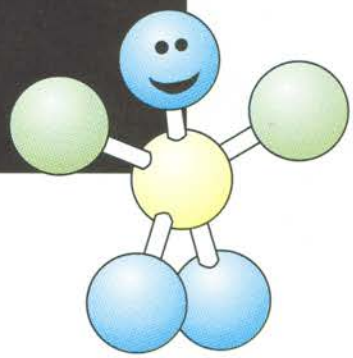
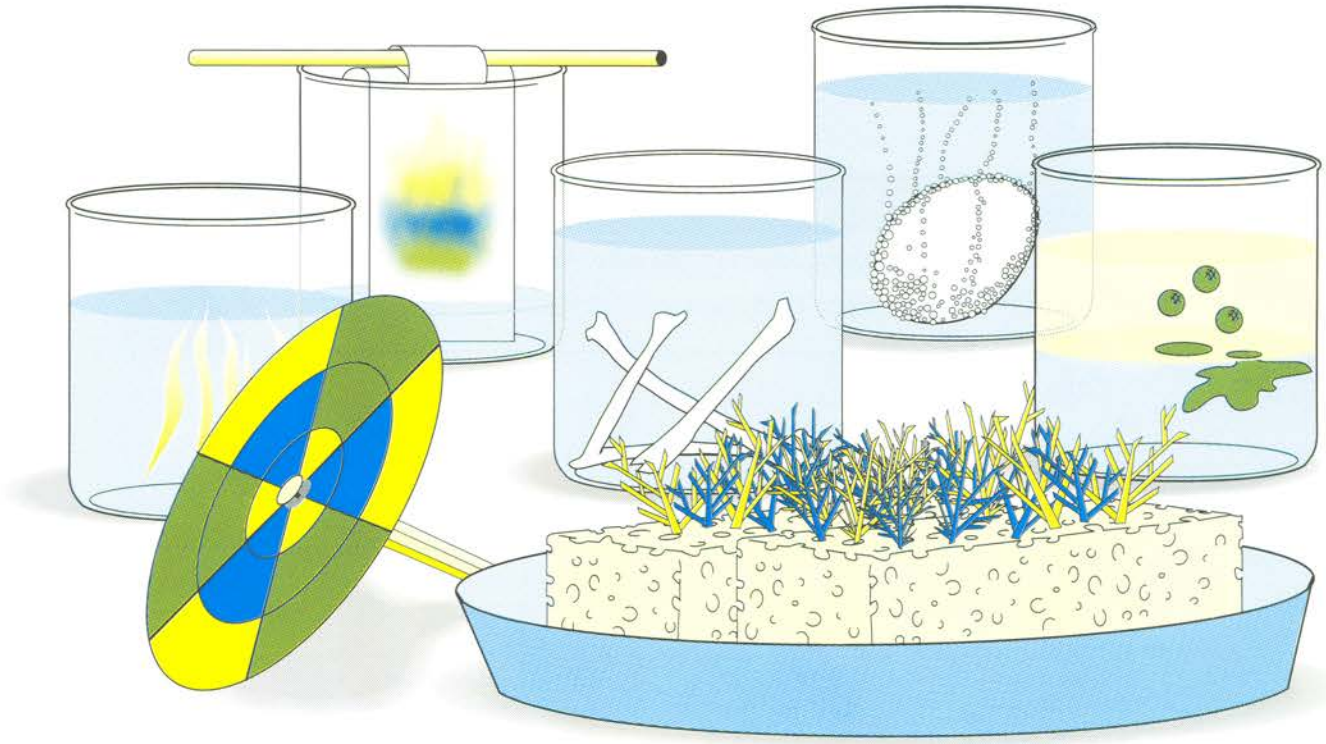
DISCOVERING CHEMISTRY



A Guidebook for Grades 4 to 6



This booklet has been designed to introduce children to chemistry and chemical concepts, in a relaxed and fun way. The target group is Grade 4 to 6 students, although many of the activities will delight and intrigue younger or older children.

Each activity has been selected to introduce a few important concepts, and allow discovery through observation and explanation. It is hoped that they will encourage wonder and curiosity about the world around us. These activities may be enhanced through writing notes in a science journal.

The materials for all the activities are readily available from the grocery store; no "exotic" chemicals are required, although some do show "exotic" features! Of course, students should exercise common sense in handling materials and wash their hands after.

Each activity has been coded for use with individuals  , small groups  , or for demonstration in a large class setting  . This is to help the teacher to determine supply requirements for the class. The "needs list" for each experiment reflects the requirements for one set-up (individual, group or demonstration) of each experiment.

Teachers may not be the only ones who find this booklet useful. It may be helpful to parents, those leading activity clubs (Guides, Scouts, 4-H, etc.) and anyone else who wishes to interest others in science.

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Have fun!

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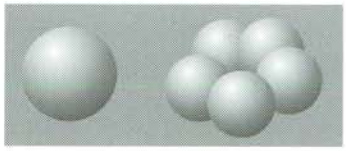
HIDDEN COLOURS



THE AIM:

to find out what colours are hidden in different coloured inks

Each colour will be carried up by the water at a different rate. This process is called chromatography. It is used by scientists to discover the ingredients in a substance.

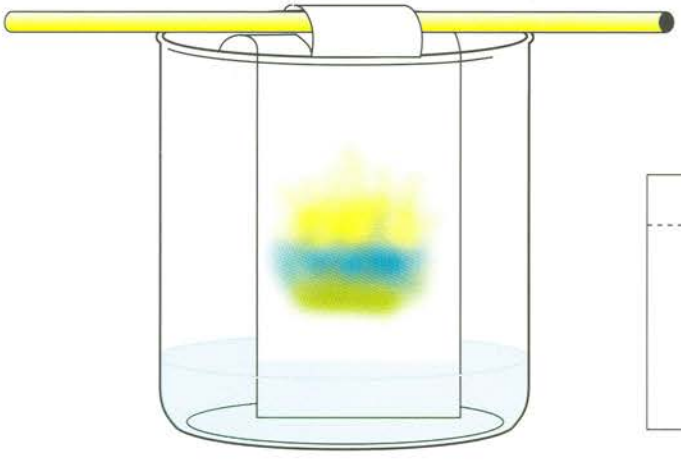
WHAT YOU WILL NEED :

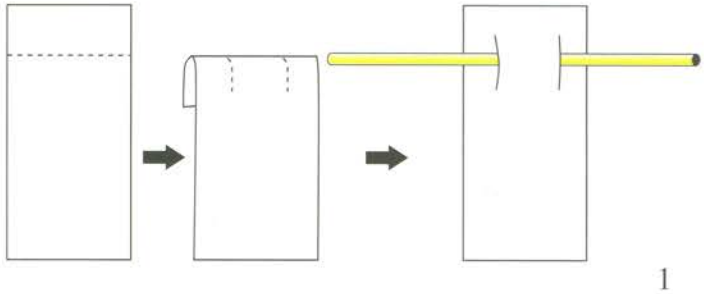
- ❑ white paper towel
- ❑ scissors
- ❑ ruler
- ❑ plastic drinking straw
- ❑ small glass
- ❑ different colours of watercolour markers
- ❑ water

WHAT TO DO:

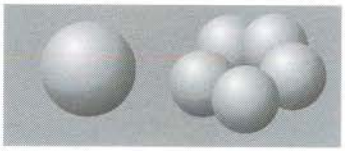
1. Cut a strip of paper towel that will be about 5 cm wide and about 3 cm longer than the height of the glass.
2. Fold the top of the strip down about 3 cm from the top.
3. Cut two slits. (See picture.)
4. Unfold the strip and slip the straw through the slits.
5. Place the straw across the top of the glass. The bottom of the paper should just touch the bottom of the glass.
6. Lift the straw and make a coloured marker line about 3 cm from the bottom of the strip.
7. Pour a little water into the glass and lower the paper strip into the water. The water level should be lower than the coloured marker line.
8. After some time the colours will be seen to separate. Encourage class discussion.

Also see the experiment COLOUR MIXING (page 4). HIDDEN COLOURS shows that some colours will separate into more than one component. COLOUR MIXING shows the separate colours and the effect produced by mixing them.





FALLING SPHERES



THE AIM:

to make spheres of coloured water float between a layer of water and oil

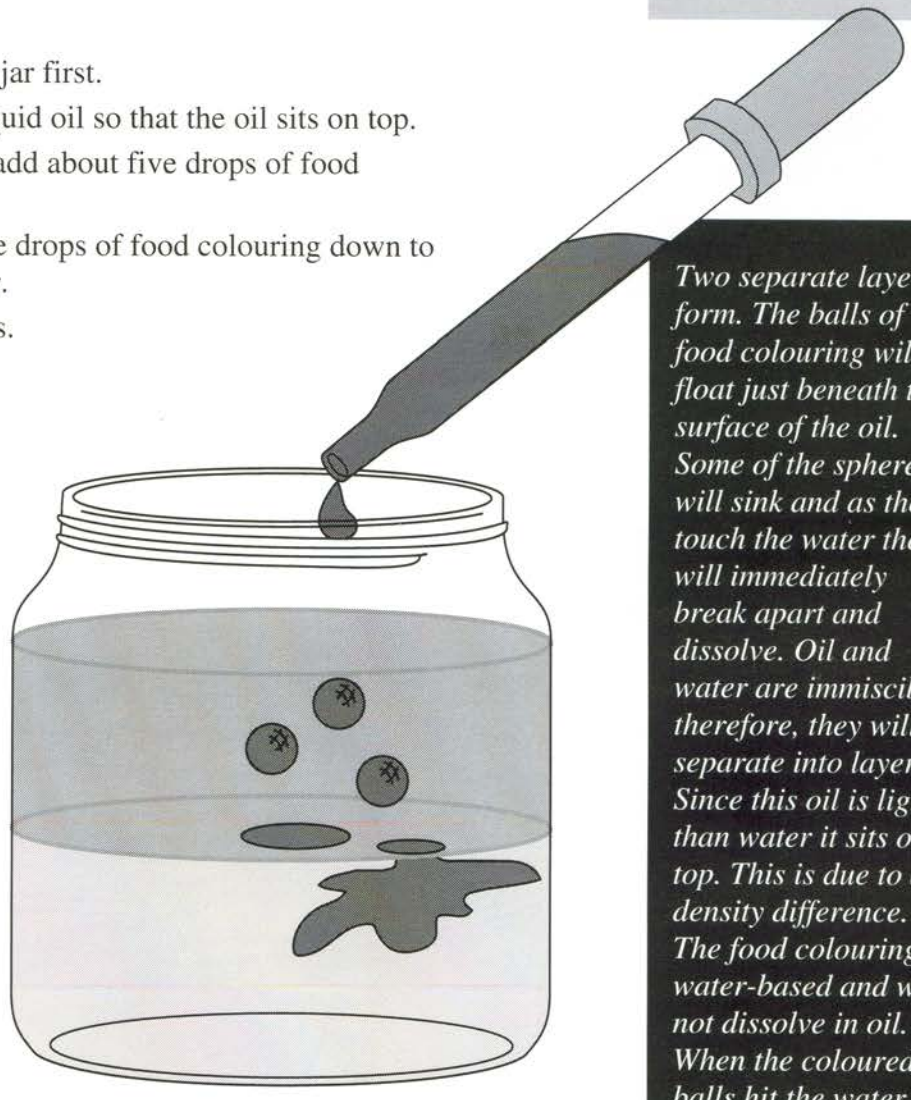
WHAT YOU WILL NEED:

- ❑ 60 mL (1/4 cup) of liquid cooking oil (Crisco oil works well.)
- ❑ 60 mL (1/4 cup) of water
- ❑ 1 glass jar (baby food size)
- ❑ blue, red or green food colouring
- ❑ eyedropper
- ❑ pencil

You could also try this using vinegar in place of the water layer, and powdered baking soda in place of the coloured water drops. Spectacular!

WHAT TO DO:

1. Pour the water into the jar first.
2. Very slowly add the liquid oil so that the oil sits on top.
3. Using the eyedropper, add about five drops of food colouring to the jar.
4. Use a pencil to push the drops of food colouring down to the surface of the water.
5. Encourage observations.



Two separate layers form. The balls of food colouring will float just beneath the surface of the oil. Some of the spheres will sink and as they touch the water they will immediately break apart and dissolve. Oil and water are immiscible, therefore, they will separate into layers. Since this oil is lighter than water it sits on top. This is due to a density difference. The food colouring is water-based and will not dissolve in oil. When the coloured balls hit the water they will dissolve in it.

After the spheres have all dissolved, cap the jar and shake it vigorously. Set the jar down and observe what happens.

The denser water will sink to the bottom. The centre is a mix of oil and water. This is heavier than oil but lighter than water. The top layer is the oil with some trapped water in it that will eventually settle out.

COLOUR MIXING

THE AIM:

to observe the mixing of primary colours to form secondary colours

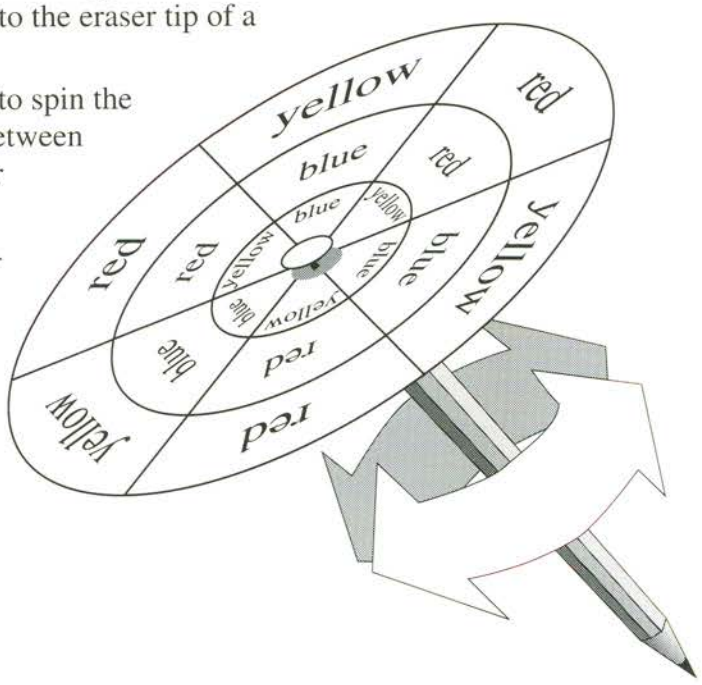
WHAT YOU WILL NEED:

- ❑ red, blue, and yellow felt tip markers
- ❑ one thumb tack for each student
- ❑ one pencil with an eraser end for each student
- ❑ white paper
- ❑ scissors
- ❑ compass
- ❑ protractor
- ❑ ruler

The disk is spinning very fast and this makes our eyes mix the colours. The three new colours that are seen (orange, green, and violet) are a result of the combination of the primary colours, red, blue, and yellow.

WHAT TO DO:

1. Have the students use the compass to draw a circle with an 8 cm radius. In the middle of this circle have them draw a circle with a 5 cm radius and in this circle's centre have them draw a 2 cm radius circle.
2. Have the students divide the colour wheel into 6 even pie-slice shaped pieces (every 60^0) using a ruler and protractor.
3. Have the students colour the sections as labelled on the picture below. (It may be useful to have this sketched on the blackboard or let your students use a colour wheel that you have coloured as a guide.)
4. Stick a thumb tack through the centre of the circle after it is completed and into the eraser tip of a pencil.
5. Tell the students to spin the pencils rapidly between the palms of their hands.
6. Encourage observations.



To see colours separate try the HIDDEN COLOURS experiment. (page 1)

GREEN PENNIES

THE AIM:

to demonstrate a chemical change using pennies and vinegar

WHAT YOU WILL NEED:

- ❑ saucer
- ❑ paper towel section
- ❑ vinegar
- ❑ 3-5 pennies

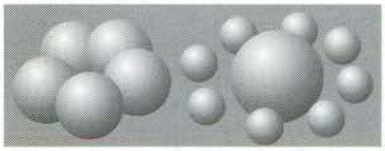
WHAT TO DO:

1. Fold the paper towel to form a square.
2. Place this paper towel in the saucer.
3. Pour enough vinegar into the saucer to cover the paper towel.
4. Place the pennies on top of the wet paper towel and wait 24 hours.
5. Encourage observations; look at both sides of the pennies.

The tops of the pennies turn green and the bottoms of the pennies stay copper coloured. Vinegar is an acid that has the chemical name of acetic acid. Part of this acid combines with the copper of the pennies to form a green coating that is composed of copper acetate. Oxygen must be present for this chemical reaction to occur. Oxygen comes from the air, and this is why the tops of the coins turn green but the bottoms do not.

To see other chemical changes that occur due to an acid see THE DISAPPEARING EGG SHELL (page 6), BONES IN KNOTS (page 7) and THE ERUPTING VOLCANO (page 8).

THE DISAPPEARING EGG SHELL



THE AIM:

to remove the shell from an egg without breaking the egg

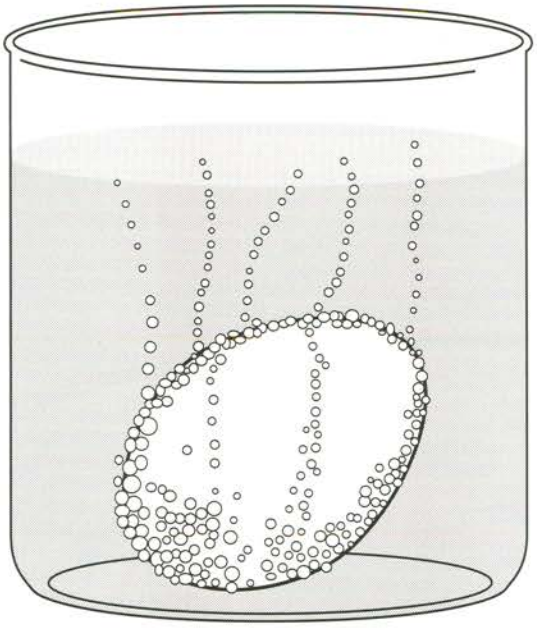
WHAT YOU WILL NEED:

- ❑ 1 glass jar
- ❑ 1 hard-boiled egg (A raw egg can be used but it can be messy if it accidentally bursts.)
- ❑ 250 mL (1 cup) of vinegar

WHAT TO DO:

1. Place the egg in the jar.
2. Cover the egg with vinegar.
3. Encourage the class to make observations immediately and 24 hours later.

Bubbles will immediately form on the surface of the egg and will increase in number over time. The bubbles are carbon dioxide gas. After 24 hours the shell is gone. The membrane of the egg remains. The chemical name of vinegar is acetic acid and egg shells are made up of calcium carbonate. There is a chemical reaction between the vinegar and the shell. This is what causes the bubbles to form initially and what causes the shell to disappear.



Allowing the egg to react with the carbon dioxide in the air will cause the egg to harden again. Chalk is also made up of calcium carbonate. What would happen to a piece of chalk if it was placed in vinegar?

For other chemical reactions with an acid see GREEN PENNIES (page 5), BONES IN KNOTS (page 7) and THE ERUPTING VOLCANO (page 8).

BONES IN KNOTS

THE AIM:

to tie chicken bones in knots with the help of chemical changes

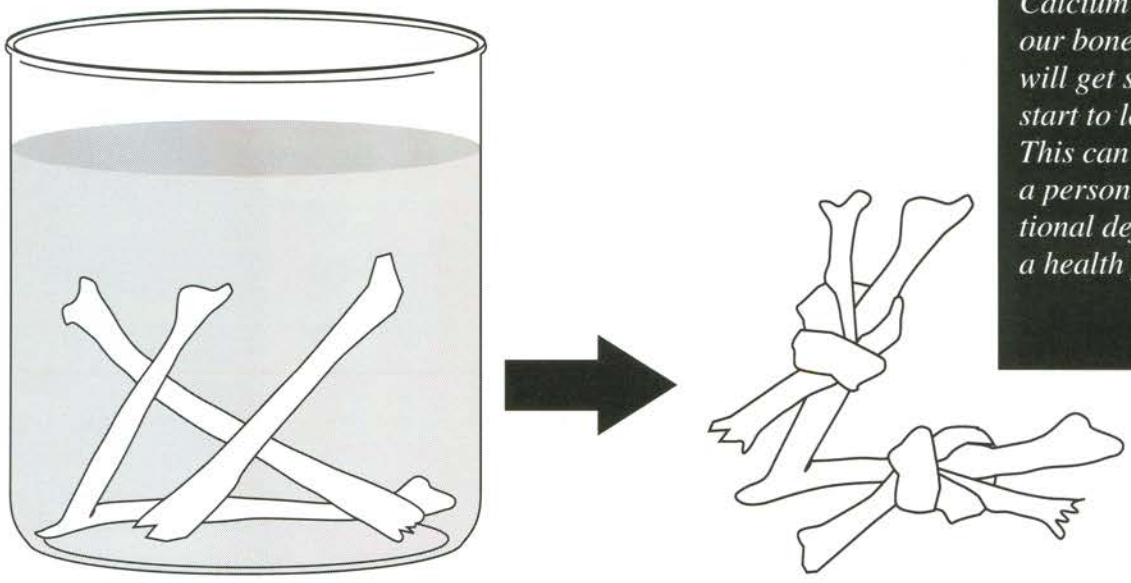
WHAT YOU WILL NEED:

- ❑ 1 large jar
- ❑ small, long, thin chicken bones, washed and clean
- ❑ enough vinegar to cover the bones

The vinegar chemically reacts with the bones so that they soften. The bones will then chemically react again with the carbon dioxide in the air and this will cause the bones to harden. This is a fun trick.

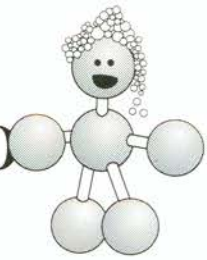
WHAT TO DO:

1. Put the chicken bones in the vinegar for 3-4 days.
2. Remove the soft bones from the solution and tie the bones in knots.
3. Set the bones aside and they will dry and harden.



Calcium is what keeps our bones hard. Bones will get soft if they start to lose calcium. This can happen when a person has nutritional deficiencies or a health problem.

THE ERUPTING VOLCANO



THE AIM:

to cause a miniature volcanic eruption

WHAT YOU WILL NEED:

- ❑ empty pop bottle
- ❑ shallow baking pan
- ❑ 250 mL (1 cup) vinegar
- ❑ 10 mL (2 teaspoons) dishwashing detergent
- ❑ 30 mL (2 tablespoons) baking soda
- ❑ red food colouring (optional)
- ❑ dirt or clay or papier maché or aluminum foil

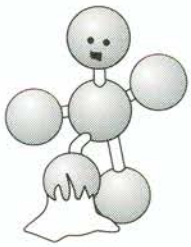
WHAT TO DO:

1. Place the pop bottle in the pan.
2. Place dirt, clay, papier maché or aluminum foil around the bottle to create the volcano.
3. Pour the 30 mL of baking soda into the bottle.
4. Add the 10 mL of dishwashing detergent.
5. Colour the vinegar using a few drops of red food colouring and pour this mixture into the mouth of the bottle.
6. Encourage observations.

Foam will spew out of the volcano. This happens because the baking soda chemically reacts with the vinegar, producing carbon dioxide gas. The gas will build up enough pressure inside to force the liquid out of the top of the bottle. The foam is produced due to the gas and the liquid mixing with the detergent.

For other chemical reactions with an acid see GREEN PENNIES (page 5), THE DISAPPEARING EGG SHELL (page 6) and BONES IN KNOTS (page 7).

IN SUSPENSE



THE AIM:

to examine the characteristics of a cornstarch suspension

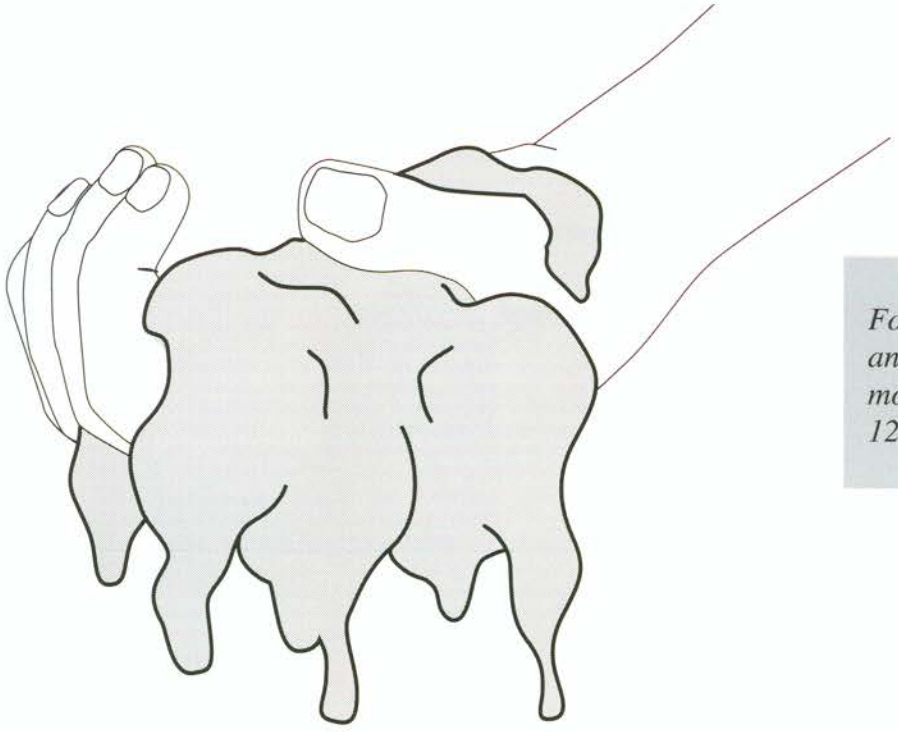
WHAT YOU WILL NEED:

- ❑ 75 mL (5 tablespoons) of cornstarch
- ❑ 45 mL (3 tablespoons) of water
- ❑ food colouring (optional)
- ❑ popsicle stick for stirring
- ❑ shallow bowl or pie plate

WHAT TO DO:

1. Put the cornstarch in a bowl or pie plate.
2. Add water and stir this mixture. It may be a little difficult to stir.
3. If you wish, add a very small amount of food colouring to colour the material.
4. Encourage the children to squeeze the mixture first and then tell them to release the pressure and ask them to make their observations.

When the mixture is pressed it feels like a solid because its molecules line up. When squeezing is stopped the molecules can relax and the material flows. This mixture has the characteristics of both a solid and a liquid. It is called a suspension.



For an explanation and demonstration of molecules see pages 12 and 13.

CRYSTAL STREAMERS

THE AIM:

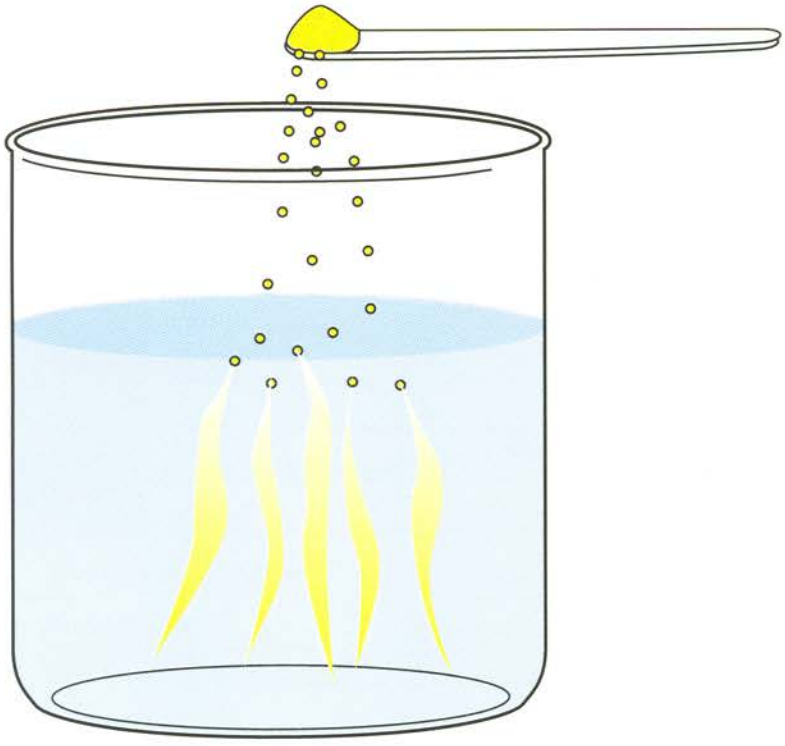
to observe a solid as it dissolves in a liquid to produce streamers of colour

WHAT YOU WILL NEED:

- ❑ 1 clear plastic drinking glass or glass jar per group
- ❑ grape or cherry juice crystals (e.g. Koolaid)
- ❑ flat toothpicks

WHAT TO DO:

1. Fill the glasses 2/3 full with water.
2. Use the flat end of the toothpick to scoop up some drink crystals.
3. Sprinkle crystals on the water's surface.
4. Encourage observations.
5. Keep adding crystals until the water is completely coloured.



The streamers of colour happen because the crystals dissolve in water as they fall. Where they dissolve there is now a solution containing the dissolved crystals.

THE PAPER BAG MYSTERY

THE AIM:

to find out what is hidden inside an inflated paper lunch bag

WHAT YOU WILL NEED:

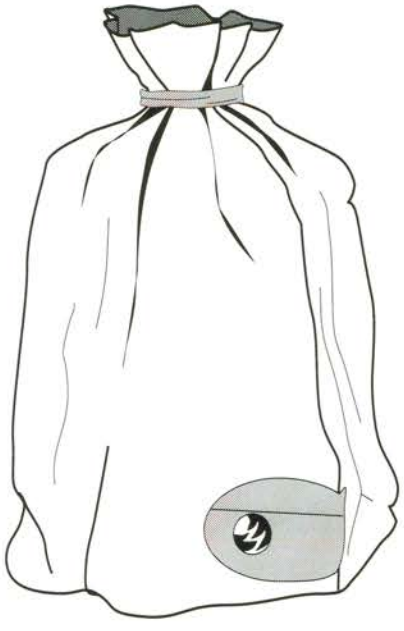
- ❑ 6 brown paper lunch bags
- ❑ marble
- ❑ penny
- ❑ pen cap
- ❑ cotton ball
- ❑ paper clip
- ❑ wrapped bouillon cube

(The above items may be replaced by items of similar size.)

This exercise is very similar to what scientists do to find out what is inside an atom. They cannot see directly inside the atom but can figure it out by other observations.

WHAT TO DO:

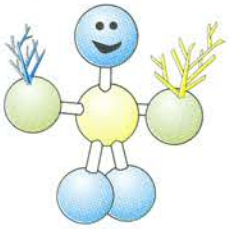
1. Insert one item into each paper bag. Label the bags with numbers and keep a list so that you know what is inside them. Make sure that your students do not know what you have put into each paper bag.
2. Put some air into each bag so that it does not lie flat and then close it with tape. List the objects that are in the bags on the blackboard.
3. This experiment can be set up in stations where the students can each take a turn at touching and moving the paper bags in attempt to figure out which object is inside. The students should keep their own lists so that answers may be compared later when the contents are revealed.



For an explanation and demonstration of atoms see pages 12 and 13.

To make this more challenging for upper grades, do not tell the children what the objects are – let them guess.

CRYSTAL GARDEN



THE AIM:

to create a crystal garden

WHAT YOU WILL NEED:

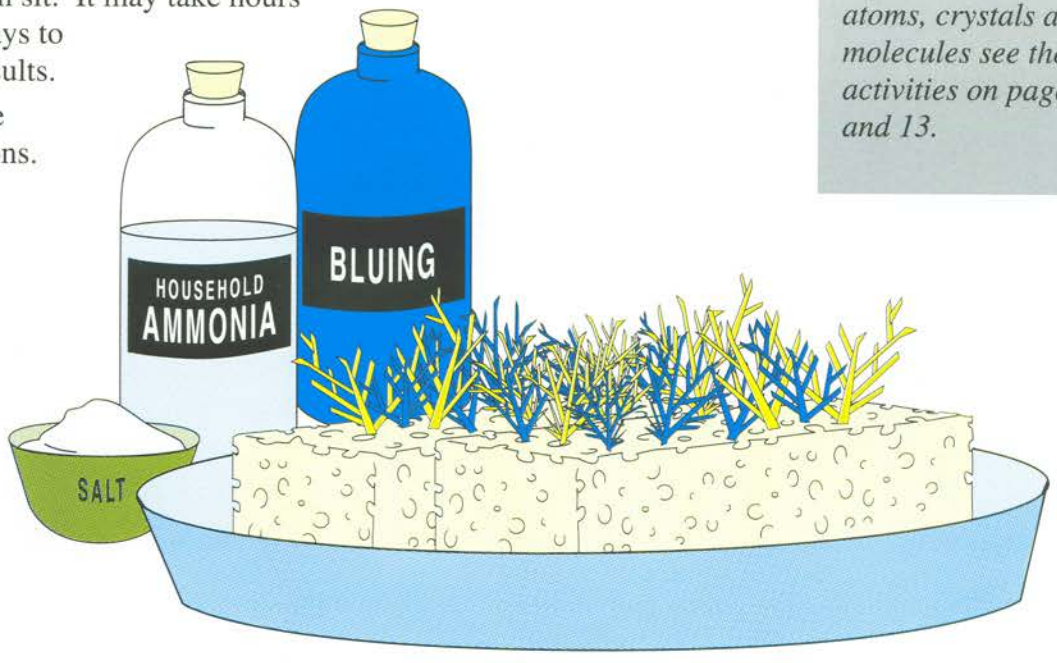
- ❑ 3 clean dry sponges
- ❑ aluminum pie plate
- ❑ glass measuring cup
- ❑ 60 mL (1/4 cup) of table salt
- ❑ 60 mL (1/4 cup) of water
- ❑ 60 mL (1/4 cup) of laundry bluing
  (Bluing can be bought by the bottle at the grocery store under the brand name of Mrs. Stewart's Laundry Bluing.)
- ❑ 30 mL (2 tablespoons) of household ammonia
- ❑ a mixing bowl
- ❑ a metal spoon
- ❑ blue and green food colouring

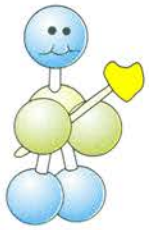
WHAT TO DO:

1. Arrange the three sponges in the pie plate.
2. Pour the salt, water, bluing and ammonia into the mixing bowl and stir to mix well.
3. Pour this mixture over the sponges and then spoon out the rest of the thick portion spreading it out evenly over the sponges.
4. Sprinkle the drops of blue and green food colouring randomly on the sponges.
5. Let the pan sit. It may take hours or even days to see the results.
6. Encourage observations.

The crystals will grow due to the liquid evaporating into the air. There are molecules in this liquid and molecules are made up of atoms. When the liquid evaporates the remaining atoms will pack together in a more favourable form called crystals. The time that it takes for this to happen will depend on how quickly the water is evaporating.

To learn more about atoms, crystals and molecules see the activities on pages 12 and 13.





ATOMS AND
AND WHERE THEY FIT IN

It must be stressed that atoms are extraordinarily small and although they join to form larger particles called molecules even the molecules are so small that we still cannot see them unless we use a very special microscope. There are about 20,000,000,000,000,000,000,000,000 atoms in a glass of water.

WHAT YOU WILL NEED:

- ❑ different coloured gum drops (Coloured marshmallows also will do.)
- ❑ toothpicks

A. MAKING MOLECULES:

WHAT TO DO:

1. Designate each colour to be a certain atom. Either write a legend on the blackboard, or have each child make an individual legend.

   Example: Yellow = hydrogen
   Blue = oxygen
   Green = carbon

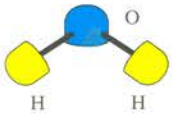
2. Encourage the children to use the gum drops and toothpicks to create molecules. They may create molecules that do not exist but that is fine.

Example: The gum drops are the atoms

Hydrogen: Oxygen: Carbon:

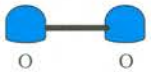
When the atoms (gumdrops) are put together molecules are created. Below are some examples of molecules children may be familiar with.

H_2O: water

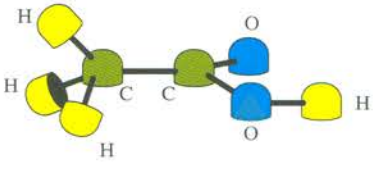


CO_2: carbon dioxide

O_2: oxygen



CH_3COOH: acetic acid



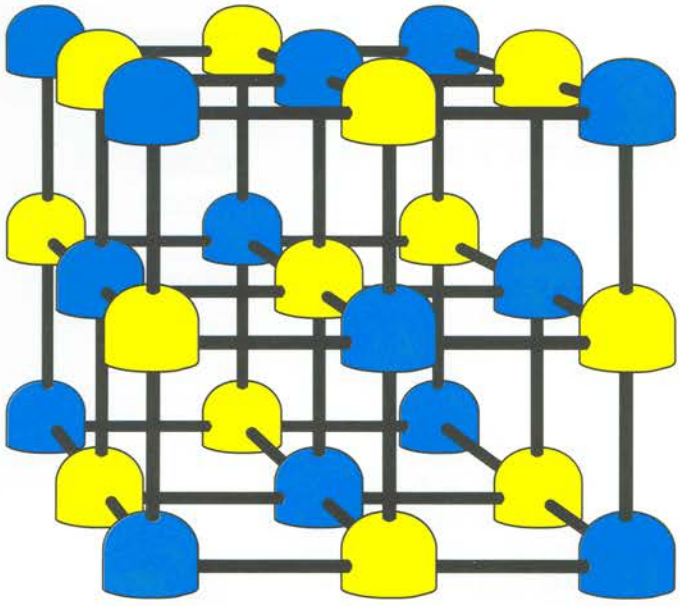
MOLECULES
WITH WHAT WE CALL MATTER

B. MAKING CRYSTALS:

To make a cubic crystal such as salt (sodium chloride) you need 27 gum drops. There should be 13 of one colour and 14 of another colour. You will also need toothpicks.

Make a model of a cubic crystal as shown. Notice that there is a particular pattern in the crystal. Each side is the same shape and the same size and each side also contains the same number of atoms.

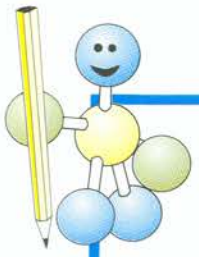
In the salt shown, each blue (sodium) atom has yellow (chlorine) atoms for neighbours, and each yellow atom has blue atoms for neighbours.



Matter is everything in this world that surrounds us. Everything around us is made up of extremely small particles called *atoms*. Atoms join with each other to form larger particles called *molecules*. Atoms and molecules connect to form everything outside of us and even inside of us. We, too, are made up of atoms and molecules.

In a crystal, atoms or molecules join together in a pattern that repeats itself over and over to create a certain shape. A crystal is able to grow by adding atoms or molecules to all its sides in the exact same pattern as the atoms and molecules that were added before.

These two pages include class activities on atoms, molecules and crystals. This is sure to be enjoyed by your students. Have fun!



SEARCH FOR CHEMISTRY IN AND AROUND YOU!

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P U C A N D Y U R A N I S G
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BLOOD
FURNITURE
CARBONDIOXIDE
SODIUM
BONES
FLOWERS
GASOLINE
KOOLAID
TOYS
OXYGEN
CALCIUM
FOOD
CLOTHES
TOOTHPASTE
WATER
MONEY
MEDICINE
CANDY

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O A T U G L A S S N H O L I J O
N R R P L A S T I C T H T A N O
N O E N U C L E R B A E T S U D
S O A P E E N R A S P I R I N O

WATER
NYLON
VINEGAR
SILVER
COPPER
GOLD
PERFUME
DYE
HYDROGEN
PLASTIC
HELIUM
SOAP
GLUE
RUBBER
CRAYONS
GLASS
CLOTHES
OXYGEN
ALUMINUM
CARBON
PAINT
ASPIRIN
SALT

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