

Tales From Scales

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Grades: 10-12

Subject: science

Skills: observation, graphing, analyzing

Duration: 60-90 minutes

Vocabulary: circulus, annulus, focus, otolith

Objectives:

- Students will be able to:
- 1) describe the structure of a typical fish scale.
 - 2) understand how the age of a fish can be determined by studying scales.
 - 3) understand environmental factors that affect the growth of fishes.

Method:

Students collect and mount fish scales to determine the ages of fishes.

Background:

Trying to determine the age and lifespan of fish from observations in the wild is very difficult if not impossible. Fortunately, for fisheries researchers, fish keep a permanent record of their life history in some of the hard tissues of their body such as vertebrae, pectoral fin rays, dorsal fin spines, cheek bones and scales.

As fish grows, its scales grow as well. If a scale is lost or removed a new one will replace it. The process is similar to the way a tree grows, but while a tree adds one ring per year a fish scale may gain several rings in a single year.

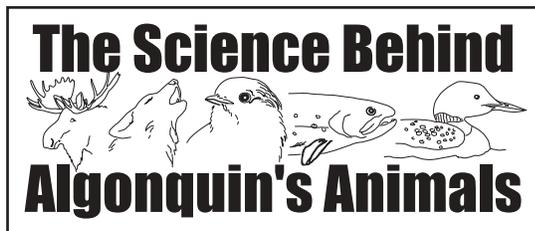
The basis of most aging techniques in fish is the annulus, or year mark. In Algonquin Park where there are distinct seasonal changes, clear annular zones form during winter. The focus is the first



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part of the scale to develop. Then a ridge called the circulus is laid down around the focus (this appears as a dark ring) as the fish continues to grow. Several circuli are added to the scale each year, increasing the size of the scale.

During the late spring and summer warmer, water temperatures, and more available light, stimulate an increase in a fish's metabolism, and circuli are formed further apart. When conditions are not as favourable, such as in winter, growth slows down, and circuli, if formed, are closer together and can appear broken and fragmented. The rings create a zone called the annulus, which indicates the termination of that year's growth. The age of a fish is thus determined by counting the number of annuli.

By determining the age of individual fishes, fisheries researchers are able to gain some insight into the population as a whole. The rate at which fish grow in a given lake or stream can be determined and compared to expected normal growth rates. The onset of sexual maturity in fish does slow the growth rate and because of this, fisheries researchers can thus estimate the age when different species reach sexual maturity. This assists in the development of fishing regulations, such as slot limits for Lake Trout, on many lakes along the Highway 60 corridor in Algonquin Park where stocks have been reduced by over fishing, which protects a large portion of spawning age fish. This regulation was introduced in 1989 largely due to stress on the fish population by anglers. This resulted in an uneven distribution of different ages of fish. Typically, a lot of the older fish will be gone and those that do remain tend to be larger for their age, and most of the population will be dominated by younger fish. The younger fish population will then slowly start to decline as the majority of spawning age fish are gone. By protecting spawning age fish there is a greater production of young Lake Trout.

Fish scales are unique to each species. This is useful as evidence when prosecuting someone for fishing out of season, or when identifying what fish other fish are eating.



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Materials:

✓	Items Required	Quantity
	Parts of a Scale handout	one per student
	Parts of a Scale overhead	one
	Aged Scale overhead transparency	one
	Sample Fish Scale handout	one per student
	fish with scales intact (see Note below)	one
	small knife	one per group
	beaker or jar	one per group
	dish detergent	one bottle
	paper towels	one roll
	microscope slides	one per group
	masking tape	one roll
	microscope (see Note below)	one per group
	small envelopes (optional)	three per group

Note: Scale samples can be taken from a live fish and the fish can be released without harm and the scales will grow back. A dead specimen may be obtained from an angler or purchased from a fish market. The aging process is particularly clear on Lake Whitefish which may be purchased with scales intact.

If microscopes are not available, a scale may be mounted in a 35mm slide mount then projected on a screen.

Procedure:

- 1) Brainstorm what techniques could be used to determine the age of a human, e.g. height, weight, hair colour, skin texture/appearance, teeth, voice etc. Discuss the reasons for the unreliability of these methods (and any other techniques student might come up with)
- 2) Explain that some living organisms keep a record of their age in some of their body structures (e.g. tree rings in a cross-section of a trunk, rings of cementum in the cross-sections of some



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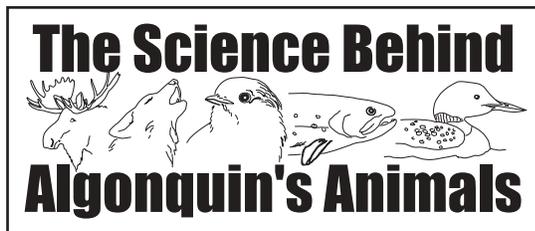
- mammal teeth and annular zone in some hard body parts of fish). These structures change their growth patterns as a result of annual changes in the environment of the organism, e.g. the rings of trees are farther apart when growing conditions are more favorable such as during the spring and summer, and are closer together when conditions are not favourable, such as during the winter.
- 3) Have students list the annual environmental fluctuations that could cause changes in the growth pattern of a fish. Some examples would be warmer water temperatures in the summer, less light in the winter, more biological activity leading to more available food in the summer, etc. Once students have exhausted the list have them hypothesize which seasons a fish would grow the most.
 - 4) Prepare an overhead transparency of the Parts of a Scale and have students note the position of the focus of the scale, the circuli and the annuli. Using the enlarged section of a scale, explain that the annulus is a result of slow growth during the winter and the circuli appear closer together.
 - 5) Give each student a Sample Fish Scale handout and have them determine the age of the fish the scale was taken from.
 - 6) When the students have finished, ask them what the age of the fish is. Write the answers on the blackboard or overhead.
 - 7) Put up the fish scale with age markings to show how the scale is aged.
 - 8) Tell the students that they will now be aging a fish using real scale samples.
 - 9) Divide the class into groups. Have one member from each group scrape away a few scales using a small knife.
 - 10) Instruct some students from each group to soak the scales in a small beaker or jar of warm water with a few drops of dish soap. Have them stir the water briskly to remove much of the mucus and other debris from the scales.
 - 11) Have the students remove the scales from the water solution and pat them dry on a piece of paper towel. Demonstrate how to mount a scale for observation by placing it between two microscope slides.
Note: placing cleaned scales in an envelope to dry for a few days will make the scales easier to read.
 - 12) Have students place the prepared slide on their microscope to observe it.



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13) Have students sketch the scale and label the visible structures and determine the age of the fish by counting the annuli.

Extensions:

- Compare annual growth rings on a tree disc with growth rings from a fish scale. Have students find out how wildlife researchers determine the age of other living things.
- Obtain fish scales from several different species and have students distinguish between them. In what ways were the scales different? How were they the same?
- Contact your nearest Ministry of Natural Resources district office and find out if the fish and wildlife section or the fisheries assessment or research units have any aged fish scales mounted on slides from old lake surveys that they would be willing to donate to your class. Have students determine the age of the scales and compare their results.

Evaluation:

Ask students to:

- 1) Create a graph. If fish scales came from the same species, have students exchange age and length data and prepare an age/length graph for the selected species. A good graph will require a minimum of twenty fish.
- 2) Brainstorm how fishery biologists might use the age data collected from fishes in Algonquin Park to assist in the management of the fishery.
- 3) Obtain another fish scale and assess students' ability to determine the age of the fish and label the following parts: focus, circulus, and annulus.
- 4) Draw the scale they prepared, label the circuli, annulus, and focus and indicate the age of the fish.



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