Hot & Cold Running Oil

Target Grade Levels
Sixth - Twelfth

Time
45 minutes

Materials
- sealed test tubes containing regular and synthetic oils
- thermometers
- cooler containing ice cubes
- warm water baths (buckets of warm water will be fine)
- stop watch or clock with second hand
- overhead of challenge question

Knowledge and Skills (TEKS)
- Science:
  - Conduct field and laboratory investigation;
  - Use scientific inquiry methods to plan and implement investigative procedures including asking questions, formulating testable hypotheses, collecting data, making measurements with precision, organize, analyze, predict trends, and communicate valid conclusions; and
  - Organizes and records new information in systematic ways.
- Language Arts:
  - Uses effective listening strategies to provide appropriate feedback in a variety of situations such as informal conversations; formal debates; class discussions; and informative, persuasive, or artistic presentations.

Overview
The purpose of this experiment is to discover how the viscosity of oil changes with temperature. This relationship plays a vital role in the efficient running of a car engine.

Background Information
A challenge for motor oils is maintaining protection during high temperature conditions. According to SmartSynthetics.com, without a quality motor oil protecting it, an engine can be damaged through motor oil breakdown, viscosity increase and deposits—all caused by excessive heat.

Procedure
1) Vocabulary
   a) viscosity
   b) synthetic oil
   c) non-synthetic oil
   d) W (as in 5W30)

2) Activities
   a) You will need to prepare a number of test tubes containing regular motor oil and a sample of synthetic oil, ahead of time. (Mobil 1 would be a good synthetic oil to use and is available at most auto and discount stores.) Longer test tubes are preferred over shorter ones. Students will time how long it takes the oil to run from one end of the tube to another. They will observe a greater time difference between the fast and slow flowing oil when using longer test tubes. A length of 15 centimeter (cm) works well. If you have longer tubes available, try them. If using shorter test tubes, experiment with the amount of oil added to each test tube to determine which volume works best with a small test tube. Three to five cm of oil placed in a corked 15 cm test tube works well.

b) The student challenge is to test how the viscosity, speed of "flow", for two different oils changes at different temperatures.

c) Students will design their own experiment to show how the viscosity of each oil is affected by different temperatures.

d) Warm water baths and cold water baths are available for you to use. Your big restriction is that you are not to unseal the test tubes containing the oil. With this in mind, get together with your partners to set up a plan that will allow you to determine the effect of temperature on oil viscosity.

e) Before beginning to collect data, write a few sentences describing how you will compare the viscosity of the two types of oil.

f) Place a heading in the first column of a data table on the next page. Use the table to record all of your findings.

g) Even though the oil is sealed test tubes, do not have any open flames in your classroom at while carrying out this experiment. In this experiment students will try to discover what it is about synthetic oil that makes it so much better than regular motor oil. A short synopsis of the student challenge is provided below.

h) You are to test how the viscosity for two different oils changes at different temperatures. Design your own experiment to show how the viscosity of each oil is affected by different temperatures. Warm water baths and cold water baths are available for you to use. Your big restriction is that you are not to unseal the test tubes containing the oil. With this in mind, get together with your partners to set up a plan that will allow you to determine the affect of temperature on oil flow-ability.

i) You may be surprised at the different ideas students use in determining oil viscosity. Some students will likely suggest marking the side of the test tube by centimeters. Students could tip the cooled or warmed test tube and time how long it takes for a certain number of centimeters to flow from one end to the other. There is no one correct way to do this. Encourage creativity, allowing time after the data has been collected to discuss how the data was gathered.

3) Review
Discuss results with students, reviewing the topics they will have to know for the evaluation.

4) Evaluation

a) Questions:

i) Which type of motor oil flowed faster under warm conditions?

ii) Which type of motor oil flowed faster under cold conditions?

iii) Much of the wear and tear on a car engine occurs during the first few minutes after the car is started. When all of the moving parts of the engine are well oiled, they run smoothly and efficiently. But in order to reach all the moving parts, the oil must move throughout the engine's moving parts when the engine is started. If it gets too thick, it won't get to the moving parts right away. Using these ideas, explain whether one of the oils tested would be better for your car in winter months than the other.

Be sure to use your data about the flow-ability of the oils at different temperatures in answering this question.

b) Sample Answers to Questions:

i) The synthetic motor oil should flow the fastest under warm conditions, although the oils are fairly similar at warm temperatures. Many students will likely get similar results for both the oils under warm conditions.

ii) The synthetic oil will also flow the fastest under cold conditions.

iii) Students should come to the conclusion that the synthetic oil would be best for your car in winter months. This is true because the synthetic oils remain pretty runny at cold temperatures. This means that it can still circulate in your engine to those parts in need of lubrication. If the oil was thick, it would be slower in reaching all parts of your engine.

5) Extension

a) Find out what the weight numbers mean on oil labels. Design an experiment to discover the relationship between oil weight and viscosity.

b) Why are frequent oil changes important? Have students do research to answer their question in relation to viscosity.

c) Find out what kind of oil is used in your family vehicle. Ask one of your parents o show you how to check the oil.

d) Find out where in your community, oil is recycled. Where does your oil go when you have it changed at a local garage? Can synthetic oil be recycled?

e) Invite a local mechanic to class to discuss some of the ideas covered in this activity. Perhaps one of the parents of a student in class would be able to present information of oil from a mechanics perspective.

Adapted from: "Hop on the Bus, Gus!" *Department of Earth Science at the University of Northern Iowa.* www.earth.uni.edu/EECP/mid/mod3_sc.html.