The NASA SCI Files™

The Case of the Ocean Odyssey

Segment 3

Armed with lots of information on ocean currents, the tree house detectives decide that they need to learn more about oil, how it forms, and how to drill for it. While in Houston with his family, Jacob stops by the Houston Museum of Natural Science to get a little help from Mr. Paul Bernhard. Mr. Bernhard explains how oil formed millions of years ago and the special conditions that were necessary for its formation. Next, Jacob visits Mr. Kent Wells, of BP Productions, at the Ocean Star drilling rig and museum in Galveston, Texas. As Mr. Wells shows Jacob around an actual drilling rig, he describes the process of drilling for oil. After learning from Bianca that there haven't been any recent oil spills, Jacob remembers something that Mr. Wells said and suggests that someone visit Ms. Jennifer Miselis at the Virginia Institute of Marine Science (VIMS) in Gloucester Point, VA. Ms. Miselis helps the tree house detectives better understand the topography of the ocean floor. With all this new information, the detectives think they might be close to solving the mystery of the tennis shoes and oil globs.

Objectives

Students will

- learn that different liquids vary in density.
- understand how oil forms.
- learn the devices used to drill for oil.
- learn that ocean floor topography varies.
- understand oil seeps.
- compare water pressure at different depths.
- realize that pressure increases as water depth increases.

Vocabulary

abyssal plain—the flat seafloor in the deep ocean

anaerobic—having or providing no oxygen

continental shelf—the part of every continent that extends under the ocean

continental slope—a part of the continental shelf that dips steeply to the seafloor

drill bit—a device used to cut through rock in search of oil and gas

drilling rig—a structure used in offshore oil drilling that supports drilling equipment and is either fixed to the seabed or floats independently

casing—a liner pipe or tube in water, oil, or gas wells

fossil fuels—a fuel made of the decayed remains of ancient plants and animals; includes coal, oil, and natural gas

impermeable—rock or soil that has very small pores that prevent water from passing through

mid-ocean ridge—an underwater mountain range that extends through the middle of most oceans; formed when forces within the Earth spread the seafloor apart, causing it to buckle

natural seepage—the escape of oil from permeable rock and soil that occurs without any assistance by man (naturally)

ocean trench—a deep trench in the ocean, caused when one piece of the seafloor is pushed beneath another piece

permeable—describes rock or soil that has connecting pores that allow water to pass through easily

pressure—the force acting on a surface divided by the area over which it acts

seamount—an underwater volcano

submersible—an underwater vessel, especially a small craft designed for use at deep levels

oil—petroleum, the crude product that is distilled and refined to produce a variety of industrial oils and oil-based products

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 3 of *The Case of the Ocean Odyssey*, discuss the previous segment to review the problem and assess what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on **Tools**. The **Problem Board** can also be found in the **Problem-Solving Tools** section of the latest online investigation. Have students use this section of the web site to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 2 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during previous segments. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 2.
5. Read the overview for Segment 3 and have students add any questions to their list that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the **Educators** area of the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program so they will be able to answer the questions. An icon will appear when the answer is near.
7. **"What's Up?" Questions**—These questions at the end of the segment help students predict what actions

the tree house detectives should take next in the investigation process and how the information learned will affect the case. Teachers can print them from the **Educators** area of the web site ahead of time for students to copy into their science journals.

Careers

museum curator
petroleum engineer
marine geologist
seismic engineer
driller
tool pusher

View Segment 3 of the Video

For optimal educational benefit, view *The Case of the Ocean Odyssey* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" Questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about currents, tides, oil formation, oil production, and ocean floor topography. Organize the information, place it on the Problem Board, and determine whether any of the students' questions from the previous segments were answered.
4. Decide what additional information is needed for the tree house detectives to determine how the oily tennis shoes washed up on the Virginia shore. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
5. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
6. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files ™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Wacky Water Cycle*. In the green box, click on **Download the Educator Guide**.

   a. In the Educator Guide you will find

      a. **Segment 1** – *Seepy Sandwich*

      Close the PDF window to return to the **Educator Guide** page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Disappearing Dirt*. In the green box, click on **Activities/Worksheets**.

   b. On the web site in the **Activities/Worksheets** section you will find

      a. *Amphibious Vehicles*

      Close the PDF window and return to the **Educator Guide** page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2001–2002 Season and click on *The Case of the Mysterious Red Light*. In the green box, click on **Download the Educator Guide**.

   a. In the **Educator Guide** you will find

      a. **Segment 3** – *The Three Little Volcanoes*

      b. **Segment 3** – *The Ring of Fire*

7. If time did not permit you to begin the web activity at the conclusion of Segments 1 or 2, refer to number 6 under After Viewing on page 15 and begin the PBL activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, PBL activity:

   Research Rack—books, Internet sites, and research tools

   Problem-Solving Tools—tools and strategies to help guide the problem-solving process.

   Dr. D's Lab—interactive activities and simulations

   Media Zone—interviews with experts from this segment

   Expert's Corner—listing of Ask-an-Expert sites and biographies of experts featured in the broadcast

8. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon, as suggested on the **PBL Facilitator Prompting Questions** instructional tool found by selecting **Educators** on the web site.
9. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools found on the web site. Visit the **Research Rack** in the **Tree House** and find the online PBL investigation main menu section, **Problem-Solving Tools**, and the **Tools** section of the **Educators** area for more assessment ideas and tools.

Resources *(additional resources located on web site)*

Books

Berger, Melvin: *Oil Spill! Harper Collins Children's Books,* 1994, ISBN: 0064451216.

Borden, Louise: *Sea Clocks: The Story of Longitude*. Simon and Schuster Children's, 2004, ISBN: 0689842163.

Cole, Joanna: *The Magic School Bus on the Ocean Floor.* Scholastic, Inc., 1994, ISBN: 0590414313.

Collard, Sneed: *The Deep Sea Floor*. Charlesbridge Publishing, Inc., 2003, ISBN: 1570914028.

Gibbons, Gail: *Exploring the Deep Dark Sea*. Little, Brown Children's Books, 2002, ISBN: 0316755494.

Littlefield, Cindy: *Awesome Ocean Science*. Ideals Publications, 2002, ISBN: 1885593716.

Oleksy, Walter: *Mapping the Seas*. Scholastic Library, 2003, ISBN: 0531166341.

Scholastic: *Scholastic Atlas of Oceans*. Scholastic, Inc., 2004, ISBN: 0439561280.

Taylor, Leighton: *Atlantic Ocean*. Blackbirch Press, 1999, ISBN: 1567112463.

Vieria, Linda: *Seven Seas: Exploring the World Ocean*. Walker and Company, 2003, ISBN: 0802788335.

Video

Cousteau Productions: *Under the Waves, Exploring with Submarines, Vol. 2*
Grades K–5

Disney Channel: *Ocean Exploration (Bill Nye, the Science Guy)*
Grades 3–6

Discovery Channel: *The Blue Planet*
Grades 6–adult

Schlessinger Media: Oceans
Grades 5–8

Status: *Captain Jon Explores the Ocean*
Grades K–3

Web Sites

The Houston Museum of Natural Science
Visit this site to learn more about the Houston Museum of Natural Science in Houston, Texas. Be sure to visit the Hall of Energy exhibit.

http://www.hmns.org/

How Oil Drilling Works
Learn how oil is formed, how we find oil, how we drill and extract oil, and the parts of an oil well. There are also links for more information on oil drilling.

http://www.howstuffworks.com/oil-drilling.htm/printable

Offshore Energy Center's Ocean Star
Less than an hour from downtown Houston, the world's petroleum capital, the Offshore Energy Center (OEC) operates its state-of-the-art facility, the Ocean Star. Visitors step onboard, tour the completely refurbished jack-up drilling rig, absorb the day-to-day excitement of offshore drilling and production, marine transportation, environmental protection, construction, pipelining—all experienced through three decks of videos, equipment exhibits, and interactive displays. It's like a museum, educational attraction, and working drilling rig all rolled into one. Take a virtual tour while visiting the web site.

http://www.oceanstaroec.com/

BP Productions
Petroleum Energy
On this kid-centered web site, learn all about oil, where it comes from, how it's used, and how it affects the environment.

http://www.eia.doe.gov/kids/non-renewable/oil.html

The Ocean Floor
Brain POP's interactive web site for kids. Learn about the ocean floor through comics, movies, and activities. You must be a subscriber to complete more than two activities per day.

http://www.brainpop.com/science/earth/oceanfloor/index.weml

Dive and Discover: Expeditions to the Seafloor
This interactive distance learning Web site immerses you in the excitement of discovery and exploration of the deep seafloor. Dive and Discover brings you right onboard a series of research cruises to the Pacific and Indian Oceans and gives you access to the latest oceanographic and deep submergence research as it happens!

http://science.whoi.edu/DiveDiscover/

Oceans Alive! Looking at the Sea
Visit this site to learn about the topography of the ocean floor, how the ocean changes over time, the water cycle, and the four oceans of the world.

http://www.mos.org/oceans/planet/index.html

Physiography of the Ocean Basins
This site acquaints visitors with the topography of the ocean basins, the ocean basin configuration, and has some good illustrations to support the ideas.

http://www.physicalgeography.net/fundamentals/10p.html

Smithsonian—Ocean Planet: How Deep Can They Go?
On this interactive web site, learn about the different depths of the ocean and at which of the various depths animals can live.

http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_how_deep.html

Plate Tectonics
Brain POP's interactive web site for kids. Learn about plate tectonics through comics, movies, and activities. You must be a subscriber to complete more than two activities per day.

http://www.brainpop.com/science/earth/platetectonics/index.weml?&tried_cookie=true

Virginia Institute of Marine Science
The Virginia Institute of Marine Science (VIMS) has a three-part mission to conduct interdisciplinary research in coastal ocean and estuarine science, educate students and citizens, and provide advisory service to policy makers, industry, and the public. The VIMS School of Marine Science (SMS) is the professional graduate school in marine science for the College of William & Mary.

http://www.vims.edu/

National Ocean Industries Association
Visit this web site for a great activity book about oceans and energy—great for kids to use and learn more about ocean oil rigs.

http://www.need.org/needpdf/activitybook.pdf

Activities and Worksheets

Density Stackers

Segment 3

Purpose

To learn about density

Background

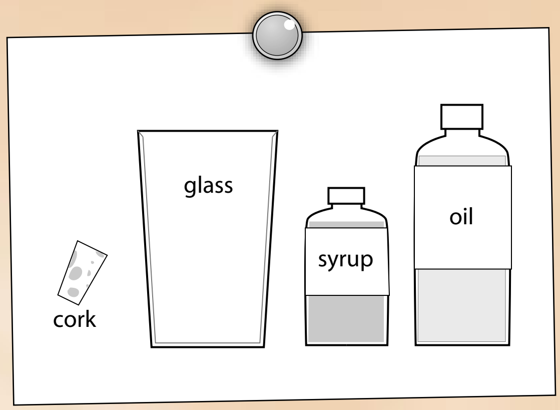
Density is the amount of mass an object has compared to its volume. Different liquids have different densities. A liquid of lesser density will rest on top of a liquid of greater density. Consider a bottle of salad oil dressing. If you look at the bottled dressing, you will see that the different density levels of the liquids cause different layers to form. If you shake up the salad oil, it will scatter the layers, but the liquids will never fully combine. In time, the liquids in the salad oil will separate again to form density layers. Different objects have different densities as well. When placed in liquids, the objects will "layer" themselves in the order of their own densities. Ocean waters also have various density layers. Colder water is denser and is usually found below warmer water. Saltwater is denser and is usually below freshwater.

Materials

80-mL syrup
1 glass jar
80-mL cooking oil
80-mL water
measuring cup
1 small piece of plastic
1 grape
1 small cork
science journal

Procedure

1. Pour 80 mL of syrup into a glass jar.
2. Add 80 mL of cooking oil to the jar.
3. Observe the liquids and record your observations in your science journal.
4. Add 80 mL of water to the jar.
5. Observe the liquids and record.
6. Drop a piece of plastic in the jar.
7. Observe the location of the plastic and record. Illustrate.
8. Drop a grape in the jar.
9. Observe the location of the grape and record. Illustrate.
10. Drop a cork in the jar.
11. Observe the location of the cork and record. Illustrate.
12. Write an explanation of your observations.



Conclusion

1. What happened when you poured each liquid into the jar? Why?
2. Did the objects (plastic, grape, and cork) all rest in the same place? Why or why not?
3. Describe how this experiment explains density.
4. Explain why it is important to understand density when cleaning up an oil spill.

Extension

1. Predict what will happen if you mix the layers. Stir the mixture and observe what happens. Predict what will happen to the layers after a few hours. Let the mixture sit undisturbed for 2 hours and then observe. Repeat this experiment with different liquids and different objects. Do the results vary? Why or why not?
2. Fill an aquarium two-thirds full of room temperature water. Acquire several brands of full soda cans. Predict which soda cans will sink or float. Test your hypothesis. Perform research to better understand why some brands of soda floated while others sank.

Texas Tea, Black Gold

Segment 3

Purpose

To learn the difficulties involved in drilling for oil

Materials

1 piece of 15-cm X 15-cm foam board
4 sharpened pencils
2 clear plastic straws
37.85-L (10-gallon) aquarium
300 mL (300 cubic centimeters) of dark sand
1 large bag of light sand
clear tape
water
metric ruler
science journal

Background

Both oil and natural gas form over millions of years from the decaying of tiny organisms in the ocean. The process begins when plankton organisms die, fall to the seafloor, and pile up. Later, sediment is deposited over them, and they are compacted by the weight. This pressure on the organic matter helps chemical reactions occur, creating the liquid we call oil, as well as the gases we call natural gas. As oil and natural gas migrate toward the surface, an impermeable layer of rock, such as shale, may stop their movement. When this rock traps the oil or natural gas below it, a reservoir of oil or gas forms.

The question is how to find these reservoirs. Have you ever tried to get dressed in the dark? Imagine trying to find a matched pair of socks without being able to look at them first. Chances are, you probably would not get a matched pair on your first try. You would have to try several times before you were successful. Drilling for oil is a lot like that. Because the oil is under the ground, it is difficult to know exactly where to find it. Geologists and engineers study the geology of the Earth and usually have a general idea where oil might be located, but it may take several drilling attempts before they actually find it.

Teacher Prep

1. For each aquarium, pour the dark sand in 3 equal mounds.
2. Cover the bottom of the aquarium and the mounds of dark sand with the light sand to a depth of 6 centimeters (cm). See diagram 1.
3. Trying not to disturb the sand, fill the aquarium with water to a depth of 20 cm.
4. WITH ADULT HELP, use a sharp knife to cut a 2-cm hole in the middle of each foam board.

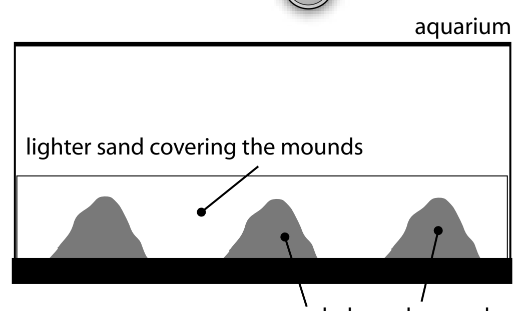


Diagram 1

Procedure

1. Insert a sharpened pencil into each of the 4 corners of the foam board. The pencils represent the legs of an oil rig. See diagram 2.
2. Carefully place the oil rig in the water.
3. The deck (foam board) of the oil rig should be slightly above the water.
4. Tape 2 straws together end to end, making sure to completely seal the connection.
5. Use masking tape or string to create a 6-sided, equal quadrant grid on top of the aquarium tank. See diagram 3 on page 53.
6. Label the quadrants A, B, C, D, E, and F.
7. In your science journal, draw and label the grid.
8. Using the straws as a drill, try to strike oil.
   a. Insert the straw into the hole of the deck and into the sand until it hits the bottom of the aquarium.
   b. Cover the end of the straw with your finger.
   c. Remove the straw, still holding the end of the straw with your finger.
   d. If you have dark sand in your straw, you struck oil!
   e. Record the letter of the grid in which you drilled for oil and your findings. Place a small dot in your grid diagram to mark the approximate spot you drilled.
   f. Continue drilling for "oil" and recording your findings.

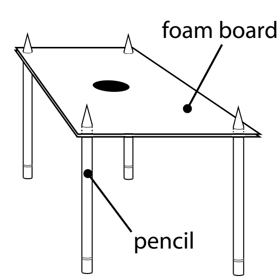


Diagram 2

Texas Tea, Black Gold

Segment 3

Conclusion

1. Was it helpful to mark the location of each well you drilled? Why or why not?
2. If you were to repeat the activity, what would you do differently?
3. How do think drilling companies track each hole that's drilled?

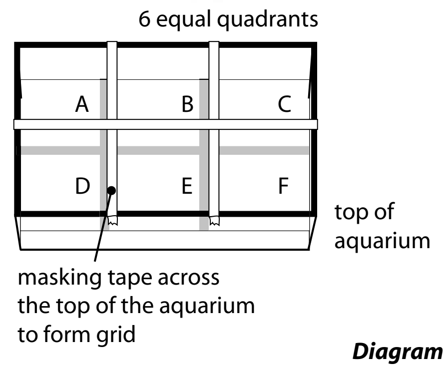


Diagram 3

Extensions

1. Research oil exploration careers such as petroleum engineer, geologist, roustabout, roughneck, derrick man, driller, and tool pusher. Write a job description and include the salary range for each. Present your findings to the class. Tell which job you might someday apply for (if any).
2. Choose one of the careers and write a story depicting what a typical day would be like in that job. Give a presentation to the class as if you held that job.

Building a Rig

Segment 3

Purpose

To learn about various types of oil drilling platforms

Background

There are four general types of offshore oil rigs, semi-submersible, platform, jack-up, and drill ship.

- A semi-submersible rig is a floating, drilling unit with pontoons and columns, which, when flooded with seawater, cause the pontoons to submerge to a predetermined depth. Although wave action moves the rig, it floats low in the water, with a large part of its structure underwater. It is very stable and the preferred choice for exploring deep water wells.
- A platform rig is an immobile (stationary) structure made of concrete and steel. When oil or gas is located, a platform rig can be constructed to drill more wells. Barges float the platform rig to the location and then lower it to the seabed. Its legs are then flooded and anchored to the seabed. This type of oil rig is used in shallow water.
- A jack-up rig is a mobile structure but instead of floating over the drilling location, it has long leg structures that lower to and into the seabed, raising the rig out of the water. The maximum depth for operation is 500 feet.
- A drill ship is a vessel shaped like a ship that uses computers to maintain its position over a drill hole. This type rig is not as stable as semi-submersibles, but it can drill in very deep water.

Materials

- 2 pieces of 15-cm X 15-cm foam board
- aquarium from Texas Tea, Black Gold (p. 52)
- water
- toothpicks
- modeling clay
- 4 small empty glue bottles with twist-close tops
- 4 pieces of string or yarn, each 45 cm long
- 8 small weights (sinkers)
- metric ruler
- science journal

Teacher Prep

1. Follow the directions in Texas Tea, Black Gold (p. 52) to set up an aquarium. If the aquarium was previously built, remove the grid.
2. Using a sharp knife, cut a 2-cm hole in the middle of each foam board.
3. In one of the foam boards, cut 4 holes in the corners large enough for a straw to fit through.
4. For each student, cut two 1-cm slits 2–3 cm from the bottom of 4 straws.
5. Cut 2 small holes near the bottom of each empty glue bottle.
6. Cut 4 holes in the corners of the last foam board big enough for the necks of the glue bottles to fit (without the caps).

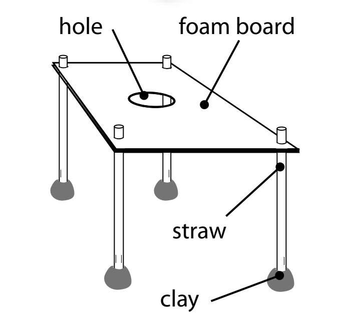


Diagram 1

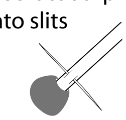


Diagram 2

Procedure

Platform Rig

1. Adjust the water level in the aquarium so that it is 15 cm deep.
2. Carefully examine the 4 straws and note the slits on one end.
3. Slide the un-slit end of the straws through the foam board with the 4 holes (1 in each corner).
4. Use clay molded into square "feet" to seal the bottoms of each straw. See diagram 1.
5. Using a small amount of clay, seal the top of each straw.
6. To represent opening the valves of the oil rig legs, insert toothpicks into the slits to hold them open. See diagram 2.
7. Float the platform in the aquarium.
8. Use a toothpick to break the seal of the clay at the top of the straws so that the air in the straw can escape.
9. Observe and record what happens to the rig as the straws fill with water.
10. Optional: Use a straw to drill for oil. See Texas Tea, Black Gold (p. 52).

Building a Rig

Segment 3

Semi-Submersible Rig

1. Add water to the aquarium so that the water depth is 20 cm.
2. Thread a piece of string through the holes in each empty glue bottle. Make sure the string hangs evenly.
3. Attach the weights to the ends of the strings. See diagram 3.
4. Remove the tops of the glue bottles.
5. In the other foam board, insert a glue bottle through each of the four holes.
6. Replace the tops of the glue bottles and close them tightly. See diagram 4.
7. Place the floating oil rig in the water.
8. Spread out the weights on the bottom of the aquarium and secure the rig. Note: If the weights don't reach the bottom, adjust the water level of the aquarium.
9. Open the tops of the glue bottles.
10. Observe and record what happens to the oil rig.
11. Optional: Use a straw to drill for oil. See Texas Tea, Black Gold (p. 52).

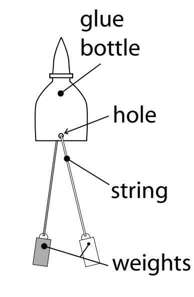


Diagram3

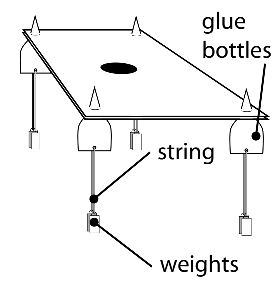


Diagram 4

Conclusion

1. What are some of the challenges faced by people who drill for oil?
2. What happened to the stationary oil rig as the straws filled with water? What problems might this situation pose for people trying to drill for oil?
3. What happened to the floating oil rig when you opened the glue bottle caps?
4. Which oil rig do you think is the easiest to use?

Extension

1. Visit **http://papertoys.com/rig.htm** to download and print a copy of a paper model of a jack-up oil rig. *(Consists of four pages with instructions on how to assemble the rig.)*
2. Make an edible oil drill! Mix batter for white, yellow, and chocolate cake mixes. Make cupcakes with layers of each flavored batter to represent rock layers. In each layer, hide chocolate-covered candies to represent oil deposits. After the cupcakes are baked, use a clear straw to drill for oil. If there is melted chocolate in your straw, you struck oil! Repeat several times. Enjoy the cupcake!
3. Research the various types of oil rigs. Choose one and build a model of it from materials found at home. Label the various parts and write a description of each and its use. Present your model to your group or class.

Seepy Seeps Seep Seepily

Segment 3

Purpose

To understand oil seeps

Background

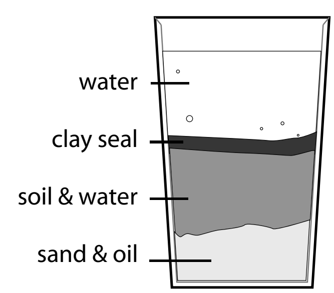
Millions of years ago, huge deposits of petroleum formed in ocean basins. As time went by, layers of sedimentary rock formed over the oil deposits, sealing the oil inside. Over time, earthquakes, erosion, and other natural phenomena have created cracks in the layers of rock. Some layers of rocks also have tiny holes throughout (are permeable). Because oil and natural gas are less dense than water, they migrate upward to get on top of water-saturated rock layers. The oil oozes through these cracks and holes. This natural oozing of oil is called a seep. The oil rises through the water to the surface where it congeals into floating globules of sticky tar, which is carried by ocean currents and can sometimes end up on beaches around the world. For hundreds of years, people have been using naturally seeping oil to waterproof various items. Natural seepage accounts for approximately 62 million gallons of oil being added to the ocean each year. Some oil companies have even built devices to "catch" some of the natural seepage for commercial use.

Materials

- 1 large, clear glass
- 1 small mixing bowl
- 2-mL cooking oil
- 10-mL (or 10-cm^3 – cubic centimeters) sand
- 30-mL (or 30-cm^3 – cubic centimeters) soil
- 1 piece modeling clay
- water
- measuring cup
- science journal
- stopwatch or clock with second hand

Procedure

1. In your group, discuss oil seeps and in your own words, write a definition of seepage.
2. Pour the sand into the bottom of the glass.
3. Pour the oil onto the sand.
4. Add 1 mL of water to the oil in the glass.
5. In a mixing bowl, mix the soil with water until the soil is very wet.
6. Pack the soil and water mixture into the glass, making sure it is tightly packed.
7. Make a prediction of how long it will take for the oil to seep into the water. Record your prediction in your science journal.
8. Flatten and mold the clay into a circle the same size as the circumference of the glass.
9. Place the clay in the glass, creating a thin seal over the soil.
10. Fill the glass with water.
11. Start the stopwatch.
12. Observe the oil and time how long it takes the oil to seep through the layers to the top of the water.
13. Record your observations and time.
14. Share your data with the class and create a class chart of each group's data. Create a graph depicting the data.
15. Find the average time it took for the oil to seep to the top of the water.
16. If times were different among the groups, discuss why and talk about the factors that could make the oil seep at different intervals.



Seepy Seeps Seep Seepily

Segment 3

Conclusion

1. How long did it take for the oil to begin seeping to the top of the water?
2. How long do you think it would take for all the oil to seep to the top of the water?
3. If the clay seal were not tight, how would the oil seep be affected? Why?
4. What do you think would happen if you used saltwater instead of freshwater?
5. In the program, Ms. Mislesis told Kali that divers have described seepage areas as a bunch of gopher holes. Write a short story that describes a dive adventure of your own and tell what you might see in an oil seepage area.

Extension

1. Allow time to observe the experiment until all the oil has seeped to the top of the water. How long did it take?
2. Repeat the same experiment, replacing the freshwater with saltwater. Did using saltwater make a difference?
3. Using a taller glass, repeat the experiment. Did the height of the glass make a difference in the time it took for the oil to begin seeping? Why or why not?
4. Repeat the experiment, but use a toothpick to create "vents" (holes) in the clay.

Read All About It!

Segment 3

Choose one

1. Research the various uses of oil and natural gas in our everyday lives. Research the environmental consequences of drilling for oil and gas. Decide whether you are in favor of or against continued oil exploration. Write a letter to the editor explaining your viewpoint.
2. Create a cartoon to illustrate the pros or cons of oil exploration.
3. Research renewable energy sources and choose one to give as a report to the class. Explain why renewable energy sources are a must for the future.
4. Create a poster or collage showing the various ways that oil and the products made from oil have improved the quality of our lives.

EXTRA! EXTRA!
READ ALL ABOUT IT!

Pressing Pressure

Segment 3

Purpose

To compare water pressure at different depths

Background

Have you ever tried to swim to the bottom of a pool? Did you feel a squeezing in your head and ears? This squeezing sensation is a result of water pressure, which is a function of weight that is related to depth. Water pressure increases with depth. Density also affects water pressure and is related to weight. The greater the density of water, the greater the pressure it exerts. Saltwater is denser than freshwater because of the salt and dissolved minerals in it; therefore, if you are diving in freshwater to a 3-m depth, you will feel less pressure than if you dived 3 m deep in saltwater.

Teacher/Adult Note

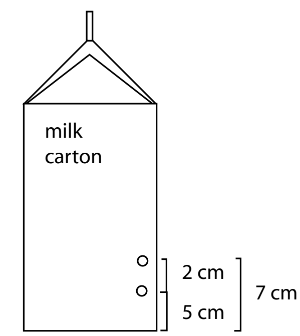
Use a pencil to make 2 identical holes in both milk cartons. One hole should be about 5 cm from the bottom. The other hole should be about 7 cm above the first hole.

Materials

cup
1.9 L (1/2 gallon) milk carton – not plastic
946.36-mL (1 quart) milk carton – not plastic
pencil
masking tape
deep pan
water
metric ruler
science journal
access to a sink or outside

Procedure

1. On each carton, tape over the holes with one long strip of masking tape.
2. Place the 1.9 L carton in the deep pan.
3. Fill the carton with water.
4. Remove the tape.
5. Observe the flow of water through the holes.
6. Record your observations in your science journal.
7. Empty the pan.
8. Place the 946.36-mL carton in the empty, deep pan.
9. Fill the carton with water.
10. Remove the tape.
11. Observe the flow of water through the holes.
12. Record your observation in your science journal.

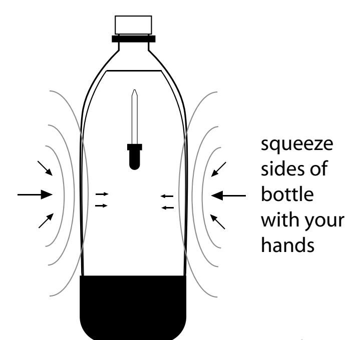


Conclusion

1. Which hole, top or bottom, squirted farthest? Why?
2. Was there a difference between the large and small carton? Why or why not?
3. Does volume affect water pressure? Depth? Why or why not?
4. How might increased water pressure affect deep-sea exploration? Aquatic life?

Extension

1. Repeat the activity but this time add a few more holes to the carton. Is there a difference in water flow through the holes? Record your observations in your science journal.
2. Repeat the activity with saltwater. Did it make a difference in the water flow through the holes? Why or why not?
3. Fill a 2-L soda bottle with water until it is almost completely full. Partially fill an eyedropper with water. Put the eyedropper in the bottle of water. If the dropper sinks, remove it and squeeze some of the water out. Once the dropper floats, close the bottle lid tightly. Squeeze the sides of the bottle with your hands. Observe the water level inside the dropper. What happens to the water level inside the dropper? Why does the water level change? What does this activity have to do with pressure?



Extension

Submersibles and Marshmallows

Segment 3

Purpose

To understand the difficulty of ocean exploration by human beings

To realize that pressure increases as water depth increases

To learn how density affects submersibles

Materials

1 plastic soda bottle
1 balloon
91 cm of rubber tubing
tape
rubber bands
scissors
1 nail
coins
large basin, sink, or inflatable pool
tap water
1 large marshmallow
1 glass bottle (with an opening large enough for the marshmallow to fit)
flexible straws
modeling clay
science journal
pen

Background

Water pressure in the ocean is one of the many factors that oceanographers encounter when exploring the ocean depths. The ocean is very deep in places. The average ocean depth is about 3,800 meters. The greatest ocean depth is over 11,000 meters. The pressure at any depth in the ocean is caused by the weight of the overlying water. The deeper you go in the ocean, the greater the pressure. Pressure is usually expressed in atmospheres. One atmosphere is equal to the weight of the Earth's atmosphere at sea level, or about 1.03 kilograms per square centimeter. So if you are at sea level, every square centimeter of your body surface is subjected to a force of 1.03 kilograms. The pressure increases about 1 atmosphere for every 10 meters of water depth. At 5,000 meters below the surface, the pressure would be approximately 500 atmospheres, or 500 times greater than the pressure at sea level.

Human beings cannot travel to the ocean depths unaided. We use a device called the Self-Contained Underwater Breathing Apparatus (scuba), to help us go to extreme depths. Even though technological advances keep making it possible to dive deeper, there are severe restrictions on the depth and length of time that divers can spend underwater. Aquatic research often requires diving to depths beyond 40 meters—depths that exceed the limits of conventional scuba equipment. However, divers can extend their bottom time by breathing nitrox, a mixture of oxygen-enriched air. Even when using nitrox, the weather, the gas supply in their tanks, and the risk of decompression sickness, commonly known as "the bends," still limit divers' capabilities and time spent underwater.

To go deeper, we must use other devices such as remotely operated vehicles (ROVs) and submersibles. These vehicles are designed to handle the enormous pressure of the ocean depths. These vehicles have reinforced walls to withstand the pressure. Some aquatic animals can live at deep ocean depths. Sperm whales can dive 2,250 meters deep. Scientists are studying deep dwelling animals to find out how they can withstand such great pressure.

Teacher Prep

Use the scissors to make 6 holes across the top of the bottle and 6 holes across the bottom. Use a nail to punch a hole in the bottle cap large enough for the tubing to fit through. Note: Tape flexible straws together and use as a substitute for the tubing. Stretch the balloon before attaching it to the tubing.

Procedure

Soda Bottle Sub

1. Attach a balloon to the end of the rubber tubing with the rubber band. See diagram 1.
2. Put the balloon in the plastic bottle.
3. Put the other end of the tubing through the bottle cap. See diagram 2 (p. 61).
4. Screw the bottle cap onto the bottle.
5. Attach a few rubber bands around the bottle.
6. Slide some coins underneath the rubber bands. See diagram 3 (p. 61). Now you have a soda bottle sub!
7. Fill the basin 1/2 full with water.

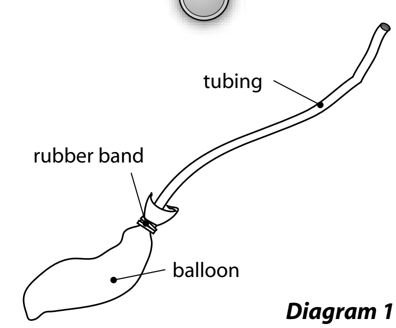


Diagram 1

Submersibles and Marshmallows

Segment 3

8. Place your sub in the water.
9. Blow into the tubing until the balloon inflates.
10. Hold your finger over the end of the tube to keep the air in the balloon.
11. Rearrange the coins around your sub so that the sub floats evenly.
12. Slowly take your finger off the tube and allow the air to escape.
13. Observe what happens to your sub.
14. Blow air back into the tube to fill the balloon again.
15. Observe what happens to your sub.
16. Record your observations in your science journal.

Pressure Marshmallows

17. Use a pen or marker to draw a face on one of the flat ends of your marshmallow.
18. Put the marshmallow into a glass bottle.
19. Wrap the modeling clay about 2.5 cm from the end of a straw. The clay should make a ring around the straw. See diagram 4.
20. Put the short end of the straw into the bottle. The clay should prevent the straw from dropping farther into the bottle.
21. Press the clay around the mouth of the bottle to completely seal it. No air should be able to get in or out.
22. Using the straw, suck air out of the bottle. Fix any leaks in the clay.
23. Have your partner observe what happens to the marshmallow as the air is removed.
24. Replace the used straw with a clean one and have your partner suck out the air while you observe.
25. Record your observations in your science journal.

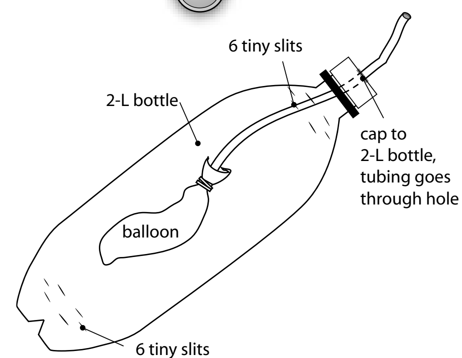


Diagram 2

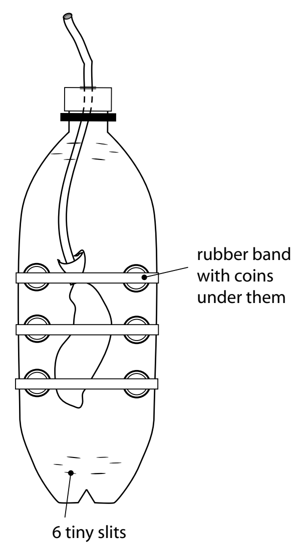


Diagram 3

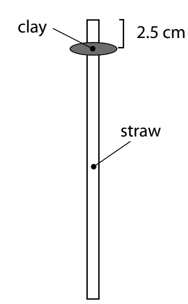


Diagram 4

Conclusion

1. What happened to the sub when you blew air into the balloon? Let air out?
2. Why did the sub submerge and resurface?
3. What does density have to do with the movement of the sub?
4. What happened to the marshmallow when the air was removed? When the air was returned?
5. Why did the marshmallow change shape?
6. What does the marshmallow activity tell you about ocean pressure?

Extension

1. Research to find out the various submersibles used for deep-sea exploration both in the present and in the past. Create a time line to show the technological advancements in deep-sea exploration.
2. Design your own ROV like Dr. D and test it in a tub of water.

Answer Key

Segment 3

Density Stackers

1. The liquids separated and did not mix because they had different densities.
2. The objects all rested in different location because their densities were different.
3. Different liquids have different densities and so do different objects. The denser items will sink under the less dense items.
4. Oil is less dense than water. During an oil spill, the oil will initially float on the surface. Oil slicks on the surface of the water are more easily seen and contained than denser oil that sinks to the bottom. However, wave action, stormy weather, and other factors can begin to break the oil slick apart, wash it onto beaches, and slowly cause oil to sink to the bottom.

Texas Tea, Black Gold

1. Answers will vary, but students should have found the grid useful because it helped them better organize their search for oil and keep track of previously drilled areas.
2. Answers will vary.
3. Answers will vary but might include global positioning systems (GPS), detailed ocean floor maps, and so on.

Building a Rig

1. Answers will vary.
2. The stationary rig sank and anchored itself to the bottom. The rig can no longer move freely. If oil is not at the anchored location, it will have to be moved again.
3. The glue bottles sank and brought the foam board down as well.
4. Answers will vary.

Seepy Seeps Seep Seepily

1. Answers will vary.
2. Answers will vary.
3. Oil would leak through the sides of the clay because there would be no seal to hold the oil under the clay.
4. Answers will vary.

Pressing Pressure

1. The bottom hole should have squirted the farthest because the greater the depth, the greater the pressure. The more pressure, the farther the water will go.
2. There should not have been a difference in the two containers because depth, not volume, affects water pressure.
3. No. Volume does not affect water pressure. Yes. Depth does affect water pressure. Pressure is a function of weight. It is the amount of weight pushing down on an object from above, not from the sides.
4. Increased water pressure means deep-sea explorations have to have equipment strong enough to withstand the pressure. Aquatic life at these depths must adapt to the high levels of pressure to survive.

Submersibles and Marshmallows

1. When air was blown into the balloon, the sub rose to the surface. When the air was let out, the sub sank.
2. The sub changed its density as it took in and released air and allowed the sub to submerge and to resurface.
3. When the sub was denser than the water, it sank. When the sub was less dense than water, it floated.
4. When the air was removed from the bottle, the marshmallow expanded. When the air was returned to the bottle, the marshmallow returned to its original shape.
5. The marshmallow changed shape because the pressure inside the bottle changed. When the air was removed, the pressure in the bottle decreased, causing the marshmallow to expand. The marshmallow shrank back to its original size when the air was returned because the pressure increased.
6. The deeper you go in the ocean, the more the pressure increases. With enough pressure, objects will collapse.

On the Web

The Heavy Weight

1. The blue saltwater sank and the freshwater floated at the top.
2. The saltwater was denser because it sank.
3. The denser body of water will sink underneath the less dense body of water.
4. Saltwater is denser than freshwater. Water with less density will float on top of denser water.