Mystic Sand

Introduction

You've never seen sand like this! Mystic Sand, with its hydrophobic coating, forms fun underwater sand cakes, towers, and "intestine-like" designs—and then, when removed from the water, it is found to be completely dry!

Concepts

- Polar vs. non-polar properties of water
- Hydrophobic effect

Materials

Mystic Sand
White beach sand
Tap water
Vegetable Oil
Beakers, 250-mL, 2
Large bowl or beaker
Paper, 3″ × 3″ pieces, 2, or funnel
Spoons, 2
Paper towels or newspapers
Microscope and slides (optional)

Safety Precautions

Although Mystic Sand and white beach sand are considered non-hazardous, they may be irritating to body tissues and eyes. Do not ingest or get into the eyes. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

Activity #1—Making a Sand Diver

1. Obtain two beakers and label them A and B.
2. Fill two 250-mL beakers with approximately 200 mL of tap water.
3. Gently sprinkle a small amount of white beach sand on top of the water in Beaker A.
4. Gently sprinkle a small amount of mystic sand on top of the water in Beaker B. *Note:* Notice the white sand sinks while the mystic sand floats.
5. Now sprinkle more mystic sand on top of the mystic sand already in Beaker B. Watch the sand plummet to the bottom of the beaker.
6. Notice the intestine like structures that form. This is an illustrative model of the hydrophobic effect.
7. Pour the water out of both Beakers A and B. Notice the white sand clumps together.
8. Pour the Mystic Sand onto a paper towel. Notice sand is dry.

Activity #2—Looking at the Sand Grains

1. Fill a large bowl or beaker with tap water.
2. Place a small amount of white beach sand into one spoon and a small amount of Mystic Sand in the other spoon.
3. Lower both spoons into the water. Notice that the individual grains of white sand are clearly visible while the Mystic Sand appears to be surrounded by a silvery layer that looks like plastic film.
4. Lift the spoons out of the water. Notice the white sand is wet and appears to be clumped together while Mystic Sand is not clumped together and appears to be dry.

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Activity #3—Making "Mystic" Sand Cakes

1. Make a tube out a small dry piece of paper (approximately 3″ × 3″) to be used as a funnel.
2. Use the paper (glass or plastic funnel may also be used) to pour a small mound of Mystic Sand into an empty bowl or beaker.
3. Gently pour water from a beaker down the side of the bowl until the level is just below the top of the sand mound.
4. Use the funnel to add another layer of Mystic Sand on top of the first. Repeat step three.
5. Steps 3 and 4 may be repeated as many times as desired.

Activity #4—Making a "Mystic" Sand Tower

1. Wet a small piece of paper, approximately 3″ × 3″ and roll it into a tube.
2. Place the paper tube vertically in an empty bowl or beaker.
3. Pour Mystic Sand into a paper tube, using a funnel if available.
4. While still holding the tube, carefully pour water into the bowl or beaker until it almost reaches the top of the tube.
5. Remove the paper tube by un-wrapping the paper slightly and then lifting it out of the bowl.
6. Observe your mystic sand tower.

Activity #5—Erasing the "Magic" Effect of Mystic Sand

1. Fill a 250-mL beaker approximately half full with vegetable oil.
2. Sprinkle some magic sand into the beaker. Notice the magic effect disappears and the Mystic Sand behaves in the vegetable oil much like the white beach sand does in water.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Mystic Sand may be used over and over again. Pour off as much water as possible and pour the Mystic Sand onto some paper towels or newspapers. When dry, return the Mystic Sand to its container. If disposal of Mystic Sand is desired, dispose of it, as well as the white beach sand, in the solid waste disposal according to Flinn Suggested Disposal Method #26a.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Discussion

Ordinary beach sand consists mostly of mineral quartz broken down into tiny pieces. The chemical name for sand is silicon dioxide (SiO_2), or silica. In silica, silicon and oxygen atoms are covalently bonded in a three-dimensional network made of billions of atoms. The silica network contains two oxygen atoms for every silicon atom with the surface of the sand containing mostly the oxygen atoms. These oxygen atoms form polar covalent bonds with hydrogen atoms, and thus are able to form hydrogen bonds with water. For this reason, water is attracted to the sand, and sand grains are said to be *hydrophilic* or "water-loving."

When a few grains of Mystic Sand are sprinkled on water, the repulsion of the polar water molecules to the non-polar sand causes the water to hydrogen bond and attract even more to other polar water molecules ("like dissolves like"). This causes a high surface tension on the water which prevents the grains of Mystic Sand from breaking through its surface. Once the layer of Mystic Sand becomes rather thick, the magic sand finally sinks, yet the same surface tension effect keeps it dry, causing it to appear surrounded by a silvery-looking layer like plastic film. The air between the grains of Mystic Sand cannot be forced out because the water molecules do not flow between the grains of "hydrophobic" Mystic Sand. However, the non-polar vegetable oil readily flows between the sand grains; thus, Mystic Sand does not exhibit its "magic" effect in non-polar vegetable oil or non-polar solvents.

Acknowledgments

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References

Robson, D. P. "Magic Sand," *Chem Matters,* April 1994, 8–9.

Mystic Sand is available from Flinn Scientific, Inc.

Catalog No.	Description
AP4304	Mystic Sand, 200 g

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