Oil Viscosity Races

Grade Level: 6-12
Length: 45-60 Minutes
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NGSS Standards

MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Crosscutting Concepts

Patterns Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Related Resources

Worksheets Oil Viscosity Race

Overview

Viscosity is an important characteristic of petroleum products that determines their uses.

Objectives

- Students will measure the relative viscosity of different petroleum products and plant-based oils.
- Students will understand the concept of viscosity and how it affects the usefulness of petroleum products.

Materials

- ☐ Variety of Petroleum-based Oils (kerosene, mineral oil, motor oil, gasoline, diesel, crude oil, etc.)
- ☐ Variety of plant-based oils (corn, peanut, sesame, coconut, etc.)
- ☐ Glass Pipettes with Removable Rubber Tops OR Pipettes and Plastic Straws
- ☐ Worksheets: Oil Viscosity Race
- ☐ Pencils
- ☐ Petri Dishes or Other Small Containers
- ☐ Disposable Gloves
- ☐ Oil-Absorbent Pads
- ☐ Tape
- ☐ 2 ft x 2 ft Piece of Countertop, Laminate, or Other Non-porous Plastic or Glass
- ☐ Permanent Marker
- ☐ Stopwatches
- ☐ Bowl with Ice Water
- ☐ Bowl with Hot Water

Notes

Background

The viscosity of various petroleum products plays an important role in both the potential uses of that product and its behavior in the environment. Viscosity is defined as the property of resistance to flow in a fluid or semi-fluid; it is the "thickness" of a liquid, or the opposite of "runniness." Molasses has a higher viscosity than water. In lubricating oils, the oil must be just the right viscosity –thin enough to fit between metal parts and yet thick enough to adhere to the parts.

Preparation

This experiment should take place in a well-ventilated area. Crude oil and the petroleum products to be tested include many toxic and flammable chemicals. Use proper safety precautions at all times, and make sure students are wearing gloves. Be sure to reuse or dispose of oil products correctly at the end of experiment. Use a permanent marker to draw a line on the pipettes or plastic straws at a standardized volume.

Introducing the Lesson

Ask students to think about the various ways they use petroleum-based oils. Consider the different tasks these oils perform and how viscosity (or "thickness") determines their ability to do so.

Present students with the variety of oils and tell them that they are going to conduct an experiment to identify the least and most viscous petroleum-based oils and plant-based oils. Explain that petroleum-based oils are synthetic materials made from natural, nonrenewable resources. Caution students about safety procedures and pass out rubber gloves.

Activity

1. Begin by demonstrating a viscosity test on a vegetable-based oil. Submerge the tip of the pipette into the oil. Squeeze the rubber top and bring oil into the pipette until it reaches the calibration mark.
2. Have a student ready with the stopwatch. Hold the pipette upright over a petri dish, pull off the rubber top, and begin timing (if the liquid got sucked higher up into the pipette, wait until it reaches the bottom of the pipette before starting the timer). Stop timing

when the last of the liquid has exited the pipette. Faster draining liquids have lower viscosity.

3. Divide students into lab groups of 2-5 and have them test the viscosity of at least 3 vegetable-based oils and at least three petroleum-based oils. They should record their results on the worksheet. Have each group share their results.
4. Then, each group should choose one oil to enter into the race. The goal of the race is to get to the finish line last (into the petri dishes at the end of the countertop piece). They will achieve this by having the most viscous liquid.
5. Set the piece of countertop against the wall at about an 80-degree angle to be the race board. Place the petri dishes along the bottom to catch the oils. Have each group select their oil and fill their pipette. Then, tape the pipettes to the top of the race board and have an individual from each group remove the rubber topper at the same time. Let the (slow) race begin. Whichever oil reaches the petri dish last is the winner. Wipe off the race board with the oil adsorbent pad.

>>Educator Tip: If you want to focus on MS-PS1-4, pause here and ask students to draw a model that predicts and explains what will happen to particle motion and viscosity of the oil when the thermal energy is added or removed.

6. Float a container of the winning oil in the hot water and a container in the ice bath. Fill three pipettes, one with hot oil, one with cold oil, and one with room-temperature oil. Repeat the race with these three pipettes.

Wrap-up

Discuss how viscosity affects the usefulness of different oils, and also how viscosity affects the way oil behaves in the environment. Examine the results from the temperature tests and ask students why it is important to understand how viscosity is affected by temperature. Are any of these oils used at high or low temperatures? How would temperature affect the way oil behaves in the environment? Ask students to think about how oils with different viscosities affect the environment and society in different ways and respond to the final questions in their data sheet.

Assessment

Review student data sheets for completeness and for accuracy. Students who successfully meet the performance expectation will respond to questions in a way that shows they understand that synthetic oils impact society in both positive and negative ways, and that key characteristics of the oils (such as viscosity) influence those impacts.

Oil Viscosity Races Data Sheet

Test the viscosity of at least 3 vegetable-based oils and 3 petroleum-based oils. Submerge the tip of the pipette into the oil. Squeeze the rubber top and bring oil into the pipette until it reaches the calibration mark. Have a student ready with the stopwatch. Hold the pipette upright over a petri dish, pull off the rubber top, and begin timing (if the liquid got sucked higher up into the pipette, wait until it reaches the bottom of the pipette before starting the timer). Stop timing when the last of the liquid has exited the pipette. Record the time, in seconds, in the viscosity row for each type of oil.

	Vegetable-Based Oils			Petroleum-Based Oils		
Type of Oil						
Viscosity (seconds)						

Which oil has the highest viscosity (slowest to exit the pipette)?

What sorts of uses is this oil good for?

Which oil has the lowest viscosity (fastest to exit the pipette)?

What sorts of uses is this oil good for?

Which oil do you want to use in the viscosity races?