FINS & SCALES

An Introduction to Bony Fish

A MARINE SCIENCE PROJECT GUIDE FOR 4-H LEADERS AND EDUCATORS

Florida 4-H Youth Development Program

UF/IFAS Extension

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Sea Grant Florida

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What Is a 4-H Project?

A project is a topic that youth learn about in 4-H. It is something that youth can do or engage in. Projects help youth learn new knowledge and skills. Youth learn about the project by attending club meetings, being involved in educational programs, going on field trips, attending camps, and participating in shows and competitions, as well as through family outings and group activities. During a project, it is important to let youth share what they have learned with the club, you, and their parents. You should review a youth's project book and initial tasks and goals as the youth accomplishes them.

Why Should Youth Complete a Project Book?

A project book is a way to help youth learn about a topic. A project book also does the following:

- Helps youth learn to set goals and be more organized about achieving these goals.
- Helps youth record what they have done and learned as a result of the project!
- Can provide information that might be needed to apply for awards and scholarships in 4-H and maybe even resumes for jobs and college!

About the Fins and Scales Project

The **Fins and Scales Project** is intended for **Intermediate 4-Hers** (11-13 years), yet open to any youth interested in learning about fish. The project provides youth with opportunities to investigate fish and their adaptations for living in water. As a result, youth practice a variety of science skills and life skills. Youth conduct their own research, make observations and comparisons, use critical thinking skills, communicate to others what they have learned, and can even teach others about fish!

If you have youth that like marine science and would like to do other projects in this topic, visit the 4-H website at: http://florida4h.org/. Youth may also enter the 4-H State Marine Ecology Event (MEE) which further enhances their opportunities to learn about fish and other forms of aquatic or marine life. Check it out at: http://florida4h.org/mee.

Fins and Scales Support Kit: To support the activities found within the Fins and Scales Project, a limited number of teaching kits were produced. These kits were distributed to Extension offices around the state. Please contact your county extension agent for more information. A complete list of what is in the kit can be found in the back of this guide.

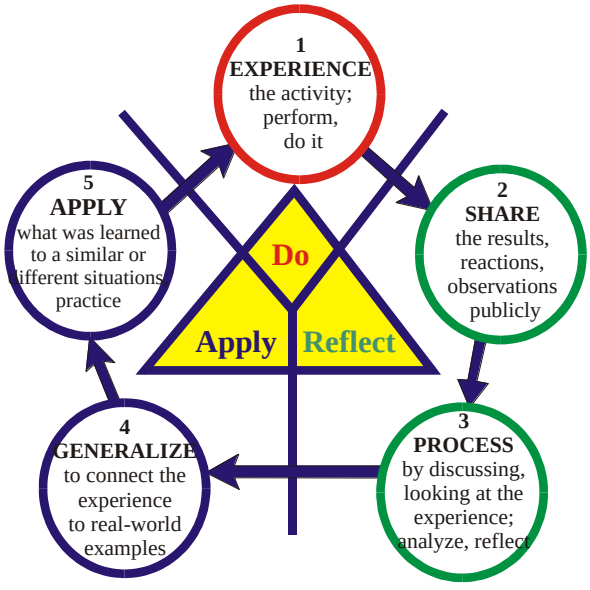
About the Leader's Guide

The Youth Project Book is divided into sections based on the physical characteristics of fish. The Leaders Guide follows the layout of the Youth Project Book and provides a suggested approach for each section. Each section of the Leaders Guide contains:

- Additional background information on fish adaptations.
- Answers to questions found in the youth guide. Although answers are provided, it is important that you let youth discover their own answers for the greatest learning benefit.
- Additional ideas and/or descriptions of activities to support learning in youth.
- The identification of life skills and/or science process skills being practiced in the activities.
- A *"Let's Review"* section provides opportunities for youth to apply what they learned to a new situation.
- A *"Dive Deeper"* section provides ideas that allow youth to further explore a concept, question, term, or process.
- A *"Think Like a Scientist!"* section asks youth to investigate a question further to find possible answers and solutions.

Experiential Learning Model

The Fins and Scale Project is based on the Experiential Learning Model. In experiential learning, youth learn through self-discovery. The experiential learning model uses a "do, reflect, apply" approach to learning. All three of these steps are important for meaningful learning to occur. The new knowledge that youth gain should then be applied to a new situation that can lead to another experience for youth!



Remember though, it is not the experience alone that promotes learning but how the experience is processed by the learner. As a club leader, you can help youth process their project experiences by asking open-ended questions where youth can come up with their own answers and solutions. Make sure you provide opportunities for youth to share what they did and what they learned with others. More information on experiential learning is available on the 4-H website.

The Fins and Scales Leader's Guide provides questions to help guide the learning process. As a 4-H leader you are an experiential educator, facilitator, mentor, and even a co-learner! You do not need to be an expert on fish to help youth in this project. You just need to be willing to learn new things along with the youth!

Using Science Inquiry

Science inquiry is a process that involves asking questions then seeking ways to find answers to those questions. Inquiry can be used to learn about most any subject. Ideally, inquiry-based learning comes from questions that are generated from the interests, curiosities, and perspectives of the learner.
As the project helper, you can help guide the inquiry process by asking questions that challenge the learner to investigate some phenomena further. Here are the three main types of inquiry approaches. Which one do you think is the most meaningful to the learner?

- *Structured* – Project helpers ask youth questions, a way to answer them, the needed materials, but not the outcomes.
- *Guided* – Leaders ask a question but youth must determine the best way to find the answer.
- *Open* – Youth form their own questions and design an investigation to help them find possible answers or solutions.

Science Process Skills

The 4-H Youth Development Program has identified 30 science skills that are considered necessary for a young person to master in order to be "scientifically literate." These skills include:

- Build/construct
- Categorize/classify
- Collaborate
- Collect data
- Communicate
- Compare/contrast
- Design solutions
- Develop solutions
- Draw/design
- Evaluate
- Hypothesize
- Invent/implement solutions
- Infer
- Interpret/analyze
- Measure
- Model/graph
- Observe
- Plan investigation
- Predict
- Problem solve
- Question
- Research a problem
- State a problem
- Summarize
- Test
- Use tool

As youth work to complete the Fins and Scales Project, they will utilize a number of these skills in their quest to uncover answers to the questions presented. When youth are encouraged to use science process skills to discover knowledge on their own, they are more likely to become motivated to continue learning by asking their own question!

Life Skills

4-H has identified a number of important life and workforce skills that youth should practice and develop through their 4-H experience. These skills are identified in the beginning of the leader-lead activities but also applied throughout the project. These skills include:

- Responsibility
- Critical thinking
- Teamwork
- Problem solving
- Goal setting
- Working cooperatively

Science Standards

Depending on the types of activities youth do in *The Fins and Scales Project,* a number of science education standards can be addressed.

Next Generation Sunshine State Standards

Big Idea 1: The Practice of Science - SC.5.N.1.1; SC.5.N.1.2; SC.6.N.1.1; SC.6.N.1.4;

Big Idea 14: Organization and Development of Living Organisms - SC.5.L.14.2; SC.6.L.14.1

Big Idea 15: Diversity and Evolution of Living Organisms - SC.5.L.15.1; SC.7.L.15.3; SC.912.L.15.6;

National Science Standards

MS-LS2-2: Ecosystems: Construct an explanation that predicts patterns of interactions among organisms across multiple systems.

MS-LS4-4: Biological Evolution: Construct an explanation based on evidence that describes how variations of traits in a population increase an individual's probability of surviving and reproducing in a specific environment.

MS-LS4.B: Natural Selection: Natural selection leads to the predominance of certain traits in a population and the suppression of others.

MS-LS4.C: Adaptation: Species change over time in response to changes in environmental conditions.

Introducing the Fins and Scales Project

Suggested Approach: Have youth complete the first page by filling in their name and contact information. *Then ask:*

- Why did they choose to do the Fins and Scales project?
- What do they already know about fish
- What do they want to learn about fish?
- What are the project goals? *Discuss as a group how each goal below might be accomplished.*
- What materials do youth need to complete the project and how will they obtained?
- What will be the timeline for completing the project?

Go over the following goals with the youth:

Goal 1 - Youth should complete the following sections in their project guide.

A. What is a fish?
B. How do fins help a fish?
C. How does body shape help a fish?
D. How does body color help a fish?
E. Why do fish have different mouths?
F. Why do fish have scales?
G. How can we determine a fish's age?

The Leaders Guide contains answers to many of the questions found in the sections of the Project Book. The Helper's Guide also contains additional questions that may be helpful in guiding learning.

Goal 2 - Youth should participate in a learning experience related to fish. A "learning experience" can be one of the suggested activities found in the sections in this guide, or another activity related to fish. Your club could go on a fishing trip, tour a fish research facility, or participate in an aquarium program. They may also enter the **State Marine Ecology Event**. This annual contest recognizes youth for their achievement in marine science. For more information, go to the Florida 4-H website.

Goal 3 - Youth should mentor or help another youth through a learning activity. Within the sections are suggested activities. Once youth do these activities within the club, they could teach one activity to younger youth at camps, clubs, schools, festivals, etc.

Goal 4 - Youth should share what they have learned in the project with others. This could include speaking to a group about something they learned, an illustrated talk or poster display at a local, district, or state event.

What Youth Will Need for the Project

1. Internet/Access to some of the resources listed on the back page of this Leaders Guide.

2. If possible, access to a real fish. Youth can obtain a real fish by going fishing, catching a fish in a net along a shoreline, buying a fish at a seafood market (mullet, tilapia, grunts are fine). Youth may also go to an aquarium store or public aquarium and select a fish to observe! If a real fish is not available, youth can select a fish from a book or research the Internet for a fish to use in the project.

3. A microscope (or strong magnifier) will be needed for looking at scales and/or fish ear bones (otoliths). Local schools, science labs, or even your county Extension office may have one you can borrow or use.

4. **Fins and Scales Support Kit:** The F/S Support Kit contains laminated pictures of fish, examples of scales, otoliths (fish ear bones), rubber fish model, magnifiers, and more to support the Project. Each 4-H District should have one of these kits for loan. Having this kit is helpful but not required to complete the project. A list of what the kit contains can be found in the back of this Guide.

Setting a Timeline

Let youth decide on a realistic timeline for when they feel they can complete the tasks of the project. When the timeline has been decided, youth should fill in the information requested on the first few pages of their project guide. When youth have completed the Project, have the youth, a parent, and the club leader sign the **"End of Project"** signature page to verify that each goal was fulfilled.

Awards and Recognition

As youth accomplish their goals for the project, it is important to acknowledge their accomplishments in some way. On the last page of this Leader's Guide is a "Certificate of Completion" for the Fins and Scales Project.

A. What Is a Fish?

Purpose: This section introduces fish and some of their adaptations.

Suggested Approach: At a club meeting, introduce fish by finding out what youth already know about them. Sample question are below. (Most answers are in the "Background Information.")

- How would you describe a fish?
- What features do fish have that help them live in water?
- What are the two main types (or classes) of fish?
- How are these two classes alike yet different?
- What is an ichthyologist?

Youth can complete the section tables and questions as a group or at home. Later discuss their answers. Additional activities are suggested in *"Lets Dive Deeper"* and *"Think Like a Scientist!"*

Background Information: A fish, as most people think, is an animal that has fins and lives in the water. Fish can breathe, smell, hear, and move around but not as we do. There are many different kinds of fish and all have special adaptations that help them survive in water.

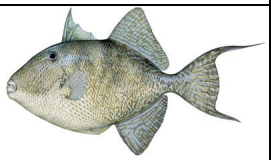
Most fish fall into one of two taxonomic classes. Bony fish are in the class of fish called **osteichthyes** (os-te-ich-thyes) and have a skeleton made of hard bone. Other fish, such as sharks, skates, and rays, have skeletons made of cartilage and are in the class **chondrichthyes** (kan-drik-the-ez). Cartilage is soft flexible connective tissue. We have cartilage in our nose and ears.

Both groups have jaws, gills, paired fins, scales (most!), and are considered cold-blooded. This project will focus only on the bony fish. There are about 23,000 different kinds of bony fish and they can live in fresh or saltwater, sometimes both! Some examples of bony fish include: bass, snapper, tarpon, catfish, herring, flounder, and swordfish.

Did you know? The field of science that studies fish is called ichthyology. A scientist that studies fish is called an ichthyologist.

Table 1 – Name That Fish!

In the Youth Guide, youth are asked to identify each fish below and where it lives. You can do this as a group or have them look-up the names on the web or in fish books on their own. Salt water = SW, Fresh water = FW *(SW images © Diane Rome Peebles; FW fish images by Duane Raver.)*

1. Redfish or Red Drum (SW) 	***2. Tarpon (SW)*** 
3. Triggerfish (SW) 	***4. Sheepshead (SW)*** 
5. Jack Crevalle (SW) 	***6. Seatrout (SW)*** 
7. Largemouth bass (FW) 	***8. Bluegill (FW)*** 

You can help youth process the activity by asking questions such as:

- What did they learn?
- What resources did they use to find the names? *Answers may vary.*
- What features do all these fish have in common*? Possible answers – all have fins, a mouth, gills to breathe with, some type of color, etc.*
- What are some differences in their appearance? *Answers may vary - body shapes vary, mouths are different looking, not all have the same kinds of fins, different color patterns, etc.*
- Why are there different types of fish? *Answers may vary but because there are different types of habitats and different needs for living there, fish over time develop adaptations or behaviors that help them better survive in that habitat.*
- Have youth seen any of these fish in real life? *Let them share their stories*.

You can help youth apply what they learned by asking questions such as:

- What is the purpose of an "adaptation"? Have youth look at the fish pictures in their project guide (or the Fins and Scales Kit) and give an example. *Adaptations are features or characteristics that allow an organism to survive and flourish in a particular habitat.*

- Why is it important to study fish? *Fish research is important for a number of reasons. Fish is a significant source of protein/food for other ocean animals as well as millions of people around the world. As fish populations decline and human populations grow, research is needed to helps us better understand how to manage this food source better.*

- Can youth name some fish that are important to humans as food? *Tuna, cod, salmon, anchovies, groupers, snappers, halibut, sardines*

Let's Dive Deeper!

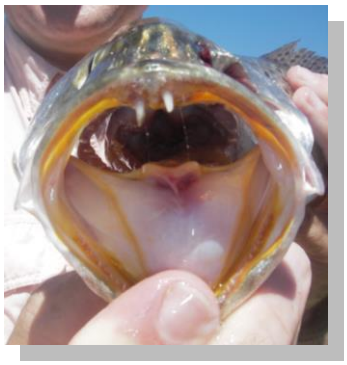
- Have the club make a list of all the names of fish they currently know. Then have youth pick a fish to research and then share what they learned about it.
- As a club, plan a field trip to a place where they can learn about fish.
- Contact local experts on fish and ask them to come in and give a talk to the club!

Think Like a Scientist!

Here are some examples of "investigations" youth can do!

- What kinds of fish make it to our dinner table? Are some types more popular than others? Are they all bony fish? Investigate the types of fish local seafood markets sell. Interview the customers (get permission first!) and find out what fish they like the most. Analyze your results and share them at a club meeting or county or state event.

- Do all bony fish have teeth? If not, then how do they hold or eat their food? Investigate the jaws of at least 6 different fish. Research how they use their jaws and/or teeth for getting/holding their food. Share your observations and what you learned with others.



B. How Do Fins Help a Fish?

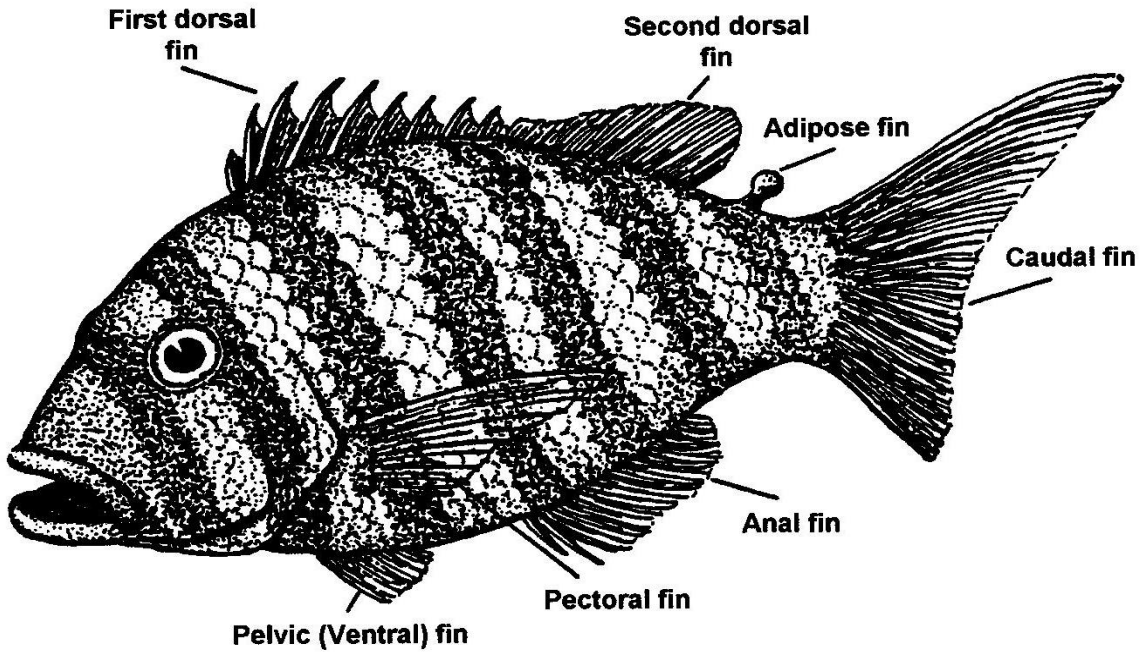
Purpose: This section helps youth learn the names and functions of the different fins fish have.

Suggested approach: As the project helper, you can help youth begin this section by asking the questions below. Youth can then complete this section at home. At the next club meeting be prepared to ask them about their progress and what they learned. It would be helpful to have a fish model or real fish to help them review the different fins.

Find out what youth already know about the fins of the fish.

- Why are fins important for a fish to have?
- Can youth describe what the purpose is of each of the fins on the fish below?
- Can they describe the function of each one?
- What do we call the study of a fish's body structures?

Background: Bony fishes have different kinds of fins for different purposes. Each fin plays an important role in the survival of the animal. The body structures of an animal, such as the fins of a fish, are part of the animal's **anatomy**. The anatomy of a fish can give us lots of "clues" about how it lives!



Dorsal Fin

Background: This is a single (not paired) fin located on the fish's back. Some fish have only one dorsal fin while others have two or even three. In many bony fishes the dorsal fin has stiff spines in the front to help give the fin support. The dorsal fin helps the fish in swimming as well as in protecting itself. The fish can protect itself against predators by raising its dorsal fin. This makes it difficult for other animals to eat the fish, especially if the dorsal fin(s) is supported by spines! The triggerfish and filefish are good examples of fish that have well developed dorsal spines which help to protect them from predators. The dorsal fin also acts as a stabilizer and helps to keep the fish upright.

Suggested approach:

1. Find out what youth know about the fins of fish by asking:
    - What is the function of the dorsal fin?
    - What is a spine and what is a ray?

2. As a group, compare the dorsal fins of the fish in Table 2. Below are possible answers to the questions found in the Youth Project Book.

3. As a group, discuss additional activities from "*Lets Dive Deeper*" and "*Think Like a Scientist*!"

Table 2 - Compare the Dorsal Fins of Fish

Q. Look at the fish in the table on the next page. How are the dorsal fins different in each fish?

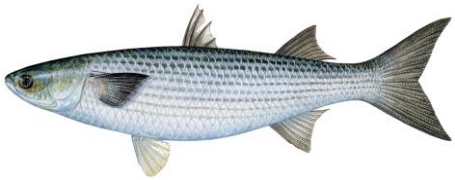
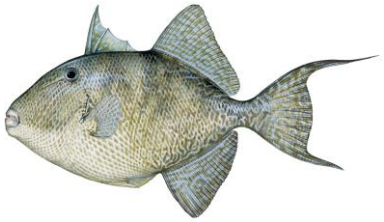
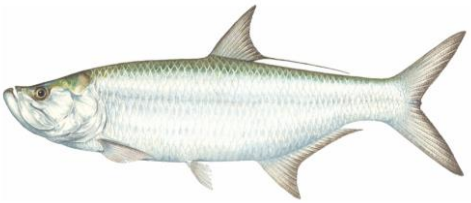
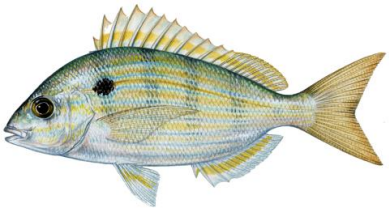
A. *The number, sizes, and lengths of the dorsal fins are different. The tarpon and pinfish have one dorsal fin but the pinfish's dorsal fin is much longer and almost goes to the tail. The mullet has two dorsal fins that are similar in size but one is placed further back toward the tail. The triggerfish has two dorsal fins that are quite different in shape and size.*

Q. Why do fish have different types of fins?

A. *Depending on where and how a fish lives, the shape and type of dorsal fin may help the fish survive better. Dorsal fins act as stabilizers, but whether one or two or one long one is better in doing this, well, perhaps youth can research this!*

Q. The pinfish has spines in its dorsal fin. How do you think these spines help the fish?

A. *Spines are stiff supporting structures in fins. The spines can help protect the fish from predators because they are quite sharp.*

A. mullet 	**C. triggerfish** 
B. tarpon 	**D. pinfish** 

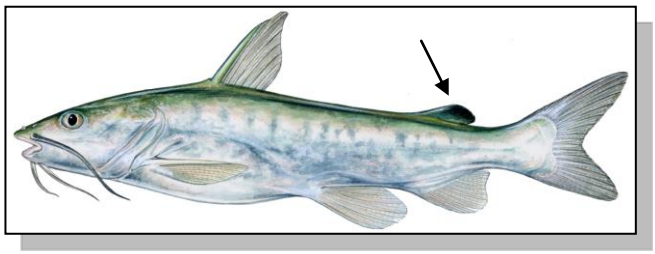
(Saltwater fish images © Diane Rome Peebles)

Adipose Fin

Q. What is the purpose of the adipose fin?

A. This fin lies behind the dorsal fin in some fish. It does not serve much of a purpose. It is probably just part of an ancient fin that was once found on the fish's ancestors.

Q. Label the adipose fin in the picture. What is the name of this fish? *A. catfish*



Let's Dive Deeper!

- How does the dorsal fin of a triggerfish help it from being eaten? Youth can conduct research using resources in the back of their project guide to find the answer. Afterwards, let them share what was learned with the group.
- Can youth identify a fish with an unusual dorsal fin and describe how the fin is used.

Think Like a Scientist!

- Have a couple youth research the adipose fin and find out more about its origin. Make a list of fish that have an adipose fin. Let youth share what they learned with the group.

Tail Fin

Suggested approach: Find out what youth know about the tail or caudal fin of a fish. Some possible questions are:

- What is the purpose of a tail fin?
- Why do fish have different types of tails?
- What can the shape of a fish tail tell us about the fish?

Background Information: The tail fin is also called the caudal (kaw-del) fin. Without a caudal fin, a fish such as the tuna would not be able to swim at great speeds over long distances. Why? It helps propel the fish through the water. Not all fish tails are designed to do the same thing. The blunt tail of a grouper helps it move swiftly from one hole in a reef to another. There are several types of caudal fins and each helps the fish to swim a certain way. By looking at the shape of the caudal fin, scientists can often determine where that fish lives and how it swims.

Have youth look at the two fish below. Based on the shape of their tails, ask youth to describe where each fish might live and then explain their reasons. (*Fish images © Diane Rome Peebles)*

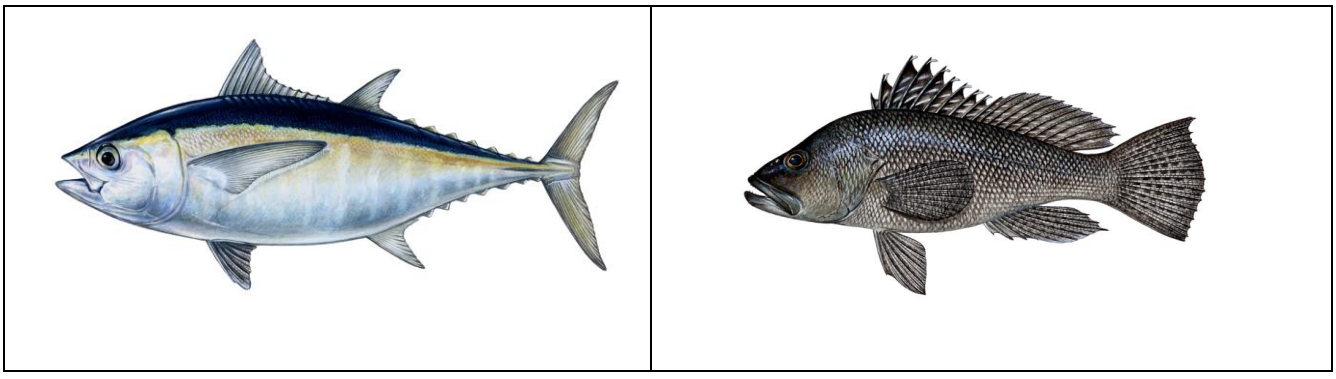


Table 3 - How Does Tail Shape Help a Fish?

Suggested approach: Youth should fill in the table on the following pages in their project book. They can use the resources listed in the back of their project book. Afterwards, go over possible answers with them so they can check their answers in the table. Can they describe how the shape of the fin affects the way the fish swims? Can they give examples of different fish that have these types of tails? To help visualize the tails, have youth make drawings of each one or find pictures of fish to use in the group discussions on tail shape. Information is provided in the vocabulary list in the back of the Leader's Guide. *(Fish images © Diane Rome Peebles.)*

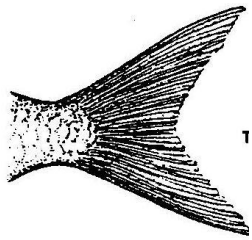
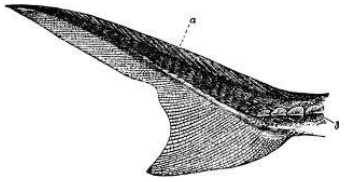
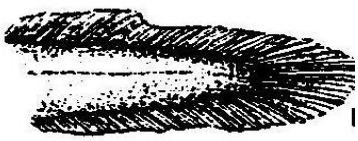
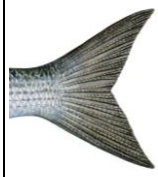
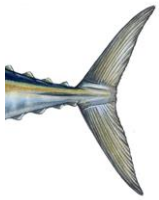
Tail Shape Drawing	How does this shape affect the way the fish swims?	Name a fish that has this type of caudal fin.
Homocercal tail 	*Example: The upper and lower parts of the fin are symmetrical (the same). This helps the fish swim at moderate speeds over long distances. This type of tail includes forked and lunate tails.*	*A. This would include many fish. Snappers, grunts, bass, perch, tuna, billfish, and more!*
Heterocercal tail 	*A. The upper and lower parts of the tail are NOT symmetrical (not the same). This type of tail helps propel the fish forward and provides some upward lift.*	*A. most sharks, sturgeons, and paddlefish*
Protocercal 	*A. The tail helps a fish swim between rocks and crevices.*	*A. Eels, some catfish, certain blennies, and more. Answers may vary!*

Table 3 - How Does Tail Shape Help a Fish? (continued)

Tail Shape Drawing	How does this shape affect the way the fish swims?	Name a fish that has this type of caudal fin.
Rounded tail 	*A. This tail has a rounded edge. It allows for good acceleration and maneuvering but creates drag and will allow a fish to tire more easily.*	*A. bowfin, toadfish, black sea bass, some groupers. Answers may vary!*
Truncated tail 	*A. This tail has a flattened edge and is good for maneuverability and making shorts bursts of speed.*	*A. Groupers, some snappers, doctorfish, scorpionfish, and others! Answers may vary.*
Forked tail 	*A. This type of tail has longer top and bottom extensions than the center. This tail helps a fish accelerate quickly but provides less maneuverability.*	*A, barracuda, pinfish, tarpon, sheepshead, and many others! Answers may vary.*
Lunate tail 	*A. This type of tail is curved or shaped like a crescent. Not as good for maneuvering but great for fast speed over very long distances.*	*A. tuna, jack, mackerel, swordfish, some sharks, and others. Answers may vary.*

Let's Dive Deeper! - In the project book, youth were asked to select a fish and describe how its tail helped the fish survive in its habitat. *Let youth share their choices and explanations*.

Think Like a Scientist! - What types of fish swim the fastest? Find out and make a list of their names. What tail shape do most have in common?

Suggested Approach: Allow youth to complete the anal, pectoral, and pelvic fins sections of their Project Book. Possible answers are below and may be discussed as a group.

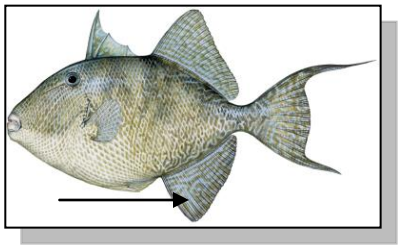
Anal Fin

The anal fin is a single, unpaired fin. This fin may not be present in some fish while on others it may be very long. The anal fin is on a fish's underside and usually right behind the anus.

Q. What is the role of the anal fin? *A. The anal fin helps stabilize the fish while it's swimming.*

Q. How do triggerfish use their anal fin? *A. In some fish, such as the triggerfish, the anal fin is also used for forward movement. This is necessary because the triggerfish has a rather rigid body and the wave-like motion of the anal fin helps propel it through the water*.

(Triggerfish image © Diane Rome Peebles)



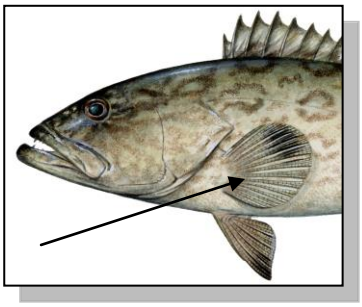
Q. What is a gonopodium and what is it used for? *A. In some live-bearing fish (fish whose young are born alive and not hatched from an egg) the anal fin of the male is modified into a* ***gonopodium****. The gonopodium is used in transferring sperm from the male fish into the female fish. Youth can use their resources to find a fish that has a gonopodium. (Check out youtube.com!)*

Q. Name a fish that has a gonopodium. *A. Liverbearers include guppies, mollies, swordtails*

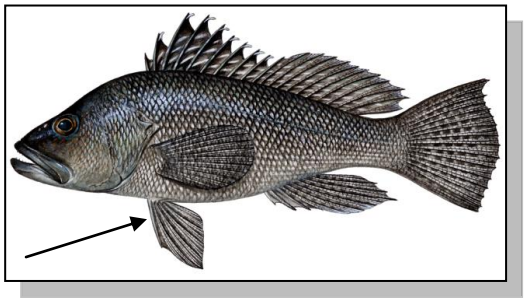
Pectoral Fin

Pectoral fins are paired fins. They are usually located on the side of the body near the fish's head.

Q. Describe how a fish uses its pectoral fins. *A. These fins are used for turning and moving forward or holding its position in the water. Most fish move the pectoral fins back and forth. If you watch a fish in an aquarium, notice that the pectoral fins move back and forth in order to keep the fish in one place. Pectoral fins may also be used for steering a fish while swimming.* *(Grouper image © Diane Rome Peebles)*



Pelvic Fin



There are two pelvic fins, a right one and a left one. On some fish the pelvic fins may be way up front and very close to the fish's throat while on other fish they may be further back and very close to the anal fin.

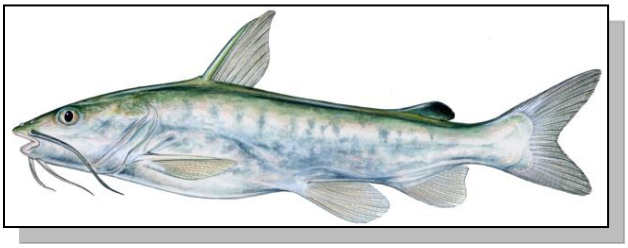
(Black seabass image © Diane Rome Peebles)

Youth should use their resources to find the answers to the following questions.

Q. What are pelvic fins used for? *A. The pelvic fins are also used in stabilization and for stopping. They also help the fish move forward. Some fish, such as clingfishes, have pelvic fins resembling suction cups that help them "cling" to rocks.*

Q. Name a fish that has its pelvic fins directly under its pectoral fins? *A. Answers will vary! Example - black sea bass (see image above)*

Q. Name a fish that has its pelvic fins further back on its body? *(Catfish image © Diane Rome Peebles)*
A. Answers will vary. Example – catfish

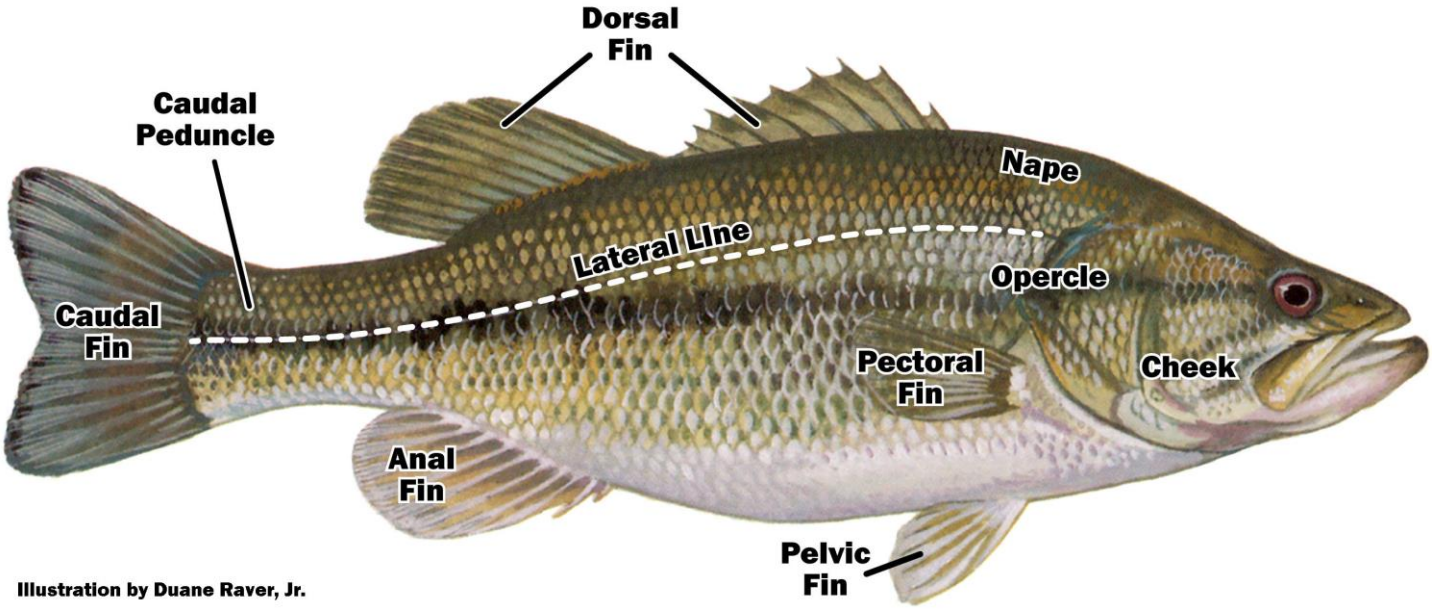


Let's Dive Deeper! - Some fish use their pelvic fins for clinging to rocks, like "clingfish." Ask some youth to find out more about these fish and how they live! Then let them share what they learned with the club.

Think Like a Scientist! - Do fish that live in the same underwater habitat (like a coral reef) have similar looking fins? Why or why not? How would you investigate this?

Let's Review!

In the Youth Project Book is the following image. Youth are asked to label the fins of the fish then explain and/or demonstrate to others how each fin helps the fish. Leaders should initial these tasks in the youth's project book. *(Note: Some additional parts are labeled below that have not been discussed. Perhaps have youth find out more about these features.)*



C. How Does Body Shape Help a Fish?

Purpose: Youth will investigate the role body shape has in helping a fish survive in the ocean.

Suggested approach: Youth can complete this section as a group or at home. However, to introduce it, find out what youth know about the shapes of fish. Here are some possible questions.

- Why do fish have different shapes?
- How would they describe the different shapes?
- Can they give examples?

To further introduce the role body shape has in a fish's survival, do the activity described below. Don't forget to mention other possible activities in "Let's Dive Deeper!"

ACTIVITY: 3-D Fish Shapes

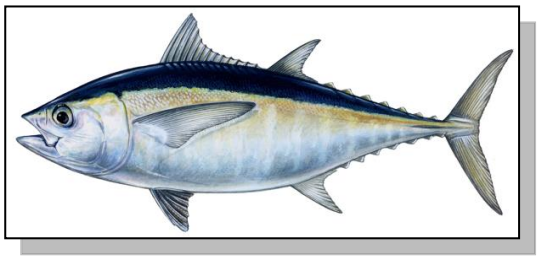
Goal: To design fish of different shapes and describe how these shapes help the fish survive.
Content Objective: To demonstrate the importance of body shape in a fish's ability to survive.
Science Skills: communicate, compare/contrast, observe, design
Life skills: critical thinking, working cooperatively
Materials needed: a variety of items with shapes that fish might have (or not have!) such as soup cans, paper rolls, paper plates, etc.; scissors, paper, markers, tape.
Time: 15-20 minutes

Do: Youth will construct models of fish from the items provided. First, let them draw/design the different fins on cardstock paper, cut them out, and then tape them on the fish's "body." When all have created a fish, try to organize the fish shapes into similar groups. Have each group come up with ideas on how the shape might help the fish survive.

Reflect: Some questions to ask can include

- How did you create your fish? How would you describe its shape?
- Are the shapes of all the fish models the same? What are some differences?
- Which shapes might help a fish to swim faster?
- Which shapes could help the fish hide in cracks or under things?
- How can the shape of a fish indicate where it lives?

If appropriate, leaders can go through the following questions in the project book with youth.



Q. Looking at the fish to the right, how would youth describe its body shape? *A. It can be called a torpedo or streamlined shape.*

Q. Where in the ocean does this fish live? *A. A tuna lives in open water and must constantly swim.*
(Tuna fish image © Diane Rome Peebles)

Q. Based on its shape, how do you think it would obtain its food? *A. Based on its shape it can probably move pretty fast and be a good predator.*

Q. What is another name for this "torpedo" shape? *A. This body shape is called "**fusiform."***

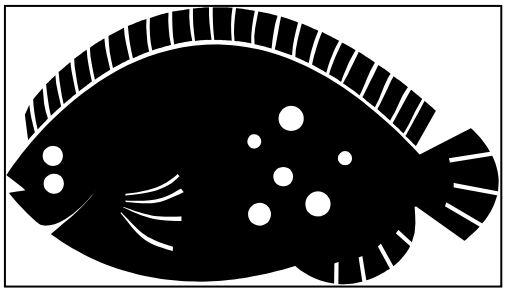
Q. List two other fish that have a similar body shape. *A. Billfish, jacks, barracudas, and others that live in open water.*

Q. The fish in the picture to the right is called a batfish. It has a flat or wide belly. Where do you think it lives? *A. If a fish has a flat or wide belly, it may feed and live near or on the bottom.*

Q. How does its body shape help it survive? *A. The batfish lays on top of the soft sand or mud and uses it large fins to "walk" across the bottom in search for food. Its shape is called "**depressiform."***

Q. Look at the fish to the right. How would you describe the shape of its body*? A. Like a dish laying on its side. It is called a lookdown! Its body shape is called **"compressiform."***

Q. Where do you think it lives? *A. If a fish swims like a dish on its side in the water, it may feed just above the bottom and/or below the surface.*



Q. A flounder lies on the bottom of the ocean. How would you describe its body shape? *A. A flounder is flat like a pancake! Their body shape is called "**depressiform."***

Let's Review!

Q. What kind of body shape would a fish most likely have if it lived under a rock? Why?

A. A fish that lived under a rock would probably have a flattened body so it could fit in a flat space. A toadfish is an example. However, some fish can burrow under rocks and make the hole conform to their body shape. Blennies and gobies may do this.

Q. What kind of body shape would a fish have if it lived out in the open ocean? Why?

A. It would have a streamline shape so it could move fast and reduce drag on its body.

Let's Dive Deeper!

- Have youth collect and bring in pictures of different fish. Have them sort them according to their body shapes: fusiform (torpedo shape), depressiform (flattened), and compressiform (like a dish on its side).

- Do some fish undergo a change in their body shape as they grow up? Can you find examples?

D. How Does Body Color Help a Fish?

Purpose: To help youth describe how color and patterns play a role in a fish's survival.
Suggested Approach: Youth may complete this section as a group or individually at home. To introduce the importance of colors and patterns in a fish's survival, do following activity with them.

ACTIVITY: Hidden Fish

Goal: Youth will be able to describe how a fish's color helps it survive.
Content Objective: To demonstrate the importance of color in a fish's ability to survive predation.
Science Skills: communicate, compare/contrast, observe, draw and design
Life skills: critical thinking, working cooperatively
Materials needed: fabric pieces with different patterns and colors, sheets of paper, markers, scissors
Note: *The Fins and Scales Kit already has fabric and fish shapes that can be used as templates. If a kit is NOT available, have youth bring in fabric pieces, wrapping paper, or other flat materials that have a background pattern. You can use white paper plates as fish!*
Time: 15-20 minutes

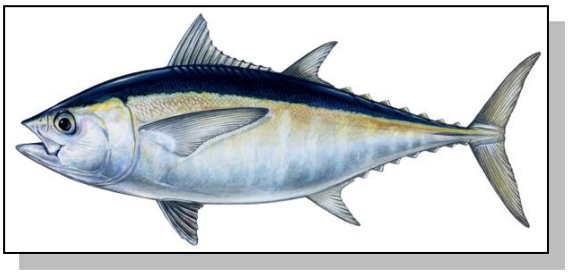
Do: Give each youth, or pair of youth, a fabric square, white paper, some markers, and a pair of scissors. Have them draw a fish, cut it out, and then color it so that it blends in with their pattern. Have each youth place the "fish" on their fabric piece and talk about what they see. Then have each youth move their fish to different patterns (backgrounds) and make observations.

Reflect:

- Did your fish blend in?
- Why is "blending in" important? *A. Blending in is a form of camouflage. It helps the fish hide from possible predators but can also help them hide them from their prey too!*
- What happened when you moved the fish to different backgrounds? How does this affect its survival? *A. The fish stands out. It has a greater chance of being seen or eaten.*
- What did youth learn about fish patterns/colors?

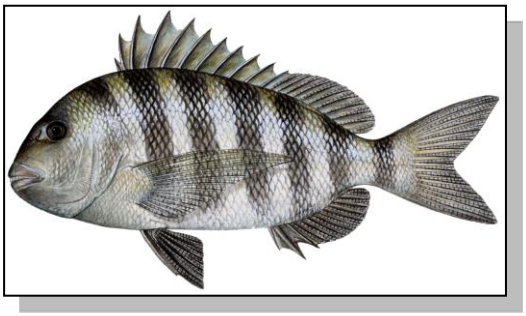
Apply: What other types of patterns can fish have that might help them blend in or hide from predators? *A. Answers could be countershading, disruptive coloration, mottling, and false eyespots.*

To Leader: The following questions are in the Youth Project Book. Possible answers are provided.



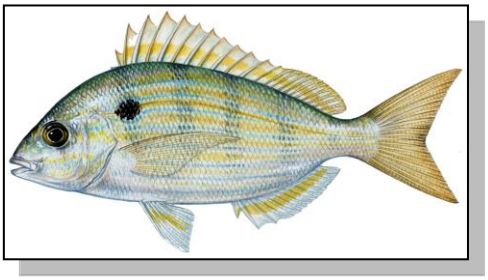
Q. How does countershading help a fish? *A. Many fish that live in open waters of the coast or ocean have* ***countershading****. Countershading helps a fish blend in with the background of open water. From the surface, the back of the tuna is dark, so it blends in with the dark blue of deeper water. From below, the light underside will help it to blend in with the light or brightness of the sky*.
(Tuna fish image © Diane Rome Peebles.)

Q. Can youth name another fish that shows countershading? *A. Possible answers are barracudas, dolphin fish, billfish, wahoo, and even mullet! You can use images in the* ***Fins and Scales Kit****!*



Some fish have **disruptive coloration** to confuse predators. This is any color pattern that helps break up a fish's body outline. For example, some fish have **vertical** or **horizontal** stripes on their body. Stripes can help a fish hide or blend in with vegetation or other vertical structures. It can also help to break up the outline of a fish's body. This can confuse predators. The saltwater fish called a sheepshead (on right) has this type of coloration. *(Sheepshead image © Diane Rome Peebles.)*

Q. Name some other fish with a disruptive coloration pattern. *A. Other examples are coral reef butterfly fish, black drum, spadefish, and more!*



Some fish have false "**eye spots**" on parts of their bodies. These "false eyes" often fool predators into attacking the wrong part of the fish giving the potential victim a chance to escape. The pinfish has a "false eye." *(Pinfish image © Diane Rome Peebles.)*

Q. Name another fish with a "false eye" somewhere on its body**.**
A. Some examples might be redfish, butterfly fish, and others.

Camouflage is a type of coloration that helps the animal blend into its surroundings. **Mottled** coloring (a type of camouflage) helps the fish blend into the rocks or the bottom.

Q. What is the name of the fish in the photo?
Based on its coloring, where do you think it lives? *A. Smooth puffer. It lives around oysters, rocky areas, and muddy bottoms.*

Q. Name another fish with this type of coloration and describe where it lives. *A. Some examples might be – flounders/muddy bottom, groupers/reef, largemouth bass/vegetation*

Let's Review!

Using what they now know about body shapes and coloration, have youth share a story about a fish they have caught or seen somewhere. What did it look like? How did its color help it survive?

Let's Dive Deeper!

Have youth work together and collect pictures of fish from magazines. Sort them according to color. Make a collage. Discuss how the fish's color might help the fish survive.

Are there other types of coloration patterns that fish can have? If so, how do they help the fish?

Think Like a Scientist!

Do fish have the same color pattern throughout their life? Or do they change their coloring as they get older? How would youth investigate this? Can they find examples?

E. Why Do Fish Have Different Mouths?

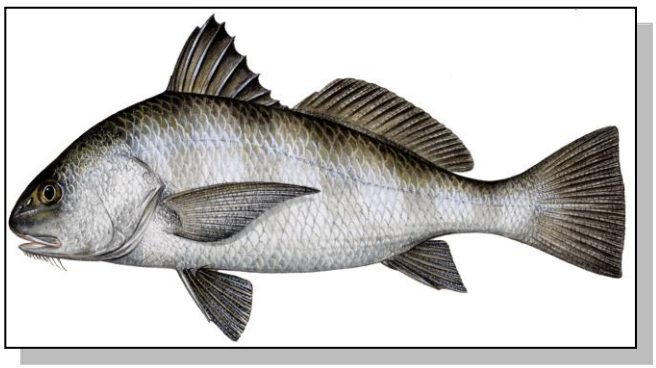
Purpose: This section provides opportunities for youth to investigate the different types of mouths fish have and how they are used for getting food.

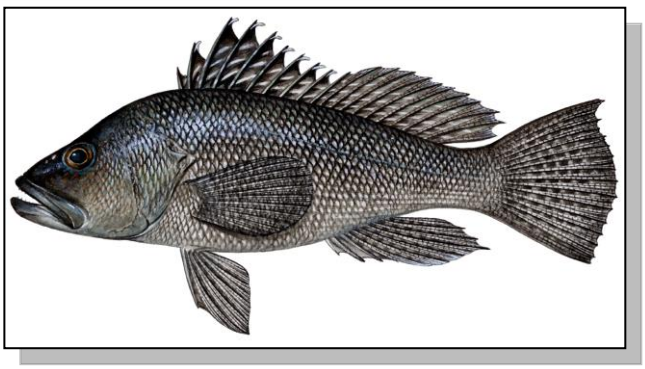
Background: The type of mouth a fish has can give you a clue as to what and where it eats in the water. A fish with a very **large mouth** surrounds its food and often swallows it whole. A fish with a **small mouth** may eat small bits of food or prey. Fish with a **sucker-shaped mouth** (or mouth on underside) feed near the bottom and search the sediment for food. Fish with long **duckbill-like jaws** (pickerel or gar) will use their jaws to grasp the prey before swallowing it. Fish with jaws that angle **upward** (like snook and tarpon) feed more on prey near the surface.

Suggested Approach: Ask youth to look at the fish below (in their Project Book):

- Does any fish mouth look like it could swallow prey whole?
- Is one shaped for feeding off the bottom?
- Which one(s) might feed on prey near the surface? *(Barracuda, black drum, and black seabass images © Diane Rome Peebles.)*

You can follow-up this introduction by doing the **"Feeding Frenzy**" activity with youth. After doing the activity youth can complete the rest of this section at home. Later, when all youth are together again, let them share what they learned about fish mouths as a group!





ACTIVITY: A Feeding Frenzy!

Goal: Youth will simulate the feeding behaviors of fish.

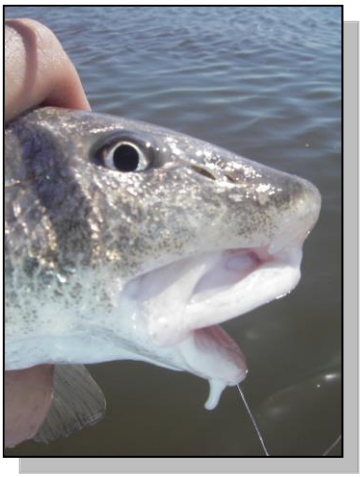
Content Objective: To observe the effectiveness of different kinds of fish "mouths" for getting food.

Science Skills: Problem solve, collaborate, predict, hypothesize, analyze

Life skills: critical thinking, teamwork

Materials needed: Mouth "tools" - Tweezers, basters, spoons, scissiors, straws, etc. Food items - bags of beans, rice, macaroni, nuts, or other small "food" items. Cups to hold the different "food"; a scale for measuring the weight of the food collected; and a stopwatch or timer. Flip chart paper might be helpful.

Time: 15-20 minutes



DO: In this activity youth will investigate how effective different types of "mouths" are at getting food. Let youth come up with ideas for each type of mouth. For example, tweezers can be used for duckbilled fish and a food baster for sucker-like mouth. Use macaroni, rice, nuts or other items as food. Small cups can be used to hold the different types of food. Let youth predict which type of mouth is more efficient at picking up food. Set a "feeding time" of around 30 seconds. When time is called, each youth should weigh the food they collected and record the weight. Then have them sort the food into categories and weigh each category. Record these weights. On flip chart paper write amount of each food "eaten" or collected in the cup by each type of mouth. (If a scale is not available, count the number of pieces for each category.)

REFLECT

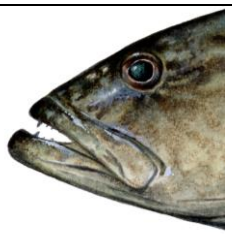
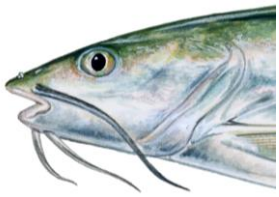
- What happened?
- What mouths were most effective in collecting food? Why?
- Were some mouths better at getting a certain kind of food?

APPLY

- What would happen if all of one kind of food/prey disappeared?
- How would that affect fish populations?

Table 4: Fish Mouths

Below is a table found in the Youth Project Book. The images on the left are examples of fish with certain mouth shapes. Youth should investigate what each fish might eat based on its mouth shape. Have them find other examples of fish with the same kind of mouth using the resources in back of their Project Book. *(Images used with permission © Diane Rome Peebles and Duane Raver)*

	Q. The fish on the left is a grouper. It has a large mouth. What do you think it eats? *A. Other fish most likely!*	Q. Give another example of a fish with a large mouth. What do you think it eats? *A. Examples: largemouth bass and sea trout. They would eat prey whole such as fish or shrimp.*
	Q. The fish on the left is a pinfish. It has a small mouth. What do you think it eats? *A. Most likely small shrimp or crabs*.	Q. Give another example of a fish with a small mouth. What do you think it eats? *A. Examples - Seahorse, pipefish, filefish. Most would eat small crustaceans.*
	Q. The fish on the left is a catfish. It has a sucker-like mouth that is turned downward. What do you think it eats? What are those whiskers for? *A. They are scavengers on the bottom and will eat a variety of animals, living or dead.*	Q. Give another example of a fish with a sucker-like mouth. What do you think it eats? *A. Example - Bonefish will search for small shelled animals in the sand like crabs, shrimps, or snails.*
	Q. The fish on the left is a gar. It has duckbill-like jaws. What do you think it eats? *A. It eats other fish.*	Q. Give another example of a fish with duckbill-like jaws. What do you think it eats? *A. Example - needlefish, northern pike They will eat other fish.*
	Q**.** The fish on the left is a tarpon. It has a large mouth that is turned upward. What do you think it eats? *A. It probably eats near the surface. It eats mostly live fish.*	Q. Give another example of a fish with a large mouth that is turned upward. What do you think it eats? *A. Example - A snook has a large upturned mouth. It probably eats food whole, such as shrimp and other fish.*

Let's Dive Deeper!

Youth can select a fish to research how it eats based on the type of mouth it has. Let then share what they learned with the group.

Let's Review!

The image below is in the Youth Project Book. Youth should be able to answer the following questions based on what they learned in the previous sections.

Q. Look at the fish below. What kind of swimmer is it?

A. It is a moderately fast fish that is often on the move.

Q. What kind of body shape does it have?

A. Since it is on the go a lot, it has a streamlined shape that is called fusiform.

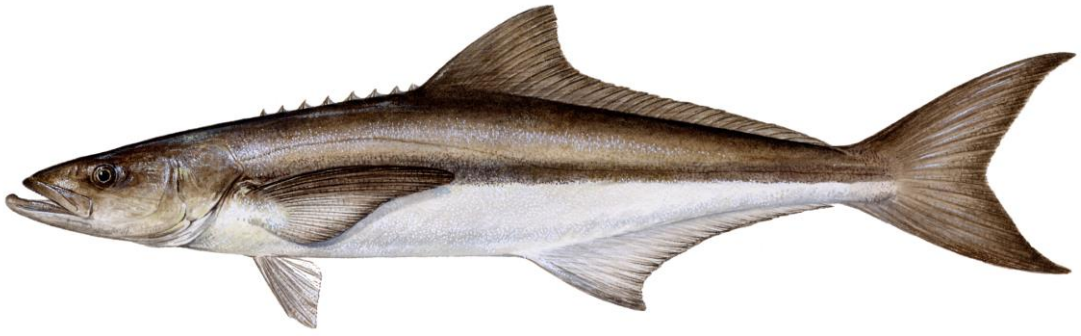
Q. Where in the water column does the fish most likely feed? What do you think it eats?

A. It has a large mouth that is turned slightly upward so it can feeds on fish near the surface.

Q. What kind of coloration does it have? How does this coloration protect or help the fish?

A. The fish is darker on top and lighter below. This color pattern is called countershading. This helps the fish to be less visible to predators. This coloration can also make it less visible to prey!

Cobia image © Diane Rome Peebles



ACTIVITY: Imagine-a-Fish

Goal: Youth will create an imaginary fish that is adapted for living in a selected environment**.**

Content Objective: To demonstrate how fish are adapted for living in different environments.

Science Skills: Collaborate, draw/design, problem solve, communicate

Life Skills: Teamwork, critical thinking, problem solve

Materials needed: Flipchart paper, colored markers, space for drawing

Time: 30 minutes (15 min. to create a fish, 15 min. to share depending on the number of youth.)

DO: This activity applies what youth have learned about a fish's fins, body shapes, coloration, and types of mouths to a new situation through their own creation of an imaginary fish. Their drawings should illustrate the following: (1) how the fish protects itself from predators, (2) how it gets its food/ what it eats, and (3) how it swims or moves in the water.

Let them choose what habitat their fish "fits" in. The fish can live in:

- a colorful coral reef
- a seaweed or seagrass bed
- in the open ocean
- or under oysters and/or rocks
- or under mud or sand
- or have them make up a habitat!

Youth can work individually or in pairs. Let them share their creations as a group when they are done! If possible, take photos and have youth place their photos in their project book.

REFLECT

- What kind of fish did youth draw? Why did they choose that fish?
- What did they learn about fish?

APPLY:

- What would happen if any of the fish created by youth were placed in another fish's habitat?
- Would they survive? Why or why not?

Let's Review! ACTIVITY: Observing a Real Fish!

Goal: Youth will observe and describe the adaptations found on a real fish.
Content Objective: Youth will be able to describe a fish by "reading" it!
Science Skills: Observe, collect data, compare and contrast, infer, predict
Life skills: critical thinking, responsibility, problem solving
Materials needed: fish, aluminum tray, ice, probing device, paper towels
Time: 15-20 minutes

Suggested Approach: This review activity can be done individually at home or as a group. To best complete this part of the project, youth will need to obtain a real fish to observe. Youth can obtain a fish by going fishing, buying a fish at a seafood market (mullet, tilapia, grunts are ok). You can also arrange for the club to visit a local aquarium store or public aquarium where they can select a fish to observe. If youth are unable to find a real fish to use, they can go on the Internet and find a video to view. As a last resort, they may select a fish from a book to use. In the Youth Project Book, youth are asked questions about their fish. You can use the questions below to guide the activity if you do it as a group.

- What kind of fish did they get? What is its common name?
- How/where did they get their fish?
- Did they encounter any problems in getting it? How did they solve it?
- Let them talk about the types of fins their fish has/have.
- What kind of body shapes are represented among the fish?
- How are the fish colored? How does their color help them survive?

Reflect: If they did the activity at home, let them share their experiences by spending some time talking about what they did and learned about their fish's fins, body shape, mouth, and color.

Apply: Based on what they learned about their fish, can they make a "prediction" as to where in the water their fish lives? Have them check their answers by looking up the fish on the Internet or in books.

Youth are asked to draw or take a photo of their fish and paste it in their Project Guide. Let them share their pictures. NOTE: IF THEY PLAN TO DO SECTIONS F AND G, THEY SHOULD KEEP THEIR FISH OR AT LEAST REMOVE A FEW SCALES FROM THE FISH TO USE.

F. Why Do Fish Have Scales?

Purpose: This section introduces the different types of scales bony fish can have and why they are important. Youth will need to use their own fish or at least scales from some other fish.

Background: Most fish have scales. Scales are used for protection, much like our fingernails. Rather than protecting just a little part of a fish's body, scales help protect a fish's skin from being cut by sharp objects. Scales also have color pigments which give the fish its coloration. Fish scales are covered with a protective layer of slime. This slime helps to protect the fish from diseases and parasites. *(Photograph credit: joysaphine.)*

Some fish such as catfish have no scales and are said to be "naked." Other fish such as trout and freshwater eels have scales that are very small. The scales are so small on these fish that many people think that they are naked like the catfish. Some fish have very large scales. A tarpon fish, which can grow up to five feet or so, has scales that can be three inches around!

Suggested Approach: It may be easiest to do this section as a group. Find out what youth know about fish scales**.** Possible questions are:

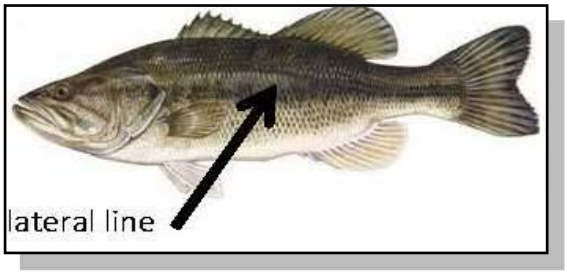
- What are scales? How do they help a fish survive in water?
- Do all fish have scales? If not, how do they protect their skin?
- Besides protecting the skin of the fish, are there other things that scales are good for?

Afterwards, ask them the following questions about <u>their</u> fish.

Q. Does your fish have scales? *A. Most will have scales but scale size will vary.*

Q. Are all the scales the same size? *A. Even on same fish, size will vary.*

Q. Where do the scales seem the largest? *Have youth check head and gill areas, versus near tail!*

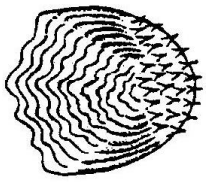
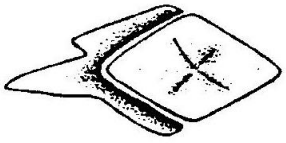


There are special scales along the side of the fish that make up the lateral line. This line contains sensory receptors which enable the fish to detect wave vibrations in the water. Ask youth to find the lateral line and pull off a scale or two. Pull off another scale somewhere else on the fish and compare the two.

Q: Is there anything different about the lateral line scale? If so, describe what you see. *A. Youth should see a small hole or pore in scale*.

Table 5 - What Are the Different Types of Fish Scales?

Different fish have different types of scales. Bony fish can have one of three different kinds of scales. If possible, youth should remove a scale from their fish. Using a magnifier, youth should determine what kind of scale their fish has and circle the name in the table provided.

1. A ctenoid (teen-oid) scale has small sharp spines on one end	 CTENOID Perch Scale
2. A cycloid (syk-loid) scale is a smooth scale.	 CYCLOID Carp Scale
3. A ganoid (gan-oid) scale is a thick plate like scale found on sturgeons and gars.	 GANOID Gar Scale

As a group, ask youth:

- Did all fish have the same type of scale?
- What type of scale was the most common?
- Make a list of what fish have what scales.

Note: If youth are using a fish in a book, or the Internet, or in an aquarium, they may need to conduct some research to determine the type of scale their fish has.

Let's Dive Deeper!

Have youth research the lateral line and what it is used for.

Think Like a Scientist

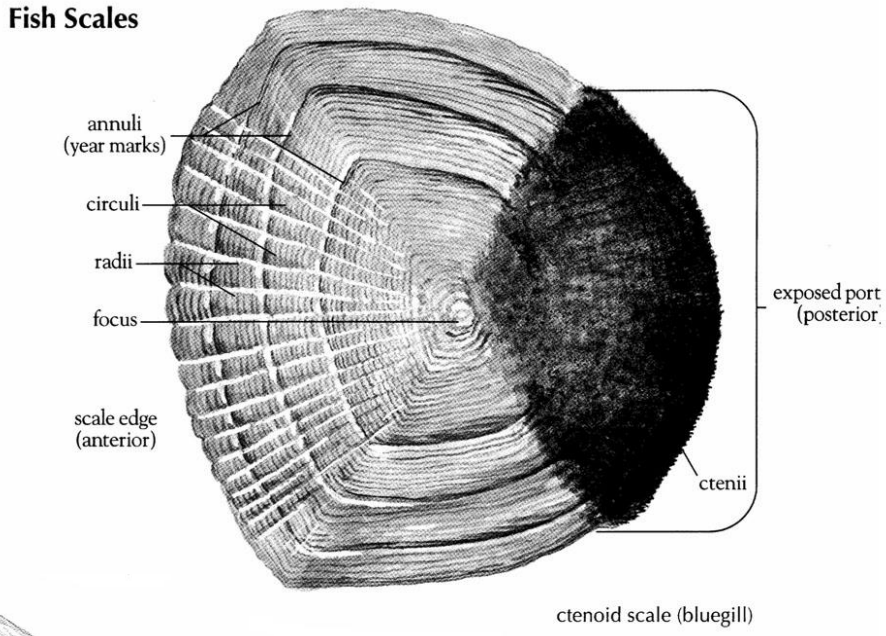
Are all the scales on a fish the same size and/or shape? How can youth determine this?

G. How Can We Determine a Fish's Age?

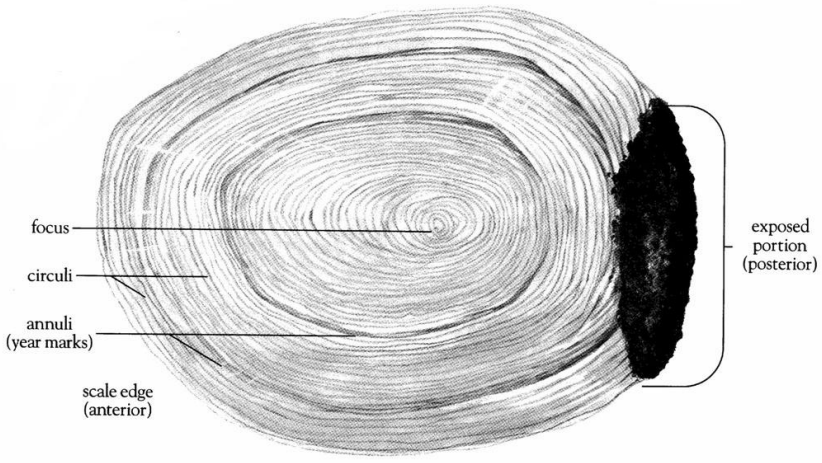
Parts of a Scale

Background: When a fish hatches, it has small scales covering its body. The center (focus) of an older fish's scale represents that scale when the fish was newly hatched. As the fish grows the scales get larger. Rather than growing smooth like our fingernails, scales produce small circular growth rings around themselves. These growth rings are called **circuli.** A fish grows faster in the summer and slower in the winter. Circuli formed during the summer are widely spaced. Circuli formed in the winter, however, are spaced very close together. A dark ring is formed where the circuli are spaced close together. The darker ring of circuli is called the **annulus**. The age of a fish can be determined by counting the number of annuli on its scales. *(Images courtesy of Duane Raver and North Carolina Fish and Wildlife.)*

Did you know?
The study of growth rings in aquatic organisms is called sclerochronology. It is an actual field of study in science!



ctenoid scale (bluegill)



cycloid scale (rainbow trout)

ACTIVITY: Determining the Age of a Fish

Goal: Youth will learn how to age a fish by using its scales.

Content Objective: Youth will use the scales of their fish (or another fish) to determine how old it is.

Science Skills: Plan investigation, evaluate, interpret/analyze, observe, infer

Life Skills: critical thinking, problem solving

Time: 10-15 minutes

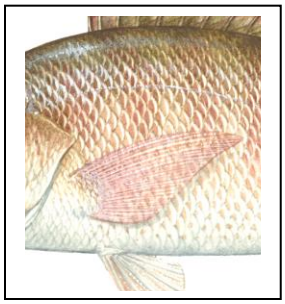
Materials:

- If making a glass slide mount you will need: forceps, microscope slides, and silicon glue.
- If making a laminated scale mount, you will need: Pocket size laminating film, laminating machine. (County Extension offices may have a laminator.)
- You will also need a microscope or good glass magnifier.

NOTE: The **Fins and Scales Kit** has laminated scales that can be used for this activity.

DO: To determine the age of a fish, youth must pull some scales off its body. Two or three scales may be pulled from a live fish without hurting it. *(If a fish has very small scales or lacks scales, go ask a seafood market for scales from a large fish such as a snapper or salmon. Note: The two fish have different types of scales!)*

The best place to take scales, for age determination, is from under the fish's pectoral fin. The pectoral fin has a tendency to protect the scales and keep them from being lost. If a scale is lost, a new one will begin to grow back. If you count the annuli of a replacement scale you will find that it has fewer annuli than an original scale. By taking scales from under the pectoral fin you have a better chance of getting original scales. *(Image credit © Diane Rome Peebles.)*



Step 1 - To ensure an accurate count of annuli, take at least three scales using the forceps. Take one scale from under the left pectoral fin, a second one from under the right pectoral fin and a third from someplace else, such as the fish's back. If all three scales have the same number of annuli, you can be pretty sure that you have original scales.

Step 2 – To make a glass slide: Place one small drop of silicon glue at each of the four corners of a clean microscope slide. Place one, two or all three scales in the center of the slide, if there is room. Allow room for the glue to spread when the second slide is placed on top. When the second slide is placed on the first, press both firmly together. If the scales are large, three individual slide preparations will have to be made. Place a weight, like a book, on top of the slides and allow at least one hour for glue to dry. **If you are using laminating film to make a slide mount**, clean and dry the scales first, then place them between the plastic sheets. Make sure the laminator machine is at the appropriate setting before running the film through.

Step 3 – Youth should observe the scales under a microscope or with a strong magnifier and make a sketch of each scale in their project book. They should label the general features of the scales: focus, annuli, and circuli. If they are ctenoid scales, indicate the cteni (small spines).

Step 4 – Youth are asked to determine the age of each scale by counting the number of annuli. There are squares in their project book to do this. Have them share what they found out!

REFLECT

Q. What can you conclude about the age of your fish? *A. Answers will vary!*

Q. Did youth have any problems aging the fish using its scale? *A. Answers will vary*

APPLY

Using the resources listed in the back and/or Internet resources, find the answer to this question. How could age determination of fishes be useful in fishery biology?

Let's review!

Q. What are the three types of scales bony fish can have? *A. Ctenoid, Cycloid, and Ganoid*

Q. How do scales help a fish? *A. Protects skill from abrasion or sharp objects.*

Q. Why are the "original" scales most likely to be under the pectoral fin? *A. The pectoral fin helps protect the scales in that area so they are less likely to be lost and replaced.*

OPTIONAL ACTIVITY: Using Earbones to Age Your Fish

Goal: Youth will learn how to age a fish by using its earbones or otoliths.

Content Objective: Youth will use the otolith of their fish (or from the Fins and Scales Kit) to determine its age.

Science Skills: Plan investigation, evaluate, interpret/analyze, observe, infer

Life Skills: critical thinking, problem solving

Time: 15 minutes

Materials needed:

- **Fins and Scales Kit** OR
- Whole fish for pairs or small groups of youth
- Cutting utensil (scalpel or filet knife)
- Gloves
- Forceps or tweezers
- Dissecting scope
- Heat source
- Vegetable oil

Background Information: Today, scientists often use the earbones, or otoliths, of fish to determine a fish's age. Otoliths are usually more accurate in ageing a fish than using its scales, but getting to the earbones inside a fish's head and preparing each one for observation takes more time and skill.

NOTE: This activity takes special skills and materials. **If you have access to a Fins and Scales Kit, fish otoliths are already provided and mounted for this activity.** Another option is to contact local Fish and Wildlife scientists and see if they can demonstrate this to your club. However, below are directions on how to remove the otolith and use it to age a fish**.** DO NOT LET YOUTH DO THIS UNSUPERVISED.

DO: Removing Otoliths

1. Securely grip the head of the fish with the body resting on a table and the tail pointing away from you.

2. Place the blade of the knife on top of the fish's head just a little behind the eyes. Slant the blade away from you.
3. Slice into the skull. You should feel the blade contact and slice through the bone of the skull. You will need to remove the top part of the skull to reveal the white brain tissue underneath.
4. Once the brain is visible, expose it more by pressing the two ends of the fish down until you hear a snapping sound where the skull breaks more. The otoliths should pop up and become more visible.
5. Remove the rear portion of the brain to allow better access to the two otoliths.
6. Use forceps to pull out both otoliths.
7. Clean them with water and your fingers and pat them dry.

Aging the Otolith

1. If the otolith is thin enough, it may be possible to age it as it is. Look for alternating light and dark zones (the annuli).
2. If the annuli are not visible, you will have to crack the otolith in half. Try to make the break as flat and straight as you can.
3. Hold the cracked half of the otolith vertically with a forceps and lightly burn it to make the annuli visible. Hold it in a flame until it turns a medium brown color (10-15 seconds) and then place on a counter to cool.
4. Once it is cooled, spread a drop of vegetable oil over it then place it under a magnifier of about 10x.
5. The annuli should be visible as thin dark lines. Count only the dark rings that you see that are the most prominent.
6. If you do not see these dark rings, try reburning the otolith.
7. Have at least three youth verify the age of a fish. Calculate the average.

REFLECT

- How did youth like this activity? How did it work for them?
- If they could age their fish, what did they find out?
- Which one had the "oldest" fish? Which one had the "youngest" fish?

APPLY Do all fish have the same type of otolith (shape, size, etc.)? Ask youth to come up with an investigation to find the answer to this question. Describe the steps they would take.

ACTIVITY: Fish Printing or *Gyotaku*

Although this activity may be done at any point in the Fins and Scales Project, it is placed here so that youth can do it as a way to review what they have learned about fish. It is also a good opportunity to connect art and science!

Goal: Youth will paint a fish and make a print of it on paper or a t-shirts! Youth will learn/review the parts of a fish through an art form.
Content Objective: To demonstrate the connection between art and science**.**
Science skills: Draw/Design, communicate/demonstrate
Life skills: Decision making, problem solving, and critical thinking
Time: If youth are working with rubber fish it will take around 15-30 minutes. If using real fish, it is best to estimate 30-45 minutes.

Materials:

- Paints*
- Newspaper
- Wax paper
- Paper towels
- Small paint brushes or foam rollers**
- Rubber fish
- T-shirts
- Poster paper

* Use **tempera** for paper, **acrylic** for fabric
** One inch brushes are fine.

If you plan to use any real fish, you will also need

- Fresh, whole fish with large scales
- Straight pins
- Modeling clay

Background: **Gyotaku** is an ancient art form where fish are painted and then paper or fabric are pressed over them to produce a shadow-like image of the fish. In the early 1800s, Japanese fisherman used the technique of gyotaku to record their catch. In the US, this technique has been used as an art form for many years. The name "gyotaku" actually means "fish rubbing.

Prior to doing the activity:

- Can they describe a fish and some of their adaptations? Using a real fish or simply a big picture, ask them to describe some adaptations - fins, type of mouth, body shape, etc.
- Go over what gyotaku is and what it means.
- How can science be a form of art and how can art be form of science?

DO: Activity Directions

1. Rinse fish under water and pat dry with paper towel. Try not to rub any scales off. (If using rubber fish make sure it is simply clean and dry before it is painted.)

2. Place the fish on newspaper. Use pins and modeling clay to spread out and hold the fins in place. This will make the fish print look more like a real fish “in action”! (Rubber fish already have their fins spread out so omit this step if you are using them.)

3. Brush or roll on just a thin coat of paint. Make sure the texture of the scales and fins are visible! Start at the head and work down to the tail. Don't paint over the eye. Brush again from tail to head to get the paint under the scales.

4. Once the fish is painted, carefully move the fish onto a clean sheet of newsprint. This will prevent any stray patches of paint from getting on the paper or t-shirt being printed on.

5. If using paper, carefully place the sheet **on top** of the fish. Press it firmly over the entire surface (but not too hard!). Gently rub your hands over the paper, making sure it has contacted the fins and outer edges of the fish. Don’t let the paper slide! Carefully remove the paper.

6. If using a T-shirt, place a piece of wax paper between the front and back of the T-shirt. This prevents the paint from running through to the other side during the printing process. Carefully place the T-shirt over the fish and rub gently, making sure the shirt has contacted the fins and outer edges of the fish. Once done, carefully remove the T-shirt and check-out the print.

7. Youth may use a small brush to paint in the eyeball on their fish print. A black circle surrounded by a rim of yellow (or orange) makes the eye stand out.

8. Most fish can be painted several times. Wash off the paint immediately after printing. (IF USING RUBBER FISH, DO NOT LET THE PAINT DRY ON THE FISH!)

REFLECT:

Let youth share their creations as a group! (Take photos!).

APPLY:

How could this art form be useful to scientists?

Completion of Project Goals

As a leader/educator, you can help youth complete the **Fins and Scales Project** by providing assistance and/or guidance in fulfilling the other goals of the project.

1. Did they help or mentor another person through one of the activities?

- Who did they help?
- What did they help them with?
- What did they learn from the experience?

2. Did they participate in a learning experience related to fish?

- If so, what did they do?
- What was something they learned from the experience?

3. Did they communicate to others what they learned in the project?

- What did they do?
- What was something they learned from the experience?

Fins and Scales Project Summary

Don't forget to remind youth to complete the Project Summary at the back of their Project Book. Here are the questions.

1. Why did they do this project?
2. What were three things they learned from this project?
3. What problems did they encounter in this project and how did they them?
4. How did they share what they learned?
5. What was their favorite learning experience related to this project?
6. What suggestions do they have for improving this project?
7. Who were the people that helped them with this project?
8. How will they use what they learned in the future?
9. They should also list any additional books, references, magazines, etc., that they read on fish, scales, age determination in fishes, or any other aspect of fish biology.

Helpful Vocabulary

Anal fin – The fin that is located under the fish and between the anal vent and the tail.

Barbels – These are located under the mouth or the chin of the fish. They are slender whisker-like strands that have a sensory function.

Caudal fin – The tail of the fish. The tail can be shaped differently, depending on where the fish lives and how it moves in the water.

Camouflage – A coloration that helps a fish blend in to match its surroundings. This helps it to hide from predators.

Countershading – When a fish is dark on its upper side and light on its lowerside. This helps a fish "hide" in open water. The dark color helps the fish blend in with the bottom when viewed from above. The light color helps the fish to blend in with the sky when viewed from below.

Disruptive coloration – When a fish has bars, stripes, spots or patches of color to break up an animals outline in the water.

Dorsal fin – The fin on the back (or top) of the fish. This fish may be one long fin or divided into different fins. The fin may have spines and/or rays to support it.

Forked tail – This type of tail has longer top and bottom extensions than the center. Looks like a sideways "V". This tail helps a fish accelerate but provides less maneuverability.

Fusiform – A body shape that is tapered at each end and helps in streamlining the fish. A tuna is an example of a fish with a fusiform body shape.

Heterocercal tail – The upper and lower parts of the tail are NOT symmetrical (not the same). This type of tail helps propel the fish forward and provides some upward lift.

Homocercal tail – The upper and lower parts of the fin are symmetrical (the same). This helps the fish swim at moderate speeds over long distances.

Lateral line – The sensory organ that detects vibrations in the water. It looks like a line that runs along each side of the fish.

Lunate tail – This type of tail is curved or shaped like a crescent. Looks somewhat like a flat “C”! Not as good for maneuvering but great for speed over long distances.

Otoliths – These are bony structures found in a fish’s inner ear. They are located in the head. Otoliths can be used to determine the age and growth rate of fish.

Pectoral fins – The paired fins found on each side of the fish just behind the gill opening.

Pelvic fins – The paired fins located on the underside of the fish, just under or further back from the pectoral fins.

Rays – Soft supporting fin structures.

Rounded tail – This tail has a rounded edge. It allows for good acceleration and maneuvering but creates drag and will allow a fish to tire more easily.

Spines – Stiff supporting fin structures. Spines may make it difficult for predators to eat the fish. The spines on some fish may contain painful toxins.

Truncated tail – This tail has a flattened edge and is good for maneuverability and making shorts bursts of speed.

Resources for the Fins and Scales Project

WEB RESOURCES

Florida 4-H Marine Ecology Event – This website has study materials for this state event including fish pictures and descriptions. *http://florida4h.org/programsandevents/marineevent.shtml*

Florida Museum of Natural History – The museum has a website on fish anatomy and adaptations. Visit *http://www.flmnh.ufl.edu/fish/Kids/kids.htm*

Florida Fish and Wildlife Conservation Commission – The FWCC has information on many Florida fish found in both freshwater and saltwater fish! *http://myfwc.com/wildlifehabitats/profiles/fish/* *http://myfwc.com/fishing/saltwater/publications/fishing-lines-magazine/*

Take Me Fishing: This website has information on a variety of fish, where they live, and the best ways to fish for them! *http://www.takemefishing.org/fishing/fishopedia/home*

YouTube: http://www.youtube.com/watch?v=mcjLUEd2SHY&list=PL9ACBD5546703D9B9&index=13

BOOKS

Robins, C. Richard; Ray, G. Carlton; Douglas, J. *Atlantic Coast Fishes: Peterson Field Guides*, Houghton Mifflin Company, 1986.

Page, L. M., and Burr, B. M. *Freshwater Fishes: Peterson Field Guides*, Houghton Mifflin Company, 1991.

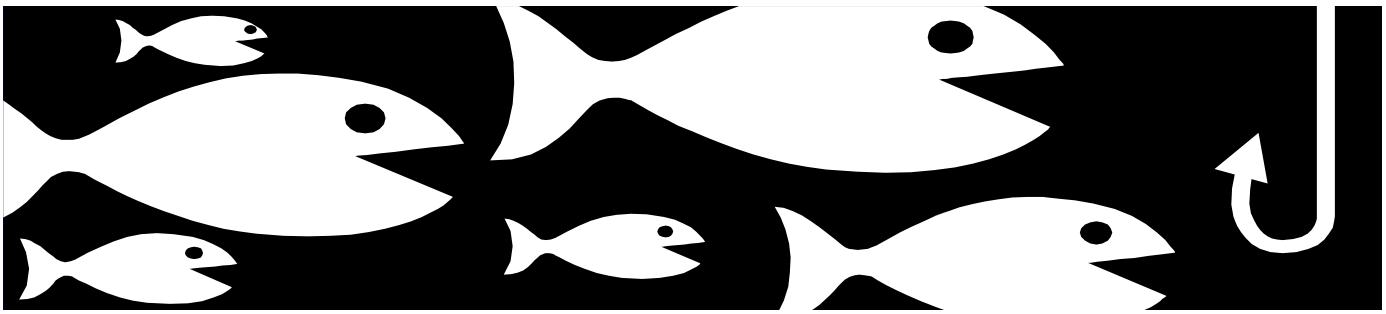
Kells, V., and Carpenter, K. *A Field Guide to Coastal Fishes from Maine to Texas*. John Hopkins University Press, 2011.

Fins and Scales Teaching Kit

A limited number of teaching kits to support the Fins and Scales Project were created at the state level and can be loaned to counties. Check with your county's 4-H Agent for how to obtain a support kit. If counties want to create their own, below is a list of what the kit contains.

Description	Quanity	Where to obtain	Approximate Cost
1. Plastic container to hold all items	1	Store/Walmart	$5.00
2. Rubber fish for fish printing	1	Acorn Naturalist	$10-$12 each
3. Hand-held Microscope	1	Online	$10-$15 each
4. Otoliths (whole)	4 from different fish	Fish and Wildlife Fishery biologists	Should be free, but give them lead time
5. Otoliths – sectioned	2 glass slides	Fish and Wildlife Fishery biologists	Should be free, but give them lead time
6. Laminated fish scales	2-3 small sheets	Seafood market Fishermen	Free
8. Small container to hold scales and otoliths	1	store	$1.00
9. Laminated fish images	1 set	Workshop participants will get a file containing them. These are only to be used for educational purposes	Free
10. Otolith Cards	1 set	Workshop participants will get a file containing them.	Free
11. Fabric pieces for activity	4 squares	Fabric store	$10
12. Fish outlines/cutouts	5 shapes	Workshop participants will get a file containing them.	Free

Other possible items that could be added includes: food scale, timer, "mouth tools" such as tweezers, straws, spoons, etc.; probes, holding tray for fish, paints, and brushes.



CERTIFICATE OF COMPLETION

This certificate is awarded to

Name _____

Club _____

County _____

For your successful completion of the

Fins and Scales Project

Completion Date _____

_____ **Date** _____

Club/Project Leader Signature

_____ **Date** _____

County 4-H Agent

EVALUATION FOR FINS AND SCALES PROJECT

Please provide us with your thoughts and comments on this curriculum so that we may continue to develop and enhance the learning experiences we offer youth.

1. County in which you are located or teach: _____

2. Age level at which you implemented activities: _____

3. Approximately, how many of your youth were engaged in the activities of this curriculum? _____

Circle all answers that apply.

4. The population of youth I work with is**: _____ rural _____ suburban _____urban**

5. The group(s) I work with is a:

_____ 4-H Community Club
_____ In-School Group
_____ After-School Group
_____ Homeschool Club
_____ Other _____

6. How did you receive this activity guide?_____

Please answer the following statements by circling your response. One (1) being strongly disagree, three (3) being neutral, and five (5) being strongly agree.	**Strongly Disagree**		**Neutral**		**Strongly Agree**
7. The activities are appropriate for 11-13 year olds (or Intermediate 4-Hers).	1	2	3	4	5
8. The activity directions are clear and easy to follow.	1	2	3	4	5
9. Activities in the project build on previous experiences of youth.	1	2	3	4	5
10. Youth were able to complete the project book on their own, with little assistance from me.	1	2	3	4	5
11. Youth enjoyed doing the project.	1	2	3	4	5
12. As a result of doing the project, youth learned new information about fish.	1	2	3	4	5
13. As a result of the project, youth were able to practice and learn new science skills.	1	2	3	4	5
14. As a result of the project, my youth's interest in science increased.	1	2	3	4	5
15. As a result of the project, my youth's interest in marine science has increased.	1	2	3	4	5

16. As a result of doing this project, did your group participate in a marine/aquatic science service learning project (e.g., a river cleanup, restoration project, or other citizenship action activity)? If so, please briefly describe it.

17. What did youth enjoy most about this project?

18. How can the Fins and Scales Project be improved?

Please return this form to: UF/IFAS 4-H State Headquarters
2142 Shealy Drive
PO Box 110225
University of Florida
Gainesville, FL 32611

Or fax to: (352) 294-FL4H (3544)
Attn: Karen Blyler