JOURNEY TO PLANET EARTH

Dispatches from the Gulf 2:

Research • Innovation • Discovery

Educators Guide

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NEXT GENERATION SCIENCE STANDARDS

"Dispatches from the Gulf 2" 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 2" examines the impact of the 2010 Deepwater Horizon oil spill upon the Gulf of Mexico and in particular its environmental effect on humans, wildlife, and the ecosystem. Take an up-close tour on research ships to find out what scientists are learning about the condition of the Gulf and its marine inhabitants since the spill, where the 200 million gallons of spilled oil. Meet biologists, chemists, engineers, and oceanographers in action, to learn how these scientists go about finding answers to their questions, both in the field and in the lab. Discover both the expected and unexpected lessons being learned and the questions that still need to be answered about the impacts of oil spills.

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
- Gulf of Mexico (including the sea floor)
- 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.
- **Larval fish** — many fish species begin as eggs that go through a larval stage before becoming juveniles and adults. In the larval stage, fish are very small, don't swim well and often float in currents. They are also known as zooplankton.
- **Mahi-mahi** — an open ocean fish found in waters around the world, including the Gulf of Mexico. Known for being acrobatic, mahi-mahi are a fast growing and valuable commercial fish.
- **Marine Snow** — a continuous shower of mostly organic detritus falling from the upper layers of the water column.
- **Microbes** — microscopic single-celled organisms that include bacteria and archaea, as well as some fungi and some protists.
- **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.
- **Sonogram** – a procedure that uses high-frequency sound waves to scan the abdomen of a dolphin to create a picture of a baby.
- **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 video segments and post-viewing questions are indicated below.

Dolphins

Dispatch #1: The World's Healthiest Dolphins (00:02:15 - 00: 07:18) and
Dispatch #2: Not So Healthy Dolphins (00:07:19 - 00:14:39)

1. Why was it so important for veterinarians to study the health of dolphins in the Navy Marine Mammal Program?
2. What are some of the examinations performed on the dolphins of Barataria Bay?
3. What did veterinarians discover about the health of Barataria Bay dolphins?
4. What caused these problems?
5. Why didn't the dolphins leave Barataria Bay during the oil spill?

Oysters

Dispatch #4: Mardi Gras, Jazz, and Oysters (00:17:31 - 00:21:55) and
Dispatch #5: "We Need Facts" (00:21:56 - 00:24:33)

1. How important are oysters to Louisiana's economy?
2. What happened to Louisiana's oysters after the oil spill?
3. How did officials try to keep the oil from reaching oyster reefs?
4. What caused the decline of oysters after the oil spill?
5. What are the environmental benefits of oyster reefs?

Sharks

Dispatch #7: Secrets From The Deep (00:27:55 - 00:38:27)

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?

Mahi-mahi

Dispatch #8: Centers of Innovation (00:38:28 - 00:41:58)

1. How do scientists study the hearts of Mahi-mahi?
2. What did they discover about the health of Mahi-mahi?
3. Why is a healthy heart so important to fish like Mahi-mahi?

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 video segments and post-viewing questions are indicated below.

Marshes

Dispatch #8: Good News and Bad News (00:14:40 - 00:17:30)

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 #6: Underwater Blizzards (00:24:34 - 00:27:54)

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 #10: Tracking Ocean Currents (00:45:11 - 00:53:03)

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/view_activity.php?url=collection/cub_/activities/cub_enveng/cub_enveng_lesson01_activity1.xml

- **Flinn Scientific**

  http://www.flinnsci.com/media/980622/bf10058.pdf

- **NOAA**

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

  http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html

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 (http://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 2” 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:

ACER: Alabama Center for Ecological Resilience

http://acer.disl.org/

The Alabama Center for Ecological Resilience (ACER) Consortium came together to investigate how biodiversity influences an ecosystem's ability to resist and recover from disturbance, specifically the ecosystems of the northern Gulf of Mexico to the 2010 Deepwater Horizon oil spill. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

ADDOMx: Aggregation and Degradation of Dispersant and Oil by Microbial Exopolymers

http://www.tamug.edu/addomex/

ADDOMEx investigate the impacts of spilled oil and dispersants on the formation of an extracellular matrix called EPS (exopolymeric substances) formed by marine microbes that is thought to be instrumental in determining the fate of oil. EPS formed by marine microbes can aid in the formation of marine snow that is important in the self-cleansing capacity of natural waters. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

American Institute of Biological Sciences Educational Programs

http://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.

CARTHE: Consortium for Advanced Research on Transport of Hydrocarbon in the Environment

http://carthe.org/

CARTHE studies the oil spill and its impact on the Gulf's delicate ecosystems. Their scientific work is based on one of GoMRI's intellectual themes and focuses on the physical distribution, dispersion and dilution of petroleum, its constituents and associated contaminants under the action of physical oceanographic processes, air-sea interactions and tropical storms. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

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.

C-IMAGE: Center for Integrated Modeling and Analysis of Gulf Ecosystems

http://www.marine.usf.edu/c-image/

C-IMAGE studies the effects of oil spills on marine environments and will advance the understanding of the processes, mechanisms, and environmental consequences of marine oil blowouts. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

C-MEDS: Consortium for the Molecular Engineering of Dispersant Systems

http://dispersant.tulane.edu/

C-MEDS is researching how dispersants can be part of the effective management and mitigation of large oil releases from deep ocean environments. In addition to its research mission, the C-MEDS has a strong education mission to train participants in advanced science and technology related to the mitigation of oil spills, and an outreach mission to communicate and provide information on the role of dispersants in oil spills. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

CONCORDE: Consortium for Oil Spill Exposure Pathways in Coastal River-Dominated Ecosystems

http://www.con-corde.org/

CONCORDE conducts scientific studies of the impacts of oil, dispersed oil, and dispersant on the Gulf's ecosystem and public health. An important part of the scientific process—one as carefully planned as every experiment in a well-thought-out program—is how to share findings with the community who will benefit most from understanding them. The education program of CONCORDE addresses the level of public trust in science. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

Consortium for Ocean Leadership

http://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.

CRGC: Consortium for Resilient Gulf Communities

http://www.rand.org/gulf-states/resilient-communities.html

How can communities build resilience to future adverse events like the Deepwater Horizon oil spill?

To find out, CRGC will study the public health, social, and economic impacts of the 2010 Deepwater Horizon (DH) oil spill in the Gulf of Mexico region. CRGC uses an interdisciplinary approach to research and outreach activities to address a major policy issue in this region with implications for the rest of the United States. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

CWC: Coastal Waters Consortium

http://cwc.lumcon.edu/

CWC is assessing the chemical evolution, biological degradation, and environmental stresses of petroleum and dispersant within Gulf of Mexico coastal and shelf ecosystems. CWC's Education and Outreach program translates research investigating the effects of the Deepwater Horizon Oil Spill on coastal ecosystems into understandable formats for all levels of society. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

Deep-C: Deepsea to Coast Connectivity in the Eastern Gulf of Mexico

http://deep-c.org/

Deep-C is a long-term, interdisciplinary study of deep sea to coast connectivity in the northeastern Gulf of Mexico. The study is investigating the environmental consequences of petroleum hydrocarbon release in the deep Gulf on living marine resources and ecosystem health. Deep-C will examine the geomorphologic, hydrologic, and biogeochemical settings that influence the distribution and fate of the oil and dispersants released during the Deepwater Horizon (DwH) accident, and use the resulting data for model studies that support improved responses to possible future incidents. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

DEEPEND: Deep-Pelagic Nekton Dynamics of the Gulf of Mexico

http://www.deependconsortium.org

DEEPEND is investigating deep-pelagic communities on short-term (sub-generational) and long-term (evolutionary) timescales to appraise extant recovery and potential future recovery of these communities, using a suite of integrated approaches. An integrated outreach program will disseminate DEEPEND consortium activities to scientific, educational, and public sectors. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

DROPPS: Dispersion Research on Oil: Physics and Plankton Studies

https://sites.cns.utexas.edu/utmsi.dropps

DROPPS is studying the effects of oil spills in the Gulf of Mexico by examining the breakup of oil as well as the interactions of different planktonic and microbial species with oil. The information gathered from this research helps to predict the overall impact of oil spills, allowing for better protection of people and the environment. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

ECOGIG: Ecosystem Impacts of Oil and Gas Inputs to the Gulf

https://ecogig.org/

ECOGIG is bringing together physical oceanographers, marine biologists, and chemists from 14 research institutions in a holistic effort to understand the impacts of natural seepage versus that of abrupt, large hydrocarbon inputs on coupled benthic-pelagic processes in deepwater ecosystems in the Gulf of Mexico, and to chart the long-term effects and mechanisms of ecosystem recovery from the Macondo well blowout. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

Environmental Defense Fund (EDF)

www.edf.org

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

Environmental Protection Agency (EPA)

http://www.epa.gov/land-research/oil-spills-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.

GISR: Gulf of Mexico Integrated Spill Response

http://gisr-consortium.org/

The vision of GISR (pronounced *Geyser*) is to understand and predict the fundamental behavior of petroleum fluids in the ocean environment. This capability is critical to inform decisions during response to oil spills and for development of mitigation plans, ultimately yielding significant environmental and financial savings. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

Gulf Coast Ecosystem and Restoration Council

https://www.restorethegulf.gov/resources/education-resources/teachers-and-participants

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.

Hamburg University of Technology (TUHH)

https://www.tuhh.de/alt/tuhh/startpage.html

The Hamburg University of Technology (TUHH) is an independent university specializing in the core disciplines of "classical" engineering. First-class teaching, application-oriented and basic research at a high international level, and intensive knowledge and technology transfer characterize its principal tasks and goals. It actively promotes the process of cooperation between enterprises and researchers.

LADC-GEMM: Littoral Acoustic Demonstration Center – Gulf Ecological Monitoring and Modeling

http://www.ladcgemm.org/

Changes in marine mammal distribution and abundance, caused by environmental stresses or human activities, can have a major impact on the function of the entire deepwater ecosystem. This multidisciplinary consortium effort, which uses expertise from marine acoustics, biology, physics, engineering, mathematics, and computational predictive modeling, will equip scientists with an understanding of how the regional marine mammal population in the Northern Gulf of Mexico (GoM) has been affected by the Deepwater Horizon oil spill. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

National Environmental Education Foundation (NEEF)

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)

http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html

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—

http://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)

http://www.nwf.org/What-We-Do/Protect-Habitat/Gulf-Restoration/Oil-Spill/Effects-on-Wildlife.aspx

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

NEED

www.need.org

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

RECOVER: Relationship of Effects of Cardiac Outcomes in Fish for Validation of Ecological Risk

http://recover.rsmas.miami.edu/

RECOVER scientists are examining the detrimental effects of oil on two ecologically and economically important species of fish in the Gulf of Mexico: Mahi-mahi and Red drum. Education and Outreach modules for university, K-12 school, and general communities are available on their website.

SeaGrant

http://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.

SINTEF: The Foundation for Scientific and Industrial Research

http://www.sintef.no/en/

SINTEF – based in Trondheim, Norway – is the largest independent research organization in Scandinavia. It is a broadly based, multidisciplinary research institute with international top-level expertise in technology, medicine and the social sciences. Over the last 60 years, it has created value and innovation through knowledge generation and development of technological solutions that are brought into practical use.

Smithsonian National Museum of Natural History

http://ocean.si.edu/slideshow/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

www.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

http://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

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

http://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.

Worldwatch Institute

www.worldwatch.org

Worldwatch Institute is an independent research organization recognized for their fact-based analysis of critical global issues. Their focus is in three main areas: 1) Climate & Energy; 2) Food & Agriculture; and 3) Environment & Society.

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The Gulf of Mexico Research Initiative (GoMRI) investigates 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 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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