The Lake Game

People must work together to prevent pollution—an ounce of prevention is worth a pound of cure.

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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

The Lake Game

Minnesota Academic Standards

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

Language Arts

Grades 3 and 4
I. Reading and Literature
C. Comprehension:
Benchmark 3—The student will generate and answer literal, inferential, interpretive and evaluative questions to demonstrate understanding about what is read. ◒

Grade 5
I. Reading and Literature
C. Comprehension:
Benchmark 7—The student will generate and answer literal, inferential, interpretive and evaluative questions to demonstrate understanding about what is read. ◒

History and Social Studies

Grades K – 3
VI. Economic Choices
A. Economic Choices:
Benchmark 4—Students will give examples of tradeoffs (opportunity costs). ●
B. Producers and Consumers:
Benchmark 2—Students will recognize and explain that natural resources, human resources, and human-made resources are used in the production of goods and services. ◍ (Good on addressing resources, weak on distinguishing producers and consumers).
VII. Government and Citizenship
B. Beliefs and Principles of United States Democracy:
Benchmark 1—Students will give examples of rules in the classroom/school and community, provide reasons for the specific rules, and know the characteristics of good rules. ◒
Benchmark 2—Students will explain that rules and laws apply to everyone and describe consequences for breaking the rules or laws. ◒

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. ◍
V. Geography
C. Physical Features and Processes:
Benchmark 2—Students will describe and locate major physical features in their local community and analyze their impact on the community. ◍ (Not everyone will have a lake nearby, if so, then lesson addresses Benchmark fully).
D. Interconnections:
Benchmark 2—Students will analyze how the physical environment influences human activities. ◍
D. Interconnections:
Standard: The student will describe how humans influence the environment and in turn are influenced by it.
Benchmark 1—Students will recognize changes over time in nearby landscapes, resulting from human occupation. ◍ (Not everyone will have a lake nearby, if so, then lesson addresses Benchmark fully)
VI. Economics
A. Producers and Consumers:
Benchmark 2—Students will explain that in market economics, individuals earn income by working for firms to produce goods and services, and firms incur costs by hiring individuals and earn revenue by selling goods and services. ◒

B. Economic Choices:
Benchmark 2—Students will apply a decision-making process to make informed choices.
C. The Market Economy (Micro Economics):
Benchmark 1—Students will identify and compare and contrast various industries and the occupations related to them.

Science

Grade 3
IV. Life Science
C. Interdependence of Life:
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 2—The student will discuss the responsible use of science.
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
III. Earth and Space Science
A. Earth Structure and Processes:
Benchmark 3—The student will describe how waves, wind, and water shape and reshape the earth's surface.

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 3 • Lesson 5

The Lake Game

Adapted from: Liukkonen, B. (1998). The Lake Game, For People Who Care About Lakes. University of Minnesota Sea Grant Program. The Lake Game is reprinted with permission from the University of Minnesota Sea Grant Program.

Grade Level: 3-5
Activity Duration: 55 minutes
Group Size: any
Subject Areas: Science, Language Arts, Social Studies
Academic Skills: application, drawing conclusions, listening, observation, problem solving, reading, roleplaying
Setting: gathering area
Vocabulary: algae growth, designated use, economics, ecosystem-based management, erosion, land use, pollution, Secchi disc, sediment, sustainable, turbidity, user groups, values
Internet Search Words: water pollution, watersheds

Instructor's Background Information

Minnesota is known as the Land of 10,000 Lakes. Our lakes exist in environments ranging from developed urban settings to remote wilderness areas. Lakes face a variety of threats, including overuse, pollution, and the introduction of exotic species. Because Minnesota's lakes serve many people and purposes, there are probably as many viewpoints on their use and management as there are people in the state!

Throughout Minnesota, counties develop water management plans and citizens form lake associations. Individuals and groups involved in these processes may have very specific ideas about how water resources should be used or managed. One group may be concerned about **economics**, or the businesses and jobs in a community, while another group may be concerned about recreational opportunities like fishing and boating. Another group might be concerned about protecting a threatened species or the aesthetics of a particular area. The Lake Game introduces students to numerous environmental perspectives and the necessity of considering the **values**—those things considered important, beneficial, or useful—held by various community interest groups. In Minnesota, and elsewhere, people must work with those whose values differ from their own in order to protect and improve community water resources and use them in a sustainable way. **Sustainable** resource use means using natural resources in ways that meet present needs and aspirations without compromising the environment's ability to meet the needs and aspirations of future generations. Sustainability calls for conserving and restoring the natural environment while enhancing economic opportunity and community well-being.

Summary

The Lake Game challenges students to make decisions in a variety of situations related to water use, pollution, recreational and industrial values, economics, and exotic species. Using roleplaying cards, students assume the roles of various people and consider situations affecting a local lake. As the game progresses, the lake's water becomes polluted and depleted as a result of the players' decisions. After the game, the decisions are discussed and alternatives explored.

Student Objectives

The students will:

1. Participate in a game in which they make decisions that impact the quality of a local lake.
2. Discuss actions that make them better stewards of water resources.

Materials

Some of these materials are optional. You may find it helpful to read the lesson procedure before collecting materials.

- **Roleplaying Cards**, one set for students and **Discussion Cards**, one set for instructor
- Map of a local lake and the surrounding area
- Clear container to represent the lake, such as an aquarium, large bucket, wading pool, or a clear plastic garbage bag suspended from a frame

continued

Materials (continued)

- Clear plastic cup for withdrawing water from the "lake"
- Two buckets (one for dirty water, the other for clean water)
- Red and green food coloring, with droppers (one drop of red represents one unit of pollution; one drop of green represents one unit of fertilizer)
- Small shaker filled with soil (players add "shakes" of turbidity to the lake)
- One cup of molasses (to represent oil leaks and pet waste)
- Toilet paper, candy wrappers, crumpled paper, or napkins (to represent trash)
- Rubber worms (available from most sporting goods stores)
- At least three sponge silhouettes of fish, weighted to stand on the bottom of the lake
- At least ten small, colored fish (different than the sponge fish; these represent invasive fish species)
- Fishing rod made from a wooden dowel and string, with a magnet or paper clip hook (or an ice-fishing jiggle stick)
- One picture of a loon or other animal
- One pair of scissors
- Note cards, for mounting **Roleplaying Cards** and **Discussion Cards**
- Clear contact paper (optional)
- Rags
- A representation of a Secchi disc for use in the "lake" (optional; make your own)

This activity focuses on natural science within a social context, addresses the issue of environmental valuing, and identifies the actions that students and others can take to protect and enjoy the environment.

Minnesota Waters

Most of Minnesota's state boundaries are actually water—the Pigeon River and Lake Superior in the northeast, the St. Croix and Mississippi Rivers in the east and southeast, the Red River along the western boundary, and, to the north, the Rainy River and border lakes within the Boundary Waters Canoe Area wilderness. Three of the major continental drainage basins have headwaters in Minnesota. Surface water leaving Minnesota flows eastward through the Lake Superior basin and the Great Lakes to the Atlantic Ocean, southward through the Mississippi and Missouri Rivers to the Gulf of Mexico, or northward through the Red and Rainy Rivers to Hudson Bay.

Very little surface water enters Minnesota from a neighboring state or country. Minnesota exports surface water—and **pollution**—downstream to the water users in other states and Canada. Pollution is defined as anything that alters the water, or makes it harmful, less desirable, or less useful.

Water pollution comes from a variety of sources including: the atmosphere, municipal and industrial discharges, agricultural and urban runoff, contaminated groundwater, and contaminated **sediment**. Sediment is the accumulation of a watershed's erosion (silt, sand, and organic and inorganic material), which accumulates on lake, river, and stream bottoms. Types of water pollution include toxic substances (such as mercury and PCBs), debris (litter and garbage), and sediments (soil, sand, silt, particles). **Land use** practices, or people's activities on land, can cause **erosion,** defined as the gradual wearing away of soil and rock surfaces by natural forces, such as flowing water, wind, and ice. Animal activities can also disturb the soil and vegetation that holds the soil in place. When surface runoff carries silt and sediments from disturbed ground to rivers and lakes, water clarity declines, with increased **turbidity**. Turbidity refers to the quantity of solid suspended particles that scatter light rays through the water. Turbidity makes water cloudy or, in extreme cases, opaque. Silt and sediments negatively affect lakes and rivers. They can cover and suffocate the eggs of fish and other aquatic animals. Sedimentation also prevents sunlight from reaching aquatic plants, inhibiting photosynthesis and oxygen production.

The excessive growth of algae or **algae blooms**, can be triggered as additional nutrients enter water bodies in runoff, including: pet and farm animal wastes improperly collected, contained, or managed; grass clippings and leaves swept into storm sewers; and excessive amounts of fertilizers. Algae blooms also prevent sunlight from reaching aquatic plants. As algae mats die, bacteria decompose the dead plant matter. In

the process of decomposition, bacteria use oxygen, reducing the water's oxygen levels. Algae blooms also diminish the water's beauty and cause unpleasant odors.

In Minnesota, all lakes and streams have a **designated use**. There are seven classes of water for the state, and each has a specific set of water quality standards. These designated use classifications are:

- Aquatic, Fish, and Wildlife
- Recreation
- Industrial
- Limited Resource Value
- Domestic Water Supply
- Agricultural
- Navigational

All Minnesota lakes and 99 percent of its river miles are designated for fishable and swimmable uses. All rivers are classified for agricultural, navigational, and industrial use. Water quality is most often considered in terms of fitness for human consumption, but many other uses also require protecting and preserving adequate supplies of high-quality water.

What is the source or your drinking water? Water contamination can pose the risk of health problems, as well as damaging fishing industries and associated businesses by making fish less desirable to eat. For more information on fish consumption advisories, see **Lesson 6:5—Eating Fish.**

Minnesota has many lakes and rivers, so it may appear that the state has plenty of water to meet its needs. But water consumption is becoming a concern worldwide. The waters of Minnesota are "public waters," meaning they belong to all of us. If property adjacent to lakes or streams is privately-owned, the owner may deny access to the water, but the water itself is in the public domain. This means that all of us are responsible for Minnesota's precious water resources, and numerous values must be considered when making decisions that impact water quality.

Management of Watershed Areas

Increasingly, Minnesota citizens and natural resource professionals are working together to provide sustainable management of the state's invaluable natural resources through management that considers all elements of an ecosystem.

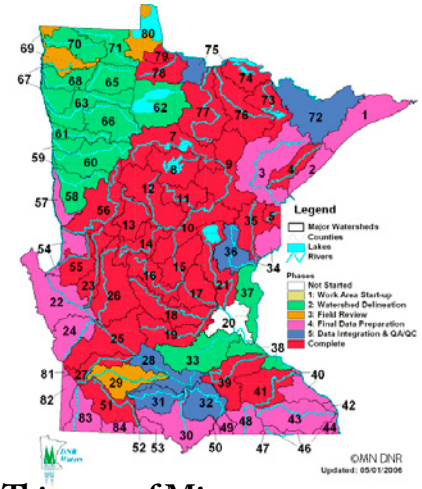
What is an ecosystem? It's a geographic area that includes all the living organisms (plants, animals, microorganisms), their physical surroundings (as soil, water, and air), and the natural cycles that sustain them. All of these elements are interconnected—managing

A **Secchi disk** is a simple, eight-inch diameter tool that measures water clarity (transparency). The depth at which a Secchi disk is visible is directly related to the transparency of the water in a lake.

As an optional addition to this game, you can make a Secchi disk from a white plastic coffee can lid. Cut a two-inch diameter circle from the lid and punch a hole in the center. Use an indelible black marker to color the disk as shown in the photo. Then thread a 16-24-inch length of string or cord through the hole. Use the indelible black marker to mark off every half-inch of the string or cord, beginning at the level of the disk. The disk must be weighted so that it sinks as it's lowered into the "lake" bucket or container. During the game, perform Secchi disk readings to measure the water clarity of the lake at regular intervals during the game. Record the depths at which you no longer see the disk's wedge-shaped markings.

To value something means to judge, rate, or scale its relative worth, cost, importance, or usefulness. For many community environmental issues, value considerations include aesthetics, convenience and efficiency, economics, ecosystem health, education, human health, jobs, recreation, religion, social factors, sustainability, water quality, and wildlife.

The term watershed, or catchment basin, refers to the entire physical area drained by a distinct stream or riverine system, physically separated from other watersheds by ridgetop boundaries. (This definition appears in *Entering the Watershed: A New Approach to Save America's River Ecosystems*, by The Pacific Rivers Council.) For more information on watersheds, see **Lesson 3:3—Wonderful Watersheds**.



This map of Minnesota watershed boundaries shows Minnesota's eight major basins and 82 major surface water watersheds.

one resource affects the ecosystem's other resources. Ecosystems can be small (a single pond) or large (an entire watershed including hundreds of forest stands owned by many different people).

An ecosystem-based management approach explicitly recognizes not only the environment, but also the critical importance of community and economic concerns.

Many stories framed by watersheds and landscapes illustrate the creative work of Minnesota's land managers—and numerous **user groups** (people that use resources in varied ways) including farmers and other landowners, hunters and anglers, DNR professional and technical staff, government and civic leaders, environmentalists, and business owners—as they consider how to best use and protect Minnesota's natural heritage. Individual watershed districts and landscape areas are geographic units that provide effective meeting places for citizens and natural resource professionals addressing environmental issues using the ecosystem-based approach. Many everyday decisions impact the condition of our natural resources, and ultimately, the lives of many people.

Considering that people interact with one another to obtain life's necessities from the environment, it's apparent that people are a component of an ecosystem, too. We must learn how to work together to use resources in a sustainable way.

Procedure

Preparation

1 Before playing the Lake Game, gather maps and factual information about your lake. Obtain a topographic map of the area. USGS maps for most of the state, at a scale of 1:24,000, are available from bookstores, outdoor outfitters, libraries, surveying companies, or the U.S. Government. It's also helpful for players to see the drainage area or watershed of the lake because it shows how land use affects the lake. Obtain copies of maps to pass out, or make a large version to display. Geographic Information Systems (GIS) maps for your area may be available from the Minnesota DNR. (See the Free Maps area on the Minnesota DNR website.) GIS are computer-generated layers of graphic information combined in one map to create a comprehensive view of a place. These layers can be used for different purposes, such as analyzing environmental damage or viewing public parks and waterways in a city. A bathymetric (bottom contour) map of the lake is helpful, too. Lake contour maps can be obtained for many Minnesota lakes from the lake survey information in the Lake Finder area of the Minnesota DNR website: **www.mndnr.gov.** Statewide land use and vegetation cover maps are also available from the Minnesota DNR.

2 Research your lake and its surrounding land uses. Possible questions include:
   - What are the watershed's agricultural, residential, industrial, and forestry uses?
   - How many streams flow into the lake?
   - Does the lake have an outlet?
   - How much of the lakefront is developed?
   - Are lake levels or fishery resources managed? By whom? For what purposes?
   - Do individuals or communities use the water for drinking?
   - Are roadways near the lake salted during the winter?

3 Identify key issues relating to your area lake and land use. Which factors are of concern regarding your lake and surrounding area? Are people concerned about individual point source polluters, or nonpoint sources in general? Are they worried about using the lake for specific purposes such as swimming, fishing, or boating? Does the lake have problems related to invasive plants or animals? What are the primary issues to address during the roleplaying game? You may wish to create some additional role cards to fit the issues relevant to your situation.

4 Cut several fish silhouettes from sponges and weight their bases so they can stand on the bottom of the "lake." Each fish should have a paper clip at its mouth so it can be easily hooked with the fishing pole. You can either place a paperclip loop at the mouth, or, for magnet hooks, attach a paperclip to the mouth so the magnet will stick to it.

The fish silhouettes for the game are cut from sponges and weighted with paper clips, coins, or other items. Each fish should measure approximately four and one-half inches long, and have a paperclip "lip" that can be hooked or attracted to a magnet when players fish in the lake during the game. Examples of these fish silhouette species include bluegill, smallmouth bass, walleye, northern pike, and catfish.

Minnesota Lakes

- Minnesota's rich surface water resources include almost 92,000 miles of streams and more than 11,000 lakes larger than ten acres. (An acre is about the size of a football field.) That's more than 3,400,000 acres of water—not to mention approximately 5,000,000 acres of wetlands!
- Minnesota lake sizes range from less than ten acres to the 3,000,000-acre Lake of the Woods; half are smaller than 50 acres.
- More than 98 percent of Minnesota's lakes are found in the northern and central part of the state.
- Minnesota has 261 Mud Lakes. The other most common names are Long (256), Rice (122), Bass (83), and Twin (72).

The DNR has used GIS since the early 1970s. Minnesota DNR GIS Services staff works with DNR hydrologists and other staff, state and federal agencies, local units of government, and legislators. The staff develops new geographic data sets and provides or coordinates service delivery of GIS maps, data, and interpretive services for the state's wetlands, public waters inventory basins, river resources, watersheds, and calcareous fens. You can download much of this GIS data free of charge from the website: **www.mndnr.gov**

5 Copy and attach the **Roleplaying Cards** to note cards. Make one set—these are for the students. To make the instructor's **Discussion Cards**, place the situation from each of the student **Roleplaying Cards** on one side of a blank note card. Place the **Discussion Card** text on the other side of the card. Cards may be laminated or covered with clear contact paper to waterproof them.

6 Select the situation cards that are appropriate for your class, considering your students' ages and experience, your geographic region, and the economic issues affecting your part of the state. (You may wish to create some different cards than those included here. Take into account issues that may be affecting local water bodies.)

7 Number the cards in the order in which they should be played to allow some pollution of the lake to occur before students remove drinking water and go fishing.

8 Prepare materials. The fishing pole can be constructed from a length of string tied to a dowel, using a bent paper clip or magnet as a hook. Or you can use an ice fishing jiggle stick. If possible, trace a large-scale map of your lake on plastic or a large tarp. Or sketch the map on the ground with chalk. Indicate cities with dots and township or county borders with lines, but do not necessarily identify them by name. If roles have been assigned to specific locations, finding their "home" can be part of the experience for participants unfamiliar with the entire lake. The map should be large enough so that participants can sit around it as they play the game. Fill the container nearly full of clean water to represent your lake. Have access to an extra bucket or sink in which to dump water removed from the lake during the game. Fill an extra bucket with clean water to represent rain.

Option: You may also wish to set up a second lake to use as a control. In the concluding discussion, students can compare the clean water from the control lake with the polluted water of the lake used in the activity.

Activity

Warm-up

1. Ask a guest speaker from the Minnesota DNR or other state agency, a local watershed district representative, resort owner, angler, lake association representative, resource management specialist, city tourism official, bait shop owner, or member of another user group to give a short presentation about what they do and how they're involved with the local lake.
2. Or, ask students to name the nearest lake. Pass out copies of the map of a local lake and discuss the businesses, parks, homes, agriculture, tourism, recreational, and other activities taking place on and around the lake. Ask the students: Who uses the lake? What activities occur there? To whom is the lake important? Which animals and plants live in and around the lake? You may consider creating a PowerPoint presentation about the different user groups to introduce your students to issues surrounding your lake. Ask your local lake association or DNR office for information for this presentation.

Lesson

1. Place the container representing the lake in the center of the large lake map. Stand the fish silhouettes on the bottom of the container.
2. Place the pollution solutions, eyedropper, turbidity shaker, and the container for withdrawing water near the lake. Place the picture of wildlife near the lake. Keep the fishing pole and other game props until their particular roles are read during the game.
3. Distribute the **Roleplaying Cards** and explain the playing order. You may wish to give one card to each student, or have students draw a card before their turn. To reduce playing time and explore fewer situations, place students in groups of two or three per **Roleplaying Card.** Encourage the players to make decisions as they think the person described on their card would. Have participants sit around the map of the lake, read their cards, and consider their decisions.
4. As the participants' turns come, have them read their roles aloud and state the choices they've made if a choice is indicated. Each role should involve an action of some sort. You may or may not want to allow participants to influence one anothers' decisions. (You may read the cards to younger student groups.)
5. Have participants perform the actions indicated on the **Roleplaying Cards**. After the participant has made their decision, the instructor should read the text on the back of the card. This provides some background information and stimulates discussion.
6. Take Secchi disk readings to measure the water clarity of your lake at regular intervals during the game. Record the measurements at which the Secchi disk markings become indiscernible.

Some students may get carried away with putting pollutants in the water just to see what the materials will do to the water in the container, or because it's more fun to add something to the container than not. To address this directly with the students, wait until the discussion at the end of the game, and then inform the students that the lake provides the community with its drinking water. Take a clear glass, dip it into the lake, lift it up for the students to see and ask, "Now, who would like to drink this water?" Discuss the actions that could have been taken to keep the community's drinking water supply clean. Remind students that it's more expensive to clean contaminants from the water at a treatment plant—if it is, indeed, possible—than it is to use water from a clean drinking water supply.

7. Discuss the decisions as you play. Balance economic considerations against idealism. If no one opts to pollute, question the realistic nature of the situation. Compare the multimillion-dollar decisions—which students may feel they can't influence—with personal decisions about actions that reduce or prevent pollution. Discuss how they can influence corporate decisions through letter-writing campaigns, boycotts, and other forms of consumer activism.

Wrap-up

1. Remind students that the container is a simplified model of your lake. In an actual lake, water is constantly added through precipitation (rain) and runoff. Pollution is diluted or flushed out at the outflow. Emphasize that the water in your lake is a limited resource: there isn't an infinite supply of water, and the effects of pollution can linger for many years.
2. Conclude with a review of the choices that polluted or depleted the lake water. Discuss values and economics. Have participants discuss which choices were acceptable and which choices were difficult to make. How could they alter their own or others' behavior patterns and values to better protect their lake? Although they may not be able to alter corporate decisions, they can choose to recycle, avoid littering, and support family actions that reduce pollution.

Option: If you set up a second lake as a control, compare the lake that the students polluted with the water in the control lake. Take a sponge fish from the polluted lake and squeeze out the water. Then squeeze out a sponge fish from the clean lake. Ask the students which fish they would rather eat! Discuss how the pollutants can contaminate fish. (See **Lesson 6:5—Eating Fish**.) Tell students that consumption advisories help people (particularly children and pregnant women) know how much fish they can safely eat if it came from lakes and rivers where these pollutants have been found.

Assessment Options

1. Have students identify a potential or existing local situation concerning conflicting water use interests. By writing a short story, students should identify the various interest groups, the conflicts, and a compromise reflecting the best interests of the community and the lake or stream.
2. Have students create situation and discussion cards based on lake or river protection actions that can be taken by children their age. Create a match game where students match the situation cards to the correct discussion cards. Ask students to write about how their decisions on each situation impact other community members and lake users. Have them include alternate choices or compromises that consider the values and needs of others in the community.
3. Assessment options include the Checklist and Rubric on the following pages.

The Lake Game Checklist

(This Checklist is for Assessment Option 1.)

Possible Points	Points Earned Student	Points Earned Instructor	
4	_____	_____	Story identifies a real or potential conflict in an issue related to a nearby lake or stream.
3	_____	_____	Interest groups are identified.
3	_____	_____	Issue is defined clearly and objectively.
4	_____	_____	Story clearly defines the water use conflict from the viewpoint of each interest group.
4	_____	_____	Story provides at least two solutions to the water use conflict that represent compromises for each interest group's position.
3	_____	_____	Story evaluates how the solution benefits each interest group.
3	_____	_____	Story is well-written with correct paragraph structure and without grammatical errors.
2	_____	_____	Student can define *compromise*.
2	_____	_____	Student can define *water stewardship*.
Total Points			
28	_____	_____	**Score** _____

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

26-28 points = A
Excellent. Work is above expectations.

23-25 points = B
Good. Work meets expectations.

18-22 points = C
Work is generally good. Some areas are better developed than others.

14-18 points = D
Work does not meet expectations; it's not clear that student understands objectives.

0-13 points = F
Work is unacceptable.

The Lake Game Scoring Rubric

(This Rubric is for Assessment Option 1.)

Story Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Water issue	Story identifies a real or potential conflict in an issue related to a nearby lake or stream. Issue is clearly and objectively defined, with interest groups identified.	Story identifies a real or potential conflict in an issue related to a nearby lake or stream. Issue is clearly and objectively defined. Interest groups are unclear.	Story identifies a real or potential conflict in an issue related to a water body in general. Issue is defined but interest groups aren't clearly identified.	Story identifies an unrealistic conflict in an issue related to a made-up lake. Issue is unclear. Interest groups aren't clearly identified.	Doesn't complete story.
Conflicts	Story clearly defines the water use conflict from the viewpoint of each interest group.	Story defines the conflict from the viewpoint of each interest group, but definitions aren't clear.	Story defines the conflict from the viewpoints of a few major interest groups.	Story defines the conflict from the viewpoint of one interest group.	Story includes no water use conflict.
Solution	Story provides at least two solutions to the water use conflict that represent compromises for each interest group's position. Story evaluates how the solution benefits each interest group.	Story provides at least one solution to the water use conflict that represents a compromise for each party's interests. Story evaluates how the solution benefits each interest group.	Story provides at least one solution to the water use conflict that represents a compromise for each party's interests. Story evaluates how the solution benefits most of the interest groups.	Story provides an unsatisfactory solution to the water use conflict that doesn't demonstrate compromise. The story doesn't evaluate how the solution benefits each interest group.	Story provides no solution for the water use conflict.
Grammar and structure	Story is well-written, with correct paragraph structure and without grammatical errors.	Story is well-written, with correct structure and one or two grammatical errors.	Story is written with correct structure, but contains numerous grammatical errors.	Story is poorly-written with numerous errors.	Story isn't completed.

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

Diving Deeper

Extensions

1. Contact resource people and leaders in your community before playing the game and invite them to your classroom to provide information and participate in the game. Key resource people may be representatives of state agencies such as the Minnesota DNR, the Board of Water and Soil Resources, the Minnesota Pollution Control Agency, and the Department of Health. Other contacts include representatives of local government (city, county, or township board members) and officials from local departments of zoning and planning, solid waste, highways and bridges, and public health. Other local resources include the University of Minnesota Extension Service, state Soil and Water Conservation districts, and colleges and universities.
2. You can also identify and contact key people involved in managing and protecting the lake. Does a lake association exist? Is there a core group interested in forming one? Have conflicts developed between user groups such as swimmers and boaters, urban and rural users, or new and long-time residents? If so, be sure to make advance arrangements to involve members from both sides of the dispute.
3. Ask students to research and report on the ecology of a local lake, including major causes and areas of pollution, surrounding population demographics, or the cultural history of the region.
4. Fish often accumulate toxins from polluted water in their bodies. Pollutants, such as PCBs and mercury, build up in the fatty tissues of fish. Have students show the class how to remove these contaminated parts when preparing fish for eating. (See fish consumption advisory information in **Lesson 6:5—Eating Fish.)**
5. Encourage students to identify practices at home that positively and negatively impact the local aquatic environment. Have them list suggestions on how negative practices can be changed to protect the environment. Have them share these with their friends and families.
6. Have students make roleplaying cards for a lake association member, DNR conservation officer, city landowner, member of an angler's club, lake resident, farmer, highway department worker, and other members of groups that have various interests in a local lake or river. Have the students discuss the perspective, values, and point of view of each person depicted on a roleplaying card.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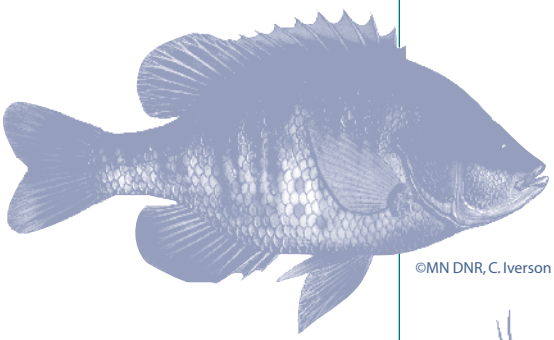
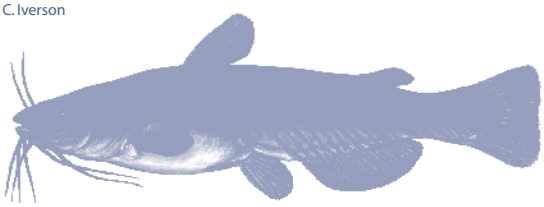
For the Small Fry

K-2 Option

The activity and concepts explored in this lesson may not be suitable for younger students. Instead, have students identify and draw some local community members that depend on the local lake or river for a job, drinking water, business, or recreation. (Possibilities include an angler, instructor, bait seller, tackle industry owner, water treatment plant worker, lakeside restaurant owner, resort owner, tourist, child who likes to swim, conservation officer, or lifeguard). Cut out each drawing. Then have students draw the local lake or river on a piece of poster board. Draw fish in the lake or river. Arrange and glue the community member cutouts around the lake or river. Underneath each cutout, write each person's name or position. Using string or yarn or drawn lines, have students connect the community members to the water and fish. Write the reasons why each person needs clean water or healthy fish (or both) on the line. Then have students make connections between the various people, indicating who is likely to need whom in the community. Discuss how people are part of the natural community and part of the human community. Ask students to place themselves in the picture. What, if anything, connects them to the lake? Are they connected to other members of the community? How? Within a habitat, people interact with one another to obtain life's necessities, or habitat needs. Ask the students to summarize how the lake or river is part of a natural community and how it is important to the human community. Have students create a title for their poster.





Roleplaying Cards

SITUATION 1: Swimming Beach
Your family moves into a new home on a lake. You can't wait to go swimming, but you see a lot of aquatic plants down in the water. What would you do?

1. Ask your parents to get a machine that removes all aquatic plants.
2. Explain that aquatic plants are important to lake health and to fish, and ask your parents to remove no more plants than the DNR allows.
3. Ask your parents to drive you to the public beach and leave the aquatic plants alone.

SITUATION 2: Jet Ski
You're at a friend's lake cabin. Your friend asks if you'd like to ride on a jet ski. You know that your friend rides very fast near shore. What would you say?

1. "Sure, I like going fast, and you don't get to ride a jet ski every day!"
2. "Yes, if we go slowly and don't ride fast near shore because that erodes the shore."
3. "No, thanks."

SITUATION 3: Fertilizer
You're volunteering with your scout group at a local park. There's a lake nearby. You help by picking up sticks so workers can mow the lawn. A worker notices the lawn is not very green or lush and decides to spread extra fertilizer on it. What would you say?

1. Nothing. You're just a kid and he's an adult.
2. "That seems like a lot of fertilizer. How much do you need to make the grass greener?"
3. "Does the fertilizer have phosphorus in it? I've heard that phosphorus can cause algae blooms that harm fish."

SITUATION 4: Leftover Earthworms
You dig or buy some earthworms to use as bait. When you're done fishing, you have extra worms. What would you do?

1. Put the earthworms in the refrigerator at home and use them the next day.
2. Leave the container of earthworms on the fishing pier for the next person to use as bait.
3. Pour the earthworms into the lake to feed the fish.
4. Dump the earthworms onto the shore to set them free.
5. Throw the whole container of earthworms into the trash.

SITUATION 5: Leftover Live Bait
After buying minnows and leeches from a local bait store, you go fishing at a fishing pier. When you're done, you have leftover minnows and leeches. What would you do?

1. Take the minnows and leeches home and use them the next day.
2. Give the minnows and leeches to a friend or to some other angler.
3. Pour the minnows and leeches into the lake.
4. Dump the water and minnows and leeches onto the shore.
5. Bury the minnows and leeches in your garden at home.

SITUATION 6: Aquarium Fish
You have an aquarium at home and you don't want the fish anymore. (Before answering this, decide how many you have—between one and ten fish—and how many you no longer want. Tell the instructor.) What would you do?

1. Ask friends or neighbors if they would like your fish for their aquariums, or give them your aquarium.
2. Release the fish into a lake.
3. Freeze the fish for fish printing.
4. Throw them away.

SITUATION 7: Oil Change
Your seventeen-year-old brother is changing the oil in his car. He asks you to get rid of the dirty oil by pouring it down the storm sewer in the street. What would you do?

1. Do as he says so he'll give you a ride in his car.
2. Dump the oil on the gravel driveway—the sewer is too far away and you've heard that oil keeps down the dust from the gravel.
3. Tell him that it's against the law to dump oil and that he should return it to the place he bought it so that it can be recycled.

SITUATION 8: Littering
You're fishing with a friend, and you notice that he's kind of messy. He opens a new fishing lure and throws the package on the ground. Then he gets a big tangle and has to cut the line. He rolls up the tangled line and leaves it on the ground. After a while he catches a carp and says it's a garbage fish and throws it up on the bank to die. The two of you are getting ready to go home for the day. What would you do?

1. Don't say anything because you think it will hurt his feelings.
2. Tell your friend to pick up his garbage and put the carp safely back in the water.
3. Open the garbage sack you keep in your tackle box and offer to help him clean up his mess.
4. Come back later and clean up his mess.

Roleplaying Cards

SITUATION 9: Pet Waste
You're taking your dog for a walk along your neighborhood lake. Your dog poops on shore. What would you do?

1. Just keep walking.
2. Look around to see if anyone saw what happened. If not, you keep walking.
3. Pull some grass from along the shore and cover it up so that no one sees it.
4. Use the plastic bag you brought along to pick it up and put it a trash can.

SITUATION 11: Electricity
Whenever you leave a room, your mother says, "Don't forget to turn off the light!" What would you do?

1. Turn off the lights because you know it's the right thing to do.
2. Ignore her—you're tired of hearing this and you don't really think there's a shortage of electricity.
3. Turn the lights off sometimes, but not always.

SITUATION 10: Flooding
It's been very rainy this season. It seems like it's rained every day. The streams are running very fast and soil from farm fields, construction sites, and riverbanks is washing into the stream. The stream looks brown in the place where it enters the lake. You wonder how this will affect the fish.

SITUATION 12: Fishing
You want to catch some fish for supper tonight. Have our decisions created a good fishing lake?

Discussion Cards

DISCUSSION 1: Swimming Beach
If you chose:
1. Put six shakes of soil into the water
2. Put three shakes of soil into the water
3. Don't do anything to the lake

Aquatic plants are important to fish because they:
- reduce erosion from waves
- clean the water
- provide food and shelter, and places to hide from predators
- shade the water from the sun, keeping it cool
- make oxygen
- provide places for fish to lay eggs

DISCUSSION 2: Jet Ski
If you chose:
1. Put six shakes of soil into the water
2. Put one shake of soil into the water
3. Don't do anything to the lake

Waves from jet skis and boats stirs sediment from the bottom of the lake and washes soil away from the shoreline. This is called erosion. Disturbed sediment can settle on fish eggs, which kills them.

Discussion Cards

DISCUSSION 3: Fertilizer
If you chose:
1. Put 3 drops of green food color into the water
2. Put 1 drop of green food color into the water
3. Don't do anything to the lake

Unneeded or excess fertilizer on grass can wash into lakes or down storm drains and flow into lakes and streams when it rains. Fertilizer may contain phosphorus, a nutrient that plants need, but when too much phosphorus gets into lakes, it can cause algae blooms that can harm for plants and animals, including people. Most fertilizers sold in stores (in small amounts) no longer contain phosphorus. But the large quantities of fertilizers sold to parks, industries, and farms may still contain phosphorus.

DISCUSSION 4: Leftover Earthworms
If you chose:
1. Don't do anything to the lake
2. Put 3 pieces of string into the water
3. Put 3 pieces of string into the water
4. Put 3 pieces of string into the water
5. Don't do anything to the lake

Never dump earthworms into a lake. This is littering. It's also illegal! Although it may seem like a good idea to leave the container of earthworms for the next angler, this is littering, too. All earthworms in Minnesota are non-native, invasive species from Europe and Asia. At least fifteen non-native worm species have been introduced so far, and research by University of Minnesota and forest managers has shown that at least seven species are invading Minnesota's hardwood forests, causing the loss of tree seedlings, wildflowers, and ferns.

Discussion Cards

DISCUSSION 5: Leftover Minnows and Leeches (Live Bait)
If you chose:
1. Don't do anything to the lake
2. Don't do anything to the lake
3. Add three plastic fish to the lake
4. Put 1 drop of red food color into the lake
5. Don't do anything to the lake

Never put any bait, including minnows and leeches, into a lake they didn't come from. This is illegal! They can spread diseases, or they might not be native to the lake. Dumping minnows and leeches on shore is littering. If possible, bury dead minnows or leeches away from the fishing site.

Minnesota Statute 609.68 Unlawful deposit of garbage, litter, or like.
Whoever unlawfully deposits garbage, rubbish, cigarette filters, debris from fireworks, offal, or the body of a dead animal, or other litter in or upon any public highway, public waters or the ice thereon, shoreland areas adjacent to rivers or streams as defined by section 103F.205, public lands, or, without the consent of the owner, private lands or water or ice thereon, is guilty of a petty misdemeanor.

DISCUSSION 6: Aquarium Fish
If you chose:
1. Don't do anything to the lake
2. Add colored fish sponges to the lake (the same number you said you wanted to get rid of)
3. Don't do anything to the lake
4. Don't do anything to the lake

It's illegal to release aquarium fish into the wild. They can carry diseases—or other invasive species from the aquarium water—including plants or other small animals.

It's illegal to transport live fish, including any in livewells, except for display in a home aquarium. These fish must be purchased from an authorized pet shop (you must have the sales receipt), or anyone over 16 can transport legally-caught largemouth bass, smallmouth bass, yellow perch, rock bass, black crappie, white crappie, bluegill, pumpkinseed, green sunfish, orange spotted sunfish, and black, yellow, and brown bullheads. No more than four of each species may be transported at one time, and individual fish can be no longer than ten inches. At no time may water from infested water bodies be transported.

Schools wishing to keep sportfish in an aquarium should contact the DNR for permit requirements.

Discussion Cards

DISCUSSION 7: Oil Change
If you chose:
1. Put 3 drops of molasses into the water
2. Put 1 drop of molasses into the water
3. Don't do anything to the lake

Anything placed in a storm sewer will end up in a lake or river. Oil dumped on land can also be washed into the water when it rains. Once in the water, oil can kill fish and other animals. It's illegal to dump used motor oil into lakes, sewers, wetlands, or on the ground. All used motor oil should be taken to a gas station or other place-of-purchase for recycling.

DISCUSSION 8: Littering
If you chose:
1. Add three squares of toilet paper to the water
2. Add two squares of toilet paper to the water
3. Don't do anything to the lake
4. Don't do anything to the lake

Littering is illegal. Besides, it's nicer to fish at an unlittered site. Litter (fishing line, food wrappers, and bait containers) can blow into the lake and harm fish and other animals. If people think all anglers litter all the time, they might want to close down your fishing area—so please don't litter.

The DNR Fishing Regulations say that anglers must return any fish back to the water if it "will not be utilized." Does this refer to carp and other rough fish? I thought we weren't supposed to put those fish back in the water.

This is commonly misunderstood because, at one time, it *was* illegal to release rough fish. This law was removed from the books in 1981 because it was ineffective. Only a few of the 35 rough fish species, including carp and bullheads, cause problems in lakes, and even those harm only some shallow lakes—not all lakes. (Rivers are almost never affected.) The small number of carp and bullheads caught by anglers has no effect on a lake's carp and bullhead populations. Due to the old law, anglers were tossing carp and a wide range of ecologically valuable rough fish (redhorse, mooneye, gar, suckers, and buffalo) onshore to rot. The old law seemed to encourage wanton waste, which is illegal. The current situation is that, if you catch a fish—whether it's walleye, carp, or mooneye—and you don't plan to keep it, return it to the water alive so that another angler may catch it someday.

—Q & A, *Conservation* Magazine

Discussion Cards

DISCUSSION 9: Pet Waste
If you chose:
1. Put 3 drops of molasses into the water
2. Put 3 drops of molasses into the water
3. Put 3 drops of molasses into the water
4. Don't do anything to the lake

When pet waste washes into lakes or streams, it decays. This uses up oxygen. Sometimes ammonia is released. Low oxygen levels and ammonia, combined with warm temperatures, can kill fish. Pet waste also contains nutrients that stimulate weed and algae growth. Overly fertile water becomes cloudy, green, and unattractive for swimming, boating, and fishing. Most importantly, pet waste can transmit diseases making water unsafe for swimming or drinking. When pet waste isn't properly disposed of, human health is at risk, too. Pets, children who play outside, and adults who do gardening are most at risk for infection caused by some of the bacteria and parasites found in pet waste. Flies can also spread diseases from animal waste. Pet waste may not be the largest or most toxic pollutant in urban waterways, but it's one of the many smaller sources of pollution that add up to a big problem. Fortunately, there are some simple things we can do to help keep our water clean.

DISCUSION 10: Flooding
Put 6 shakes of soil into the lake.
No option

You can't control nature. Big rains often cause soil erosion that can harm fish and other aquatic life. It's important to retain or restore buffers of trees, shrubs, and native grasses near waterways—they prevent erosion and runoff from entering lakes, rivers, and streams.

Turf grasses used for lawns have extremely shallow root systems, so they don't effectively prevent erosion. The deep roots of native trees, shrubs, and grasses resist erosion, soak up a lot of water, and hold the soil in place.

When you go fishing on a lake or stream, consider using fishing piers and other shore fishing structures rather than walking down a shore bank. This can prevent vegetation from being trampled and destroyed.

Discussion Cards

DISCUSION 11: Electricity
If you chose:
1. Don't do anything to the lake
2. Put 3 drops of red food color into the water
3. Put 1 drop of red food color into the lake

"Coal production has been increasing since the 1950s, and today the United States extracts huge quantities of coal (over 1 billion short tons in 1998) . . . over 90 percent of the coal produced is used for electricity generation. Besides being cheap and abundant, the only thing that coal has to recommend it is that is can provide power on-demand. Coal mining has major impacts on terrestrial and aquatic ecosystems. In many cases, whole mountaintops are removed for coal extraction, and valleys are filled in with the waste rock (tailings). Whether it is mountain-top removal, open-pit, or underground mining, however, a major problems stems from rain filtering through the coal mine and tailings. Some of the sulfur in the coal dissolves into the water, turning it acidic; this "acid mine drainage" has impacted thousands of stream miles across the country. The combustion of coal also produces many gaseous wastes, some of which are "scrubbed" out of the emission stream in smokestacks, but many are not, including carbon dioxide. A single household being supplied solely from coal-produced electricity would generate over 61 pounds of sulfur dioxide, 60 pounds of nitrogen oxide, 30 pounds of particulates, 6 pounds of carbon monoxide, 2 pounds of volatile organics, and 17,000 pounds of carbon dioxide, and require over 7,000 gallons of water."

–Environmental Working Environmental Working Group Report, *The Power of Information,* **www.ewg.org/reports/choosinggreenenergy/sources.html**

DISCUSSION 12: Fishing

Try to catch fish. Fifteen seconds will be allowed for fishing.

Squeeze the water from the fish to see how much contamination they've accumulated in their bodies.

Pollution in our environment can enter lakes. We can make choices that will result in less pollution and a better environment.

If you eat fish, you should consult the Lake Finder area of the Minnesota DNR website **www.mndnr.gov/lakefind/index.html** or the Minnesota Department of Health for fish-eating guidelines **www.health.state.mn.us/divs/eh/fish/index.html**. It's best to eat smaller fish because they have less body fat, and fatty tissue contains pollutants. Smaller fish are also less likely to be affected by biomagnification, the accumulation of pollutants in a food chain.