**OIL AND CLIMATE CHANGE TEACHER INSTRUCTIONS**

See lesson plan for all activity materials.

***Fish, Fossils, and Fuel Activity***

Adapted from[http://www.energy4me.org](http://www.energy4me.org/).

**Day 1**

1. Ask students:
	1. Do you have dinosaurs in your gas tank? Did you ever hear that oil and natural gas are fossil fuels?
	2. Do you think oil and natural gas can be made from old fossils? How long do you think it takes fossil fuel to form?
2. Split the students into groups of four. Assign each student a job from the list below.

 Recorder: the student who writes down the information from the experiment

 Reporter: the student who presents their group’s findings to the class

 Material Collector: the student who gathers and puts away the materials for the experiment

 Facilitator: the student who oversees the experiment and ensures their group stays on task.

1. Pass out student lab books with worksheets to each student. Have students read through the lab instructions once.
2. Teacher says: “We are going to learn what eventually happens to animals and plants when they die.”
3. Ask the students to perform step one and step two of the experiment.
4. Teacher says: “As the plants and animals lay lifeless wind and ocean currents deposit sediments on top of the dead marine life.” Explain the definition of sediments to the students.
5. Have them complete step three of the experiment.
6. Teacher asks: “As millions of years passed, what continued to cover the dead plants and animals?” *(More sediments deposited by wind and ocean currents).*
7. Ask students to complete step four of the experiment.
8. Teacher says: “Something is still missing to help our fish fossilize. What is it?” *(Pressure)* Students should now complete steps five, six and seven of the experiment.
9. Have students individually answer the Day 1 lab questions and fill out Day 1 observation chart.

**Day 2**

1. Explain to the students that during this experiment each day represents 1 million years. By the end of the experiment Day 3, 3 million years have passed.
2. Split the students into the same lab groups as Day 1; rotate jobs. Have the students retrieve their group’s bread fossil and complete Day 2 observation chart.

**Day 3**

1. Split the students into the same lab groups as Days 1 and 2; rotate jobs.
2. Have the students complete the Day 3 of their observation chart in workbooks.
3. Have the students complete steps 1 through 4 of student instructions.
4. Have students answer the Day 3 lab questions independently. Observe the students during this activity.
5. Have the reporter of each group stand up and present their findings.
6. At the end of the lab, lead a discussion with the students. Compare the colored residue of the gummy fishing the bread fossil to the remains of the plants and animals that seep into the rock. The residue left by the gummy fish represents oil deposits left behind by dead plants and animals. Over millions of years, these remains are pressurized to become oil and natural gas deposits. As we journey back in time, let’s think about how we can recreate the historical formation of fossils. What eventually happens to sea animals and plants when they die? (They fall to the ocean floor.) As the plants and animals lay lifeless, wind and currents deposit sediments on top of the dead. As these layers increase, the pressure also increases creating fossils and fossil fuels. What has changed about our “bread fossils?” What happened to the layers?

***Foraging in a Changing Arctic Activity***

Adapted from <http://www.polartrec.com>.

1. Prepare before activity:
* Measure out four different lines in a large space (gym or cafeteria) using tape or floor markings. The four lines are: Starting Line, Line 1 (about 20 feet), Line 2 (twice the distance from Line 1), Line 3 (three times the distance from Line 1).
* Place bins that represent summer sea ice upside down on Line 1 equal distances apart.
* Place the same amount of “fish” under each container.
* Place the containers representing nests beside the starting line.
* Prepare lab books with recording sheet and graph paper.
1. Show students the first picture of a guillemot in the slideshow (slide 1). Without telling them what the bird is, ask them what they notice (details of the bird: color, beak, etc.; any ideas about its environment).
2. Using their answers, talk about how black guillemots live.
	* They live on the ice in the Arctic Ocean and come to land to nest in the summer.
	* They nest in cavities on rocky shorelines. They typically lay two eggs, which are incubated for 28 days.
	* Chicks grow quickly and are ready to fledge in 5 weeks. For these five weeks, both parents care and provide for the chicks. They forage for food under the summer sea ice. They primarily feed their chicks Arctic cod.
	* As the coverage of summer sea ice is drastically declining, this is affecting how far parents have to travel to get food for their chicks. They are beginning to feed their young sculpin, which is a less desirable, lower-energy near-shore fish.
	* (More information about guillemot biology can be found with at <http://www.polartrec.com/resources/lesson/foraging-fish-in-a-melting-arctic>)
	* Use the pictures in the slideshow to show how guillemots live.
3. Show the video in the slideshow about George Vivoky’s work with guillemots on Cooper Island (slide 11). This talks more about the biology of guillemots and the decline in sea ice cover.
4. After the video have a brief discussion and recap about guillemots, emphasizing that they have to travel under the sea ice to find Arctic cod to feed their young. Talk about what the students like to eat and how far they have to go to find food. Compare this with the guillemots (questions on slide 12).
5. Move to a large space to play the game. Divide the students into groups, one group per bin for the guillemot game.
6. Explain the game:
	* Tell the students that they are black guillemots. The bins out on the floor are the summer sea ice.
	* Ask them what lives under the sea ice that is important to guillemots (Arctic cod). There are cod underneath the bins that students have to grab and bring back to your nest which is here at the starting line.
	* Groups have only one minute (can adjust for age/distance) to collect as many cod as they can.
	* Only one person from each group can go at a time, because the nest can’t be left vulnerable to predators and they can only grab one cod at a time, because guillemots can only carry one. This can either be done by giving each individual one minute to try and rotating through the group or by giving each group 4-5 minutes and having them rotate through group members like a relay.
7. Set the timer and make sure that students are only bringing one cod at time. After the time is up, have students record how many cod they got on their data sheet.
8. Have students take the cod they collected and put them back under the bin.
9. Ask students for their thoughts. “Do you think you collected enough cod to feed your chicks? What do you think will happen when we move the sea ice back?”
10. Move the bins representing sea ice back to the second line. Repeat the activity, followed by the questions.
11. Move the bins representing the sea ice back to the third line and repeat the activity and questions.
12. Collect materials and return to the classroom. Students can create a bar graph on their data sheet for the 3 trials.
13. Wrap-up questions:
14. What do you notice about the data? Is there a trend?
15. What happened as the sea ice moved farther and farther away from the nest?
16. In the Arctic Ocean, why is the sea ice moving farther away from the shore?
17. Why is it hard for a guillemot to get to the sea ice to find food for its young?
18. What can we do to keep the sea ice from shrinking?

***Design an Oil Field Activity***

1. Give each student (or group) the “Geobotanical Map” produced by ARCO.
2. Discuss what the different colors and symbols mean and how oil could influence them. (i.e., do you want to build your drill site right on a bird’s nest? What kind of ground would be best for your drill site?)
3. The goal of this activity is for the students to pick where they want to build their drill site. Remind them that the drill site should be located as close to the well location (marked on map) as possible. They are trying to base their plans on what’s best for the environment while being the most economic.
4. Have students draw the gravel pad where they want to place the drill site and then draw a line to the production facility. This line represents the pipeline and road used to transport the oil.
5. Have students discuss why they chose their site and road location.