

## Inspector Bright

### Lesson Abstract

**Summary:** Optical brighteners are present in laundry detergents to make clothes “whiter” after washing. Optical brighteners exhibit fluorescence under a black light. The presence of optical brighteners in surface water or groundwater is a qualitative indicator of contamination from sewage. (This activity was created by Tom Aley of Ozark Underground Laboratory, Protem Missouri.)

**GLE:** SC7.1.A.6, 7.1.B.6, 7.1.C.6, 7.1.D.6, 7.1.E.6,

**Subject Areas:** Science, Mathematics

**Show-Me Standards:** Goals – 1.2, 1.3, 3.1, 3.4, 3.5, 4.7  
Strands – SC 5, 7, 8; MA 1

**Skills:** Measuring, making comparisons

**Duration:** 2 class periods (50 minutes), one week apart

**Setting:** Field and classroom

**Key Vocabulary:** Optical brighteners, black light

### Rationale:

- Everyone uses cleaning materials to wash clothes. Advertisements emphasize whiter and brighter are cleaner.
- Students will determine basic contamination of water by household cleaning agents.
- Discovery of optical brighteners can signal a need to monitor for fecal coliform, phosphates, and nitrates in a stream or other water sources.
- Being able to test for contaminants helps determine the safety of surface and ground water.

### Student relevance:

- Students will identify if household cleaning agents are getting into streams or springs.
- By studying the effects of household cleaning agents, students have a better understanding of one source of nonpoint water pollution.

## **Learning Objectives:**

Upon completion, students will be able to . . .

- Students will write a hypothesis, summary of the experiment and conclusions derived from the experiment.
- Identify water contaminated by household cleaning agents.
- Determine how individual households impact water quality.
- Understand how product selection for household use can have an effect on the environment.

## **Students Need to Know:**

- Water is an integrated part of life.
- How to conduct an experiment using the scientific methods. (Scientific Inquiry)
- Wastewater must go somewhere.
- Wastewater from a home is a nonpoint pollutant if not properly handled.

## **Teachers Need to Know:**

- All laundry detergents have optical brighteners that range from one to five percent.
- Most laundry waters are discharged to septic fields, lagoons, and sanitary sewers.
- When optical brighteners are found in streams, they are an indicator of sewage contamination.
- Other indicators of sewage contamination are high levels of fecal coliform and phosphates.

## **Resources:**

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## **Materials Needed for Lesson:**

White cotton balls (test that cotton balls do not have brighteners by soaking in distilled water and checking under a black light)

Assortment of laundry detergents (students can bring from home)

Distilled water

Black light

Containers

Plastic coated wire

Nylon screen mesh

Plastic sandwich bags

Thread and needle or stapler

Hole punch

## Procedure:

- **Introduction to lesson:**
  - (1) Discuss laundry detergent ads with students. Ask what the ads emphasize. As a homework assignment, ask students to pay attention to such ads for the next week and write down how many times bright is mentioned.
  - (2) Ask students to bring a small sample of the laundry detergent they use at home.
  - (3) Mix an equal amount of each type of detergent with tap water in individual containers labeled with the name of each soap. Soak a cotton ball in each cup for a day.
  - (4) Place cotton balls under the black light, then rank each for level of brighteners.
  - (5) Discuss where laundry water goes after leaving the washer.
  - (6) Explain to students that they will make a bug detector device to determine if laundry water with optical brighteners is entering nearby streams.
- **Making the detector bug device:**
  - (1) Fold screen material into the shape of a small envelope.
  - (2) Place four cotton balls (that have been tested and found to not contain optical brighteners) into screen envelope and sew or staple closed.
  - (3) Hole punch at the top and bottom of the bug detector device.
- **Placing the bug detector device in water:**
  - (1) Thread a foot of wire through the bottom hole and attach a rock or weight.
  - (2) Secure a piece of wire to an overhanging tree limb, deck, etc. and attach to top hole of the device. Position so the device is below the surface of the water and in as much current as possible.
  - (3) Leave the device in the water for a week.
- **Recovery and storage:**
  - (1) Recover the device after one week and put it in a new and clean ziplock bag to transport it to the place where it will be washed.
  - (2) Wash the device in strong jets of water such as a garden hose sprayer. Sprayers on household sinks do not have enough pressure to get the samplers clean.
  - (3) You may store the cotton at this point by placing washed cotton in plastic bags and storing in refrigerator for no more than one month.
- **Preparation:**
  - (1) Prepare a control negative sample by soaking a cotton ball in distilled water.
  - (2) Expose washed cotton and control cotton ball to black light for comparison.
- **Interpreting results:**
  - (1) If the washed cotton sample is entirely brighter compared to the control – there is strong contamination in the water.
  - (2) If washed sample is not brilliantly white yet whiter than the control – there is moderate contamination.
  - (3) If less than 75 percent of the washed sample is white – there is weak contamination.
  - (4) No detection of brightness compared to the control sample – there is no detectable contamination.
  - (5) Have students write a hypothesis, summary of the experiment and conclusions derived from the experiment.

## **Evaluation Strategies:**

- Have students write a letter to local city council members expressing need and reasons for proper wastewater treatment. Also discuss purpose of protective ordinances.

## **Extension Activities:**

- Repeat this activity in various places and plot results on a watershed map.
- Write a newspaper article about the study.
- Have students bring in fabrics, articles of clothing, gauze, etc., and test each under a black light to determine use of optical brighteners.

## Suggested Scoring Guide:

### Inspector Bright

Teacher Name: \_\_\_\_\_

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Experimental Hypothesis</b>	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated, but appears to be based on flawed logic.	No hypothesis has been stated.
<b>Experimental Design</b>	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
<b>Safety</b>	Lab is carried out with full attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual.	Lab is generally carried out with attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but one safety procedure needs to be reviewed.	Lab is carried out with some attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but several safety procedures need to be reviewed.	Safety procedures were ignored and/or some aspect of the experiment posed a threat to the safety of the student or others.
<b>Analysis</b>	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends, or predictions are made based on the data.	The relationship between the variables is not discussed.
<b>Conclusion</b>	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.

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