STEM CLUBS

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

How can we live smarter?

2 Cleaning our oceans

Objective

In this activity students will simulate a small-scale oil spill and investigate different methods of cleaning it up.

TOPIC LINKS

- Design and technology: exploring properties of materials
- Science: visualising chemicals in oil and observing the effect of dispersants

ESSENTIAL SKILLS SUPPORTED

Listening, presenting, problem solving

TIME

120 minutes

RESOURCES AND PREPARATION

Before the session set out the resources at different stations.

- materials for the booms:
  - nylon tights - 1 leg per team
  - paper towels
  - bendable straws
  - cardboard
  - cotton balls
  - feathers
  - wool - natural or knitting
  - foam wedge makeup sponges
- gratnells tray other large container (one per group)
- food colouring
- vegetable oil (200ml per group)
- 250ml beaker (one per group)
- glass stirring rod (one per group)
- water
- name-brand washing-up liquid
- notebook/paper
- glass bowl - (one per group)
- paper towels

DELIVERY

1. Explain that a lot of the energy we use in our daily lives comes from fossil fuels (oil, gas and coal), but the transport of fossil fuels has led to oil spills in our oceans. Oil spills are bad for marine environments, animals, and even humans.
2. Obviously it's vitally important that we remove oil from these marine environments. There are many different ways we can do this, and some measures are more effective than others.
3. Describe how booms are used to clean up oil. In Useful links below, there are two interesting videos about how booms can be made out of hair and nylon.
4. Tell students that they will use a model to simulate an oil spill and its clean-up.
5. Guide students as they work through the student guide.
6. After the practical, ask students the following comprehension questions:
   - was it hard to contain the oil to a small area in this experiment
   - which of the absorbent materials was able to absorb the oil the fastest? Rank them from worst to best and explain your reasoning.
   - you probably noticed that the oil and water don't mix. Did this make it easier or harder to remove it from the water
   - the food colouring in this experiment represented the chemicals that can be found in crude oil. Did anything happen with these chemicals in the oil during the experiment? What do you think this means

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NUMBER 1 FOR STEM

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DIFFERENTIATION IDEAS

Support: students simulate a small-scale oil spill and investigate the effectiveness of two different oil clean-up efforts.

Challenge:

- students can independently investigate how the amount of oil affects the clean-up strategy that works best. They can explore how doubling the oil spill affects the spread of the oil slick over the surface of the water. How does it affect the amount of time required to contain it

EXTENSION IDEAS

1. Add a dispersant (washing-up liquid) to break up the oil "slick" surface into little droplets and ask the students how effective this would be in a clean-up. Dispersants contain molecules with a hydrophilic end (the "head") and hydrophobic end (the "tail"). These molecules attach to the oil, reducing the interfacial tension between oil and water, breaking up the oil slick. See more information in the Useful links section.
2. This topic can be further extended by including the clean-up of wildlife (e.g. birds) by dipping a feather in the oil and cleaning it with water or cleaning it with the dispersant.

TIPS

- divide students into small groups of 3-6 students
- assign roles within each group before getting started. The roles are: observer, data collector, and oil remover. Two students can have the same role in each group
- this activity can be messy. Prepare enough paper towels and soap for clean-up
- all oil waste should be placed in refuse bins, only minimal oil remaining on surfaces/objects should be washed off with detergent and disposed of down the sink as it can separate out in the sewerage system. Ideally wipe most residue with paper towels and place in bin

HEALTH AND SAFETY:

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

USEFUL LINKS

- 10 impressive innovations for cleaning up oil spills developed since the Gulf disaster
  www.treehugger.com/slideshows/clean-technology/10-impressive-oil-spill-clean-technologies-developed-past-five-years/
- Nature: The science of dispersants
  www.nature.com/news/2010/100512/full/news.2010.237.html
- YouTube video: Making a boom using hair and nylon nets
  www.youtube.com/watch?v=aHuWyFVo62o
- YouTube video: Hair boom vs. conventional boom demo
  www.youtube.com/watch?v=W68L53WkIAw

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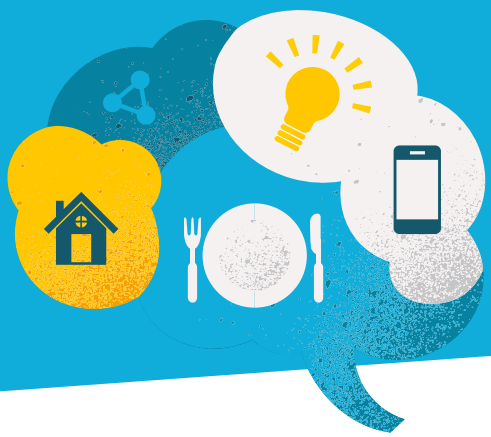

Your challenge

Oil spills are pretty nasty. They can harm the environment, animals and even people living nearby. It's therefore vital that we keep the seas clean! Floating objects called booms (like a floating sock) help us today, but what materials are best to use and are there even better methods we should be using in the future?

YOUR TASK **Simulate an oil spill and work out the most effective way to clean it all up again - what is the best material to be used as a boom?**

WHAT YOU NEED TO DO

1. Take the tights leg and carefully cut off the ankle and foot section. Cut four 10 cm lengths off the remaining tights leg. Tie a knot in one end of each segment.
2. Fill each segment of the tights with one of the absorbent materials to create a small sausage shape - try not to stretch the tights. Do this for each material until you have four booms with similar size, shape and density. Tie off the open ends.
3. Measure out 200ml of vegetable oil into the glass beaker. Add 10 drops of food colouring to make it easier to observe the oil. Mix with the stirring rod.
4. Half-fill the large container with cold water and pour 50ml of the oil mixture into the centre. Record your observations. Is there one big oil puddle or separate droplets? Does the oil spread out quickly? Does it sink or float? What happens if you gently blow on the surface?
5. **Phase 1**

   Place one of the booms in the oil and water. Move it around gently to soak up the spill. Squeeze out the boom into the bowl and place back in the water to remove the remaining oil. Work together to record all of your observations. How effective was the boom? How long did it take to remove 50%, 75% and 100% of the oil?

   Repeat the experiment with each of the booms recording your observations for comparison.
6. **Phase 2**

   What happens if you contain the oil in some way?

   a) Repeat the experiment with the booms but use straws or cardboard to form barriers to stop the oil from spreading. How effective is this method? Observe and compare your findings.

   b) Repeat the experiment but tie three of the booms together. Try containing the oil with the three connected booms and use the fourth to soak up the oil. How effective is this method? Observe and compare your findings.
7. Present your findings and compare results for each experiment with the other teams. Discuss how you could improve the booms to make them more effective and cost efficient.
8. **To clean up:**

   Throw away the booms in the bin along with any other materials contaminated by the oil. Use paper towels to absorb as much of the oil as possible and throw away. Mix the remaining water with washing up liquid and carefully pour down the sink. Thoroughly wash the equipment with hot soapy water to remove the oil residue.

FUN FACTS

1. After the Gulf of Mexico oil spill, a non-profit organisation called "Matter of Trust" used human and animal hair stuffed into nylon stockings as an absorbent to contain and soak up the oil. They obtained the hair from hairdressers and pet stores and sent hundreds of thousands of pounds of hair wrapped in recycled nylon stockings to help clean up the pollution.
2. Scientists have investigated other ways for us to effectively and quickly clean up oil from our oceans. DNA research in one particular investigation suggests that bacteria could be used to eat the oil, cleaning the water. By understanding how to support these natural occurring microbes, we may also be able to better manage the aftermath of oil spills.