**Invisible writing**

Materials needed:

- paper (35 pages)
- lemon juice
- paint brushes (3)
- oven
- 10 messages (1 per group) that have been prepared ahead

Preamble:
In the past, invisible inks were used to write secret information. Onion juice and milk were often used but we will be using lemon juice.

Instructions:

- dip paint brush frequently in lemon juice
- in large, clear writing write out your message
- let it dry
- heat paper with iron or in warm oven for a minute

What's happening?:
When the lemon jice is heated, the water molecules are evaporated away and the remaining compounds combine with the oxygen in the air. This is known as oxidization and the result is that the lemon juice turns brown.

**Chemical Reaction**

Materials needed:

- plastic pop bottle
- baking powder
- vinegar
- balloon
- funnel

Preamble:
Have you ever wondered why cakes rise in the oven or what the bubbles in pop are really made of? The answer is: carbon dioxide. Carbon dioxide is a gas which is formed when two atoms of oxygen join with one atom of carbon. It is formed in cakes when acids react with bicrbonates in the ingredients.

Instructions:

- put 1 tbsp of baking powder in the bottle
- add ¼ cup vinegar
- quickly fit the balloon over the top

What's happening?:
The vinegar (an acid) reacts with the sodium bicarbonate in the baking powder (an alkali). The reaction produces carbon dioxide gas. This would work with water, too, only the reaction would be slower (like in cakes).

**Melting Snow**

Materials needed:

- styrofoam cup(s)
- snow
- ruler
- hair dryer

Preamble:
Have you ever wondered what the difference is between an inch of snowfall and an inch of rainfall?

Instructions:
Fill a styrofoam cup 2/3 full of snow. Measure the depth with a ruler. Use the hairdryer to melt the snow. Measure the water that is left.

What's happening?:
Have you ever put a can of pop in the freezer to cool off quickly and then left it too long? Had the can burst when you went to take it out? When water freezes the molecules expand, taking up more space. Can you see one reason why farmers would rather have an inch of rain than an inch of snow?

**Huff and Puff**

Materials needed:

- 2 balloons
- 1 pop bottle
- 1 pop bottle with hole drilled in bottom

Instructions:

- place a balloon just inside each pop bottle
- stretch over the lips of the bottles so no air can escape
- challenge 2 girls to blow up the balloons

What's happening?:
Only one will be able to blow up the balloon. Can you tell which one?

The bottle with no hole in it will not let the balloon inflate. As you try and inflate the ballon it takes up more space in the bottle but the bottle is already full of air!

The bottle with the hole in it allows air to escape, making room for the balloon.

* from The Manitoba Museum web site – KidScience Experiments

**Comparing fingerprints:**

Materials:

- fingerprint evidence
- sample fingerprints from suspects
- microscope

Preamble:
No 2 people in the world have identical fingerprints.

Instructions:

- under the microscope, look at the fingerprint evidence on the slide
- have the sample fingerprints beside you
- look from one to the other and see if you can identify which suspect left the fingerprint

**Comparing hairs:**

Materials:

- hair evidence
- sample hairs from suspects
- microscope

Instructions:

- under the microscope, look at the fingerprint evidence on the slide
- have the sample slides
- compare each sample hair to the hair evidence see if you can identify which suspect left the hair

**Comparing shoeprints:**

Materials:

- shoeprint evidence
- sample shoeprints from suspects

Preamble:
Many shoes have very distinctive patterns from the manufacturer. People wear down their shoes in different ways, too.

Instructions:

- compare the shoeprint evidence to the shoeprint samples collected from the suspects
- look from one to the other and see if you can identify which suspect left the shoeprint

**Magnetic or not?**

Materials:

- 4 small magnets
- selection of items of different materials

Instructions:

- spread the items out on the table
- give each Embers a magnet
- let them discover which items are attracted to the magnet and which are
- what do the items which are attracted have in common?

**Mixtures - Oil Spill:**

Materials:

- cake pan
- cooking oil
- dishwashing soap
- 3 sponges
- spray bottle full of water
- water

Preamble:
Some of the worst environmental disasters of the past decades have been spills from oil tankers. The oil floats on the surface of the water, forming a slick. This can spread, destroying sea-life including birds and coastlines.

Instructions:

- fill cake pan 2/3 full of water
- spread ¼ cup of cooking oil over the surface
- give one Embers the spray bottle, the rest the sponges
- the Embers with the sponges try to mop up the spill while the brownie with the spray bottle (bad weather) sprays the surface of the water
- now spread some detergent on the water and see what happens

What's happening?:
The detergent makes the oil mix with the water so that it breaks down into smaller particles and can be washed away.

**Fire Fighting - Invisible Reactions:**

Materials:

- cork "boat" with candle
- fireplace matches
- lemon juice
- baking powder
- glass jar
- water

Preamble:
Did you know that when a fire is burning a chemical reaction is taking place? To stop a fire we have to stop the chemical reaction. We can do this with fire extinguishers, buckets of sand, water, foam, wet blankets . . . .

Instructions:

- fill the jar 1/3 full with water
- float the cork boat
- light the candle with the fireplace match
- add several spoons of baking powder to the water and stir gently with a long spoon
- before the baking powder and water stop fizzing add a ¼ cup of lemon juice. watch what happens
- the fizzing should carry on for a few minutes. If it doesn't, add more baking powder and lemon juice
- the flame of the candle should dim and then die completely

What's happening?:
When you light the candle you start a reaction between the candle wick (fuel) and the oxgen in the air. The heat of the candle burning keeps the reaction between the fuel and the oxygen going.

The reaction between the lemon juice and the baking powder produces $CO_2$. $CO_2$ is heavier than the air in the jar so the air is pushed up andout of the jar. Without the oxygen in the air the burning reaction stops and the flame is extinguished.

**Warm and Cool Water:**

Materials:

- coloured ice cubes
- glass jar
- warm water

Preamble:
Did you know that warm water rises above cold water just like warm air rises over cold air?

Instructions:

- fill the glass jar ¾ full with warm water
- have each Embers add 1 coloured ice cube
- watch what happens

What's happening?:
As liquids or gases warm up, the particles of which they are made move further apart. This makes them expand and become "lighter" and they move upward.

As the ice melts the cold coloured water will sink down to the bottom.

**Fizzing Lemonade – Visible Reactions:**

Materials:

- lemon juice
- 1 quart water
- sugar to taste
- bicarbonate of soda
- dixie cups

Instructions:

- lemonade will be premade
- fill dixie cups ½ full with lemonade
- add ½ tsp. bicarbonate of soda
- stir and drink at once!

**Computer type circuits:**

Materials:

- 1 “And” type circuit
- 1 “Or” type circuit
- 1 “And” and “Or” circuit

Preamble:
Circuits in computers are on very small chips about the size of your fingernail. There can be many circuits on one chip. This experiment will help you understand what a circuit or a chip does. The make either “And”or “Or” types of choices.

Instructions:

- first look at the “And” circuit. Experiment with opening and closing the switches. For the lightbulb to light up both Switch A AND Switch B must be closed
- next look at the “Or” circuit. Experiment with opening and closing the switches. For the lightbulb to light up either Switch A OR Switch B must be closed
- last, look at the “And” and “Or” circuit. Experiment with opening and closing different combinations of switches (sheet for girls to fill out). Which switches must always be closed for the lightbulb to light up?

**try these on the AND and OR circuit board:**

**IF** A and B and C and F are closed and the light bulb lights up, take another clue (doesn’t)

**IF** A and B and D and E and F are closed and the light bulb lights up, take another clue (does)

**IF** A and B and C and E and G are closed and the light bulb lights up, take another clue (does)

**IF** A and D and E and F are closed and the light bulb lights up, take another clue (doesn’t)

**try these on the AND and OR circuit board:**

**IF** A and B and C and F are closed and the light bulb lights up, take another clue

**IF** A and B and D and E and F are closed and the light bulb lights up, take another clue

**IF** A and B and C and E and G are closed and the light bulb lights up, take another clue

**IF** A and D and E and F are closed and the light bulb lights up, take another clue

**try these on the AND and OR circuit board:**

**IF** A and B and C and F are closed and the light bulb lights up, take another clue

**IF** A and B and D and E and F are closed and the light bulb lights up, take another clue

**IF** A and B and C and E and G are closed and the light bulb lights up, take another clue

**IF** A and D and E and F are closed and the light bulb lights up, take another clue

**try these on the AND and OR circuit board:**

**IF** A and B and C and F are closed and the light bulb lights up, take another clue

**IF** A and B and D and E and F are closed and the light bulb lights up, take another clue

**IF** A and B and C and E and G are closed and the light bulb lights up, take another clue

**IF** A and D and E and F are closed and the light bulb lights up, take another clue

**try these on the AND and OR circuit board:**

**IF** A and B and C and F are closed and the light bulb lights up, take another clue

**IF** A and B and D and E and F are closed and the light bulb lights up, take another clue

**IF** A and B and C and E and G are closed and the light bulb lights up, take another clue

**IF** A and D and E and F are closed and the light bulb lights up, take another clue

**Goop:**

Materials:

- cornstarch
- water
- pan or bowl

Pre-amble:
aka as Oobleck. Oobleck is a non-Neutonian fluid. This means that when a small amount of force is used, it acts like a liquid, but when more force is applied, it acts like a solid. For instance, one can slowly put a spoon in Oobleck, but it is impossible to stir it quickly. Another fun activity (though potentially messy!) is to pour a little Oobleck in the palm of your hand and watch it puddle like a liquid. Now make a fist and quickly open your hand. The Oobleck will have formed a hard ball from the pressure of your fist; but when the pressure is release, it will seem to "melt" into a liquid again.

Instructions:
Goop will be premade. Have the girls pour a little Oobleck in the palm of their hand and watch it puddle like a liquid. Now have them make a fist and then quickly open their hand. The Oobleck will have formed a hard ball from the pressure of their fist; but when the pressure is release, it will seem to "melt" into a liquid again.

Ask the girls what is something that is different in every solid and every liquid and how they could test that. They should come up with the following for tests.
1. push test -- can you push into it?
2. pick up test -- if you pick some up, does it all come up?
3. pour test -- does it pour out smoothly, or does it just fall out in a clump?
4. shape test -- does it keep the same shape?

What's happening?:
Is it a solid or a liquid? Actually, it is both in a way. Oobleck is a non-neutonian liquid. All that means is that it is a liquid that doesn't follow Newton's equations for liquids under pressure. Have you seen glass in very old buildings that is thin at the top and thick at the bottom? That is because glass is also a non-neutonian fluid and is slowly flowing out of the pane.

**Constellations**

Materials:

- tin lids with constellation patterns punched on them
- flashlights (4)
- extra tin lids to give to each girl

Preamble:
In ancient times people imagined pictures they could see in the stars: Taurus, Orion, etc. These groups of stars or constellations have these names still today.

Instructions:

- show girls the different constellations
- show girls how to fit lids over flashlights
- darken room and let them project the constellations onto a wall
- give each girl a tinlid constellation of Casseopia to take home

## Cyclone Bottles

This is also known as “whirlpool glass” and tornado machine.” It demonstrates to children what hurricanes, tornadoes and whirlpools look like.

Materials:

- Two 2-liter plastic soda bottles
- Water
- Blue food coloring
- Glitter (optional)
- 3 x 5-inch card
- Masking tape and Duct or electrical tape
- Safety scissors

Wash out the soda bottles and remove their labels. Fill one bottle with water and add a teaspoon of blue food coloring and a few pinches of glitter, if desired. The food coloring and glitter make the cyclone more visible.

Roll the card width-wise so that it will fit in the mouths of the soda bottles. Use masking tape to hold the end of the card in place. Put the rolled-up card in the mouth of the bottle that contains the water. Take the other soda bottle and place its mouth over the rolled-up card, pushing the bottle down so the mouths of both bottles are flush. Tape the mouths of the bottles together with duct or electric tape, making sure that the seal between the two is as waterproof as possible.

Grab the bottles by their bases and turn the “cyclone” upside down. As the water begins to pour from one bottle to the other, gently swing the bottles in a counterclockwise motion until the tornado forms.

# Tilting Earth

Materials needed:

- 1 globe, ball, orange or other round object
- 1 flashlight

Preamble:

Seasons occur because the Earth is tilted at an angle on its axis. As the Earth moves around the sun during the year, different parts of the Earth are tilted towards the sun at different times. In the Northern Hemisphere, when the North Pole tilts away from the sun, the sun is low in the sky and days are short, bringing the season we call winter. When the North Pole tilts towards the sun though, more light and heat reaches the Northern Hemisphere as the sun is high in the sky and days are long. This change brings what we know as summer. Between these two seasons are spring and autumn, where the region becomes gradually warmer and colder as it tilts towards or away from the sun respectively.

The Earth's axis is an imaginary line through the Earth between the North and South Poles. The Earth is tilted on this axis at an angle of 23.5°, although the tilt always points the same way in space. The tilt of the Earth affects the regions around the Poles the most and they experience long hours of daylight in the summer and darkness in the winter. In fact, the sun never sets for six months of the year near the North and South Poles and these areas have become known as the *land of the midnight sun*. In the summer it is light all the time and in the winter it is dark all the time.

In contrast, the areas around the equator receive sunlight at a much more direct vertical angle and so these regions are hot all year round. In between these two extremes, the regions between the Poles and the equator become gradually warmer and colder as the angle of the sunlight varies.

Questions:

Use the flashlight like the sun, what happens when one side of the globe is lit up?
The Earth is tilted on its axis, what happens when you tilt the globe a bit? What angle is the sun?

**Chia people**

Materials:

- Grass seed
- Potting soil
- Styrofoam Cups
- Pantyhose
- Sawdust
- Craft material to decorate

Instructions:

- Cut the foot off of the pantyhose.
- Fit the pantyhose over the lip of the Styrofoam cup and push pantyhose inside.
- Fill the bottom of the pantyhose with a teaspoon of grass seed
- Fill the pantyhose with potting soil leaving enough hose leftover to tie up in a knot.
- Decorate your chia head as you wish remembering that the grass will grow and look like hair.
- Water your chia head when needed.

**Magnets with iron filings**

Materials:

- Various magnets
- Acetate sheets
- Iron filings

Instructions:

- Place 1 magnet under a sheet of acetate.
- Sprinkle sparingly some iron filings on the acetate sheet
- Watch where they go.
- Scoop up the filings and try it with another magnet

What's happening?

Each magnet has two magnetic poles, (N) north and (S) south. According to Lenz's law, when a current is caused to flow in an electrical conductor by a change in the external magnetic field surrounding the conductor, the direction of flow of the current is such as to produce a magnetic field opposing the original change in the external magnetic field.

This explains the behavior of magnets and conductors when one is moving relative to the other. For example, when a conductor is moving across a magnetic field, a current is caused to circulate in the conductor producing a magnetic field which tries to stop the conductor from moving.