

Student Worksheet or Guide

Exploring the Properties of Magic Sand

In this activity you will explore how the properties of a substance at the molecular level affect the way that it reacts and behaves. You will use a product called Magic Sand to determine how it interacts with oil and water and why this reaction occurs.

Background

What is nanotechnology? Nanotechnology is the science and technology of very small things. It is an exciting area of science and engineering that occurs at the **atomic and molecular level**. This interdisciplinary field occurs at the 1-100 nanometer range. One nanometer is 10^{-9} meters or about 3 atoms long. For comparison, a human hair is about 60-80,000 nanometers wide.

There are many different views of precisely what is included in nanotechnology. In general, however, most researchers agree that three things are important:

1. Small size, measured in 100s of nanometers or less
2. Unique properties because of the small size
3. Control the structure and composition on the nanometer scale in order to control the properties.

Scientists have discovered that materials at small dimensions, i.e., at the nanoscale, can **have significantly different properties** than the same materials at larger scale. Researchers are developing and engineering devices so small they are measured on a molecular scale. Nanotechnology has great potential for improving devices, structures, and materials if we can understand these nanoscale differences and learn how to control the assembly of small structures.

This emerging field is truly interdisciplinary and involves scientists from many different disciplines, including physics, chemistry, biology, engineering, material science, and information technology. Nanotechnology is being applied to a wide variety of fields, including electronics, optics, information technology, materials, homeland security, and medicine

Materials

- One copy *Nano Science Surface Properties Lab* sheet (below)
- Three 60 ml Petri dishes per lab sheet or any other shallow clear dish
- Small bottles (30-60 ml) of regular sand and Magic Sand
- One 250 ml beaker with water.

- One 30-60 ml dropper bottle with surfactant
- One stirring rod
- Filter paper, funnel, and residue beaker

Procedure

- Place each of the Petri dishes on the circles of the lab sheet.
- Fill your beaker with water and pour some water in each of the Petri dishes.
- Open your bottle of regular sand and sprinkle a small amount into the first dish labeled regular sand and water. Observe what happens and note this on your worksheet. Add additional regular sand if you want. Did the results change?
- Open your bottle of Magic Sand and sprinkle a small amount into the second dish labeled Magic Sand and water. Observe what happens and note this on your worksheet.
- Add some additional Magic Sand into the second dish and using a stirring rod press down on the surface of the sand. You may also mix the sand and water with the rod. Observe what happens and note this on your worksheet.
- Take the bottle labeled “surfactant” and add a several drops to the third dish labeled Magic Sand, water and surfactant. Now sprinkle a small amount of Magic Sand. Observe what happens and note this on your worksheet.

Cleanup:

- Decant the first Petri dish (regular sand) into filtration set up in your classroom. Remove the filter paper with the sand and let it dry before returning it to the bottle. Your teacher will direct you to where these will be placed for drying.
- Decant the second Petri dish (Magic Sand) into the filtration set up in your classroom. Remove the filter paper and pour the Magic Sand back into its bottle.
- Pour the third Petri dish (with surfactant) into the classrooms waste container as indicated by your teacher. **Do not** mix the Magic Sand in this dish with the bottle of Magic Sand.

Discovering the Properties of Magic Sand Worksheet

1. What do you know about regular sand such as beach sand?
2. What is hydrophilic? Can you provide an example?
3. What is hydrophobic? Can you provide an example?

4. What causes a substance to be either hydrophilic or hydrophobic?
5. What occurred when you sprinkled regular sand into the first dish of water? Why do you think this occurred?
6. What occurred when you sprinkled Magic Sand into the second dish of water? Why do you think this occurred?
7. What occurred when you sprinkled Magic Sand into the third dish of water with the surfactant? Why do you think this occurred?
8. Can the properties of a surface be changed? What is your evidence?
9. Can you predict what Magic Sand was originally developed for? What was its possible commercial use besides being a fun “toy-like” substance?
10. What is the relationship of Magic Sand to nanotechnology?