Nano Sand
Instructor Notes

In this activity, students compare and contrast the properties of regular sand with a special hydrophobic sand often sold under the name Magic Sand. The messiness of the sand and water is controlled by using plastic spoons that have the sand attached using spray adhesive. Drops of water are placed in the bowls of the spoons. The regular sand absorbs the drops, while the Magic Sand repels the water, forming small spheres that roll around in the spoon.

Explanation
The Exploring Products—Nano Sand handout (see References) describes Magic Sand:

   Magic Sand is special sand that’s been chemically treated to repel water. This hydrophobic, or “water-fearing”, sand is coated with a silicon compound that makes it repel water. The layer is only one nanometer thick, so the coated sand looks and feels like regular sand—but it behaves very differently.

   Hydrophobic sand was invented to clean up oil spills in water. When the coated sand is poured on a spill, it bonds to the oil (but not the water) and sinks to the bottom, where it can be dredged and treated. Currently, though, hydrophobic sand is too costly to use this way.

   Hydrophobic sand has also been used to protect utilities in cold climates. Electrical junction boxes can be covered with a layer of coated sand, then capped with a few inches of soil. The hydrophobic sand can be dug through even when the ground is frozen, making repairs easier.

For additional background material, see the ChemMatters article: Robson, D. P. Magic Sand. ChemMatters, April 1994 pp 8–9.

Tips
To prepare the spoons, first coat the bowl of the spoon with a spray adhesive. Then over an empty container, sprinkle either regular sand or Magic Sand to fully cover the bowl of the spoon. Excess sand can be shaken off into the container for reuse. The prepared spoons can be reused many times or sent home with students.

Magic Sand can sometimes be purchased in local stores in the toy section. It is sometimes called Space Sand, Astro Sand, Mystic Sand, or Aqua Sand. It can also be ordered online from science suppliers such as Educational Innovations.
(http://www.teachersource.com; use the promo code ACSNCW through the end of October 2012 for 10% off all items in your order) and Steve Spangler Science (http://www.stevespanglerscience.com). At the time this handout was written, the Educational Innovations website said that Magic Sand was out of stock, but would be available in mid-October.

Extensions

This activity can be linked with a discussion of intermolecular forces and what makes a molecule polar/non-polar.

The situation described in question #3, adding drops of cooking oil to Magic Sand, could be demonstrated to students rather than adding a hands-on portion, since the Magic Sand cannot be reused with water afterward.

Magic Sand that fluoresces under a blacklight could be used as a third type of sand.

The leaves of certain plants, such as lotus flowers and nasturtiums, are able to shed water, which is called the lotus effect. The surface of the leaves have waxy, nanometer-sized bumps that keep water and dirt from sticking to them. Students could compare how water behaves when dropped onto leaves of iceberg lettuce leaves (not hydrophobic) and hydrophobic leaves such as mustard greens, leafy kale, broccoli, and Chinese cabbage.

A past ChemMatters article discussed Magic Sand and challenged students to think of new applications for the sand (Robson, D. P. Magic Sand. ChemMatters, April 1994 pp 8–9). A follow-up article described the winning entries, such as use in golf course sand traps and as a base under asphalt roads (Black, H. Magic Sand Winners. ChemMatters, February 1995, pp 14–15).

Club members should consider submitting a blog post and/or photos about this activity to the ACS ChemClub office for possible publication online. Material can be emailed to HSChemClubs@acs.org. Photo releases must be submitted with all pictures. The release form is available at http://www.acs.org/chemclub, under the Advisors link.

Suggested Answers

1. Compare and contrast what happens with the two types of sand when:
   a. the sand is dry
   b. water is added
   c. the water is poured off
a. When the sand is dry, the two sands are both granular, but the special sand will likely be a vivid color rather than the typical brown/black/tan colors of regular sand, since the special sand is usually marketed as a toy.

b. When water is added, the drops soak into the regular sand, but form small balls and roll around in the bowl of the spoon containing the special sand.

c. The water is not able to be poured off the bowl of the spoon with regular sand, but can be poured off the special sand.

2. One sand can be labeled as *hydrophobic*, the other as *hydrophilic*. Which is which? Explain.

*Hydrophobic* means “water-hating”; the special sand repels the water and is hydrophobic. *Hydrophilic* means “water-loving”; the regular sand absorbs the water and is hydrophilic.

3. What do you think would happen if drops of cooking oil were placed on the special sand instead of water? Why?

*Cooking oil is hydrophobic.* Drops of oil placed on the special sand would be absorbed in much the same way that regular sand absorbed drops of water.

4. What would be a benefit of applying a coating of the same nanomaterial that is on the special sand to a pair of pants?

*A coating like this could keep water and other liquids from soaking into the fabric of the pants, which could help it to remain dry and possibly repel certain stains.*

References

Exploring Products—Nano Sand.

Exploring Products—Nano Fabric.

Teacher’s Preparatory Guide. Lesson #1—Polarity and Solubility of Molecules.
http://pubs.acs.org/doi/abs/10.1021/ed077p40A

(all URLs were accessed September 2012)