The Importance of Motor Oil Viscosity in Optimal Car Functioning

Background
In this series of activities, you will learn how the structure of motor oil determines its function. You will look for patterns in the data. Finally, you will evaluate your data and determine which type of oil might be best for the functioning of your car.

Assignment 1
Watch the video and answer these questions in class discussion:
- What does oil have to do with speed?
- What does the speaker mean when he says the oil is designed so the racers can run faster, hotter, harder?

Assignment 2
1. Observe the different oils your teacher has placed in test tubes. Discuss in groups:
   - How are they similar and different?
   - Why might a car need one oil type and not another?
   - Why might race cars have different oil needs than a normal passenger car?
2. How is oil used in cars? What physical properties of oil are important for its use? Use the table below for guidance as you research on the internet and share with your classmates. Here are some useful websites to start with:
   - Motor Oil Bible
   - Where the oil goes
   - Easy to understand background on motor oil and purpose

<table>
<thead>
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<th>Location of oil in car</th>
<th>Purpose of oil</th>
<th>Physical properties of oil that are important for the purposes listed</th>
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3. Testing oil for viscosity
   As you found in your research, the viscosity of motor oil is important to lubricate the moving parts of the car and reduce the wear on them. Thicker or more viscous oils are good lubricators, but may be too thick to operate in the small spaces between moving parts in the engine. Thinner oils can move more easily, but are less lubricating. Today you will devise a plan to determine the relative viscosities of the oils provided by your teacher. In your plan, include the following:
   - Title of study:
   - Materials needed:
   - Proposed method:
   - Disposal and safety plan: (make sure your teacher approves these plans before
Post Lab Questions
a) Compare your rankings to the known viscosity ratings of the oils (your teacher will provide this for you).
b) How close were you? How do you explain if your data does not agree with the actual viscosity ratings?
c) How does your group data compare to the class data? Explain any differences.
d) What sources of error occurred in your test (be sure to include errors of accuracy and precision as well as bias).
e) Tell why knowing the viscosity of oil is important to the functioning of your car.
f) You put 50W oil in your car to make sure it stays lubricated. However, you find that your car won’t start. What might account for this?

4. Testing an Unknown
Your teacher found an unlabeled sample of oil in the chemical storage room and would like you to determine what it is. Perform a viscosity test and write a conclusion.

Conclusion:
- What is the type of oil you tested?
- What evidence (use your data) supports your claim?
- Now check with your teacher. Were you accurate? If not, explain what might account for this.

Assignment 3
Now you will explain how the molecular structure of an oil sample determines its viscosity.
1. How do intermolecular forces affect: Viscosity? Freezing point? Boiling point?
2. Oil is made from chains of carbon. Some are longer than others. What type of bond is between carbon and hydrogen in long chains?
3. How might more H-bonds affect viscosity? Melting point? Boiling point?
4. How does the length of the hydrocarbon chain affect these same physical properties?
5. What is the relationship between the structure of motor oil and its viscosity?
6. What pattern exists between carbon chain length and viscosity?
7. When oil is used for a while, it breaks down. Hypothesize: How does this affect viscosity? What might happen to your car if you don’t get new oil?
8. Hypothesize: How would the seasonal temperature changes affect the performance and wear on your car?

Assignment 4
As an engine runs, the materials and fluids inside of it get warm. Heat is generated from combustion of fuel and friction. In fact, an engine can get very hot. How might this affect the functioning of the engine? To answer this, you will devise a plan to determine how temperature affects viscosity. You already have the oil viscosity at room temperature from your first test. You are not allowed to directly heat oil with any flame. You may use a hot water bath and an ice/salt bath to change the oil temperature. Be sure to record the temperatures!
Include the following in your study:
- Title of study: (What is the effect of ____________ on ___________?)
- Hypothesis:
- Materials needed:
- Proposed method:
- Disposal and safety plan: Do not proceed until your teacher has approved the plans.
- Data table:
- Graph:
- Conclusions: write a complete sentence about each of the following:
  1. Was your hypothesis supported or not?
  2. What data indicates this?
  3. What might explain your observations? Hint: Use what you know about the behavior of matter at various temperatures.
  4. How does your data compare with class data? Why are there differences between groups?
  5. List sources of error that occurred in this experiment.
  6. Compare your data to the SAE rating on the oil container. Does the oil you used change viscosity within the temperature range you tested?
  7. Tell why the temperature of motor oil is important to the functioning of a car and why your data is important.
  8. Why would a race car driver need 10W-40 rather than 10W-20 oil?

**Assignment 5**
Write a paragraph that indicates which of the oils that you tested would be best suited for your car (family car) and which would not be suitable. Take into consideration the seasonal temperatures in your area, the age of the car, and the speed at which you normally drive (i.e. engine temperature while driving). In your paragraph, defend your claims with data from your viscosity test and the temperature tests and be sure to use quantitative data. Explain how oil works by relating intermolecular forces and hydrogen bonding to its function.