

# Lubricants, Viscosity and Machines

**Grade Level: 4-8**

## Lesson Overview

Have you heard the phrase "well-oiled machine?" For machines to work effectively, they must run smoothly with no glitches. Many machines, including cars, trucks, tractors, and combines, require lubricants to prevent wear and tear. A lubricant's weight, or thickness, tells us the viscosity when tested at a specific temperature. Students will utilize the scientific method as they test the viscosity of household liquids at various temperatures.

## Student Objectives

1. Define friction and explain its effects.
2. Define viscosity and explore what affects it.

## Materials

- ✓ 5 - graduated cylinders (other clear containers, bottles, or jars may be used; tall graduated cylinders will use less fluid)
- ✓ 5 - marbles of the same size and weight that are smaller than the diameter of the graduated cylinder or container being used
- ✓ 5 - different types of somewhat translucent fluids as must be able to see the marble inside; recommend using water, corn syrup, and vegetable oil (other suggestions: honey, molasses, liquid soap, shampoo, motor oil.)
- ✓ Viscosity and Types of Fluids worksheet
- ✓ 5 - cups or containers to pour liquids into to reset activity
- ✓ stopwatch or timing device for each group
- ✓ paper towels
- ✓ calculators (1 or 2 per group)
- ✓ plastic funnels (optional)

Additional materials for temperature activity:

- ✓ hot water (hot water from a faucet is okay)
- ✓ cold water
- ✓ ice cubes
- ✓ container large enough for graduated cylinders or containers bottles to fit in for heating and chilling
- ✓ Viscosity and Temperature worksheet

## Vocabulary

- **force** - strength or energy put forth.

- **friction** - the rubbing of one thing against another; the force that resists motion between bodies in contact.
- **lubricant** - something capable of reducing friction when applied between moving parts.
- **polymer** - natural or man-made material formed by combining units, called monomers, into long chains. The word polymer means many parts.
- **viscosity** - measure of a fluid's resistance to flow.

## Background Information

See Lubricants, Viscosity and Machines Information Sheet

## Procedure

The Lubricants, Viscosity and Machines Information Sheet included with this lesson may be used as a teacher and/or student resource.

### Types of Fluids Activity

In this activity, students will be comparing the viscosity of different types of fluids. We recommend using water, corn syrup, vegetable oil, and two other fluids. Choose somewhat translucent fluids as you must be able to see the marble inside. Other suggestions include honey, molasses, liquid soap, shampoo, motor oil. You may have the class discuss and decide on the types of fluids to test. One type of fluid, graduated cylinder, marble, and stopwatch or other timing device should be placed at each station.

1. Divide students into five groups. Groups will rotate around to each of the five types of fluids to conduct the experiments.
2. Distribute copies of Viscosity and Types of Fluids worksheet to all students to complete. The worksheet will lead them through the activity using the scientific method.
3. Review the worksheet with the students prior to beginning the experiment, including calculating averages and graphing if necessary.
4. Between each trial, students will need to reset the activity by removing the marble. An additional cup or container could be used to pour the fluid into temporarily to remove the marble. Clean the marble off. Pour the fluid back into the graduated cylinder. Some additional fluid may need to be added to keep the beginning levels consistent.
5. After the activity, please dispose of the used fluids responsibly.

Note: If the marble falls too quickly through the fluid to obtain accurate timing, try using a taller graduated cylinder or a lighter marble.

### Temperature Activity

In this activity, students will examine the effect of temperature on the viscosity of vegetable oil. Students may not see large differences. More extreme temperatures would have better results such as in real life – cold winters and hot summers. For even better results or less preparation time in class, you may want to warm and cool fluids in advance.

1. Divide students into five groups.
2. Distribute copies of Viscosity and Temperature worksheet to all students to complete. The worksheet will lead them through the activity using the scientific method.
3. Review the worksheet with the students prior to beginning the experiment, including calculating averages and graphing if necessary.
4. After the activity, please dispose of the used fluids responsibly.

Teacher's note: Students should discover that the time it took the marble to sink in the room temperature oil was greater than the time it took the marble to sink in the warm oil and less than the time it took to sink in cold oil. From the data, one can see that cold oil has a higher viscosity than warm oil and room temperature oil. We can then infer that the viscosity of oil increases as the temperature decreases.

### Additional Resources

- <https://grade2cl.schoolsites.ca/learning-for-fun/discovering-gods-world-through-science/science-lesson-3-viscosity> viscosity videos

## Standards

### ***Illinois Science Standard***

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

### ***Illinois English Language Arts Standard***

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

The **M**ultidisciplinary **A**gricultural **I**ntegrated **C**urriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in September 2021.



These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

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## **Lubricants, Viscosity and Machines Information Sheet**

When machines work, friction is created. Friction is the force that resists motion between two objects in contact or the rubbing of one object against another. Sometimes friction is undesirable when it comes to machines for it can make them work less efficiently. It may cause parts to wear out more quickly. Friction can also reduce the power of a machine or create heat which can cause damage or failure.

Lubricants are used to address some of these problems. A lubricant is something capable of reducing friction, heat, and wear when applied between moving parts. Types of lubricants include oil, grease, hydraulic fluid, graphite, water, etc. Lubricants often help increase the efficiency of the machine while keeping machines running smoothly. Some lubricants are made from agricultural sources such as cattle by-products or plant oils, while other lubricants are made from petroleum products.

Viscosity is the measure of a fluid's resistance to flow. For example, water has a low viscosity for it is thin and flows easily. However, honey has a high viscosity because it is thick and gooey. Lubricants often have a viscosity grade to tell you its' thickness. For instance, a thin oil has a low number and flows more easily, while thick oils have a higher number and are more resistant to flow. Multi-weight oils contain polymers added to oils which prevent them from thinning while it increases in temperature. The polymer allows the oil to have different weight values at different temperatures. The first number indicates the viscosity of the oil at a cold temperature, while the second number indicates the viscosity at operating temperature. A 20W-50 oil is a 20-weight oil that will not thin more than a 50-weight oil at high temperatures. At cold temperatures, the polymers are coiled up and allow the oil to flow as their low numbers indicate. As the oil warms up, the polymers start to unwind into long chains that prevent the oil from thinning as much as it normally would.

Name \_\_\_\_\_

## Viscosity and Types of Fluids Worksheet

1. Hypothesis:

2. Procedure:

- a. Your group will be rotating around the room to each of the five stations to conduct the experiment.
- b. Drop a marble from the top of the graduated cylinder filled with the first fluid and use the stopwatch or timing device to measure the time it takes for the marble to sink to the bottom of the cylinder. Record the time under trial 1 in the data table.
- c. Pour the fluid into a cup temporarily to remove the marble. Clean the marble off. Pour the fluid back into the graduated cylinder. Some additional fluid may need to be added to keep the beginning levels consistent.
- d. Repeat steps b & c four more times for a total of five trials. Record each trials time.
- e. Calculate the average time it took the marble to sink and record your answer in the table. (average = total time of trials 1-5 / 5)
- f. Repeat steps b-e for each of the fluids being tested.

3. Results/Data Table:

Trial	Water	Corn Syrup	Vegetable Oil		
1					
2					
3					
4					
5					
Average Time					

Please use the back of the paper to design a bar graph of the average times for the fluids.

4. Conclusion:

Extra Credit - Use the information sheet or individual research to answer the following:  
What types of fluids are used in agricultural machines?

## Viscosity and Temperature Worksheet

1. Hypothesis:

2. Procedure:

- a. Get a stopwatch or timing device, a graduated cylinder of room temperature vegetable oil, a cup, and a marble.
- b. Drop a marble from the top of the graduated cylinder filled with the first fluid and use the stopwatch or timing device to measure the time it takes for the marble to sink to the bottom of the cylinder. Record the time under trial 1 in the data table.
- c. Pour the fluid into a cup temporarily to remove the marble. Clean the marble off. Pour the fluid back into the graduated cylinder. Some additional fluid may need to be added to keep the beginning levels consistent.
- d. Repeat steps b & c four more times for a total of five trials. Record each trials time.
- e. Take the graduated cylinder to your teacher for warming. Using your stopwatch, have one group member time the warming of your cylinder for 15 minutes.
- f. While the cylinder is warming, calculate the average time for all 5 trials. (average = total time of trials 1-5 / 5)
- g. Repeat steps b-d with the warmed oil. (Work quickly to minimize the amount the oil cools.)
- h. Take the cylinder to your teacher for cooling. Using your stopwatch, have one group member time the cooling of your bottle for 15 minutes.
- i. During cooling, repeat step f.
- j. Repeat steps b-d with the cooled oil. (Work quickly to minimize the amount the oil warms.)
- k. Return the cylinder to your teacher and begin calculating the average for the cooled oil trials.

3. Results/Data Table:

Trial	Room Temperature Oil	Warm Oil	Cold Oil
1			
2			
3			
4			
5			
Average Time			

Please use the back of the paper to design a bar graph of the average times for the fluids.

4. Conclusion:

Extra Credit - Use the information sheet or individual research to answer the following:  
What, if anything, has to be done differently with agricultural machines because of temperature changes?