How These Polymers Work

Atoms and Bonding

Atoms are composed of protons, neutrons, and electrons. Two or more atoms bond together to create a molecule by sharing electrons. If the electrons are distributed evenly throughout the molecule, it creates a non-polar molecule. If the protons and neutrons are not evenly distributed, this makes the molecule polar. Like a magnet, the molecule has a side that is more positively charged (with more protons) and a part that is more negatively charged (with more electrons). Polar molecules tend to bond only with other polar molecules, and non-polar molecules bond with other non-polar molecules. For example, water is a polar molecule, and oil is non-polar. Therefore, oil and water do not mix. Anything that dissolves or gets wet in water is polar, and anything that does not is non-polar. Likewise, anything that dissolves or gets wet in oil is non-polar.

Super Snow

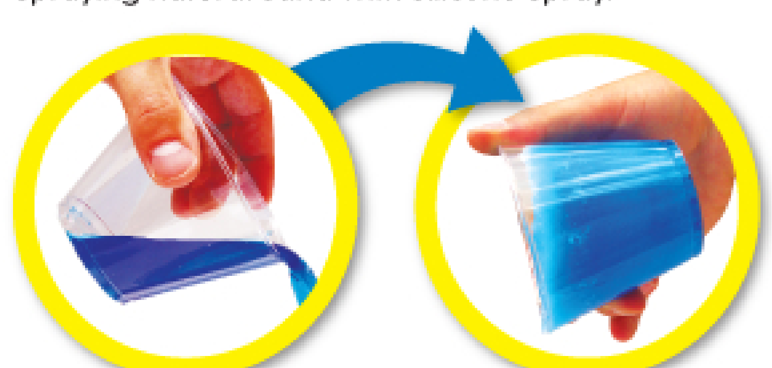
Super Snow is a cross-linked polymer that rapidly absorbs water by using the process of osmosis. When water comes in contact with the polymer, it moves from outside the polymer to the inside and causes it to grow and expand. A polymer is a group of molecules that are linked together. They come in many shapes. The shape of the polymer determines certain characteristics, including the amount of water it can hold. Polymer chains are elastic and will continue to grow to a certain point. Super Snow is a special polymer that is polar, so it mixes with water, and it absorbs more than 100 times its mass of water!

Instant Solid Powder

Instant Solid Powder is made from sodium salts cross-linked with polyacrylic acid to form sodium polyacrylate. Polymerization produces a linear molecule that has a very high molecular weight usually greater than one million molecular units. Instant Solid Powder is also a cross-linked polymer that rapidly absorbs water through the process of osmosis. When the sodium polyacrylate is immersed in water, there is a higher concentration of water outside the polymer. When water approaches a sodium polyacrylate molecule it is drawn to the center of the molecule by osmosis. It is a special polymer that is polar, so it mixes with water, and absorbs 200-300 times its weight in water and holds it in a gooey gel!

Space Sand

Space Sand is ordinary sand that has been exposed to the vapors of a silicon compound. This process changes the composition of the surface of the sand and makes it unbondable with water. Space Sand is hydrophobic, which means "water fearing." Natural sand is made up of silicon and oxygen bonded together in a three-dimensional network of billions of atoms. Natural sand is hydrophilic, which means or "water loving." Space Sand can be created by spraying natural sand with silicone spray.



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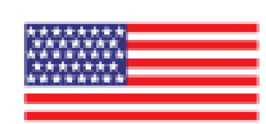

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Sand, Snow, and Solid Physical Science Wonder Kit™

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Discover the science behind the fun while you experiment with these fascinating polymers! Demonstrate real world examples of conservation of mass, surface tension, polarity, osmosis, saturation, evaporation and more! Learn the difference between hydrophobic and hydrophilic. Discover how to neutralize these amazing polymers! All of the included polymers are reusable for hours and hours of mesmerizing fun!

It is important to understand how to use our Science Fair Kits. The kits are designed to be used in conjunction with basic school science fair education. Rather than focus on the science fair techniques and methods you will employ, the point of these kits is to provide you with the materials you will need and give you an idea of some experiments you can do in developing your own unique project.

Be sure to write down your hypothesis before you conduct any experiments and record your observations during and after the experiment. You will document what happened and research and explain why it happened, and what else should happen. You will want to conduct further research on the Internet or in your library both before and after you complete your experiments.

You can conduct countless experiments with the items in this kit. So you should not feel limited to only the suggested experiments. Once you research and learn about the materials and things used in the kit, you will see the possibilities!

Contents

35g	Instant Solid Powder
56g	Space Sand Red, Yellow & Blue
75g	Super Snow
3	Coloring Tablets
1	Experiment & Science Guide

Experiment Ideas

Science Fair Kits™

Experiments with Space Sand

Principles Illustrated: Hydrophilic, Hydrophobic, Surface Tension
What You Need: 1 cup, 8 oz. water, 1 tsp. Space Sand
1. Put 1 teaspoon of Space Sand in water. Did it get wet?

Space Sand never gets wet! Space Sand is ordinary sand treated with silicone vapors. This process changes the composition of the surface of the sand and makes it unbondable with water. Space Sand truly is the closest thing to soil from Mars that most of us will ever experience. Reddish in color and very dusty and dry, Space Sand is hydrophobic sand with the same properties as the sand on Mars. It is theorized that it exhibits hydrophobic properties because it has not been exposed to water in over 13 million years! Space Sand is currently being used in NASA Mars Exploration Classroom Experiments.

Principles Illustrated: Hydrophilic, Hydrophobic
What You Need: 1 cup, 2 oz. water, 1 tsp. Space Sand, 1 tsp. soap
2. Put 1 teaspoon of Space Sand in water with a little soap. What happens to the sand?

The Space Sand turns into ordinary sand when mixed with soap, dish detergent, or alcohol. These substances are able to break down the oil coating on Space Sand. Adding any of these things will change the composition of the surface of Space Sand and make it hydrophilic just like ordinary sand.

Principles Illustrated: Hydrophilic, Hydrophobic
What You Need: 1 tbsp. Space Sand, 1 tbsp. natural sand, 2 tbsp. vinegar, 2 pieces of construction paper
3. Lay two pieces of construction paper on a flat surface. Add one tablespoon of Space Sand to the first piece of paper. Add one tablespoon of natural sand to the second piece of paper. Drizzle one tablespoon of vinegar over each type of sand. What happens? Does the Space Sand get wet? Does either sand bubble?

The Space Sand repels the vinegar. The vinegar forms pools on the paper, but does not have the ability to wet the Space Sand. The natural sand absorbs the vinegar, as it is hydrophilic. If some of the sand grains give off tiny bubbles when you add the vinegar that means they were once part of a living being. They could be bits of coral, shells, or bone. The Space Sand will never bubble since the vinegar is not absorbed.

Principles Illustrated: Saturation
What You Need: 1 tsp. Space Sand, 2 oz. canola oil, 1 cup
4. Put 1 teaspoon of Space Sand in canola oil. Did it get wet?

When the Space Sand is poured over the oil it mixes with it and falls to the bottom. Cooking oil is another way to change Space Sand into ordinary sand. This substance is able to break down the oil coating on Space Sand.

Principles Illustrated: Surface Tension
What You Need: Red, Yellow, and Blue Space Sand, 4 oz. water, 1 cup or bowl
5. Put all three colors of Space Sand in water. What happens? Did it get wet? Do the colors mix?

The Space Sand will float on top of the water if a small enough amount is sprinkled on top. Also, the surface tension of the water makes the Space Sand float. Otherwise it will sink below the water. The different colors of Space Sand do not mix while under water. If the Space Sand is pulled out of water with a spoon, the colors will mix, since they are dry.

Principles Illustrated: Surface Tension
What You Need: 1 bowl, ¾ cup of water, Space Sand, pencil
6. Fill one bowl (not provided) three-quarters full with water. Sprinkle a thin layer of Space Sand on the surface of the water. Take a pencil and slowly push it through the thin layer of Space Sand. What happens? Now take the pencil out. Is the pencil wet or dry? Why?

The Space Sand will coat the pencil when it is submerged into the thin layer. Since Space Sand is hydrophobic, the pencil only comes in contact with Space Sand, and doesn't get wet.

Principles Illustrated: Surface Tension
What You Need: 1 cup, cooking oil, 4 oz. water, Space Sand
7. Add a small amount of oil to a cup (not provided) of water. It forms pools on top. Pour some Space Sand over the oil pools. Watch the oil mix with the Space Sand and fall to the bottom. Space Sand was originally created to clean up oil spills in the ocean.

Principles Illustrated: Hydrophilic, Hydrophobic
What You Need: 2 bowls, 16 oz. water, 2 tbsp. Space Sand, 2 tbsp. natural sand, freezer
8. Fill two bowls with water. Add two tablespoons of Space Sand to the first cup, and two tablespoons of natural sand to the second cup. Place both cups in a freezer overnight. Take them out the next morning. What happens? Did both cups of sand freeze?

Normal sand and soil get wet and have the potential to freeze when the temperature is below zero degrees Celsius. The natural sand will freeze since it absorbs water, but since Space Sand does not absorb water, it will not freeze! Because of Space Sand's ability to not freeze, utility companies use it to protect underground areas.

Principles Illustrated: Surface Tension
What You Need: 1 cup, 8 oz. water, Space Sand
9. Fill a cup with water. Slowly sprinkle Space Sand on top to create a "raft" of sand floating on the surface. Put drops of water on top of the "raft." Notice how the water remains beaded, trying not to touch the water. Be careful not to put too much water on top—too much water will force the raft to fall apart, causing the water to fall through.

Experiments with Super Snow

Principles Illustrated: Crosslinking, Osmosis, Polarity, Viscosity
What You Need: 1/8 tsp. Super Snow, 2 oz. water, 1 cup, stirring spoon
10. Put 1/8 teaspoon of Super Snow in 2 ounces of water. Stir continuously for 20-30 seconds. What happens?

The snow will form a clear gel and then fluff up into snow. Stirring is the most important step in the process. The more the snow is stirred, the more it shines and sparkles. The snow will form more quickly if warmer water is used. Super Snow expands to more than 100 times its size and can last for four to six weeks without rewetting.

Principles Illustrated: Conservation of Mass
What You Need: ¼ tsp. of Super Snow, 1 cup, 4 oz. of water, scale, stirring spoon
11. The Conservation of Mass is an important scientific principal that states mass can never be created or destroyed. Even though the volume of Super Snow grows when water is added, the mass of the wet Super Snow is the same as the sum of the ingredients. Find the mass of ¼ teaspoon Super Snow and 4 ounces of water. Mix well and weigh again. The resulting mass should equal the sum of the initial mass of the powder snow and water. (Don't forget to subtract the mass of the container.)

Principles Illustrated: Evaporation
What You Need: Super Snow, open container, sealed container, 2 cups with different surfaces, measuring tool
12. Water absorbed in Super Snow evaporates like water anywhere else on the planet. Measure the rate of evaporation (how quickly water leaves Super Snow) under various circumstances: in an open container, in a sealed container, exposed to heat, and in cups with different surface areas.

Experiments with Super Snow & Instant Solid Powder

Principles Illustrated: Crosslinking, Osmosis, Polarity
What You Need: ¼ tsp. Super Snow, ¼ tsp. Instant Solid Powder, 2 cups, food-coloring tablets, 4 oz. water
13. Put ¼ teaspoon of Super Snow in one cup. Add ¼ teaspoon of Instant Solid Powder to a second cup. Mix food coloring with 4 ounces of water. Slowly pour colored water into both cups. You will see the colored water move through the snow and Instant Solid Powder until it is evenly distributed throughout the polymers. This movement of water to achieve equal distribution is called osmosis. How long does it take to complete?

The colored water will move through the Super Snow and Instant Solid Powder until it is evenly distributed throughout the snow. Osmosis is defined as the movement of water molecules from an area of high concentration to an area of low concentration. Osmosis is very important in the study of cells and transfer of materials.

Principles Illustrated: Crosslinking, Osmosis, Polarity
What You Need: ¼ tsp. Super Snow, ¼ tsp. Instant Solid Powder, 2 cups, food-coloring tablets, 4 oz. cold water, 4 oz. hot water
14. Does osmosis occur at a quicker rate with hot or cold water? Repeat the above experiment using both hot and cold water. Which water do the polymers absorb the quickest? Why?

The polymers will absorb the hot water much quicker than the cold water. When the water is hot, the individual molecules move much more quickly. Since they move faster, they move into the tiniest spaces in the polymers faster. When the water is cold, the molecules move at a slower rate, thus taking longer to create a gooey gel or fluffy snow.

Principles Illustrated: Crosslinking, Polarity, Saturation, Viscosity
What You Need: ¼ tsp. Super Snow, ¼ tsp. Instant Solid Powder, 2 cups, 8 oz. of water, stirring spoon
15. How much water can Super Snow and Instant Solid Powder hold? Put ¼ teaspoon of Super Snow in a cup with 2 ounces of water. Add ¼ teaspoon of Instant Solid Powder to a second cup with 2 ounces of water. Now add 2 more ounces of water and stir. Pause occasionally to make sure that all of the water is absorbed before continuing. How much water can be added before the Super Snow and Instant Solid Powder can't hold any more?

Super Snow and Instant Solid Powder's molecular composition allows them to absorb large quantities of water. However, there is a limit to how much water Super Snow and Instant Solid Powder can absorb. The limit to how much they can hold is called saturation. Super Snow can hold about 10 ounces of water in this scenario before it is completely saturated and can't hold anymore. You can see water move through Super Snow by osmosis as it becomes saturated. Instant Solid Powder becomes a solid with 2 ounces of water. At four ounces it becomes a gooey gel, and at 6 ounces it becomes saturated.

Experiments with Instant Solid Powder

Principles Illustrated: Crosslinking
What You Need: ¼ tsp. Instant Solid Powder, 1 cup, 2 oz. of water, 1 tsp. salt, stirring spoon
16. Put 1/4 teaspoon of powder in a cup with 2 ounces of water. Stir. Now shake the gel out into a cup, and smash the gel down with your fingers. Add 1 teaspoon of salt, and stir for 20 to 30 seconds. What happens?

The salt will neutralize the polymer as it takes away the gel's water-holding abilities. As the polymer is being stirred, it loses its water-holding abilities more and more and eventually becomes a liquid.

Principles Illustrated: Crosslinking, Viscosity
What You Need: ¼ tsp. Instant Solid Powder, 3 cups, 4 oz. of milk, 4 oz. of pop, 4 oz. of orange juice, stirring spoon
17. Add 1/4 teaspoon of powder to three cups. Add 4 ounces of milk to the first cup, 4 ounces of soda (any kind will work) to the second cup, and 4 ounces of orange juice to the third cup. Do not stir! What happens? Now stir and see what happens.

Before the cups are stirred, it appears that all but the cup with milk are making this gooey gel. But if you look closer, you'll see that the cup with the soda in it is separating from the powder. The carbonation causes the powder to fizz when they are mixed together. When the cup with the soda is stirred, it begins to make a thick gooey gel. The milk does not turn into a gel at all. It looks as if it neutralizes the powder's super-absorbent qualities, and stays the same when it is stirred. Before the cup with the orange juice is stirred, it turns into a wet, gooey gel. After it is stirred, it becomes more liquid but is thicker than the milk. Water is the only liquid that this powder mixes with properly.

Principles Illustrated: Crosslinking, Polarity
What You Need: ½ tsp Instant Solid Powder, 2 cups, 8 oz. of water, 1 tsp. dish soap, 1 tsp. of cooking oil
18. Add 1/2 teaspoon of powder to two cups. Now add 4 ounces of water to both. In the first cup, add 1 teaspoon of dish soap and in the second cup add 1 teaspoon of oil. What happens?

Oil and water do not mix. The oil sticks to the outside of the polymer, causing it to become greasy. When soap is added to the gooey gel, the powder loses some of its absorbent qualities. It looks like a foamy liquid. Soap does mix with water, but it also contains salt, therefore the powder becomes non-absorbent.

Principles Illustrated: Osmosis, Polarity
What You Need: ¼ tsp. Instant Solid Powder, 4 oz. water, stirring spoon
19. Put 1/8 teaspoon of powder in a cup. Add 2 ounces of water. Do not stir! Put 1/8 teaspoon of powder in a second cup. Add 2 ounces of water and stir for 20 to 30 seconds. Which cup makes gel faster? Does stirring the powder into the water have an effect on the polymer? Why?

The second cup will make gel the quickest. Stirring is a very important step in making this gel correctly. If the powder is not stirred, it will form a clear, wet gel. Simply stir to create a dry, moldable gel.

Principles Illustrated: Viscosity
What You Need: ¼ tsp Instant Solid Powder, 2 oz. water, 1 cup
20. Put 1/4 teaspoon of powder into a cup. Now add 2 ounces of water. Do not stir! Now turn the cup upside down. What happens?

This powder is also known as slush powder, and it instantly turns a liquid into a solid. With these ratios of powder and water, the gel becomes a solid. It does not fall out of the cup!