

Hook, Line & Thinker

Science Guide



**Fish Knowledge—
Ecology & Biology**
**People Knowledge—
Social, Political, &
Management Issues**



Select a fish that lives in Wisconsin that you would like to learn more about. Use this worksheet to profile the fish as you work through the different sections of this booklet. If each of your classmates selects a different fish, your classroom will know how to catch just about anything!

Profile of a Swimmer

Common Name(s): _____

Scientific Name: _____

SENSE	FEATURE AND DESCRIPTION	IMPORTANCE TO FISH (HIGH, MEDIUM, LOW)
Sight		
Smell		
Hearing		
Taste		
Touch		

Identifying Characteristics: _____

Natural Food: _____

Habitat Description: _____

Niche (role): _____

Spawning habits and habitat: _____

Environmental stressors: _____

Tackle and Bait: _____ Bag Limit: _____

Is there a health advisory for this fish? if so, where? _____

Any restoration or stocking efforts for this fish? _____

Good to eat or simple recipes? _____

Other interesting facts about this species (list 5): _____

Sources: _____

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 scenes at the beginning of each section to guide our investigations. As you read these scenes, 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.

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Grass pickerel

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?

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.

1

One Fish, Two Fish, Panfish, Catfish

The fishing group in the scene 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.



Largemouth bass

1

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?

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.

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.

Poikilotherms

Animals whose body temperature is that of the environment

Chordates

Animals with primitive or well-developed backbones

Natural selection

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

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

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.



Brook Trout

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 H₂O) 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

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.

Swim bladder

An air-tight sac in most fish.

Skeleton

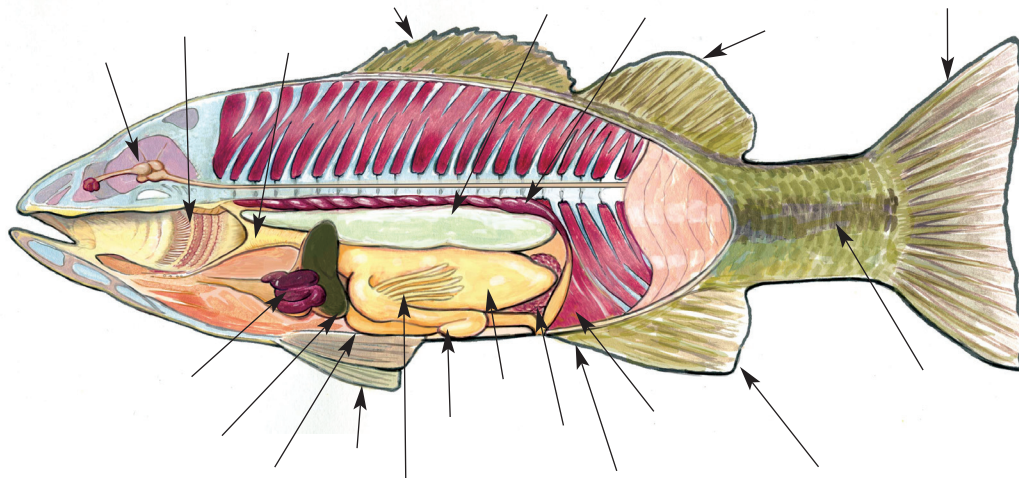
Most fish have a bony skeleton. However, some fish, like lamprey and sturgeon, have skeletons made of cartilage, rather than bone.

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

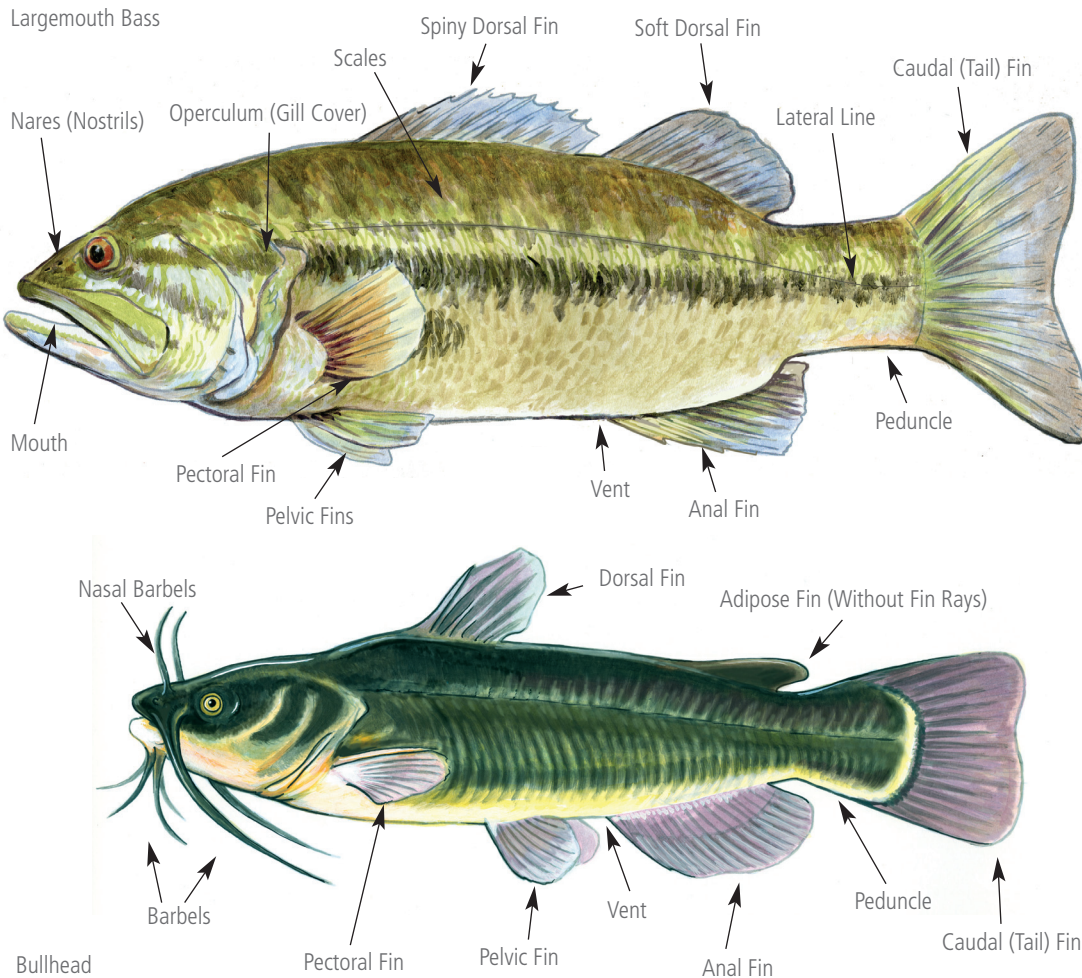
Fins are membranes supported by hard, bony spines or soft rays. They provide balance and make it possible for a fish to maneuver through tight spaces and stay upright in water. There are six types of fins, but not all fish have all types. Different species of fish have developed different sizes of fins 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?



ONE FISH, TWO FISH, PANFISH, CATFISH



1



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

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?

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. _____

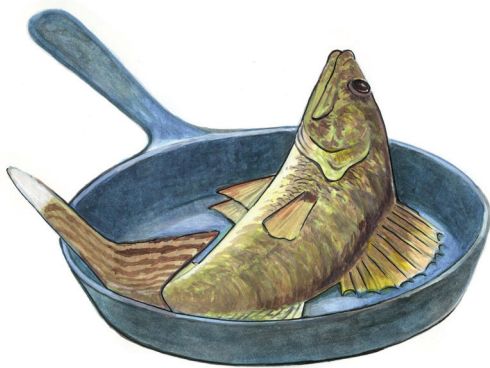
4. _____

5. _____

Which Fish Is This?

What did you catch? What does it matter, anyway? A trout doesn't care if you call it a trout, a carp, or a muskellunge, but conservation wardens do and so should you.

Many fish are subject to **bag limits** (the number of fish you may catch in a day), while others are superior in flavor, and still others can be unhealthy if eaten too frequently. Legal requirements, taste preferences, and health issues are a few important reasons to learn to identify what kind of fish you've caught. The problem is, anglers, conservation wardens, and scientists may all place different labels on the same fish.



Surely That's a GamePanMinnow-Fish

The easiest way to identify a fish is to place it in a category based on its purpose.

Anglers group fish by taste and how challenging they are to catch. To an angler, a panfish is generally a fish that is edible, fits in a frying pan, and is legal to keep. A game fish is generally any fish that is caught for sport. But, as you can imagine, definitions as broad as these can include many different fish and might mean something slightly different to each person. Ask around: is a walleye a panfish, a game fish, both, or neither?

That's Rough

The term "rough fish" seems to imply that these species have little or no value, but enlightened anglers, biologists, and chefs know better. Rough fish often inhabit a rough neighborhood, the murky bottom, but that doesn't mean they don't taste good. Take a chance and try one sometime!

To avoid confusion, Wisconsin conservation wardens use the following specific description of fish categories.

By Wisconsin law, **game fish** are defined as all varieties of fish except rough fish and minnows.

Rough fish include: dace, suckers, carp, goldfish, redhorse, freshwater drum, burbot, bowfin, gar, buffalo, lamprey, alewife, gizzard shad, smelt, mooneye, and carpsuckers.

Minnows include: suckers, mud minnow, madtom, stonecat, killifish, stickleback, trout perch, darter, sculpin, and all species of the minnow family (except goldfish and carp).

Wisconsin law is simplifying the identification process by calling *all* panfish game fish. This makes it easier to regulate the catch of the most popular species of fish. You might have noticed that the last sentence of the definition above hints of yet another way of identifying fish: by family.

For legal purposes, goldfish and carp are not considered minnows, but scientifically they are. Biologists identify fish by their **morphology** (structure) rather than by their purpose. Scientists use morphology to classify organisms into **taxonomic groups** (groups of closely related organisms) to build family trees and trace the evolutionary history of everything from plants to bugs to fish.

Once a scientist has built a family tree, she can use it to make a **dichotomous** (die-kot-o-mus) **key** (an identification tool). Keys begin with broad differences and work toward specific distinctions.

By scientific identification, no two fish of different structure will have the same name. A brook trout (*Salvelinus fontinalis*) is in a separate taxonomic group from a smallmouth bass (*Micropterus dolomieu*). Of course anglers and conservation wardens also use this scientific system of identification, but not usually the scientific name.

1

Bag limits

The amount you may catch in a day

Morphology

Structure

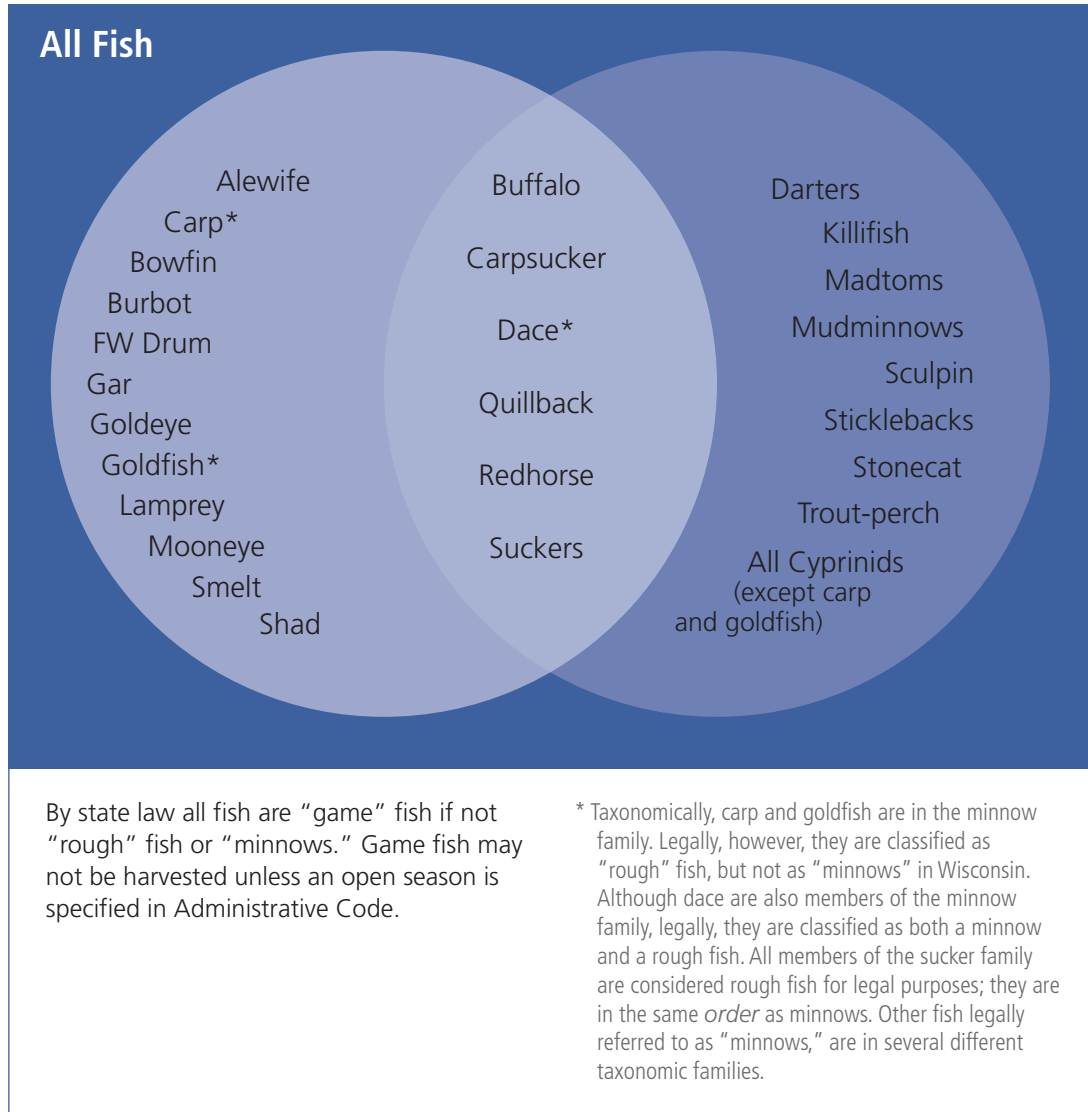
Taxonomic groups

Groups of closely related organisms

Dichotomous key

An identification tool

Game Fish, Rough Fish, Minnows



What's That?

What would you expect to see if your friend said, “Hey I just caught an Animalia Chordata Actinopterygii Perciformes Centrarchidae Lepomis gibbosus!”

A Taxonomic Grouping of Esocidae



Identify this fish using the key below.

1. a. Body lacks large bony plates. Go to #2
- b. Body has large bony plates **Lake Sturgeon** (not in Esocidae family)



2. a. Dorsal fin is short, much less than half the body length Go to #3
- b. Dorsal fin is nearly half the body length or longer **Bowfin** (not in Esocidae family)



3. a. Teeth are visible and sharp Go to #4
- b. Mouth is fleshy, teeth are not visible and sucker-like **White Sucker** (not in Esocidae family)



4. a. Tips of tail fin are rounded Go to #5
- b. Tips of tail fin are pointed **Muskellunge** (Esocidae family)



5. a. Cheek and gill cover are fully scaled **Grass Pickerel** (Esocidae family)



- b. Cheek and only upper half of gill cover are scaled . . . **Northern Pike** (Esocidae family)



Family Ties

Construct your own taxonomic groups of fish.

Notes