

## Coastal Edition Teacher's Guide: Additional Resources

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## Table of Contents

Additional Teacher Resources .....	3
Fashion a Fish: Adaptations for Survival .....	4
Fashion a Fish: Student Worksheet .....	5
Squid Dissection Lesson .....	7
Squid Dissection Student Handout .....	8
Ocean Currents .....	11
Ocean Circulation Student Handout .....	14
Where Did My Beach Go? Design Challenge .....	17
Oil Spill Clean Up Methods .....	19
Oil Spill Clean Up Methods Handout .....	20
Oil Spill Clean Up Lab .....	24
Oil Spill Clean Up Student Handout .....	25
Ocean Plastics WebQuest Lesson .....	27
Ocean Plastics Webquest.....	288
Designing Ocean Friendly Products .....	31
Gone Fishin' .....	33
Gone Fishin' Rules.....	344
Gone Fishin' Fishing Log.....	355
Ocean Careers .....	37
Ocean Careers.....	38

## Additional Teacher Resources

The following includes a variety of lesson plans that individual teachers may incorporate into their classrooms. Each of the lessons is specifically designed to address aspects of the marine environment. Included within the resource are lessons on adaptations, ocean circulation, erosion, pollution, resource management and ocean careers.

## Fashion a Fish: Adaptations for Survival

\*Activity modified from Project Wild.

**Objective:** Students will be able to identify different ways in which organisms survive in different habitats. Some species need to withstand drying out during low tide, some immobile species need to have spines to protect against predators. The unique characteristics allow species to adapt and survive in their environment. In this activity students will design their own marine organism that will have adaptations that help survival.

**Duration:** 1 – 2 class periods

**Materials:**

- Student worksheet
- Markers, pencil crayons
- Blank paper

**Teacher Notes:**

Students are asked to create a new marine species that must have at least one adaptation that helps its survival in its habitat. Students must provide a rationale as to how the feature affects the organism's ability to survive and they should indicate whether the adaptation is a behavioural (schooling of fish), physiological (metabolism), or structural (spines or coloration). Students will complete a mini poster and the questions on the student worksheet.

**Part 1: Design your own creature! Complete on blank white paper.**

## Part 2: Questions

1. Write a complete paragraph explaining the attributes of the fish you have designed. You must identify and describe the adaptation and explain the significance of the adaptation in the fish's survival

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

2. Do you believe your fish would survive in the “real world”, or ocean? Explain why or why not.

[illegible]

3. Describe the advantages to the fish's adaptations. Are there any disadvantages or negative effects of the adaptation?

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4. Explain why biodiversity is important for ecosystem survival.

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5. Explain how biodiversity is affected by adaptations within a species and why adaptations are important to animal survival.

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6. Name a marine organism with adaptations in each of the following categories and describe the adaptation:

- a) Mouth (ex. Sharp teeth)
- b) Shape (Ex. Flat to live on the bottom)
- c) Coloration (Ex. Countershading)

Describe the advantages and disadvantages of the adaptation to the survival of the organism.

Organism:

Describe Adaptation to Mouth:

Advantages/Disadvantages:

Organism:

Describe Adaptation to Shape:

Advantages/Disadvantages:

Organism:

Describe Adaptation to Colouration:

Advantages/Disadvantages:

## Squid Dissection Lesson

**Objective:** Students gain an insight into various adaptations that marine organisms have that aid in survival.

**Duration:** 1 class (This can be done as a demo or in groups)

**Materials:**

- Squid (Can be order as preserved specimens or purchased from bait shops or markets)
- Dissection tray
- Dissection Kit
- Gloves, aprons, safety goggles
- Student Worksheet
- Pen, paper

**Teacher Notes:** The squid is one of the most highly developed invertebrates. Have students complete the reading on the squid and answer the questions before starting the dissection.

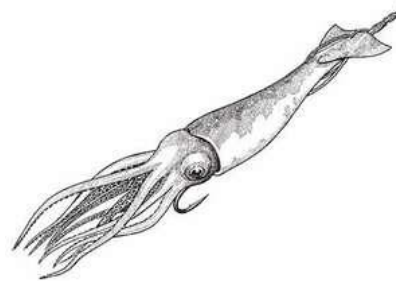
**External Anatomy:** Have students look at the squids and find each of the structures indicated on the diagram. Students should make note about which of the structures are adaptations for the squid and how they help it to survive.

**Internal Anatomy:** This can be completed as a demonstration or in small groups (4 students). Have students make note of the internal structures that are adaptations as well (such as the ink sac!).

## Squid Dissection Student Handout

### BACKGROUND INFO:

The squid is one of the most highly developed invertebrates. It is in the phylum Mollusca, which is derived from the Latin word meaning “soft body”. It belongs to the class Cephalopoda, meaning “head-footed”, because its head is pushed down toward the foot. This class also includes the octopus, cuttlefish and ancient nautilus.



All mollusks have a soft body with a special covering called the mantle, which encloses all of the body organs such as heart, stomach and gills. Squid have a large mantle, eight arms with two longer feeding tentacles all with suckers, a beak and mouth, a siphon, a large head (with a brain), two large eyes, and three hearts. The tentacles are long and retractable and have suckers only at the tips. Their large eyes are very similar in structure to people's eyes. The shell has been reduced to a chitinous pen that is embedded in the upper surface of the mantle.

Squid breathe using gills. They move by squirting water from the mantle through the siphon, using a type of movement called jet propulsion. They can move both backward and forward just by changing the direction of the water flow through siphon.

Some of the animal's structures explored in this lesson illustrate the ways in which the squid has adapted to life in the ocean. Its streamlined body and jet propulsion make the squid a fast, active predator. This animal also has a very good defense mechanism.

Squid can change the color of their skin to mimic their environment and hide from predators. When in danger, squid release a cloud of dark ink from their ink sac in order to confuse their attacker and allow the squid to escape.

These fast-moving carnivores catch prey with their two feeding tentacles, then hold the prey with the eight arms and bite it into small pieces using a parrot-like beak. The esophagus runs through the brain, so the food must be in small pieces before swallowing. Squid feed on small crustaceans, fish, marine worms, and even their own kind!

Squid reproduce sexually by releasing eggs into the water. After mating, a female squid will produce 10-50 elongated egg strings, which contain hundreds of eggs in each string. In many species, the parents will soon die after leaving the spawning ground. The egg strings are attached to the ocean floor, are left to develop on their own, and hatch approximately ten days later.

Squid are an important part of the ocean food web. Squid are a major food source for many fishes, birds and marine mammals. Squid are gaining popularity as a food source for humans around the world (calamari). However, over-fishing is a growing concern because there are no regulations on squid harvesting.

Squid can be as small as a thumbnail, or as large as a house. The giant squid, *Architeuthis*, can measure 20m in length and weigh three tons! Southern California squid populations spawn mainly in the winter (December to March). Squid are caught with a seine net (a net that hangs vertically in the water column) commercially at their spawning grounds. About 6,000 metric tons are taken yearly for human food and bait.

**PROCEDURE: Part I – External Anatomy:**

1. Place the squid on the plastic plate dorsal side up (darker side). Notice the counter shading. One side is darker than the other.

2. Notice and label on the squid diagram the **chromatophores**. The “freckles” allow the squid to change colors. These spots change size to change the squid’s color for camouflage. Try rubbing them to see if you can see a change.

3. Look and label the **fins**. These help the squid change direction when swimming.

4. Locate and label the **mantle**. The mantle is the main part of the squid’s body—all organs are inside.

5. Locate and label the **pen**. The squid is related to other “shelled” animals like clams and snails. The pen is all that is left of the shell the squid’s ancestors once had.

6. Look and label the **eyes** on the squid diagram. Squid have big eyes compared to their head. In comparison, humans’ eyes would be the size of dinner plates if the proportion were the same. They are positioned on the side. Being on the side gives them more peripheral vision. This is great for hunting.

7. Count and label the number of **tentacles** the squid has. The tentacles are longer than the arms and have suction cups only at the tips. These are used to pass food to the shorter arms and then to the mouth.

8. Count and label the number of **arms** the squid has. Arms have suction all the way down. Label the suction cups as well on the diagram. The suction cups help the squid to hold onto food.

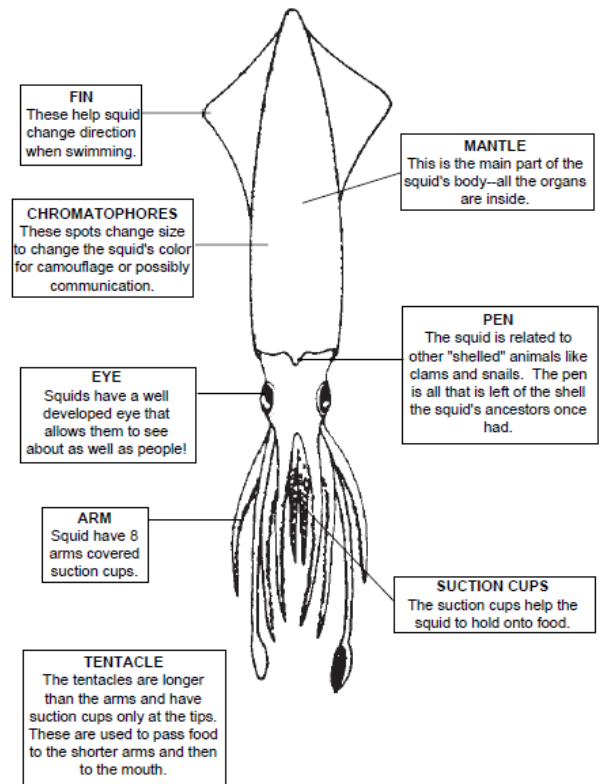
9. Look and try to find the **beak**. The beak is hard and is a dark brownish color. Draw the beak in on the internal anatomy squid diagram and label it.

10. Now, lay your squid ventral side up (lighter side). Locate the collar. The collar is the opening of the mantle (like the collar of your shirt).

11. Locate and label the **siphon** (a.k.a. funnel). You can label the siphon on the internal anatomy diagram. Water is pulled into the mantle. The mantle is squeezed forcing water out through the siphon. This type of movement is called jet propulsion. Squids are the fastest invertebrates and swim at approximately 40-50 mph.

**Part 2: Internal Anatomy:**

1. Place the squid on the ventral side (lighter side). Cut the mantle UPWARDS to avoid puncturing internal organs. Cut all the way to the tip of the tail. Lay the flaps of mantle to the sides.



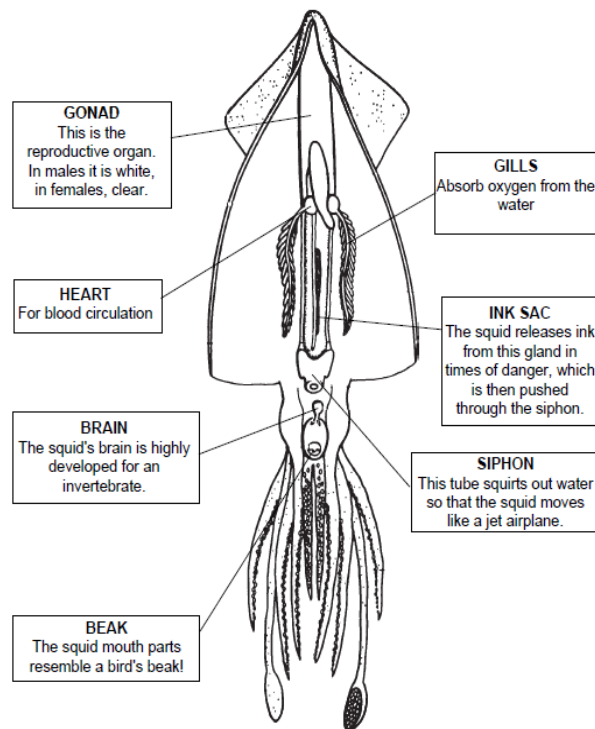
2. Label and remove the **gills** from the body (place them on the side of the plate). The gills are feathery structures that absorb oxygen from the water.

3. Locate and label the **ink sac**. The ink sac lies on top of the liver. Carefully, pull it up with the tip of your scissors or finger and snip the ink sac away. Lay aside for now. The squid releases ink from this gland in times of danger, which is then pushed through the siphon.

4. Locate and label the **heart**. Squid have 3 hearts – 2 branchial and one systemic. The hearts are located at the bottom of the gills. The heart is for blood circulation.

5. Locate and label the **gonads**. This is the reproductive organ. In males, it is a white-ish mound (sperm sac). In females, it is clear to yellow/orange mass of eggs.

6. Place your fingers on your **mantle** (on either side of the head). Peel back head and guts from the mantle. Locate and remove the **pen**. Finally, take the pen and dip it into the ink sac. Then try to write your name on the dissection tray.



#### Questions:

1. How many arms does the squid have? How many tentacles?
2. What is the function of the arms and tentacles?
3. What is the function of the water jet?
4. Explain how squid can change direction in movement.
5. Name two features that are adaptations for the squid's predatory life.
6. To what kingdom does a squid belong? What phylum? What class?
7. Name one other organisms in the same CLASS
8. Describe the squids place in the food web. What does it eat? What eats it?

## Ocean Currents

**Objective:** Students will be able to identify the impact of temperature and salinity (salt) on ocean currents. Using water with different temperatures and salt contents, students can see how water moves based on changing conditions.

**Duration:** 1 class

**Materials Required:**

Required for each group:

- Transparent container (Shoebox-size or larger)
- Two transparent cups (put a small hole in the center at the bottom of one cup)
- Food Colouring
- Table salt
- Gloves, spoon or spatula
- Thermometer
- Ice cubes
- Access to a sink or water

**Teacher Notes:** Students will complete 3 trials; A. Baseline trial, B. Changing Temperatures and C. Changing Salinities.

A. Baseline Trial:

1. Put cold tap water in transparent container until the surface of the water is a few centimeters from the rim of the container.
2. Add a small amount of table salt to the water and stir. As the teacher you may want to circulate around and add the salt to each basin to monitor how much is being added.
3. Measure and record the temperature of the cold saltwater.
4. Half fill a plastic cup (the one with **no hole** in the bottom) with some of the cold saltwater from the large container of saltwater.
5. Add a few drops of food coloring to the cold saltwater in the plastic cup. **Caution:** Food coloring can permanently stain materials. Use paper to cover work surface. It is best if the teacher walks around and adds the food colouring for students.
6. Obtain a plastic cup that has a hole in the bottom.
7. The person who is going to hold the plastic cup that has a hole in the bottom should wear a glove and **cover the hole** with their finger to avoid staining their skin.
8. Another person should pour the water containing food coloring into the plastic cup that has a hole in the bottom (make sure the partner is covering the hole!)
9. The person covering the hole in the bottom of the plastic cup should lower that cup into the large container of water **at one end of the container** until the water level inside the cup is exactly the same as the water level in the larger container.
10. When the water in the large container is not moving very much, the person covering the hole in the bottom of the cup should slowly uncover the hole.
11. Record observations of the movement of the water that has been dyed with food coloring as it enters the large container of water.

### Experimental Trial with Water at Different Temperatures

1. Put cold tap water in transparent container until the surface of the water is a few centimeters from the rim of the container.
2. Half fill a plastic cup (the one with **no hole** in the bottom) with some of the cold water from the large container.
3. Measure and record the temperature of the water in the large container and in the plastic cup.
4. Add some ice cubes to the water in the plastic cup and stir gently until the water reaches approximately 4° Celsius.
5. Remove any un-melted ice cubes.
6. Add a few drops of food coloring to the colder water in the plastic cup. **Caution:** Food coloring can permanently stain materials. Use paper to cover work surface. It is best if the teacher walks around and adds the food colouring for the students.
7. Obtain a plastic cup that has a hole in the bottom.
8. The person who is going to hold the plastic cup that has a hole in the bottom should wear a glove and **cover the hole** with their finger.
9. Another person should pour the water containing food coloring into the plastic cup that has a hole in the bottom (make sure the partner is covering the hole).
10. The person covering the hole in the bottom of the plastic cup should lower that cup into the large container of water **at one end of the container** until the water level inside the cup is exactly the same as the water level in the larger container.
11. When the water in the large container is not moving very much, the person covering the hole in the bottom of the cup should slowly uncover the hole.
12. Record observations of the movement of the water that has been dyed with food coloring as it enters the large container of water.

### Experimental Trial with Water of Different Salinities

1. Put cold tap water in transparent container until the surface of the water is a few centimeters from the rim of the container.
2. Add a small amount of table salt to the water and stir.
3. Half fill a plastic cup (the one with **no hole** in the bottom) with some of the cold salt water from the large container of saltwater.
4. Measure and record the temperature of the cold saltwater in the large container and also in the plastic cup.
5. Add more salt to the water in the cup to make it more saline than the saltwater in the transparent container of water.
12. Add a few drops of food coloring to the more saline water in the plastic cup. **Caution:** Food coloring can permanently stain materials. Use paper to cover work surface. It is best if the teacher walks around and adds the food colouring for students.
6. Obtain a plastic cup that has a hole in the bottom.
7. The person who is going to hold the plastic cup that has a hole in the bottom should wear a glove and **cover the hole** with their finger.
8. Another person should pour the water containing food coloring into the plastic cup that has a hole in the bottom (Make sure their partner is covering the hole!)
9. The person covering the hole in the bottom of the plastic cup should lower that cup into the large container of water **at one end of the container** until the water level inside the cup is exactly the same as the water level in the larger container.

10. When the water in the large container is not moving very much, the person covering the hole in the bottom of the cup should slowly uncover the hole.
11. Record observations of the movement of the water that has been dyed with food coloring as it enters the large container of water.

Once the activity is completed have students complete the questions. There is an additional optional trial that can be done if there is time. Teacher will need to add structures to the bottom of the containers to determine the impact of the structure of the ocean. This can be done as a demo if there is not enough time.

## Ocean Circulation Student Handout

Surface currents, such as the Gulf Stream, are pushed by the wind. Deep ocean currents, called the “Thermohaline Circulation”, are the result of changes in the density of water. In this activity you can investigate how differences in the temperature and salinity of water can produce deep ocean currents.

### Baseline Trial:

Describe the movement of water when the water from the cup was added to the bin:	
Explain why the water moved like this:	Draw a sketch of how the water moved (us coloured pencils to illustrate the different temperatures and salinities)

### Evaluating the Baseline Trial:

1. What, if any, movements of water were observed as the water containing food coloring entered the larger container of water?

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2. What factors seem to influence the movement of the water containing food coloring?

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3. Why was it important that the water level inside the small cup be the same as the water level outside the cup?

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### Experimental Trial with Different Temperatures:

Describe the movement of water when the water from the cup was added to the bin:
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Explain why the water moved like this:	Draw a sketch of how the water moved (us coloured pencils to illustrate the different temperatures and salinities)
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### Evaluating Different Temperatures:

1. What movements of water were observed as colder water (containing food coloring) entered the larger container of water?

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2. Why would a change in the temperature of water produce the motion that you observed?

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3. What factors could influence the speed of the movement of water that you observed?

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### Experimental Trial with Different Temperatures:

Describe the movement of water when the water from the cup was added to the bin:	
Explain why the water moved like this:	Draw a sketch of how the water moved (us coloured pencils to illustrate the different temperatures and salinities)

### Evaluating Different Salinities:

1. Why is the movement of water that you observed referred to as a “Thermohaline Circulation”?

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2. What movements of water were observed as the more saline water (containing food coloring) entered the larger container of less saline water?

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3. Why would a change in the salinity of water produce the motion that you observed?

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**Overall:** Describe why the movement of water that you observed is referred to as “Thermohaline” circulation.

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### **An Additional Optional Trial**

You have observed the influence of differences in the temperature and/or salinity of water on the movement of water that is referred to as a thermohaline circulation. The flat bottom of the plastic container had very little influence on the movement of water.

Objects or materials can be put onto the bottom of the water container as a model of landforms that can influence the speed and direction of the thermohaline circulation. The positioning of the objects or materials can be placed in locations that simulate the changes in direction seen on a map of Earth’s thermohaline circulation.

Add items to the bottom of the container and repeat the temperature trial. Do you notice anything different in how the water travels?

## Where Did My Beach Go? Design Challenge

\* Activity is from Cove 2019 – Ocean Toolkit

**Objective:** The process of erosion occurs around us all of the time. It is a natural phenomenon that impacts humans in both positive and negative ways. Coastal erosion is generally perceived as negative as it impacts coastlines, coastal services and coastal habitation.

**Duration:** 2 – 3 class periods

**Materials:**

- Tape, glue
- Popsicle sticks
- Elastic bands, string,
- Nuts and bolts
- Tools
- Egg cartons
- Any materials students wish to bring in from home!

**Design Rationale:** The design addresses issues in the topics below:

- Issues of coastal erosion
- Outlines aspects of erosion that have positive and negative impacts
- Social/ecological impacts
- Frame story by establishing what erosion is through pictures

**Problem Scenario:**

Lawrencetown Beach\* is located in a well populated area of eastern Nova Scotia (\*the location can be changed to represent a local area that experiences erosion). Lawrencetown beach is known for its large waves and as a result it is a renowned surfing area. The area also supports a broad and active community, with housing, biking trails and opportunities to be close to nature. Over the past few years as a result of increased wave action due to stronger and more prevalent storms and rising sea levels, the beach and surrounding area is being eroded at accelerated rates. Your team has been hired based on your expertise is mediating coastal erosion to design a solution to the Lawrencetown beach crisis. Your team has the task of designing a structure that will reduce the impacts of erosion. It is important that you pay attention to the details of the ecosystem, and the various stakeholders involved. Be careful that your solution doesn't cause additional problems!

Each team will be assigned a specific role within the community that will shape their design and solution to the erosion crisis. Stakeholder groups can include:

- Homeowners
- Surfers
- Insurance companies
- Environmentalists
- Government
- Taxpayers (People who do not live in the area)
- Indigenous people

**Success Determinants:**

- Create a plan, providing a sketch and rationale for the design
- Research the future impacts of implementing the design structures into the area
- Reflect on what you did that worked, what didn't and where improvements can be made.

**Parameters:**

- You can use items and materials from the pantry and also bring in recycled materials from home.
- You can use any of the tools that have been provided
- Your prototype can be a scale version rather than to scale

**Teacher Notes:**

This activity is designed as a makerspace activity that allows students to think critically about the scenario problem and use their creativity to come up with a solution. Students should be allowed 1 class period to think about the scenario and brainstorm ideas on what they might create to fix it. In groups, they will need to come up with a sketch and provide a rationale for their design. Students at this point should create a list of materials that they will need to build a prototype of this design. As the teacher, you may wish to create a "pantry" where students can use common materials such as popsicle sticks, elastic bands, tape, glue, and any other materials you wish to provide. Students are encouraged to bring in recycled items from home to use in their design. An additional class will be needed to build the prototype and at least part of another class for the reflection.

## Oil Spill Clean Up Methods

**Objective:** This activity is designed to help students understand the various methods used in cleaning up oil spills. Students will identify which methods are the most effective and identify positive and negative aspects about each method. Students will then research a major oil spill that has happened, identifying key facts and the methods used in the cleanup. Have students write this as a reporter for a newspaper.

**Duration:** 1 – 2 classes

**Material Required:**

- Internet access.

**Teacher Notes:**

This is a two-part activity:

Part 1: Research Cleanup Methods: Students may work individually or in pairs. Have students research each of the six oil spill cleanup methods and record a description of the method along with both positive and negative aspects associated with the method in the chart. The methods could be divided up in the class, different groups being assigned a different method to research. Classmates can then share information through a class discussion.

Part 2: Write a Newspaper Article: When the chart is complete have students choose a historical oil spill to research and write a newspaper article on. Students should include all required information and write the article to resemble a news paper article (See template). The article should include information of the environmental impacts of the oil spill and clean up methods, often clean up methods can have significant environmental impacts as well!

## Oil Spill Clean Up Methods Handout

Oil spills can have a serious effect on our environment. Without first-hand experience, it may be hard to imagine the difficulty of cleaning a spill or what they can do to our water and ecosystems.

### Part 1

1. Describe the following oil spill cleanup methods. Indicate the positive and negative aspects associated with each.

Clean Up Method	Description of the Method	Positive Aspects	Negative Aspects
Oil Spill Boon			
Skimmers			
In-situ burning			
Sorbents			
Chemical Dispersants			
Biodegradation			

Clean Up Methods Answer Key: Teacher Copy

Clean Up Method	Description of the Method	Positive Aspects	Negative Aspects
<b>Oil Spill Boon</b>	Many different types are used. Floating barrier that is used to contain the oil spill. Floaters are attached to skirts which prevent oil from getting under the floats.	Contains oil to a localized area and can be used to block oil from reaching the shoreline.	Must be used quickly before oil travels too far for containment. In high waves or open ocean conditions often ineffective. Also requires additional methods (skimmers) to remove oil.
<b>Skimmers</b>	Skimmers can be boats, vacuum machines, sponges or oil-absorbent ropes that skim spilled oil from the water's surface often used with oil spill booms.	Effective for removing surface oil spills. Does not contaminate and have low impact on the environment.	Only oils that are less dense than water can be removed this way.
<b>In-situ burning</b>	Freshly spilled oil is ignited and burned while on top of the ocean.	Quick removal.	Burning oil releases the toxins into the atmosphere amplifying the toxicity.
<b>Sorbents</b>	Sponges are placed on the surface of the affected area. Sorbents suck and absorb the oil from the surface of the water.	<b>Effective on larger oil spills. Used when oil spills have become too big for Booms and Skimmers.</b>	<b>Surface oil spills. Not effective for cleaning oil beneath the surface.</b>
<b>Chemical Dispersants</b>	Dispersants work similar to dish detergents. The consist of particles that have a hydrophilic and hydrophobic ends. The result of the opposing forces is that the oil is broken up into smaller droplets of oil.	Breaking apart the oil allows for biodegradation by naturally occurring bacteria to occur more easily. Can be used on oil beneath the surface.	Dispersants are mixtures of emulsifiers and solvents that break oil droplets down into smaller droplets. Adding chemicals to that are often toxic has significant impacts on the environment, wildlife and humans. The dispersants may actually be more toxic than the oil itself. Implications to the ocean food chain, as toxins make their way through.
<b>Biodegradation</b>	Naturally occurring bacteria breaks down the oil in the water into fatty acids and carbon dioxide.		Takes a very long time to occur naturally. Can be expensive to add biological agents to an area. The oil and toxins remain in the environment until the bacteria can break them down, way too long to prevent negative impacts.

## Part 2: Oil Spill Research

1. Select a historical oil spill to investigate.
2. Research the following information:
  - When did the oil spill occur?
  - Where did the oil spill occur?
  - How large was the spill? (Amount of oil spilt, size of the area it covered).
  - What caused the spill?
  - What company was responsible for the spill?
  - What methods were used to clean up the oil?
  - What were the environmental impacts? (Of both the oil AND cleanup methods!)
3. Using your information, write a newspaper article including the “Who, What, Where, Why, and When’s”. The article should outline the key facts of the oil spill as indicated above.
  - Remember, your article is being written for the general public. It should be easy to understand and fit within the article template limits.
  - Use the Newspaper article template to structure your article
  - Things to include:
    - Include a picture with a caption.
    - Create a catchy title for your article that would make someone want to read it!
    - The article should contain all important information and is limited to one page (including title, picture and text!)
    - The main text of the article should be written in size 12 font using a common font such as Times New Roman or Calibri.

# The Daily Times

Website for Paper

Date

## Article Title

Main body of text. This should be written in column form and fit within the page limitations.

Picture related to the oil spill

## Caption for the picture

The article should continue under the photo.

This is simply a template! Feel free to structure your article differently as long as it meets the criteria!

Author: (Your Name!)

## Oil Spill Clean Up Lab

**Objective:** This activity is designed to help students understand the difficulties associated with oil spill cleanup methods. Students will simulate an oil spill and assess the effectiveness of the materials used. It should be clear that when working in the environment there are many factors that individuals cannot control such as wildlife populations, ocean currents and weather.

**Duration:** 1 – 2 classes

### Materials Required:

Required for each group:

- Containers 2' deep (Pie tins can work well for this activity). This will be the "Ocean"
- Blue food colouring to colour the ocean (optional but it makes it look cool!)
- Oil (regular cooking oil is fine). Groups do NOT need very much, approximately 1 Tablespoon.
- Small reusable containers to hold the oil (Glass beakers will work for this)
- Cotton balls, tweezers, medicine dropper, paper towel, string (All of these are not required but students should have options on how they would like to clean up the ocean).
- Feathers and/or fur (this represents the wildlife)
- Stir stick to gently mix the ocean (ocean currents!)
- Dawn dish detergent
- Access to water (sink)
- Student Handout

### Problem Scenario:

"There has been a major oil spill that threatens many fragile marine ecosystems and the habitat of countless plant and animal species. Your company is involved in an oil spill cleanup attempt. As the CEO you are required to purchase the materials required to clean up the spill with the least amount of negative environmental effects. You are also responsible for the cleaning of any wildlife affected by the spill."

### Parameters:

- Students must purchase the cleanup materials from their given budget.
- A plan must be shown to the teacher before purchasing materials.
- All wildlife must be cleaned (you must budget for this) at the wildlife station. No detergent can be brought back to help with the cleanup of the spill.
- Students must purchase tweezers; cotton balls and paper towels cannot be touched with hands, only tweezers

### Teacher Notes:

In groups students are to develop a plan to clean up their oil spill. Have students add the oil to their "ocean" and gently mix it up. At this point students can look at the various strategies that they can purchase to clean up the spill. Students will need to discuss the options as a group and decide what their best course of action will be. As the teacher, you will be the keeper of all cleanup materials, groups must purchase their supplies from you. Be careful that the groups stay within the budget. While groups are creating a plan, walk around and add "wildlife" to their oceans. Students are required to clean all wildlife at the wildlife station (sink or buckets of water). Make sure detergent stays at the wildlife station, it cannot be brought back to help with the spill.

## Oil Spill Clean Up Student Handout

There has been a major oil spill that threatens many fragile marine ecosystems and the habitat of countless plant and animal species. Your company is involved in an oil-spill clean-up attempt. As the CEO you are required to purchase the materials required to clean up the spill with the least amount of negative environmental effects. You are also responsible for the cleaning of any wildlife affected by the spill.

### Procedure:

1. In groups of 3-4 you will begin work on your "Ocean". Your blue ocean represents your ocean before the oil spill.

### The Spill:

2. Obtain your oil sample. Pour the oil VERY slowly onto the surface of the ocean from a height of approximately 1 cm. If you pour it too quickly the experiment will not work.

3. Sometimes it takes a cleanup crew time to reach the oil spill. Unfortunately, nature does not stop for cleanup crews to get organized. Mix up the oil (very gently) to simulate wind and water currents.

### The Cleanup

4. Rules of Ocean Cleanup:

1. Each group must purchase at least one set of tweezers.
2. Cotton balls and paper towels cannot be touched with fingers, only tweezers.
3. Purchasing detergent allows one group member the use of the "Wildlife Rehabilitation Center". Your group **MUST** account for this in their cleanup.

5. You must buy the materials to clean up the oil spill out of a budget of \$20,000,000. You cannot get refunds or extras after you buy the cleanup materials.

Materials	Cost
Tweezers	\$1,000,000
Cotton Balls	\$7,500,000
Paper Towels	\$5,000,000
Medicine dropper	\$10,000,000
Detergent	\$2,500,000

6. If you have purchased detergent you may take your oil-soaked wildlife to the "Wildlife Rehabilitation Center". You may not bring any materials back to your ocean to help with shoreline cleanup.

7. Press Release: It is important that the public know what you are doing to clean up the oil spill. Write a short press release outlining what activities you have done, the estimated environmental and human impacts of the spill (This should be ½ page in length).

**Questions:**

1. What happened to the oil when it was added to the “ocean”?

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2. Describe your group’s method of cleaning up the oil spill. Was this an effective way to clean up the spill?

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3. How would you change your strategy if you were to do it again?

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4. How does this simulation relate to real world oil spills?

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5. What happens to a feather or fur when it gets oil on it? How easy is it to clean?

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6. How might this affect real birds or mammals in a real situation?

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7. Did you feel you had an adequate budget for cleaning up the oil spill?

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8. Explain what factors influence cleaning up an actual oil spill in nature. Why does this become a very complicated issue?

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9. What are some adverse effects of oil spills in the ocean?

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## Ocean Plastics WebQuest Lesson

**Objective:** Students gain an insight into the ocean plastic crisis. Students answer a series of questions that will inform them of the dangers associated with plastic pollution and watch videos that will explore some of the possible and positive solutions!

**Duration:** Two 1h classes (Can be reduced if students are working in pairs/groups)

**Materials:**

- Student Worksheet
- Access to computers
- Pen, paper

**Teacher Notes:**

There are three parts to this activity. In the first part, students are acquiring knowledge about plastic pollution by answering questions using the web resources provided. In the second part, students are asked to look at the advantages and disadvantages of existing solutions and in part three students are asked to watch a TED talk video on what new solutions are being developed and deployed to help with eliminating plastic pollution.

## Ocean Plastics Webquest

The global ocean is in crisis. On average more than 8 million tons of plastic are dumped into our ocean each year. Plastic contamination and toxins are entering the food web and causing the alarming decline of many marine organisms.

Complete the following Webquest to learn more about the Ocean Plastic Crisis!

### Part 1: Plastic Soup

Visit the following Website: [https://plasticoceans.org/wp-content/uploads/2018/01/Plastic-Oceans\\_Educational-Supplement\\_vJan2108.pdf](https://plasticoceans.org/wp-content/uploads/2018/01/Plastic-Oceans_Educational-Supplement_vJan2108.pdf)



In the “Key Facts” section answer the following questions:

1. What is the problem with plastic?

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2. a) How much plastic do we produce each year? \_\_\_\_\_  
b) How has this changed over previous decades? \_\_\_\_\_  
c) What might account for these changes? \_\_\_\_\_

3. What materials are required to make 1 disposable water bottle?

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4. On average how many water bottles are thrown away in the US each year? How much plastic does this add up to?!

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5. What percentage of all waste comes from beverage bottles? \_\_\_\_\_

6. Of the 100.7 billion beverage bottles sold in the US, what percentage were water bottles?

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7. What is plastic composed of?

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8. The chemicals used in making plastic “mimic estrogenic activity”. Explain what this means. Are there implications for humans?

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9. Explain how plastics are transported throughout the ocean. Can this explain why plastic from other parts of the world wash up on our beaches?

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10. Explain how toxins in the water are becoming part of the food chain.

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11. How are humans at risk of consuming these toxins?

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12. What are microplastics? Why are these so detrimental to the ocean?

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13. What is a “Nurdle”?

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14. Explain how seabirds are starving on “full” stomachs.

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## Part 2: Possible Solutions, Possible Problems

From the list of potential solutions choose 2 and identify the advantages and disadvantages of each potential strategy.

Strategy 1:		Strategy 2:	
<u>Advantage:</u>	<u>Disadvantage:</u>	<u>Advantage:</u>	<u>Disadvantage:</u>

**Part 3: Visit the following Web site: Ocean Clean Up Project: <https://www.theoceancleanup.com/>**

1. What is the Ocean Clean Up Project?

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2. What happens to the ocean plastic when it enters the ocean?

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3. Who created this project?

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4. What is the projected impact of the Clean Up Project?

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5. Describe the ocean cleanup system that has been implemented in the Pacific Ocean in September 2018.

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6. What are the five items that the team is checking for during the trial run?

Watch the following TED talk: <https://www.youtube.com/watch?v=ROW9F-c0kIQ&vl=en>

1. 

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2. 

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3. 

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4. 

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5. 

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7. What was the motivation for creating this project?

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8. Why are there very few red plastic particles?

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## Designing Ocean Friendly Products

\* Activity is from Cove 2019 – Ocean Toolkit

**Objective:** Many of the products that we use end up as garbage dumped in the ocean. These products are harmful to the ocean creatures and to the environment. Many of these products will take thousands of years to break down (if at all!) which means they are a very long-term problem.

**Duration:** 2 – 3 class periods

### Materials:

- Tape, glue
- Popsicle sticks
- Elastic bands, string,
- Nuts and bolts
- Tools
- Egg cartons
- Any materials students wish to bring in from home!

**Design Rationale:** Students will use their understanding of the environment (recyclable, reusable, biodegradable materials) and how to build structures to design and build an environmentally and ocean friendly product.

### Problem Scenario:

Students will research common types of marine garbage (fishing nets, water bottles, flip flops, etc.) and will choose one to focus on. In their groups, they will redesign that product with easier recycling, reusable, reduced materials or biodegradable materials in mind.

### Success Determinants:

- The design must fulfill the function of the original product.
- The design must be more environmentally and ocean friendly
- You haven't just created a new form of garbage and the production of your design isn't more resource intensive than the original
- The design is esthetically appealing; customer would want to buy it!
- The design should be able to be sold for roughly the same price as the original

### Parameters:

- You can use items and materials from the pantry and also bring in recycled materials from home.
- You can use any of the tools that have been provided
- Your prototype can be a scale version rather than to scale
- You need to design something that floats
- Your group must work within an assigned budget (Students are given a budget and each item available is assigned a dollar value)
- Your group will create a compelling advertisement to promote your product and explain why your product is more ocean friendly.

**Teacher Notes:**

This activity is designed as a maker space activity that allows students to think critically about the scenario problem and use their creativity to come up with a solution. Pervious to the activity students should be aware of the various products that harm sea creatures (plastic bags, plastic rings, items that are confused as food, etc.). Students should be allowed 1 class period to think about the scenario and brainstorm ideas on what product they would like to create. In groups, they will need to come up with a sketch and provide a rationale for their design. Students at this point should create a list of materials that they will need to build a prototype of this design. As the teacher, you may wish to create a “pantry” where students can use common materials such as popsicle sticks, elastic bands, tape, glue, and any other materials you wish to provide. Students are encouraged to bring in recycled items from home to use in their design. An additional class will be needed to build the prototype and at least part of another class for the reflection.

## Gone Fishin'

**Objective:** The purpose of this activity is for students to develop an understanding of environmental, social, and economic impacts of overfishing and resource management along with the difficulties of managing a common resource.

**Duration:** 1 class

**Materials:**

- Small bowls
- Straws (try to get paper straws!)
- Goldfish: Plain (or pretzel), Cheese, Chocolate and M&M's
- Paper towels (these will serve as the student boats)
- Student Worksheet

**Teacher Instructions:**

Prep:

- Fill the "ocean" (paper plates or bowls) with 8 pretzel goldfish, 6 Cheese Goldfish, 6 Chocolate Goldfish and 4 M&M's with the spoon.
- Each group of 4 students will be assigned to one ocean, each ocean should have 4 straws and 4 napkins.

Procedure:

- Begin by engaging students in a conversation about the tragedy of the commons, local resource management and or local fish/fishing:
  - Ask students if they eat fish? Does anyone in their family fish? What do they know about fishing practices?
- If not discussed previously, introduce the concept of sustainability:
  - "Sustainability is meeting the needs of the present without limiting the ability of people, other species and future generations to survive."
- Ask students why sustainable fishery practices are important?
- Explain to students that today they will be going fishin' to explore some of these issues surrounding sustainability.
- Explain game rules to students (It may be easier to post the rules so students may refer back to them during the game)
- Let students fish for 30 seconds and tell them to stop fishing!
- Have students fill in their fishing logs.
- While students are completing their fishing logs move around the classroom and refill the "oceans" adding an extra baby fish for every pair that is left in the ocean.
- Monitor student catches to ensure that each student has earned \$5. If they haven't they may not fish in the next round.
- If students fish their entire "ocean" they are not able to play in the next round.
- Begin next round, allowing students to fish for 30 seconds.
- Repeat previous steps.
- If there are students who have overfished their ocean you may want to let them invade neighbouring oceans illegally in the next round!
- Continue allowing groups to fish for the remaining years.
- Once the activity is complete have students complete the reflection questions.

## Gone Fishin' Rules

1. Each student will be a fisher whose livelihood depends on catching fish.
2. 4 students will be assigned to one ocean. Students may assign their ocean a name.
3. Within each ocean there are 4 types of fish:
  - a. Pretzel Fish: Small fish that feed on phytoplankton which is abundant in our oceans. Valued at \$2.
  - b. Cheese Fish: Medium sized fish who feed on Pretzel fish. Valued at \$4.
  - c. Rainbow Fish: Medium sized fish who feed on Pretzel fish. Valued at \$4.
  - d. M&M Fish: Large fish who feed on Cheese and Chocolate fish. Valued at \$6.
4. Each individual must earn at least \$5 of income to stay in business and to be able to fish the following year. Remember fishing is your livelihood, you depend on this income to live!
5. At the end of each fishing season the fish are given the chance to reproduce. For every 2 fish of the same species, 2 baby fish will be produced. Fish mate in pairs; single fish will not reproduce.
6. Fish are a part of a complex food web and require food for their survival. At the end of the fishing season there must be at least 1 Pretzel fish left in the ocean for the Cheese and Chocolate fish to survive and at least one of the Cheese or Chocolate fish left for the M&M fish to survive.
7. Teams will be given 30 seconds to fish for each season.
8. Students may use the straw in any way that they choose, but at no time are they able to use their hands.
9. The ocean must not be tipped, touched, or moved.
10. Students must stop fishing immediately after 30 sec.
11. If the fish does not make it to the boat (ie, Falls onto the desk) the fish is dead and does not get returned to the ocean or counted in the fisher's catch.
12. Fish must not be eaten from the fishers catch or from the ocean during the activity.

## Gone Fishin' Fishing Log

**Ocean Group:** \_\_\_\_\_

Write a brief description of the status/health of your fishery:

\_\_\_\_\_

Year	Catch					Fish Remaining in Ocean
	Low Value Fish: Pretzel Goldfish	Medium Value Fish: Cheese Goldfish	Medium Value Fish: Chocolate Goldfish	High Value Fish: M&M's	Total Catch	
<b>1</b>						
<b>2</b>						

Write a brief description of the status/health of your fishery:

\_\_\_\_\_

Year	Catch					Fish Remaining in Ocean
	Low Value Fish Pretzel Goldfish	Medium Value Fish Cheese Goldfish	Medium Value Fish Chocolate Goldfish	High Value Fish M&M's	Total Catch	
<b>3</b>						
<b>4</b>						

**Ocean Group:** \_\_\_\_\_

Discuss the changes in fishing practices or regulations.

\_\_\_\_\_

Are there any fisheries in trouble? What did they do and how did that impact your fishery?

\_\_\_\_\_

Year	Catch					Fish Remaining in Ocean
	Low Value Fish  Pretzel Goldfish	Medium Value Fish  Cheese Goldfish	Medium Value Fish  Chocolate Goldfish	High Value Fish  M&M's	Total Catch	
5						
6						

Write a brief description of the status/health of your fishery now:

\_\_\_\_\_

What are some strategies that could have been used to make your fishing sustainable?

\_\_\_\_\_

## Ocean Careers

**Objective:** The purpose of this activity is to let students discover a variety of jobs and careers that are involved in ocean science. Choosing a career can be difficult when you don't know what kind of jobs exist! By investigating careers in ocean science students may find a career goal that they may have never thought of.

**Duration:** 1 class

**Materials:**

- Internet access
- Projector (to show videos)
- Student Worksheet

**Teacher Notes:** Review various careers that are involved in the ocean sector. It could be useful to complete a small brainstorming activity with students to see what careers they are aware of. The following links provide a couple of short videos on careers related to the ocean:

- Ocean Engineering
  - <https://www.youtube.com/watch?v=G5rPfAeEMds>
  - <https://www.youtube.com/watch?v=BF0nSo0kWao>
- Marine Ecologist
  - <http://truecallingcanada.com/video/just-keep-swimming>
- Halifax Ship Building
  - <http://truecallingcanada.com/video/making-the-makers>
- Marine Biologist
  - <https://www.youtube.com/watch?v=EAZvxukW8kY>

Once students have watched the videos, have them complete the Career Carousel.

**Career Carousel:** Have students investigate 4 careers that are interesting in ocean science using the websites provided. Once 4 careers are investigated have students write a paragraph on what career is best suited for them and explain why!

**Extension:** Post-secondary Link: Have students complete further research on 2 careers that are interesting to them. Look up what high school courses are needed for the program and what college or university degrees are required to become that profession.

## Ocean Careers

<b>Career 1:</b>	
Job Description (what does a person with this career do?)	
Yearly Income:	Key Skills:
<b>Career 2:</b>	
Job Description (what does a person with this career do?)	
Yearly Income:	Key Skills:
<b>Career 3:</b>	
Job Description (what does a person with this career do?)	
Yearly Income:	Key Skills:
<b>Career 4:</b>	
Job Description (what does a person with this career do?)	
Yearly Income:	Key Skills: