Run For Your Life Cycle

A fish migration route is full of obstacles! How does a northern pike negotiate three habitats to complete its life cycle?

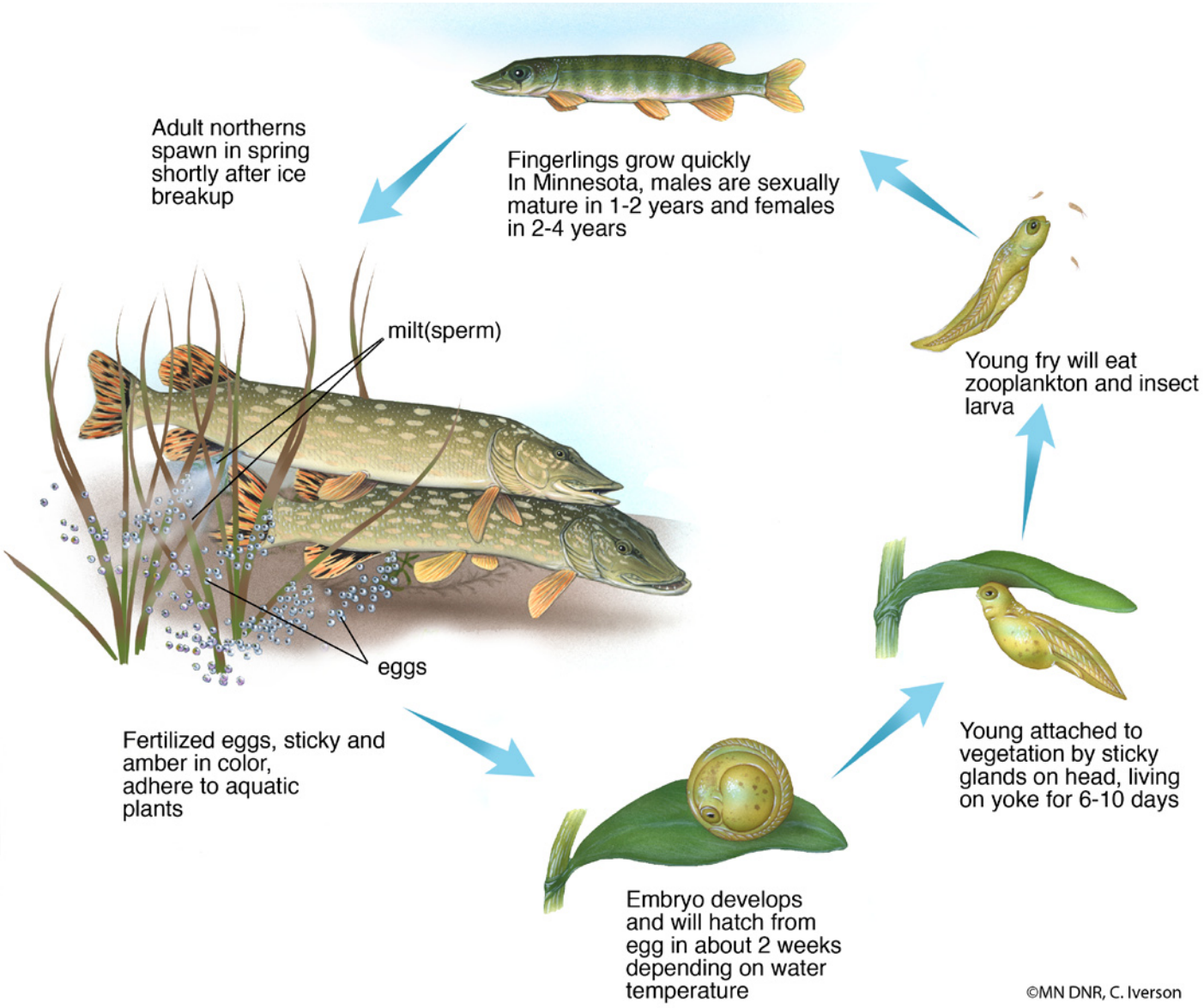


Table of Contents

Chapter 1 • Lesson 3

Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

Run For Your Life Cycle

Minnesota Academic Standards

◒ Lesson *introduces* this Benchmark.
◒ Lesson *partially* addresses this Benchmark.
● Lesson *fully* addresses this Benchmark.

Language Arts

Grade 3
I. Reading and Literature
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand, and use new vocabulary through explicit instruction and independent reading. ●
Benchmark 3—The student will use context and word structure to determine the meaning of unfamiliar words. ◒
III. Speaking, Listening, and Viewing
A. Speaking and Listening:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups. ●
Benchmark 2—The student will demonstrate active listening and comprehension. ●
Benchmark 3—The student will follow multi-step oral directions. ●
Benchmark 5—The student will organize and express ideas sequentially or according to major points. ◒

Grades 4 and 5
I. Reading and Literature
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand, and use new vocabulary through explicit instruction and independent reading. ●
III. Speaking, Listening and Viewing
A. Speaking and Listening:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups. ●
Benchmark 2—The student will demonstrate active listening and comprehension. ●

History and Social Studies

Grades K–3
IV. Historical Skills
A. Concepts of Time:
Benchmark 1—Students will define and use terms for concepts of historical time. ◒ (Life cycles and seasons)

Grades 4–8
II. Minnesota History
G. Post–World War II to the Present:
Benchmark 4—Students will identify and describe significant land use changes in Minnesota, issues related to land use, and analyze the impact of those changes and issues. ◒ (low-head dams)

Geography

V. Geography
D. Interconnections:
Benchmark 1—Students will recognize changes over time in nearby landscapes, resulting from human occupation. ●

Science

Grade 3
IV. Life Science
C. Interdependence of Life:
Benchmark 1—The student will know that organisms interact with one another in various ways besides providing food. ●
Benchmark 2—The student will know that changes in a habitat can be beneficial or harmful to an organism. ●

Grade 4
I. History and Nature of Science
A. Scientific World View:
Benchmark 3—The student will recognize the impact of scientific and technological activities on the natural world.
III. Earth and Space Science
A. Earth Structure and Processes:
Benchmark 1—The student will identify and investigate environmental issues and potential solutions.

Grade 5
IV. Life Science
F. Flow of Matter and Energy:
Benchmark 1—The student will recognize that organisms need energy to stay alive and grow, and that this energy originates from the sun.
Benchmark 2—The student will use food webs to describe the relationships among producers, consumers, and decomposers in an ecosystem in Minnesota.

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)

For the full Environmental Literacy Scope and Sequence, see:
www.seek.state.mn.us/eemn_c.cfm

Chapter 1 • Lesson 3

Run For Your Life Cycle

Grade Level: 3-5
Activity Duration: 50 minutes
Group Size: 20-60
Subject Areas: Language Arts, Social Studies, Physical Education, Science
Academic Skills: drawing conclusions, generalization, kinesthetic concept development, large group skills, listening, public speaking, reading, role-playing, simulation
Setting: large indoor or outdoor open area
Vocabulary: embryo, fingerling, fish passage, imprint, life cycle, limiting factor, low-head dam, migration, population, run, sac fry, swim-up fry, spawn
Internet Search Words: fish life cycle, fish limiting factors, fish migration, low-head dam, Minnesota DNR Fisheries, northern pike, northern pike life cycle

Instructor's Background Information

Cold winters, hot summers, dry seasons, lack of food, and the need for a safe spot to bear young are factors that induce animals to travel from one habitat to another. Many animals, including mallard ducks, caribou, and butterflies, travel from one location or habitat to another at some point in their lives. **Migration** is the annual or seasonal movement of an organism from one habitat to another, and typically involves a return trip to the original habitat. Many fish migrate at specific times in their **life cycle**. An organism's life cycle is its progression through a series of developmental stages from inception to its sexually mature state.

Summary

The northern pike is an example of a Minnesota fish species that migrates to complete its life cycle. In this role-playing activity, students become northern pike traveling a migration route through a course depicting a wetland, a stream, and a deep-water lake. Dangers accompany migration—the northern pike encounter both natural and human-induced obstacles as they grow to adulthood and return to the wetland to spawn.

Student Objectives

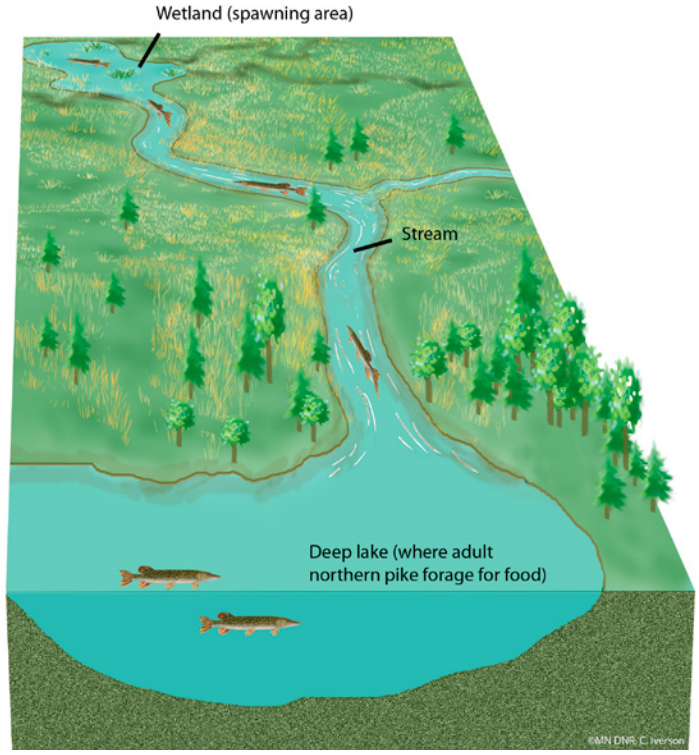
The students will:

1. Name three habitats through which northern pike migrate during their life cycle.
2. Identify the stages of the life cycle of northern pike (egg, sac fry, swim-up fry, fingerling, and adult), as well as the northern pike's place in the food web (as both predator and prey) at each stage.
3. List three natural and three human-induced limiting factors that can affect northern pike during their life cycle.

Materials

- **Northern Pike Life Cycle Sheets**
- **Northern Pike Migration Sheets**
- **Northern Pike Life Cycle Cards**
- **Playing Field Diagram**
- Laminating materials
- Large playing area (100 x 50 feet)
- 100-200 feet of rope, six traffic cones, or masking tape for marking boundaries
- Six to eight traffic cones or other objects to represent aquatic plants in the wetland
- Two jump ropes, each approximately sixteen feet long
- **Kingfisher Name Tag Sheet** (for making name tags or headbands)
- Card stock for kingfisher name tags
- Clothespins or yarn for kingfisher name tags
- Two cardboard boxes, small milk crates, or plastic tote boxes (approximately the size of a shoebox)
- 100 tokens, such as poker chips, crushed balls of newspaper, large washers, woodworking biscuits, or other similar objects
- Two containers for tokens, such as coffee cans or ice cream pails
- Marked area for broad jump, such as two jump ropes
- Whistle or other noisemaker
- Laminated signs for labeling obstacles and game areas (optional)

The northern pike is an example of a freshwater fish that migrates to complete its life cycle. Northern pike depend on varied habitats, such as the shallow areas of lakes, wetlands or flooded areas, in which they lay their eggs (their young also use these areas) and streams leading to the deep-water lakes where, as adults, they forage for food.

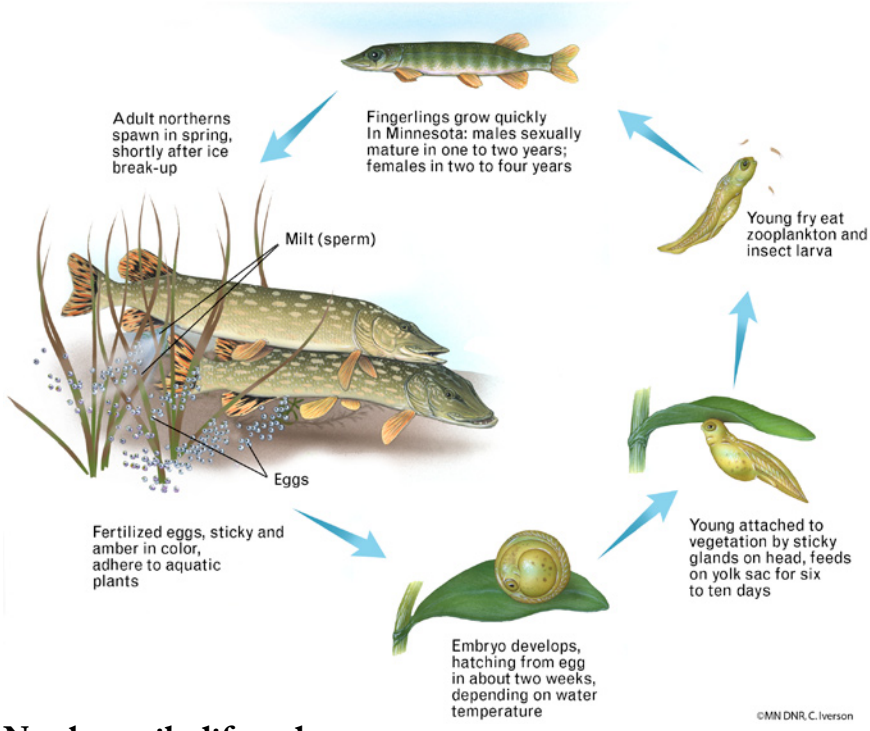


Fish migration or fish traveling to a spawning location is known as a run.

In Minnesota, northern pike spawning begins in late March to early May, when water temperatures reach 33˚ to 52˚ F and lake ice begins to melt. To spawn, male and female northern pike swim, or migrate, from deep water in lakes or large rivers to shallow, vegetated water in wetlands or flooded areas connected to lakes. **Spawning** (reproduction) occurs when the female fish releases and randomly scatters eggs, which are then fertilized by milt (fluid containing sperm) released by the males. Females scatter approximately 32,000-100,000 eggs over plants in water that is often no more than three feet deep. Northern pike eggs are immediately vulnerable to a variety of environmental factors, including predators (crayfish, aquatic invertebrates, and small fish) and suffocation due to oxygen deprivation. After spawning, the male and female northern pike swim back to deeper water, leaving the fertilized eggs, or **embryos,** on their own. The sticky fertilized eggs sink slowly in the water. As they fall through the water, the eggs cling to live or decaying plants, or to the roots of aquatic vegetation. The eggs stick to the plants for approximately two weeks. The embryos then hatch, and are referred to as **fry**.

The shallow water of a wetland warms faster than the deeper water in lakes. The warmer temperatures cue the eggs to develop and hatch,

usually in twelve to fourteen days, when water temperatures reach approximately 49° F.



Northern pike life cycle

Newly hatched northern pike are called **sac fry**. Their sticky heads keep them attached to plants as they absorb proteins from yolk sacs located near their bellies. Sac fry are vulnerable to the same environmental factors as eggs. After a few weeks, the yolk sacs disappear, and the small, free-swimming fish are called **swim-up fry**. Swim-up fry are vulnerable to predation by small fish, dragonfly larvae, back swimmers, predacious diving beetles, and other aquatic insects. The ravenous swim-up fry consume plankton and aquatic invertebrates, but soon switch to a diet consisting mostly of small fish. Because northern pike are the first Minnesota fish species to spawn, and their eggs are the first to hatch each year, young northern pike have an advantage—they can eat the fry of other fish species emerging from their egg stages. After a few more weeks, the swim-up fry are four inches long—the length of a finger—and are called **fingerlings**. In late spring or early summer, the fingerlings move from shallow water to deeper, cooler water to find room to grow and more fish to eat. Juvenile northern pike are vulnerable to predation by larger fish and other aquatic organisms.

When the fingerlings are a year old, they're considered adults. Small adult northern pike remain in shallow, weedy water throughout much of the year, where they find food and hide from larger predators. At two years old, an adult reaches sexual maturity. Large adult northern pike move to deeper water, seeking well-oxygenated water of 65° F or cooler. Northern pike often live for ten to twelve years, but some have lived for more than 20 years.

Female sunfish lay eggs in nests hollowed from the lake bottom by the males. After fertilizing the eggs, male sunfish stay to guard the nests, fanning their tails over the eggs to keep them free of silt and sediment and to keep them oxygenated. The males also protect newly hatched fry from predators.

All organisms, including fish embryos, juveniles, and adults, need food energy to grow and to function. All food energy originates from the sun. The sun's energy enters the food chain when plants convert the sun's energy into food energy through the process of **photosynthesis.**

Large northern pike become lethargic in warm water—their metabolism slows and they eat very little, sometimes losing weight. During prolonged exposure to high temperatures and low oxygen levels, northern pike can actually starve to death.

Like salmon, northern pike return to their original spawning sites. Juvenile northern pike **imprint** or memorize, the unique odors of their home spawning sites. As adults, their sense of smell helps them detect these odors, guiding them on the return trip upstream to their original spawning area.

The state record for the largest northern pike caught in Minnesota is 45 pounds, 12 ounces. This fish was caught in Basswood Lake in Lake County on May 16, 1929.

A low-head dam and water current.

Adult northern pike eat a variety of fish species. With a torpedo-like body shape, they're built for quick acceleration in the water. Due to their large size, northern pike can't afford to expend a lot of energy pursuing small morsels. They concentrate their effort on larger forage, often swallowing prey one-third their own length. Common foods include yellow perch, tullibee, suckers, large minnows, and other northern pike. Although northern pike do eat sunfish and bass, they prefer cylindrical-shaped fish—they're a better fit for their mouths, and they usually swallow their prey head-first. Northern pike also eat leeches, frogs, and crayfish, and pretty much anything else that comes within reach of those large, sharp-toothed mouths!

Limiting Factors

Northern pike face a variety of **limiting factors** from egg stage through adulthood. A limiting factor is a condition influencing the survival of an organism or population. A **population** is the collection of organisms of a particular species living in a given geographic area. Limiting factors can be natural, or can result from human activity.

Natural limiting factors include drought, floods, and other weather conditions, as well as predators, food shortages, inadequate cover, lack of space, and disease. Human-induced limiting factors include pollution, overfishing, drainage of wetlands for development or agriculture, and accidental chemical or waste spills.

Low-head dams are small, relatively inexpensive concrete structures built to control water levels at the outlet of a lake or a stretch of river. During the 1930s, the Works Progress Administration built hundreds of low-head dams throughout Minnesota. Low-head dams can be limiting factors because they block or impede fish migration. They also create dangerous backflows on their downstream sides. The flow of water over the head (top) of the dam creates a waterfall, and below this waterfall, a turbulent **backflow** or circulating water current is produced. The backflow can capture and hold animals or objects that pass over the dam. When fish attempt to jump over the head of the dam during their spawning run, they often can't pass the backflow—or the dam. Low-head dams pose danger to people as well as to fish. Because the tops of the dams are low in the water on their upstream sides, boaters and swimmers sometimes don't notice the dams until it's too late, and they're suddenly swept over the top of the dam and into the backflow. Numerous drownings have occurred in this manner.

Low-head dams can be removed or modified to include fish passages that help restore natural spawning runs. **Fish passages** are water-filled canals, ladders, or staircases placed in front of the dam. All are designed to help fish bypass human-constructed obstacles. In Minnesota, fish passages over low-head dams are often created by adding boulders and backfill to raise the level of the stream to the height of the dam. This type of project is usually less expensive than removing the dam. Fish

passages minimize the dangers of the head, the drop, and the backflow current, allowing fish to pass upstream or downstream. The risk of people drowning in the backflow currents of the dam is also greatly reduced.

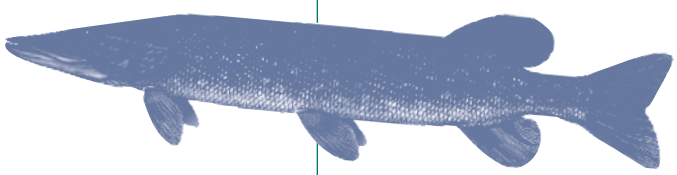
A style of fish passage commonly used in Minnesota.

Fishing pressure can also be a limiting factor for northern pike populations. State fishing regulations keep fishing pressure in check, preventing overharvest.

Biologists view habitat destruction as a primary concern for the health of northern pike populations. Causes of habitat destruction include wetland drainage, loss or removal of aquatic and shoreline plant life, and the construction of barriers (dams or roads) between wetland areas and lakes.

Predators are another limiting factor for northern pike, and include turtles, otters, mink, kingfishers, egrets, great blue herons, osprey, other northern pike, and people (anglers).

A female lays from 32,000 to 100,000 eggs during a spawning season. Due to natural and human-induced limiting factors, only a small percentage of these offspring survive to return to the wetlands where they hatched to spawn as mature adults.



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Procedure

Preparation

1. Copy one **Northern Pike Life Cycle Sheet** and one **Northern Pike Migration Sheet** for each student, or enlarge them and make posters to hang in the classroom.
2. Make one set of **Northern Pike Life Cycle Cards.**
3. Using the **Kingfisher Name tag Sheet**, make two kingfisher Name tags or headbands.
4. Refer to the **Playing Field Diagram** and set up the playing field as shown. Include the wetland spawning grounds, plants, low-head dam, downstream, lake with two token containers, upstream, low-head dam (with a waterfall), and broad jump.
5. You may want to make laminated signs for each area along the migration course to remind students what each obstacle course area represents: wetland, plants, downstream, lake, upstream, low-head dam, waterfall, and fish passage.

Activity

Warm-up

1. Choose five student volunteers to stand in front of the class. Distribute one **Northern Pike Life Cycle Card** to each. Have students hold their cards on their foreheads with the picture side facing out. Ask them to arrange themselves in order of youngest to oldest northern pike life stage. When they're in the correct order, have each student read their card aloud to the class. Discuss the definition of life cycle with the students.
2. Project or distribute copies of the **Northern Pike Life Cycle** and **Northern Pike Migration Sheets**. Tell students that northern pike migrate to complete their life cycle. Ask students what it means to migrate.
3. Ask students to think of the types of obstacles or challenges that a fish might encounter as it travels along its migration route to spawning habitat. Answers will be general and will vary because the students don't yet have a specific type of fish or habitat to consider.
4. Tell students that they're going to travel an obstacle course to learn more about the migration and life cycle of northern pike. As they play the game, ask them to think about the various food web roles that northern pike play during different stages of their life cycle.

Lesson

Round One: Playing the Game

1. Explain the general set-up of the playing field to the class. Tell the students they're all northern pike eggs—newly deposited in a wetland—and that they'll try to complete their life cycles. Their job will be to migrate from the wetland, down the stream, and into the big lake. When they reach the lake, they'll find lots of food and grow into adults. They'll then migrate upstream (the upstream

- The **Playing Field Diagram** illustrates the set-up for each round of the game.
- Each student participates in every round. You may wish to switch the students' roles (northern pike, kingfishers, anglers) in different rounds.
- You may wish to time each round and have students discuss the reasons why it takes differing amounts of time to complete each round.

area is separated from the downstream area to avoid collisions) and return to the wetland to spawn and have their own young.

2 Describe the course locations the students will visit during Round One.

Wetland spawning ground—This is where the game starts. Six to eight cones in the wetland represent aquatic plants. The northern pike begin their lives as eggs, which attach themselves to the plants. Students begin the game curled up next to the cones. **Downstream—**After hatching and growing into fingerlings, the northern pike travel downstream to the lake. **Lake—**In the lake, the northern pike must move back and forth across the lake area to gather four tokens: there is a container of tokens on each side of the lake. The tokens represent food, and players can pick up only one at a time—first from one container and then, after crossing the lake, from the other container. As it crosses the lake and returns to the first container, each northern pike picks up a third token, and travels back across the lake for a fourth token. When a fish has four tokens, it has had enough food to grow into a mature adult fish, which may then migrate upstream to the wetland to spawn. **Upstream—**The adult northern pike travel upstream to the wetland. **Wetland spawning ground—**This round ends when all northern pike return to the spawning ground.

3 Review the northern pike life cycle with the students. Explain that each northern pike should loudly declare the stage of their life cycle as they proceed from one stage to the next.

- As the game begins, students curl up next to plants (cones) in the wetland. They should all shout, "Egg!" and touch a cone. They should continue to touch the cone while slowly counting aloud to fourteen (it takes approximately fourteen days for an embryo to hatch from an egg).
- Then they must stand, with their hands still on the cone, and shout, "Sac fry!" and count aloud to ten.
- Shouting, "Swim-up fry!" the students may let go of their cones and swim (crawl) around the wetland, moving up and down, while slowly counting aloud to 21.
- After counting to 21, the northern pike shout, "Fingerling!" and begin their journey downstream to the lake.
- Upon reaching the lake, and after gathering the four tokens as instructed, the northern pike shout, "Adult!" They've spent one or two years growing and maturing in the lake. They're ready to head downstream toward the wetland to spawn.
- When the northern pike reach the wetland, they shout, "Spawn!" They've now completed their life cycle.

4 Using a whistle or other noisemaker, signal the students to begin Round One.

5 This round concludes when all northern pike have reached the wetland spawning ground. Signal the end of Round One. Discuss with students what happened in this round. How many northern pike completed their life cycle? (All of the northern pike should

During the round, stop students at different points along the migration route. Ask students to state their stage of the northern pike life cycle at that point. Ask them what a northern pike might eat, and what might eat them during this stage of their life cycle. What roles do they play in the food web—predator, prey, or both?

have completed the cycle because there were no obstacles, or limiting factors, on the migration route.)

Round Two: Natural Predators as Limiting Factors

1. Follow the same directions as for Round One, but this time, add a natural predator (kingfishers) as a limiting factor for the northern pike as they travel downstream.
2. Choose two students to be kingfishers and give them kingfisher Name tags (or headbands). Place them in the downstream area of the course. The predators must catch (tag) the northern pike with both hands after the fingerlings leave the wetland and arrive in the downstream area. Tagged fish are dead and must sit out. They may become eggs again after the first successful adult northern pike return to the wetland to spawn. The kingfishers must escort the tagged northern pike to a designated area outside of the stream. (This allows some northern pike to pass downstream to the lake without the kingfishers present.)
3. Can the students predict what will happen in this round?
4. Signal the students to begin the round. You may wish to continue the round, allowing the returning northern pike to spawn. The students on the sidelines can become eggs again, while the surviving adults continue back downstream after they've spawned. Signal the end of the round sometime after the last surviving adult northern has returned to the wetland to spawn.
5. At the end of this round, discuss with the students the number of northern pike that made it back to the wetland to spawn, comparing the results to Round One. Discuss why fewer adult northern pike made it back to the wetland in this round.

Round Three: Anglers as Limiting Factors

You can adjust the number of anglers and other predators according to class size.

1. Follow the same directions as Round Two, but this time, add an angler as a limiting factor for the northern pike in the lake. (Keep at least one kingfisher in this round if you have enough participants.)
2. Choose two students to be anglers and give each a cardboard box to represent a fishing boat. With one foot in the box, anglers should shuffle along in the lake to attempt to catch (tag) northern pike in the lake with both hands. Tagged fish must sit out. The anglers then escort the tagged northern pike to a designated area outside of the lake. Again, this allows some northern pike to pass freely while anglers lead their catches to the designated area.
3. At the end of this round, discuss with the students the number of northern pike that made it back to the wetland to spawn in Round Three, comparing the results to the previous rounds. Discuss why a different number of northern pike may have made it back to the wetland this time.

Round Four: Low-head Dam as a Limiting Factor

1. Follow the same directions as in Round Three, but add a low-head dam as a limiting factor as northern pike travel between the stream and the lake.
2. Choose two adults or tall students to be a team. Between the downstream section of the course and the lake, this team swings the jump rope, which represents a low-head dam located in the downstream area next to the lake. The students must jump rope before entering the lake, representing northern pike jumping over the head of the dam and trying to clear the turbulent water below. The northern pike must not go around the jump rope twirlers. They may slip under the twirlers' arms, but *must not get touched by the twirlers or the rope as they do so.* They may also run underneath the twirling rope or jump it several times, if they prefer. A northern pike "dies" if touched by the twirling jump rope at any time.
3. When all the northern pike moving downstream have passed the dam, the rope twirlers simulating the low-head dam should move to the upstream side of the course, between the upstream area and the lake, to represent the waterfall, or jumping the head of the dam. They should place two jump ropes on the ground (see **Playing Field Diagram**) to represent the distance that northern pike must jump to clear the waterfall and the dam. Be sure this jumping distance is challenging, but the students should be able to do it as a standing broad jump. The northern pike must jump the entire distance of the standing broad jump to continue. If a northern pike fails to make the jump, it doesn't survive the waterfall and backflow current and must sit out.
4. At the end of this round, discuss with the students the number of northern pike that made it back to the wetland to spawn, comparing results from the previous rounds. Discuss why there might have been a difference in the number of northern pike that made it back to the wetland this time.

Round Five: Fish Passage Reducing the Impact of a Limiting Factor

1. Follow the instructions for Round Four, but place a fish passage between the lake and the wetland on the upstream side of the stream—to take the place of the upstream waterfall over the lowhead dam. The lowhead dam on the downstream side of the course will still remain.
2. Any northern pike that "dies" during in this round will immediately become part of the fish passage. The kingfishers and anglers will escort the tagged northern pike to the fish passage. This removes the predators from the field regularly, providing a more realistic survival ratio.
3. The students depicting the fish passage should kneel on the ground in a line facing the wetland, an arm's-length apart, and in single file. The adult northern pike must weave through the line of students forming the fish passage in order to enter the wetland. This enforced trip through the fish passage demonstrates how restricted

If you wish, use cones rather than students to represent the fish passage. The expired northern pike can be escorted to the sideline area.

and tedious an upstream journey through a fish passage can be. Within the fish passage, the predators may not tag the northern pike.

4 At the end of this round, discuss with the students the number of northern pike that made it back to the wetland to spawn, comparing the number to previous rounds. Discuss why there might have been a difference in the number of northern pike that made it back to the wetland this time.

Round Six: A Drought Year as a Limiting Factor

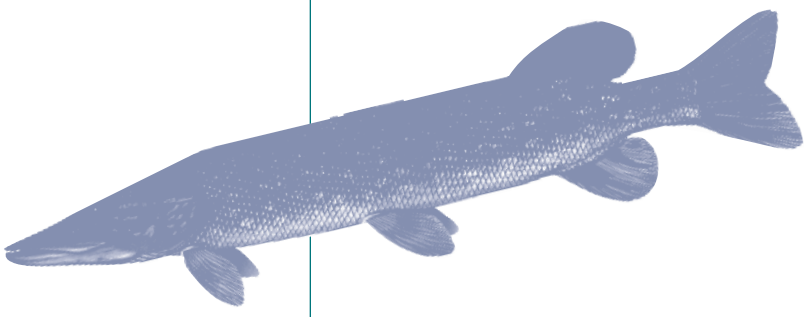
1 Follow the instructions for Round Five, but this time, drought is the limiting factor for fish traveling downstream.
2 Narrow the size of the stream to simulate reduced water flow. This will crowd the students and make it harder for them to get past the kingfishers.
3 At the end of this round, discuss with the students the number of northern pike that made it back to the wetland to spawn, comparing the number to previous rounds. Discuss why there might have been a difference in the number of northern pike that made it back to the wetland this time.

Wrap-up

1 Engage the students in a discussion of the following questions:
   - Do all northern pike fingerlings become adults?
   - What were the limiting factors in the game? Can you think of other limiting factors?
   - What was the most challenging part of the migration course?
   - Where were the most northern pike caught? Which parts of the route were less difficult?
   - What would happen if all the fingerlings made the journey successfully?
   - What seemed realistic about this game? What didn't seem realistic?
   - Name the three habitats though which northern pike must migrate to complete its life cycle.
   - Do northern pike have more than one role in a food web? At what stages of its life cycle is it a predator? At what stages is it prey for other predators?
   - Why do adult female northern pike produce so many eggs?
2 Have students draw the limiting factors they encountered during the game on their copies of the **Northern Pike Migration Sheet**.
3 Encourage the students to form the generalization that all animals, not just northern pike, are affected by limiting factors in their environments.

Assessment Options

1. Have students draw a picture of a northern pike's migratory route, including the following:
   - major stages of the life cycle (egg, sac fry, swim-up fry, fingerling, adult)
   - the locations to which northern pike travel (wetland, stream, lake)
   - some natural limiting factors (such as drought, floods and other weather conditions, predators, food shortages, inadequate cover, crowding, and disease)
   - at least three human-induced limiting factors (such as pollution, anglers, drainage of wetlands for development or agriculture, and accidental chemical or waste spills)
2. Have students draw or make a model of a food web that includes northern pike eggs, sac fry, swim-up fry, fingerlings, and adults. You could also have them use a computer graphics program to make their food web.
3. Have students compose a ballad (narrative song or poem, especially a traditional one telling a story in a number of short, regular stanzas, often with a refrain) that depicts the life cycle of northern pike and the challenges or limiting factors they face as they migrate to complete their life cycle.
4. Assessment options include the Checklist and Rubric on the following pages.



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Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

20-22 points = A
Excellent. Work is above expectations.

17-19 points = B
Good. Work meets expectations.

13-16 points = C
Work is generally good. Some areas are better developed than others.

9-12 points = D
Work does not meet expectations; it isn't clear that student understands objectives.

0-8 points = F
Work is unacceptable.

Run For Your Life Cycle Checklist

Possible Points	Points Earned Student	Points Earned Instructor	
5	_____	_____	Student draws all life stages (egg, sack fry, swim-up fry, fingerling, and adult).
3	_____	_____	Student draws all three habitats (lake, stream, wetland).
3	_____	_____	Student places the correct life stage in each of the three habitat areas.
6	_____	_____	Student draws or describes at least three natural and three human-caused limiting factors.
3	_____	_____	Poster is attractive, legible, and easily viewed from a distance.
2	_____	_____	Student defines *migration* and *life cycle*.
Total Points			
22	_____	_____	**Score** _____

Run For Your Life Cycle Scoring Rubric

Migratory Route Poster Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Life stages of northern pike	Drawing contains all life stages: egg, sack fry, swim-up fry, fingerling, and adult.	Drawing contains four life stages.	Drawing contains three life stages.	Drawing contains two life stages.	Didn't attempt to complete drawing.
Habitat	Drawing contains all three habitats (lake, stream, wetland) with the correct life stages.	Drawing contains all three habitats. One of the life stages appears in an incorrect habitat.	Drawing contains two habitats. Life stages appear in the correct habitat.	Drawing contains two or fewer habitats. Life stages appear in incorrect habitats.	Didn't attempt to complete drawing.
Natural and human-caused limiting factors	Drawing or description contains at least three natural and three human-caused limiting factors.	Drawing or description contains at least two natural and two human-caused limiting factors.	Drawing or description contains at least one natural and one human-caused limiting factor.	Drawing or description contains one natural or one human-caused limiting factor.	Didn't attempt to complete drawing.
Materials and design	Final product is attractive, legible, and easily viewed from a distance.	Final product is attractive, and easily viewed. A few marks on the poster.	Final product is hard to read from a distance and lacks visual appeal.	Final product is messy, illegible and not easily viewed from a distance.	Didn't attempt to complete drawing.

Score _____ (Calculate score by dividing total points by number of criteria.)

Diving Deeper

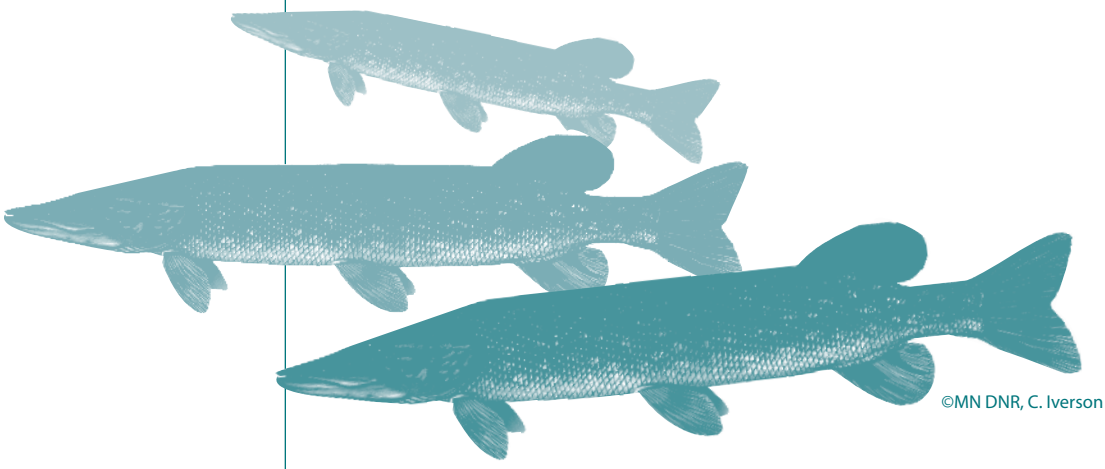
Extensions

1. Compare and contrast the life cycle of the northern pike with the life cycle of another fish such as pumpkinseed sunfish, rainbow trout, or fat head minnows.
2. Tour a fish hatchery that raises migratory species.
3. Look up Minnesota Fishing Regulations referring to northern pike.
4. Call your local Minnesota DNR Fisheries Office and find out if it's possible to view northern pike running (migrating) in your area in the early spring. If so, you could plan to complete this lesson during the spring migration, and then take your students to the stream to view the migrating northern pike. Have students look for rocks and ledges where the northern pike might stop to rest. Ask the students to remember what it was like for them in the Run For Your Life Cycle Game as they tried to pass the various obstacles as they migrated. Help them compare their experiences in the game with their observations of what the northern pike appear to be experiencing as they migrate.

For the Small Fry

K-2 Option

You can do this activity with K-2 students—just reduce the number of limiting factors in the game and play fewer rounds.



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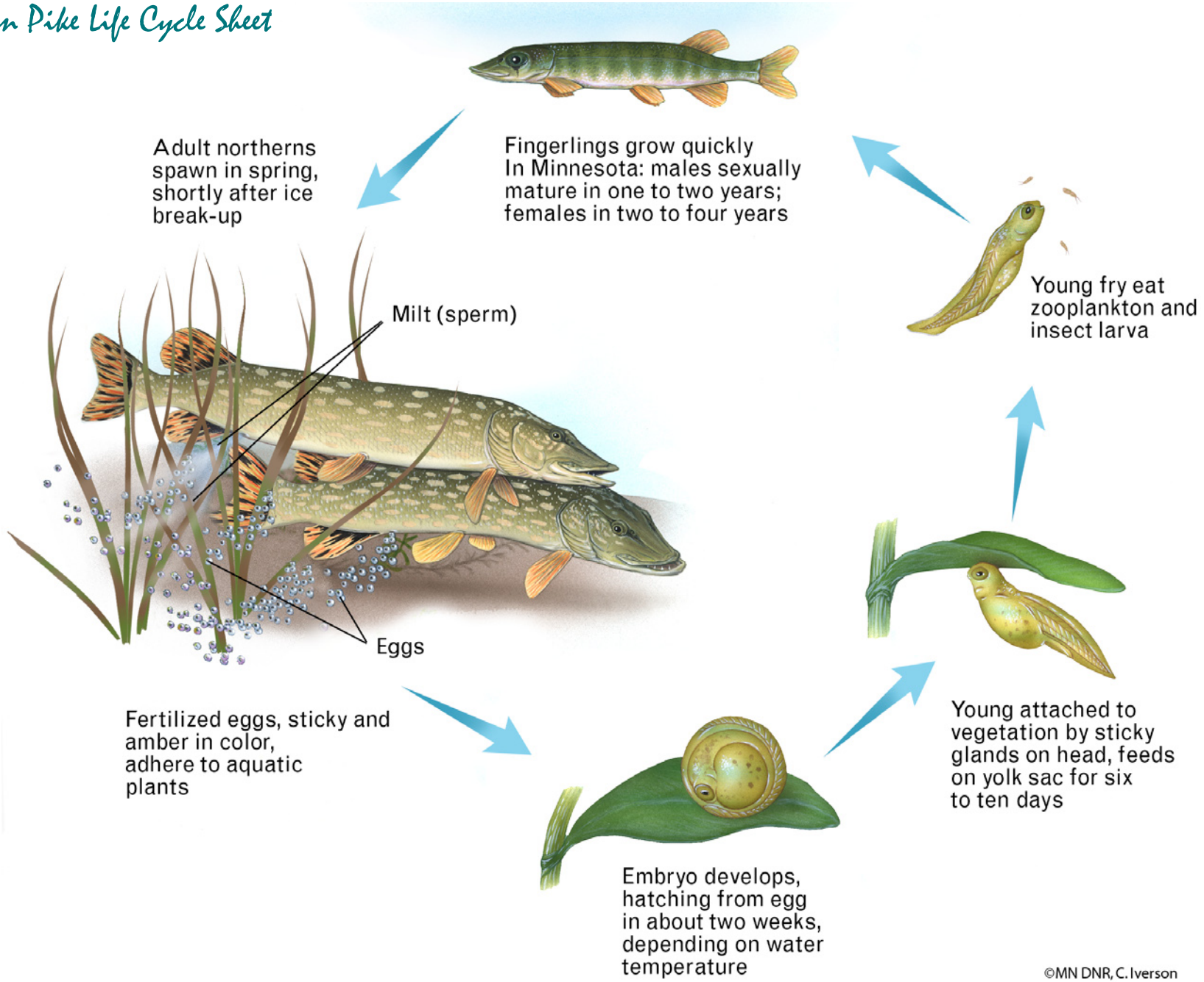
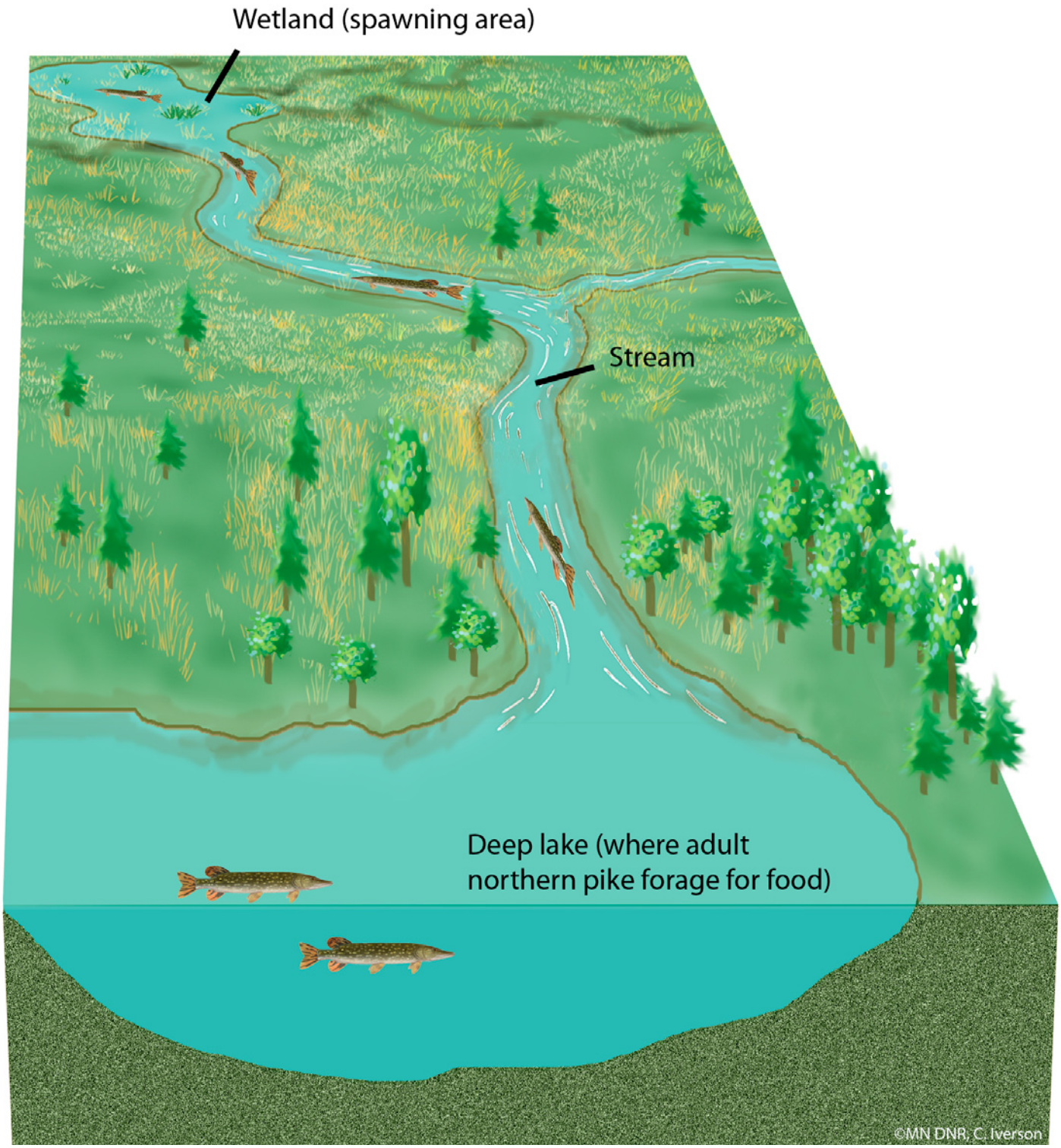
STUDENT COPY

Northern Pike Life Cycle Sheet



STUDENT COPY

Northern Pike Migration Sheet



Northern Pike Life Cycle Cards

Copy these cards, cut them out, and cut or fold them to make two-sided cards.
Glue them to card stock or laminate them.

Egg: 14 days

I'm an **egg**. I'm stuck to a plant in a shallow water area called a wetland.

Sac fry: 6-10 days

I'm a **sac fry.** I've just hatched out of my egg. I absorb food from a yolk sack near my belly. My head sticks to a plant in the wetland to keep me from falling into the muck.

Swim-up fry: 21 days

After my yolk sac is gone, I get very hungry! I eat plankton, little bugs, and small fish. I'm learning to swim, so when I try to swim up, I sink. That's why I'm called a **swim-up fry**.

Northern Pike Life Cycle Cards

Fingerling: 90 days

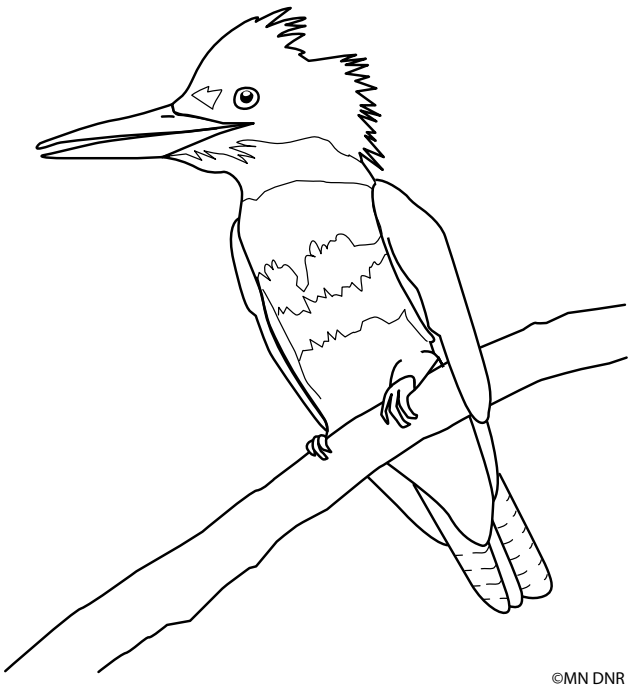
When I've grown as long as a person's finger, I'm called a **fingerling**. I move out into the bigger lake to eat bigger prey and to grow some more.

Adult: One year
Sexually mature adult: One to two years

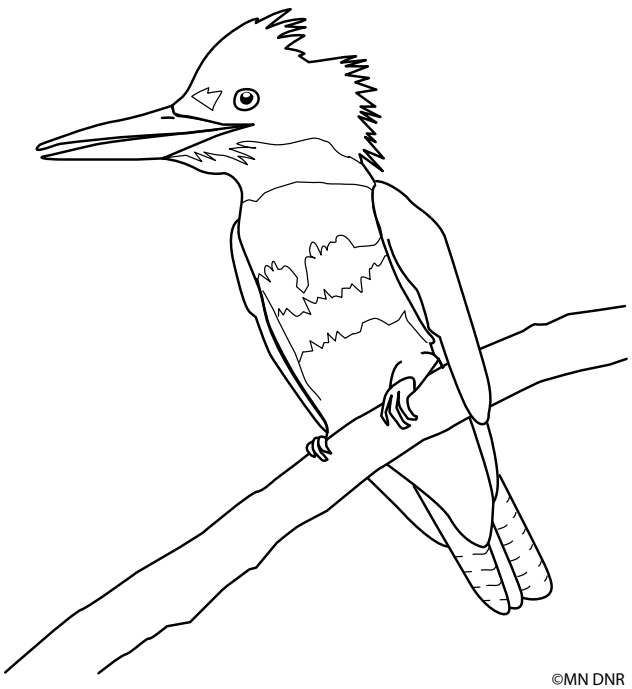
After a year or two, I'm an **adult,** and I'm ready to reproduce. In spring, I *migrate* from the big lake or river back to a small stream or wetland to reproduce. After I *spawn* (lay eggs if I'm a female, or fertilize eggs if I'm a male), I return to the lake or river until next year.

Kingfisher Name Tag Sheet

To make identification name tags or headbands, copy and cut out the tags and glue (or laminate) them to card stock. Students may color the kingfishers.



Kingfisher



Kingfisher

INSTRUCTOR COPY

Playing the Game—Crib Sheet

- Do the Life Cycle activity explained in the Warm Up of this lesson.
- Explain the general set-up of the playing field to the class. Tell the students they're all northern pike eggs—newly deposited in a wetland—and that they'll try to complete their life cycles.
- Explain that students will migrate from the wetland, down the stream, and into the big lake.
- When they reach the lake, they'll retrieve 4 poker chips, one at a time from each side of the lake.
- They'll then migrate upstream (the upstream area is separated from the downstream area to avoid collisions) and return to the wetland to spawn and have their own young.

Round One:

- Curl up next to plants (cones) in the wetland and touch a cone. Shout EGG, counting aloud to 14.
- Shout SACK FRY, continue to touch the cone, and count aloud to 10.
- Shout SWIM UP FRY, let go of their cones, swim (crawl) around the wetland, moving up and down, count aloud to 21.
- Shout FINGERLING and begin their journey downstream to the lake.
- Gather four tokens, shout ADULT, head downstream toward the wetland to spawn.
- At the wetland shout SPAWN.
- Discuss with students what happened in the round.
- This cycle is repeated in the rest of the rounds.

Round Two: Natural Predators as Limiting Factors

- Add a natural predator (kingfishers) as a limiting factor for the northern pike as they travel downstream.

Round Three: Anglers as Limiting Factors

- Add an angler (or two) as a limiting factor for the northern pike in the lake. (Keep at least one kingfisher in this round if you have enough participants.)

Round Four: Low-head Dam as a Limiting Factor

- Add a low-head dam as a limiting factor as northern pike travel between the stream and the lake. (Keep kingfishers and anglers if you have enough participants.)

Round Five: Fish Passage Reducing the Impact of a Limiting Factor

- Place a fish passage between the lake and the wetland on the upstream side of the stream—to take the place of the upstream waterfall over the lowhead dam. The lowhead dam on the downstream side of the course will still remain. (Keep kingfishers and anglers if you have enough participants.)
- Any northern pike that "dies" during in this round will immediately become part of the fish passage. The kingfishers and anglers will escort the tagged northern pike to the fish passage. This removes the predators from the field regularly, providing a more realistic survival ratio.

Round Six: A Drought Year as a Limiting Factor

- Narrow the size of the stream to simulate reduced water flow. This will crowd the students and make it harder for them to get past the kingfishers. (Keep or remove lowhead dams and/or anglers.)

Playing Field Diagram