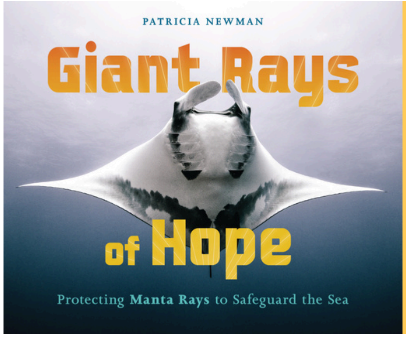


Standards-aligned Activity Guide

GIANT RAYS OF HOPE

Protecting Manta Rays to Safeguard the Sea

The book

Age Range: 9 - 14 years
Grade Level: Grades 4 - 8
Publisher: Millbrook Press
ISBN: 979-8765607992

Off the coast of Perú, gentle giants swim beneath the waves. Thanks to the work of Kerstin Forsberg, giant manta rays have become a symbol of hope for ocean conservation in the region. Mantas are a flagship species, and when they're protected, the whole ocean ecosystem benefits.

Kerstin, who founded the organization Planeta Océano, has taken a new approach to ocean conservation. Previous conservation projects were often led by scientists from other places who didn't work with the local people. When Kerstin decided to help manta rays, she sought the opinions of local fishers and educated them about the dangers of overfishing, bycatch, and poaching—things that affect both manta rays and fishers. She also involved local schools and teachers.

With the help of teachers, students, and fishers, Kerstin launched a project to identify and track manta rays and protect them, making the ocean a better place for all creatures. Dive in with author Patricia Newman and explore how taking care of the ocean can benefit everyone!

The author

Patricia Newman wants us all to know we are part of nature. As a Robert F. Sibert Honor recipient, she shows us how our actions ripple around the world, empowers us to find our own connections to nature, and encourages us to use our imaginations to act on behalf of our communities. Patricia hopes her books help make the world a better place for the next generation. Her other distinguished titles include *A River's Gifts*; *Planet Ocean*; *Eavesdropping on Elephants*; *Sea Otter Heroes*; *Zoo Scientists to the Rescue*; and *Plastic, Ahoy!*

Objectives

- To help students understand our unbreakable connection to the ocean and we affect it
- To encourage and empower students to become a voice for the ocean in their homes, schools, and communities
- To help students become better science communicators

What's in this guide?

Ocean Literacy Standards

Ocean literacy is an understanding of the ocean's influence on us—and our influence on the ocean. An ocean-literate person:

- understands the Essential Principles and Fundamental Concepts about the functioning of the ocean;
- can communicate about the ocean in a meaningful way;
- is able to make informed and responsible decisions regarding the ocean and its resources.

Developed through a community-wide consensus-building process, this definition along with the seven essential principles outlined below build on previous efforts to define ocean literacy, assess what the public knows about the ocean, and redress the lack of ocean-related content in state and national science education standards, instructional materials and assessments (excerpted from the Ocean Literacy Framework).

OCEAN LITERACY PRINCIPLES

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean made Earth habitable.
5. **The ocean supports a great diversity of life and ecosystems.**
6. **The ocean and humans are inextricably interconnected.**
7. **The ocean is largely unexplored.**

These principles are covered in this activity guide.

United Nations Sustainable Development Goals

excerpted from the United Nations Foundation

The Sustainable Development Goals (SDGs) are the world's shared plan to end extreme poverty, reduce inequality, and protect the planet by 2030. A report from the Nippon Foundation's Nereus Program says, **"ocean sustainability holds the key not only to our future prosperity but also for our survival from a comprehensive science-based perspective."**

Adopted by 193 countries in 2015, the SDGs emerged from the most inclusive and comprehensive negotiations in UN history and have inspired people from across sectors, geographies, and cultures. Achieving the goals by 2030 will require heroic and imaginative effort, determination to learn about what works, and agility to adapt to new information and changing trends.

The UN Foundation focuses on ideas and initiatives that generate larger impact, advance the SDG imperative to "leave no one behind," and are backed by evidence, practical commitments, and action.

Individuals, innovations, and actions are helping the planet realize the potential and promise of the SDGs.

The circled goals are covered in this activity guide.

Manta Ray Anatomy

by Dr. Dieuwertje Kast, Director of STEM Education Programs, USC Joint Educational Project

Develop a hands-on understanding of a manta ray's anatomy and how each part contributes to its ability to navigate and survive in the ocean.

Subject

Science

For ages 8–12

Other subject links:

Anatomy, Literacy, Design

Themes

biodiversity + humans, compare/contrast diversity of life, planning/carrying out investigations

OBJECTIVES

Students will be able to identify and describe the main anatomical features of a manta ray by creating an origami model, enhancing their understanding of marine biology and the form and function of manta ray anatomy.

Differentiation strategies to meet diverse learner needs:

- Students will use pictures and corresponding labels on a visual word wall to help them remember terms.
- Students will use manipulatives, for students who are tactile learners.

STANDARDS

NGSS

- 2-LS4-1: Make observations of plants and animals to compare the diversity of life in different habitats.
- K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Idea:

- LS4.D: Biodiversity and humans

Science and Engineering Practice:

- Planning and carrying out investigations

Crosscutting Concepts:

- Structure and function: The shape and stability of structures of natural and designed objects are related to their functions

ENGAGE

- Introduction
  - Begin with a introduction of manta rays, including their habitat, behavior, and unique anatomical features by reading *Giant Rays of Hope* either as a group or individually.
  - Show images or videos of manta rays in their natural environment.
- Anatomy overview
  - Discuss the main parts of a manta ray: cephalic fins, pectoral fins, gill slits, mouth, and tail.
  - Use diagrams or models to highlight each part and explain its function.

EXPLORE

- Origami activity
- Distribute origami paper and provide step-by-step instructions for folding an origami manta ray. (Use this video, pausing when necessary: https://www.youtube.com/watch?v=LwiGBrqosOk)

Materials

- 8" x 8" square origami paper
- Manta origami video
- Markers or pens
- Reference images or diagrams of manta ray anatomy
- *Giant Rays of Hope* by Patricia Newman

- Assist students as needed, ensuring everyone completes their model.
- Note: The tail section might be difficult for students. Ask them to do the best they can, and then wind the tail around their fingers to make it as slim as possible.

- Labeling the model:
  - Once the origami manta rays are completed, have students use markers or pens to label the anatomical features on their models.
  - Encourage them to refer to the diagrams and information discussed earlier.

EXPLAIN

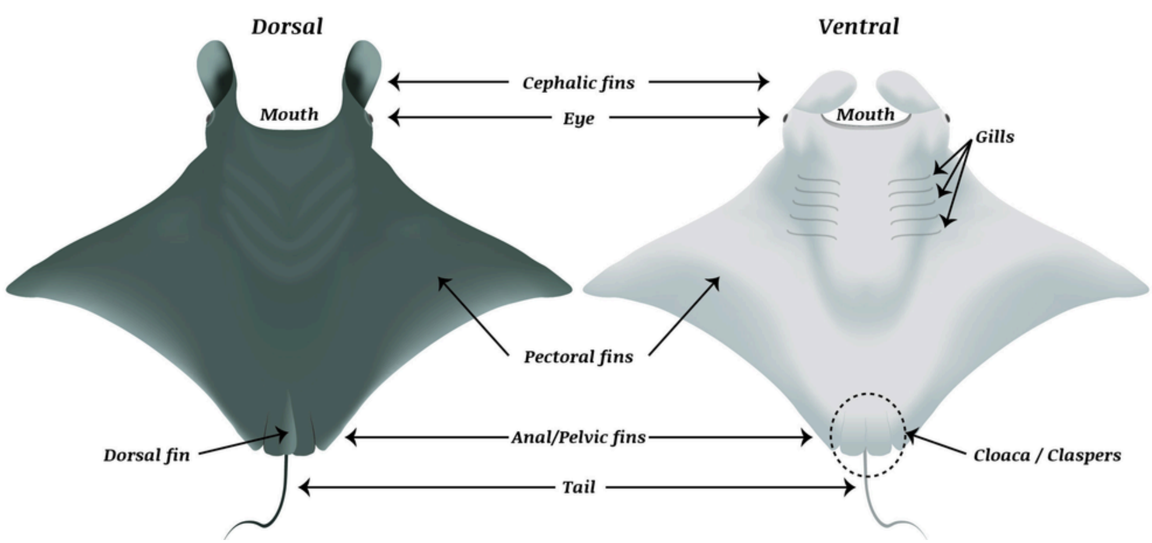
- Have students share their labeled models and explain the function of each part they labeled.
- Facilitate a discussion on how the anatomical features of a manta ray help it survive and thrive in its environment.

ELABORATE

- Research Project
  - Students can research more about manta rays and create a presentation or report on their findings.
- Comparative Anatomy
  - Compare the anatomy of a manta ray with other marine animals, such as sharks or dolphins, to understand evolutionary adaptation

EVALUATE

- Students will be assessed based on their participation in the activity, the accuracy of their labeled models, and their ability to explain the function of the different anatomical features of a manta ray.



From: https://bluecornerconservation.org/manta-rays-of-penida

Bycatch Simulation

by Neva Ayn Magalnick, Environmental Steward District TOSA, Solana Beach (CA) School District

Students explore how bycatch happens and how data collection helps to make positive change

Subjects

Science, Math

For ages 10-14

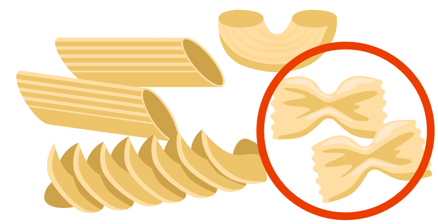
Other subject links:
Citizenship, Literacy, Biology

Themes
ocean resources, human impacts, developing solutions, interdependence

BACKGROUND

Fishers catch unintended animals in their nets. This common occurance is known as bycatching. Industries, fishers, and conservation groups work to engineer nets, escape mechanisms, or sounds that prevent bycatching. These modifications to nets and lines require research and data collection to better understand which animals can be freed, how nets can be engineered to prevent bycatching, and to track the effectiveness of their modifications.

Read more about this work with sea turtles through the National Oceanic and Atmospheric Administration.



farfalle (bowtie) pasta represents manta rays

Materials

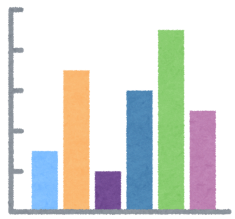
- A variety of serving spoons, ladles, slotted skimmers, pasta servers, ice separators, even large whisks: the larger better. These represent different nets or fishing gear.
- A variety of pasta in different sizes and shapes, i.e. macaroni, radiatori, penne, and farfalle (bowtie) pasta, which represents the shape a of manta ray.
- A bowl or bucket for each team to represent the ocean, which will hold dry pasta where the kitchen tools go fishing.
- Copies of the data sheet for each team.
- CER sentence frames if completing (see following handouts).
- Optional: Designing app (i.e. Tinkercad or Seesaw), paper for designing a net to prevent the bycatch of manta rays (farfalle pasta) after data collection.
- Further option: Attempt build prototype designed using Engineering Design Process and materials including floss, wikki stix, pipe cleaners, rubber bands, other easily accessible recycled items.

OBJECTIVES

This activity explores the concept of bycatching by utilizing different (fishing) tools to collect dry pasta (fish). In the process, the farfalle pasta (shaped similarly to manta rays) may accidentally be collected with the other pasta (fish). This represents bycatching.

Each scoop will represent the fishers reeling in their nets after a large catch. How many pasta (targeted fish for catching) are collected? How many farfalle (manta rays) are caught? After this data is collected, different shaped tools will be used to see if the bycatching increases or decreases due to these changes. Teams will collect data as evidence of the change.

After sharing data based on bycatching using different tools, scientific reasoning will support designing a net or fishing system to prevent the bycatching of manta rays... there is so much we can do to protect our ecosystems!



STANDARDS

5th grade NGSS: 5.ESS3.1 Earth and Human Activity: Obtain and combine info about ways individual communities use science ideas to protect the earth's resrouces and environment (CCC Systems, DCC Human Impact)

Environmental Princial Integration K-12: Principle II- People Influence Natural Systems: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. Concepts A-D are all applicable and lend themselves to this book and activity.

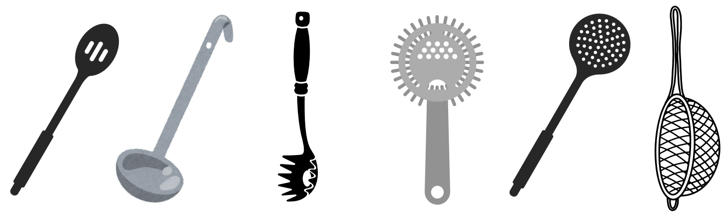
NGSS

- 3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is liekly to meet the criteria and constraints of the problem.

5th grade math: Represent and Interpret Data.
5th grade Writing Standards 7 & 8 regarding conducting research projects.

ENGAGE

- Have students read *Giant Rays of Hope* either as a class or individually.
- Divide students into teams. Each team creates a themed team name and records it onto the Data Collection Sheet. Jobs are divided into data collector, fisher, and ecologist. These jobs can be maintained for the simulation, or switched for each change.



possible fishing gear

possible fish

manta rays

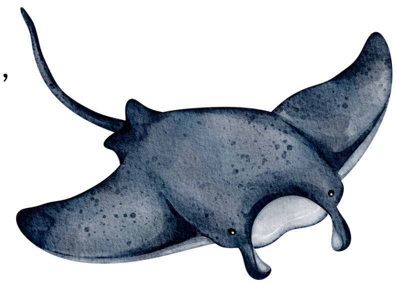
EXPLORE

- Mixed pasta is distributed into the buckets/bowls for each group. It is most important that each bucket contains farfalle to simulate the manta rays present in Peru's coastal waters.

- Each group goes fishing: using the tool provided (fishing method), scoop once into their bowl, pulling up the daily catch of pasta (fish and manta rays). The goal is to get as much pasta (fish) as possible. After the fisher brings up the catch, the ecologist can sift/sort through to count the number of total pasta (fish), separating out the farfalle (manta rays). This information will be plotted on the data chart in two bars (one for fish, one for only manta rays) by the data collector. Return all pasta to the bucket once recorded.
- Repeat fishing using the same tool two more times. Count and record the data, discussing bycatching patterns. As a whole class, discuss if teams are collecting similar data. It helps if all teams begin with the same tool initially.
- Using a second tool (fishing method), each team will scoop three times into the bowl, counting and collecting data as before. The group will record which utensil is associated with the results in their data. This is an opportunity for team members to switch roles.
- Consider allowing teams to select their choice of tool by considering shape, size, strategic placement of holes or slots. Focusing on form and function is the aim, and so discussion around this is encouraged.
- Using a third and final tool, fish and collect data. Consider switching roles a final time.

EXPLAIN

- Allow time for each team to look over their data collection:
  - which tool (fishing method) allowed for the most bycatching of manta rays?
  - Which prevented the most bycatching?
  - If groups used different tools than others, have them share data on a shared document, by presenting, or by conducting a gallery walk to see the results.
- As a class, dIscuss how these tools are similar to fishing nets. Discuss how the pasta is similar to sea life. Also make sure to address the shortcomings of a simulation like this: how is it different from real fishing? How are these pasta not like real sea creatures?
- As a class, in teams, or individually, have students record Claim, Evidence, Reasoning (CER) statements based on the simulation (see handouts that follow).



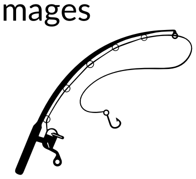
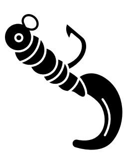
ELABORATE

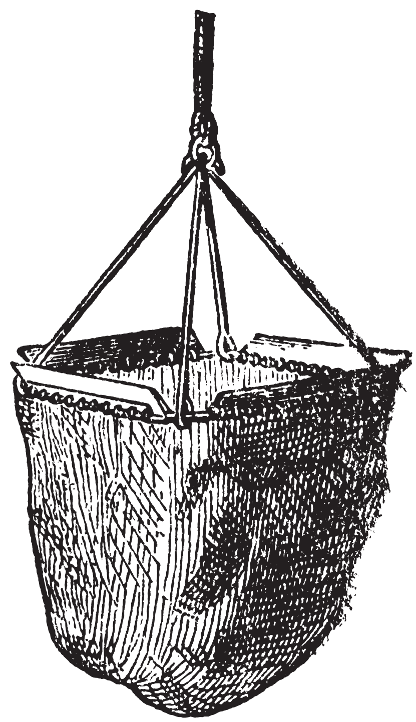
- Using designing apps (Tinkercad, Seesaw) or paper, design a net for catching fish (research and agree upon a particular type of fish) with the goal of preventing manta ray bycatching. What net designs, technologies, materials should be included? This is an extension that calls upon the Engineering Design Process.
- Applying the designs above, or as an engineering challenge, allow teams to attempt to build a physical prototype of nets. Have teams display and share their learning about bycatching and the need to engineer fishing nets or methods that take the bycatching of specific animals into account. This often takes 30 minutes for teams to draw, plan, and agree upon materials, another 20-30 minutes to build the prototype, and then additional time to share their learning with others.

- Practicing environmental literacy, invite students to reserach different methods of large-scale fishing to share their learning about the diversity of fishing methods for different catches. See the sample bellow. This may be a step before students design or create new fishing systems. Some fishing methods to consider researching are trawl, dredge, gill net, and harpoon. If this task seems too displaced from students' environmental experiences, keep their learning place-based and consider researching a local animal in need of protection instead. What can students engineer or design to create awareness and proection for that animal in their community? Use *Giant Rays of Hope* as a springboard for ways to initiate change locally.

EVALUATE

- Completion of the Resources handout (see next page).
- Participation in class discussions/brainstorming.
- Following directions and successfully completing data collection sheet.

POLE FISHING	DESCRIPTION, FACTS, HOW IT ALLOWS BYCATCHING
pictures/images  diagrams or close-ups  	• best for catching variety of sunfish • rod size can change based on targeted animal • If the pole is too light, it makes the person and fish fight each other longer • depending on the lure, throwing back bycatches may be injured nad can't recover.



HANDOUT #1 - Resources (one per student)

Claim, Evidence, Reasoning (CER) Template

Claim: Bycatching is an effect of fishing with tools that do not target a specific species of animal. Some tools can be used to prevent manta ray bycatching.

Evidence: (Give data from your simulation: which tools worked best to prevent bycatching? Be specific, and use data). ________________________

____

____

Reasoning: Based on this data, bycatching can/cannot be prevented when fishing.

Questions to Generate Conversation or Design Inspiration

What are unique characteristics of manta rays (that are not the same as other fish, whales, or sharks)?

How might a manta ray survive if caught in a net?

What should fishing companies and/or net manufacturers consider to prevent manta ray bycatching?

What can we learn from NOAA's Turtle Excluder Devices that might spark ideas for engineering new nets?

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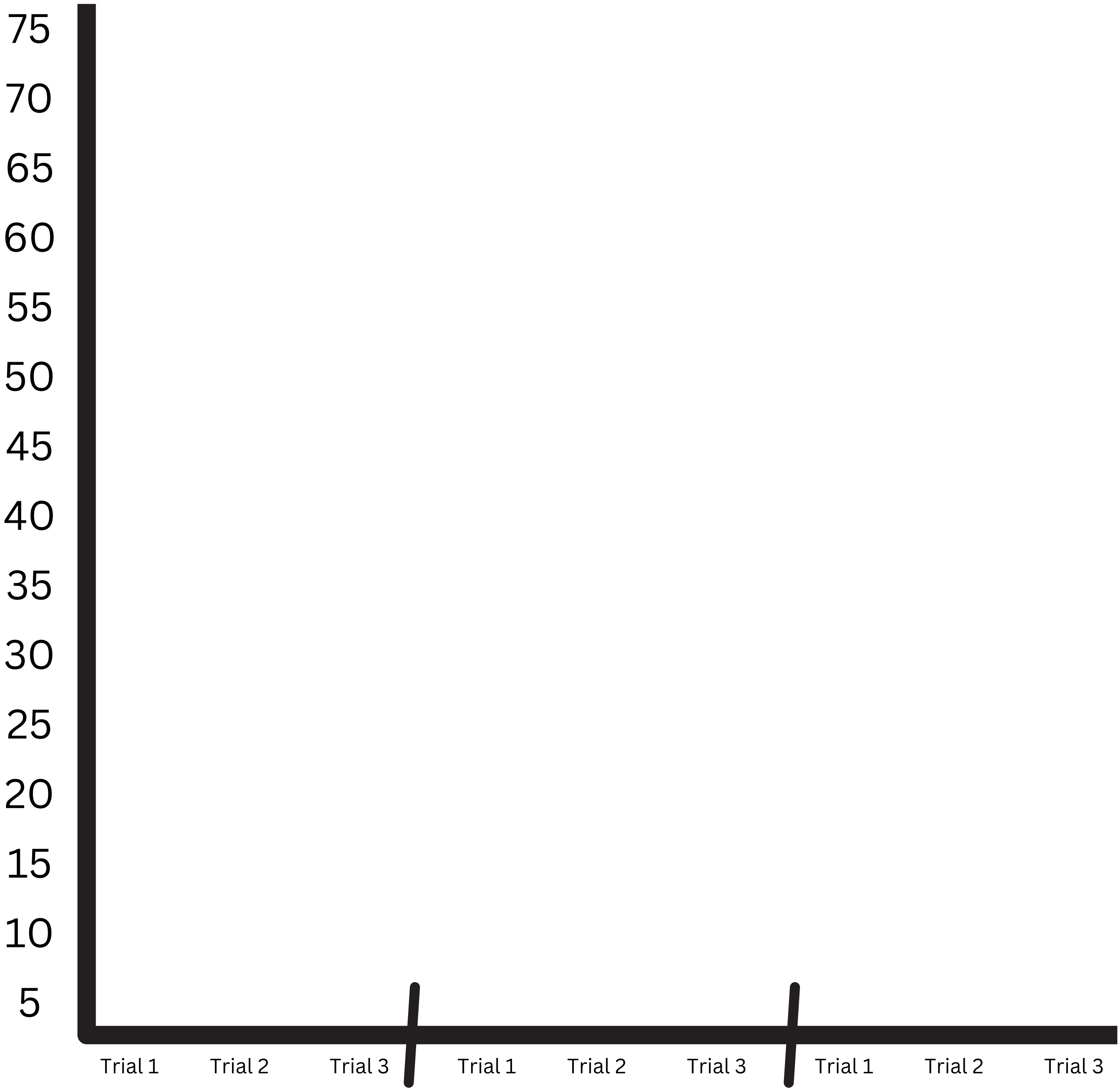
HANDOUT #2 - Data collection (one per student)

Team Name:

Member Names:



Tool 1 _______________ Tool 2 _______________ Tool 3 _______________

The Challenge of Overfishing

inspired by lessons in the MantaTrust Ocean Education guide

Let's understand how overfishing affects our food supply and the ocean's health.

Subjects

Math, Design + Technology

Other subject links:

Citizenship, Literacy, Biology

For ages 10-14

Themes

ocean resources, human impacts, developing solutions, food chains, interdependence

OBJECTIVES

Students will:

- understand the difference between sustainable and unsustainable fishing.
- understand how humans affect the ocean's fish supply and develop strategies to protect it

STANDARDS

Common Core

- CCSS.MATH.CONTENT.4.OA.A.3: Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted.
- CCSS.ELA-LITERACY.SL.5.1.C: Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

NGSS

- MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment
- 5-ESS3-1: Obtain and combine information about ways individul communities use science ideas to protect the Earth's resources and environment

Disciplinary Core Ideas

- ESS3.C: Human impacts on Earth's systems

Science and Engineering Practices

- Engaging in argument from evidence
- Using mathematics and computational thinking

Crosscutting Concepts

- Patterns
- Cause and effect

ENGAGE

- Tell students you will be showing them a video about an imaginary village with a pond. Their goal is to determine how many fish each villager should catch each to day maximize their food supply.
- Watch the TedEd video, "What is the Tragedy of the Commons," **only until the 46 second mark (0:46)** - https://ed.ted.com/lessons/what-is-the-tragedy-of-the-commons-nicholas-amendolare

EXPLORE

- Ask students to talk among themselves to brainstorm solutions for a few minutes.
- Then, begin a class discussion where students offer ways to solve the problem. If students are stumped, you might try drawing the fish and

Materials

- Videos:
  - What is the Tragedy of the Commons?
  - Sustainable Eating
- *Giant Rays of Hope* by Patricia Newman
- Video recording/editing equipment

their babies on the board as you will see in the video.

- Ask questions:
  - Do we need an even or an odd number of fish in the pond? Why?
  - What happens if we take too many fish?
- Write the class answer on the board.
- Continue watching the video to the end.

EXPLAIN

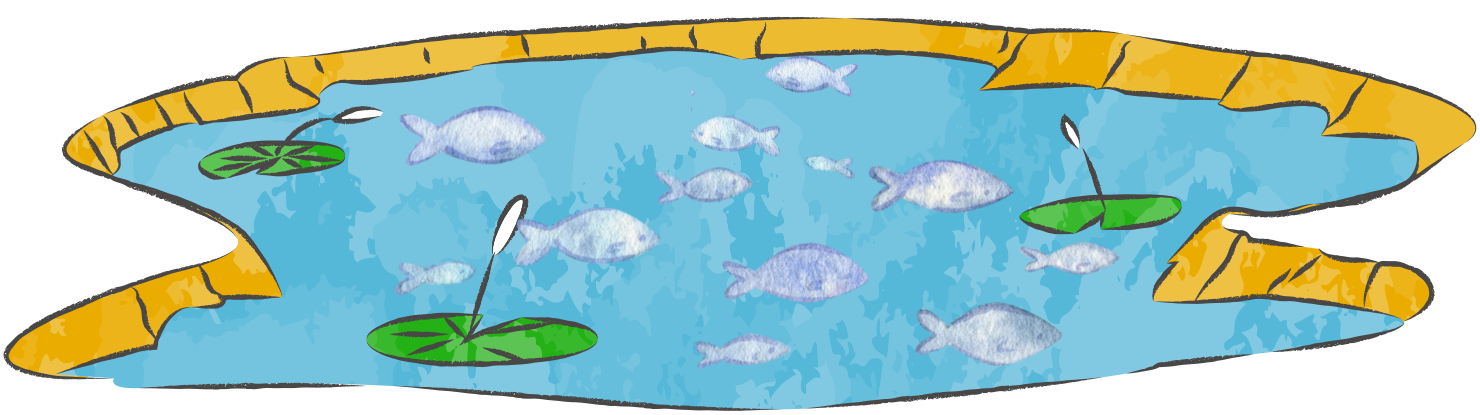
- Compare the class answer to the math problem with the **answer in the video (0:48)**. Feel free to pause the video to discuss.

ELABORATE

- Now watch the Sustainable Eating video by MantaTrust - https://youtu.be/crfmw0KCnbA
- The video asks several questions. After each question, the narrator will prompt you to pause the video and initiate a class discussion. Questions include:
  - What did you last eat?
  - List threats to our ocean.
  - What is bycatch?
  - How do humans rely on marine ecosystems?
  - How can we help our ocean?
- Design a plant-based meal.
- Make a cooking demonstration video to share with your school and families.

EVALUATE

- Students will be able to explain the difference between sustainable and unsustainable fishing.
- Students will be able to choose foods that help protect our ocean.



Plotting Manta Sightings

by Maria Dietz, Teacher Librarian, Merced City (CA) School District

Students will pretend they are fishers and plot manta ray sightings for their colleagues to help avoid by-catch.

Subjects

Math, Science

For ages 8-12

Other subject links:

Biology, Social Studies, Literacy

Themes

ocean resources, human impacts, developing solutions, interdependence, policy

OBJECTIVES

Students will:

- identify individual mantas by their ventral surface
- plot a manta's location on a graph

STANDARDS

Common Core

CCSS.MATH.CONTENT.6.G.A.3- Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

NGSS Standards

- MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

Disciplinary Core Idea

- Human Impacts on the Environment

Science and Engineering Practices

- Constructing Explanatios and Designing Solutions

Crosscutting Concepts

- Cause and effect

ENGAGE - part 1 (20 minutes)

- After reading chapter 2 of *Giant Rays of Hope*, go to the website https://www.mantatrust.org/ and display the webpage to the group. On the top right side, select ID the Manta, scroll down to Spot the Difference. Show students the unique spotting on the manta's ventral side. Reiterate how this uniqueness is like our own fingerprints.
- Provide each student with Handout #3 and an ink pad
- Direct each student to use a finger or thumb to make a unique ink fingerprint pattern on the belly or ventral side of their manta. Have students write their names on the back of their papers.
- Cut the coordinates from the Coordinates Resource page. Give each student a coordinate pair.
- Direct students to write the coordinate pair on the designated blank next to their manta ray.

Materials + Sources

- Handout #3 - Giant manta ray image (one per student)
- Handout #4 - Recording page (one per student)
- Handout #5 - Coordinate plane/map (one per student)
- Coordinates Resource (single sheet only)
- Ink Pads
- *Giant Rays of Hope* by Patricia Newman
- Mantatrust.org website

ENGAGE - part 2 (45 minutes)

- Hang up the personalized mantas around your room/playground/school, whatever works for your situation.
- Establish a set time for students to complete the task. Ten minutes for a classroom will be sufficient; more time when using a larger area.

EXPLORE

- Reference page 27 of *Giant Rays of Hope*. The fishers suggested reporting manta ray sightings to help prevent them being caught in fishing nets. The students will become the fishers and record sightings of manta rays.
- Divide students into "fishing boats" a.k.a. small groups or pairs.
- Provide them with Handout #4. There is a space to draw the spots on the manta and a blank for the coordinates. Model how to record the manta and its coordinates. While the drawing is not critical for the rest of the lesson, biological illustration is one method scientists use to record and communicate visual observations.
- Set a time limit according to your space.The playground would be ideal so that the manta rays are spaced apart. Each fishing boat should send members to different areas to look for manta rays.

EXPLAIN

- Call all your fishers back to their dock (table group).
- Students will now become scientists who will plot and analyze the data.
  - Display a coordinate grid and model how to plot x and y coordinates on the four quadrants. This should be a review of the skill.
  - Distribute Handout #5, one copy for each group.
- Using the group's collected data, students within the group will plot their sightings on the same coordinate plane. This will yield more "sightings". If the same coordinate has been recorded by more than one student, they should draw a circle around the plotted coordinate.
- Ask students to explain where manta rays are found.

ELABORATE + EVALUATE

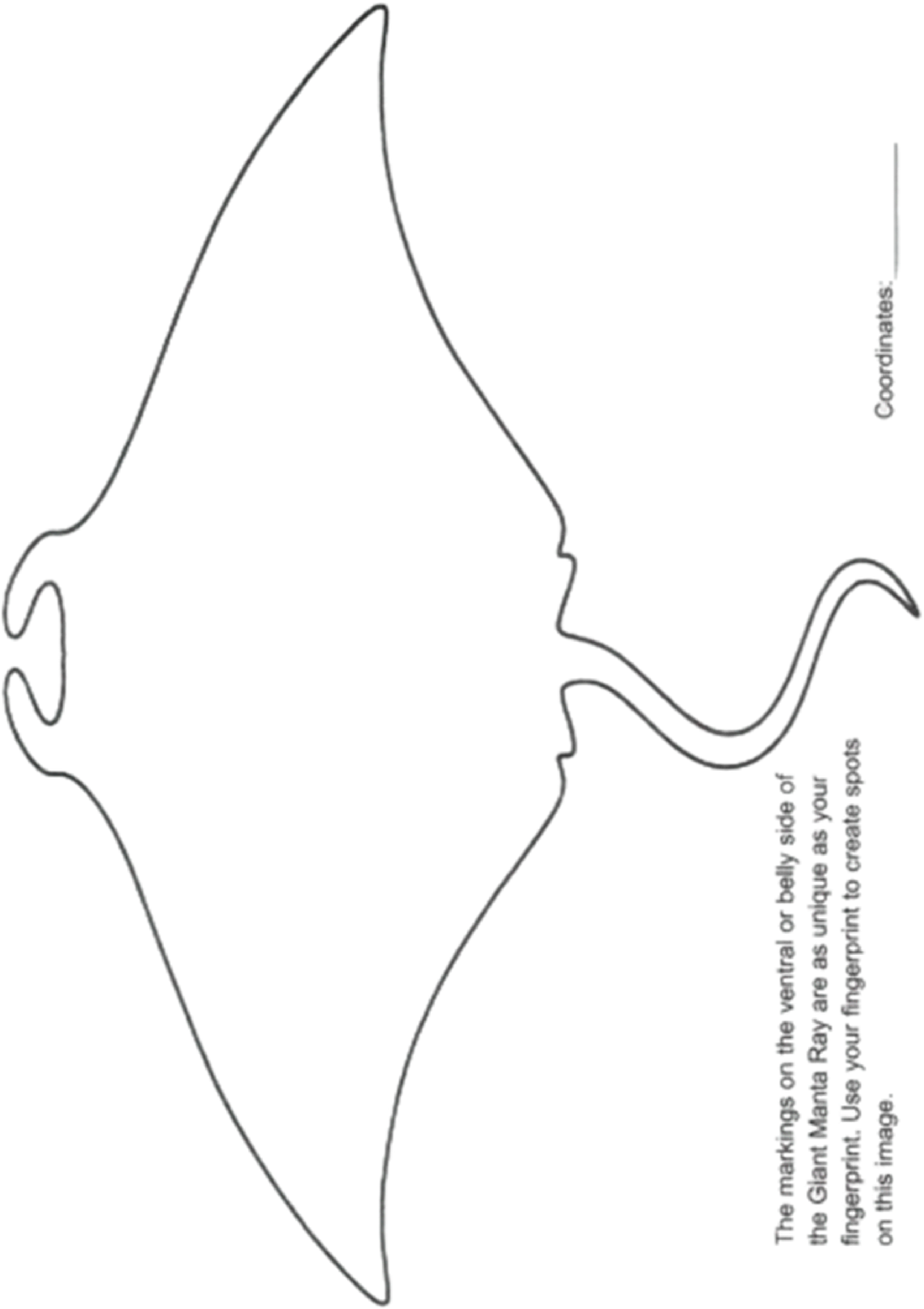
- Gather and display all of the coordinate planes. Facilitate the sharing of student's observations of their own data compared to that of other groups. You can use the prompts below as a guide:
  - What math skill did we use to determine where the manta rays are located?
  - Consider the locations of the coordinates on the map. Do you notice any patterns or trends?
  - What could be drawing the manta rays to these locations?
  - How might the manta rays' location coordinates be used to help the fishers?
  - How might the manta rays' presence or absence in these locations impact the ecosystem?
  - What conclusions, if any, can you draw from your data in terms of establishing a marine protected area?

COORDINATE RESOURCE

Print, cut out and distribute one coordinate pair per student.

14, 13	19, -19
15, 16	-10, 6
9, 7	-3, -6
14, 1	-2, -2
17, -6	-7, 5
11, -5	14, -14
13, -7	-8, 8
15, -2	-4, 3
2, 6	-5, 7
15, 7	18, -15
13, 12	16, -11
14, 4	15, -5
3, 4	8, -4
7, 3	4, 2
12, -2	13, 3
15, -2	12, 4
17, -8	-12, 11

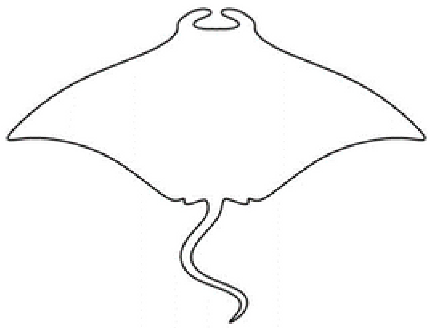
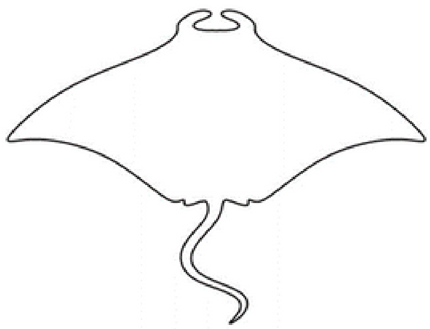
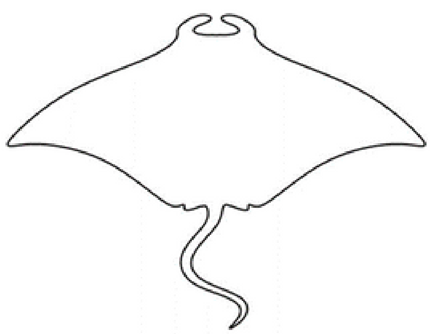
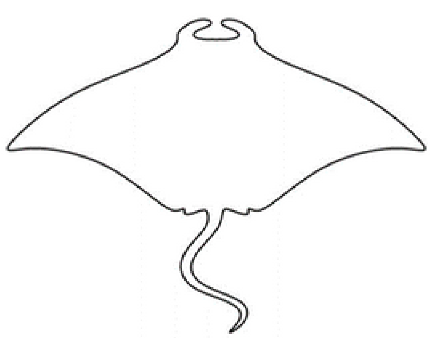
HANDOUT #3 - Giant manta ray image (one per student)



The markings on the ventral or belly side of the Giant Manta Ray are as unique as your fingerprint. Use your fingerprint to create spots on this image.

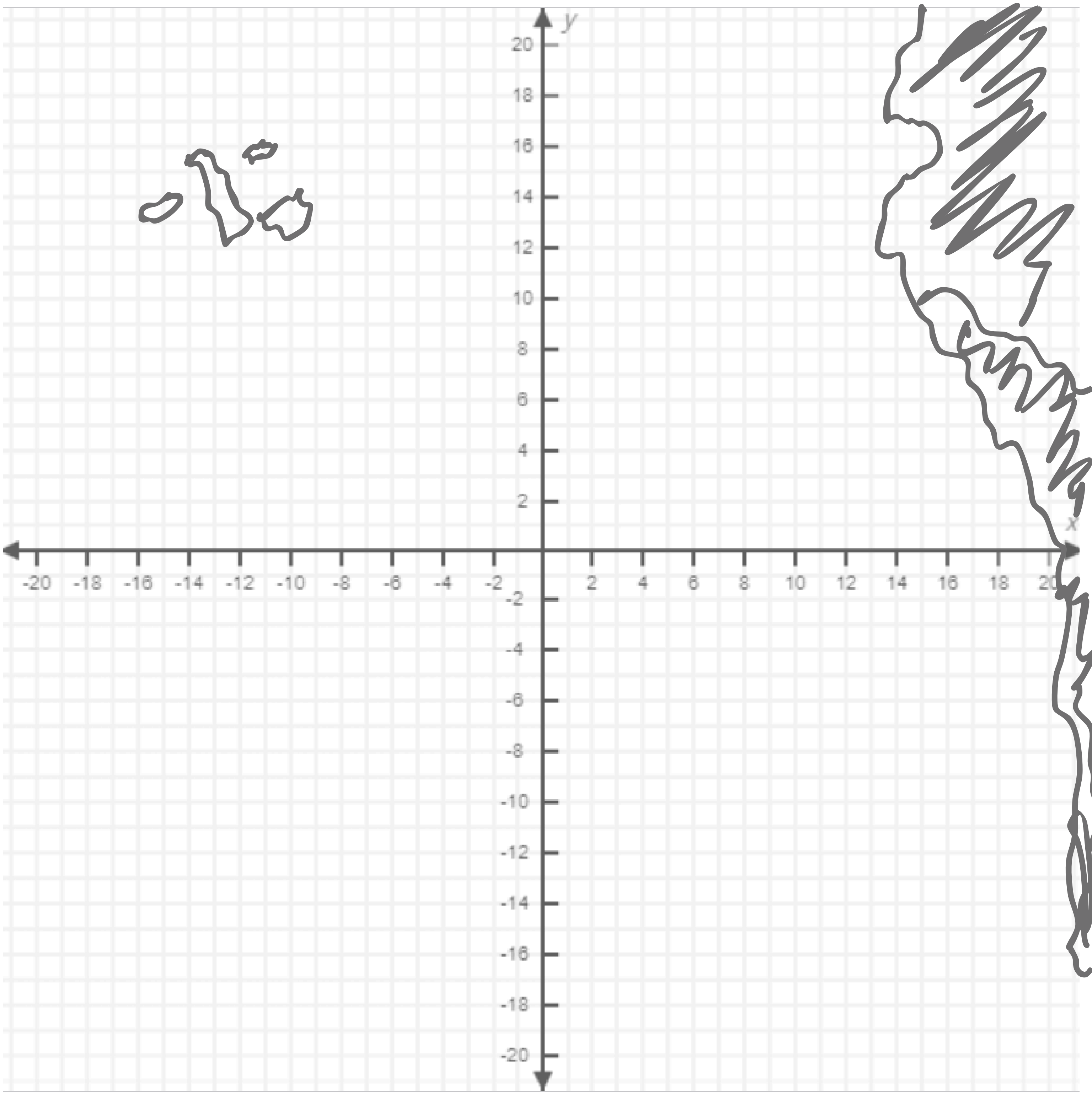
Coordinates:________

HANDOUT #4 - Recording page (one per student)

Document where the spots on the manta ray are located.	Record the coordinate pair. (x,y)
	(,)
	(,)
	(,)
	(,)

HANDOUT #5 - Coordinate plane/map (one per group)

Each group member will plot the coordinates from their recording sheet on this graph. In the event there is a duplicate coordinate, simply draw a circle around the coordinate.



Civic Role Models

Subjects

Social Studies, Art

Other subject links:

Citizenship, Literacy, Civics

Themes

community involvement, human impacts, developing solutions

For ages 9-14

Role models are important in all aspects of a child's life. In this lesson, students will understand the concept of civic role models.

OBJECTIVES

Students will:

- identify qualities that make someone a positive civic role model
- research and present information about civic role models
- reflect on civic role models and their impact

STANDARDS

Common Core

- CCSS.ELA-LITERACY.RH.6-8.1: Cite specific textual evidence to support analysis of primary and secondary sources.
- CCSS.ELA-LITERACY.RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- CCSS.ELA-LITERACY.SL.6.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

NGSS

- MS-LS2-5: Evaluate competing solutions for maintaining biodiversity and ecosystem services.

Disciplinary Core Ideas

- LS2.C: Ecosystem dynamics functioning, and resilience
- LS4.D: Biodiversity and humans
- ETS1.B: Developing possible solutions

Crosscutting Concepts

- Stability and change

ENGAGE

- Discussion
  - Begin by asking students what they think a role model is.
  - Write their responses on the board.
- Brainstorm
  - Have students brainstorm qualities that make a good role model.
  - List these qualities on the board.
- Introduce the concept of a civic role model.
- Interactive Poll
  - Ask students to name a person they know or read about who they consider a civic role model. Students should back up their choice with evidence. Use a tool like Google Classroom or Nearpod to conduct the poll.

Materials

- Marker board/Chalkboard
- Computers with Internet access or encyclopedias
- Worksheets for writing and drawing
- Art supplies (colored pencils, markers, paper, pipe cleaners, etc.)
- Handout #6: T-chart
- *Giant Rays of Hope* by Patricia Newman

EXPLORE

- Reading
  - Ask students to read *Giant Rays of Hope* either as a class or individually.
- Group Activity
  - Divide students into 5 small groups and assign each group a different chapter in the book.
- Guided Inquiry
  - Ask students to identify one or more civic role models in their chapter.
  - Distribute one T-chart per student (see next page for Handout #6)
  - List the qualities from the chapter that make that person a civic role model.

EXPLAIN

- Group Discussion
  - Each group discusses the qualities of their the role models they identified and how these qualities make them civic role models.

ELABORATE

- Role Model Action Figure
  - Provide students with various craft materials (e.g., pipe cleaners, fabric scraps, cardboard, clay, markers).
  - Ask each group to create an "action figure" of their assigned civic role model.
- The action figure should include:
  - a representation of the person
  - at least three "accessories" that symbolize their achievements or qualities
  - a "character card" listing their key traits and contributions
- This activity allows students to creatively represent their understanding of the role model's impact and characteristics.
- Group Presentations
  - Each group presents their role model action figure to the class, explaining the symbolism behind their design choices and accessories.
  - Encourage students to ask questions and engage with the presentations.
- Class Discussion
  - Discuss as a class how these role models contribute to their communities and the world, connecting back to the UN SDGs.
  - Have students explain how their action figure designs reflect these contributions.
- Becoming a civic role model
  - Ask students to brainstorm environmental problems in their commuinty.
  - List their ideas on the board.
  - Ask students to choose one of the problems listed and
    - Research that problem
    - Brainstorm ways they could become civic roles models to address the problem

EVALUATE

- Evaluate students based on their participation in discussions, quality of research and presentations, and completeness of art and writing assignments.

HANDOUT #6 - T-chart (one per student)

Person	Role Model Qualities

Exploring Plankton

by Neva Ayn Magalnick, Environmental Steward District TOSA, Solana Beach (CA) School District

Manta rays primarily eat plankton. Let's find out more about these tiny organisms.

Subjects

Science, Art

For ages 7-10

Other subject links:

Biology, Ocean Literacy, Design

Themes

food web connections, how structure determines function

OBJECTIVES

Students will:

- learn plankton is vital to all marine life
- understand that manta rays exist mostly on plankton
- design ways that plankton might stay afloat

STANDARDS

NGSS- Science

- K-2: K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- 2nd grade: 2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2nd Grade: 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 2nd Grade: 2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
- 2nd Grade: 2.LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.
- 5th Grade: 5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Fine Arts (California)

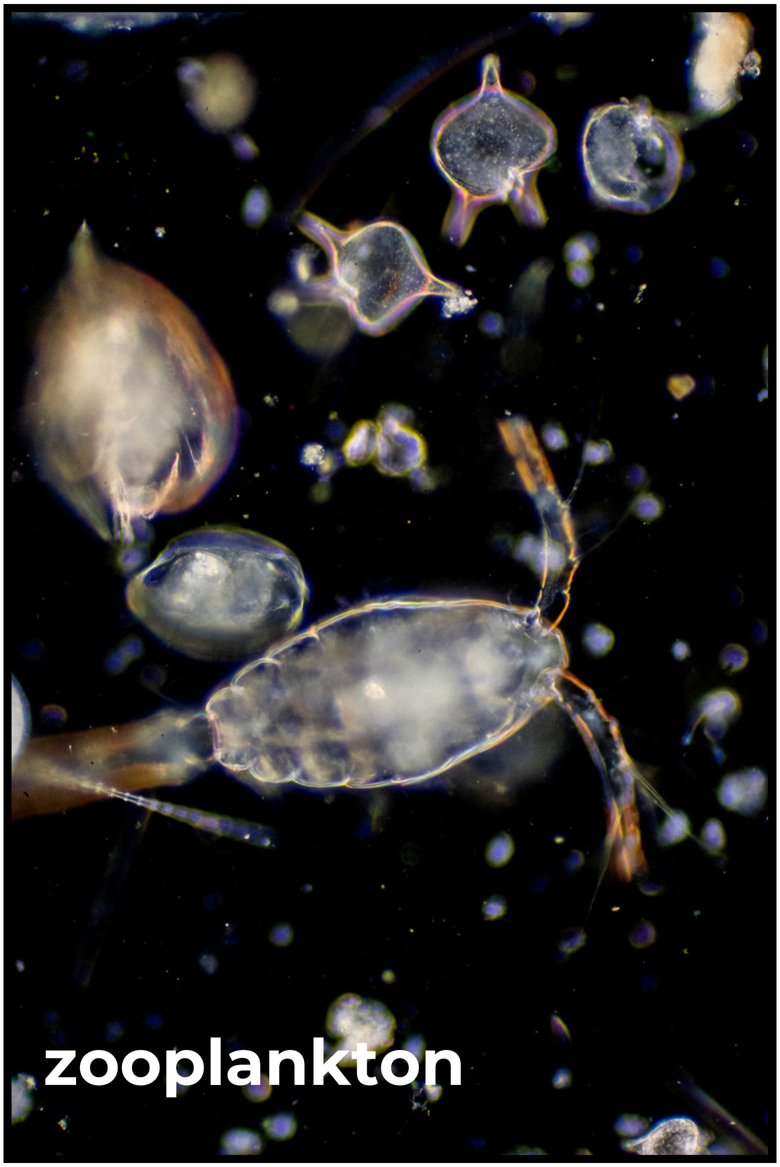
- 1.VA:Cr2.3 Identify and classify uses of everyday objects through drawings, diagrams, sculptures, or other visual means.
- 1.VA:Dr3 Use art vocabulary to describe choices while creating art.
- 8.VA:Cr2.1 Demonstrate willingness to experiment, innovate, and take risks to pursue ideas, forms, and meanings that emerge in the process of art-making and design.

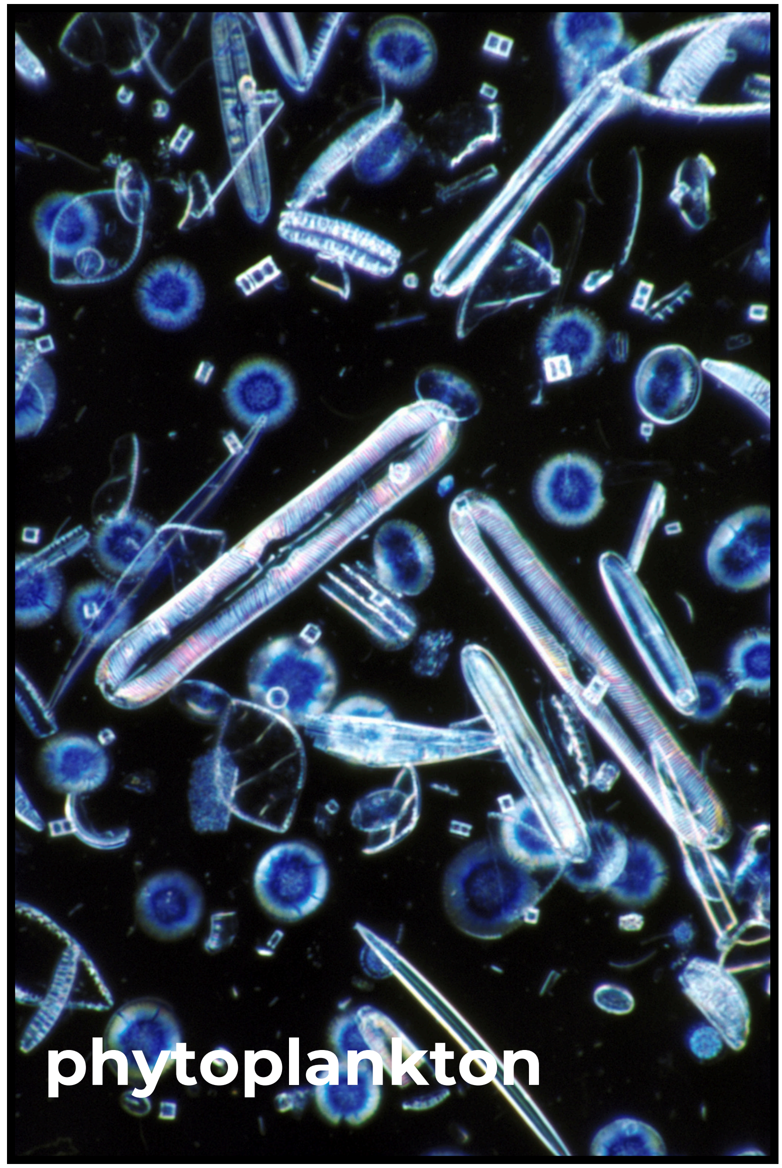
Media Arts (utilizing sketch tools, websites, or 3D modeling design tools) (California)

- 2.MA:Cr3 a. Construct and assemble content for unified media arts productions, identifying basic aesthetic principles, such as positioning and attention.
- 5.MA.Cr3 a. Create content and combine components to convey expression, purpose, and meaning in a variety of media arts productions, utilizing sets of associated aesthetic principles, such as emphasis and exaggeration. b. Determine how elements and components can be altered for clear communication and intentional effects, and refine media artworks to improve clarity and purpose.

Materials

- Clay for each student
- Other art supplies, such as paper, pipe cleaners, wire, sticks, etc.
- Large buckets/basins of water





ENGAGE

- Manta rays eat plankton. But what's plankton?
- These minuscule animal and plant ocean drifters are vital to all marine life. Without them the ocean wouldn't survive. And if the ocean doesn't survive, we won't either.
- Plankton drift with currents. They cannot sink to the bottom of the ocean. Phytoplankton feed off sunlight, and zooplankton feed off of photoplankton and other zooplankton, so they must stay afloat.

To prevent themselves from sinking, plankton increase their surface area. Flat surfaces, stretched limbs, or lengthened spines are ways to increase surface area without increasing density. These characteristics can be seen in the microscopic pictures above.

EXPLORE

- Divide students in groups of 2.
- Ask them, Can you create different shapes of floating plankton?
- Use the art materials provide to design plankton with traits to help them float.
- Ask students to test their creations in a large bucket/basin of water.
- If the plankton doesn't float, students should modify their designs and try again.

EXPLAIN

- Ask each group to explain their design process.
  - What worked?
  - What didn't?
  - How did you fix it?

ELABORATE

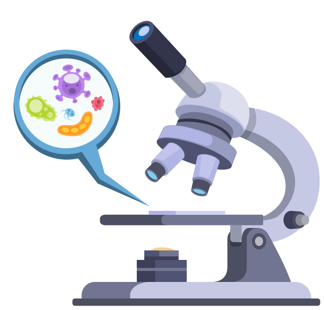
- Ask students to create a biological drawing of their plankton on Handout #7.

EVALUATE

- Assess students on whether they followed directions and embraced the design process by attempting to solve their design flaws.
- Assess the students' oral presentations for clear, logical thinking.

HANDOUT #7 - Where science meets art (one per student)

Design creative plankton with traits to help them float!



Mantas + Microplastics

adapted from a lesson by Laura Tiu, Sea Grant Marine Extension Agent, Sea Grant Florida, University of Florida IFAS Extension

Engage in a hands-on activity to understand the impact of microplastics on manta rays.

Subjects

Science, Math

Other subject links:

Biology, Ecology

Themes

food web connections, human impact, plastic marine debris

For ages 7-10

OBJECTIVES

Students will:

- identify microplastics and their effects on marine life.
- calculate the percentage of microplastics ingested as compared to food.
- engage in discussions about environmental conservation.

STANDARDS

NGSS- Science

- Next Generation Science Standards (NGSS) ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- Common Core State Standards for Mathematics (CCSS.MATH.CONTENT.5.NF.B.6): Solve real-world problems involving division of fractions by fractions.

ENGAGE

- Introduction (10 minutes)
  - Begin with a brief discussion about what microplastics are and where they come from.
  - Ask students if they've heard about any effects of plastic pollution on marine animals.
  - Show a short video clip illustrating the impact of plastic on ocean life.

EXPLORE

- Activity Setup (5 minutes)
  - Distribute supplies and explain students' roles as baby giant manta rays.
- Feeding Frenzy Game (15 minutes)
  - Students will use tongs to "feed" on rice while avoiding lentils in the container.
  - Option 1: Time the activity for 30 seconds to 1 minute, encouraging quick feeding.
  - Option 2: For older students, have them pour their "stomach" contents into coffee filters and count the pieces of plastic and rice.

EXPLAIN

- Discussion (10 minutes)
  - Discuss what students observed during the activity. Ask guiding questions:
    - How did it feel to try to eat while avoiding plastic?

Materials

- 1 container (12x8x4 inch Rubbermaid container with lid)
- 3 small cups (measuring cups)
- 3 tongs (or spoons)
- 5 lbs. white rice (edible food)
- 1 lb. brown or green lentils (microplastics)
- Optional: minute timer, coffee filters, calculator

- What did you notice about the rice and lentils?
- Why do you think marine animals confuse plastic for food?
- Introduce the concept of bioaccumulation and its impact on health.

ELABORATE

- Calculating Percentages (15 minutes)
- Students will calculate the percentage of microplastics in their "diet"
- Discuss scenarios where the percentage of plastic is significant and the implications for marine life
- If the game is repeated, students can also choose to be baby fish, baby turtles, or baby seabirds.

EVALUATE

- Reflection (10 minutes)
  - Have students write a short reflection on what they learned about microplastics and how they can help reduce plastic pollution.
  - Encourage them to think about actions they can take in their daily lives.