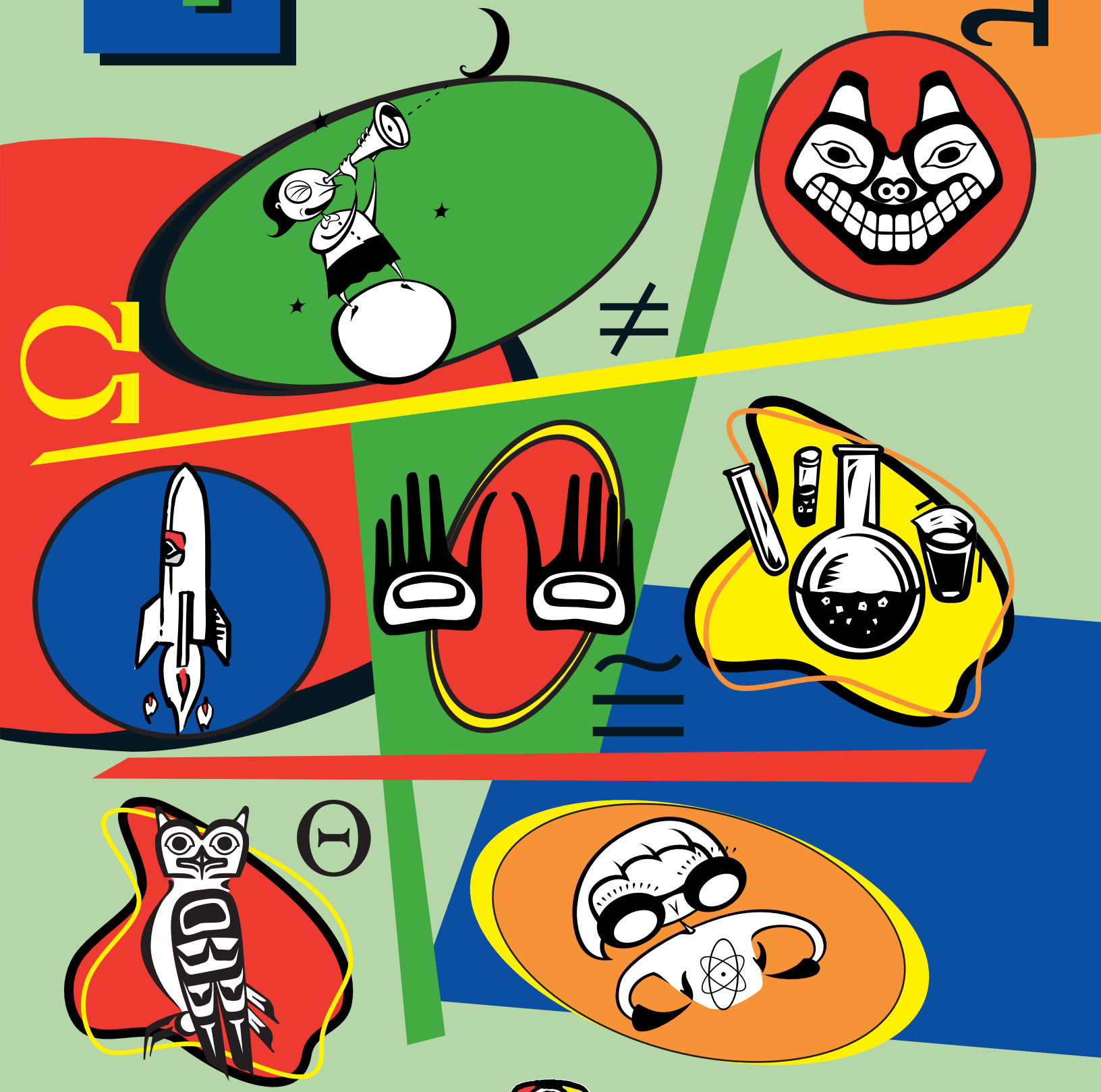
BOOK

4

SEVENTH GENERATION SCIENCE EXPERIMENTS



SEVENTH GENERATION CLUB

The Seventh Generation Club thanks Mad Science for their contribution of the twelve experiments found in the Seventh Generation Club Science Experiments Book 4.

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Seventh Generation Club
Mission Statement

To create a club where First Nations youth can envision their future by recognizing their own energy, the culture of their people, and the teamwork needed to succeed by giving them opportunities to make healthy life choices, participate in their community, and to meet the challenges of life.

The Seventh Generation Club would like to thank the following partners:

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

HISTOR!CA

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THE POWER IS YOURS

Administration and coordination is provided by the
First Nations Schools Association

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WATER FUN FACTS

A dairy cow must drink 4 gallons of water to produce 1 gallon of milk.

2,072 gallons of water are used to make four new car tires.

Notes

Aqua-Filter

Most of the water we use everyday for drinking, cooking and washing is taken from lakes, rivers or wells. In many countries, water treatment plants clean the water before distributing it for consumption. This experiment will help you to understand one of the many stages that water must go through in a water treatment plant.

You will need:

- Scissors
- Coffee filter
- Charcoal
- 2 Litre plastic soda bottle
- Sand
- Muddy water (This can be collected from a water source like a pond or stream with adult supervision)

Safety Warning:

Do not drink the water; it may contain harmful germs!

Procedure:

Step 1: Cut off the top of the soda bottle, about 8-10 cm below the mouth.
Step 2: Turn the top upside down and rest it on the remainder of the bottle.
Step 3: Place a coffee filter inside, followed by a layer of wet sand.
Step 4: Pour some muddy water onto the sand. You will notice that it looks a little cleaner as it drips through the filter!
Step 5: Try improving your filter by putting a layer of finely-crushed or powdered charcoal above the sand. Add another layer of sand above the charcoal. Repeat Step 4. What do you notice?

Explanation:

This experiment illustrates one of the stages of water purification at a water treatment plant. Particles of dirt in the muddy water are trapped in the layers of wet sand, which helps clean the water. The finer particles in the powdered charcoal trap more dirt than the larger grains of sand, so the water becomes even purer.

For further exploration:

Experiment with your water filtration system by changing the layers that filter the water. Try using gravel, clay, or even marbles in a coffee filter to clean your muddy water. What works best?

WATER FUN FACTS

Raindrops are not tear-shaped. Scientists, usinghigh-speed cameras, have discovered that raindrops resemble the shape of a small hamburger bun.

Bottle Barometer

Make a bottle barometer that will help you predict the weather!

You will need:

- Water
- One-litre plastic soda bottle
- Tape
- Saucer
- Index card
- Pencil

Procedure:

Step 1: Fill the saucer halfway with water.
Step 2: Pour water into the bottle until it is about three-quarters full.
Step 3: With your thumb over the mouth of the bottle, turn the bottle upside down and hold it in the water in the saucer.
Step 4: Make sure the mouth of the bottle is under the surface of the water in the saucer. Remove your thumb from the mouth of the bottle and rest the bottle upside down in the saucer.
Step 5: Cut the index card into thin strips.
Step 6: Place a strip of index card vertically along the outside of the bottle, toward the top. Tape it in place.
Step 7: Using your pencil, gently mark the level of water inside the bottle on your index card, and write the date next to your mark.
Step 8: For the next few days, repeat step 7. What do you notice?

Explanation:

The water didn't pour out of the bottle when you removed your thumb. Instead, the water level dropped a little, and then came to rest. The weight of the air in our atmosphere presses down on the water in the saucer, keeping water inside the bottle. The weight of the air in the atmosphere and the force it exerts is called air pressure. Air pressure changes slightly from day to day. When there is a decrease in air pressure, the water level drops. An increase sends the water up. When the level of the water inside the bottle drops, you can expect warmer, wetter weather!

WATER FUN FACTS

About 70% of the human body is water.

An automatic dishwater uses 9 to 12 gallons of water to wash one load.

Buoyancy Boat

When it comes to floating, size doesn't matter—just look at cruise ships! Learn about the role of displacement in this fun boat building experiment.

You will need:

- Marbles or pennies
- A waterproof marker
- Water
- Aluminium foil
- A big bowl or kitchen sink
- Modelling clay (optional)

Procedure:

Step 1: Fill a big bowl, or your kitchen sink, with water.
Step 2: Lay a sheet of aluminium foil about the size of a piece of paper on the surface of the water.
Step 3: Take the foil and fold it in half. Place it back on the surface of the water.
Step 4: Repeat the last step 3 more times. What do you notice?
Step 5: Now bend up the edges of the folded foil and pinch them together to form a simple boat shape. Make sure to seal the edges tightly so that it doesn't leak!
Step 6: Gently place your boat in the water. It should float. Mark the water level on the side of your boat using your waterproof marker.
Step 7: Slowly add some weight to your boat, a little at a time. Observe the mark on the side of your boat each time you add some weight.
Step 7: Keep adding weight until you sink your vessel.

Explanation:

Huge cruise ships and other vessels like aircraft carriers float, yet if you let it in some water, they would sink! When it comes to flotation, size is not important. What matters is the weight of the water displaced (moved out of the way) by the object as it sits in the water. If the weight of the water displaced is greater than the weight of the object, the object will float!

When you made your foil boat, the water your boat displaced weighed more than the boat itself, so it floated. When you added weight to your boat, your boat started weighing more than the water it displaced. Eventually, it sank!

For further exploration:

Have a boat building competition with friends using modelling clay for your boats. Make sure that you all start with the same amount of clay. Whose boat can hold the most marbles? Why?

WATER FUN FACTS

More than half of the world's animal and plant species live in the water.

Capillary Power!

How does water travel from a plant's roots to its leaves? Check out the power of *capillary action* in this waterlogged experiment!

You will need:

- Shallow bowl filled with water
- Construction paper (standard paper will not work)
- Scissors
- Pencil

Procedure:

Step 1: Cut a square piece of construction paper. Fold it in half.
Step 2: Fold the paper in half again to make a square.
Step 3: Fold it in half again to make a triangle.
Step 4: Cut a petal shape out of the side of the paper with the thickest fold. Unfold the paper, and you will have made a flower!
Step 5: Use a pencil to roll the petals of the flower so that it looks as if the flower is closed.
Step 5: Drop the flower into the water and watch the petals. What happens?

Explanation:

Water has many important properties and functions. In plants, water acts like a muscle allowing the leaf to hold itself up so that it can absorb sunlight. This pressure that keeps leaves up is called **turgor pressure**. When leaves wilt on a plant and become droopy, there is not enough water to maintain this turgor. The plant is not dead when this happens, but it is a sign that it is time to water our plants—and soon!

The stem of a plant is a transportation system filled with tiny tubes called **capillaries**. The attractive force between molecules of water and the sides of capillaries is strong enough to draw water up the plant, just as water was drawn up the paper to make your flower bloom! In the tallest of trees, **capillary action** can draw water up dozens of metres!

For further exploration:

This is a fun experiment to try again with your own flower designs. You can get different results using different shapes and numbers of petals. What happens if you use different kinds of paper, such as newspaper or tissue paper?

WATER FUN FACTS

Almost 75% of the earth is covered in water.

Ocean Currents

Ocean currents are huge moving masses of water that travel around the world. Investigate how warm and cold water combine to help produce these currents.

You will need:

- A deep glass bowl
- Another bowl (any kind); roughly the same size as the bowl above.
- Blue food colouring (or coloured dish detergent or liquid soap)
- A spoon
- Very cold water
- Very hot tap water
- Oven gloves

Note:

The greater the difference in temperature between the cold and hot water used, the better this experiment will work. To get very cold water, place a few ice cubes in two or three glasses of cold tap water, and allow the ice a few minutes to melt.

Procedure:

Step 1: Fill the glass bowl about half-full with very cold tap water.
Step 2: Using oven gloves, fill another bowl half-way with very hot tap water.
Step 3: Pour a few of drops of colouring into the hot water and mix it thoroughly with your spoon.
Step 4: **Slowly** pour some of the hot water into the bowl of cold water. Do not stir! What do you observe happening to the two waters that you mixed?

Explanation:

You should notice the coloured hot water resting on top of the cold water. The hot water stays on top because hot water is actually *lighter* than cold water. As substances warm up, their molecules move around faster and take up more space, making the substance less dense. The molecules in colder substances don't move around as much, and don't take up as much space, making them denser.

Ocean waters in warm areas of the Earth become lighter than the waters in cooler areas of our planet. As the wind pushes ocean waters around the Earth, different streams of different-temperature water travel over and under each other because of their different densities!

After a while, the hot coloured water in your experiment will cooled and begin to mix with the lower-temperature water below—they mix as their densities become the same!

WATER FUN FACTS

The human body needs 2 litres of water a day in our climate; we can last only a few days without water.

Picky toothpicks

Surface tension is what gives water and other liquids an invisible "skin" on top. This tension is enough to support an object that you would *think* would sink.

You will need:

- Shallow bowl filled with water
- 6 toothpicks
- Cube of sugar
- Small piece of soap

What to do:

Step 1: Arrange the toothpicks in a circle in the bowl of water.
Step 2: Place the sugar in the centre of the circle.
Step 3: Change the water in the bowl and arrange the toothpicks in a circle again.
Step 4: Place the soap in the centre of the toothpicks as you did with the sugar cube. What do you notice?

Explanation:

When you place the sugar in the centre, the toothpicks are drawn to it. When the soap is placed in the centre, the toothpicks move away from the centre. Sugar absorbs, or sucks up water, creating a current that carries the toothpicks with it toward the centre of the bowl. The soap, however, gives off an oily film that spreads outwards. This film weakens the surface tension of the water and it carries the toothpicks away with it!

For further exploration:

What happens when you add a drop of vegetable oil into the middle of the toothpicks? Try adding a drop of soap to the oil. See where the toothpicks end up!

WATER FUN FACTS

Most of our food is water: tomatoes (95%), spinach (91%), milk (90%), apples (85%), potatoes (80%), beef (61%), hot dogs (56%).

Sink or Swim?

Did you ever wonder why you float better in the ocean than you do in a lake? Try this experiment, and you'll see why!

You will need:

- An adult
- A plastic knife
- A clear drinking glass
- Food colouring (optional)
- Salt
- Coloured cellophane
- Water
- A potato
- A bowl
- Tablespoon

Note:

You can add a few drops of food colouring to the regular water if you wish!

Procedure:

Step 1: Have an adult cut you a 5-cm long, 3-cm high, and 1-cm thick slice of potato to make the body for your fish. Cut out a semi circle and a triangular piece of coloured cellophane. These will be the fins and tail of your fish.

Step 2: Make a slit through the middle of the back of your potato fish and push the cellophane semicircle through the slit to make the fins above and below the body.

Step 3: Make a slit at the back of the potato fish and slide the cellophane triangle inside to make the tail.

Step 4: Fill a bowl with cold water and add a few tablespoons of salt. Stir the mixture until all the salt dissolves. Keep adding salt, and stirring, until no more salt will dissolve.

Step 5: Pour some of this salty water into a clear drinking glass until the glass is filled halfway.

Step 5: **Slowly** add some cold tap water to the salty water by pouring it over the back of a tablespoon. You have to do this slowly and carefully!

Step 5: Gently place your fish on the water's surface, and let go. What do you observe?

Explanation:

The fish will sink through the regular tap water in the upper half of the glass and float in the middle of the glass, where the saltwater meets the unsalted tap water. Saltwater is denser than freshwater because the salt molecules swimming among the water molecules adds to the weight of the water. Salted water is denser than unsalted tap water, so the saltwater sinks to the bottom of the glass while the freshwater stays on top. Your fish is denser than the freshwater, but less dense than the saltwater. As a result, it floats between the two layers.

Most of the water on Earth is found in our oceans and seas, and is salty. A smaller amount is found in rivers and lakes, and is not salty (freshwater). We float better in the dense saltwater of the ocean then we do in less dense freshwater found in lakes—just as your potato fish floated better in salted water than it did in unsalted water!

WATER FUN FACTS

Water acts as a natural insulator to regulate the earth's temperature.

1.5 to 7 gallons of water are used to flush a toilet. Newly manufactured toilets can only flush a maximum of 1.6 gallons of water.

20,000 Leagues Under the Cap

Send a submarine diving through the water!

You will need:

- Flexible drinking straw
- Scissors
- Paper clip
- Modelling clay
- 2 L Plastic soda bottle with cap
- Water

Procedure:

Step 1: Fill the soda bottle to the top with water.
Step 2: Cut out the ribbed part of a flexible drinking straw, and bend it in half.
Step 3: Open up a metal paper clip and push it through the bent straw. Make sure that it cannot slide out!
Step 4: Roll three thin strips of modelling clay. Loop and pinch each one around the paper clip. These strips will help give your submarine some weight.
Step 5: Test your design by floating your submarine in a glass of water. It should float with the modelling clay hanging down. If it doesn't, add more modelling clay
Step 6: Place your submarine inside your soda bottle and screw the top of the bottle back on securely.
Step 7: To make your submarine dive, use both hands to squeeze the sides of the bottle. Release the bottle to make the submarine rise again.

Explanation:

Your submarine is able to dive and surface because there should be a bubble of air trapped in the straw. When you squeeze the soda bottle, the water is pushed into the straw and squashes the air bubble. This makes your submarine heavier, and makes it sink. Real submarines have built-in tanks in which they pump water or air, to make them heavier or lighter, as needed!

WATER FUN FACTS

Only 1% of the earth's water is available for drinking.

Surface Tension Challenge

Take the surface tension challenge, and see how many drops of water you can put on a penny!

You will need:

- An eyedropper or straw
- A penny
- A plate
- A cup
- Water

Procedure:

Step 1: Put a penny in the centre of your plate.
Step 2: Fill a cup of water.
Step 3: Predict how many drops of water you think you can fit onto a penny.
Step 4: Using an eyedropper or straw, see how many drops you can fit onto the penny before the water spills over!

Explanation:

The molecules of water stick together forming water drops. The ability of molecules to stick together, their **cohesion**, causes water to form a "skin" on its surface. The force holding this "skin" together is called **surface tension**. Surface tension is strong enough to hold many drops of water together on top of a penny—but only to a point! One drop too many, and the weight of the water is greater than the tension. The surface tension is overcome, and the water spills over!

WATER FUN FACTS

Water is the only substance on earth found naturally in three forms—solid, liquid, and gas.

Tension Trick

Now that you know all about surface tension, show off your skills by trying this "tension trick" with some friends or family!

You will need:

- A glass
- A cork
- Water

Procedure:

Step 1: Fill an empty glass almost to the top with water.
Step 2: Ask someone to float the cork in the centre of the glass. No matter how hard they try to centre the cork, it will drift to one side!
Step 3: Gently pour in some more water so that the water's surface bulges over the top edge of the glass. Place the cork in the water. Presto! It moves to the centre where the water level is highest, on top of the bulge.

What's going on?

Cork is lighter than water, and so it seeks to rise above the water at its highest point. When the glass was a little less than full, water clung to the sides of the glass, rising slightly above than the surface of the water at the middle of the glass. The cork drifted toward the higher water. When the glass was a little more than full, the water formed a convex surface—a bulge—and the cork drifted to the higher water, on top of the bulge. In both cases, the shape of the water's surface was determined by surface tension!

WATER FUN FACTS

You can survive about a month without food, but only 5 to 7 days without water.

300 million gallons of water are needed to produce a single days supply of the world's newsprint.

Air Dry

Can a paper towel stay dry even under water?

You will need:

- A clear drinking glass
- Two sheets of paper towel
- A bucket taller than the glass

Procedure:

Step 1: Fill your bucket with water.
Step 2: Wad your paper towel into a ball and then push it down into the glass. The paper towel should be wedged deep inside.
Step 3: Turn the glass upside down.
Step 4: With the glass upside down and vertical, push it straight down into the water in the bucket.
Step 5: Slowly lift the glass out of the water. Be sure not to tilt the glass!
Step 6: Dry your hands and remove the paper towel. What do you observe?

Explanation:

The glass is actually full before it even enters the water! It has paper and air inside. The air takes up space that the water would otherwise fill. With the air taking up the space, the water can't enter the glass. The air inside acts like a guard, protecting the paper towel!

WATER FUN FACTS

It is possible to drink water that was here in the dinosaur era.

Water Deception!

Create a cool optical illusion with a glass of water and a pencil!

You will need:

- A pencil
- A tall, clear glass
- Water

Procedure:

Step 1: Fill the glass with water, stopping 5 cm from the top.
Step 2: Put the pencil into the glass of water.
Step 3: Look down into the glass at the pencil. Then, look at the pencil sideways, through the glass. What do you notice?

Explanation:

Have you ever been in the bath and reached in the water to pick up a toy only to find it wasn't where it seemed to be? You were tricked by an effect called **refraction—**the bending of a wave of light when it crosses from one medium, like air, to another, like water. Refraction is what caused the pencil to appear "broken" when you looked at it sideways through the glass. Light rays travelled through the air and into the water, slowing down slightly and bending away from its original path. In the bathtub, the reflection of light off the object at the bottom of the tub bent as it left the water, giving you the impression it was a few centimetres from where it actually was!

WATER FUN FACTS

On average, a person uses about 100 gallons of water a day.

Build Your Own R.O.V.

(Remote Operated Vehicle)

Parental help is necessary for this experiment. Ask Mom or Dad to give you a hand!

You will need:

- 2 pieces PVC pipe 10 cm long*
- 4 pieces PVC pipe 7 cm long*
- 6 pieces PVC pipe 3.5 cm long*
- 4 PVC T-cross pieces
- Drill
- Wire mesh/screen
- 2 floats
- 2 pieces PVC pipe 9 cm long*
- 4 pieces PVC pipe 6 cm long*
- 10 PVC corner pieces
- PVC glue
- 1/4" drill bit
- Tie wraps
- 12 V gel cell battery

** Lengths must be identical*

Notes:

The projected cost of this ROV is approximately $75.00, not including the tools, battery and general supplies you may require.
For more detailed information about this project, please contact:
Mad Science of Vancouver 1-888-954-6237 (outside area code 604)
or 1-604-589-6237

Procedure:

Step 1: Glue the PVC tubes together once happy with the structure of your ROV.
Step 2: Once assembled and glued, drill 1/4 inch holes in each of the corner pieces. This allows water to pass through and will permit the ROV to sink.
Step 3: Use tie wraps to secure the mesh to the bottom of the ROV. This is used for payload purposes and/or to carry additional weights.
Step 4: Use three pipe clamps for the motors and attach to the unit. The clamps will assist in securing the motors.
Step 5: Use film canisters for your motors and make sure to waterproof them with toilet bowl wax, petroleum jelly etc.
Step 6: Solder and wire in the connections as required.
Step 7: Use tie wraps to keep the wires together. Do so every few feet to keep it from tangling. Use weights on the ROV as well.
Step 8: Create a control box for the land operation.
Step 9: Make sure to have enough wire for the distance you want to cover.
Step 10: Bring three wires into the control box and tie a knot at the entrance to reduce pulling. You will need three switches, one each for the vertical, port and starboard motors.
Step 11: Wire appropriately and then connect to the power source.

WATER FUN FACTS

A five-minute shower takes 10 to 25 gallons of water.

Notes

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