

Hands-On Activity

Drilling for Oil

In this activity, students will demonstrate the following Inquiry Skills:

- Design Investigations
 - Make or use models that:
 - § Simulate a real thing that cannot easily be studied or manipulated.
- Gather Data
 - Use Tools and the SI (metric) system to accurately measure:
 - § Length/distance/depth
 - § Volume
 - Chooses appropriate tools to conduct an investigation:
 - § Ruler/tape Measure
 - Use senses to observe:
 - § Seeing (color, shape, size, texture, motion)
- Evaluate Evidence
 - Assessing the conclusion by:
 - § Extrapolating results beyond the investigation
- Analyze Scientific Results
 - Participate in critiquing/peer review by:
 - § Evaluating an investigative design

Materials:

- Ruler
- For each group:
 - One model oilfield
 - § A small box
 - § Four different colors of clay
 - A box of clear, plastic drinking straws
 - Cooking oil for lubricant
 - Paper towels
 - Ruler

Prior to class, you will need to create a clay “oilfield” for each group. To do this, you will need one small box per group and four different colors of clay. Three of the colors of clay represent rock layers; the fourth color represents a reservoir of oil. (Be sure to use the same color to represent the oil for each group, so that all groups know what they are looking for; the other three colors can differ from group to group if necessary.)

At the bottom of each box, build an uneven “rock” layer (high in some places, low in others) using the first color of clay. Somewhere along this layer, place a small disc of oil (the “lens”). (Before placing the

disc, measure and record its radius and height so that you can calculate its volume using the formula for volume of a cylinder: $V = \pi r^2 h$.) Cover the oil and the first layer with another uneven layer using a different color of clay. Cover this layer with a final layer, also uneven, using the final color of clay. The location or size of the oil lens should not relate in any way to the contours of the surface layer of rock—for example, students shouldn't be able to guess the location or size of the lens because the ground bulges up on top of it.

(Note: if you standardize the size of the “lens” and keep this constant for all models, you can reduce the time needed to prepare and run this activity. Also, keep the size of the box to a minimum to avoid having to use a lot of clay. A box used to contain four quarters of butter is a good size to use.)

Divide students into groups of four or five students. Give each group a model oilfield and a box of clear, plastic drinking straws, plus some paper towels and oil to use as lubricant for the straws, if necessary. Explain that each oilfield contains several layers of rock and a reservoir of oil, each made of a different color clay. (Identify the color of the oil at this time.) Students must develop and execute a plan to determine the location and volume of the oil deposit; the only materials they may use are the ruler and the straws, which they may lubricate using the oil and clean using the paper towels. Students may not use their fingers to dig away the clay—their goal is not to remove the oil from the rocks but simply to calculate its volume.

Before students begin, they should write their plan on a piece of paper and submit it to you for approval. A typical plan will consist of using the lubricated straws to “drill” through the clay in different places. When a straw is pulled out of the clay, students will be able to see the layers of differently colored clay inside the straw; if one of the layers they see includes the color for oil, they'll know they've located the reservoir. Measuring the height of the layer in the straw will give them one component of the volume formula. They will then drill using additional straws to determine the breadth of the reservoir at its widest point, giving them the second component of the volume formula.

When students think they have calculated the volume of the oil reservoir, check their answer; if they are wrong, give them an opportunity to check their work and re-calculate. Give groups about 20 minutes to work, then re-group to discuss their results. Have groups that successfully calculated the volume of their reservoirs explain their plans, and compare to those of the unsuccessful groups. Ask the unsuccessful groups how they could adjust their plans to make success more likely. Then ask students to brainstorm how this activity is likely similar to and different from the process used to drill for oil in the real world. What kinds of tools or information might make the real-world process more efficient?