Module: **Material Structure**
Focus: ***Allotropes of Sulfur***
Duration: 43 minute period

Objectives:

1. Students will be able to illustrate that a material's performance is connected to its structure.
2. Students will be able to distinguish between crystalline and amorphous structure.
3. Students will be able to define the term "allotrope."
4. Students will be able to compare and contrast the 3 allotropes of sulfur.

Materials:

Vegetable Oil	Safety Goggles
Powdered Sulfur	Bunsen Burner
Filter Paper	Test Tube
Cold Distilled Water	Test Tube Holder
3 Beakers (50,100,250 mL)	Microscope
Dropper	Microscope Slides
Graduated Cylinder	Spatula (Spoon)
Funnel	Ring Stand
Ring Stand Clamp	Stirring Rod
Wire Gauze	

Procedures:

1. Introduce and illustrate the term "allotrope."
2. Teacher will perform a demonstration lab on the allotropes of sulfur.

Assignment:

1. Complete lab write up.

Assessment:

1. Laboratory Experiments**,** Classroom Participation, Quizzes & Test.

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Teacher Notes:

This teacher demonstration lab should be done in a fume hood.

After a brief introduction to the term "allotrope", fill a test tube 1/3 full of powdered sulfur. Make sure that you keep the sulfur off the sides of the test tube. Set up your filter so that it rests in the 100 mL beaker. Heat the test tube very slowly, passing it back and forth above the flame until the powder is totally melted. Pour the liquid sulfur into the filter. As soon as a crust develops on the surface of the sulfur, open up the filter paper to its original shape. Have students observe with the microscope the crystals formed. They should see monoclinic sulfur, which appears as small needle shaped crystals.

Into the 50-mL beaker, pour a small amount of vegetable oil (~0.5 cm). Add a small quantity (pea size) of sulfur to the oil. Set up the rind stand, clamp and wire gauze heating assembly. Heat the mixture over a low flame for a few seconds. Using a dropper, place a few drops onto a microscope slide. Have students observe with the microscope the crystals formed. They should see orthorhombic sulfur, which appears as large blocky crystals.

Fill a test tube 1/3 full of powdered sulfur. Make sure that you keep the sulfur off the sides of the test tube. Nearly fill the 250 mL beaker with cold distilled water. Heat the test tube slowly. It should melt to a yellow liquid, change to a red liquid, turn to a dark reddish-brown syrup and then finally change to a dark runny liquid. Under the fume hood, quickly pour the hot sulfur into the beaker of water. Leave under the fume hood over night. Have students observe the sulfur under a microscope. They should see no crystals; a non-crystalline form of sulfur was formed.

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