Teeming with Fish

How many rockfish can we catch and still have a sustainable fishery?

Overview

People love to go fishing in the ocean and catch fish. When they want to catch "bottom fish" or "groundfish" many go to rocky reefs because these areas are **teeming** with life. To be able to fish over the long haul and still have fish to catch, researchers and managers **team up** to provide sustainable fisheries. In this lesson, students look at data and video footage collected in nearshore rocky habitats off the Oregon Coast, and investigate how such data could be used to inform fishery management decisions.

Essential Questions

- *How many fish are allowed to be caught each year, and why?*
- *What is the life history of rockfish?*
- *How do scientists use math to answer these questions?*
- *How can scientists estimate how many rockfish of each species live on rocky reefs off Oregon?*
- *What should people do to take care of these fish?*
- *Why are rockfish important? Why is biodiversity important?*

Learning Goals

Students will learn the following:

- *Scientists need to understand the habitats and life cycles of rockfish to predict their populations.*
- *Scientists use statistics and plot data to answer questions.*
- *Video lander technology can be used to collect data in offshore rocky habitats.*

Learning Objectives

Students will be able to:

1. *Use statistics to understand and analyze rockfish populations.*
2. *Draw or describe the rockfish life cycle.*
3. *Advocate for the importance of biodiversity.*

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Grade Level

6-8

Anchoring Phenomenon

Teeming with Fish

Driving Question

How many rockfish can we catch and still have a sustainable fishery?

Standards

Next Generation Science Standards

LS2.C – Ecosystem Dynamics, Functioning and Resilience
LS4.D – Biodiversity and Humans
ESS3.C – Human Impacts on Earth Systems
ETS.1B – Developing Possible Solutions

Common Core Math Standards

6.SP.A.1
6.SP.A.2
6.SP.A.3
6.SP.B.4
6.SP.B.5

Expanded Essential Questions

More Questions (pdf) (doc)

Introduction

This middle school unit combines a study of Oregon's amazing rockfish population with an introduction to statistics, and is guided by the essential question: *How many rockfish can we catch and continue to be able to fish for them over the long haul to have a sustainable fishery?* Many of our students have experience going fishing, possibly even to a rocky reef or ocean fishing such as a jetty or on a boat. We invite them to dig deeper, learning about the life cycles and habitats of rockfish, and analyzing sets of data gathered by fisheries scientists to determine if the populations are healthy. As mathematicians, students learn about measures of center and ways to organize, plot, and graph data. As scientists, students are tasked with developing (engineering) a system to monitor the human impacts on this rocky reef ecosystem. Students learn about monitoring systems used by the Oregon Department of Fish and Wildlife (ODFW) and how fisheries scientists use engineering and math to protect the fishery populations while balancing the human impact of commercial and recreational fishing.

One tool that ODFW has used to look at fish and the habitat that they live in is called a video lander. This tool was developed for rocky bottom areas which are impossible to sample with nets. The video lander is made from a video camera mounted in an underwater housing to protect it from getting wet. The camera housing along with underwater lights and a battery also in an underwater housing are all mounted inside an aluminum frame that has a breakaway base with weights. The whole package is called a video lander and the frame is designed to help protect all these part from being damaged. The base is designed to break free from the frame if it gets stuck in the rocks so that the more expensive parts can all be recovered. The lights help illuminate the bottom habitat and fish when the video lander is dropped to greater depths where light from the sun is limited. The aluminum frame has a line attached to it with a buoy that floats on the surface while the video lander is on the bottom collecting video samples of any fish that are there and what the bottom habitat looks like. The video lander is then retrieved with a winch that hoists it up from the bottom. Once all the video data is collected, ODFW staff have to go through all the videos, classify the bottom habitat, and identify and count the number of each species of fish observed before analyzing the data.

LESSON RESOURCES

Oregon Conservation Strategy

- *Overview – Oregon Department of Fish & Wildlife (ODFW) has an overarching state strategy for conserving fish and wildlife.*
- *Nearshore Species – This section contains images and life history information on the many rockfish species in Oregon nearshore waters.*

Image: Deploying/retrieving a video lander. Source: ODFW Information Report 2019-20, p. 41

Image: Screenshot of video lander footage. Species labels were added during editing. Source: ODFW Rocky Reef Species

Lesson Procedure

ENGAGE

Activity: Activate Student Thinking (choose one)

- Quick write: How do you think scientists count fish in the ocean? or … Who should get to decide how many fish are acceptable to catch each year from the ocean?
- Red Light/Green Light (sticky notes or digital) prompt: "It's easy for scientists to count how many fish live in the ocean."
- K-W-L-A: Fill in K & W: What do you know and want to know about how scientists count fish in the ocean. Turn and talk.

Next, show students the *Rocky Reef Species* video clip of a reef habitat, and ask them to record their observations as they watch. Then show students examples of still images taken from video lander footage, including images of a barren area vs. an area teeming with fish. Ask students to jot down differences they see in the two habitats on sticky notes. Following the video, discuss the students' observations as a class.

Activity: How Do I Fish?

Include equity to your class by asking students to collect a photo or video of "how they fish" (recreational, jetty, bottom fishing, lake fishing, eating fish, religious connections, commercial or family business, smoking fish, etc.). Create a class bulletin board or slideshow with evidence of student relationships to fishing.

EXPLORE

In this section, students learn about key Oregon nearshore species of rockfish and their life cycles.

Activity: All About Rockfish Species Jigsaw

What are rockfish, and what is their life cycle? Each student or team of students researches one key species, creates a *One Pager*, and presents their species to the class. A grading *Rubric* is provided. Students can find the information they need about their species on the Oregon Conservation Strategy *Fish Species* page. Assign one of the following six species to each student group to research: Black Rockfish, Blue Rockfish, Deacon Rockfish, Canary Rockfish, Lingcod* and Kelp Greenling. Lingcod and Kelp Greenling are not rockfish but these groups are included as comparison species.

Activity: All About Rockfish – Teacher Presentation

If you don't have time for the jigsaw, the teacher may instead present the key species to the class and as a group use a Venn diagram to compare the rockfish with the other species.

LESSON RESOURCES

Video Lander Images:

- *Video: Rocky Reef Species*
- *Still images of barren areas*
- *Still images of areas with fish*

All About Rockfish Species Jigsaw

- *Research: Fish Species*
- *One Pager Worksheet (pdf) (doc)*
- *One Pager Rubric (pdf)(doc)*

Key Species

- *Black Rockfish*
- *Blue Rockfish*
- *Deacon Rockfish*
- *Canary Rockfish*
- *Lingcod*
- *Kelp Greenling*

Image: Blue Rockfish. Source: NOAA

Image: China Rockfish. Source: Oregon Sea Grant

Activity: Additional Ideas to EXPLORE, if time permits

- Fishing techniques – practice casting on the field
- Invite a guest speaker to class to talk about fishing - commercial fisher, recreational fisher, tribal member
- Play life cycle games – adapt the game SALMON for rockfish
- Take a field trip – visit a local fishing harbor, seafood store, or seafood restaurant
- Dissect a rockfish; Cook and eat rockfish
- Make fishing lures or flies

EXPLAIN

In this section, students learn more about how fish are counted and how video lander data inform fishery management decisions. Invite a fishery management expert from ODFW to visit the classroom.

Presentation: Video Lander Study

Share the *Good Things from Rocky Landing* presentation from ODFW's Greg Krutzikowsky, and show students still images taken from video lander footage.

Activity: Develop Vocabulary

Use the *Building Background* student worksheet for direct instruction (3-column notes) or cut up the worksheet and make it into a Memory, Go Fish, or other vocabulary game.

Activity: Using Math to Analyze Rockfish Population Statistics

Measures of Center

- Lesson 1: *Guided Notes* for teaching the lesson, written in AVID stye for student Interactive Notebook or math notebook, plus processing/practice problems
- Lesson 2: *Dice Game* to practice the concept
- Lesson 3: *Says, Means, Matters* - Analyzing Video Lander Data

Image: Students learn about fish during Outdoor School

Video Lander Study

- *Presentation: Good Things from Rocky Landing (pdf)(ppt)*
- *Folder: Still Images*

Develop Vocabulary

- *Building Background (pdf) (doc)*

Measures of Center Lessons

- *Guided Notes (pdf) (doc)*
- *Dice Game (pdf) (doc)*
- *Says, Means, Matters (pdf) (doc)*

Image: 6th graders play a spawning game

Activity: Using Math to Analyze and Plot Rockfish Population Data
Summarize and describe box plot, histogram, and dot plot distributions:

- Lesson 1: *Guided Notes* with overview of dot plot, box plot and histogram, with practice problems.
- Lesson 2: Students plan their own statistical question, gather data from classmates, and draw a dot plot and box plot to represent the results. They can practice generating graphs with their data using the online *Math is Fun Data Graphing* tool.
- Lesson 3: Analyze Figures 6, 7, 8, and 10 of the ODFW Information Report 2019-10 *Video Lander Study*. Working in groups or as a class, students discuss what these histograms and dot plots are telling us about the research.

ELABORATE

In this section, students use and extend what they have learned about rockfish.

Activity: Town Hall Writing & Research Project
How are rockfish important to Oregonians? Students use the *Rockfish Town Hall* worksheet to research and report on different community perspectives. A rubric is included in the worksheet.

Presentation: Explore Career Connections
What kind of careers are available in marine science? Use the *Career Presentation* to explore training, salaries, and job outlooks.

Activity: Explore related edpuzzles & videos

- Ocean ecosystems
- Finding Sustainable Fishing Methods (Florida)
- Rockfish Identification in B.C. video from Vancouver Aquarium
- Rockfish recompression video from ODFW

EVALUATE

Assessment: Exit Ticket for Statistics
Students fill out the *Exit Ticket* to demonstrate understanding of the math concepts.

Assessment: Develop a Monitoring Plan
How can we design a system to monitor human effects on a natural habitat? Use the *Engineering Solution* slides to guide students to create a proposal for a system that monitors human impacts on a local coastal ecosystem. Evaluate student work using the assessment *Rubric*.

Plotting Rockfish Data

- *Guided Notes (pdf) (doc)*
- *Math is Fun: Data Graphing Tool*
- *ODFW Video Lander Study No. 2019-10*

Writing & Research Project

- *Rockfish Town Hall (pdf) (doc)*

Career Connections

- *Researcher Bio: Greg Krutzikowsky (pdf)*
- *Research Related Careers in Marine Science (pdf)(ppt)*

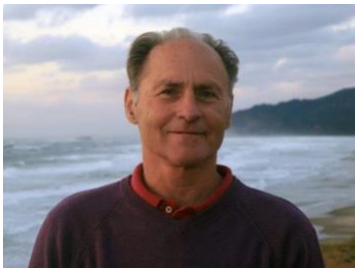

Image: Greg Krutzikowsky, ODFW

Related Resources

- *Video: Fishing for Data*
- *EdPuzzle: Ocean Ecosystems*
- *EdPuzzle: Finding Sustainable Fishing Methods*
- *Video: Rockfish ID in B.C.*
- *Reading and Video: Rockfish Recompression*
- *Video: Black Rockfish Survey*

Math Assessment

- *Exit Ticket for Statistics (pdf) (doc)*

Human Impacts Assessment

- *Engineering Solution (pdf)(ppt)*
- *Rubric (pdf)(doc)*

Next Generation Science Standards

Performance Expectations:

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success

Science & Engineering Practices:

Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

Disciplinary Core Ideas:

LS2.C- Ecosystem Dynamics, Functioning, and Resilience
LS4.D – Biodiversity and Humans
ESS3.C - Human Impacts on Earth Systems
ETS.1B - Developing Possible Solutions

Crosscutting Concepts:

Cause and Effect
Stability and Change

Common Core Math Standards

Math Standards:

6.SP.A.1
6.SP.A.2
6.SP.A.3
6.SP.B.4
6.SP.B.5.A
6.SP.B.5.B
6.SP.B.5.C

Math Practices:

MP.1 - Make sense of problems and persevere in solving them
MP.2 – Reason abstractly and quantitatively
MP.3 - Construct viable arguments and critique the reasoning of others
MP.4 – Model with mathematics
MP.5 - Use appropriate tools strategically
MP.6 – Attend to precision
MP.7 – Look for and make use of structure
MP.8 – Look for and express regularity in repeated reasoning

Acknowledgments

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References

ODFW Informational Report # 2019-10: A video lander of a nearshore rocky reef

See more lessons on the ORSEA webpage:oregoncoaststem.oregonstate.edu/orsea