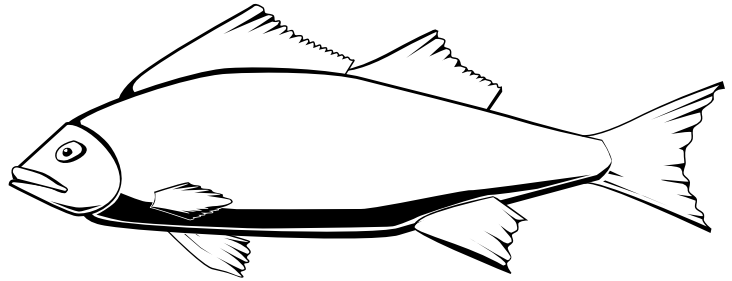
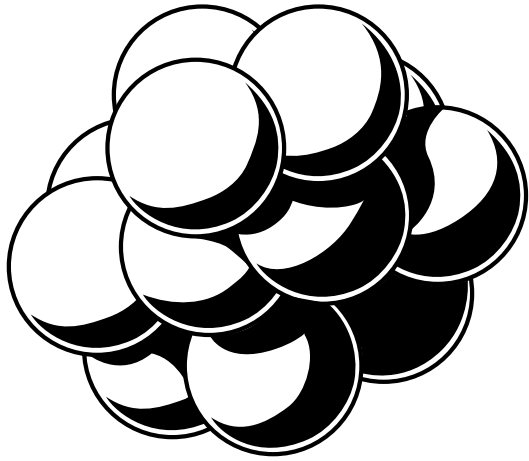
While very few eggs hatch, even fewer fish survive to become adults. There are many obstacles preventing fish from reaching a reproductive age including predators, fishing, and disease to name just a few. To reach maturity, fish must also locate an adequate food supply. To successfully reproduce a fish must find a mate. Some species of fish may live many years, reproducing numerous times. Others live relatively short lives, reproducing just once.

The final stage of the fish life cycle is death. Some species of fish live dozens of years, while others may live just one or two years before dying. When a fish dies, its body decomposes, returning valuable nutrients to the water to be used by other living things.

Life Cycle of a Fish

Name: _____

Directions: Below are four images of the basic life stages of fish. Cut out the images and arrange them onto a piece of paper in the correct order to represent the life cycle of fish. Use arrows to indicate the order of the cycle. Describe the process that is occurring at each stage in the life cycle, and explain what must occur at the stage to successfully reach the next stage.



Evolution of Fish

Name: _____



Background:

Fish have occupied the planet for a long time. The first fish evolved about 500 million years ago. They were the only vertebrates on Earth for nearly 100 million years. Early fishes consisted of five orders of ostracoderms. Many ostracoderms were bottom dwellers, with a jawless mouth located under a relatively flat head. They became almost entirely extinct about 370 to 360 million years ago. The only surviving group, the jawless Agnatha, exist today as hagfishes and lampreys.

A very important evolutionary advance that occurred in early fishes was the development of jaws. A group of early fishes, called placoderms, possessed jaws. These fish developed quite powerful jaws enabling them to become ferocious predators. Placoderms dominated the seas, reaching lengths up to 10 meters! They became entirely extinct at the end of the Devonian Period (about 350 million years ago).

During the Devonian period (408 to 360 million years ago) sharks and bony fishes first evolved. These fishes possessed a jaw that was even further developed, with the mouth opening very wide to almost a full circle. In many species of sharks the jaws were lined with several rows of teeth. Sharks and bony fishes developed amazing swimming abilities. Their stream-lined shape, muscular tails, and fins enabled them to carry out expert maneuvers in the water with great speed. In the Carboniferous period (360 to 280 million years ago) sharks became the dominant predators. Sharks, skates, and rays still survive today with over 750 species successfully living on Earth.

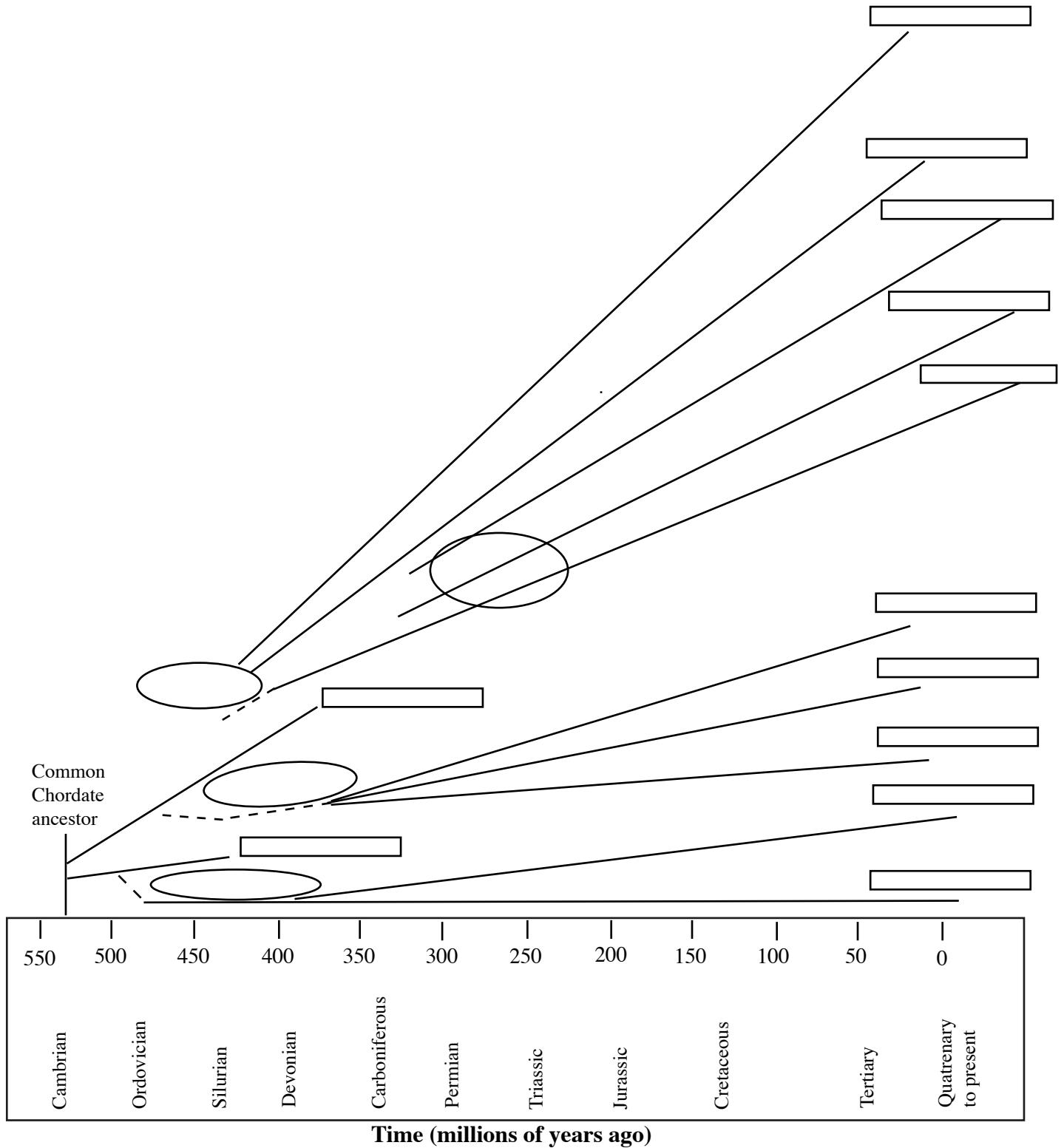
Bony fishes evolved at approximately the same time as sharks, about 400 million years ago. They evolved much differently than sharks whose skeleton is made of cartilage. Instead, the skeleton of bony fishes is made of bone. It is thought bony fishes evolved in freshwater instead of seawater. The first bony fishes were most likely small and contained air sacs that could be inflated to buoy the fish up, or deflated to sink. Most bony fishes possess mobile paired fins, thin scales, and segmented tails enabling them to swim on a straight course. Important groups that survive today evolved from early bony fishes: the lobe-finned fishes (class Sarcopterygii), lungfishes (Dipneusti), and the ray-finned fishes (class Actinopterygii). There are over 24,000 species of ray-finned fishes making up about 90% of all fish species living today.



Evolution of Fish

Name: _____

Directions: Below is a simplified, unlabeled family tree of fishes throughout time. Using information provided in the background and other references, complete the family tree



Migration of the Eels

Name: _____

Directions: Read the information below and answer the questions.



While swimming or boating perhaps you have been startled by a fast-swimming, snake-like animal called an eel. True eels are an order of fish that possess a snake-like, elongated body and no pelvic fins. For thousands of years people have eaten eels, and today are considered a delicacy in many parts of the world. Many eels have a very interesting life cycle. For centuries scientists were intrigued by freshwater eels (family Anguillidae) living in coastal streams flowing into the North Atlantic Ocean. Every fall large numbers of adult eels were observed swimming down rivers toward the ocean. However, adults were never observed returning up these streams. Instead, in the spring, larval eels, called “elvers”, only about 5-8 centimeters in length returned, swimming upstream. It was assumed that the adult eels went to sea to spawn, and the larval eels returned. But, the location of the spawning grounds remained a mystery for hundreds of years.

It was not until the mid 1890s when two Italian scientists discovered that the larval eels were in fact not larva, but relatively advanced juvenile eels. They found that true larval eels were tiny transparent organisms called leptocephali that were leaf-like and didn't resemble

eels at all. Later, other scientists supported this evidence and reconstructed the spawning migration of the European and American eel. They found that when adult eels leave coastal rivers of Europe and North America, they swim steadily for one to two months until they reach the warm Sargasso Sea, southeast of Bermuda. Here, at depths of 300 meters or more the adult eels spawn and then die.

The tiny eel larvae then begin an incredible journey back to coastal rivers in North America and Europe. Drifting on ocean currents the European eels reach the middle of the Atlantic Ocean after two years. Near the end of the third year they reach the coastal waters of Europe. They then undergo metamorphosis, changing from the larval form to the juvenile form that appears much more eel-like. The journey for North American eels only takes eight months because the distance is much shorter from the spawning area. Once the eels metamorphose, the males remain in brackish coastal waters, while the females proceed up freshwater tributaries. Some females migrate hundreds of kilometers upstream. After 8 to 15 years of growth the females, one meter or more long, return to sea where they join the males. Both males and females then return to ancestral breeding grounds to spawn to complete the life cycle. While there are many other types of fish such as salmon and tuna that migrate great distances, the life cycle of these freshwater eels is truly one of the most remarkable in the fish world.

Questions:

1. What are eels?
2. What intrigued scientists about the migration of eels?
3. Describe what happens to European eels once they are born.