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Lophelia II 2010:
Cold Seeps and Deep Reefs

Oil Floats, Right?

Image captions/credits on Page 2.

lesson plan

Focus
Properties of oil in water

Grade Level
5-6 (Physical Science)

Focus Question
How does oil behave when mixed with water, and how is this behavior altered by dispersants?

Learning Objectives
- Students will define the property of density, and explain how this property applies to the behavior of oil and water.
- Students will compare and contrast solutions, mixtures, and emulsions, and explain how these properties apply when oil and water are combined.
- Students will define dispersant and discuss how dispersants may influence the impacts of oil on biological organisms.

Materials
- Copies of *Oil in Water Inquiry Guide*; one copy for each student group
- For each group of 2-4 students:
  - 50 ml **unused** motor oil (see Learning Procedure, Step 1)
  - 500 ml tap water
  - 3 - 250 ml graduated cylinders; glass or clear plastic; tall glass jars, approximately 200 ml capacity (such as those containing olives, capers, or sauces) may also be used
  - 1 - 50 ml graduated cylinder; glass or plastic (or other-size cylinder that can measure a 10 ml volume)
  - 3 Pieces of plastic wrap, approximately 20 cm square
  - 3 Rubber bands
  - Paper towels
  - Timer, stopwatch or clock
  - 1 ml liquid dishwashing detergent
  - Disposable gloves for each student
  - Eye protection for each student
  - Copies of the *Student Handout* and the *Student Observation Worksheet*
  - Newspapers for surface protection and easy cleanup

Audio-Visual Materials

- ❑ (Optional) video projection or other equipment to show images of deep-sea ecosystems from http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/photolog/photolog.html

Teaching Time

One or two 45-minute class periods

Seating Arrangement

Groups of 2-4 students

Maximum Number of Students

32

Key Words

Gulf of Mexico
Cold seep
Lophelia
Deepwater coral
Deepwater Horizon
Oil
Dispersant

Background Information

NOTE: Explanations and procedures in this lesson are written at a level appropriate to professional educators. In presenting and discussing this material with students, educators may need to adapt the language and instructional approach to styles that are best suited to specific student groups.

For the past four years, NOAA's Office of Ocean Exploration and Research (OER) has sponsored expeditions to locate and explore deep-sea chemosynthetic communities in the Gulf of Mexico. On April 20, 2010, a gas explosion occurred on the mobile offshore drilling unit Deepwater Horizon about 40 miles southeast of the Louisiana coast. The explosion killed 11 workers, injured 17 others, ignited an intense fire that burned until the Deepwater Horizon sunk 36 hours later, and resulted in a massive release of crude oil that is now considered the greatest environmental disaster in U.S. history. The total volume of oil released into the Gulf of Mexico is estimated to have been 205 million gallons (4.9 million barrels), dwarfing the 11-million gallon *Exxon Valdez* spill of 1989. Efforts to prevent the released oil from making landfall included the use of dispersants, some of which were injected at the wellhead to reduce the amount of oil that reached the surface. Extensive media attention has been directed toward the ecological impacts of released oil on beaches, marshes, birds, turtles, and marine mammals. Many scientists, however, are also concerned about how oil and dispersants may affect the unusual and biologically-rich communities of the Gulf of Mexico seafloor.

Images from Page 1 top to bottom:
Lophelia pertusa on the seafloor. Note extended polyp on the right. Image courtesy of Ian MacDonald, NOAA.
http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/sept1/media/lophelia_insitu_close.html

Video monitors inside Jason control van allow scientists and Jason crew to see all seafloor operations. Tim Shank (right) records observations using the "Virtual Van" software. Image courtesy Troy Kitch, NOAA.
http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/aug31/media/controlvan.html

Preserved specimens collected during *Lophelia* II 2009. Image courtesy Troy Kitch, NOAA.
http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/aug23/media/species_jar.html

Viosca Knoll Wreck: The stempost of the wreck is covered in *Lophelia*, Stalk Barnacles, *Acesta* clams and Anemones. A little *Eumunida picta* is also evident in the lower corner. Image courtesy Stephanie Lessa, NOAA.
http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/sept6/media/7_biostem.html

Deepwater ecosystems in the Gulf of Mexico are often associated with rocky substrates or "hardgrounds." Most of these hard bottom areas are found in locations called cold seeps where hydrocarbons are seeping through the seafloor. Two types of ecosystems are typically associated with deepwater hardgrounds in the Gulf of Mexico: chemosynthetic communities and deep-sea coral communities. Hydrocarbon seeps may indicate the presence of undiscovered petroleum deposits, so the presence of these ecosystems may indicate potential sites for exploratory drilling and possible development of offshore oil wells. At the same time, these are unique ecosystems whose importance is presently unknown.

In this lesson, students will investigate the behavior of oil in water and how dispersants may alter this behavior.

Learning Procedure

1. To prepare for this lesson:
   - Review introductory essays for the *Lophelia* II 2010: Cold Seeps and Deep Reefs Expedition at http://oceanexplorer.noaa.gov/explorations/10lophelia/welcome.html. You may also want to consider showing students some images of deep-sea ecosystems from http://oceanexplorer.noaa.gov/explorations/09lophelia/logs/photolog/photolog.html. You can find a virtual tour of a cold-seep community at http://www.bio.psu.edu/cold_seeps.
   - Review procedures and questions on the *Oil in Water Inquiry Guide*, and decide whether you want to do these procedures as a demonstration or as a student activity. If you opt for the student activity, make a copy of the *Inquiry Guide* for each student group. Otherwise, make a copy of the *Student Observation Worksheet* only for each student (or student group, if you want students to work together).
   - Gather materials needed for procedures described on the *Oil in Water Inquiry Guide*. Do not use discarded motor oil, since it is contaminated with heavy metals and polycyclic aromatic hydrocarbons, many of which are carcinogenic. Crude oil should also be avoided, since it contains a variety of volatile substances that are also harmful. Be sure students wear gloves and eye protection throughout these procedures. Spread newspapers over work surfaces to simplify cleanup. Review your school or district policies for laboratory activities and for handling laboratory waste.

2. Briefly introduce the *Lophelia* II 2010: Cold Seeps and Deep Reefs Expedition, and describe cold-seep and deepwater coral communities. If desired, show images from the Web page referenced in Step 1. Lead a brief discussion about the Deepwater Horizon blowout. Ask students what was done to deal with the oil that was released from the well. Be sure that dispersants are mentioned.

3. If you plan to conduct this lesson as a demonstration, tell students that we (as a class) are going to investigate some of the ways oil behaves in water. Provide each student or student group with a copy of the *Student Observation Worksheet*. Follow procedures described in the *Oil in Water Inquiry Guide* and have students record their observations where indicated. When these procedures have been completed, have students answer the questions on the *Worksheet*, then skip to Step 5.

4. If you plan to conduct this lesson as a student activity, tell students that they are going to investigate some of the ways oil behaves in water. Provide each student group with copies of the *Oil in Water Inquiry Guide* and the *Student Observation Worksheet*. Have each group follow procedures described on the *Inquiry Guide*, and record their observations on the *Worksheet*. When they have finished recording their observations, they should answer the questions on the *Worksheet*.

5. Have each group report their observations. Since these should be similar among all groups, you may want to have one group report on one stage in the procedure, then ask whether other groups observed anything different or additional. Observations should include:
   - Immediately after shaking, the contents of Cylinders A and B are cloudy and foamy, with a film of cloudy liquid adhering to the walls of the cylinder above the level of the liquid.

   - Immediately after shaking, the contents of Cylinder C appear cloudy, but clear rapidly and are clear (transparent) after five minutes.

   - After five minutes, the contents of Cylinders A and B appear to separate into three levels: a cloudy lower layer, a layer of colored liquid (oil) in the middle, and a cloudy foamy layer on top. The film of cloudy liquid still is present on the walls of the cylinder above the level of the liquid.

   - After resting for an hour:
     - The contents of Cylinder A have separated into two layers; a cloudy, whitish layer on the bottom, and a colored (oil) layer on top.
     - The contents of Cylinder B also have separated into layers that include a cloudy whitish layer beneath a colored (oil) layer. But there also appears to be additional thin layers above and below the oil layer. Also, the oil layer in Cylinder B is thinner than the oil layer in Cylinder A.
     - The film of cloudy liquid still is present above the level of the liquid on the walls of Cylinders A and B.
     - The contents of Cylinder C are transparent.

6. Lead a discussion about these observations and students' answers to questions on the *Worksheet*. Key points include:
   - Density is a physical property of matter that is related to an object's mass (how heavy it is) and volume (the object's physical size). Students know that a handful of styrofoam weighs much less than a handful of rocks. This is because the density of the styrofoam is less than the density of the rocks. Density is usually defined as "mass per unit volume," and the density of an object or substance is stated in "grams per cubic centimeter."

   - Based on their observations, students should infer that the density of oil is less than the density of water.

   - A mixture is a combination of two or more substances that is formed without a chemical reaction, so that each of the substances is still present. A combination of salt and sugar is an example of a mixture. A solution is a mixture of two or more substances that is homogenous so that the substances cannot be distinguished from the mixture. A mixture of salt, sugar, and water is an example of a solution. An emulsion is mixture of liquids in which small droplets of one liquid (oil in this case) are suspended in another liquid.

   - The cloudy foam that appears on top of liquids in Cylinders A and B is called mousse. After an oil spill, mousse is formed when wind and waves mix oil, water, and air. Mousse can also be formed under water if other gases (besides air) are present and turbulence causes these gases to mix with oil and water.

   - Oil released from the Deepwater Horizon blowout is classified as "light crude," but the released material is a mixture of pressurized oil and gas. As the more volatile components evaporate, oil becomes thicker and tar-like. As the oil moves through the water, turbulence breaks the oil mass into smaller particles that become tar balls. Small droplets of oil rise more slowly than larger oil masses, and very small droplets (less than about 100 μ in diameter) rise so slowly that they may remain in the water column for several months.

   - The cloudy film that persists on the side of Cylinders A and B is an unstable emulsion of oil and water. In an unstable emulsion the liquids will eventually separate, but they may continue to move together for long periods of time.

   - Cylinder B illustrates how dispersants (in this case, a detergent) can affect the behavior of oil in water. Dispersants cause oil to form stable emulsions in water. These emulsions are the "extra" layers in Cylinder B, and account for the smaller size of the oil layer in Cylinder B.

- Motor oil (like crude oil) is a mixture of many substances. The cloudiness that persists in the lower layers of Cylinders A and B demonstrates that some of these substances are still present in water even after much of the oil has apparently separated. Some substances may partially dissolve in water and form a solution that will not separate.

- The ecological significance of dissolved substances and stable emulsions depends upon length of exposure time and concentration. If currents and other mixing forces cause emulsions to be rapidly dispersed over a wide area, the length of exposure time and concentration will both be reduced. On the other hand, the adherence of an oil-water emulsion to the sides of the cylinders shows that even a brief exposure can have a coating effect that might affect functioning of gills, sight organs, and other physiological structures.

- Since deep-sea ecosystems in the Gulf of Mexico are often found in close proximity to hydrocarbon seeps, it might be supposed that organisms in these systems may have some tolerance for small droplets of oil from the Deepwater Horizon blowout. Students may be curious about how natural seepage compares to the volume of oil released by the Deepwater Horizon blowout. In 2003, the National Research Council estimated that the amount of oil seeping into the entire Gulf of Mexico ranges from 80,000 to 200,000 tonnes per year (a tonne is equal to 1,000 kg or about 2,205 lb, and is approximately the mass of one cubic meter of water at 4°C). For comparison, the amount of oil released by the Deepwater Horizon blowout is estimated to have been about 4.9 million barrels (205 million gallons) or about 780,000 cubic meters of crude oil. Since the density of crude oil is about 80% to 90% the density of water, 780,000 cubic meters of crude oil is approximately 624,000 – 702,000 tonnes.

- Students should realize that the idea behind using chemical dispersants is to disperse the oil into a much larger volume of water in hopes that dilution will reduce toxic effects, and to remove large masses of oil from the water surface where they are harmful to birds and other organisms. Preventing landfall of oil from the Deepwater Horizon blowout was a major objective of response efforts, and at least 1.8 million gallons of dispersant were applied as part of these efforts. About 720,000 gallons of this total were injected below the surface near the wellhead. At the end of May, 2010, a group of engineers, scientists, and spill responders concluded that "...up to this point, use of dispersants and the effects of dispersing oil into the water column has generally been less environmentally harmful than allowing the oil to migrate on the surface into the sensitive wetlands and near shore coastal habitats." (Coastal Response Research Center, 2010).

The BRIDGE Connection

www.vims.edu/bridge/ - Click on "Ocean Science Topics" then "Human Activities," then "Environmental Issues," then "Pollution" for links to resources about oil spills.

The "Me" Connection

Have students write a brief essay describing how the Deepwater Horizon blowout might be of personal significance.

Connections to Other Subjects

Life Science, Social Studies, English/Language Arts, Mathematics

Assessment

Written reports and class discussions provide opportunities for assessment.

Extensions

1. Investigate whether oil fluoresces under ultraviolet light; see *Lessons from the Deep: Exploring the Gulf of Mexico's Deep-Sea Ecosystems Education Materials Collection Educators' Guide, Appendix 2* (http://oceanexplorer.noaa.gov/edu/guide/gomdse_edguide.pdf)
2. See http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html for links to multimedia resources, lessons & activities, data, and background information from NOAA's Office of Education.

Multimedia Discovery Missions

http://oceanexplorer.noaa.gov/edu/learning/welcome.html - Click on the links to Lessons 3, 5, 6, and 12 for interactive multimedia presentations and Learning Activities on Deep-Sea Corals, Chemosynthesis and Hydrothermal Vent Life, Deep-Sea Benthos, and Medicine from the Sea.

Other Relevant Lesson Plans from NOAA's Office of Ocean Exploration and Research

Entering the Twilight Zone

(from the Expedition to the Deep Slope 2007)

http://oceanexplorer.noaa.gov/explorations/07mexico/background/edu/media/zone.pdf

Focus: Deep-sea habitats (Life Science)

Students will describe major features of cold-seep communities, list at least five organisms typical of these communities and infer probable trophic relationships within and between major deep-sea habitats. Students will also be able to describe the process of chemosynthesis in general terms, contrast chemosynthesis and photosynthesis, and describe major deep-sea habitats and list at least three organisms typical of each habitat.

Animals of the Fire Ice
(from the Expedition to the Deep Slope 2007)
http://oceanexplorer.noaa.gov/explorations/07mexico/background/edu/media/animals.pdf

Focus: Methane hydrate ice worms and hydrate shrimp (Life Science)

Students will define and describe methane hydrate ice worms and hydrate shrimp, infer how methane hydrate ice worms and hydrate shrimp obtain their food, and infer how methane hydrate ice worms and hydrate shrimp may interact with other species in the biological communities of which they are part.

Deep Gardens
(from the Cayman Islands Twilight Zone 2007 Expedition)
http://oceanexplorer.noaa.gov/explorations/07twilightzone/background/edu/media/deepgardens.pdf

Focus: Comparison of deep-sea and shallow-water tropical coral communities (Life Science)

Students will compare and contrast deep-sea coral communities with their shallow-water counterparts, describe three types of coral associated with deep-sea coral communities, and explain three benefits associated with deep-sea coral communities. Students will explain why many scientists are concerned about the future of deep-sea coral communities.

Let's Make a Tubeworm!
(from the 2002 Gulf of Mexico Expedition)
http://oceanexplorer.noaa.gov/explorations/02mexico/background/edu/media/gom_tube_gr56.pdf

Focus: Symbiotic relationships in cold-seep communities (Life Science)

Students will describe the process of chemosynthesis in general terms, contrast chemosynthesis and photosynthesis, describe major features of cold seep communities, and list at least five organisms typical of these communities. Students will also be able to define symbiosis, describe two examples of symbiosis in cold seep communities, describe the anatomy of vestimentiferans, and explain how these organisms obtain their food.

Chemists with No Backbones
(from the 2003 Deep Sea Medicines Expedition)
http://oceanexplorer.noaa.gov/explorations/03bio/background/edu/media/meds_chemnobackbones.pdf

Focus: Benthic invertebrates that produce pharmacologically-active substances (Life Science)

Students will identify at least three groups of benthic invertebrates that are known to produce pharmacologically-active compounds and will describe why pharmacologically-active compounds derived from benthic invertebrates may be important in treating human diseases. Students will also be able to infer why sessile marine invertebrates appear to be promising sources of new drugs.

Keep Away
(from the 2006 Expedition to the Deep Slope)
http://oceanexplorer.noaa.gov/explorations/06mexico/background/edu/gom_06_keepaway.pdf

Focus: Effects of pollution on diversity in benthic communities (Life Science)

In this activity, students will discuss the meaning of biological diversity and compare and contrast the concepts of variety and relative abundance as they relate to biological diversity. Given information on the number of individuals, number of species, and biological diversity at a series of sites, students will make inferences about the possible effects of oil drilling operations on benthic communities.

What's In That Cake?
(from the 2006 Expedition to the Deep Slope)
http://oceanexplorer.noaa.gov/explorations/06mexico/background/edu/gom_06_cake.pdf

Focus: Exploration of deep-sea habitats (Life Science)

Students will explain what a habitat is, describe at least three functions or benefits that habitats provide, and describe some habitats that are typical of the Gulf of Mexico. Students will also be able to describe and discuss at least three difficulties involved in studying deep-sea habitats and describe and explain at least three techniques scientists use to sample habitats, such as those found on the Gulf of Mexico.

Other Resources

The Web links below are provided for informational purposes only. Links outside of Ocean Explorer have been checked at the time of this page's publication, but the linking sites may become outdated or non-operational over time.

http://oceanexplorer.noaa.gov/explorations/10lophelia/welcome.html – Web site for the *Lophelia* II 2010: Cold Seeps and Deep Reefs Expedition

http://oceanexplorer.noaa.gov/edu/guide/gomdse_edguide.pdf – *Gulf of Mexico Deep-Sea Ecosystems Education Materials Collection Educators' Guide*

http://oceanexplorer.noaa.gov/edu/development/online_development.html – Online professional development opportunities, including *Lessons from the Deep: Exploring the Gulf of Mexico's Deep-Sea Ecosystems*

http://celebrating200years.noaa.gov/edufun/book/welcome.html#book - A free printable book for home and school use introduced in 2004 to celebrate the 200th anniversary of NOAA; nearly 200 pages of lessons focusing on the exploration, understanding, and protection of Earth as a whole system

http://www.piersystem.com/go/site/2931/ – Main Unified Command Deepwater Horizon response site

http://response.restoration.noaa.gov/deepwaterhorizon – NOAA Web site on Deepwater Horizon Oil Spill Response

http://docs.lib.noaa.gov/noaa_documents/NESDIS/NODC/LISD/Central_Library/current_references/current_references_2010_2.pdf – Resources on Oil Spills, Response, and Restoration: a Selected Bibliography; document from NOAA Central Library to aid those seeking information concerning the Deepwater Horizon oil spill in the Gulf of Mexico and information on previous spills and associated remedial actions; includes media products (Web, video, printed and online documents) selected from resources available via the online NOAA Library and Information Network Catalog (NOAALINC)

http://www.gulfallianceeducation.org/ – Extensive list of publications and other resources from the Gulf of Mexico Alliance; click "Gulf States Information & Contacts for BP Oil Spill" to download the Word document http://www.darrp.noaa.gov/southeast/deepwater_horizon/index.html – Information about damage assessments being conducted by NOAA's Damage Assessment Remediation and Restoration Program

http://www.noaa.gov/sciencemissions/bpoilspill.html – Web page with links to NOAA Science Missions & Data relevant to the Deepwater Horizon/BP Oil Spill

http://www.geoplatform.gov/gulfresponse/ – An online tool developed by NOAA, EPA, U.S. Coast Guard, and the Department of Interior that provides a "one-stop shop" for spill response information

http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html - "Gulf Oil Spill" Web page from NOAA Office of Education with links to multimedia resources, lessons & activities, data, and background information

Coastal Response Research Center. 2010. Deepwater Horizon Dispersant Use Meeting Report May 26-27, 2010. Coastal Response Research Center, University of New Hampshire. June 4, 2010; available online at www.crrc.unh.edu/dwg/dwh_dispersants_use_meeting_report.pdf

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National Science Education Standards

Content Standard A: Science As Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard B: Physical Science
- Properties and changes of properties in matter

Content Standard C: Life Science
- Populations and ecosystems
- Diversity and adaptations of organisms

Content Standard E: Science and Technology
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives
- Personal health
- Populations, resources, and environments
- Natural hazards
- Risks and benefits
- Science and technology in society

Ocean Literacy Essential Principles and Fundamental Concepts

Essential Principle 1.
The Earth has one big ocean with many features.
Fundamental Concept g. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

Essential Principle 2.
The ocean and life in the ocean shape the features of the Earth.
Fundamental Concept a. Many earth materials and geochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks.

Essential Principle 5.
The ocean supports a great diversity of life and ecosystems.
Fundamental Concept b. Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.
Fundamental Concept d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
Fundamental Concept f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and

circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.
Fundamental Concept g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Essential Principle 6.
The ocean and humans are inextricably interconnected.
Fundamental Concept b. From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
Fundamental Concept e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.
Fundamental Concept f. Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).
Fundamental Concept g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Essential Principle 7.
The ocean is largely unexplored.
Fundamental Concept a. The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.
Fundamental Concept b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.
Fundamental Concept c. Over the last 40 years, use of ocean resources has increased significantly, therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.
Fundamental Concept d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

Fundamental Concept f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Send Us Your Feedback

We value your feedback on this lesson.
Please send your comments to:
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Acknowledgements

This lesson was developed by Mel Goodwin, PhD, Marine Biologist and Science Writer. Design/layout by Coastal Images Graphic Design, Mt. Pleasant, SC. If reproducing this lesson, please cite NOAA as the source, and provide the following URL: http://oceanexplorer.noaa.gov/

Student Worksheet
Oil in Water Inquiry Guide

Procedure

1. Wear gloves and eye protection throughout this procedure.

2. Place 100 ml tap water in each of three 250 ml graduated cylinders. Label these cylinders A, B, and C.

3. Add 10 ml unused motor oil to Cylinders A and B.

4. Add ONE DROP of liquid dishwashing detergent to Cylinder B.

5. Place a square of plastic wrap on top of each cylinder, and secure it in place with a rubber band to make a tight seal.

6. Shake each cylinder vigorously for 30 seconds, then place the cylinders in a location where they can be observed without further disturbance. Record what you see in each cylinder every five minutes for one hour. Record your observations on the Observation Worksheet.

Student Observation Worksheet
Demonstrating Some Properties of Oil in Water

Resting Time	Cylinder A	Cylinder B	Cylinder C
5 min			
10 min			
15 min			
20 min			
25 min			
30 min			
35 min			
40 min			
45 min			
50 min			
55 min			
60 min			

Draw a sketch of each cylinder after it has rested for one hour:

Student Observation Worksheet - 2
Demonstrating Some Properties of Oil in Water

1. What is density?

2. How does density help explain your observations of the behavior of oil in water?

3. Compare and contrast solutions, mixtures, and emulsions. Did you observe any of these during the oil in water activity?

4. What is a dispersant?

5. It is common knowledge that oil and water don't mix. Is there anything you might add to this statement that would explain your observations?

Student Observation Worksheet - 3
Demonstrating Some Properties of Oil in Water

6. What do you conclude about the effect of detergent on the behavior of oil in water?

7. What effects do you think oil might have on deep-sea ecosystems in the Gulf of Mexico? What effects do you think adding dispersants to oil might have on these ecosystems?