



Instant Snow/Magic Sand Lesson Grade 4

Lesson created by: UTeach Outreach

Date of Lesson: Fall 2014

Description of the class: 4th grade; group of ~30 students

Length of lesson: ~50-60 minutes total

Resources: UTeach Outreach

I. TEKS Addressed:

(4.5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:

- (A) measure, compare, and contrast physical properties of matter, including size, mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float;
- (B) predict the changes caused by heating and cooling such as ice becoming liquid water and condensation forming on the outside of a glass of ice water; and
- (C) compare and contrast a variety of mixtures and solutions such as rocks in sand, sand in water, or sugar in water.

II. Overview:

To show two different experiments dealing with physical changes in two different ways and what the difference is between a physical change and chemical change. In one experiment, students are introduced to the swelling of a polymer (long chain) causing absorbance of water to produce the popular prop: instant-snow. In another experiment, students are also shown the opposite effect called the hydrophobic effect and its appearance in the form of sand. Students are later to compare and contrast these two lessons on how they are different and similar.

III. Objectives:

Instant Snow

- Introduce concept of physical change and have students examine how it is different from a *chemical* change
- Explain to students and have them examine the “constant cooling effect” witnessed in the instant snow

Magic Sand

- Have students discuss why magic sand acts differently than naturally-occurring sand
- Introduce concept of hydrophobic effect and how oils play a part in it
- Have students compare and contrast with what they took away from the instant snow lesson and the magic sand lesson

IV. Resources, Materials and Supplies:

Per coach:

- 3 Styrofoam cups

- 2 bottles of water (1 as an extra)
- Vial filled with instant snow mixture

Per student:

- Magic Sand/Instant Snow worksheet

Per pair of students:

- 1 clear cup for magic sand
- Vial filled with magic sand
- Water to fill clear cup ~ half up
- 1 tray to cover spillage

V. Advanced Preparation:

- For instant snow, line up the 3 Styrofoam cups and fill one cup with water
- Fill another cup, which will be used last, as shown below, with instant snow without the students seeing. Do NOT put water in this cup until it is the last one left
- For magic sand, have students pair up stand in front of one tray with their sets
- Make sure students fill out their worksheets, stating their hypotheses

VI. Supplemental Worksheets, Materials and Handouts:

- Magic Sand Worksheet

VII. Background Information:

College Level

Background information for leaders: Insta-Snow

How does it work?

Insta-Snow® is actually derived from the superabsorbent polymer found in baby diapers. The only difference (and it's a big one) is that the Insta-Snow polymer not only absorbs water but the long chains of molecules swell to an enormous size. The polymer soaks up water using the process of osmosis (water molecules pass through a barrier from one side to the other). When water comes in contact with the polymer, it moves from outside the polymer to the inside and causes it to swell. The polymer chains have an elastic quality, but they can stretch only so far and hold just so much water.

If you allow the water to evaporate, the Insta-Snow powder dries out and returns to its previous state, ready to be used again. Similar superabsorbent polymers have been used in the past to absorb moisture in disposable baby diapers... without the incredible expanding property! Insta-Snow is so realistic that it is now being used in indoor snowboarding parks throughout the world.

What are the best mixing proportions?

Mixing 1 teaspoon of Insta-Snow powder with 2 ounces of room temperature water produces the best quality snow. It is always recommended to make the snow in small quantities to achieve the greatest amount of mixing. Insta-Snow powder expands 100 times its original volume. Just a small amount of powder is needed to make an impressive quantity of snow. On a much larger scale, 1 pound of Insta-Snow powder makes nearly 8 gallons of fluffy snow!

How long does the hydrated snow last?

The snow will start to dehydrate after a few days due to evaporation. Just spray the top of the snow with water and fluff the snow with your fingers to give it a fresh, fluffy look. You can also let the snow completely dry out to use it again. The dry form of Insta-Snow powder will last forever!

Why does the snow feel cold to the touch?

Since the snow is almost entirely made up of water, and the water is bound to evaporate. The process of evaporation produces a constant cooling effect. That's why it's so much fun to touch!

Will the snow ever turn back into water? No, the fake snow will not melt since it is not really ice. However, the water can be released from the superabsorbent polymer by adding salt. The addition of salt destroys the water absorbing properties of Insta-Snow® forever.

Does Insta-Snow have to be on a special surface?

No, Insta-Snow can be used on almost any surface except untreated wood. Keep the snow off of any surface that might be damaged by water. Surfaces that are ideal include tile, plastic and glass. Insta-Snow will not stain fabric, but normal care should be taken when applying this water-based material.

Can Insta-Snow be thrown away in the trash?

Insta-Snow is very easy to clean up and can be disposed of in the trash. Just brush the surface clean or use a vacuum to pick up the snow. Eventually the hydrated snow will turn back into the dry powder and can be easily swept or vacuumed. Insta-Snow powder is a non-hazardous, non-toxic, environmentally safe polymer.

Is Insta-Snow safe to use outside?

Yes! Insta-Snow looks so real that it is being used by special effects artists in movies to snow outdoor scenes without damaging the plants and grass. Sprinkle the hydrated snow on evergreen trees to produce a realistic snow effect. In fact, the water absorbing properties of the snow are actually beneficial to the plants. Remember, Insta-Snow® is very slippery when wet. Use special care to keep the snow off of any walking surface.

Background Information for Magic Sand

Magic Sand is regular sand that has been coated with an oil- like substance that is water-hating or hydrophobic. Hydrophobic substances do not mix with water. Hydrophilic substances, on the other hand, are “water-loving”. You will notice how drops of food coloring color only the water and not the oil in a glass of oil and water. Since oil is hydrophobic, the oil did not mix with the food coloring or the water.

What are other examples of oil and water not mixing? A newly waxed car will make water form beads on its surface. Oil from cars will float on top of puddles. Oil and vinegar salad dressings need to be shaken up before using.

Regular Sand vs. Magic Sand

For this activity you'll need a small amount of regular sand and Magic Sand. Fill 2 cups with water. Use a spoon to sprinkle a small amount of regular sand into one of the cups. Notice how the sand immediately sinks. Sprinkle a thin layer of Magic Sand on the surface of the water in the second cup. Why does the Magic Sand float on the surface whereas the regular sand sinks? The surface of the regular sand grains is made wet by water, which means that water molecules are attracted to sand grains. Magic Sand is regular sand that has been coated with an oil-like substance so it is water- hating. The Magic Sand grains like to stay in contact with each other. Also, the surface tension of the water makes the Magic Sand float.

Making Magic Sand Wet

Pour a small amount of Magic Sand in a cup of water. As expected, the Magic Sand stays dry. Add about 12 drops

of liquid detergent to the water and use a spoon to stir the mixture. Soap breaks down the oil coating on the sand and lowers its hydrophobic properties. Adding soap removes the “magic” from Magic Sand and causes it to behave like regular sand. The secret is revealed!

Other Uses for Magic Sand

The coating on Magic Sand is like Scotchguard, which is sprayed on fabric to protect it from stains. Magic Sand was originally developed as a way to trap oil spilled from oil tankers near the shore. The idea was that when Magic Sand was sprinkled on floating petroleum, it would mix with the oil and make it heavy enough to sink. This would prevent the oil from contaminating beaches. However, it is not being used for this purpose, perhaps because of the expense of making Magic Sand. Another potential use of Magic Sand is to bury junction boxes for electric and telephone wires in the Arctic in order to protect the utilities from the extreme cold temperatures but make it easy to dig up for repairs. Normal earth is frozen so hard because of moisture content that it is difficult to dig. However, Magic Sand remains dry and is easy to dig, regardless of how cold it is.

Elementary Level

Background information for leaders: Insta-Snow

How does it work?

Insta-Snow® is actually derived from the superabsorbent polymer found in baby diapers. The polymer soaks up water using the process of osmosis (water molecules pass through a barrier from one side to the other). When water comes in contact with the polymer, it moves from outside the polymer to the inside and causes it to swell. If you allow the water to evaporate, the Insta-Snow powder dries out and returns to its previous state, ready to be used again. Similar superabsorbent polymers have been used in the past to absorb moisture in disposable baby diapers. Insta-Snow is so realistic that it is now being used in indoor snowboarding parks throughout the world.

How long does the hydrated snow last?

The snow will start to dehydrate after a few days due to evaporation. Just spray the top of the snow with water and fluff the snow with your fingers to give it a fresh, fluffy look. You can also let the snow completely dry out to use it again. The dry form of Insta-Snow powder will last forever!

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VIII. Possible Misconceptions

- The magic sand and instant snow lessons show chemical changes

IX. Vocabulary and Definitions

College Level

Polymer: a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together.

Physical Change: Substances often undergo changes that make them have a dramatically different appearance even though the chemical composition of the substance remains unchanged.

Chemical Change: any change that results in the formation of new chemical substances. At the molecular level, chemical change involves making or breaking of bonds between atoms. These changes are chemical: iron rusting (iron oxide forms).

Hydrophilic: Having a tendency to mix with, dissolve in water; water “loving”.

Hydrophobic Effect: Molecules being repelled by water; water “fearing”.

Elementary Level

Polymer: Polymers consist of flexible, stretchable chains of molecules that repeat over and over.

Physical Change: Substances often undergo changes that make them have a dramatically different appearance even though the chemical composition of the substance remains unchanged. For example, you can take a flat, smooth sheet of paper and crumple it into a ball or fold it into an airplane.

Chemical Change: The change of one or more substances into a new substance and may release energy.

Hydrophilic: Water “loving”, or being able to be dissolved or mixed with water.

Hydrophobic Effect: Molecules not mixing with water or able to be dissolved in water.

X. Safety Considerations:

Do not allow students to eat instant snow or magic sand. May be a little messy and cause spilling of water.

XI. Question of the Lesson

How does a physical change differ from a chemical one, and in what ways did we witness a physical change?

Instant Snow:

| Engagement minutes | | Time: 1-2 |
|--|-------------------|--|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| <p><i>Alright guys, let's explore!</i></p> <p>Show 3 Styrofoam cups in a line. Without showing the kids, add one test tube of instant snow powder to one of the cups.</p> <p><i>I am going to add water to one of these cups, and you're going to guess which of these cups the water is in.</i></p> | | |

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|--------------------|-------------------------|
| Exploration | Time: 1-2minutes |
|--------------------|-------------------------|

| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
|--|--|--|
| <p>Pour water into an empty cup, and switch cups around. Let kids guess which cup the water is in.</p> <p><i>That's right!</i></p> <p>Pour the water into one of the two remaining cups and switch around again.</p> | <p><i>Which cup is the water in?</i></p> <p><i>Now, which cup is the water in?</i></p> | <p>(Correct Guess)</p> <p>(Correct Guess)</p> |

| Explanation | | Time:5-10minutes |
|---|--|---|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| <p>Repeat one more time. Pour water into instant snow powder</p> <p>Pour snow out onto a plate <i>When you weren't looking, I added some instant snow powder to one of the cups! This fake snow is used a lot in TV shows and movies.</i></p> <p><i>Instant snow contains a polymer that is found in baby diapers. Only instead of simply absorbing water, the long chain of molecules formed start to expand when it comes into contact with water. When water comes in contact with the water, it moves from outside the polymer to the</i></p> | <p><i>Where's the water?</i></p> <p><i>How do you think the powder works to create instant snow?</i></p> | <p>Students choose remaining cup</p>  <p>It absorbs the water.</p> |

| | | |
|---|--|---|
| <p><i>inside and causes it to swell.</i></p> <p><i>Instant snow is an example of a physical change. It helps to think of the powder as millions of tiny sponges. Neither the powder nor the water changed. This is how we are able to create fake snow!</i></p> <p>Allow students to feel it, but warn kids against eating the fake snow.</p> | <p><i>What do you think would happen if you allowed all the water to evaporate for a few days?</i></p> <p><i>What is the difference between a physical change and a chemical change?</i></p> | <p>The powder would return to its previous state and could be used again.</p> <p>A physical change is where the substance itself does not change. A chemical change is where a substance undergoes a change so that it becomes another substance.</p> |
|---|--|---|

| Elaboration | | Time:1-2minutes |
|--|---|--|
| What the Teacher Will Do | Probing Questions | Potential Misconceptions |
| <p><i>Notice how the snow is cool to the touch. It is because of the evaporation occurring as soon as the water is bound by the powder. The powder is saturated with water and the evaporation happening produces a constant cooling effect.</i></p> | <p><i>Why do you think this is?</i></p> <p><i>What if we use warm water, instead of cool water?</i></p> | <p>Because there is still water present.</p> <p>It won't have this cooling effect.</p> |

| Evaluation minutes | | Time: |
|--------------------------|--|--|
| What the Teacher Will Do | Probing Questions | Expected Student Responses |
| | <p><i>How is instant snow created?</i></p> <p><i>What is the difference of a physical change and chemical change?</i></p> <p><i>Is there another example of a physical change we see in everyday life?</i></p> | <p>Swelling of a polymer with water.</p> <p>A physical change still is the same chemical substance.</p> <p>Melting an ice-cube, or boiling water. It is still water.</p> |

Magic Sand:

| Engagement 5minutes | | Time:3- |
|--|-------------------|--|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| <p>Put students in pairs and have them go in front of a tray.</p> <p><i>We are going to look at an example of a product developed by chemical engineers.</i></p> | | |

| Exploration 15minutes | | Time:10- |
|---|-------------------------------------|--|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| <p>Question: 1-3 go with sample 1 (normal sand)</p> <p><i>Look at sample 1. Add Sample 1 to the cup with water. Observe. You can stir it with your spoon.</i></p> | <p>1. <i>What happened when</i></p> | |

| | | |
|--|---|--|
| <p>Questions:4-7 go with sample 2 (magic sand)</p> <p><i>Look at sample 2. Add Sample 2 to the cup with water. Observe. You can stir it with your spoon.</i></p> | <p><i>you put water with the sand?</i></p> <ol style="list-style-type: none"> 2. <i>What happens when you stir it fast?</i> 3. <i>What happened when you stop stirring it?</i> 4. <i>What happens when you stir it fast?</i> 5. <i>What happened when you stop stirring it?</i> 6. <i>Why do you think the colored sand stayed in one clump? Why is it dry when we lift it out with the spoon?</i> 7. <i>What kinds of objects can you think of that have similar water proof coatings?</i> | <ol style="list-style-type: none"> 1. It became wet 2. The sand and water mix and it moves around. 3. Most of it settles to the bottom 4. It moves around 5. It clumps some 6. Various responses 7. Wait for responses. |
|--|---|--|

| Explanation | | Time: 5 minutes |
|---|-------------------|---|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| <p><i>The colored sand was magic sand which is sprayed with an oil- like substance that is water-hating or hydrophobic. It isn't actually magic; you are actually just witnessing the hydrophobic effect. Hydrophobic substances do not mix with water. Hydrophilic substances, on the other hand, are "water-loving". Since oil is hydrophobic, the oil did not mix with the water.</i></p> <p>Show the vial containing water and oil.</p> <p><i>Chemical engineers took something as organic as sand and developed it into something with different physical properties that we are not accustomed to, which is also fun to play with.</i></p> | | |

| Explanation | | Time: 5 minutes |
|--------------------------|-------------------|---|
| What the Teacher Will Do | Probing Questions | Expected Student Responses Potential Misconceptions |
| | | |

| Elaboration | | Time:5-10minutes |
|--------------------------|---|--|
| What the Teacher Will Do | Probing Questions | Potential Misconceptions |
| | <i>Now that we have seen two different experiments, how were they similar or different?</i> | The magic sand showed the hydrophobic effect. The instant snow showed the hydrophilic effect. Both experienced only a physical change, not a chemical change. (Looking for this answer from various students, let them discuss). |

| Evaluation | | Time: 5minutes |
|---|--|---|
| What the Teacher Will Do | Probing Questions | Expected Student Responses |
| <i>In these two lessons we just walked through, we witnessed hydrophobic effect and the hydrophilic effect.</i> | <i>What is the hydrophobic effect? What does "hydrophilic" mean?</i> | Hydrophobic effect is when something is repelled by water ("water-hating"). Hydrophilic means something is attracted to water ("water-loving"). |