Mystery Light Block

Scientific Method Demonstration

Introduction

A rectangular block of paraffin is exposed to a source of light, creating a discrepant event. Students make observations, ask questions, make predictions, propose experiments and develop a hypothesis about the paraffin block.

Concepts

- Scientific method
- Making observations
- Discrepant events

Materials (for each demonstration)

Aluminum foil, 4½″ × 2¼″	Hot plate
Paraffin blocks, 4 oz, 2	Pan, non-stick
Flashlight	Scissors

Safety Precautions

Exercise caution when using a hot plate and melted wax. Do not heat the pan at a high setting. Remove the pan from the hot plate immediately after use. Wear chemical splash goggles and heat-resistant gloves whenever working with heat in the laboratory. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines. Please review current Safety Data Sheets for additional safety, handling and disposal information.

Preparation

1. Cut a piece of aluminum foil slightly smaller than the paraffin block. An easy method is to firmly press one paraffin block flat onto the aluminum foil to leave an impression. Cut the foil just inside the borders of the wax impression.
2. Place the aluminum foil on top of one paraffin block.
3. Place a second block on top of the foil, making sure the foil is not visible between the two paraffin blocks (see Figure 1). Trim the piece of foil if necessary. This is the "Mystery Light Block."
4. Place the pan on a hot plate and turn the hot plate on low heat.

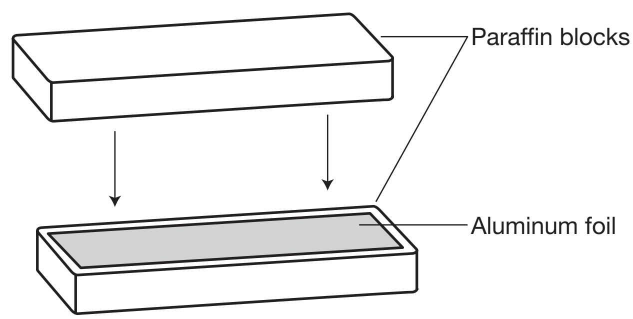

Figure 1.

5. Wearing heat-resistant gloves, hold the two paraffin blocks together with all sides aligned.
6. Place the Mystery Light Block on one edge (seam side down) on the bottom of the pan until the paraffin just starts to melt. Lightly press the block down and move it back and forth to ensure uniform melting.
7. Lift the Mystery Light Block away from the heat and rotate the block one quarter turn to heat seal another edge. Repeat step 6.
8. Continue to repeat steps 6 and 7 until all four edges are sealed and smooth.
9. Turn off the hot plate and remove the pan and the Mystery Light Block from the heat. Allow to cool.

Procedure

1. Without introduction and with the classroom lights on, hold the Mystery Light Block horizontally so the two layers are visible to the students. Do not identify the composition of the block.
2. With the classroom lights on, the top layer should look white and the bottom layer gray (see Figure 2).

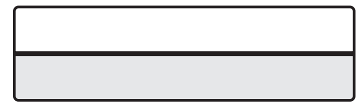

Figure 2.

3. Ask students to make observations. Help them differentiate between valid observations and assumptions. For example, "It's made of wax," is an assumption, but "It looks waxy," is a valid observation.
4. Once students have completed their observations, ask them to predict what would happen if you flipped the block over so the top layer is now on the bottom and vice versa.
5. Flip the block over. Students may be surprised to see that the white layer is still the top layer. Ask students to suggest experiments that could be conducted to investigate the appearance of the block and explain the apparent discrepancy. Emphasize that nothing may be done that would damage or destroy the block.
6. If students do not suggest using a light source, show them a flashlight and ask what tests could be done using the flashlight.
7. Follow students' suggestions using the flashlight and paraffin block. Make sure students are specific about the tests they would like to try—where and how to shine the light and how to hold the block. With each new display, have students describe the results.
8. Following the experimentation, ask students to make a hypothesis about the composition of the block. If they hesitate, help them understand that a hypothesis simply needs to be a reasonable explanation for their observations. The hypothesis may or may not be correct.
9. Conclude by explaining to the students that they have just used the scientific method. They made observations, suggested experiments, made more observations, and developed a hypothesis.
10. If desired, the next day show the students how the block was made using the remaining two paraffin blocks and another piece of aluminum foil. Do not heat seal the paraffin blocks, however.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The materials used in this activity may be stored for future use or thrown away in the regular trash.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
- MS-PS1 Matter and Its Interactions
  - PS1.A: Structure and Properties of Matter
- MS-PS4 Waves and Their Applications in Technologies for Information Transfer
  - PS4.B: Electromagnetic Radiation

Disciplinary Core Ideas: High School
- HS-PS1 Matter and Its Interactions
  - PS1.A: Structure and Properties of Matter
- HS-PS4 Waves and Their Applications in Technologies for Information Transfer
  - PS4.B: Electromagnetic Radiation

Science and Engineering Practices
- Asking questions and defining problems
- Developing and using models
- Constructing explanations and designing solutions
- Engaging in argument from evidence

Crosscutting Concepts
- Patterns
- Cause and effect
- Energy and matter

Tips

- This is a good activity for early in the school year to model the scientific method—including understanding the difference between careful observations and assumptions, experimentation and data collecting, and the importance of making a reasonable hypothesis based on observations. The demonstration may also be used as an introduction to reflection of light.
- This activity may also be done as a student inquiry lab. To supply eight student groups each with a Mystery Light Block, make "miniature" blocks by scoring across the center of each rectangular paraffin block with a sharp knife. Use a table edge to break the block in half, making two 2¼″-square blocks. Score and break these blocks again to make four 2¼″ × 1⅛″ rectangles from each original paraffin block. Follow the *Preparation* procedure to complete the Mystery Light Blocks. Students make observations and collect data in teams. Emphasize that they may not damage the Mystery Light Blocks in any way; otherwise, they may try to scratch the blocks or break them apart.
- A video of this demonstration, *Paraffin Paradox*, presented by Steve Long, is available for viewing as part of the Flinn Scientific "Best Practices for Teaching Chemistry" Videos. Please visit the Flinn Website at http://www.flinnsci.com for viewing information. The activity is found with the *Scientific Method* videos.

Discussion

Discrepant event demonstrations engage students' natural curiosity using the element of surprise. As students observe, predict, propose experiments, and make hypotheses, real learning takes place. The scientific method is sometimes presented to students as a rigid sequence of events. The scientific method, however, is not rigid, it is a process—a process of discovery! Discovery begins when observations are made and then students try to understand what they have observed by asking key questions and proposing possible answers. The process of discovery continues as experiments are designed and conducted to test whether proposed answers to these questions are valid.

When the Mystery Light Block is flipped over, students observe that the difference in "color" of the two layers is not due to a physical difference of the layers. When light enters one layer of the block, the sheet of aluminum foil reflects the light back into that layer, scattering the light and sending more light out the sides of the block. At the same time the foil barrier prevents much of the light from entering the bottom layer. Thus one layer appears white and the other gray.

Sample Questions and Answers *(Student answers will vary.)*

1. Predict what will happen if the block is flipped over 180 degrees.

   The white layer will be on the bottom and the gray layer will be on top.
2. Record any additional observations of the block after it was flipped over.

   The top layer is still white and the bottom gray.
3. Suggest an experiment that could be done to explain your observations, without damaging the block in any way.

   Some possible suggestions are shake the block; vary the orientation of the block; shine a light at different angles onto the block; place the block in water, etc.
4. Record any new observations as experiments are conducted.

   When a light shines on one broad side of the block, that side appears white and the opposite side appears dark, no matter how the block is oriented. When a light shines on an edge, directly at the interface between the two layers, the color (brightness) of each layer is (nearly) the same. Note to teacher: In the first scenario described above, the contrast in brightness is more dramatic if the classroom lights are turned off. In the second scenario, the brightness of the two layers will be more uniform if light other than the flashlight is eliminated.
5. Write a hypothesis to explain your observations of the block.

   Accept all reasonable explanations.

Materials for *Mystery Light Block—Scientific Method Demonstration* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP7341	Mystery Light Block —Scientific Method Demo Kit
AP6767	Student Flashlight
AP7234	Hot Plate, Flinn, 7″ × 7″

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.