WARNING

Not suitable for children under 8 years old. For use under adult supervision. Contains small parts that could be ingested. Handle with care. Contains some chemicals which present a hazard to health. Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes. Read the instructions before use, follow them and keep them for reference. Keep small children and animals away from experiments. Keep the experimental set out of reach of children under 8 years old. Eye protection for supervising adults is not included. This image is for illustrative purposes only, some parts or colours may differ. Keep this information for future reference.

AVAILABLE ONLINE: FI DK NO SE CZ

www.hamleys.com/explore-SuperSciencelabkits.irs

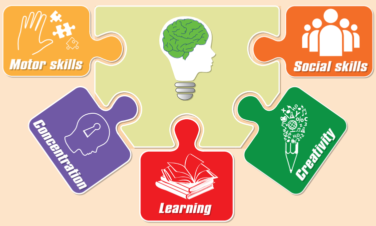
Dear parents and guardians

Through play, children develop different cognitive skills. Scientific studies show that when we are having fun or making discoveries during an experiment, a neurotransmitter called Dopamine is released.

Dopamine is known to be responsible for feelings like motivation, reward and learning and that's why experiences are related to positive feelings. So, if learning is a positive experience, it will stimulate the brain to develop various skills.

Therefore, Science4you aims to develop educational toys that combine fun with education by fostering curiosity and experimentation.

Find out below which skills can be developed with the help of this educational toy!



The educational feature is one of the key strenghts of our toys. We aim to provide toys which enable children's development of physical, emotional and social skills.

Find out more about the Brain Activator in Science4you toys at:

www.science4youtoys.co.uk/brain-activator

Science4you
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This book was produced in accordance with the curriculum goals of Natural Sciences and Physical Chemistry subjects of the following key stages:

- Key stage 1 and 2
- Key stage 3
- Key stage 4

Index

SAFETY RULES

- Read these instructions before use, follow them and keep them for reference.
- Keep young children, animals and those not wearing eye protection away from the experimental area.
- Always wear eye protection.
- Store this experimental set out of reach of children under 8 years of age.
- Clean all equipment after use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers are disposed of properly.
- Wash hands after carrying out experiments.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Do not replace foodstuffs in original container. Dispose of immediately.
- Do not apply any substances or solutions to the body.

GENERAL FIRST AID INFORMATION

- **In case of contact with eyes:** wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
- **If swallowed:** wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- **In case of inhalation:** remove person to fresh air.
- **In case of skin contact and burns:** wash affected area with plenty of water for at least 10 minutes.
- In case of doubt, seek medical advice without delay. Take the chemical and its container with you.
- In case of injury always seek medical advice.

Write the telephone number of the local poison centre or hospital in the space below. They may be able to provide information on countermeasures in case of poisoning.

In case of emergency dial
USA 911 | UK 999 |
Australia 000 | Europe 112

LIST OF CHEMICAL SUBSTANCES SUPPLIED

Chemical substance	Chemical formula	CAS number	
Calcium chloride	**$CaCl_2 \cdot 2H_2O$**	**10035-04-8**	**Attention**
Hazard Statement: **H319:** Causes serious eye irritation. **Precautionary Statement — Prevention:** **P264:** Wash hands thoroughly after handling. **P280:** Wear protective gloves/protective clothing/eye protection/face protection. **Precautionary Statement — Response:** **P305 + P351 + P338:** IF IN EYES: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. **P337+P313:** If eye irritation persists: Get medical advice/attention.			
Sodium Alginate	**$NaC_6H_7O_6$**	**9005-38-3**	

DISPOSAL OF USED CHEMICALS

When you need to dispose of chemical substances, it is necessary to make reference to national and/or local regulations. In any case you sure never throw chemicals into sewers and garbage. For more details please refer to a competent authority. For disposal of packaging make use of the specif collections points.

ADVICE FOR SUPERVISING ADULTS

Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.

The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.

This experimental set is for use only by children over 8 years.

Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.

The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids, alkalis and flammable liquids.

The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided.

Kit contents:	Quantity:
1. Protective goggles	1
2. Protective gloves	2
3. Pasteur pipettes	4
4. Test tubes with lids	4
5. Large measuring cup	3
6. Small measuring cups with lids	3
7. Plastic container	2
8. Wooden spatula	4
9. Plastic spatula	1
10. Plastic bag with zip-lock	3
11. Flask for sodium alginate solution	1
12. Calcium chloride	1
13. Green food colouring	1
14. Red food colouring	1
15. Yellow food colouring	1
16. Blue food colouring	1
17. Sodium alginate	1
18. Guar gum	1
19. Cornflour	1

1. What are polymers?

The word "polymer" comes from the greek word *polumeres*, which means "to have many parts". Polymers are very large molecules formed by the repetition of small chemical units called monomers (mono in greek means "one").

Think about when you play with a puzzle (2D or 3D). Each part that you handle is a monomer and when the puzzle is completed you have a polymer.

DID YOU KNOW...
...that polymers are giant molecules and their weight is higher than the small molecules weight, such as water molecules? That weight is at least 100 times higher.

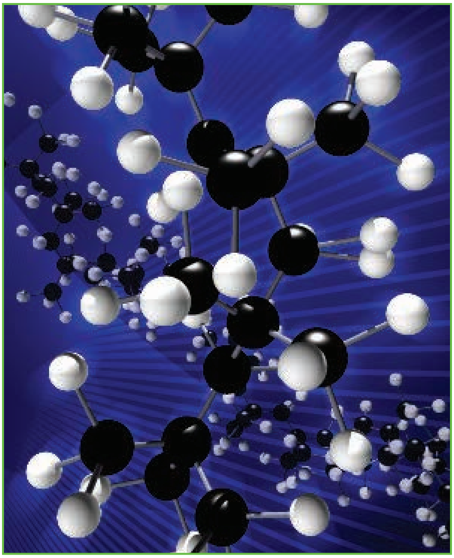


Image 1. Polymer.

2. Atoms and molecules

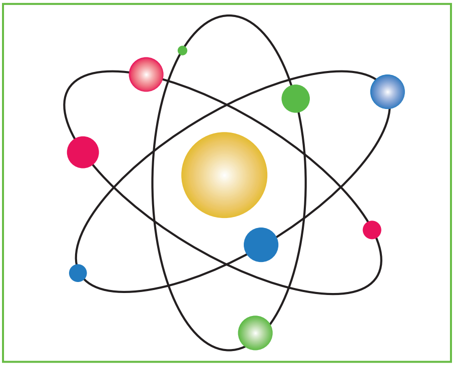


Image 2. Atom.

First you must know what atoms and molecules are, so that you understand what a polymer is.

Take a look around! There are millions of different substances: metals, plastics, glasses, people, plants, etc.

Each of these substances are formed by small particles, bonded together in different ways. These particles are called **atoms** and they are the smallest matter's particles known until now.

Each atom is composed of a nucleus, formed by protons and neutrons, and also by electrons that spin around the nucleus, forming a cloud of electrons - **electron cloud**.

Protons have positive charge, electrons have negative charge and neutrons, as the name itself says, have no charge at all.

DID YOU KNOW...
...that the most abundant atoms in nature are Carbon (C), Hydrogen (H) and Oxygen (O)?

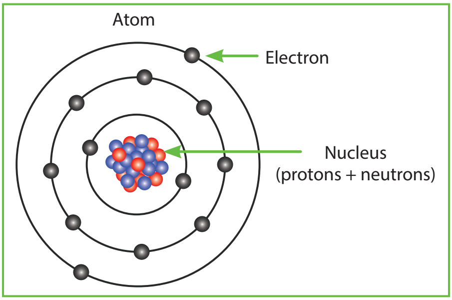


Image 3. Structure of the atom.

When the atoms bond together, trough chemical connections, **molecules** are formed. These molecules can be simple or very complex.

DID YOU KNOW...
...that water, as we know it, is essential to life?
Water is part of our body, part of the food we eat and is also part of the atmosphere, so water is everywhere.
Around 2/3 of the Earth surface is covered with water, and this is the reason why it is commonly called The Big Blue Marble.

The water molecule is probably the one you have heard about the most. This molecule is formed by two atoms of hydrogen bound to one atom of oxygen (H_2O). There are millions of water molecules in a single drop.

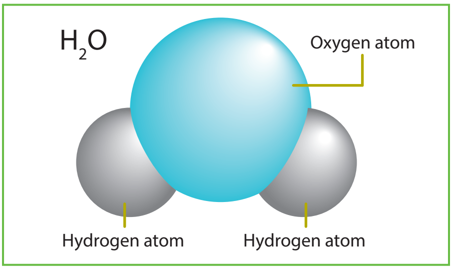


Image 4. Water molecule.

DID YOU KNOW...
...that the hydrogen peroxide molecule has one more oxygen atom than the water molecule?
The hydrogen peroxide chemical formula is H_2O_2. As the name itself says, it is more oxygenated (has one more oxygen atom) than the water molecule, presenting two atoms of hydrogen and two of oxygen.

The **chemical elements** are substances formed only by one type of atom, such as iron, helium and gold. On the other hand, chemical compounds are chemical substances, formed by atoms of different types of elements.

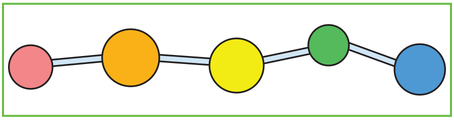


Image 5. Illustration of a molecule formed by several atoms.

DID YOU KNOW...
...that 118 different elements were discovered?
You may find them all, as well as their symbols in the Periodic Table.

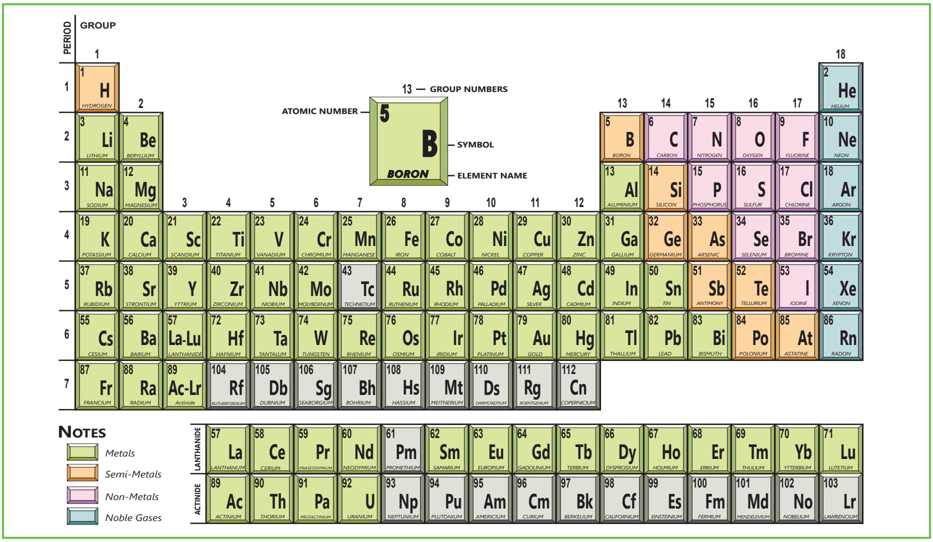


Image 6. Periodic Table. Some examples of substances formed by atoms of the above mentioned chemicals are: helium balloons that have helium inside; iron bars formed by iron atoms; neon atoms often used in advertising; copper wire formed by copper atoms.

Chemical bonds

Rarely we found atoms alone in nature.

They tend to gather through forces called chemical bonds.

There are two types of chemical bonds: intramolecular and intermolecular.

The **intramolecular bonds** are forces that join together the atoms in a molecule and there is electron sharing so that the atoms have a neutral electrical charge.

Intermolecular bonds are forces between several molecules that form a certain substance. The strength of these forces will define their state of matter (solid, liquid, gas or plasma).

3. Characteristics of polymers

Polymers are substances composed by several molecules, of which one or more types of units are repeated (monomers). Polymers are very long chains of which atoms are side-by-side, bound together like bricks on a wall.

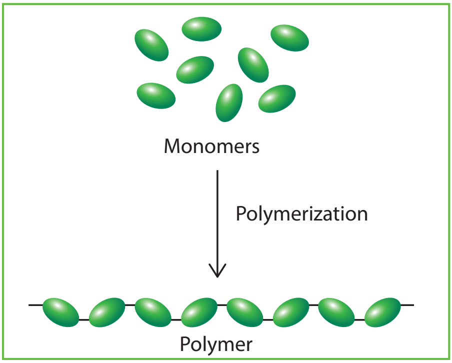


Image 7. Polymerisation reaction.

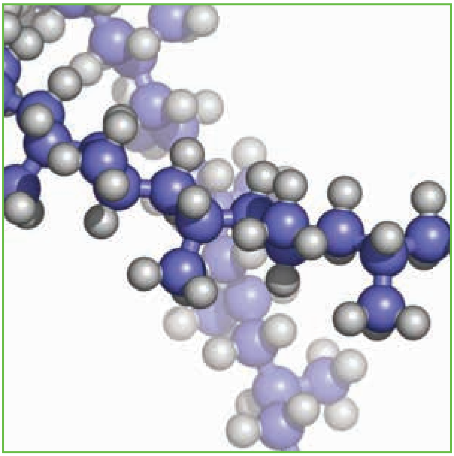


Image 8. Polymer.

When several monomers join together they give rise to polymers. Therefore, polymers are large molecules.

4. Polymers in our everyday life

Certainly, you have never stop to think about the composition of many of the objects around you and which you use everyday.

You would be surprised with the amount of objects made from polymers.

Apart from metals and organic compounds everything else is made from polymeric materials.

Polymers can be divided into 3 categories:

- Thermoplastics: commonly called plastics, constitute the major part of commercial polymers. These are easily recycled for they can be fused many times. Thermoplastics can present different characteristics and for this reason they can be malleable, stiff or fragile.

- Thermorigids: are rigid, and quite stable under temperature variations.

- Elastomers: are commonly referred as rubbers and these belong to an intermediary category between thermoplastics and thermorigids. These polymers present a high elasticity.

Most polymers present common characteristics as:

- Weightlessness
- Hard to brake
- Recyclable
- Easy to mould
- Safe and non-toxic
- Long-lasting

Some examples of polymers are:

- Proteins in our body

Image 9. Human skin.

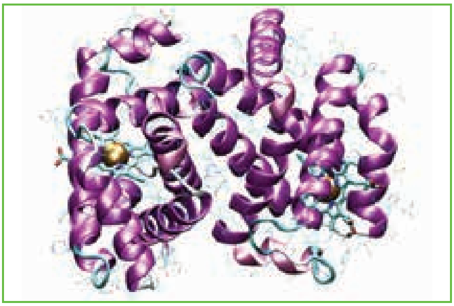


Image 10. Proteins.

- Fiber clothing: Nylon, polyester, Dacron, etc.

Image 11. Clothes.

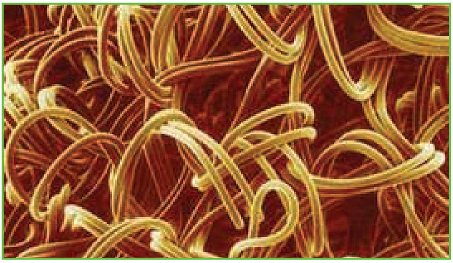


Image 12. Synthetic fibers.

- Starch

Image 13. Potatoes containing starch.

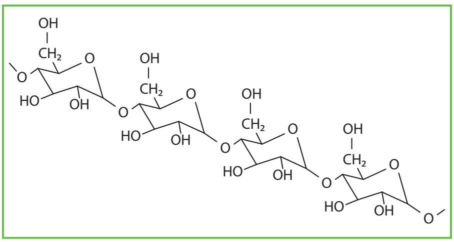


Image 14. Starch polymer.

- Tyres

Image 15. Rubber tyre.

- Paints

Image 16. Can of paint.

- Plastic

Image 17. Plastic beads.

Image 18. CD's.

Image 19. PET bottles.

- Electrical equipment

Image 20. Electrical outlet.

As you already know, currently it would be impossible for us to live without products made up of polymeric material.

5. Physical state of matter

Everything that is made up of matter, it has mass and occupies space. Every substance exists in liquid, solid or gaseous state. Such as your cap eraser, your pencil or the water you drink is visible and palpable.

The difference between these 3 physical states is how the molecules and atoms organise themselves, the force they hold and their motion as well.

Solid

A solid substance has definite shape and volume and higher or lower stiffness.

In the solid state, atoms are close together, bound by powerful forces that keep them in certain positions. As I result, the molecules are arranged in regular, repeating patterns.

Liquid

When a substance is in the liquid state, it has definite volume but it doesn't have its own particular shape, assuming the shape of its container. For instance, if you pour water (35.20 UK fl. oz/1L) into another recipient, it will take the shape of its container but its volume will not.

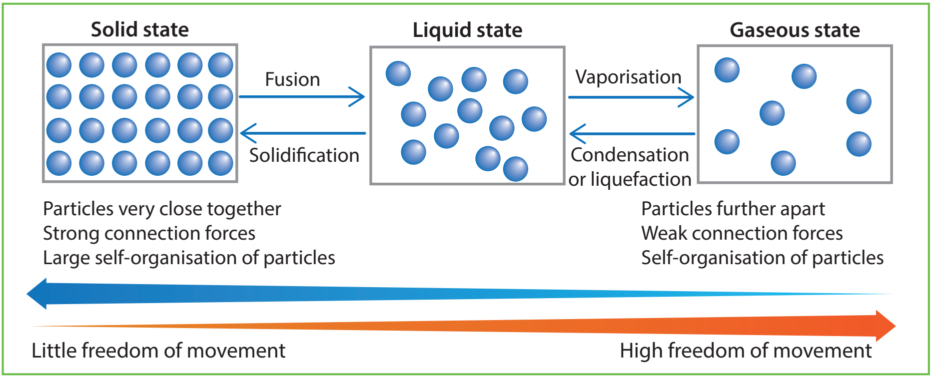


Image 21. Particles organisation in the three main physical states of matter.

Liquids don't have the same stiffness as the solids do due to fact that their molecules are further apart from each other, and also because their forces are weaker and therefore constantly breaking. This is the reason why liquid substances have more freedom of movement and are more fluid.

Gaseous

Substances in the gaseous state have no shape or definite volume of its own, occupying all the available free space. For instance, if you have gas stored in a recipient and you open it, the gas will release itself, dispersing and occupying the available space.

The molecules, on gases, are so widely dispersed and apart from each other that there is practically no interaction between them and therefore their shape and volume easily varies.

DID YOU KNOW..

...that through the temperatures changes, solid, liquid or gaseous materials can alter and change their physical state?
Water, for instance, can pass into those 3 states by increasing or decreasing the temperature.

For instance, if you put water in the freezer it will solidify due to the temperature decreasing. The transition from liquid state to the solid state is called **solidification**.

Still, the opposite also happens. If you take the ice cube tray out of the freezer and remove an ice cube and then placing it at room temperature, it will melt because the room temperature is higher than the freezer temperature. The transition from solid state to liquid state is called **fusion**.

If you heat water above 100°C (212ºF) it will start **boiling**, that is to say, it will pass into the gaseous state.

Nevertheless, below 100°C (212ºF) the water also changes from one state to the other. This process is called **evaporation** and it is a natural phenomenon, being observed for e.g. when your clothes are drying. The transition from the liquid state to the gaseous state, it's called **vaporisation**.

You may observe this process by heating water in a a pot and then watch the release of water vapour (steam).

Is you cover the pot with a lid, you will notice that when the water vapour cools, **condenses** passing once again into the liquid state and therefore accumulates in the form of drops under the pot's lid.

You can perform this experiment by pouring very cold water and observe that after some time droplets form on the outside of the cup. This happens due to the water in the air which condenses when contacts with the cold surface of the glass.

That is to say, it passed from the gaseous state into the liquid state, and this process is called **condensation**.

Viscosity

Viscosity is a property of fluids (liquids and gases) which determines their ability to resist shape changing and their own movement.

For instance, cold olive oil presents high viscosity and flows very slowly, whereas, water has a lower viscosity level and therefore it flows quite easily.

Image 22. Olive oil in water.

Fluids with high viscosity level resist to movement, such as honey, whereas fluids with low viscosity level, such as water, flow easily.

6. Viscous substances

Polymers long chains move so slowly that they make polymer to flow very slow. The larger the chains are, the slower the flux will be and consequently the polymer will be more viscous.

This is why some polymers look like mucus and drool.

The more viscous they are, the funnier it is to play with them!

Images 23, 24 and 25. Viscous substances examples.

These viscous substances can be classified as non-newtonian fluids. A non-newtonian fluid is a liquid whose viscosity is variable, depending on the force applied to it.

For instance, if you make a mixture out of Corn flour and water, you will notice that when lightly touched this mixture behaves like a thin and aqueous liquid. However, if you apply force to it, it will behave like a solid.

Some non-newtonian fluids examples are quicksand, ketchup or glue.

7. Substances and mixtures

Do you know what a substance is?

We often use this word but probably we don't know its definition!

A **substance** is a material composed of only one kind of molecules or atoms. It has a specific composition and characteristic properties.

There are two types: **simple substances** and **compounds**.

Simple substances are composed of only one kind of atoms, such as oxygen, which is formed by oxygen atoms, or iron, formed only by iron atoms.

Compounds are composed of different atoms but only of one type of molecules, such as pure water.

Water is formed by two hydrogen atoms and one oxygen atom, that is to say that water is formed only by H_2O molecules.

Therefore, a substance has always to be pure! When a substance is not in its pure state it is called a **mixture of substances**. These mixtures can be **homogeneous** or **heterogeneous**.

It is said that a mixture is homogeneous when two substances mix completely and it is impossible to distinguish one from another, such as in the water and sugar mixture.

In this case, sugar **dissolves** completely in water, forming an homogeneous mixture called solution.

In a solution, the dissolved substance which is in smaller amount is called **solute** (in this case sugar).

On the other hand, the substance in which the solute is dissolved, and which is in larger amount, is called **solvent** (in this case water).

A mixture is heterogeneous when two substances don't mix completely, such as water and oil. It is said that these are **insoluble** substances.

DID YOU KNOW...

...that some liquids don't mix due to their density difference?

In the case of water and oil, the oil has a lower density than the water. Density is like weight, and because oil weights less than water we say that it has a lower density.

Did you notice that the matter around us is in constant change? You can observe all this changes in your everyday life, when a glass breaks, the ice melts or a match burns. These changes can be physical or chemical.

Physical transformations are considered to be transformations that occur without new substances being formed. Such as the physical state changes (vaporisation, solidification, condensation, fusion) or the dissolution of a solute in a solvent (dissolution of water and sugar).

Image 26. Boiling water is the result of a physical transformation.

Chemical transformations occur when there is new substances formation out of initial substances that react and form a new substance. Some examples of chemical transformation are: soup cooking, the rusting of a nail or fruit ripening.

Image 27. Firework is also the result of a chemical transformation.

In a chemical transformation, the initial substances are called **reactants** and the new substances formed known as **reaction products.**

These chemical transformations can occur through the heat action or mechanical action.

Chemical reactions and transformations happen and they can be influenced by some factors, namely:

- concentration of reactants (usually, if their concentration is increased, there will be more reactant particles for the same volume and the rate of the reaction increases as well);

- characteritics of the reactants (e.g. if a solid reactant is broken into small pieces, its surface area is increased and the rate of the reaction will increase as well);

- temperature (usually, an increase in temperature is accompanied by an increase in the reaction rate, although after a certain point, some of the chemical species may be altered);

- catalysts (they increase the rate of reaction by lowering the activation energy needed).

Image 28. Chemical reactions in which colour change occurred.

How do we know when a chemical reaction or chemical transformation is occurring?

Well, we have to use our senses!

Therefore, we know that a chemical transformation is occurring if there is:

- colour change;
- gas releasing;
- formation of a solid/precipitate;
- characteristic smell;
- formation of a flame;
- temperature increasing or decreasing;
- substance/initial reactants disappearing.

In this experiments kit we will perform chemical transformations called **polymerization reactions**, by using some reagents in order to transform the used substances into new substances through the monomer aggregation.

The polymerization reactions consist in water molecules union (monomers) of a certain substance through the action of an emulsion or catalyst, causing the formation of a polymer.

8. Substances and reagents

To perform the experiments of your new toy: "Super Lab Slime" kit, you will have to use some substances.

Although you may not know what these substances are, they are present in the foods of your everyday life. Foods have some chemical substances which might have various functions.

If you like you may check your food components by observing the package label.

A label is a paper that you find in food and substances and which offers some additional information about what it is inside the package.

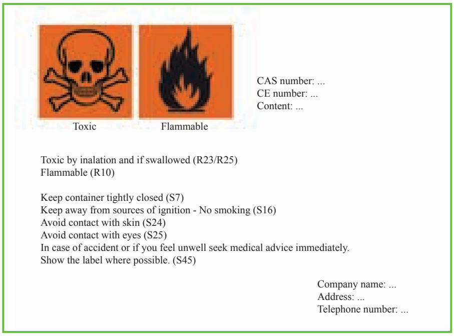


Image 29. Label of a chemical product with safety warnings to inform the user.

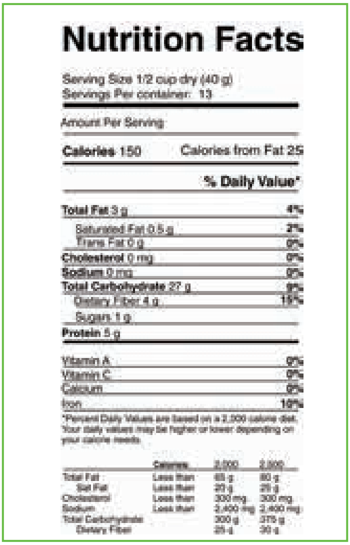


Image 30. Food label.

Some of the most important functions that food additives may have are: gelling, conservation, flavour intensifier, food colouring, emulsifiers, etc.

a) Sodium alginate

The alginates are substances that belong to the gels food additive group, namely sodium alginate, which is used in some foods to create and give structure.

This substance is a polymer extracted from seaweeds. It appears as an odorless and tasteless powder that might have a colour shade between yellow and white.

Image 31. Seaweed of *Macrocystis* type, from which alginate comes from.

It is quite soluble in water (hydrosoluble) and has the capacity of forming a viscous solution.

You may find sodium alginate in foods, such as milk ready-made chocolate milk, ice creams, ready-made sauces and cake toppings.

Image 32. Milk with ready-made chocolate (a mixture that usually has sodium alginate).

b) Calcium chloride

Calcium chloride is a substance that can be found in the sea water and which has calcium and chlorine, the two main components. Calcium chloride is a salt.

Image 33. Calcium chloride.

This substance is used in the food industry as a food preservative and is very common in canned foods. Is often used to react with the sodium alginate.

Image 34. Canned tuna is one of the foods that has calcium chloride.

c) Guar gum

Guar gum is a protein extracted from a plant named *Cyamopsis tetragonolobus*.

Seeds are extracted from this plant and a flour is produced. This flour is known as guar gum.

Image 35. *Cyamopsis tetragonolobus*, plant from which the gum is extracted.

The food industry uses Guar gum as a thickener to give texture and viscosity.

It is capable of bounding ingredients and can reduce the water loss and for this reason is considered a thickener. It is often used in cake and sweets.

Image 36. Foods containing guar gum.

Hello scientist!
Are you ready for the research?
Find out next which experiments we have for you!

9. Experiments

Attention scientist!
To perform the experiments 5, 6, 7, 8, 9 and 10 you must perform experiments 1, 2 and 3 first. Have fun!

★ **Material included in the kit.**

Don't forget to put your protective gloves and goggles every time they are showned in the material list!

Experiment 1
Sodium alginate solution

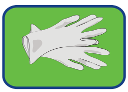
Sodium alginate is an organic salt from brown algae (i.e. *Macrocytis*, *Fucus*, *Laminaria ascophilum*), found in the cold seas. Its chemical formula is $NaC_6H_7O_6$.

It is often presented as a white powder, insipid, almost odorless and hydrosoluble. It is a gelifying agent, for it allows gel formation.

It reacts with calcium, forming a thermo irreversible gel (it doesn't go back to its liquid state with warmth). This gel formation will form a pellicle which coats the spheres resulting from spherification (a technique of external gelification).

ATTENTION: ask an adult for help.

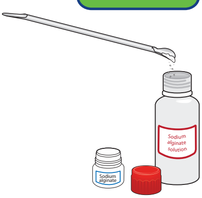
What you will need:
- Sodium alginate ★
- Flask for sodium alginate solution ★
- Hot water
- Plastic spatula ★



Steps:

1. Put on the protective goggles and the gloves.

2. With the help of the plastic spatula, pour half of the sodium alginate into the 120 ml flask.



3. Cover the flask containing the sodium alginate and save it close to the remaining materials so that you can make this solution again.

4. Fill the flask with warm water, just like the image shows (120 ml).

Suggestion: Put the water running before you place the flask under the water tap.

5. Place the lid on the flask and shake it for 20 minutes or more.

Suggestion: If you want to wait for the sodium alginate to dissolve completely, let the flask rest overnight and perform the experiment the next day.

DID YOU KNOW...
...that this procedure is called *overnight*? It is quite used by scientists in the laboratory experiments, such as promoting the rising of bacterial cultures. These are placed inside of an incubator with the necessary growing conditions.

6. Your sodium alginate solution is ready!

Note: Throughout the experiments, shake the flask before each use.

Experiment 2
Calcium chloride solution

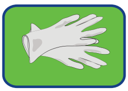
Calcium chloride is a salt soluble in water. It is produced from limestone, which is a source rich in calcium. Its chemical formula is $CaCl_2nH_2O$, and the "n" varies from 0 to 2.

Usually calcium chloride presents itself in the form of white or colourless crystals and it is odorless. Calcium chloride is a hygroscopic compound, that is to say, it absorbs moisture from the air. It dissolves in water and joins ingredients together avoiding water to be separated from the mixture.

Is a gelifying agent for using strictly with alginates, reacting with these to form gels.

DID YOU KNOW...
...that calcium chloride is quite used in the food industry for the production of cheeses promoting their coagulation?

What you will need:

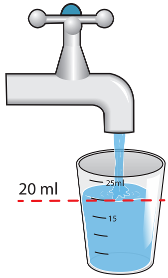


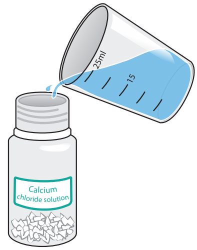
- Flask with calcium chloride ⭐
- Water
- Small measuring cup ⭐

Steps:

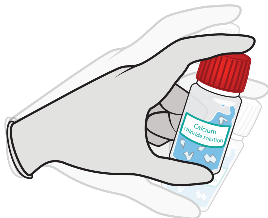
1. Put on your protective goggles and gloves.

2. Fill the small measuring cup with water, until 20 ml, and add it to the flask which contains calcium chloride. Make a new measurement, however this time only up to the mark 10 ml. Add it to the flask as well.





3. Close the flask and shake it several times until the calcium chloride is completely dissolved.

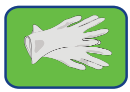


Note: If you don't use the calcium chloride solution flask for some time, it is possible that the powder settles at the bottom of the flask. Make sure you shake it every time you need to use it.

4. Your calcium chloride solution is ready!

Experiment 3
Calcium chloride dilution

What you will need:

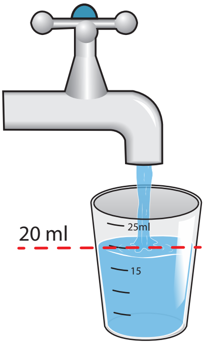


- Calcium chloride solution ⭐
- Small measuring cup ⭐
- Large measuring cup ⭐
- Pasteur pipette ⭐
- Water
- Plastic container ⭐

Steps:

1. Put on your protective goggles and gloves.

2. Make two measurements in the small cup: one with 20 ml and another with 10 ml. Transfer the water from both measurements to the plastic container.

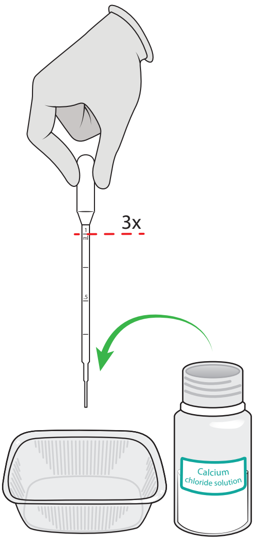


Suggestion: Put the water running before you place the flask under the water tap.

3. Carefully, open the flask on which you prepared the calcium chloride solution.

4. With the pipette, measure 3 ml of solution and pour it into the plastic container.

Note: Save this pipette separately for it will be used only with the calcium chloride solution.



Suggestion: First, practice with water so that you master the pipetting technique. Press the knob of the pipette and hold it. Then insert the tip of the pipette in the water and release the knob slowly, until the pipette reaches 1 ml. To release the water into another recipient you just have to press the knob again.

You have just perform a dilution! By pouring 3 ml of calcium chloride solution in 30 ml of water you obtained a dilution of calcium chloride solution.

Dilution

A dilution is a procedure very common in laboratory practices, used to make less concentrated solutions, by adding more solvent to the already made solution.

We also perform dilutions in our daily life, such as when we add water to concentrated juice.

Suggestion: You can make up to 9 new dilutions. You can also make a new dilution every time a dilution gets too dirty. Although the dilution is dirty, it still works.

In the next experiments you will use the calcium chloride dilution. When the alginate drops added to the calcium chloride don't form a gel, then it's time to make a new dilution.

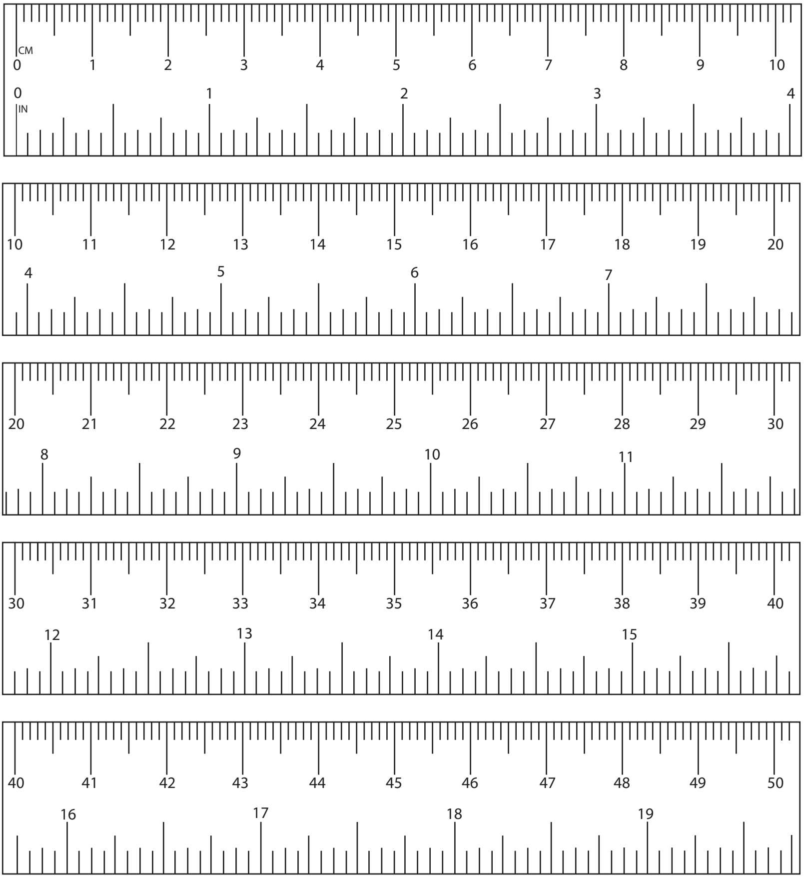
Experiment 4
Tape measure

Let's make a tape measure that will be very useful in games competitions that you will find later on. You can choose one of the following options to make your tape measure:

Option 1 - Make a photocopy of this page, then cut the tape measure images and attach them with adhesive tape.

Option 2 - Pick up a ruler, paper and pencil and draw your own tape measure. Then you just have to cut it out with a scissor.

Option 3 - If you have a 50 cm (19.7 in) ruler, you can simply use it in the games competitions that you will find later on.



Experiment 5
The multiplying monster

What you will need:

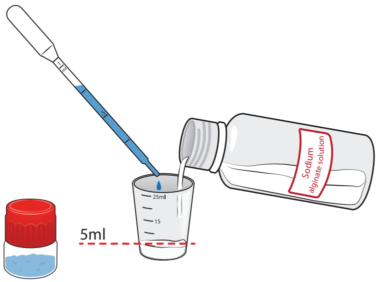
- Sodium alginate solution
- Blue food colouring
- Small measuring cup
- Wooden spatula
- Pasteur pipette
- Pipette from the calcium chloride solution
- Plastic spatula
- Plastic container with the calcium chloride dilution (exp. 3)
- Test tube with lid

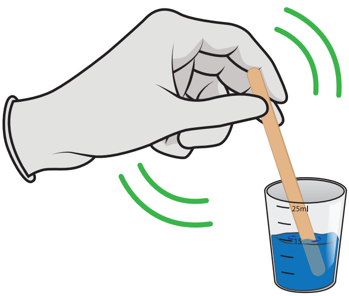
Steps:

1. Put on your protective goggles and gloves.

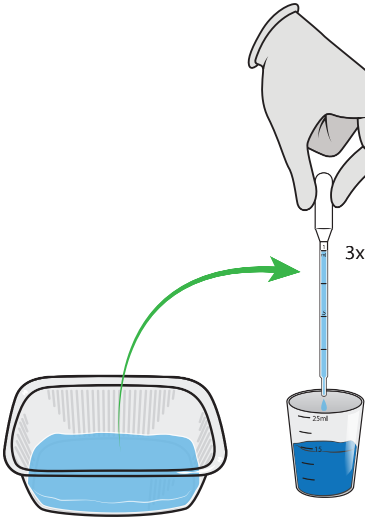
2. In the small measuring cup add 5 ml of sodium alginate solution.

3. With the pipette, add blue food colouring to the measuring cup. Mix well with the wooden spatula.



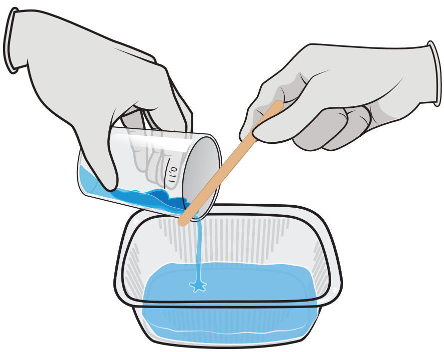


4. With the pipette from the calcium chloride solution remove 3 ml from the plastic container solution and add it to the cup that contains the sodium alginate solution.



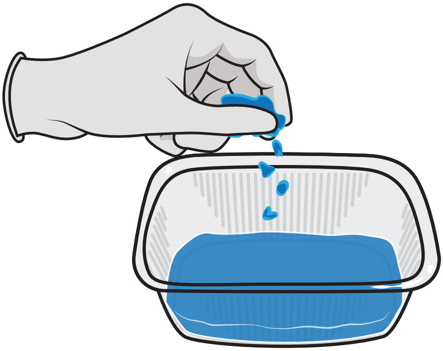
5. Slightly shake the cup so the liquid can involve all the sodium alginate solution. Wait a few seconds.

6. Tilt the cup a little to remove the calcium chloride solution remains into the plastic container. Use the wooden spatula to make sure that only the calcium chloride remains are removed.



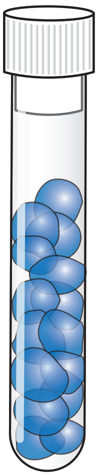
7. Hold your blue monster always with the plastic container under it. Squeeze it and let it drain into the plastic container. What happened?

Note: If the water becomes slightly blue, don't worry, it's normal!



8. Your blue monster transformed into tiny little monsters.

9. You can fill in the test tube with the remaining little monsters. Use the plastic spatula to catch them.



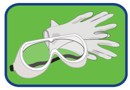
Can you explain what happened?

Explanation:
The calcium present in the solution bonds with the alginate molecules, starting by the outer part of the drops, forming a layer that covers the spheres. This is why the interior of the drops is 'gelatinous'.

Slowly, the calcium chloride enters inside the drops, hardening the gelatinous content.

Experiment 6
Coloured worms

What you will need:



- Small measuring cups ★
- Green food colouring ★
- Red food colouring ★
- Wooden spatulas ★
- Pasteur pipettes ★
- Pipette from the calcium chloride solution ★
- Sodium alginate solution ★
- Plastic container ★
- Test tube with lid ★
- Plastic spatula ★
- Calcium chloride solution ★

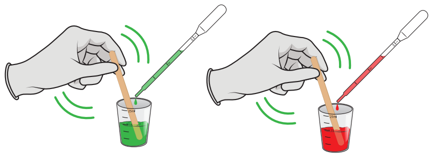
Steps:

1. Put on your protective goggles and gloves.

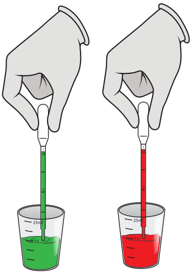
2. As you've learnt on experiment 3, prepare a dilution of 3 ml of calcium chloride solution in 30 ml of water. Use the plastic container to carry out this step.

3. In two measuring cups pour 15 ml of sodium alginate solution in each one.

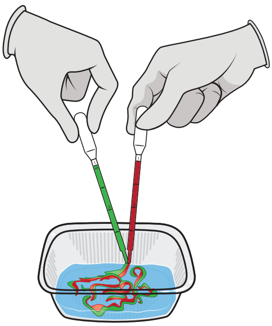
4. With the help of the pipettes, add green colouring to one cup and red to the other. Mix well.



5. Make sure you have two pipettes well washed. With one of the pipettes, collect some solution from the green cup and with the other pipette do the same however this time for the red solution.



6. Place the tip of the pipettes next to each other and slowly and continuously, start dripping the content of the pipettes into the container with the calcium chloride dilution.

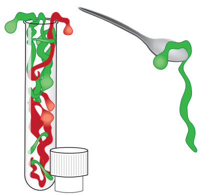


Move the pipette in circles to create your own coloured worms. It is required a great skill!

Suggestion: Tight the pipette's knob continuously and then point it with a stronger squeeze.

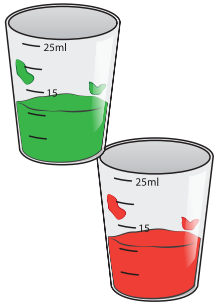
Did you create your coloured worms?

7. Use the plastic spoon and try to collect your worms. Put them in a test tube on which you can save them.



<u>Is there any green and red alginate solution left?</u>

Place the lids on the cups and store them in a fresh place and away from foods, for it will be useful in another experiment.



Experiment 7
Slime coal stone

What you will need:

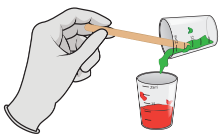
- Remaining red and green solutions (exp. 6)
- Sodium alginate solution
- Red food colouring
- Green food colouring
- Large measuring cup
- Wooden spatula
- Plastic container
- Pipette from the calcium chloride solution
- Calcium chloride solution
- Pasteur pipettes

Steps:

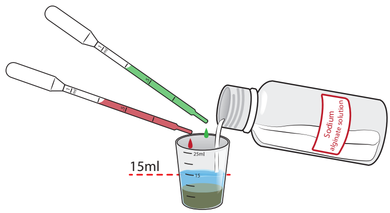
1. Put on your protective goggles and gloves.

2. With your knowledge from experiment 3, prepare a dilution of 3 ml of calcium chloride solution in 30 ml of water. Use the plastic container to carry out this step.

3. Use the wooden spatula to gather the remaining red and green solutions from experiment 6 in a single measuring cup.

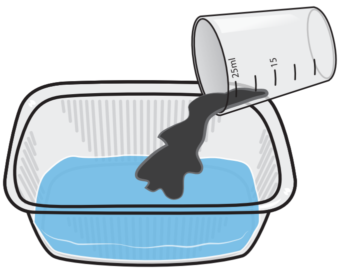


4. Add a little bit more of red and green food colouring and then add the sodium alginate solution until 15 ml.



5. Stir well until you obtain a brown/black mixture. It's the ideal colour for coal!

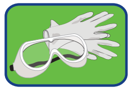
6. From about 1 cm (0.34 in) distance of the calcium chloride container, pour the mixture directly from the cup into the plastic container.



7. Remove the 'coal stone' from the container, wash it in cold water and have fun!

Note: In the end, wash all the equipment for it is quite dirty.

Experiment 8
Catch me if you can



What you will need:
- Small measuring cups
- Yellow food colouring
- Plastic spatula
- Plastic container
- Pipette from the calcium chloride solution
- Calcium chloride solution
- Pasteur pipettes

Steps:
1. Put on your protective goggles and gloves.

2. Prepare another calcium chloride dilution, such as you've learnt on experiment 3.

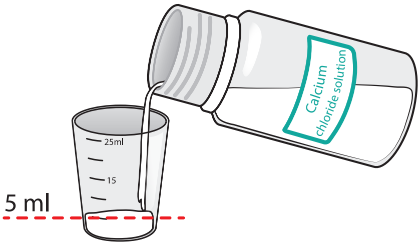
3. Put 20 ml of sodium alginate solution in a small measuring cup.

4. Add a little of yellow colouring to the calcium chloride solution.

5. With a clean pipette, start adding all the content from the small cup into the plastic container.

6. With the plastic spatula, try catching what's hidden in the calcium chloride solution. Can you catch it all?

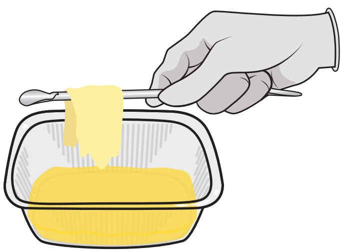
7. Prepare a small measuring cup (washed) and measure 5 ml of calcium chloride solution.



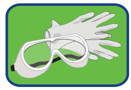
8. At once, pour the small cup with calcium chloride into the middle of the plastic container.

9. With the plastic spatula, try to catch what's hidden in the solution. Start by catching the part where you added the calcium chloride and try pulling it out. Wow!

10. Have fun, but don't forget to always wear your gloves scientist!



Experiment 9
Invisible medusa



What you will need:

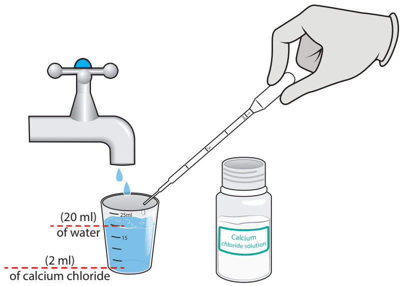
- Calcium chloride solution ☆
- Sodium alginate solution ☆
- Pipette from the calcium chloride solution ☆
- Small measuring cups ☆
- Spoon

Note: Before you begin this procedure, make sure that the small measuring cups are thoroughly cleaned.

Steps:

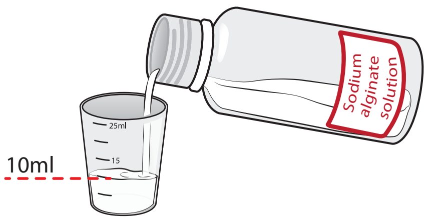
1. Put on your protective goggles and gloves.

2. Using the pipette (the one you kept for using it exclusively with calcium chloride) collect 2 ml of this solution and pour it into the small measuring cup.

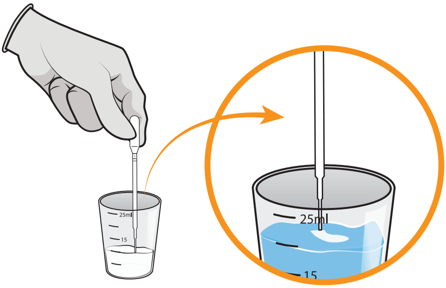


3. Add tap water until it reaches the 20 ml mark.

4. Pour 10 ml of sodium alginate into another small measuring cup.



5. Fill the pasteur pipette with sodium alginate and squirt it to the the calcium chloride solution surface inside the small measuring cup.



6. Can you find the medusas? If you can not see them, try to catch them with a spoon. Can you explain what happened?

Explanation:
The sodium alginate solution has approximately the same density as the calcium chloride solution. Therefore, the light passes through the "medusas" making it difficult for you to see them.

Experiment 10
Blue blood

What you will need:
- Small measuring cup ⭐
- Pasteur pipettes ⭐
- Blue food colouring ⭐
- Milk
- Sodium alginate solution ⭐
- Wooden spatula ⭐

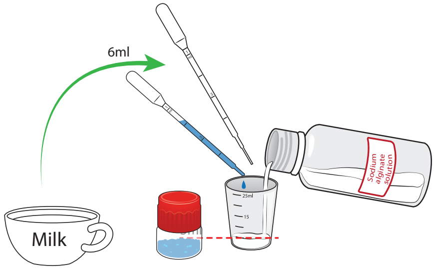
Steps:

1. Put on your protective goggles and gloves.

2. Add 10 ml of sodium alginate in the small measuring cup.

3. Fill the pipette with 6 ml of milk. Ask for permission to use the milk.

4. Add a little bit of blue food colouring and mix well.



5. Hold it in your hands (always using the protective gloves). Have fun!

Experiment 11
Crazy play dough

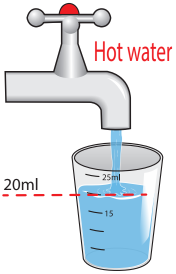
The guar gum is a polysaccharide, extracted out of the plant species *Cyamoposis tetragonolobus* endosperm (seed), which is often used as a thickener or dietary fibre. When in contact with water the guar gum forms a highly viscous gel.

ATTENTION: ask an adult for help.

What you will need:
- Large measuring cup ⭐
- Small measuring cup ⭐
- Guar gum ⭐
- Wooden spatula ⭐
- Red food colouring ⭐
- Blue food colouring ⭐
- Pasteur pipette ⭐
- Plastic spatula ⭐

Steps:

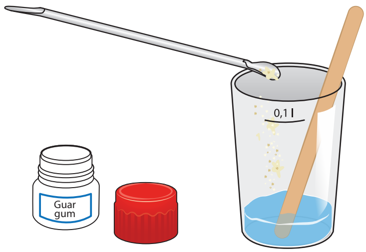
1. Put on your protective goggles and gloves.



2. Pour 20 ml of hot tap water into the small measuring cup. Now transfer the water to the large cup.

Suggestion: Put the water running before you place the cup under the tap.

3. With the plastic spatula remove ⅓ of the amount of guar gum (equivalent to 2 grams. Add it to the large cup containing water.



4. Add a little bit of red and blue food colouring.

5. Use the wooden spatula to mix it all well.

6. When the crazy play dough stops sticking to the cup walls you can remove it. To do so, make sure that the gloves are thoroughly cleaned and then wet your hands through clean running water so that the gloves stay wet.

Suggestion: If you notice that the dough has too much gum grains, add a little bit more of hot water and mix well.

7. Knead and roll the crazy play dough between your hands until it stops sticking.

8. Now you can remove your gloves and have fun with your crazy play dough.

Attention: If you feel some sort of skin irritation immediately stop touching the crazy play dough and wash your hands with plenty of water.

Experiment 12
Crazy ball

ATTENTION: ask an adult for help.

What you will need:

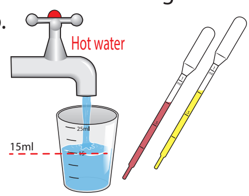
- Small measuring cup
- Yellow food colouring
- Red food colouring
- Wooden spatula
- Small plastic bag with zip-lock
- Pasteur pipettes

Steps:

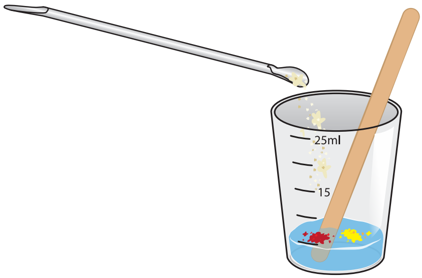
1. Put on your protective goggles and gloves.

2. Add a little bit of each food colouring to the small measuring cup.

3. Add hot tap water until 15 ml.



Suggestion: Put the water running before you place the cup under the tap.

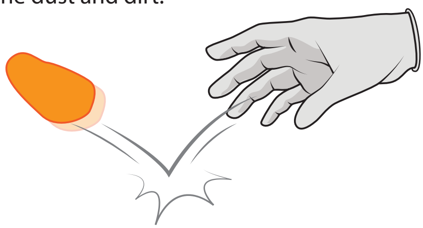


4. Add other 1/3 of guar gum.

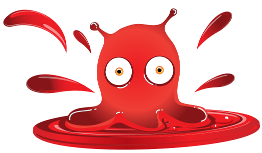
5. Repeat the steps 5 and 6 from experiment 11.

6. Collect the mixture and mould it into a ball.

7. Try your crazy bouncing ball by throwing it against clean and smooth surfaces. Careful! Do not throw it to the floor for it will catch all the dust and dirt.



8. Use one of the small plastic bag with zip-lock to save your bouncing ball. Make sure that the plastic bag is completely sealed so the air don't get through it.



Experiment 13
Silly play dough

What you will need:
- Water
- Cornflour ⭐
- Blue food colouring ⭐
- Bowl or basin

- Tablespoon
- Small measuring cup

Steps:
1. Put 5 full tablespoons with cornflour inside a bowl or basin.

2. In the small measuring cup measure 25 ml of water and add it to the cornflour.

3. With the pipette add some drops of blue food colouring. Mix it all well.

Your silly play dough is done!

Observe how your silly play dough behaves!

- If you shake it slowly it will behave as a liquid.
- However, if you punch the dough it will become a solid!
- With a lot of strength you may be able to make a small ball.
- If you drop it, it will become a liquid again!

Explanation:
This silly play dough is a non-Newtonian fluid, in other words, it is a fluid which viscosity is variable depending on the force that is exerted on it. As so, when you put sudden force on it, it becomes a solid, however if you let go, it becomes a liquid again.

Experiment 14
Homemade play dough

Homemade play dough is a very easy experiment to make at home, as you may use materials that for sure you have in your kitchen.

Ask an adult for the following ingredients and before knowing, you will have your dough to play.

Attention! Even though the materials you are going to use are quite common in a kitchen and are used for cooking, you won't be able to eat your scientific activities.

Method 1

ATTENTION: ask an adult for help.

What you will need:
- Bowl or basin
- Cup
- Tablespoon
- Cake flour
- Food colouring ⭐
- Water
- Oil

Steps:

1. Pour about 125 ml of water into the cup.

2. Add to it a little bit of food colouring until you are satisfied with the colour you've gotten (the colour of your dough will be slightly lighter than the one you may see in the water and food colouring solution).

3. In the basin (or bowl), put 10 tablespoons of flour and then add 2 tablespoons of oil.

Now get ready and set to work, you will have to put your hands on the flour.

4. Continually add water, little by little (if necessary ask an adult for help), and stir your mixture of flour and water.

5. In the beginning it will look like a pasty mixture, that gets stuck on your hands, but that's ok, it will stop sticking.

6. When the dough is done you will be able to make a small ball with your hands and it won't get stuck on your fingers anymore.

If it still is sticking, put a tablespoon of flour on your hands and rub them to get rid of the remaining play dough.

Method 2

As you could see, this experiment of making play dough is so fun that we are going to show you another way of doing it.

ATTENTION: ask an adult for help.

What you will need:
- Bowl or basin
- Small pan
- Metal tablespoon
- Cake flour
- Powdered jelly (sachet), it can be of any flavour
- Water
- Oil
- Cup

Steps:

1. Pour about 125 ml of water into the cup.

2. Inside the pan, put 10 tablespoons of flour.

3. Add the powdered jelly sachet to the flour inside the pan.

4. Add 2 tablespoons of oil.

5. Add little water at a time and stir it with the metal spoon.

6. Ask an adult to warm the pan over a low heat and keep adding water and stirring it, until all ingredients are aggregated and become a paste.

7. The colour of the jelly will appear while your mixture is heating in the pan.

Note: The dough must be saved in a box or in a bag, closed, in order to last longer. If you leave the dough in open air, it will be more vulnerable to damage.

Experiment 15
Long jump

What you will need:
- Crazy ball (exp. 12) ☆
- Tape measure (exp.4) ☆
- Starting point ☆

The winner will be the player that achieves the maximum distance with the bouncing ball.

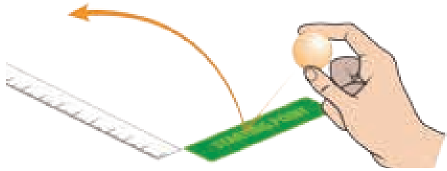
You will need 2 helpers. One of the helpers will be the judge and the other will use the tape measure to register the distance reached in the bouncing ball delivery.

Preparation of the game field:
1. Make a photocopy of page 35 and cut out the Starting Point or create your own from scratch.

2. Place the Starting Point on the floor or on top of a table. The surface of the game should be hard enough.

3. Place the tape measure perpendicularly to the Starting Point.

Game rules:
- Each player uses the crazy ball and has the right to deliver it 3 times to achieve the maximum distance possible.



- The player takes a position about 100 cm (39.4 in) away from the Starting Point.

- Then the player throws the ball so that it hits first the Starting Point on the floor, just as the image shows.

- The judge must validate the delivery. That is, the delivery is only valid if the ball hits within the Starting Point. If the ball slightly hits out of the Starting Point the delivery is considered invalid.

- The helper in charge of registering the distance must pay attention to see where the ball hits next (after hitting the Starting Point) and register the length with the tape measure. The distance should be measured from the Starting Point to the point where the ball hit the second time.

- Repeat this procedure every time a player delivers the ball (each player delivers up to 3 times).

- To register the results easily, you should create a registry table similar to the following:

Long jump			
Player	Deliver 1	Deliver 2	Deliver 3
1	in (cm)	in (cm)	in (cm)
2	in (cm)	in (cm)	in (cm)
3	in (cm)	in (cm)	in (cm)

Experiment 16
Triple jump

What you will need:
- Crazy ball (exp. 12) ⭐
- Tape measure (exp. 4) ⭐
- Starting Point ⭐
- 100 cm (39.4 in) Barrier ⭐

The winner of this game will be the player that achieves a longer distance with the ball delivery.

You will need 2 helpers. One of the helpers will be the judge and the other will use the tape measure to register the distance reached in the bouncing ball delivery.

Preparation of the game field:
1. Repeat the game field preparation of the previous experiment (experiment 15).

2. Make a photocopy of page 35 and cut out the 100 cm (39.4 in) Barrier or create your own.

3. Place the Starting Point and Barrier on the floor or on a table.

4. The Barrier should be placed 100 cm (39.4 in) away from the Starting Point (use the tape measure to measure it).

5. Place the tape measure perpendicularly to the Barrier.

Game rules:
- Each player uses the crazy ball and has the right to deliver it 3 times to achieve the maximum distance possible.

- The player takes a position about 100 cm (39.4 in) away from the Starting Point.

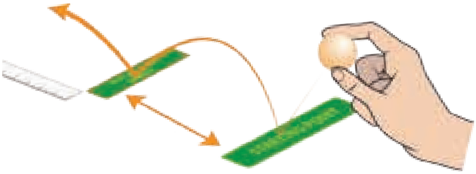
- Then, the player throws the ball so that it hits first the Starting Point on the floor and then the Barrier, just as the image shows.
- The judge must validate the delivery. The delivery is only valid if the ball hits the Starting Point and the Barrier. If the ball slightly hits out of the Starting Point or out of the Barrier the delivery is considered invalid.

- The helper in charge of the registering the distance must pay attention to see where the ball hits the 3rd time (the ball must first hit the Starting Point and then the Barrier) and register the length with the tape measure. The distance should be measured from the Barrier to the point where the ball hit the third time.

- Repeat this procedure every time a player delivers the ball (each player delivers up to 3 times).

- To register the results easily, you should create a registry table similar to the following:

Triple jump			
Player	Delivery 1	Delivery 2	Delivery 3
1	in (cm)	in (cm)	in (cm)
2	in (cm)	in (cm)	in (cm)
3	in (cm)	in (cm)	in (cm)



Experiment 17
Basketball: table shootings

What you will need:
- Crazy ball (exp. 12)
- Basketball table
- Large measuring cup

The winner of this game will be the player with the higher score.

You will need a helper to register the score results and who will be also the line judge.

Preparation of the game field:

1. Make a photocopy of page 35 and cut out the Table or create your own Basketball table.

2. Place the large measuring cup in the indicated position.

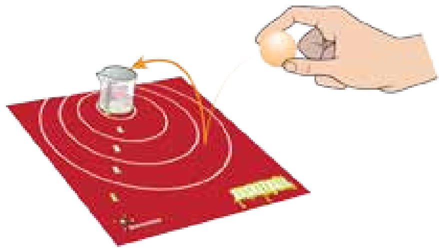
Game rules:

- Each player uses the crazy ball and has the right to deliver it 5 times.

- The player chooses the position to deliver the crazy ball.
- The ball must touch the Barrier and fall inside the measuring cup so that the shooting is considered valid. If the ball touches the Barrier more than once the shooting is considered invalid.

- The score of each shooting shall be the same as the score signed in the area where the ball hit.

- The player with the highest score after all 5 deliveries wins.



- To register the results easily, you should create a registry table similar to the following:

Table shootings				
Player 1				
Delivery 1	Delivery 2	Delivery 3	Delivery 4	Delivery 5
score	score	score	score	score
Player 2				
Delivery 1	Delivery 2	Delivery 3	Delivery 4	Delivery 5
score	score	score	score	score
Player 3				
Delivery 1	Delivery 2	Delivery 3	Delivery 4	Delivery 5
score	score	score	score	score

STARTING POINT

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