The Unpoppable Water Balloon

Description:
Why won't this balloon pop?

Materials:
2 balloons
Water
Basin
Safety glasses
Candle
Matches
Adult supervision

Procedure:
1) Put on safety glasses
2) Place the candle in a shallow basin or sink
3) Light the candle with a match
4) Blow up a balloon and tie it shut
5) Hold the balloon above the candle
6) Observe the balloon increase in size and pop
7) Partially fill a second balloon with water
8) Hold the water balloon over the flame of the candle
9) Hypothesize as to what may have been happening

My Results:

Explanation:
The balloon filled with air has two forces weakening the balloon. First, as the air heats up it expands and causes more pressure on the surface of the balloon. Second the heat energy from the flame causes the latex rubber to begin to melt and the combination of the two causes the balloon to burst. The water balloon, on the other hand, behaves differently because the heat energy on the balloon is quickly transferred to the colder water. As a result the latex does not melt and the air in the balloon is not heated. The cooler water absorbs the heat.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Stolen Heat

Description:
When is stealing not a crime?

Materials:
Cotton ball
Rubbing alcohol
Clock with a second hand

Procedure:
1) Wet a cotton ball with rubbing alcohol and place a dab on the back of your hand
2) Time how long it takes to evaporate
3) Think about how it felt (Did it feel cool?)

My Results:

Explanation:
Rubbing alcohol evaporates more quickly than water, and our bodies provide enough heat to allow that process to occur. The backs of our hands feel cool because we transferred heat away from us to the liquid enabling evaporation to occur. It stole our heat!

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Conducting Pan Insulating Foam

Description:
Things can be the same temperature, but act differently.

Materials:
Pan of Styrofoam (sterilized meat tray works well)
Aluminum pan with sides
2 ice cubes
Items larger than your hand: blocks of wood, Styrofoam, metal pan, cardboard, glass, plastic
Thermometers

Procedure:
1) Place one ice cube in the meat tray and the second in the aluminum pan
2) Predict which will melt faster
3) Lay out the materials to compare by touching (blocks of wood, Styrofoam, metal pan, cardboard, glass, plastic)
4) Lay them out in the order from coldest to warmest by touch
5) Record the temperature of each item to demonstrate that they are all the same temperature
6) Observe which ice cube is melting faster and hypothesize why

My Results:

Explanation:
This has to do with how quickly heat is conducted through materials. Although each item starts at the same temperature, the metal pan (a conductor) conducts heat quickly away from the point where it is being touched, which causes more heat to leave your hand. Eventually enough heat will be transferred that it will feel warm. The Styrofoam, as an insulator, does not conduct heat well so the surface of the foam rapidly heats up and to an even temperature as your body so no more heat leaves your hand into to foam. It "feels" warmer because less of our heat is required to reach thermal equilibrium. The same is true for the ice cube melting more quickly in the metal pan. The metal conducts heat more readily into the ice cube causing it to melt faster.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Moving Molecules

Description:
Show the effect of thermal energy on water.

Materials:
2 matching glasses, jars, or bottles
Hot water (heated on the stove, in a microwave, or from the tap)
Cold water (chilled in a freezer)
Measuring cup
Food coloring

Procedure:
1) Place a container of water in the freezer to chill (not freeze)
2) Pour one cup of the cold water into a jar
3) Get one cup hot water from the tap or heat some on the stove or in a microwave and pour into one jar
4) Add three drops of the same color food coloring to each jar and observe
5) The jar containing hot water will turn colors faster
6) Hypothesize as to why

My Results:

Explanation:
All molecules are moving with thermal energy; movement that we cannot see with our eyes. The warmer something is, the faster the molecules move and the greater the expansion that takes place. By adding in the food coloring, the warmer water blends the color throughout much faster as the molecules collide more frequently and distribute the color. The color change happens more quickly in the hot water than in the cold water where the thermal energy is less and the molecules are not vibrating so fast.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Energy Transfer with Newton's Cradle

Description:
There's no baby in this cradle.

Materials:
Newton's cradle

Procedure:
1) Demonstrate how the Newton Cradle transfers energy (one ball in and one out, two in and two out, etc.)

My Results:

Explanation:
Newton's Cradle, named after Isaac Newton but not invented by him, visually demonstrates how energy is conserved (conservation of momentum) and passes through each of the balls so that the output swing nearly matches the input collision while some of the energy converts to heat and sound. Because there is some friction created when the balls strike in the elastic collision, some of the kinetic energy from the moving ball is transferred into heat while the vibrations produce sound energy in the audible clicking noise. This model can also illustrate how molecules collide and transfer energy to one another in elastic collisions, and how fast moving molecules impact with slower molecules, getting them closer to the same speed and equilibrium.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Steam-Powered Spinning Soda

Description:
Make an engine!

Materials:
Soft drink can
Needle
Fishing line
Ring stand
Snap swivel
String
Heat source (Bunsen burner, camp stove, candle)
Matches
Ruler
Permanent marker
Adult supervision

Procedure:
1) Measure 1/2 way down form the top of the full soda can and mark a dot with a permanent marker
2) Mark a second dot on the opposite side also □ way down the can
3) Place the can in a basin and gently poke the needle into the can where the mark was (doing this with a full can offers better resistance but is messy)
4) Carefully bend the needle gently to the right (parallel to the base) to form an angle to the hole
5) Repeat and puncture the other side of the can
6) Drain the can (blowing into one hole can hasten this process)
7) Lay the can so that the hole is under flowing water and a small amount of water will enter the can (not much is required)
8) Cut a small piece of string and tie into a loop of about 2 inches
9) Without puncturing the tops seal tab, slide the loop of string under the lift tab so that it is centered on the rivet at the top of the can
10) Attach the snap swivel to one end of a length of fishing line and clip the swivel to the loop of string
11) Tie the other end of the fishing line to the ring stand so that the can is suspended just above the heat source
12) Ignite the heat source so that it heats the water to boiling
13) Observe the spinning motion of the can

(Part 2)

Steam-Powered Spinning Soda

My Results:

Explanation:
The burner transfers heat through convection through the air under the can. As the can gets hot, it passes the heat along to the water in the can by conduction and through the water as convection once more. The water then heats up and creates steam also heating up the air by convection, and the steam and air exits the cans by the little angled holes causing it to spin in the opposite direction. As the energy moves out of the can, it creates a little engine or turbine. This is a good example of how the thermal energy of the flame transferred heat to the can and increased the thermal energy of the water so that it began to evaporate. The resulting spin of the can could be used for mechanical purposes (winding up a spool of thread for example). This model is a modern example of the first heat engine operated by steam, which was developed by Hero in Alexandria in 100 BC, and the concept is still used today.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Steam-Powered Spinning Soda

Description:
Make one, and then make another one that's better.

Materials:
Empty plastic bottle (HDPE bottles work well)
Scissors or utility knife
Tea candle
Matches
1/8 (or 1/4 inch) copper tubing
Tubing cutter or hacksaw
Nail
Syringe
Small wooden spool
Large container of water (wallpaper trays work well too)

Procedure:
1) Remove the cap from the bottle
2) Vertically cut the HDPE bottle in half lengthwise with utility knife or scissors
3) Use the tubing cutter to cut a length of pipe twice the length of the bottle
4) Place the wooden spool in the center of the tube and bend the tube around it to create a complete loop then remove the wooden spool
5) On the bottom of the bottle poke two holes an inch apart so that they are above the water line when floating the bottle
6) Place the tea candle in the front of the boat (near the cap opening)
7) Slide the two ends of the copper tubing through the smaller poked holes from the inside of the boat going out creating a semi-water tight fit
8) Bend the tube so that the loop is suspended over the candle wick and the tubes rest on the bottom of the boat behind the candle
9) The tubes will then curve up to the exit holes and down once more so that the hole openings will be submerged under water
10) Place the boat in the water
11) Use a syringe to prime the tubes with water forcing out any air (they must be completely full to work)
12) Light the candle and patiently observe

(Part 2)

Simple Steam Boat

My Results:

Explanation:
When the candle heats the water in the tube it creates steam, which pushes the water out of the pipes and propels it forward. As steam continues to develop, it expands back to cooler areas of the pipe causing the steam to condense and draw in more water from the resulting vacuum. The water comes back into the pipe only to be heated and forced out once again. It is possible to place fingers behind the boat and feel the pulses of propulsion from the steam engine.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

The Curiosity Guide

Subject: Thermal Energy

Investigation: 08

Season 1 Ep. 7 (#107)

Balloon Comparison

Description:
What makes these balloons inflate (or not)?

Materials:
3 two-liter plastic or glass bottles
Hot plate
Basin of hot water
Basin of cold water
3 balloons
Pan

Procedure:
1) Fill one basin with hot water
2) Add a small amount of hot water to a two liter bottle and stand up
3) Pour cold water into the second basin adding a small amount of cold water to the second bottle and stand it up as well
4) Place a deflated balloon over the neck of each bottle
5) While waiting, fill a pan with water and place it on the hot plate
6) Add several inches of water to the third bottle
7) Place the third balloon on the neck of that bottle and stand it up in the pan on the hot plate
8) Heat the pan
9) Observe the results and hypothesize the cause
10) Consider why the plastic bottle can go on the stove

My Results:

Explanation:
Molecules move faster when they are heated, causing matter to expand (or contract when heat is transferred away). The balloons indicate whether the air in the bottle is expanding by adding thermal energy and the balloons inflate, or contract in the cool water. If the water is sufficiently cold, the contracting air may pull the balloon inside the bottle and begin to inflate in the bottle with outside room air. With respect to the plastic bottle on the hot plate, the plastic will not melt because the water pulls the heat through the bottle with conduction.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!

Making an Ice Cube Thermos

Description:
How long can you make an ice cube last?

Materials:
Ice cubes (2 per team)
Snack size Ziploc bags
Cotton Balls
Aluminum Foil
Newspaper
Rubber bands
Small boxes of cardboard
Bubble wrap
Masking tape
Wax paper
Tin cans
Small glass jars
Styrofoam peanuts
Styrofoam cups
Sawdust
Rubber gloves
Graduated cylinders/test tubes
Funnels
Stopwatch/clock

Procedure:
1) Introduce the design challenge to make the best thermos to slow down the melting process of an ice cube
2) Display the assorted materials
3) Each team should draft blueprints for two prototype thermoses
4) Establish the limitations that all insulating materials must already be at room temperature and the ice cube must be placed into a Ziploc container to measure the melt water at the end of the activity
5) When each prototype is developed, teams are each given their ice cubes at the same time
6) Begin the timer
7) After a specified period of time (possibly 20-25 minutes) pour off the water from each baggie into a test tube or graduated cylinder to compare water volumes
8) Evaluate prototypes

(Part 2)

Making an Ice Cube Thermos

My Results:

Explanation:
This challenge emphasizes the transfer of heat through conduction in which molecules in a warmer object collide with molecules in the colder object (in this case the ice). Teams will discover that there are some materials that serve as better insulators conducting less heat to the ice cube. The tin can as a conductor for example would not effectively protect the ice cube as it transfers heat too quickly. They should also recognize that building a smaller container reduces the size or area to protect, so a compact thermos has benefits. Reducing conduction and heat loss is something that engineers constantly consider in the construction of buildings and homes to maximize energy efficiency and minimize heat loss.

Parents and Educators: use #CuriousCrew #CuriosityGuide to share what your Curious Crew learned!