Welcome, Anglers!

You are holding a guidebook that will help you to better understand our aquatic resources. This booklet is organized into two main sections: **Section A, Fish Knowledge** and **Section B, People Knowledge**. In Fish Knowledge, you will focus on science: fish biology and aquatic ecology. You will build on what you learned in that section as you explore the impact that people can have on fisheries, outlined in People Knowledge. This section looks at problems that humans have caused fisheries, and it addresses the various ways that management can try to solve these problems using science as a tool. In the final activity, Great Conservationists, you will consider your own relationship to fish and our aquatic resources.

We'll be using short scenarios at the beginning of each section to guide our investigations. As you read these scenarios, think about how fish ecology, management decisions, and personal choices all play roles in the problems described and in their possible solutions.

This booklet can be paired with *Hook, Line & Thinker: Field Guide,* a booklet that focuses on the technical skills of angling. Even when done together these booklets are not detailed enough to make you an expert angler: that can take a lifetime. These booklets will, however, set you on a path towards discovering some basic principles about aquatic environments and your connection to them as an angler, as a fellow water-dependent being, and as a citizen with the ability to think and choose how you act.

Be sure to thank your teacher and community members for offering you this chance to learn more about Wisconsin's fisheries and the aquatic resources that sustain them.

INSTRUCTORS: This is the student guide table of contents and page numbers. Student page numbers are noted throughout as:

Student Science Guide 1 Student Field Guide 1

STUDENT GUIDE PAGES

SECTION A

Fish Knowledge

Ecology & Biology

SECTION B

People Knowledge

Social, Political, & Management Issues

Grass pickerel

Student Science Guide 1

The Scene

A local fishing group wants the Wisconsin Department of Natural Resources to put walleye and yellow perch in Linnie Lake, near Muskego. As a fish biologist, you are responsible for deciding whether or not to stock walleye and/or yellow perch in the lake. What sort of data do you need to collect in order to determine whether or not to stock the fish?

INSTRUCTORS: Answers found in Section Assessment on page 35.

SECTION A

Fish Knowledge

A lake is a lake is a lake, or is it? For those of us who live and breathe on land, it is difficult to comprehend how different each body of water is. But fish can tell the difference! Each species of fish requires certain conditions to survive. To be an informed angler, you need to know these conditions and be able to match the environment to the fish. In this section, you will learn how to recognize different species of fish and how to identify different components of fish habitat.

One Fish, Two Fish, Panfish, Catfish

In this chapter, two lesson plans focus on fish adaptations and taxonomic classifications.

What Makes a Fish a Fish?

OBJECTIVES: Students will be able to:

- explain that natural selection leads to adaptations that suit a particular environment
- describe the anatomical position and function of fish fins and organs

METHOD: Students fill in an anatomical drawing of a fish and practice using anatomical terms in sentences.

MATERIALS:

1) ➊ **See Appendix B** for Fish Anatomy Transparency, Salmonid Dissection Guide, and Speaking Anatomically.

2) ➊ **See Appendix C** for Fish Images*

3) Overhead projector

*Alternatively, order Fish Wildcards on cardstock from the DNR or download and print them from **dnr.wi.gov/fish/kidsparents/documents/MatchYourCatch.pdf**. Fish field guides and the fish identification website, **wiscfish.org/fishid** are other good resources for this activity.

SETTING: Indoors

DURATION: One to two 45-minute session(s)

VOCABULARY: Poikilotherms, chordate, adaptation, niche, lateral line, barbel, extirpated, dorsal, physiology, thermoregulate, swim bladder

STANDARDS:
Science: F 8.6, 12.5.
Environmental Education: B 8.2, 12.5.

BACKGROUND: There are more than 25 families of fish in Wisconsin, each adapted to a specific habitat. These adaptations are the result of millions of years of natural selection. Some of the most evident adaptations fish have are their coloration, marking patterns, shape, and fins. Fish skin and scales have developed colors and patterns that help to conceal or confuse predators and prey. In some fish, like darters, coloration attracts mates. Bullheads and many other species of fish are counter-shaded (dark across the back and light on the belly) to help them stay hidden from above and from below. Knowing the specific markings typical of different species of fish is useful in learning about their niches in an ecosystem and in assisting with identification.

Shape is also an important species and niche identification tool. The torpedo shape of inland trout assists them in swimming against currents. But not all fish could function with a trout shape. Some fish are long, skinny and almost oval in cross-section, like the northern pike, a shape which permits quick bursts of speed and agility in underwater "forests" of aquatic vegetation.

Still others look like they were stepped on (dorsoventrally flattened) or were caught in a sliding door (laterally compressed). The dorsoventrally flattened catfish can eat off the bottom while being concealed from predators. The laterally compressed bluegill is hard for predators to swallow and moves smoothly in and out of weedy growth.

Fins can also be used to identify a species and a niche. Fins are described in detail in the student section and can be used to practice anatomical terms. The internal organs of a fish are also useful in understanding the ecological niche of the species and the adaptations it has made to survive in its environment. Internal organs generally aren't used by the average angler in identification, but are used by scientists to classify fish.

OPENING: Divide the class into teams of three students each. Distribute to each group several Wildcards (with the back covered) or cut-out copies from a field guide. Have the students read the opening paragraphs of **What Makes a Fish a Fish**. Based on what they can see on the fish images they hold, what can they learn about the ecological niche of their fish? What body parts are they using to determine the niche?

After allowing five to 10 minutes of small group discussions, open the discussion to the entire class. If desired, make a chart on the

board of the different body shapes, mouth shapes, coloration patterns, and fin locations on the board. Use the fish identification website to talk through some of the different adaptations of fish and how they may have developed. What role did evolution play in these adaptations?

MAIN ACTIVITY: Have students read the **What Makes a Fish a Fish** section in their booklets and then work as a class to begin labeling the anatomical drawing of the generic fish.

Use an overhead projector to show body parts and their locations. Lead a discussion of the functions of various fish parts, making sure to include all of the body parts listed below. Have students practice using anatomical terms to describe the location of each part. The use of anatomical terms will be helpful in the **Which Fish is This** lesson that follows. Evolution and adaptations can again be a part of the discussion—gills, the operculum, the lateral line, and the swim bladder are all important adaptations for life underwater.

External

Scales/Skin/Scutes: protect a fish from disease and injury

Lateral lines: sensory lines running the length of the body, pinpoint vibrations

Opercula: bony protective coverings over the gills

Dorsal fin: fin(s) on the back of the fish, aids in balance and maneuverability

Pectoral fins: on the sides of the fish, provide aim and positioning

Pelvic fins: on the underside of the fish, provide stability and balance

Caudal (tail) fin: the fish's propeller, provides locomotion

Anal fins: on the underside of the fish, provide stability and balance

Adipose fin: on the back of the fish, function unclear

Internal

Brain: controls muscle function, processes information

Gills: absorb oxygen from water

Esophagus: short and expandable, connects the mouth to the stomach

Heart: two chambers, an atrium and a ventricle, moves blood through the fish

Liver: filters toxins, stores vitamins, breaks down fat

Stomach: usually in a "u" or "v" shape, secretes acids to break down foods

Pyloric Caecum: not found in all fish, assists with nutrient absorption

Intestine: longer in herbivorous fish, shorter in carnivorous, absorbs nutrients

Vent: expels waste

Kidneys: produce red blood cells

Swim Bladder: a gas-filled chamber, maintains buoyancy and amplifies sound

Gonads: reproductive organs, produce sperm or eggs

Bladder: holds urine

CLOSING: Ask students how knowing some of the anatomy and physiology of fish could help them become better anglers or fish biologists. Have them fill out the **Educated Angler** section at the end of the lesson either in class or as a take home project. Students can begin filling out the **Profile of a Swimmer** on the inside cover of their booklets.

ASSESSMENT QUESTION: List five adaptations most fish have and describe how each one helps suit fish for life underwater.

ANSWERS: *Scales for protection, fins for locomotion or stability, gills for breathing, swim bladder for flotation/buoyancy, operculum for gill protection, lateral line to pinpoint movement.*

EXTENSIONS:

In Depth: Dissect fish in class. ⦿ See **Appendix B** for Salmonid Dissection Guide and Speaking Aantomically, a more in-depth look at fish anatomy.

Art: Have students do a scientific drawing of a fish and label its parts.

⦿ *If you have downloaded this booklet, please see the appendix that follows for additional materials.*

1

One Fish, Two Fish, Panfish, Catfish

Largemouth bass

The fishing group in the scenario requested that both yellow perch and walleye be stocked in Linnie Lake. These are two different species of fish, but how would you tell them apart? In the following section, you will learn what makes an animal a member of the fish family and how to label and identify different species of fish.

What Makes a Fish a Fish?

If you had to describe a fish to someone who had never seen one, what would you say? What makes one species of fish like another species of fish, but different from all other kinds of animals? Scientists struggle with how to appropriately define "fish." All fish are cold-blooded, or **poikilotherms** (animals whose body temperature is that of the environment), but so are reptiles and amphibians. All fish are **chordates** (animals with primitive or well-developed backbones) but so are you. All fish breathe using gills, but so do salamanders. Most fish spend all of their lives underwater, but longnose gar and other species of fish can breathe air. Most fish have scales and fins, but some saltwater eels (which are fish) have neither. Dr. Tim Berra of Ohio State University defines a fish this way, "…poikilothermic, aquatic chordate with appendages (when present) developed as fins, whose chief respiratory organs are gills and whose body is usually covered with scales." Sound confusing?

Poikilotherms
Animals whose body temperature is that of the environment

Chordates
Animals with primitive or well-developed backbones

Fish are hard to define because they have been on earth for so long that they have had time to develop many specialized adaptations. Fish fossils have been found dating back more than 400 million years. Worldwide there are about 21,000 species of fish each adapted through **natural selection** to a particular niche (role) in an aquatic ecosystem. For example, the northern pike's torpedo-shaped body and sharp teeth make it an effective predator. Its markings enable it to hide in the weeds unnoticed while it waits in ambush for its next meal to pass by. Bluegills also rely on coloration for protection instead of predation. The bullhead's keen sense of smell and sensitive barbels (whiskers) compensate for poor vision in the murky water it often inhabits and the **lateral line** senses vibrations as it does in all fish. The more you learn about fish and their habitat, the better angler you'll become.

Natural selection
A process by which only those creatures and plants well adapted to their environment survive

Speaking Anatomically: Scales, Skins and Scutes

Scales are modified skin cells that protect a fish's body from disease and injury. Fish hatch with all the scales they will ever have. They may grow replacement scales, but not additional ones. As fish grow, the scales just get bigger and lay down a growth ring each year. With a microscope, you can count the rings on a scale to determine a fish's age, just like you'd count the rings on the cross-section of a tree trunk. It's a good idea to sample several scales from one fish and go with the highest ring count to ensure that you are not relying on the count from a newer, replacement scale.

Some fish do not have scales at all. Catfish and bullheads have very tough skin and sturgeon have bony plates called scutes for protection.

PLEASE SEE APPENDIX B
What Makes a Fish a Fish? Speaking Anatomically

Diversity Below the Surface

As of 2006, about 156 species of fish lived in Wisconsin waters; 15 of those were non-native, including five non-native game fish stocked by the Department of Natural Resources. Six other fish species are known to have been **extirpated** from Wisconsin since European settlement. Another 12 non-native species have been observed but have not yet become established.

Source: John Lyons, Wisconsin DNR Fisheries Research Biologist

Extirpated
Eliminated from an area

Northern pike

Brook Trout

Mucus

A slimy coating helps protect fish from disease, fungi, parasites, and the grasp of would-be predators. Mucus reduces friction, allowing fish to swim 60% faster than they could without it. When you catch a fish, wet your hands before handling to minimize disturbance of this protective coating.

Gills

Fish breathe every time they take a gulp of water. Water enters a fish's mouth and passes over and out through the gills, where oxygen (the "O" in H_2O) is extracted from water. Carbon dioxide is released from the fish's blood in exchange for oxygen. As a fish swims in moving water, the flow of water through the gills and exchange of gases occur without aid. Injury to the gills is often fatal, so handle fish with care.

Swim Bladder

Swim bladder
An air-tight sac in most fish.

Fish have a **swim bladder**, or gas bladder, that makes it possible for them to remain suspended in water. The bladder is an air-tight sac in most fish; some fish can add or release gas to adjust their depth in the water.

Skeleton

Most fish have a bony skeleton. However, some fish, like lamprey and sturgeon, have skeletons made of cartilage, rather than bone.

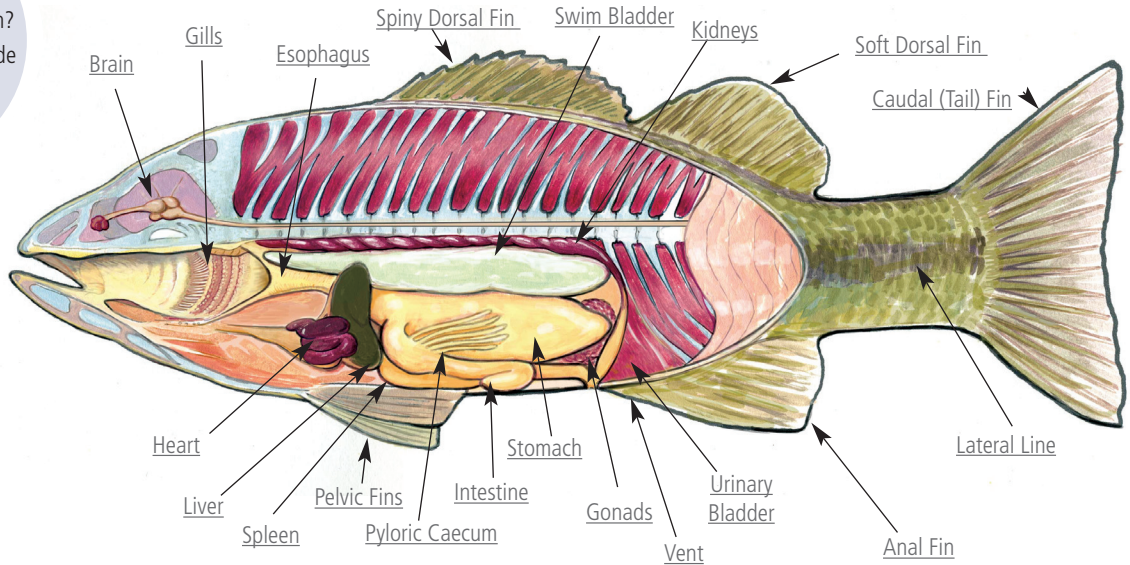
Coloration

Fish come in a variety of colors and patterns that attract mates or conceal fish from predators or prey, depending on their place in the food chain. Almost every species is counter-shaded, dark across the back and light on the belly to help them stay hidden from above and from below.

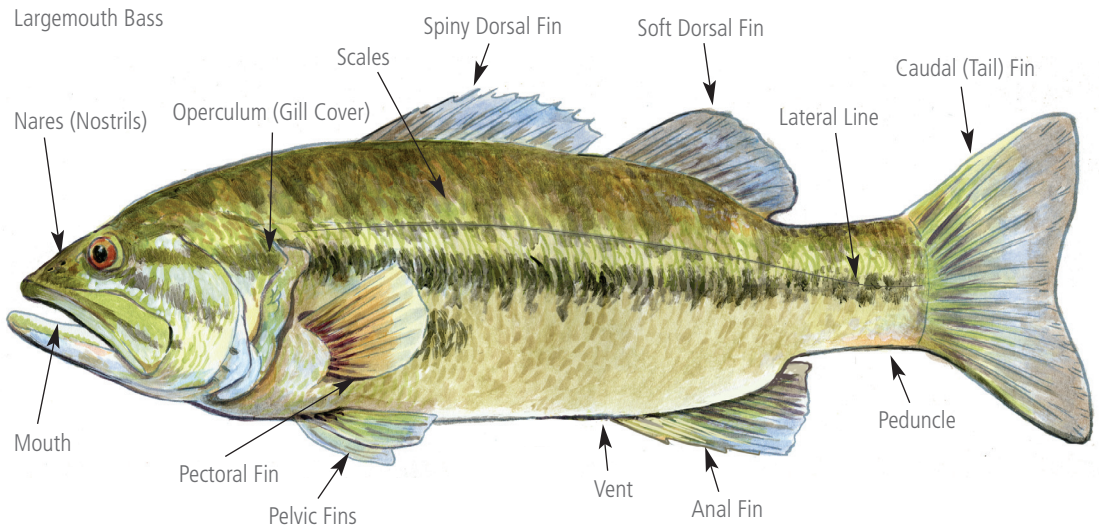
Fin-Tastic

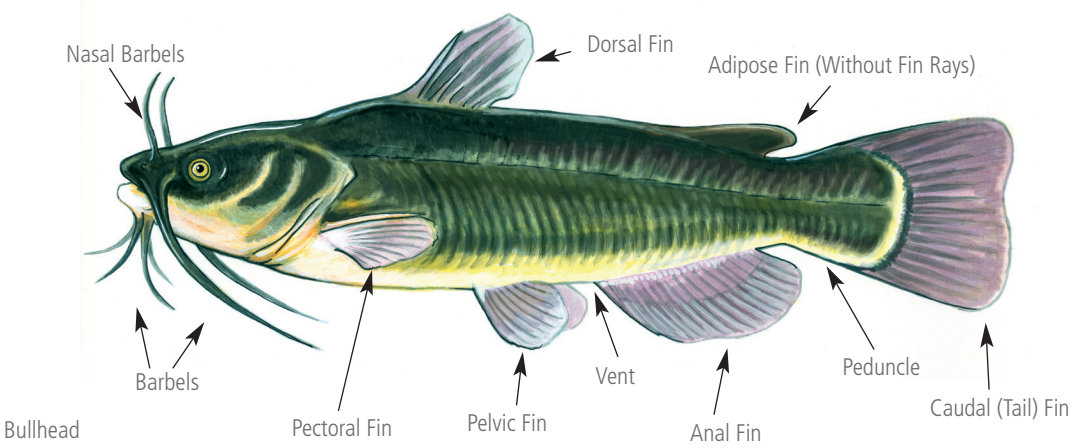
Fins are membranes supported by hard, bony spines or soft rays. They provide balance and make it possible for a fish to maneuver through tight spaces and stay upright in water. There are six types of fins, but not all fish have all types. Different species of fish have developed different sizes of fins depending on the fish's niche in the ecosystem. Knowing the size, shape, and location of different species' fins will help you later with identification. What can you know about a fish by its fins?

PLEASE SEE APPENDIX B
What Makes a Fish a Fish?
Salmonid Dissection Guide
Fish Anatomy Transparency



Use the fish image to label fish fins and anatomy as you discuss it in class.





INSTRUCTORS: Underlined content is not provided in student manual.

FIN	FUNCTION	NOTE
Dorsal	Balance and Maneuverability	Some dorsal fins are spiny-rayed and others are soft-rayed. Fish may have one, two, or three dorsal fins that can be a combination of spiny and soft rays. Fins may or may not be connected to each other.
Pectoral	Aim and Positioning	Pectoral fins help the fish aim itself, hover in one place, and dive.
Pelvic	Stability and Balance	Pelvic fins work with the dorsal and anal fins to provide balance.
Caudal or Tail	Locomotion (the propeller)	Species of fish with forked tails are fast swimmers. Those with broad, flat tails are able to turn and start swimming quickly.
Anal	Stability and Balance	Anal fins work best with dorsal and pelvic fins to provide balance.
Adipose	Unclear	The purpose of the small, fatty adipose fin is unclear. It is found on catfish, bullheads, trout,and salmon.

Marked for Research

Fin clipping is a method of marking fish for research. Biologists clip different combinations of fins to identify groups of fish. A specific clipping pattern indicates when and where a fish was stocked. When fish are recaptured, researchers refer to the fin clip records to chart survival and growth rates. The adipose-only fin clip is reserved by the Great Lakes Fishery Commission to be used throughout the Great Lakes on salmonids that are carrying a coded wire tag.

Wall-eyed

The term "walleye" is similar to an old Norse word meaning "a light beam in the eye." Walleye do indeed seem to be shooting light out of their eyes. They have reflective pigments on their retinas that allow them to see in very low light conditions, like at dawn or dusk. For this same reason, walleye avoid bright light. Remember this when seeking them out! Does anatomy play a role in other fish species' common names?

Physiology
The study of how an organism functions

Thermoregulate
Maintain a constant body temperature

INSTRUCTORS: Underlined content is not provided in student manual.

Fish-iology

Physiology (the study of how an organism functions) can also be important to an angler. As we learned earlier, fish are poikilotherms. Fish are not able to **thermoregulate** (maintain a constant body temperature) like mammals. Instead, a fish's body temperature nearly matches the temperature of its environment. How does knowing this help you to be a better angler?

Fish will live in comfortable temperatures. You probably won't find fish in really hot or really cold water, unless the fish is adapted to those extremes.

Educated Angler

Use the space below to list five facts you have learned about fish anatomy or physiology and how each could help you catch a fish.

1. _____

2. _____

3. _____

4. _____

5. _____