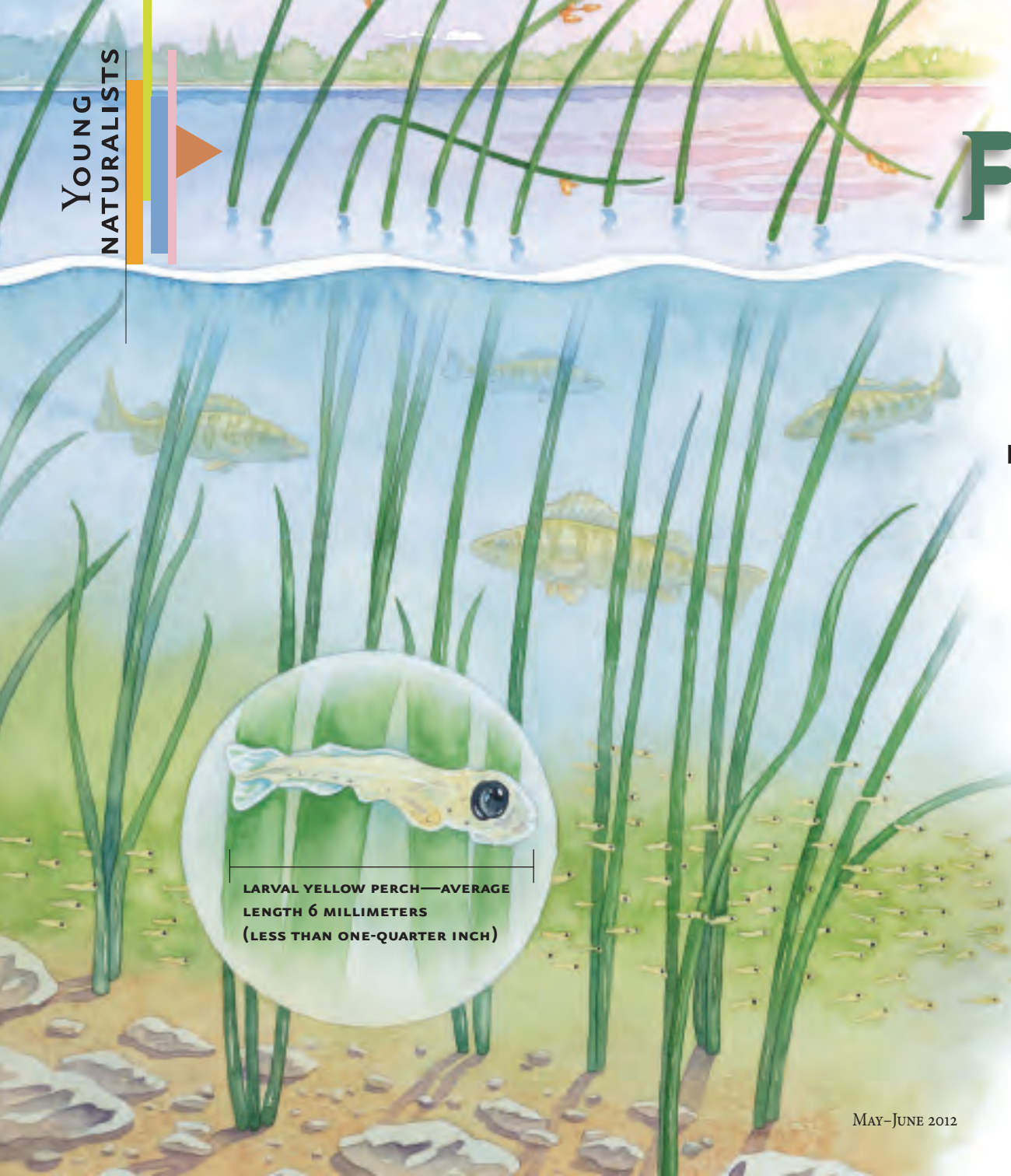


Illustrations by Bill Reynolds

Fish in the Zone

During the year, fish travel between zones of plant and animal life.

Fish all have their favorite spots in a lake. If you fish, you'll learn where certain fish are most likely to be found. Why does a fish choose to live in one part of the lake rather than another?

Where fish hang out depends on the time of year. As weather changes from season to season, conditions in a lake change. For example, as weather gets warmer, some parts of the lake warm up. Then fish might move to a different place, or zone, to find food and shelter.

Fish also change zones as they grow. Like babies, newly hatched fish need different kinds of food and shelter than grown-up fish do. This story follows young yellow perch from spring through winter. As the seasons change and the perch grow, they travel to new lake zones.

By Roland Sigurdson

First Home

In April the sun's rays warm the lake ice, causing millions of tiny cracks. Rocks along shore soak up the sun's heat during the day and give off heat at night, melting ice several feet out from shore. A strong, warm wind from the south pushes down on the cracked ice sheet.

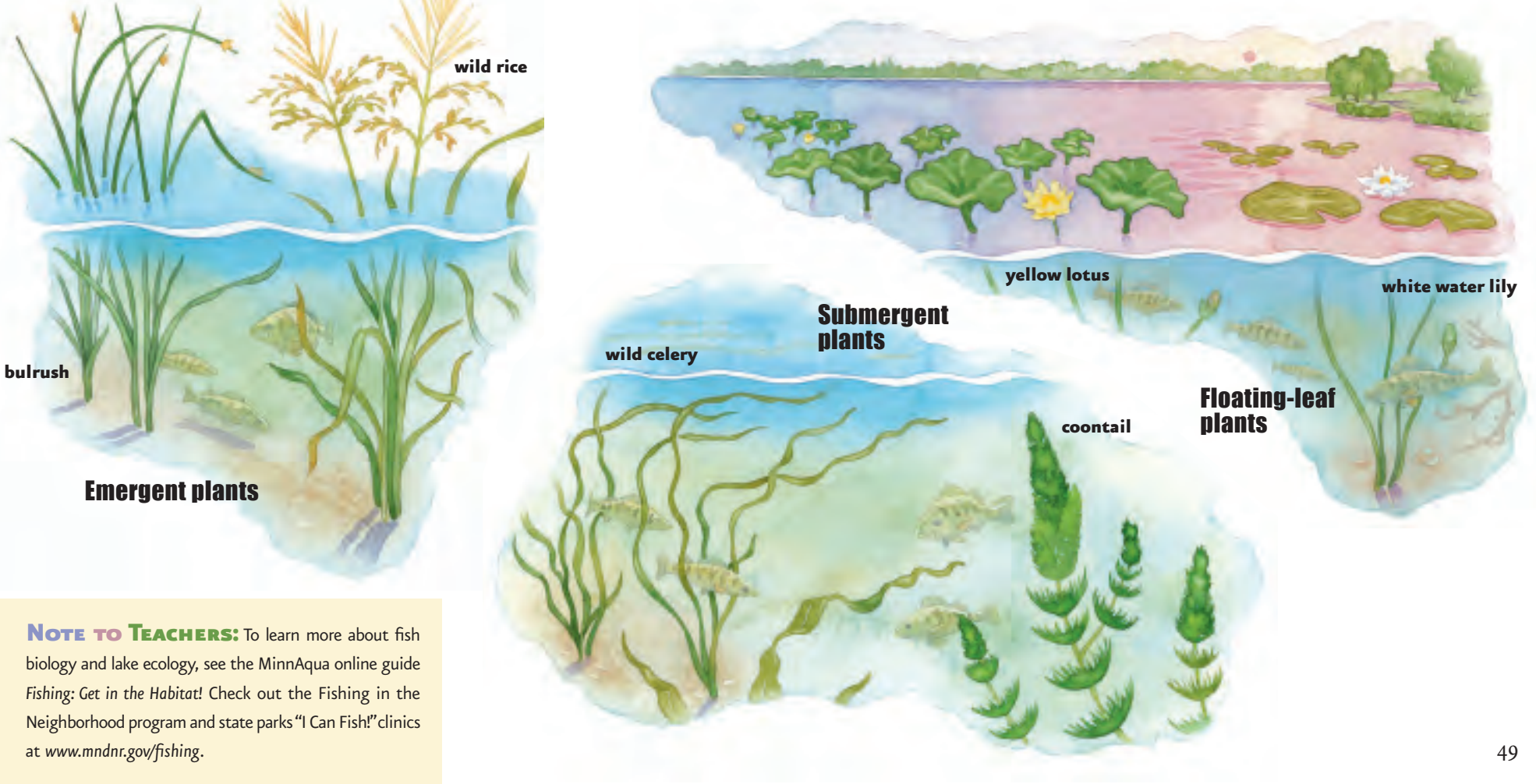
Snap! Pop! Boom! The ice splits into chunks. The wind blows the ice chunks to the north shore, where they pile up and melt. By early May, the lake is free of ice, and new life begins to churn underwater.

To lay eggs, yellow perch adults move into the warm, shallow waters of the *littoral* (shore) zone. The female perch comes to the littoral zone because plants grow there and her eggs need plants. Her eggs come out as long, jellylike ribbons, some more than 6 feet long. The ribbons get tangled around the underwater plants, so they don't get washed up on shore by wind and wave action.

Aquatic plants can grow in this zone because sunlight reaches the nutrient-rich soil at the bottom. In Minnesota lakes with clear water, the littoral zone can stretch from shore to water 15 feet deep.

After about 15 days, larvae hatch from the eggs. Less than a quarter-inch long and just beginning to grow fins, perch larvae don't look much like fish. They look more like transparent mini-tadpoles.

The littoral zone teems with small fish, insects, and other creatures that eat yellow perch larvae. The newly hatched perch would be safer in another part of the lake.



Note to Teachers: To learn more about fish biology and lake ecology, see the MinnAqua online guide *Fishing: Get in the Habitat!* Check out the Fishing in the Neighborhood program and state parks "I Can Fish!" clinics at *www.mndnr.gov/fishing*.

Safer in the Middle

When water temperatures rise to about 59 degrees, the tiny larval perch move to the *limnetic* (open water) zone. In open water away from shore and above deep water, fewer fish are hunting larval perch.

Yellow perch larvae find plenty to eat in the limnetic zone. Plants and animals called *plankton* abound here in the middle of the lake. These tiny organisms are the perfect bite size for hungry perch larvae. Phytoplankton, also called algae, are plants. Perch prefer zooplankton, which are nutritious little animals such as rotifers, water fleas, and copepods. When it grows bigger, a larval perch will hunt for bigger prey.

Dining in Deep Water

Larval perch find their biggest prey in the *profundal* (deep) zone. These waters start below the limnetic zone and reach all the way to the bottom of the lake. Because sunlight can't reach this deep, no green plants grow in the profundal zone. Large numbers of bacteria and fungi live in the bottom muck. So do invertebrates such as *Chaoborus,* also known as phantom midges.

Each evening phantom midges migrate from the profundal zone up to the surface to feed on plankton. As morning arrives, they migrate back to the bottom, so fish that could see them in the light won't eat them. Larval perch eat midge larvae in late evening or early morning when the larvae are moving between the bottom and the surface.

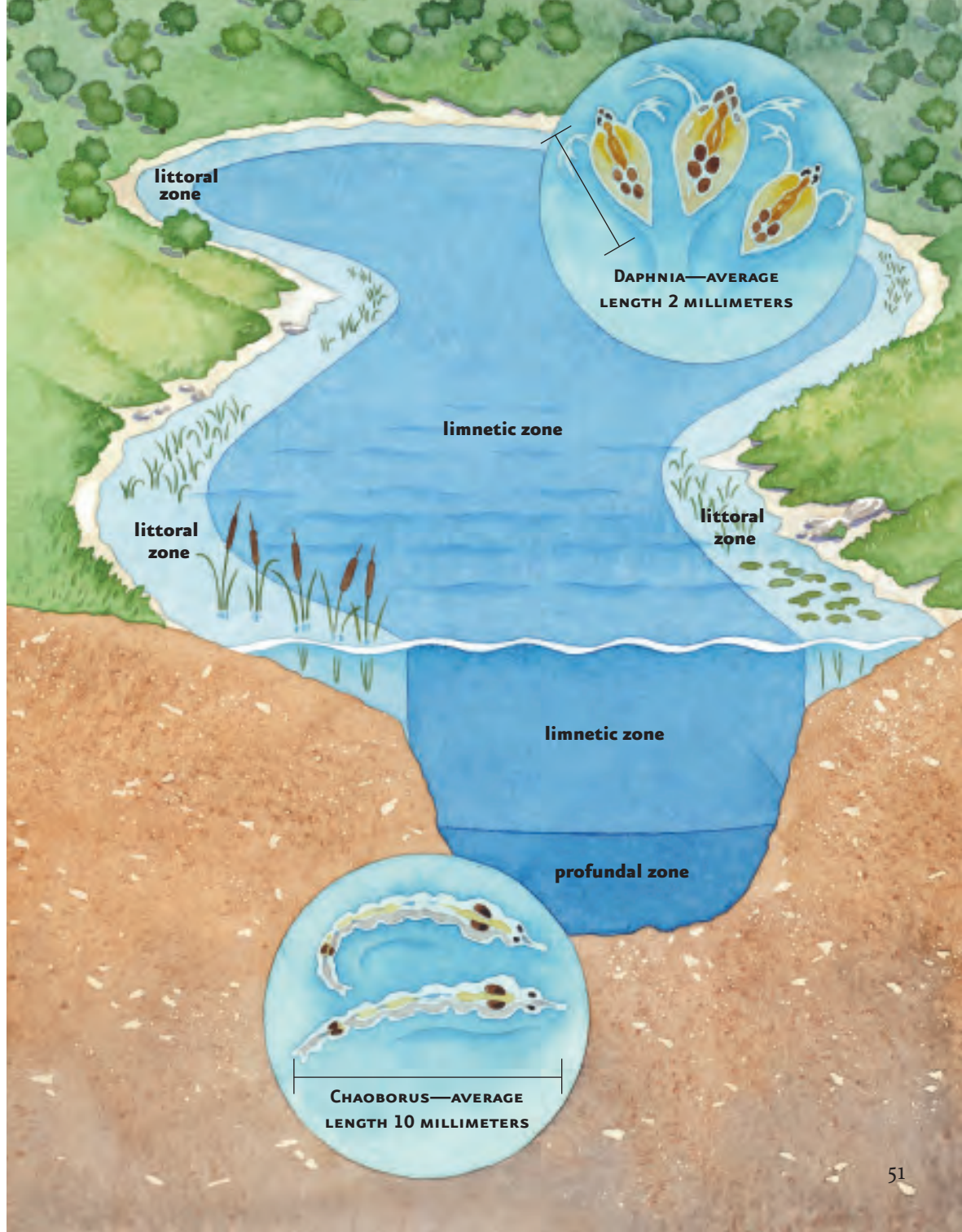
Home for Summer

By mid-June, about 40 days after hatching, a perch is about 1 inch long. It now looks like a mini-adult. It has fully formed fins, a big mouth, and a big appetite.

Juvenile perch are still growing and need food with more calories. To find more food, they migrate from the profundal zone back to the littoral zone.

The littoral zone was a dangerous place for perch when they were tiny, but now they are bigger and have fins. They can swim fast and escape predators. Their swimming speed helps them catch prey such as mayflies, midges, and scuds. Here they also can hide among aquatic plants, rocks, and fallen trees.

Juvenile perch live in the littoral zone all summer and into late fall. In the late fall, when the lake temperature and oxygen changes, called *turnover*, the perch will travel back to the profundal zone for winter.



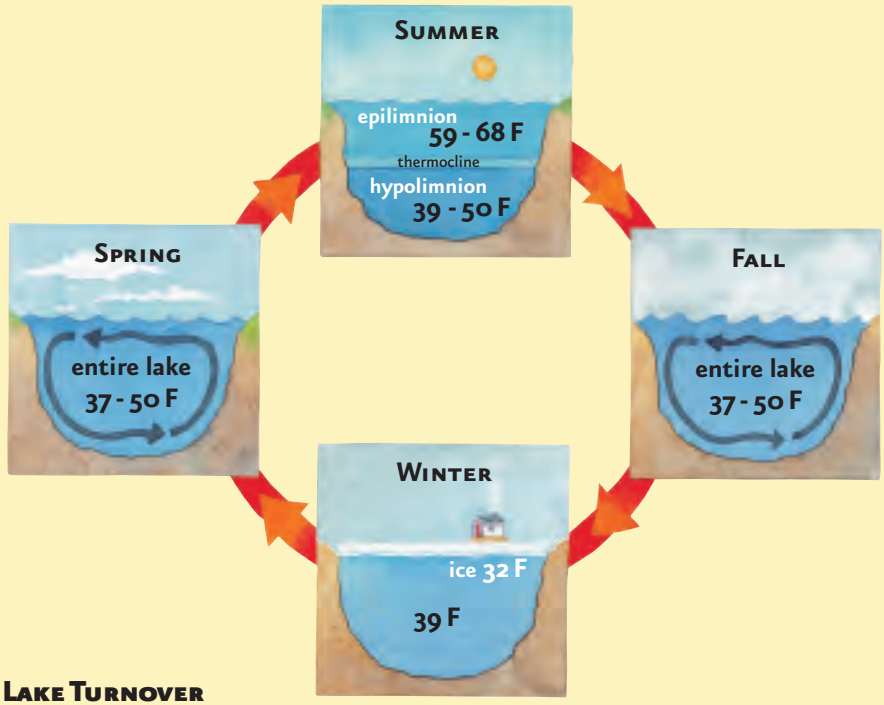
Tucked in for Winter

Like all living things, fish need oxygen. During summer, the water in the profundal zone has very little oxygen. In winter the profundal zone has the same amount of oxygen as the rest of the lake. Also, the water near the bottom is about 4 degrees warmer than the water just under the ice.

With plenty of oxygen and slightly warmer water, the profundal zone in winter has large numbers of midges, mayflies, scuds, and other invertebrates—providing young perch with plenty to eat until spring.

Another Year

Spring begins another year for the young perch. Once again, the ice melts, the littoral zone comes alive, and new food becomes abundant. With luck, the perch might live nine more springs.



Lake Turnover

In many lakes during summer, water warmed by the sun floats atop a layer of cold water. Water is densest (heaviest) at 39 F. In fall, the surface water cools to 39 degrees and sinks. The wind helps mix the lake's water layers—called *fall turnover*. When surface water cools to 32 degrees, it freezes. *Spring turnover* occurs as cold water at the surface warms to 39 degrees and sinks. Once again, wind helps mix the layers.

Want to Be a Limnologist?

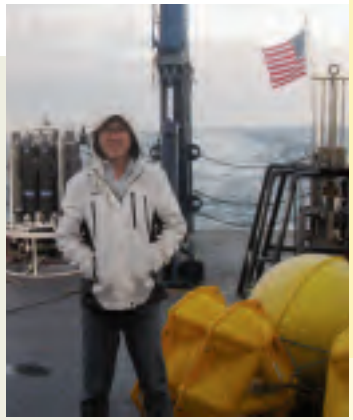
Lakes are full of mysteries to discover and solve. A limnologist is a scientist who studies lakes, ponds, rivers, springs, streams, and wetlands. Limnology is the study of all *inland waters*—bodies of water not considered oceans or seas.

A limnologist asks questions and looks for answers about every animal and plant that lives in a water body—the biological life. A limnologist also examines other things in the water and how they mix or relate to each other—the chemistry of the water.

If you were a limnologist studying a lake, you would look around to find out what might change the water. For example, you might ask: What happens when snow melts on shore and runs into a lake? Does rain running off a road and into a lake change its chemistry? If someone adds minnows or other fish to the lake, what difference might they make?

As a limnologist, you would look for patterns—how things repeat—from season to season, year to year, and century to century. You'd keep records of your observations of a lake. You'd compare them with other scientists' observations. Then you'd begin to understand what might happen to the lake in the future. Your study could help others see how to take care of the lake so the water is clean and fish and plants are healthy.

To become a limnologist, you must earn a college degree in biology, water resources science, or aquatic ecology. But you can begin studying a lake anytime. When you go fishing, stand on shore, or swim in a lake, you can think about life around and under water. What questions do you have? Where can you find answers?



UMD research assistant Jiying Li

Note to Teachers

Find links to teachers guides for this and other stories at *www.mndnr.gov/young_naturalists*.

Layers, Turnover, and Floating Ice

Which creatures live in a zone (littoral, limnetic, or profundal) depends on water temperature, amount of sunlight, and amount of oxygen. A lake has three layers, each with different levels of oxygen, light, and temperature.

In an unfrozen lake, the *epilimnion* layer at the top has plenty of oxygen and sunlight and warmer water than the layers below. The *metalimnion*, often called the *thermocline*, is the layer between warm and cold water. The deepest layer, the *hypolimnion*, is cold and dark with only a little oxygen.

In the fall, as air temperatures begin to drop, the water in the epilimnion gets colder. You will notice this change if you see steam rising from a lake on a cold morning.

As the surface water cools, it gets denser. Eventually, the epilimnion becomes as dense as the hypolimnion. Then the wind mixes the top and bottom layers together, so the water is now the same temperature from top to bottom. The water also has a good supply of oxygen from top to bottom. This mixing of layers is called *turnover*.

As the lake water turns from liquid to solid ice, the water molecules line up in a lacy pattern with many empty spaces. The spaces make the ice less dense than cold water, so it floats instead of sinking to the bottom. With a cover of ice, the water below does not freeze, and plants and animals can live through the winter.