Into the Outdoors

Educational Partner: Great Lakes Indian Fish & Wildlife Commission

RESTOCKING FOR A TEMPORARY SOLUTION

7th-12th Grade Discussion Guide

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SCIENCE CATEGORIES
Ecosystems, Resource Conservation, Populations, Data Collection

TIMEFRAME
2-3 Lessons

MATERIALS
Computer access for research and presentation, poster paper, calculators

KEY WORDS
Estimate, Lake Productivity, Mark-Capture, Recapture, Survey, Sample, Population

LEARNING OBJECTIVES

Students will be able to:

- Evaluate a fish survey simulation and determine the importance of the sampling.
- Simulate a restock population of walleye in a lake using a formula.
- Give examples of additional ways to manage the population of walleye.

ACTIVITY SUMMARY

In this lesson, students will learn why and how fisheries manage and conduct fish surveys. Students will explore survey methods that Wisconsin's fisheries use. They will conduct a problem solving investigation that helps them to evaluate the need for fish surveys and the information that can be collected by means of the survey.

The lesson will begin with students:

- Thinking about estimating populations
- Estimating and evaluating sample populations
- Calculating and simulating a walleye restock request
- Developing alternative solutions to manage the walleye population

VOCABULARY

ESTIMATE - A determination of the approximate number of something.

LAKE PRODUCTIVITY - The rate at which biomass (the mass of all living things present) is generated within a lake ecosystem.

MARK-CAPTURE - A survey method that involved tagging or otherwise marking an initial number of fish and releasing them back into the population. A subsequent sample is taken and numbers of marked fish are compared to numbers of unmarked fish in the sample to statistically estimate population size.

POPULATION - The collection of organisms of the same species inhabiting a given geographic area.

RECAPTURE - A tagged organism that is captured during a follow-up survey.

SAMPLE - A representative smaller number of a given population.

SURVEY - To gather long-term information on population size, population structure (such as the proportion of fish in age or length groups), organism growth rates, reproductive success, species abundance, harvest pressure rates, seasonal movement or migration, and habitat conditions (including plants, plankton, and invertebrates).

BACKGROUND INFORMATION

Walleye are an iconic native fish species in Wisconsin, the upper Midwest and Canada. They are in decline in some northern Wisconsin lakes. The exact reason why walleye populations are declining is not known. There are many impacting factors, but none can be pinpointed at this time at the main cause despite decades of research. Research suggests it is likely a combination of factors, including climate change, habitat degradation and harvest rates that might at times outpace production levels if not monitored closely. Additional research is ongoing regarding what declining production means for future walleye harvests in the region.

Walleye are broadcast spawners releasing their egg over vegetation or rocky substrate. Fertilized eggs stick to the plants or rocks on which they land. These fish are named walleye because of the fish's large, glossy eyes. Their unique eyes give them excellent vision in low light conditions. Walleye have a long slender body with a yellow to olive color on the sides and a white belly. The bottom tip of the tail has a distinct white mark and they have needle sharp teeth. Walleye typically weigh 1-8 pounds.

The southern walleye is a river fish; however, they will also survive in lakes and ponds. In rivers, walleye occur in close proximity to the bottom where current meets calm water. Walleye enter shallow water to feed when light levels are low. Fish may feed at dawn, dusk, and into late evening or when the water is murky. They capture their prey with their sharp teeth. In the spring, walleye migrate up rivers and into smaller tributaries to spawn. Spawning areas are usually shallow with rocky substrate.

Hatchery staff collect walleye at night in nets when the walleye are in shallow water. Fisheries consider many factors to determine what information to collect and which sampling methods to use. Survey data is used to create plans that guide fisheries work. Sampling methods that yield a large number of samples may produce a more accurate population estimate, but taking more samples can cost more money. Lake surveys help fisheries determine how to best refine their Lake and Stream Plans and manage fish populations. Problems or questions about lake ecosystem and their fish populations are addressed. If anglers' catches are decreasing, a lake survey may reveal that the lake's fish population is declining. If a lake survey shows a declining fish population, they could decide that special regulations for harvest or size limits are necessary, that the fish population could benefit from stocking programs, or that habitat protection or restoration is necessary to ensure a healthy fish population for the future.

Stocking is used to maintain or restore declining walleye populations. Walleyes play a vital role in maintaining the balance in aquatic ecosystems by regulating populations of other species that they prey upon like perch or ciscoes. Understanding this helps raise awareness about preserving these valuable food sources.

LEARNING PROCEDURE

INTRODUCTION:

Instructor will say: "How might you determine the number of students in the class?" They will probably say you can count them. Ask someone to count the students in the class. Then share out the number. A second student may volunteer to count the number of students as well.

Then hold up a bowl of goldfish crackers (or similar). Ask the students to try to count, as accurately as possible, the number of goldfish in the fishbowl, and to write their guess down.

Let the class know that the number of fish in the bowl was determined by counting each fish prior to class time.

Ask students to share their guess and any methods they may have used to count the fish. Some students may share methods of estimation to count all of the fish. (Show them the bottom of the bowl with the number written on it. Determine whose guess was most accurate.)

Once it is determined who had the closest guesses, ask those students what methods they used to make their guesses.

Ask students: "How can we quickly figure out how many fish are in the bowl without counting each one of them?"

ACTIVITY 1:
(Discussion, worksheet, or experiment done as a class or within small groups.)

Why count fish?

a. Show students a sample of a Great Lakes (or Wisconsin) fishing regulations booklet or have students view the booklet electronically. Ask the students if they've ever been fishing, and ask them why we might have fishing rules.

b. Briefly explain that biologists collect information from lakes to monitor fish populations and design regulations to conserve populations. This information helps fisheries solve a variety of challenges that fish may have (in lakes, rivers, streams, wetlands, and watersheds.)

One thing a biologist might want to know is how many fish of a given species live in a particular lake, they can figure out if current regulations successfully protect that fish population. (Although knowing how many are in the lake is important, we must also know how many fish are leaving the lake, or being harvested, to make final population size determinations.)

There are ways scientists can estimate the size of a population when counting every individual isn't practical, and the methods for making scientific estimates are more accurate than guessing. We can estimate numbers of fish because it would be too difficult, time consuming and costly to count each individual fish. Review the section of the video referring to population sampling. Ask students: "What methods do biologists use to sample populations?" "Is it helpful?" "Why is it important to have a population estimate?" Discuss what a population estimate tells us about a population.

Organize students into small groups to evaluate the following problem. Students will write their response and then share out to the group:

"For four years, a group of biologists used sampling surveys to gather data about the walleye population in a lake. Here is the number of walleye that they trapped during the survey:

2008: 18 walleye

2009: 17 walleye

2010: 9 walleye

2011: 11 walleye

Pretend you are one of the biologists. What might you think about the health of the walleye population in the lake? In your response, discuss:

a) what these results mean; b) why they may not be exact; and c) why population surveys are important.

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Provides a clear and accurate response to the question. Ideas are elaborated, with three or more relevant supporting details from the reading passage, video, and other materials in the lesson Uses at least three vocabulary words (or a form of the vocabulary words) from the lesson, and uses them all correctly.	Provides an adequate response to the question. Topic and ideas are generally well organized, with two relevant supporting details from the reading passage, video, and other materials in the lesson. Uses two vocabulary words (or a form of the vocabulary words) from the lesson, and uses them both correctly.	Provides a generally accurate response, with one supporting detail from the reading passage, video, and other materials in the lesson. Uses one vocabulary word (or a form of the vocabulary word) from the lesson, and uses it correctly.	Provides an inaccurate response to the question or fails to address the question. May include misinterpretations. Understanding of the topic is not apparent. Does not use any vocabulary words, or uses vocabulary words incorrectly.

ACTIVITY 2:
(Independent or team project.)

Ask students “Why do fisheries restock walleye in the lakes?”

Have students brainstorm as a class the benefits of stocking walleye. Write the list on the board of student responses.

Discuss the need to keep the supply up for both fishing and ecosystem stability. Walleyes play a vital role in maintaining the balance in aquatic ecosystems by regulating populations of other species that they prey upon like perch or ciscoes.

Students will simulate a stock request and then reflect on both the process and need for stocking.

Exercise: Stocking Request

You are the hatchery manager at the Hatchery. You have been assigned to stock at least 150, 000 fingerlings into the local Waterway. It is early March and water temperatures are about 51°F. You do your first collection of fish and have 15 males and 5 females. The females weigh 2 pounds, 4 pounds, 5 pounds, and 3 pounds.

- Female walleye usually produce at least 20,000 eggs per pound of body weight. How many eggs will these females potentially produce?

  _____ (total lbs.) x 20,000 = _____ (eggs)

- During the second collection, you catch three more females weighing 4 pounds each. How many eggs will these four females produce?

  _____ (total lbs.) x 20,000 = _____ (eggs)

- Add the eggs together: _____ (eggs from first group) + _____ (eggs from second group) = _____ (total eggs)

- How many fry will hatch from the eggs? The hatching success rate is 50%. That means that half of these eggs will hatch.

  _____ (total eggs) x 50% = _____ (fry)

- How many fry will survive in the pond and harvested as fingerlings? 50% - 80% of these fry will grow to be fingerlings and harvested from the ponds. As a hatchery manager, it is better to plan for the lowest percentage.

  _____ (fry) x _____% = _____ (fingerlings)

- Will you have enough fingerlings to fill your stocking request? _____

REFLECTION:

Why do hatcheries help fish populations? What events cause fish populations to decrease?

What do you think would be the hardest part of spawning walleye? What would be the most interesting part? What other thoughts do you have?

ACTIVITY 3:
(Independent or team project.)

Post the following statement on the board:

"Fish hatcheries are a solution to the current problem, but aren't a long-term solution."

Ask students to read the statement and briefly respond to it aloud.

Having students work with a close partner, students will prepare one slide in response to the statement. They will include a list of ways to help protect walleye populations in addition to stocking supply.

Students will share their slide in a brief informal presentation to the rest of the group.

In conclusion, discuss the needs for the fisheries as well as additional ways to protect walleye populations.

RELATED LINKS

- North Mississippi Fish Hatchery: https://www.youtube.com/watch?v=k3KXC754MMQ
- Facing the Future (2002). Originally adapted from Fishing for the Future in Curriculum Guide 2002. Retrieved from www.facingthefuture.org.
- Walleye Fish Populations Are in Decline: https://www.ucdavis.edu/news/walleye-fish-populations-are-decline

The following National Common Core Standards can be met teaching;

FISH HATCHERIES

7TH GRADE:

CCSS.ELA-LITERACY.RI.7.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.W.7.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-LITERACY.W.7.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.7.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.
CCSS.ELA-LITERACY.W.7.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.7.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.7.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.7.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.7.1.C	Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
CCSS.ELA-LITERACY.SL.7.1.D	Acknowledge new information expressed by others and, when warranted, modify their own views.

8TH GRADE:

CCSS.ELA-LITERACY.RI.8.1	Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.8.2	Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.8.1.A	Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
CCSS.ELA-LITERACY.W.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.8.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

CCSS.ELA-LITERACY.W.8.2.A	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.8.2.B	Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
CCSS.ELA-LITERACY.W.8.2.C	Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
CCSS.ELA-LITERACY.W.8.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.8.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.8.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented.
CCSS.ELA-LITERACY.W.8.3	Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
CCSS.ELA-LITERACY.W.8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.W.8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
CCSS.ELA-LITERACY.SL.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
CCSS.ELA-LITERACY.SL.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
CCSS.ELA-LITERACY.SL.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

9TH-10TH GRADE:

CCSS.ELA-LITERACY.RI.9-10.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.9-10.2	Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
CCSS.ELA-LITERACY.W.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create

	an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.9-10.1.B	Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
CCSS.ELA-LITERACY.W.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
CCSS.ELA-LITERACY.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
CCSS.ELA-LITERACY.W.9-10.1.B	Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
CCSS.ELA-LITERACY.W.9-10.1.C	Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
CCSS.ELA-LITERACY.W.9-10.1.D	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.9-10.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
CCSS.ELA-LITERACY.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
CCSS.ELA-LITERACY.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.9-10.2.B	Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
CCSS.ELA-LITERACY.W.9-10.2.C	Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
CCSS.ELA-LITERACY.W.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
CCSS.ELA-LITERACY.W.9-10.2.E	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.9-10.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
CCSS.ELA-LITERACY.W.9-10.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

CCSS.ELA-LITERACY.W.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
CCSS.ELA-LITERACY.SL.9-10.1.C	Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
CCSS.ELA-LITERACY.SL.9-10.1.D	Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

11TH-12TH GRADE:

CCSS.ELA-LITERACY.W.11-12.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
CCSS.ELA-LITERACY.W.11-12.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
CCSS.ELA-LITERACY.W.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CCSS.ELA-LITERACY.SL.11-12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.11-12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
CCSS.ELA-LITERACY.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.

NEXT GENERATION SCIENCE STANDARDS:

6TH-8TH GRADE:

MS-ESS3.A.1	Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.
MS-LS2-1-MI	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

SEP8	Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
MS-LS1-6	Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
MS-LS2-4	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological components of an ecosystem can lead to shifts in all its populations.