

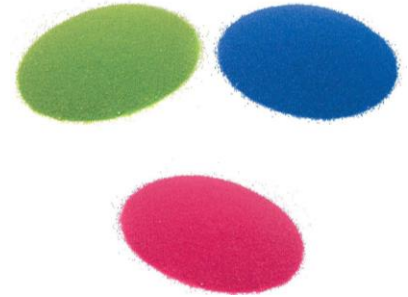
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Fluorescent Magic Sand

MS-2BLU, MS-2PNK, MS-3GRN

Introduction

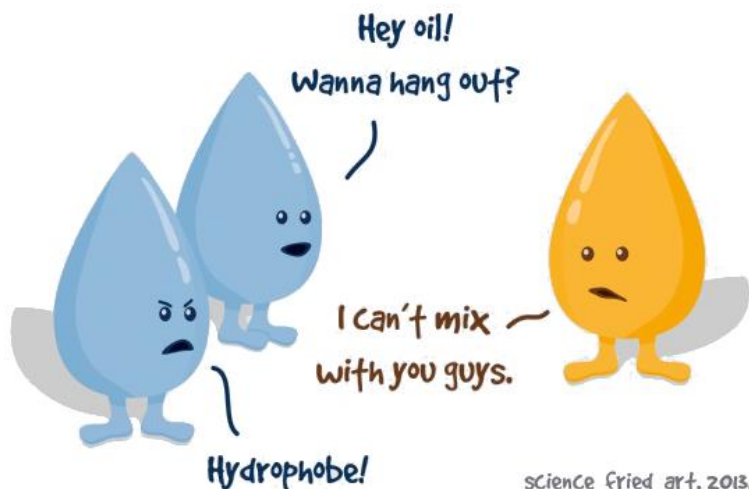
Despite its name, Magic Sand is not magic. In reality, it's normal sand that has been covered in a special coating with a tongue-twisting name: trimethylhydroxysilane or $(\text{CH}_3)_3\text{SiOH}$. This protective coating is hydrophobic, or "water fearing." Like oil and water, Magic Sand and water do not mix—at all. This gives Magic Sand some interesting properties that you and your students can explore.



Hydrophobic vs. Hydrophilic

The first step is to explain to students the meanings of the terms *hydrophobic* (water fearing) and *hydrophilic* (water loving). A simple demonstration will help. Add some food coloring to water in a clear soda bottle. Then have one of your students add a small amount of oil to the water—even a few drops will do. Seal the cap on the bottle and shake. What happens? The oil and water simply will not mix.

The question for your students is *Why does this happen?* The answer is that oil is hydrophobic. The molecules of oil will bond much more readily with each other than with the water molecules. As a result, the two substances do not mix.



NGSS Correlations

Our Fluorescent Magic Sand and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

5-PS1-3

Students can use the Magic Sand to make observations and measurements to identify materials based on their properties.

5-PS1-4

Students can conduct an investigation to determine whether the mixing of two substances (Magic Sand and water) results in a new substance.

Middle School

MS-PS1-1

Using the Magic Sand students can develop models to describe the atomic composition of simple molecules and their structures or properties.

High School

HS-PS2-6

Students will observe and communicate scientific information about why the molecular-level structure is important in the functioning of a material. Emphasis is on the repulsive forces and the hydrophobic nature of the Magic Sand.

Suggested Science Idea(s)

DCI/HS-PS2.B

Investigations using the Magic Sand will demonstrate the attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

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Magic Sand

Classroom Demonstrations

Presenting Magic Sand in Class

Once your students have understood the terms hydrophobic and hydrophilic, introduce them to Magic Sand by pouring a small mound onto a plate or piece of paper. Invite students to touch the dry sand. (If possible, have a small pile of “normal” sand available for comparison.) Ask them if they think the sand will be hydrophilic or hydrophobic.

Next, quickly pour the sand from the plate into a clear container filled with water. The hydrophobic nature of the Magic Sand allows it to retain its shape under water.



Using a stirring rod or even your finger, you can mold the sand into different shapes. Notice the silver sheen on the surface of the sand. Challenge students to explain what causes this. The reflection or refraction of light might enter into the discussion.

Another interesting demonstration of Magic Sand’s properties is to gently tap some sand on the top surface of a glass of water. If done gently, the water’s surface tension will cause the Magic Sand to float on top of the water. Once a thick, even coat of sand is floating on top of the water, you can try two experiments:

1.

First, gently press your finger down on the sand, until your finger appears beneath the surface of the water. This is especially impressive in a glass with clear sides. Remove your finger, and it should still be perfectly dry. (If you press too deeply or quickly, the Magic Sand may clump and sink to the bottom.)

2.

The second experiment also requires a floating layer of sand—once an even layer is achieved, use a pipet to gently drop water on top of the sand. Your students will be amazed to see the water bead on top of the sand! Adding enough water will eventually cause the layer of sand to break and sink.

More Magic Sand Classroom Demonstrations

Play Catch with Water!

Take two plastic spoons and cover them first in rubber cement, then in Magic Sand. This creates a hydrophobic surface that can be used to toss a drop of water back and forth! Younger students will love watching and learning about hydrophobic surfaces this way.

How to Destroy Your Sand

Magic Sand can lose its hydrophobic properties if the special coating on the sand is removed or damaged. This can be done one of two ways. Oil will readily mix with Magic Sand, and this can cause your sand to become “wet.” You will not be able to reuse the sand if it is mixed with oil. Also, common soaps such as dishwashing detergent will remove the sand’s hydrophobic coating, causing it to become ordinary, hydrophilic sand. While this can make for an interesting demonstration, please remember that the process is irreversible.

Storing Your Sand

When you’re done with your sand, simply pour as much water as you can from the glass and then add a small piece of paper towel to the sand. Gently shake the container with the sand. Remove the wet towel and return the sand to a container for storage. It’s perfectly dry! Magic Sand can be used over and over again.

Ready to Explore?

What uses can you and your students come up with for Magic Sand? Underwater sandcastles? Waterproofing sandboxes? The possibilities are endless!

The History of Magic Sand



Magic Sand was originally developed for use in the cleanup of oil spills.

Photo credit: NOAA
<http://response.restoration.noaa.gov/about/media/birds-eye-view-looking-oil-spills-sky.html>

Magic Sand was originally created as a way to mop up ocean oil spills. The idea was to spread the sand on top of the oil floating on the water’s surface. The sand would absorb oil and sink to the bottom of the ocean, where it could be dredged and removed at a later time.

Another use for the sand involves protecting underground pipes in cold environments like the Arctic. In these climates it is difficult reach damaged underground utility boxes in winter. Covering these boxes with Magic Sand ensured that the sand (and the utility box) would not freeze and become damaged by rain water.

For an excellent lesson on Magic Sand’s properties and real-life uses, please see National Nanotechnology Infrastructure Network’s lesson:

www.nnin.org/education-training/k-12-teachers/nanotechnology-curriculum-materials/exploring-properties-magic-sand

Materials:

- ✓ clear glass beakers (250 or 400 ml)
- ✓ water (tap water is fine)
- ✓ stirring rods
- ✓ coffee filters
- ✓ plastic funnels
- ✓ pipettes or droppers
- ✓ a small beaker of colored water that students can share (use food coloring)
- ✓ Optional: a display beaker containing “regular” sand

In-Class Lab Directions:

1. Pour your Magic Sand into a dry beaker. What shape does it form? Is it bumpy or flat? Rough or smooth? In the space below, describe what the surface of the sand looks like. How is this different from normal sand? (If you have access to some “regular” sand, you may want to refer to it.) Use the back of this page if you need more space.

2. Pour water into the second beaker until it is approximately half full. Quickly pour the Magic Sand from your first beaker into the water. (Note: dump the sand in all at once, not slowly.) What shape(s) does the Magic Sand form? What does the surface of the sand look like underwater? Is it shiny or dull? If possible, compare to “regular” sand.

3. With your finger, try to press the Magic Sand into different shapes against the side of the beaker. Describe what happens in the space below.

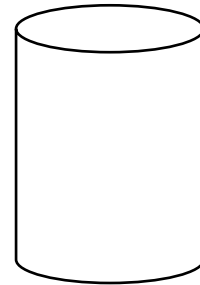
4. Using a stirring rod, mix together the Magic Sand and water. What happens? How is this different from stirring up regular sand in water?

5. Before proceeding to the next step, you must separate the Magic Sand from the water. Carefully pour the contents of your beaker through a coffee filter placed in a funnel. When you have emptied your beaker, feel the sand in the coffee filter. It is wet or dry?

6. Pour water into your beaker until it's about half full. Next, *carefully* sprinkle some sand on the surface of the water until you have a solid, thin layer of sand floating on top of the water. It should be about the size of a nickel or quarter. Keep sprinkling small amounts of sand onto your "lily pad" shape so that it is uniformly thick. Could you do this with regular sand? Why or why not? Explain.

7. Using a small beaker of colored water and a dropper, carefully drop a few drops on the surface of your sand “lily pad.” What happens?

8. Use the tip of your dropper to “chase” all the drops together into one big drop if they are not already gathered together. Next, carefully add 10 more drops to the big drop that has formed. It should be similar to a lily pad floating on the surface of a pond. Look up at the droplet from below and draw what you see.



In the space below, describe what is happening.

9. Now slowly keep adding drops of colored water to the lily pad until it no longer floats and sinks to the bottom. **COUNT THE DROPS AS YOU ADD THEM.** What is the maximum number of drops you can add to this giant droplet? Write the number here: _____

10. What happened when you added the *last* drop—the one that made the whole thing sink?

11. Explain why the whole beaker of water didn’t turn the same color as the food coloring.

12. Use a coffee filter to again separate the Magic Sand from the water. Leave the sand in the filter to dry. Clean up your area.

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, “*Teachers Serving Teachers*” isn’t just a slogan—it’s our promise to you!

Please visit our website
for more lesson ideas:

www.TeacherSource.com

Check our blog for classroom-tested
teaching plans on dozens of topics:

<http://blog.TeacherSource.com>

Educational Innovations has many hydrophilic materials that can be used in follow-up lessons. Consider our “Gro-Beasts” shaped like frogs, dinosaurs or alligators. These critters start at 1-3” long and expand by up to 600% when left in water. They are fantastic for any grade level, and affordable enough to hand out to every student in your class.



Hydrophilic Growing Spheres, Cubes, Spikes and Crystals are also excellent for investigating concepts like mass, volume, surface area, absorption and more.

Gro-Beast Alligator (GB-202)

Gro-Beast Dinosaurs (GB-106)

Growing Cubes (GB-740)

Growing Frogs (GB-25)

Growing Spheres (GB-702, GB-710, GB-730)

Sodium Polyacrylate (Diaper Polymer) (GB-6B)

Water Gel Crystals (GB-5C)

Water Gel Spikes (GB-3)



Our line of hydrophilic polymer materials are available at:

www.TeacherSource.com/category/chemistry-grobeasts