

September 4, 2010

Cloudy Days

Welcome back to school students! This first week back has been one of the cloudiest I can remember, and that got me thinking. So today we're exploring how clouds are formed.

****Always ask an adult before doing any science experiment****

Materials:

1 large clear glass or plastic jar, like a pickle jar

1 rubber glove

Water

Matches

Directions:

1. Barely cover the bottom of the jar with water
2. Have an adult light the match and drop it in the jar
3. Quickly place the glove in the jar with the fingers pointing down, making sure the glove doesn't touch the water. Stretch the other end of the glove over the end of the jar to seal it.
4. Place your hand in the glove and make a fist, pulling the glove towards the mouth of the jar. Open your hand and push it back into the jar. Make sure the jar stays sealed, or your cloud may disappear.

Explanation:

Congratulations, you have made a cloud! The cloud should form when you close your fist and pull on the glove and it should disappear when you do the opposite.

The clouds in the jar form from differences in air pressure as you pull and push on the glove. When your hand pulls out on the glove, the air inside the jar has more space, so the air pressure inside the jar has decreased. As the pressure decreases, the air in the jar expands and the temperature of the water vapor and air in the jar also decreases. The decrease in temperature, or overall energy, of the vapor causes the water vapor to condense, forming a cloud.

When you push your hand back into the jar, the cloud disappears because of the increase in air pressure in the jar. Increasing the pressure increases the overall energy of the water vapor, and the water vapor particles have too much energy to stick together and the cloud disappears.

What is the match for? First of all, the match helps provide more water vapor in the jar when it is extinguished in the water. The smoke created by the match also helps the clouds form. It is much easier for the water to condense when it has something to "hang onto". The water particles from the vapor stick together much more easily when there are solid particles, such as dirt or smoke, in the air. So now, when your barometer measures a low pressure system, you'll know not only that it might rain, but also how the clouds bringing that rain are formed.

September 11, 2010

First Law of Thermodynamics

Every day I travel past a park full of playground equipment and on Monday it got me thinking about my favourite piece of equipment, the swings. Have you ever been playing on the swings and noticed that you either have to "pump" your legs or have someone push you in order to stay at the same height? In today's experiment we will explain why that happens.

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Materials:

- Baseball or tennis ball
- Ball of string
- High bar – the swing set or monkey bars would work well
- Scissors
- Tape

Procedure:

1. Tie one end of the string around the baseball wrapping the string tightly around the ball a few times. Tape the string to the ball so the ball will hang from the string.
2. Holding onto the other end of the string and throw the ball over the high horizontal bar.
3. Catch the baseball and tie the string into a large loop. Make sure the ball won't fall off the bar. Cut off the excess string.
4. Hold the baseball up close to your nose and walk backwards until the string is pulled straight.
5. Let go of the ball and stand perfectly still. Make sure you do not push the ball.

Explanation:

If you were able to stand perfectly still you should have noticed that the ball swings down away from you, and when it comes back it just misses your nose. So why didn't the baseball smack you in the face? It all has to do with the First Law of Thermodynamics.

According to this law, energy is neither created nor destroyed, meaning that energy is always conserved. By lifting the ball into the air, you are giving the ball potential energy (a form of "store energy" from gravity). The ball only has as much energy as you originally gave it. This potential energy is converted into kinetic energy when the ball begins to move. If this were a perfect energy system, the ball would return to the starting point every time, but some of the energy is converted into other "waste" forms such as heat from the friction of the string rubbing the horizontal bar. That little bit of converted "waste" energy is what prevents the ball from smacking you in the face. If you were to leave the ball swinging all day, it would eventually stop completely.

Pretty neat. Now jump on a swing and try it out! Swing up nice and high and then stop "pumping" your legs. See how long it takes you to stop swinging.

Happy experimenting!

September 18, 2010

Hot Ice

I'm sure many of you mini-scientists out there have mixed vinegar and baking soda together to make an awesome volcano-like reaction. This volcano effect happens because the baking soda and vinegar produce carbon dioxide which bubbles out of the solution. The reaction also produces very dilute amounts of sodium acetate, which has some neat properties we will explore today.

Sodium acetate is a safe chemical to produce. It is often used as a flavoring, such as in salt and vinegar chips

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Materials:

- 1 liter of regular clear vinegar
- 4 tablespoons of baking soda

- Large pot or saucepan
- Stove
- Spoon

Procedure:

1. In the large pot / saucepan very slowly mix together the vinegar and baking soda. Mix a little baking soda into the vinegar at a time, stirring between each addition. If you do not add slowly, you will end up with a volcano.
2. Have an adult bring the solution to a boil on the stove. Boil the vinegar and baking soda until you have around 100-150mL. This may take up to an hour. The solution may become discoloured, and that is completely fine.
3. Once you have reduced the solution, remove it from heat and either cover it, or pour it into a different container with a lid. If your solution has crystals in it, slowly stir in a little bit of vinegar or water.
4. Cool the solution in the fridge.
5. Once the solution has cooled, you can take it out of the fridge. Try touching the solution to see what happens. Or slowly pour the liquid into another container to make sculptures.
6. Once you have formed solid sculptures or a solid mass, very carefully touch the solid. What do you notice?

Explanation:

Mixing vinegar and baking soda makes sodium acetate. By adding the baking soda slowly and boiling the solution, you are removing most of the water from the vinegar and concentrating the sodium acetate. Sodium acetate is an example of a supercooled liquid. Now, this experiment is super cool, but a supercooled liquid is a science term meaning the sodium acetate is at a temperature lower than its freezing point, but has remained a liquid.

When you touch the supercooled chemical you are helping it to crystallize and the entire thing forms a solid. The process of crystallization is exothermic, meaning the reaction releases energy in the form of heat. So your sculptures or solid form of sodium acetate should be warm to the touch.

Sodium acetate is often used in hand warmers you might buy when you go skiing. It's also in many heating pads. These heating pads contain sodium acetate at its supercooled state and a metal disc.

Clicking the metal disc causes the crystallization to occur and the heating pad gets warm. Supercooled liquids are pretty fantastic.

Happy experimenting!

September 25, 2010

Gravity

With nice weather predicted for this weekend, I thought we'd do an outdoor experiment, exploring gravity. We experience gravity every day. Some of these experiences are good, like being able to walk or run, and some experiences are not so good, like when you've fallen off your bike. So let's channel our inner Isaac Newton and look more closely at gravity.

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Materials:

- A Styrofoam cup
- Water
- Pen or pencil

Procedure:

1. Go outside, as this experiment could get a little wet.
2. Fill the cup with water.
3. Holding the cup in one hand, poke a hole on the side of the cup near the bottom with the pencil. Fully remove the pencil.
4. Take note of what happens

Explanation:

As you probably noticed, the water ran out of the cup. Hopefully you didn't get too wet. Gravity is acting on both the cup and the water in the cup. Because you are holding the cup, you are acting against gravity to hold it there, and the cup is holding onto the water. When you poke a hole in the cup, the cup cannot hold onto the water and gravity pulls it out.

Procedure:

1. Hold your finger over the cup and fill it with water.
2. Move your finger so some of the water starts to fall out.
3. Drop the cup before it is empty.
4. Take note of what happens.

Explanation:

In this experiment, the water should have stopped flowing out of the cup when the cup fell. This is because gravity was acting on both the cup and the water. Both the cup and the water fell at the same rate, meaning the water couldn't fall out of the cup. Gravity acts equally on all objects, heavy or light.

Astronauts use this principle when they are training for "weightlessness" in space. Part of their training includes free-fall within airplanes. Special airplanes take them up into space and then the pilot will turn the plane so it is "falling" through the sky at the acceleration of gravity. The astronauts are then falling at the same speed as the plane and experience "weightlessness", which is the same as the water in the second part of the experiment. Pretty neat!