



Protecting Southwest Florida's unique natural environment and quality of life ... now and forever.

## Ocean Matters

# Pre and Post-Program Activities

Grade Level: 9-12

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### Next Generation Sunshine State Standards

- SC.912.L.17.2; SC.912.L.17.7; SC.912.L.17.11; SC.912.L.17.16; SC.912.L.17.20

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### Program Overview

Explore the ocean's diverse ecosystems from the shallow coral reefs to the deep ocean trenches. Examine how the ocean influences all life on Earth and how human activities can impact its health. Learn how to take action to preserve the ocean and its incredible creatures for future generations.

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### Learning Objectives Students will be able to:

1. Explain the general distribution of life in marine systems.
2. Evaluate the costs and benefits of renewable and nonrenewable ocean resources.
3. Discuss large-scale environmental impacts resulting from human activity, and how human lifestyles affect sustainability.

1495 Smith Preserve Way | Naples, Florida 34102 | 239.262.0304 | Fax 239.262.0672 | [www.conservancy.org](http://www.conservancy.org)



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# **Pre-Program Activity 1: What is Ocean Acidification?**

**Duration of Activity: ~ 30 min – 1hr.**

**Materials:** computers with internet access - one for each student or they may work in teams. Also could complete as a class.

## **Background:**

The world's oceans are becoming increasingly more acidic, largely as a result of human activities. Increased ocean acidity can affect marine creatures by reducing the rates of *calcification*, the process by which many of these organisms form calcium carbonate shells and other structures.

The following interactive activity allows students to explore how the ocean is becoming increasingly acidic, and the impact that it has on marine organisms.

## **Directions:**

1. Students may work individually, in pairs, or the activities may be done as a class.
2. Go to <http://i2sea.stanford.edu/group/inquiry2insight/cgi-bin/i2sea-r1b/i2s.php>.
3. Under ACTIVITIES, click on Our Acidifying Ocean.
4. Students will be led through an interactive slide show which should take ~30 minutes to complete.

Questions for Discussion could include:

1. The lower the pH of a liquid, the more \_\_\_\_\_ it is. (acidic)
  2. What is the ideal average pH of ocean water? (8)
  3. A pH change from 8.2 to 8.1 is actually a \_\_\_\_\_ % increase in acidity. (30%)
  4. Carbon in the water: Lowered calcium carbonate levels is a great cause for concern because it can lead to \_\_\_\_\_ and \_\_\_\_\_. (weaker shells and slower growth)
  5. Exploring carbon levels and effect: Which future emissions scenario do you agree with and why? \_\_\_\_\_ (optimistic, middle ground, pessimistic)
  6. What is a calcifier? (an oceanic creature that makes calcium carbonate)  
Give 3 examples: \_\_\_\_\_ (coral, coralline algae, pteropod, tube worm, sea mats, crab)
  7. Acidification of the oceans can influence one key feature of many marine organisms, which is \_\_\_\_\_. (their ability to form calcium carbonate structures)
5. Expand students' learning! There are optional LAB activities at the end of the interactive slideshow, as well as additional resources on the Inquiry to Student Environmental Action homepage.

## **Pre-Program Activity 2: Marine Ecosystems**

**Duration of Activity: 1 hour**

**Materials:** computer & projector, computer lab: computer per student or group, online video-“Mosaic of Ocean Habitats”, Marine Ecosystems Handout, Marine Ecosystems Notetaking worksheet & Large World Map

### **Directions:**

1. **As a class, investigate twelve marine ecosystems.**

Have students watch the Mosaic of Ocean Habitats: A Video by National Geographic and the Census of Marine Life (2 minutes, 21 seconds) <http://ocean.si.edu/ocean-videos/mosaic-ocean-habitats-video-national-geographic-and-census-marine-life>

As you watch the video, ask students to note the wide diversity of ocean ecosystems.

Have students work in small groups. Students can also work independently but may need more time to research each ecosystem. Depending on the number of groups or individuals, assign each student or group one or two ecosystems from the following list.

- Abyssal Plain (communities included deep sea corals, whale fall, brine pool)
- Antarctic
- Arctic
- Coral Reef
- Deep Sea (Abyssal water column)
- Hydrothermal Vent
- Kelp Forest
- Mangrove
- Open Ocean
- Rocky Shore
- Salt Marsh and Mudflat
- Sandy Shore

2. **Give each student or group a copy of the Marine Ecosystems handout and the Marine Ecosystems Note-taking worksheet (may need more than one copy of the worksheet depending on number of ecosystems they are researching).** Have students use the handout and provided websites (see below) to research and record the following information about their ecosystems: location of one or more real-world examples of their ecosystems, the different marine organisms found there, and the unique characteristics that set the ecosystem apart from other marine ecosystems.

3. **Have students map real-world ecosystems.**

Ask one student from each group to present their ecosystem research to the class. After presenting, have each group locate and label at least one location where its ecosystem can be found on a map. You can use a large classroom map OR project a large map on a white board/smart board. Once all of the ecosystems are labeled on the Map, ask students to discuss their findings.

#### 4. Questions for Discussion:

- *Are there any links between these ecosystems?* Prompt students to think of links such as hydrologic cycle, currents, organisms, or other connections.
- *Do the ecosystems share any physical features or significant abiotic factors?* Prompt students to consider geology, depth, salinity, and water temperature.
- *Do these ecosystems face any human introduced threats?*

#### Worksheets, Videos, & Resources:

- Census of Marine Life background video, “A Journey through Habitats”.  
<http://www.coml.org/embargo/census-2010/video>
- Marine Ecosystems Handout  
[http://media.education.nationalgeographic.com/assets/file/Marine\\_Ecosystems\\_1.pdf](http://media.education.nationalgeographic.com/assets/file/Marine_Ecosystems_1.pdf)
- Marine Ecosystems Notetaking worksheet  
[http://media.education.nationalgeographic.com/assets/file/Marine\\_Ecosystems\\_Notetaking.pdf](http://media.education.nationalgeographic.com/assets/file/Marine_Ecosystems_Notetaking.pdf)
- Website Resources for Research
  - [Whitman College: Deep-Sea Biology](#)
  - [Chemosynthetic Ecosystem Science: Whale Falls](#)
  - [NOAA: Ocean Explorer—Gulf of Mexico 2002: Lakes Within Oceans](#)
  - [Ice Stories: Dispatches from Polar Scientists: Antarctic Marine Ecosystem](#)
  - [Arctic Ocean Diversity](#)
  - [NOAA: Coral Reef Information System—What are Coral Reefs](#)
  - [Whitman College: Deep-Sea Biology](#)
  - [Chemosynthetic Ecosystem Science: Hydrothermal Vents](#)
  - [National Marine Sanctuaries: Ecosystems—Kelp Forests](#)
  - [NOAA: National Ocean Service—What is a mangrove forest?](#)
  - [Sanctuary Integrated Monitoring Network: Open Ocean](#)
  - [Peoples Trust for the Environment: Seashore—A Rocky Seashore Ecosystem](#)
  - [NOAA: Ocean Service Education: Salt Marshes](#)
  - [Missouri Botanical Garden: Shorelines](#)

**(more lessons on next page)**

# **Post-Program Activity 1: Marine Debris**

**Duration of Activity: 1-2 hours**

**Materials:** computer & projector, garbage bags, latex gloves, pencils, garbage & recycling containers

## **Directions:**

1. **Activate students' prior knowledge.** Have students brainstorm different types of litter and debris. Questions for discussion:

*What happens to litter? Where does it come from? Where does it go?*

*How could litter end up in the ocean?*

Explain that garbage that does not make it to a landfill (may have to explain what a landfill is) can become litter found along the sides of roads or in waterways, eventually ending up in the ocean. Emphasize that no matter where litter comes from, wind, streams, and ocean currents carry litter throughout the globe, including to the ocean and coasts where it becomes marine debris.

2. **Have students watch the video "Marine Debris".**

Give each student a Marine Debris video worksheet (see link below). Show students the NOAA "Marine Debris" video <https://www.youtube.com/watch?v=qQpCzZI5Vqo> (3 minutes, 30 seconds) and have them answer the questions as they watch the video.

Discuss the questions with the answer key provided.

3. **Have students list sources and impacts of land-based and ocean/waterway-based marine debris.**

Divide students into small groups and provide each group with a NOAA Marine Debris Facts Handout (see link below). Have half of the groups read about and summarize sources of land-based and ocean/waterway based marine debris. Have the other half of the groups read about and summarize the effects of marine debris on ocean ecosystems, marine wildlife and people. As a class, have the groups take turns presenting what they learned. Emphasize the fact that sources and impacts of marine debris are highly varied and involve all people, no matter where you live.

4. **Have students brainstorm ways that they could help solve the marine debris pollution problem.**

Reduce, reuse, recycle; use reusable water bottles and plastic bags; clean up litter (even if you didn't put it there), etc.

5. **Take Action! If time allows, conduct a School Site Cleanup and compare data.**

First, have students brainstorm types of debris/litter they may find around the school grounds. Give each group a copy of the worksheet "School Site Cleanup Data Table" (see link below). Explain that the datasheet they will be using is designed to record the same

information that is recorded during coastal clean-up events. As needed, refer to the Ocean Conservancy's 2010 Report: Trash Travels (pages 26-32) to show students how to identify and classify different debris items. Remind students to use gloves and avoid any materials that could be considered hazardous waste. After groups have collected their data, they will count the total number of debris items in each category for the entire class and then calculate percentages for each category. Compare these percentages to the Top Ten Marine Debris Items Worldwide results from the Ocean Conservancy's 2010 Report: Trash Travels (page 11). Have students record their results in the School Site Cleanup Data Table. Once students have compiled their data and calculated the percentages, have students create a bar or pie graph with the percentages for each category.

6. **Have students reflect on what they have learned.**

Start a class discussion by asking students to summarize the effect marine debris accumulation is having on ocean ecosystems and wildlife. Then ask the following questions. These questions can be discussed as a class or can be given as a worksheet.

- Are you surprised by the amount or type of debris found? Explain.
- What are some similarities and differences between the two data sets (school site and world report)?
- What could be the reasons for these differences?
- What is the relationship between the debris data collected at the school and the data collected at a coastal site?
- What did you learn about the role you play in marine debris accumulation?
- What are you willing to do to address the problem of marine debris?
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7. **Discuss current plans to address the problem of marine debris, or have students create their own!**

[http://www.huffingtonpost.com/entry/seabin-ocean-bucket\\_5681d22fe4b06fa68880fc60](http://www.huffingtonpost.com/entry/seabin-ocean-bucket_5681d22fe4b06fa68880fc60)

**Worksheets, Videos, & Resources:**

- Marine Debris Video worksheet and answer key  
Student worksheet:  
[http://media.education.nationalgeographic.com/assets/file/Marine\\_Debris\\_Video\\_1.pdf](http://media.education.nationalgeographic.com/assets/file/Marine_Debris_Video_1.pdf)  
Answer key:  
[http://media.education.nationalgeographic.com/assets/file/Marine\\_Debris\\_Video\\_Answer\\_Key\\_1.pdf](http://media.education.nationalgeographic.com/assets/file/Marine_Debris_Video_Answer_Key_1.pdf)
- NOAA: Marine Debris 101- Marine Debris Facts  
[http://media.education.nationalgeographic.com/assets/file/NOAA\\_Marine\\_Debris\\_101\\_Marine\\_Debris\\_Facts.pdf](http://media.education.nationalgeographic.com/assets/file/NOAA_Marine_Debris_101_Marine_Debris_Facts.pdf)
- School Site Clean-up Data Table  
[http://media.education.nationalgeographic.com/assets/file/School\\_Site\\_Cleanup\\_Data\\_Table\\_1.pdf](http://media.education.nationalgeographic.com/assets/file/School_Site_Cleanup_Data_Table_1.pdf)
- Ocean Conservancy International Coastal Clean-up 2010 Report  
[http://act.oceanconservancy.org/images/2010ICCRReportRelease\\_pressPhotos/2010\\_ICC\\_Report.pdf](http://act.oceanconservancy.org/images/2010ICCRReportRelease_pressPhotos/2010_ICC_Report.pdf)

## **Post-Program Activity 2: Simulate an Oil Spill Cleanup**

**Duration of Activity: ~1 hour and 30 minutes**

**Adapted from National Geographic Simulate an Oil Spill Activity**  
<http://education.nationalgeographic.org/activity/simulate-oil-spill-cleanup/>

### **Materials:**

- A Geography of Offshore Oil-Gulf of Mexico Map
- Student worksheets (see below)
- Large mouth gallon buckets (or similar size) to hold water (1 per group)
- Mixing Utensil- Fork/Whisk (1 per group)
- Tablespoons (1 for each group)
- Vegetable oil
- Red food coloring
- Dawn dish soap
- Oil Remover Materials: (1 of each per group)  
i.e. dense foam wedge makeup or other sponges, cotton balls, cardboard, bendable straws, paper towels, etc. cut or torn into small (1-2") pieces

### **Background:**

American's increasing reliance on oil and petroleum products has resulted in multiple marine oil spills at offshore drilling sites and from transport vessels. Oil spills are detrimental to the health of marine environments and marine organisms. Scientists and volunteers try to remove oil from the open ocean and coastal environments when oil is spilled in order to lessen the effects that the oil will have on the ecosystem.

On April 20, 2010, an oil drilling rig called Deepwater Horizon exploded in the Gulf of Mexico, killing 11 people as well as causing a well deep below the surface to leak for 86 days- the world's largest accidental release of oil into the ocean. The federal task force estimates that 4.9 million barrels of oil were released from the time of the accident until the leak was contained in mid-July. British Petroleum (BP), the company responsible for the spill, uses many different methods of oil cleanup, including booms, skimmers, absorbers and dispersants. For this particular oil spill, BP used a dispersant called Corexit 9500. BP maintains that the dispersant is harmless; however, little is known about how it will affect the environment both now and over time. As of October 2010, government scientists estimate that BP has removed a quarter of the oil. They believe that another quarter has evaporated or dissolved into scattered molecules. The third quarter has been dissolved into smaller molecules by dispersants and the last quarter remains in slicks or has invaded the shorelines and estuaries of Louisiana, Mississippi, Alabama and Florida.

### **VOCABULARY:**

**Absorbers:** materials used to make up booms that help absorb oil while it is being contained.

**Boom:** an oil-containment device that floats on the surface of the water and is used as barrier to keep oil in or out of a specific location.

**Dispersants:** chemicals sprayed in oil to cause it to break up and sink

**Skimmers:** a floating boom system that sweeps oil across the water surface, concentrating the oil.

**Directions:**

1. **Give background on the 2010 Gulf of Mexico oil spill.**

Download and display the map Gulf of Mexico: A Geography of Offshore Oil from the October 2010 issue of *National Geographic* magazine.

([http://media.education.nationalgeographic.com/assets/file/A\\_Geography\\_of\\_Offshore\\_Oil-Map.pdf](http://media.education.nationalgeographic.com/assets/file/A_Geography_of_Offshore_Oil-Map.pdf))

Describe for students the events that occurred on April 20, 2010 provided above. On the map, point out the location of the Macondo well—the site of the leak and the accidental destruction of the *Deepwater Horizon* drilling rig. Point out the loop current and explain how the oil has been distributed throughout these regions by currents, waves, winds, and tides.

2. **Introduce the simulation.**

Tell students that they will use a model to simulate an oil spill and its cleanup. Divide students into small groups of 3-6 students each. Distribute copies of the worksheets (1 per group), “Observations Before the Use of Dispersant,” and “Observations After the Use of Dispersant” (see below). You may want to assign each member of the group a specific role—observer, data collector, and oil remover. Multiple students can have the same role in each group.

3. **Have students simulate the oil spill.**

Have students place one drop of food coloring AND one tablespoon (TB) of oil onto their tablespoon, and pour it into their bucket of water. Use a fork or a whisk to mix it. Do this 4 times. Ask: *What do you think the oil and food coloring represent?* Explain to students that the oil represents crude oil and the food coloring represents chemicals trapped inside of the oil. Make sure they understand that the food coloring will not mix completely with the oil.

4. **Have students simulate cleanup efforts before the use of dispersant.**

Ask the oil remover in each group to use the supplied materials—pieces of cotton, cardboard, paper towels, etc.—to try to remove the oil before it reaches the sides of their container. Using the worksheet “Observations Before the Use of Dispersant,” the data collector for each group should list the properties of each material and designate them as booms, skimmers, absorbers, or dispersants. The sponge, cotton balls and paper towel all act as absorbers that would be used to absorb the oil that has spilled in the ocean. The straw acts as a skimmer. Students could stuff the straw with the sponge/cotton ball or paper towel to possibly better absorb the “oil spill”. The cardboard could act as a boom and would help contain the oil spill. As a group, have students complete the rest of the worksheet.

5. **Have students simulate cleanup efforts after the use of dispersant (cleaning agent).**

After students have tried their clean up methods and completed the first worksheet, have them add 5+ drops of name-brand dishwashing soap (amount may depend on the amount of water in their bucket. If oil does not sink, add 5+ more drops) and complete the worksheet “Observations After the Use of Dispersant.” Have students note:

- *What happened to the oil? Why?*
- *What happened to the chemicals (dye)? Why?*
- *What color is the water? Why?*
- *Did results vary across groups? Why (inaccurate measurements, different order of absorbers, did not follow directions, etc.)?*

The dishwashing soap acts as a dispersant that should break up the “oil spill” and cause the oil to sink.

6. **If time allows, have students re-test the first set of materials in the water with the dispersant.**

Ask students to predict what they think will happen now that dispersants have been added. Have students re-test some of the supplied materials now that the dispersants have entered the environment. Ask them to add their observations to column 4 of the second worksheet.

7. **Have a whole-class discussion about the methods and possible flaws.**

After students have tested all of the materials—both before and after dispersants were added. Ask students to share some of the successes they experienced and some of the possible flaws that they see with these methods. Relate the experiment to real life.

Possible questions for discussion:

- Did any method completely remove the oil?
- What happened to the chemicals (dye)?
- Do you think all toxins or chemicals behave the same way? Why or why not?
- Based on your observations, how effective do you think the Gulf oil spill efforts (equipment types) have been?
- Did any of your observations change the way you view the cleanup strategies being used in the Gulf?
- Did any of your observations change the way you view the effects cleanup strategies may have on the water quality and wildlife in the Gulf of Mexico?

Optional: if time allows, have each student independently write a summary of their simulation results and their answers to the discussion questions above.

**(see below for Worksheet)**



