

# **JOURNEY TO PLANET EARTH**

## **Dispatches from the Gulf 3:**

*Ten Years After The Deepwater Horizon Oil Spill*

**Educators Guide**

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**To obtain "Dispatches from the Gulf 3," visit:**

**<https://dispatchesfromthegulf.com>**

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# NEXT GENERATION SCIENCE STANDARDS

“Dispatches from the Gulf 3” connects to the following Next Generation Science Standards Disciplinary Core Ideas:

**LS1.B: Growth and Development of Organisms**

- Genetic factors as well as local conditions affect the growth of the adult.

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

- Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

**ESS3.A Natural Resources**

- Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

**ESS3.B Natural Hazards**

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

**ESS3.C Human Impacts on Earth Systems**

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

**PS4.C Information Technologies and Instrumentation**

- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.

Observing how scientists in the film gathered and interpreted data relates to the following “Connections to Nature of Science:”

**Scientific Investigations Use a Variety of Methods**

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- New technologies advance scientific knowledge.

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based on empirical evidence.
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

## OVERVIEW

**Dispatches from the Gulf 3** asks *"Has the Gulf of Mexico recovered from the Deepwater Horizon oil spill?"* As the tenth anniversary of the disaster approaches, this question is regularly posed. An international team of scientists has spent nearly that long studying its environmental impact on humans, wildlife, and the ecosystem. They provide assessments of the current state of the Gulf, but lingering questions are challenging their ability to predict the long-term impacts.

For insight into the future, we journey to the Campeche region of Mexico that is still suffering four decades after the 1979 Ixtoc oil spill. We investigate how the disconnect between politicians and scientific realities is leading to the public's skepticism about science, which is hindering funding and significant change. We explore how women scientists have overcome countless challenges to become leaders in their fields. And we discover how the marine mammals of the Gulf are surviving.

It is a stark reality that the never-ending search for oil will lead to global economic and environmental challenges. Fortunately, we are living in an era that has the power to bring positive change to how we treat our planet by continuing our development of new technologies and increasing our use of renewable energies. This hope-filled documentary showcases stories that speak to that change and inspires a world still trying to recover from the largest offshore oil spill in history.

## LEARNING OBJECTIVES

Participants will be able to:

- Describe a variety of strategies for cleaning up oil spills.
- Identify the short-term and long-term impacts of oil spills.
- Explain how scientists set up studies to determine the environmental impacts of oil upon fish populations, marine mammals, and other marine life.
- Design a research study to test oil spill cleanup strategies.

## PRE-VIEWING ACTIVITIES

If participants do not know the following locations, use a map to familiarize them with the geographical areas profiled in the film:

- Alabama
- Barataria Bay
- Campeche, Mexico
- Gulf of Mexico (including the sea floor)
- Florida
- Louisiana
- Mississippi
- New Orleans
- Pointe à la Hache
- San Diego

The following terms are used in the film and may need to be introduced to participants:

- **Baseline data** — initial information gathered that is compared to data collected at a later time to see if changes or new trends have occurred.
- **Bile** — a yellowish-brown fluid produced by the liver that aids in the digestion of lipids (fats) in the small intestine.
- **Centimeter** — one centimeter = 0.3937007874 inches.
- **Cardiovascular System** — consists of the heart and blood vessels and delivers oxygen and nutrients to the tissues and carries waste products to the organs responsible for elimination.
- **Cannulate** — introduce a cannula or thin tube into a vein or body cavity.
- **Dispersant** — a substance that, after an oil spill, breaks oil into smaller droplets. Smaller droplets are thought to more easily spread oil throughout a volume of water and make the oil more easily biodegraded by microbes.
- **Marine Snow** — a continuous shower of mostly organic detritus falling from the upper layers of the water column.
- **Mitigate** — to reduce or lessen.
- **Planktonic** — refers to a group of organisms that cannot swim against a current and instead drift with them. Usually microscopic, planktonic species do vary in size and include larger species such as jellyfish. Planktonic species play an important role in marine food chains.
- **Sonar skills** — refers to echolocation, which provides dolphins with an advantage of hearing and detecting things with precision.
- **Trans-generational** — acting across multiple generations.

To help participants put the video in perspective, ask them the following questions:

- What oil spills have you heard about, both in your lifetime and in the past? What do you know about them?
- What do you know about the 2010 Deepwater Horizon oil spill in the Gulf of Mexico?
- What strategies did people use to clean up the oil spilled in the Deepwater Horizon spill?
- What do you think has happened to the 200 million gallons of oil spilled? Where do you think they went?
- What would you predict the impacts of this amount of oil to be on the marine environment in the Gulf of Mexico as well as on land and upon the people living in the Gulf coast area?
- In what ways could this oil spill be an opportunity for the scientific community?
- What technological innovations are you aware of that could help scientists study oil spills—their effects as well as how to best clean them up?

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## VIEWING ACTIVITIES

### Theme 1: How did the oil spill affect the health of marine animals?

Not long after the 2010 Deepwater Horizon oil spill scientists from around the world converged on the Gulf of Mexico to study the effects of the oil on the health of marine animals including dolphins, oysters, sharks, and Mahi-mahi.

Related segments and post-viewing questions are indicated below.

#### **Dolphins**

*Dispatch #3: A Few Highlights of What Was Discovered: ECOLOGY*

1. What are some of the examinations performed on the dolphins of Barataria Bay?
2. What did veterinarians discover about the health of Barataria Bay dolphins?
3. What caused these problems?
4. Why didn't the dolphins leave Barataria Bay during the oil spill?

#### **Sharks**

*Dispatch #3: A Few Highlights of What Was Discovered: ECOLOGY*

1. What did scientists discover about the health of deep-water sharks after the oil spill?
2. What are the long-term affects of the oil on sharks?

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## **Theme 2: What was the impact of the oil spill on marshes and marine snow?**

The Deepwater Horizon oil spill lasted 87 days and resulted in more than 200 million gallons of oil leaking into the Gulf of Mexico. To help mitigate the impact, 1.67 million gallons of chemicals were used to disperse the oil.

Related segments and post-viewing questions are indicated below.

### **Marshes**

*Dispatch #3: A Few Highlights of What Was Discovered: ECOLOGY*

1. What happened to some of the marshes after the oil spill?
2. Why is it difficult to cleanup oil from marshes and wetlands?
3. How could oil buried oil surrounding the marshes affect the Barataria Bay dolphins?

### **Marine Snow**

*Dispatch #3: A Few Highlights of What Was Discovered: CHEMISTRY*

1. What is marine snow?
2. Why is important to create marine snow in the laboratory?
3. What happened to marine snow in the Gulf of Mexico after the oil spill?

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### **Theme 3: How and why are scientists tracking the ocean currents in the Gulf of Mexico?**

A team of scientists launched an innovative and multifaceted experiment near the site of the 2010 oil spill. Their goal was to test new equipment designed to predict where the wind, waves and currents of the Gulf would take surface oil after a major blowout.

Related video segments and post-viewing questions are indicated below.

#### **Tracking Ocean Currents**

*Dispatch #3: A Few Highlights of What Was Discovered: PHYSICAL OCEANOGRAPHY*

1. Why is it so important to know where ocean currents will take oil released from a blowout?
2. What were some of the problems encountered by scientists as they released drifters into the Gulf of Mexico?
3. How did the scientists keep track of the location of the drifters?

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## SPECIAL PROJECTS

### Project 1

In this activity, participants simulate an oil spill and evaluate various cleanup methods. Younger participants can use an aluminum pie pan for their oil spill setting, half-filled with water to represent the ocean. Older participants could use a larger aluminum pan. If you'd like to add complexity, a rock could be placed in the water to represent land and a small sample of an aquarium plant could represent wetland grasses. Depending on the size of the pan, use 1-4 Tablespoons of vegetable oil to represent the oil slick. You can also consider using Marvel Mystery oil for older participants.

Ask your participants to identify various strategies for cleaning up oil spills and preventing the oil from coming ashore (absorbing, containing, skimming, and dispersing the oil). Find images of these strategies to share with your participants and then show them the aluminum pan in which they will simulate an oil spill. Ask them to make a list of common materials they could use to simulate the absorption, containment, skimming, and dispersing of oil. Possibilities include small (1") squares of absorbent paper towels, small pieces of sponge, cotton balls or cotton pads, small pieces of wool or other types of fabric, string, pipe cleaners, Popsicle sticks, and a few drops of liquid detergent.

For each cleanup strategy (absorption, containment, etc.), ask participants to make a list of possible materials to use. For example, they could use Popsicle sticks, string, and pipe cleaners for containment. Younger participants could make their lists by looking at materials you have provided. Older participants could add additional ideas of their own. For each list, ask participants to predict and record which materials they think will be most effective and why.

Run the various simulations as a class demonstration, or have participants work in small groups. (Alternately, you could assign each group to focus on one clean up strategy. For instance, testing and comparing various absorption methods or a variety of containment methods.) For each cleanup strategy, ask participants to evaluate which materials were most effective. For example, were Popsicle sticks, pipe cleaners, or string more effective at containing the oil and helping to keep it from hitting land and wetland plants? Were paper towels, cotton balls, or cotton rags more effective at absorbing oil? Participants should record their results and descriptive observations. Then, ask them to reflect upon and describe what made some materials more effective than others. Could they use this information to design a better method for containing or absorbing oil? If possible, allow them to design and test their ideas and report back to the class.

To test dispersants, use a few drops of liquid dishwashing soap. What happens when it is first applied? What happens when the water is stirred up with a spoon? Ask participants what other ways they could test dispersants that would simulate real-world conditions. For example, if they thoroughly mixed the oil and water using an immersion blender, what happens to the oil when the dispersant is added? After using the immersion blender and adding oil, test their original absorption or containment methods. Are the results the same or different? Ask participants to summarize in writing what they learned from this lab, and what it makes them think about or wonder about, especially when they apply the lessons of the lab to a real-life oil spill scenario.

For older or advanced groups, extend the oil spill activity by using an oil- absorbing polymer. Oregon State University has designed an activity that you can use or adapt. Enviro-Bond 403 is an oil-absorbing polymer available through Flinn Scientific supplies.

Design this activity for the age of your participants and your curricular goals. You can focus specifically on learning about oil spill cleanup methods; extend the lesson to allow participants to use the process of science to test questions and make sense of results; or go even further to allow your participants to use design thinking and engineering to test their own ideas. You can find a variety of oil-spill activities online. Here are several that might be helpful:

➤ **TeachEngineering**

[https://www.teachengineering.org/activities/view/cub\\_enveng\\_lesson01\\_activity1](https://www.teachengineering.org/activities/view/cub_enveng_lesson01_activity1)

➤ **Flinn Scientific**

<https://www.flinnsci.com/oil-spill-cleanup/dc10058/>

➤ **NOAA**

*(This activity focuses on simulating an oil spill response team.)*

<https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources/gulf-oil-spill>

## **Project 2**

The National Oil Spill Response Test Facility is located in Leonardo, New Jersey. This facility is known as Ohmsett and stands for the Oil and Hazardous Materials Simulated Environmental Test Tank. The Ohmsett facility houses one of the largest concrete test tanks in the world where researchers can test oil containment and cleanup methods, new equipment, and cleanup training response methods. The large tank (203 meters long, 20 meters wide, and 3.4 meters deep) allows researchers to run tests with full-size equipment.

Older or advanced participants could visit the Ohmsett website (<https://www.ohmsett.com/>) to become familiar with the specific features and capabilities of the equipment. Then, using what they've learned about oil spills, oil spill technology, the equipment at Ohmsett, and their understanding of the scientific process, participants work in small groups to design sound research studies that could be done using the facilities at Ohmsett.

- What specific question would they like to test?
- What parameters do they need to control or measure using the available equipment?
- How would they go about setting up their methodology?
- What variables and controls would they have?
- What conditions would they test in?

Afterward, they can return to the website to browse through the research that is being done and that has been published to find any research related to their question. How did the research methodology they learned about compare to the methodology they developed. Each group then prepares a detailed presentation of their research methodology as well as any lessons learned from similar Ohmsett research that has been conducted.

Whether participants prepare oral presentations or presentation boards, allow their classmates to provide feedback and to ask questions, much like the scientific community would do.

### **Project 3**

Learning about oil spills provides a good opportunity for participants to learn how oil forms. Many participants may not know that oil formed more than 300 million years ago from ancient photosynthetic marine organisms called diatoms. These microscopic creatures were prolific and sank to the ocean bottom when they died. Over millions of years, these “fossil” organisms piled up and were covered by rock and other sediments that were the result of geologic activity. Pressed and squeezed by the weight and pressure placed on them, the diatoms became oil, with the carbon and chemical energy in the living diatoms still present. Over millions of years, Earth’s crust has moved, collided, and folded, creating pockets of oil that are now located beneath the continental crust and ocean floor. Oil companies drill to find these pockets.

Ask pairs of participants to search Internet sources (diagrams, simulations, and information) that tell the story of oil formation.

Each pair should design and illustrate its own colorful poster telling this story.

Each poster should include the timeline, the process, and the forces necessary to create oil. In addition, the posters should explain why oil is considered to be a “fossil” fuel.

## **Project 4**

This activity helps participants consider the widespread implications of oil spills. Write “Gulf of Mexico Oil Spill” on the board and draw a circle around it. From this central circle, ask participants, either the entire class or organized in small groups, to draw out connecting circles, each with a “category of impact.”

Examples of categories include “Environmental Impacts,” “Economic Impacts,” “Health Impacts,” etc. From each of these circles, participants continue to connect more and more specific consequences. For example, from environmental impacts, participants could add “fish populations,” “wetland organisms,” “seabirds,” etc. Details for each of these topics are then added.

Eventually, encourage participants to begin to connect specific details to other categories. For example, participants might draw a connecting line from “decline in shrimp” to “economic impacts” (or a more specific related detail such as “fishermen lose jobs” or “fishermen lose way of life,” etc.).

Eventually, the participants should end up with a complex web of connections illustrating cause and effect relationships that are mapped out by a series of “bubbles,” much like a concept map.

Ask participants to reflect on what they learned and what questions the exercise makes them think about. You might begin by giving them a few minutes to write down their ideas in silence and then share them with the class.

## **Project 5**

The film “Dispatches from the Gulf 3” discusses natural oil seeps. Participants might be surprised to learn that natural oil seeps account for the greatest amount of oil released into oceans, and they may wonder what the concern is about accidental oil spills with so much oil naturally seeping from the ocean floor. This activity addresses this question.

Use the Internet to find a good diagram of an ocean floor oil seep to show your participants. Pose the question—why are people concerned about accidental oil spills if oil naturally seeps from the ocean floor? Then, challenge participants to research oil seeps and present their answer to this question. The Woods Hole Oceanographic Institution website is a good resource (<http://www.whoi.edu/main/topic/natural-oil-seeps>).

Ask each group to write a report of their findings.

After explaining what oil seeps are, groups should compare the following: the natural rates of oil seepage to that of an oil spill; and the life found around natural oil seeps compared to the effects of oil spills on living things. As part of their report, you also might ask them to research tar balls, the La Brea tar pits, and the origins of the word “asphalt.”

## RESOURCES

Additional educational content can be found at the following:

### **American Institute of Biological Sciences Educational Programs**

<https://www.aibs.org/education/>

AIBS is dedicated to improving biological science literacy at all levels of formal and informal education so that the public is able to make decisions informed by the biological sciences, particularly through an understanding of the process and nature of science and how biology informs societal issues. AIBS works with organizations in biology and across the scientific community to advance knowledge about issues and best practices to improve public understanding of science.

### **Center for Ocean Sciences Education Excellence (COSEE)**

<http://coseenow.net/blog/2010/08/oil-spill-resources/>

This website provides PowerPoints and hands-on activities related to the Gulf of Mexico oil spill that teachers can use in the classroom.

### **Consortium for Ocean Leadership**

<https://oceanleadership.org/>

The Consortium for Ocean Leadership manages ocean research and education programs in areas of scientific ocean drilling, ocean observing, ocean exploration, and ocean partnerships.

### **Environmental Defense Fund (EDF)**

<https://www.edf.org/>

The EDF website has educational resources on Climate & Energy, Oceans, Ecosystems, and Health.

### **Environmental Protection Agency (EPA)**

<https://www.epa.gov/land-research/oil-spill-research>

Visit this website to learn about the protocols that the EPA uses to conduct research on mitigating the effects of oil spills and to have access to their research report.

### **Gulf Coast Ecosystem and Restoration Council**

<https://www.restorethegulf.gov/resources/education-resources>

This website includes resources for teachers and participants, including lessons provided by the Council, as well as links to educational materials at other sites.

## **Gulf of Mexico Research Initiative (GoMRI)**

<http://gulfresearchinitiative.org/>

The Gulf of Mexico Research Initiative (GoMRI) will investigate the impacts of the oil, dispersed oil, and dispersant on the ecosystems of the Gulf of Mexico and affected coastal States in a broad context of improving fundamental understanding of the dynamics of such events and their environmental stresses and public health implications. The GoMRI will also develop improved spill mitigation, oil and gas detection, characterization and remediation technologies.

The ultimate goal of the GoMRI will be to improve society's ability to understand, respond to and mitigate the impacts of petroleum pollution and related stressors of the marine and coastal ecosystems, with an emphasis on conditions found in the Gulf of Mexico. Knowledge accrued will be applied to restoration and to improving the long-term environmental health of the Gulf of Mexico.

## **National Environmental Education Foundation (NEEF)**

<https://www.neefusa.org/>

NEEF works with a network of professions (teachers, weathercasters, health professionals, and land managers) to provide information, resources, and programs to thousands of households around the country. Sign up for their e-newsletter to receive updates on their programs, Environmental Education Week lessons, and more.

## **National Marine Mammal Foundation**

<http://www.nmmf.org/>

The National Marine Mammal Foundation (NMMF) has a mission to improve and protect life for marine mammals, humans, and our shared oceans through science, service, and education.

## **National Oceanic and Atmospheric Administration (NOAA)**

<https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources/gulf-oil-spill>

This website has a variety of helpful resources, including access to videos, lessons, fact sheets, and background information related to oil spills, especially the Gulf of Mexico spill.

—AND—

<https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/spill-containment-methods.html>

The link to this part of NOAA's website provides information on oil spill containment methods.

## **National Wildlife Federation (NWF)**

<https://www.nwf.org/Our-Work/Waters/Gulf-Restoration/Deepwater-Horizon>

Find out about the effects of oil spills on wildlife in the Gulf of Mexico.

## **NEED**

<https://www.need.org/>

The National Energy Education Development Project (NEED) site contains a wealth of information and educational resources for teaching about energy.

## **SeaGrant**

<https://seagrant.noaa.gov/>

Sea Grant's mission is to enhance the practical use and conservation of coastal, marine and Great Lakes resources in order to create a sustainable economy and environment. Environmental stewardship, long-term economic development and responsible use of America's coastal, ocean and Great Lakes resources are at the heart of its mission. A network of 33 Sea Grant programs in the coastal US States and territories carries out this mission through research, extension and education activities.

## **Smithsonian National Museum of Natural History**

<https://ocean.si.edu/conservation/pollution/after-oil-spill-research-projects-gulf-mexico-gomri>

Visit this site to learn about research projects in the Gulf of Mexico since the oil spill. The site relates to research studies funded by GoMRI (described above), but also includes photographs and an interactive map.

## **350.org**

<https://350.org/>

350.org is an international campaign that's building a movement to unite the world around solutions to the climate crisis. In addition to downloadable information explaining the science of carbon emissions, 350.org has guidelines on how to create a community Climate Action Plan and get community and local government involved in creating solutions to help reverse global warming.

## **Union of Concerned Scientists**

<https://www.ucsusa.org>

The Union of Concerned Scientists puts rigorous, independent science to work to solve the planet's most pressing problems. Joining with citizens across the country, they combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future. They have a plethora of educational tools for formal and non-formal education.

## **Woods Hole Oceanographic Institute**

<https://www.whoi.edu/>

Go to this website and visit the Climate and Oceans Section to view informative articles about a host of climate change research and data, especially as it relates to oceans.

## **World Resources Institute**

<https://www.wri.org/>

The World Resources Institute offers much demographic and environmental information on countries around the world, including charts and maps. Its focuses on six critical issues at the intersection of environment and development: climate, energy, food, forests, water, and cities and transport.

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## FUNDING

**“Dispatches from the Gulf 3” was made possible by a generous grant from the Gulf of Mexico Research Initiative (GOMRI).**

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The ultimate goal of GoMRI is to improve society’s ability to understand, respond to and mitigate the impacts of petroleum pollution and related stressors of the marine and coastal ecosystems, with an emphasis on conditions found in the Gulf of Mexico. Knowledge accrued will be applied to restoration and to improving the long-term environmental health of the Gulf of Mexico

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