EPSCoR Sunday Academy

Activity 1: Why Won't Water and Oil Mix?

Objective:

To have students observe the chemical and physical properties of oil.

Materials:

- Clear glass or plastic cup(s), half full of water
- Vegetable oil (cheapest you can find)
- Food coloring

Directions:

1. Pour enough oil in each glass to make a thin layer on top of the water.

https://bishbashboshed.files.wordpress.com/2014/08/oil-water.jpg

Oil is made up of different chemical bonds than water, which is why the two don't mix. (Water is polar, charged – like a magnet, and wants to bond with another charged particle, think a magnetic hanging onto a nail), oil is nonpolar (has no charge, when in water think magnet to a piece of paper – they do not bond. Oil not only can't bond to water – it doesn't like it and tries to get as far away from it as it can.)

Oil is also less dense than water so it floats on top. Density is the mass per volume. For example, if you put a cork in water, it floats because it is less dense; whereas if you put a rock in water, it sinks because it is more dense. Oil is less dense than water so it floats.

2. Add 1-5 drops of food coloring in the oil layer, keep the drops separate. Food coloring will bead and sit in the oil layer.

https://www.sciencekiddo.com/lava-lamp/

The food coloring only dissolves in water since it is water-based. When you drop the food coloring into the cup it beads and sits on the oil layer until gravity finally wins and it drops down to the water layer creating the exciting "bomb" effect. Food coloring dissolves in water (since it is water-based and polar as well), which leaves the oil sitting on top by itself.

3. Wait for a minute or two for the food coloring to drop from the oil layer to the water layer. Bombs away!

https://www.sciencekiddo.com/lava-lamp/

4. Watch as the color slowly disperses through the water. Molecules are always in motion, which you can see as the color mixes with the water without any outside stirring. Try stirring the mixture and notice what happens. No matter how much the mixture is stirred the oil will always form a layer on top while the colored water remains on the bottom. Sometimes it takes several minutes for the colors to drop into the water.

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Activity 2: Oil Simulation

Objective:

Students will simulate the three ways oil pollution occurs

1. Soil (seep, pipeline, truck tanker, et al)
2. Water (oil rig, tanker, seep)

Materials per Groups of 3-4:

For each group:

- 3 - 1 LITER Beakers (or bottom halves of 1 liter soda or water bottles)
- 2 cups of water
- 1.5 cups vegetable oil
- 3 tablespoons of Cocao powder (optional, use if you'd like your oil to be dark)
- ½ and 1 cup measuring cups
- 3 plastic snack bags
- 2 Rubber band
- 1 cup of dirt, sand, or tiny pebbles
- 2 sharp dowels (LIKE WOODEN KABOB STICKs (cheap at Walmart) OR SOMETHING SIMILAR)

Procedure:

Land Simulation:

1. Have students measure ½ cup of vegetable oil (mix with a tablespoon of cocao powder if you want it to look like realistic petroleum), pour in snack bag, push oil to one side, and tighten with rubber band to ensure it creates a tight air pocket of oil inside snack bag.
2. Place snack bag of oil at the bottom of the beaker. Place rocks, dirt or sand on top of and around the bag of oil leaving the corner of the bag visible (so that you can poke a hole in it later).
3. Poke a hole in the bag with the sharp dowel.
4. Observe the oil leak from the bottom of the beaker to the top.

Water Simulation (have 1/2 of the groups use instruction A, and the other half use instruction B.)

A.

1. Add ½ cup of oil (mix with a tablespoon of cocao powder if you want it to look like realistic petroleum), pour in snack bag, push oil to one side, and tighten with rubber band to ensure it creates a tight air pocket of oil inside snack bag.
2. Place snack bag of oil at the bottom of the beaker. Place rocks, dirt or sand on top of and around the bag of oil leaving the corner of the bag visible.
3. Add a full cup of water to the beaker.
4. Poke a hole in the bag with the sharp dowel.
5. Observe the oil leak from the bottom of the beaker to the top.
6. This simulates an oil rig leak or seep. Watch as the oil moves through the water to the top.

B.

1. Add one cup of water to the beaker.
2. Pour ½ cup of oil (mix with a tablespoon of cocao powder if you want it to look like realistic petroleum), directly into the water – this simulates a barge or tanker spill.

**Keep your water and oil from both simulations. They will be used in Activity 3.

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Activity 3: Booms, Skimmers, and Vacuums

Objective:

Students will simulate how effective it is to clean up an oil spill using booms, skimmers, and vacuums.

Materials per Group:

9x9 inch aluminum disposable pans
Bendable straws
Plastic spoon
Turkey baster or pipette/eyedropper
Oil and water from activity 2

Procedure:

1. Pour water into aluminum pan until it is about 1/2 full.
2. Gently pour your remaining oil and water into the pan from Activity 2.
3. Try to contain the oil spill with bendable straws.
4. Once the oil is contained try to skim oil off the surface of the water with the spoon. Place the oil into the liter beaker that was used in activity 2.
5. After you have skimmed most of the oil from the surface try to remove the remaining oil with a pipette/eyedropper.

**keep oil and activity set up for activity 4

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Activity 4: Absorbent Booms

Objective:
Students will simulate how effective it is to clean up an oil spill using absorbents.

Materials:
Aluminum pan filled with water and beaker with oil from activity 3
Cotton balls

Procedure:
1. Repeat steps one, two, and three from activity 3.
2. Once the oil is contained try to absorb the oil using cotton balls.

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Activity 5: Dispersant

Objective:
Students will simulate how effective it is to clean up an oil spill using dispersant. An oil dispersant is a mixture of emulsifiers and solvents that helps break oil into small droplets following an oil spill. Small droplets are easier to disperse throughout a water volume, and small droplets may be more readily biodegraded by microbes.

Materials:
Aluminum pan
Water
½ cup oil
Dawn dish soap

Procedure:

- Add water to aluminum pan
- Pour oil into the water (note the oil will stay on top of the water due to polarity – water is polar, tails of oil are non-polar and will not mix)
- Add detergent (an emulsion is created because in order to mix substances that don't normally mix, a bridge substance needs to be added; when oil (non-polar hydrocarbons) are mixed with a soap solution, the soap molecules work as a bridge between polar water molecules and non-polar oil molecules because soap molecules have both properties of non-polar and polar molecules the soap can act as an emulsifier.)

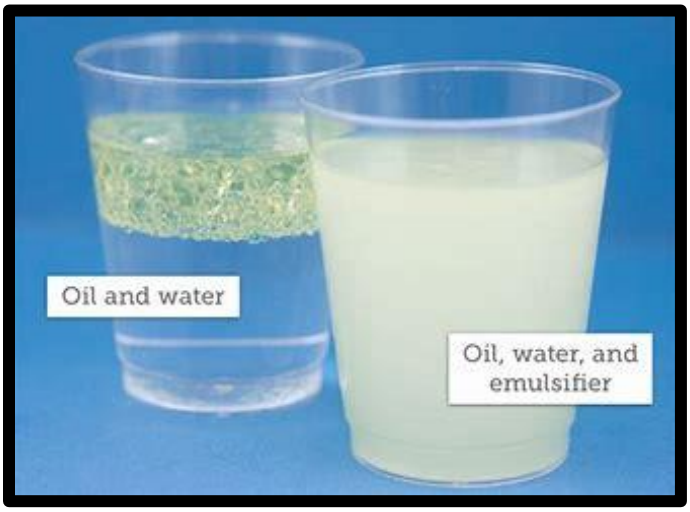

Image source: http://learn.genetics.utah.edu/content/metabolism/digestion/

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Activity 6: Bioremediation

Objective:

Students act as environmental engineers involved with the clean-up of a toxic spill. They will simulate how effective it is to clean up an oil spill using bioremediation as the process in which bacteria they will use to eat up the pollutant spilled. Luckily, there are organisms that can help "eat up" the oil and turn it into harmless substances.

In this experiment, students see how to use bacteria emulsify oil by using sugar to represent the oil, and yeast to represent the organisms that clean up oil by eating it. When yeast eats, it gives off carbon dioxide (CO_2), much like we do when we breathe out. To measure how well the yeast is eating (and therefore cleaning up the spill), we can measure the amount of carbon dioxide it gives off.

How do you think we could measure the carbon dioxide gas? How about a balloon! Let's put the balloon over the bottle of yeast. As the balloon gets blown up bigger and bigger, we can determine that the yeast is giving of lots of carbon dioxide. Therefore, we also know that the yeast is eating well and cleaning up the sugar spill. The bigger the balloon gets, the better the yeast is eating.

Materials:

Each group needs:

- 2-4 small test tubes or small plastic water bottles (small enough for a balloon to fit over the opening)
- 2-4 balloons
- 2-4 teaspoons of yeast
- 2-4 teaspoons of sugar
- Graduated cylinder (optional)
- 3 copies of the Yeast Experiment Worksheet

To share with the entire class:

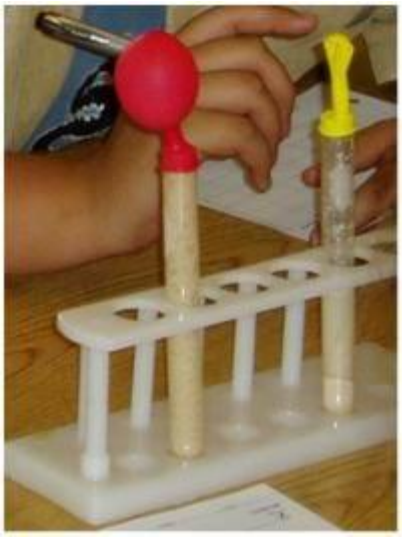
- Vinegar
- Water
- Hot plate or Bunsen burner
- Triple beam balance or digital scale (optional)

Procedure:

1. Have students break into groups of 3-4 (you can choose or let the students choose). As a group, students should plan an experiment that helps determine how to make the yeast thrive. Their Yeast Experiment Worksheet guides them through the process.

2. To complete the first page of their worksheet, it may help if you review the scientific method with students. Remind them that a testable question should ask how one variable (the independent variable) affects another (the dependent variable). Give some examples (see Yeast Experiment Worksheet–Answers for suggestions). Also, students may need to be reminded that scientific experiments require that we control our variables. Explain what the control is for this experiment (to make the yeast thrive).
3. Have students plan their experiment. Quickly check their answers on the first page of their worksheet before they begin their experiment.
4. When ready, allow students to start their experiment. The procedure section of the Yeast Experiment Worksheet guides them through the experimental steps. Students should know the exact amount of yeast, water and sugar that went into their control. (Note: it may be useful to have students measure out yeast, water and sugar using the appropriate measuring devices so that they know exact amounts.)


measures out yeast using some sort of balance or scale.



Troubleshooting Tips:

- Have students put the balloon half way on the bottle top, add the water and then put the balloon the rest of the way on the bottle top. If students have trouble getting the balloon on, get a smaller container.
- If carbon dioxide does not fill balloon, get a smaller balloon or use more yeast.
- Reaction times vary, encourage students to come back and check on their balloons if they do not see results within the class period.
- It may be useful to seal the balloon to the flask using duct tape or masking tape to prevent air from leaking.

Source:
https://www.teachengineering.org/activities/view/cub_lifescience_lesson04_activity1

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Activity 7: Discussion Q & A

After students have tested all of the materials—both before and after dispersants were added—ask:

- *Did any method completely remove the oil?*
- *What happened to the chemicals (dye)?*
- *Do you think all toxins or chemicals behave the same way? Why or why not?*

Have students compare their results for each material before and after the dispersants were added. Ask students to share some of the successes they experienced and some of the possible flaws that they see with these methods. Ask:

- *Based on your observations, how effective do you think the Gulf oil spill efforts (equipment types) have been?*
- *Did any of your observations change the way you view the cleanup strategies being used in the Gulf?*
- *Did any of your observations change the way you view the effects cleanup strategies may have on the water quality and wildlife of the Gulf?*

Have each student independently write a summary of their simulation results and their answers to the discussion questions above.

Sources:
https://www.nationalgeographic.org/activity/simulate-oil-spill-cleanup/
http://beam.ucla.edu/sites/default/files/docs/Oil_Spills_2.pdf