



Learning Activity:

Be Careful What You Fish For

Activity Type	Engineering/design challenge
Focus Areas	STEM
Time Required	60–75 minutes

● Overview

Students will learn the steps of the scientific method as they perform an experiment to understand one of the greatest threats that sea turtles face: accidental capture in fishing gear (known as bycatch). Using common materials to model existing fishing methods, students will “go fishing” and reflect on their results. Relating this to real-life challenges, students will then propose engineering design solutions to minimize the impacts that fishing has on sea turtles.

● Objective

At the completion of the activity, students should be able to:

- Identify the steps of the scientific method.
- Define “bycatch”, and describe the threat it poses to sea turtles and other marine life.
- Use engineering skills to predict and propose effective design strategies to prevent accidental capture of sea turtles.

● Subject and Standards

Next Generation Science Standards:

- 2-PS1-2 Matter and Its Interactions
 - Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 3-5-ETS1-1 Engineering Design
 - 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 Engineering Design
 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3 Engineering Design
 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

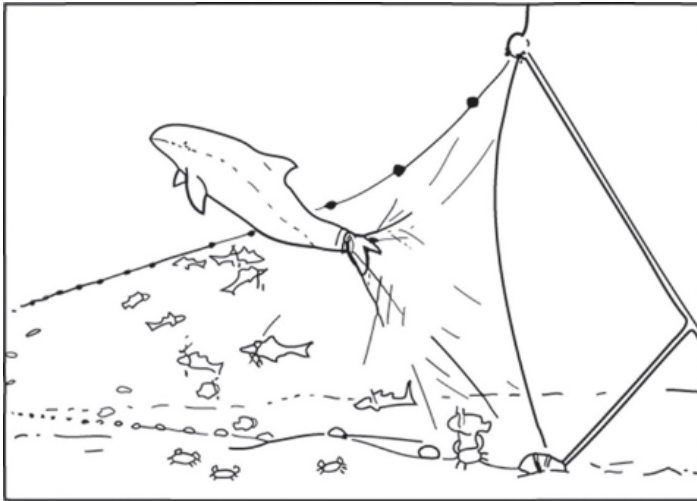
● Materials Needed

- [Sea Turtle Educator's Resource Guide](#) (for background reading)
- **Per student:** paper, pencil, Lab Report Worksheet (see handouts at the end of this activity)
- **Per student or group** (if working in groups, recommended group size is three students):
 - A variety of medium-sized, differently colored items to represent different marine species
 - Suggestions of items to use are beads, buttons, Legos, bingo chips, or a variety of colorful candy (just make sure kids don't eat the lab supplies!). The key idea is to make sure the collection contains multiple items of varying colors.
 - Try to include at least four or five different colors in the mix, with at least five and as many as 15 items of each color. These amounts can be modified to reflect the resources you have available. Having a larger number of items will better demonstrate results, although the activity can be carried out with fewer.
 - A container (preferably a large, rectangular-shaped box or bin) to hold the colored pieces
 - Items that will represent three commercial fishing methods:
 - 1 hair net (honeycomb style) to represent gillnetting
 - 1 sandwich bag, cone-shaped paper cup, or coffee filter to represent trawling
 - 1 roll of heavy duct tape or packing tape to represent longline fishing



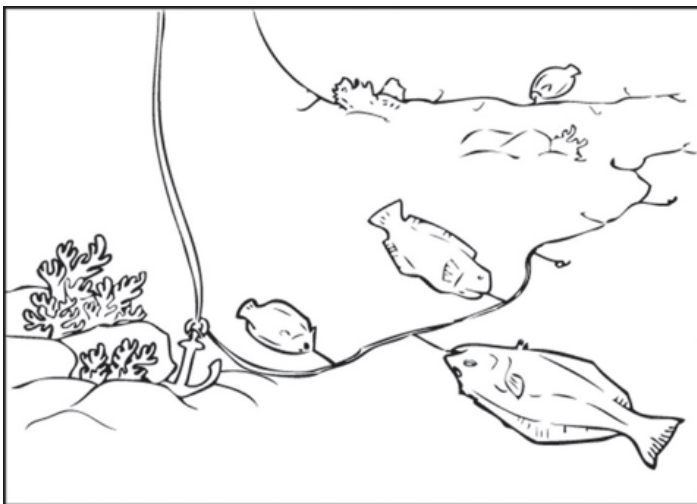
Vocabulary

- **Bycatch:** the accidental capture of species such as dolphins, marine turtles, and seabirds when fishing for or capturing other types of marine species
- **Gillnetting:** the use of mesh nets that allow fish to pass their heads and gills through a hole in the mesh and then get stuck when they try to back out; gillnets can be several miles long and up to 100 feet deep



Drawing: © Peter Diamond/WWF-Canada

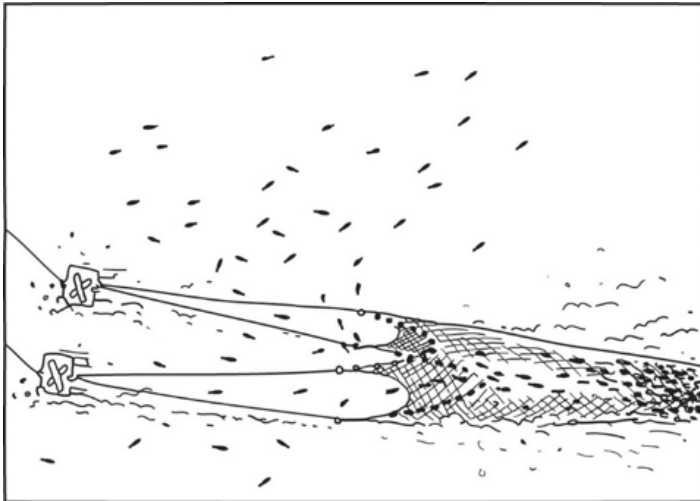
- **Longline fishing:** when hundreds of thousands of baited hooks are hung at intervals along a single fishing line



Drawing: © Peter Diamond/WWF-Canada



- **MSC logo:** a symbol from the Marine Stewardship Council placed on seafood that indicates that the fish can be traced back to a sustainable source
- **Sustainable:** of, relating to, or being a method of harvesting or using a natural resource so that the resource is not depleted or permanently damaged; an effective and innovative way to efficiently use natural resources and ensure their continued supply
- **Trawling:** when boats drag large nets along the seabed, catching almost everything in their path



Drawing © Peter Diamond/WWF-Canada



● Activity Procedure

Part 1: Introduction and Preparation

- Prepare each bin with colored materials prior to the activity. Make sure to note how many pieces of each color you place into each bin. There should be an equal number of each color to prevent unbalanced results.
- Ask students what they know about the way fishers try to catch marine animals. Many students will automatically think of a fishing pole, but there are other commercial methods designed to capture a large number of marine animals at one time.
- Using the definitions and the illustrations provided in the Vocabulary section of this activity, review the commercial fishing practices of gillnetting, longline fishing, and trawling with students so they understand how these practices operate.
- Review with students the kinds of seafood that people like to eat and that commercial fishers are trying to catch (for example, tuna and shrimp), as well as the types of marine species that they are catching accidentally (for example, dolphins, sea turtles, and seabirds).
- Now that students have a visual description and understanding of the three methods, have them consider how each one is designed and predict what potential problems might arise, particularly related to the accidental catch of sea turtles and other marine species.
 - Unfortunately, many marine species that aren't intended to be caught will get trapped in fishing nets or on hooks. Once caught in nets, sea turtles and other species will be unable to reach the surface to breathe and could drown. Others won't survive being hooked on fishing lines and pulled out of the water.



Part 2: Activity

Students will now engage in an experiment that mimics these fishing challenges. At completion, they will be able to define the bycatch problems related to these commercial fishing processes and propose possible solutions.

- Ensure that each student has something to write with and a copy of the Lab Report and Data Table Worksheets (provided in the handouts section).
- Review each section of the Lab Report Worksheet with students so that they understand the objectives. Students will follow the steps of the scientific method to observe, collect results, and reflect on the causes and effects of bycatch. Students should complete the Question, Hypothesis, and Materials portions of their lab sheets prior to beginning the experiment. If students are not familiar with the scientific method of experimentation, provide a brief overview.
 - Steps of the scientific method:
 - Define a question or purpose
 - Generate a hypothesis (a predicted answer to the question)
 - Gather materials
 - Follow experimental procedure to gather data
 - Analyze collected information and draw conclusions
- Select a color of item to represent the species for which you want to fish. The rest of the colors will be species to avoid. Choose one color to represent sea turtles. It may be helpful to provide a guide on the board or on paper, identifying each color as representing a certain species. For example:
 - Blue = the species you are trying to catch (for example, shrimp or tuna)
 - Red = dolphins
 - Green = sea turtles
 - Yellow = sharks
 - Purple = stingrays
- Distribute the materials, and make sure to have students count and record the amount of each color and species prior to using the various tools.
- If students are working in groups, each should assign a fishing tool to a specific person in the group. If working individually, the student can try all three fishing methods.



- One at a time, each student will use the assigned tool to try the corresponding fishing method. The goal is to pull up as many of the targeted species and as few of the non-targeted species as possible.
 - To represent trawling, the student will grasp the bag or coffee filter on opposite edges and drag it across the bottom of the bin.
 - To represent longline fishing, the student will rip off one large piece of tape and stick it to the items, pulling up what they can.
 - To represent gillnetting, the student will attempt to pick up their catch with the hairnet.
- After each person pulls up the “catch,” students should record in the Data Table Worksheet the name of the student, the tool that was used, and how many of each color were caught (intentionally and unintentionally) in the Trial 1 box. Take particular note of the number of sea turtles accidentally caught.
- Once totals are recorded, students should mix the items back into the bin in preparation for the next person and repeat the process of recording data.
- At your discretion, depending on time and/or group size, multiple trials can be performed, rotating which students are responsible for each fishing tool. For accuracy, when carrying out an experiment, it is recommended to do a minimum of three trials. If multiple trials are performed, be sure to record the results of each in the Data Table Worksheet.
- Have students complete the Conclusions Worksheet, where they will consider their data and why group members may have gotten different results. As with any experiment, the scientists involved should look for any slight differences that could account for varying data. For example, in this experiment, students using the same tool could have gotten different results depending on how the colors were spread out in their bins or how they used their tools.
- Students should also brainstorm and record potential improvements in net or fishing hook designs that could prevent bycatch.





SEA TURTLES

Part 3: Discussion and Assessment

- Recap the activity by comparing the groups' results. Was one method more successful than the others? Have students discuss the challenges they faced throughout the activity.
- Share with the class what WWF is doing to help prevent and reduce instances of bycatch (links to webpages with information on these are provided in the Additional Background Info section below):
 - **Circle hooks:** WWF is promoting circle hooks to be used for fishing. As opposed to other fishing hooks (like J hooks), if a sea turtle is accidentally caught by a circle hook, it is not as life-threatening and will not affect a fisher's catch.
 - **Turtle Exclusion Devices or TEDs:** Turtle Exclusion Devices were developed for trawlers to allow shrimp to enter the net but provide a way for turtles to escape. This design continues to improve, and WWF is working to promote its use throughout fishing communities.
- Encourage students to share any engineering ideas they have for how they would design a fishing method that would be more effective at reducing bycatch.
- Review ways that students can help. For example, next time you go grocery shopping with your family, make sure to buy seafood with the MSC (Marine Stewardship Council) logo on it, certifying it as being produced using responsible fishing methods that minimize accidental catch.



Extended Learning Options

- To incorporate a more advanced math component, have students calculate success rates as percentages or fractions as part of their Data Table Worksheet.
- Download the [WWF Together app](#) and explore the sea turtle segment. Use these interactive tools to help kids learn more about sea turtles and the threats they face.
- Start a class fundraiser to protect sea turtles and other wildlife and their habitats, using WWF's online fundraising tool, Panda Nation. Learn more at www.pandanation.org.



● Additional Background Info

You can use the information found at the links below to enhance your discussion with the class, or you may want to share some links directly with students if you determine they are grade-level appropriate.

- Video: [Reducing Bycatch in the Coral Triangle](#)—demonstrates the benefits of using circle hooks
- Article: [International Smart Gear Competition](#)—shares information about a real-life engineering competition to create a solution for targeting only intended fish species and reducing bycatch
- Article: [Can LED Lights Save Sea Turtles?](#)—describes a game-changing invention by one of the participants in the WWF International Smart Gear Competition
- Article: [How a Simple Technology Is Saving Sea Turtles](#)—shows the mechanics behind Turtle Excluder Devices
- Article: [The Vaquita: 5 Facts About the Most Endangered Marine Mammal](#)—provides information about the vaquita, including the severity of the threat of bycatch and what can be done to help save this species



For more fun classroom activities with a focus on wild species and conservation, visit wildclassroom.org.



SEA TURTLES

Name: _____ Date: _____

● Be Careful What You Fish For Lab Report Worksheet

Question
 (What are you trying to find out?)

Hypothesis
 (What do you predict will happen?)

I think _____

because _____

Materials
 (List amounts of everything you're using)

-
-
-
-
-
-
-

● Procedure

- 1) With your group, count the total number of each color in your bin, and record these in your materials list.
- 2) Decide who will use what tool. Remember, if performing more than one trial, you will switch tools after each trial. Start with Trial 1, and write down everybody's name and what fishing tool/method they will be modeling in your Data Table Worksheet (first two columns).
- 3) Decide who is going first. In one attempt, use your assigned fishing tool and method to pull up as many of the targeted species and as few of the non-targeted species as possible.
- 4) Count and record the results in your Data Table Worksheet. Then return the pieces to the bin, mix them, and proceed with the next person.
- 5) If performing more than one trial, rotate who uses which tool and repeat steps 2 through 5, recording results in the various trial tables on your worksheet.



SEA TURTLES

● Data Table Worksheet

Trial 1

Group member name	Fishing device/method used	Number of species caught on purpose	Number of species caught by accident	How many of the species caught by accident were sea turtles?

Trial 2

Group member name	Fishing device/method used	Number of species caught on purpose	Number of species caught by accident	How many of the species caught by accident were sea turtles?



SEA TURTLES

Trial 3

Group member name	Fishing device/method used	Number of species caught on purpose	Number of species caught by accident	How many of the species caught by accident were sea turtles?



SEA TURTLES

● Conclusions Worksheet

1) What did you and your group discover by doing this activity?

2) What could be a reason for your group members getting different results than you?

3) Was your hypothesis correct? What fishing method seemed to work best at catching your targeted species and excluding your non-targeted species?

4) What were some difficulties your group encountered while doing this activity?

5) How might the difficulties your group had compare to the real-life difficulties that commercial fishers have?

6) How do the problems with these fishing practices affect sea turtles?

7) Can you think of any solutions to this problem?
