Explosive Science

Kaboom

Science4you

PLAY MONSTER

⚠ WARNING:

CHOKING HAZARD - Children under 8 years can choke or suffocate on uninflated or broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons at once.

⚠ WARNING:

This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

- **Burn within sight.**
- **Keep away from flammable items.**
- **Keep away from children.**

Remove packaging before burning. Burn in proper holder. Keep wax pool free of debris. Stop burning when 1/2" unmelted wax remains. Trim wick to 1/4" each time candle is lit. Avoid drafty areas.

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.

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 strengths of our toys. We aim to provide toys which enable children's development of physical, emotional and social skills.

Find out more about Science4you toys at:

www.playmonster.com

Science4you

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PLAYMONSTER

We wanna hear how much fun you had! Get in touch at:
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playmonster@playmonster.com | 1-800-524-4263
For more fun, visit playmonster.com

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SAFETY RULES

- Read these instructions before use, follow them and keep them for reference.
- Keep young children and animals away from the experimental area.
- 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 food items back in their original container(s) or packaging. Dispose of immediately.

FIRST AID INFORMATION

- **In case of eye contact:** 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 immediately. Take the chemical and its container with you.
- In case of injury always seek medical advice.

ADVICE FOR SUPERVISING ADULTS

- Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.
- This experimental set is for use only by children over 8 years.
- The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.
- 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.
- Substances in non-reclosable packaging should be used up (completely) during the course of one experiment, i.e. after opening the package.
- This experimental set contains colorings. Colorings can stain. Keep it away from objects and fabrics.

In case of poisoning by any of the components used in the experiments of this toy, contact your local poison control center or the nearest hospital. Please consult the following link for more information: https://www.poison.org/

In case of emergency dial:
9-1-1 or Poison Control: 1-800-222-1222

LIST OF SUBSTANCES SUPPLIED

Blue Coloring

INGREDIENTS: CI 42090, SODIUM BENZOATE, POTASSIUM SORBATE

Precautionary Statements:
P202 Do not handle until all safety precautions have been read and understood.
P233 Keep container tightly closed.
P234 Keep only in original container.

Red Coloring

INGREDIENTS: CI 16255, SODIUM BENZOATE, POTASSIUM SORBATE

Precautionary Statements:
P202 Do not handle until all safety precautions have been read and understood.
P233 Keep container tightly closed.
P234 Keep only in original container.

LIST OF CHEMICAL SUBSTANCES SUPPLIED

Citric Acid $C_6H_8O_7$ (CAS # 77-92-9)

Hazard Statement:
H319 Causes serious eye irritation.

Sodium Bicarbonate $NaHCO_3$ (CAS # 144-55-8)

Recommendations for substances and mixtures: Do not ingest. Avoid contact with the eyes and mouth. Use only according to the instructions. Store in tightly closed containers. Keep in a cool, dry place. Protect from moisture, direct sunlight and heat sources.

DISPOSAL OF CHEMICAL SUBSTANCES

Observe national regulations concerning the disposal of chemicals when disposing of chemical substances and / or mixtures. Do not dispose of substances and / or mixtures together with household or other waste. Please recycle packaging materials where local recycling programs exist.

KIT CONTENTS

1. The chemistry of explosions

Chemistry is the main science that happens in an explosion!

Scientist, look at the symbol!

It's used to indicate places where the danger of an explosion exists.

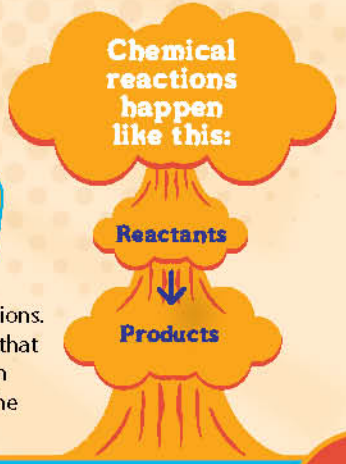
This symbol indicates that a substance is an explosion hazard. If it gets close to a flame, spark, static electricity, heat or friction. It also indicates the hazard of fragment projection.

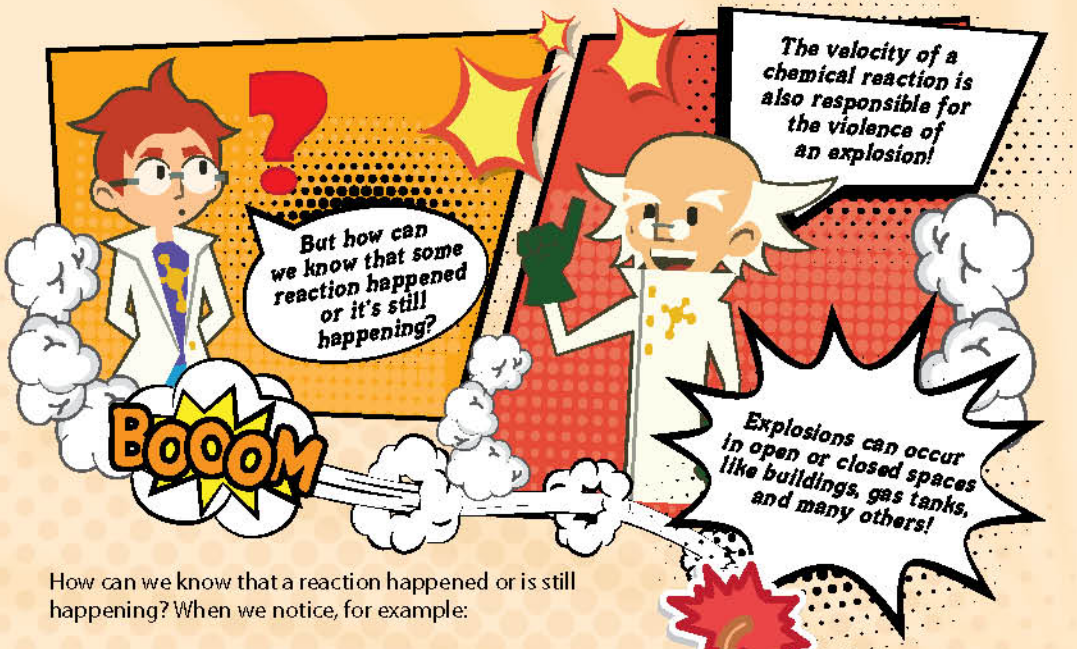
DID YOU KNOW...
That an explosion can occur due to an exothermic chemical reaction?

An exothermic reaction is a chemical reaction that releases energy by light or heat.

1.1. Chemical reactions

Every day we are surrounded by lots of chemical transformations or reactions. In every chemical reaction there are the **reactants** (the initial substances that react) and the **products** (the new substances that form while the reaction is happening). The products have different characteristics than those of the reactants.





How can we know that a reaction happened or is still happening? When we notice, for example:

- Temperature changes
- A color exchange
- A gas release
- The appearance of a solid
- A special smell
- The formation of a flame

These kinds of transformations may occur by the action of heat, light, electric current, mechanical action or by the combination of substances.

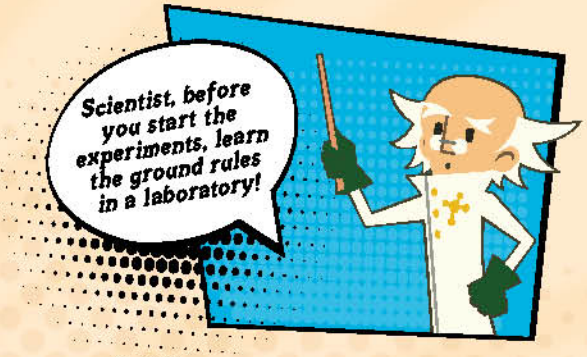
There are also **physical transformations** (transformations that occur without forming new substances). For example: solidification of water.

DID YOU KNOW...
That an explosion can be a way of combustion with the formation of a flame and a rumble?

DID YOU KNOW...
That mechanics (the science that studies forces and their actions) is also related to explosions?

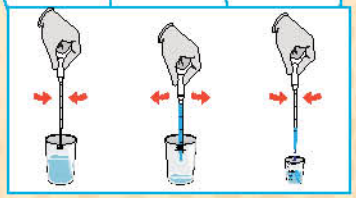
Image 1. Explosion.

2. Explosive experiments



Before you prepare the experiments, learn how to use an instrument widely used by scientists - the pipette dropper:

1st Squeeze out the air from the top of the pipette dropper.	2nd Release inside the liquid to fill the pipette dropper.	3rd Squeeze gently until drops start falling one at a time.



2.1. Ground rules in the laboratory

All experiments labeled with this symbol have an explosive and spectacular effect, and must be performed outdoors and under the supervision of an adult!

Every time you finish an experiment, you should wash and store all the materials.

During an experiment, do not use the same material for different reagents without washing it first.

Use the quantities recommended in each step, so that you can make the most of your reagents.

Always wash your hands before and after each experiment.

If you want to do an experiment but the recommended material is being used in another experiment, you can use similar materials that you find at home.

Before starting an experiment, you should cover your work table with an old towel or old newspapers. This way, you make sure that it won't stain!

Now, you are able to begin the experiments!

2.2. Color explosion

CAUTION: when you complete the experiment, throw away all food products used.

Experiment 1
The dance of colors

What you will need:
Material included in the kit:

- Large measuring cup
- Colorings
- Small measuring cup
- Pipette droppers

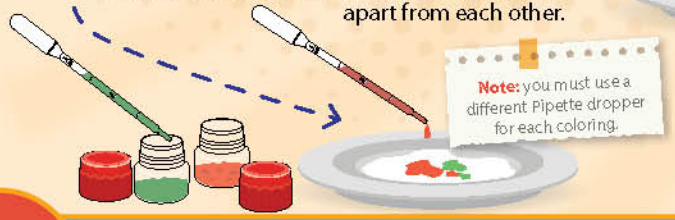
Extra items you will need:
- Toothpicks or cotton swab
- Milk
- Dish soap
- Shallow bowl

Always ask an adult for help!

Steps:

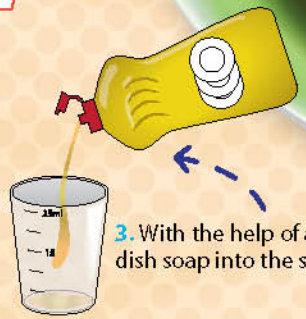
1. Measure 100 milliliters (ml) of milk with the large measuring cup and then pour it into the bowl. Let it rest for a few minutes.

2. Using a separate pipette dropper for each color, add some drops of colorings to the milk. Make sure the drops remain at the surface and apart from each other.



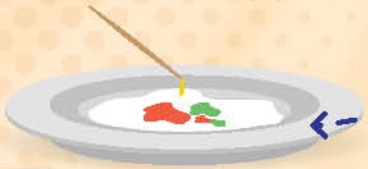
Note: you must use a different Pipette dropper for each coloring.

3. With the help of an adult, add some dish soap into the small measuring cup.



4. Dip the toothpick's tip in the dish soap, enough to collect only one drop.

5. Place the toothpick (with the drop of dish soap) in the middle of a coloring spot.



Scientist, did your colors "explode?"

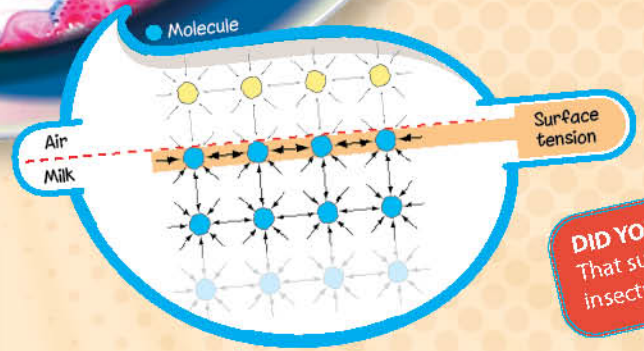
What happened?

This incredible effect happens because the dish soap will break the bonds between the milk fats and break the **surface tension**, mixing the milk fats and creating the color patterns you see!

Milk is a liquid made up of water, fat and proteins. When you put the coloring on its surface, it doesn't get mixed with the milk.

Image 2. Milk.

The dish soap causes the colored drops to move away from each other, creating a color explosion!



DID YOU KNOW...
That surface tension allows some insects are able to walk on water?

Surface tension happens because the molecules of milk on the surface have a stronger bond. Inside the liquid, all molecules of milk have the same bond but in all directions. The molecules of milk at the surface are only bonded by molecules on the side and underneath; on the surface there is only air. As the number of molecules that are bonded is lower, there is compensation, a greater strength at the surface, forming a kind of film/layer. This property is what we call surface tension.

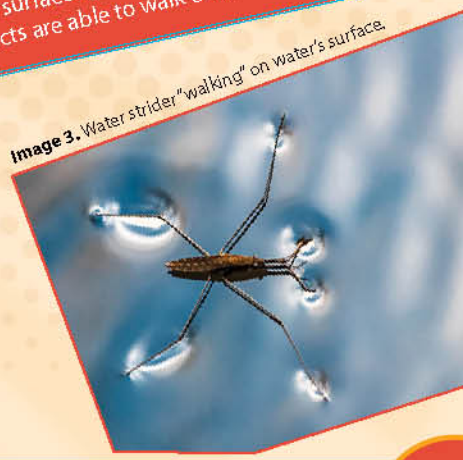


Image 3. Water strider "walking" on water's surface.

Experiment 2
Chromatography

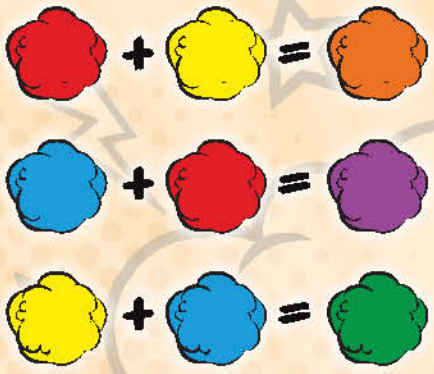
What you will need:
Material included in the kit:

- Paper filters

Extra items you will need:

- Colored markers
- Water
- Paper towels

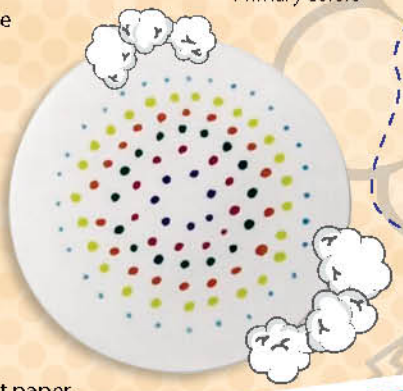
Learn about primary and secondary colors:



Primary colors — Secondary colors

Steps:

1. With the markers make small dots on the paper filter, in a circular scheme, as you can see in the image below.

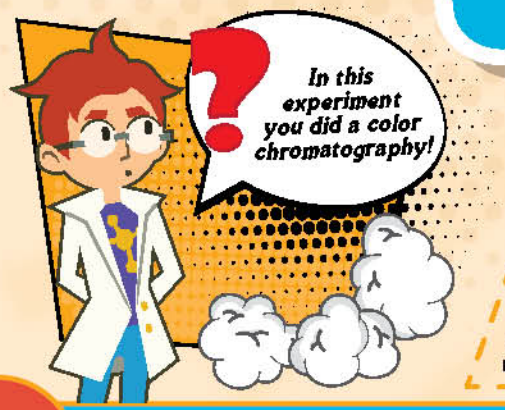


2. Roll up a sheet of paper towel into a pencil shape and dip the tip in water.

3. Press the tip of the wet paper towel against the center of the filter paper in order to wet it.

What happened?
It is possible with this chromatography technique to break down a secondary color into its primary colors.

Observe what happens to the small dots of different colors that you drew on the paper filter!



This happens because the "basic" colors have different weights and, this way, they remain in different positions on the paper filter when the water can't drag them anymore.

Chromatography is a physical/chemical method used to separate homogeneous mixtures. The separation of its components is possible because they present different weight, mass and density.

Observe how the colors are dragged by water!

SCIENTIFIC CHALLENGE:
Candy rainbow

1. On a flat plate, arrange many pieces of colored candy (like Skittles) in a circle.
2. Then, using a Pipette dropper, add some drops of warm water to the center of the plate.

Wait a few seconds and observe what happens!

2.3. Production of carbon dioxide and effervescence

Experiment 3
Fizzy bombs

What you will need:
Material included in the kit:

- Large measuring cup
- Coloring (of your choice)
- Sodium bicarbonate
- Citric acid
- Wooden stirrer
- Small measuring cup
- Pipette dropper

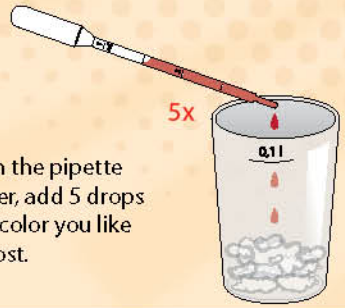
Extra items you will need:
- Table salt
- Teaspoon
- Plate
- Water
- Gloves

Always ask an adult for help!

Citric Acid
WARNING
Hazard Statement: Causes serious eye irritation.

Steps:

1. Measure 5 ml of citric acid with the small measuring cup. Now, transfer it into the large measuring cup.



2. With the pipette dropper, add 5 drops of the color you like the most.

3. Ask an adult for table salt and add one teaspoon of it to the large measuring cup.

4. Mix well with the wooden stirrer.

5. Measure 5 ml of sodium bicarbonate with the small measuring cup. Now add it to the large cup and stir with the wooden stirrer.

6. The mixture of your fizzy bomb must be dry but slightly sticky. If it is too dry, add some droplets of water with the Pipette dropper.

7. With gloves on, wet your hands and collect small amounts of the mixture to form little balls with your hands. Create two little balls and place them on a plate, with some space in between them so that they don't get stuck to each other.

8. Let them dry overnight.

Note: you'll also use these fizzy bombs in experiment 14.

9. When dry, test your fizzy bombs by putting them in water and watching what happens!

Scientist, do you know why your bomb is FIZZY?

CAUTION: when you complete the experiment, throw away all food products used.

What happened?

Your bomb is effervescent because when it comes in contact with water, a chemical reaction between sodium bicarbonate ($NaHCO_3$) and citric acid happens, releasing carbon dioxide (CO_2).

The release of the gas is characterized by the formation of little bubbles inside the liquid that cause effervescence.

The following chemical reaction occurs:

$$NaHCO_3 + Acid \rightarrow Na\text{-}Acid + CO_2 + H_2O$$

OH...

DID YOU KNOW...
That this type of reaction is very common in some medicines?

Image 4. Aspirin in water.

Experiment 4
Explosive bag

OUTDOOR EXPERIMENT

What you will need:
Material included in the kit:

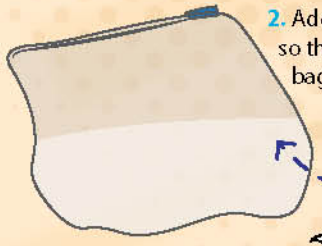
- Sodium bicarbonate
- Large measuring cup
- Plastic bag
- Wooden stirrer

Extra items you will need:
- Vinegar
- Warm/hot water
- Small cloth

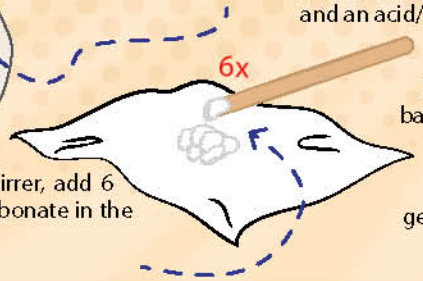
Always ask an adult for help!

Steps:

1. With the large measuring cup, fill the plastic bag 1/4 full. Ask an adult for help when using hot water.



2. Add enough vinegar so the liquid fills the bag halfway.



3. With the wooden stirrer, add 6 scoops of sodium bicarbonate in the middle of the cloth.

4. Fold the cloth so that the sodium bicarbonate stays inside.

5. Now you have to work fast! Partially seal the bag, leaving enough space to add the cloth containing the sodium bicarbonate.

6. Place the cloth with sodium bicarbonate in the bag and seal it completely.

7. Set the bag on the ground and move away quickly!

What do you observe? Did your bag explode?

CAUTION: when you complete the experiment, throw away all food products used.

What happened?

You should have observed the bag expanding until it exploded! The sodium bicarbonate and the vinegar get mixed up, and an acid/base reaction happens giving off carbon dioxide. This gas needs space, so, it fills the bag while being formed. The bag can't hold it any longer and then it explodes! Even if it doesn't quite "explode," you can observe the bag getting bigger!

Catalysts are substances that increase the speed of a chemical reaction!

- Pressure
- Reagents concentration
- Temperature
- Contact surface area to react that is available
- Presence of catalysts

Experiment 5
Foam with egg white

What you will need:
Material included in the kit:

- Small measuring cup
- Sodium bicarbonate
- Pipette dropper
- Coloring (of your choice)
- Wooden stirrer

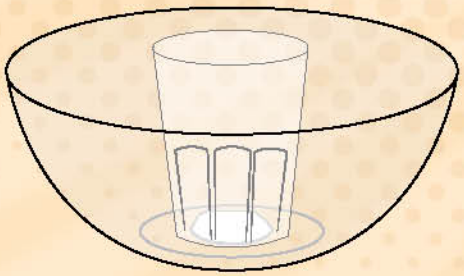
Extra items you will need:
- Large bowl
- Tall glass
- Egg (egg white)
- Water
- Vinegar
- Teaspoon

Always ask an adult for help!

Steps:

1. Carefully separate the egg white from the egg and discard the yolk.

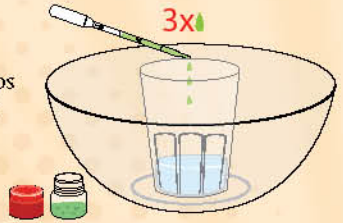
2. Pour half of the egg white into the tall glass and place the glass in the bowl.



3. With the small measuring cup, measure 25 ml of water and pour it into the glass.

4. Add 2 teaspoons of sodium bicarbonate to the glass. Stir with the wooden stirrer.

5. With the pipette dropper, add 3 drops of a coloring to the mixture.



6. With the small measuring cup, measure 25 ml of vinegar and pour it into the glass.

CAUTION: when you complete the experiment, throw away all food products used.

Scientist, did you create foam?

Wow!!

What happened?

Egg white isn't only used to make delicious desserts. It can also work to fix the gas formed during an experiment. When you add the vinegar, a great amount of colored foam is formed and overflows out of the cup. Sometimes, when turning the cup upside down the foam won't fall out!

Yolk
It has a higher caloric value. Contains proteins, fat and vitamins.

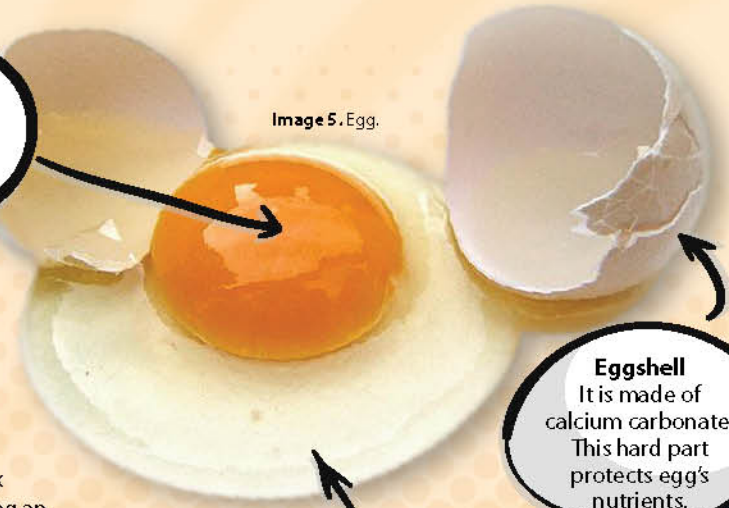


Image 5. Egg.

Eggshell
It is made of calcium carbonate! This hard part protects egg's nutrients.

Egg white or albumen
It is made mainly of water and proteins.

Do you know why?

The acid from vinegar, called acetic acid, reacts with the sodium bicarbonate, creating CO_2. The gas gets "stuck" in the egg white, which causes the formation of foam.

Experiment 6
Colored foam

OUTDOOR EXPERIMENT

What you will need:
Material included in the kit:

- Colorings (of your choice)
- Large measuring cup
- Small measuring cup
- Wooden stirrer
- Sodium bicarbonate
- Pipette dropper

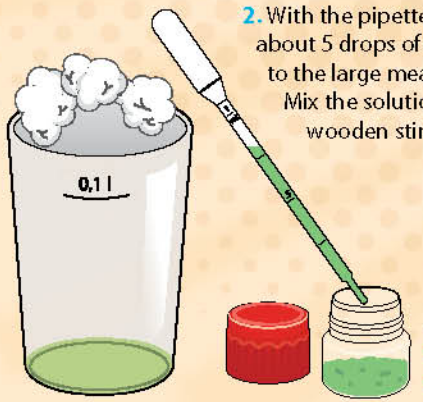
Extra items you will need:
- Dish soap
- Vinegar
- Teaspoon

Always ask an adult for help!

Steps:

1. Add 2 teaspoons of sodium bicarbonate to the large measuring cup. Then, add 2 teaspoons of dish soap to the same cup.

2. With the pipette dropper, add about 5 drops of coloring to the large measuring cup. Mix the solution with the wooden stirrer.

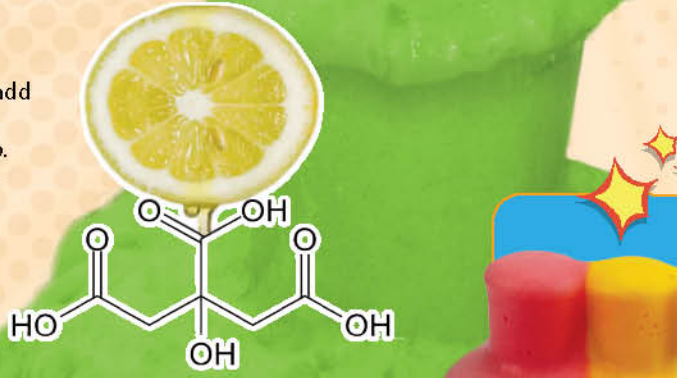


3. Measure 25 ml of vinegar in the small cup and then pour it into large measuring cup.

Scientist, what do you observe?

CAUTION: when you complete the experiment, throw away all food products used.

WOW!



Scientist, try replacing vinegar with citric acid and repeat this experiment! Dissolve 5 ml of citric acid in 20 ml of water. **Do you get the same result?**

DID YOU KNOW...
That there are minerals which — due to their composition — react with acids, creating effervescence? This kind of characteristic helps us identify the different minerals present in a rock. This identification is very important for the classification of rocks. For example, calcite is made up of calcium carbonate minerals which react easily with acids, giving off carbon dioxide.

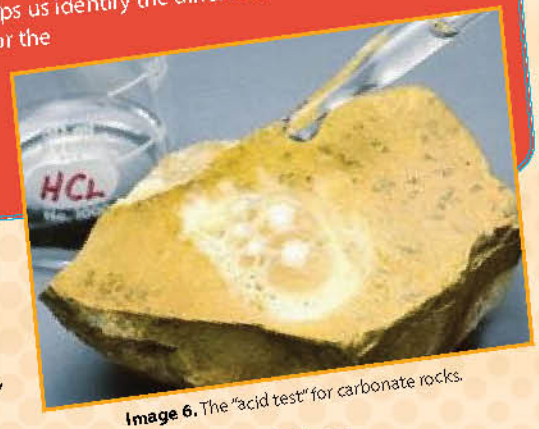
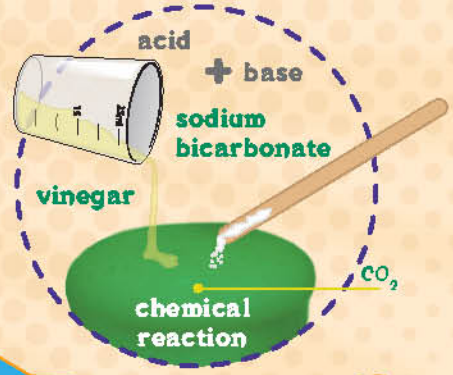


Image 6. The "acid test" for carbonate rocks.

What happened?
When the **acetic acid** present in vinegar (an acid) is mixed with **sodium bicarbonate** (a base) it creates a **chemical reaction**. From this reaction, a gas is released — **carbon dioxide**, which creates the foam!



OH...

SCIENTIFIC CHALLENGE:
Colorful foam run

Scientist, repeat this experiment with your friends! Use different colorings and have fun creating foams of different colors!

2.4. Will it explode?

Experiment 7
Pierce a bag of water with a pencil

What you will need:
Material included in the kit:

• Plastic bag

Extra items you will need:
• 1 to 3 Sharpened pencils • Water

ATTENTION: ask an adult for help.

Steps:

1. Fill the plastic bag 2/3 full with water.

2. Ask someone for help. Your assistant can hold the bag (from the upper part) or handle the pencil. You decide!

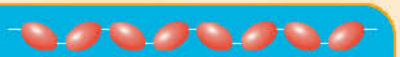
3. Get a pencil and poke it into the bag (through the filled part). Keep pushing the pencil through until it comes out on the other side of the bag.

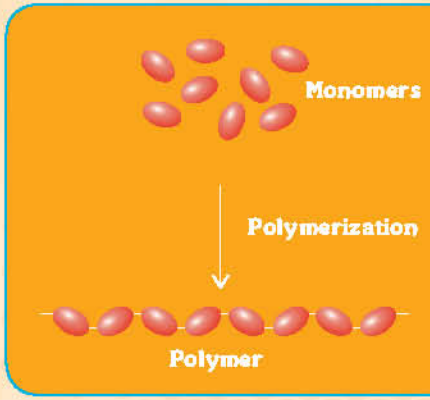
Tip: the secret of this experiment is to pierce the bag very quickly through both sides, so that the water doesn't have time to leak out of the bag!

4. You can use 2 or 3 more pencils and repeat the last step.

What happened?
The bag is made of polymers. Polymers are made up of large chains of molecules and are very flexible. When you pierce the bag with a pencil, the molecules of the plastic bag rearrange around the pencil, creating a kind of air-proof seal, preventing the water from leaking out of the bag.

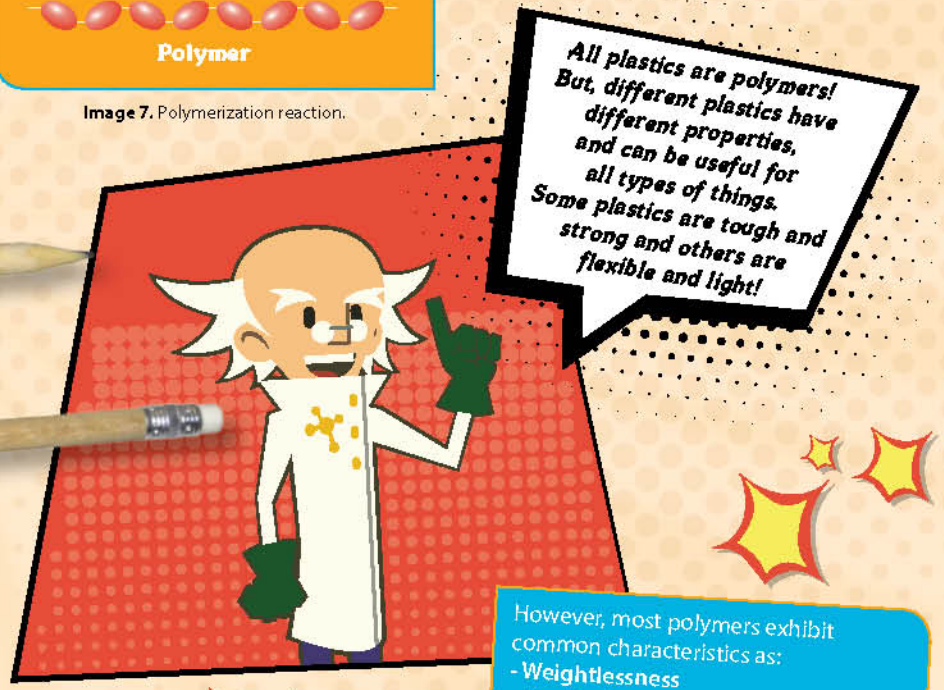
The bag is made of plastic which is often made of **polymers**.





Polymers are substances made up of several molecules, of which one or more types of units are repeated (monomers). We can say that polymers are large molecules — very long chains of which atoms are side-by-side, bound together like bricks on a wall.

Image 7. Polymerization reaction.



However, most polymers exhibit common characteristics as:
- Weightlessness
- Hard to break
- Recyclable
- Easy to mold
- Safe and non-toxic
- Long-lasting

Experiment 8
Balloon that doesn't pop

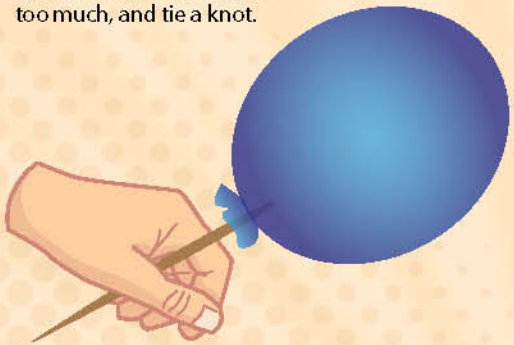
What you will need:
Material included in the kit:

- Balloon

Extra items you will need:
- Wooden skewer

Steps:

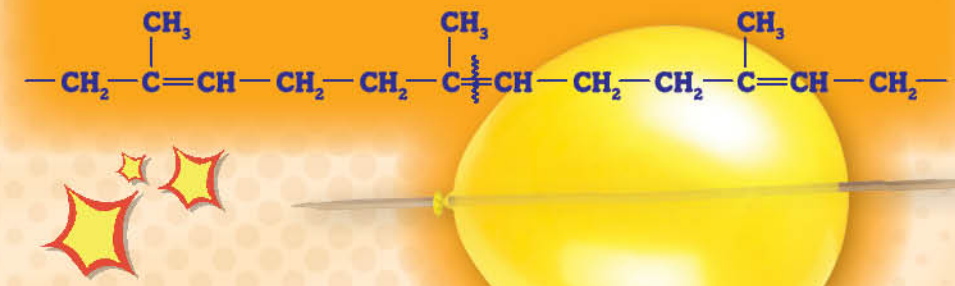
1. Blow up the balloon, not too much, and tie a knot.



2. Insert the wooden skewer carefully into the thicker area right next to the knotted end of the balloon.

3. Carefully, keep on inserting until the skewer reaches the other side. You should pierce the oppositte end of the balloon.

Balloons are composed of long chains of molecules — **polymers**. The elasticity of these chains inceases when filling the balloon; they will "stretch" without breaking.



Does the balloon pop or not? If it does, do not give up and try it again!

What happened?

In this experiment, the same principle of the previous experiment occurs. The ends of the balloon (darker areas) are spots with less pressure, this is to say, where the balloon is less resistant. This way, when you insert the skewer in these areas it is less likely that the balloon will pop.

Experiment 9
Fire-proof balloon

What you will need:
Material included in the kit:

- Balloon
- Small measuring cup
- Candle

Extra items you will need:
- Cold water
- Funnel
- Matches/lighter

What happened to the balloon? Does it take long to pop?

Can you see the black patch from the soot, located on the bottom part of the balloon which is in contact with the flame?

Always ask an adult for help!

Steps:

1. Hold the end of a balloon open and use a funnel to pour some water into it. You can pour about a small measuring cup of water.

2. Blow up the rest of the balloon with air (not too much) and tie a knot.

3. Ask an adult to light the candle and hold the balloon over it.

In this experiment, when placing the balloon with water over the flame, it doesn't burst immediately.

Do you know why?

What happened?

The balloon doesn't burst because the temperature of the flame is distributed by the elements that are in contact with it, this way the heat is also transferred to the water which is a great heat absorber. If the balloon doesn't reach its combustion temperature, which is much higher than the boiling temperature of water, it doesn't burst.

2.5. Small explosions

Always ask an adult for help!

Experiment 10
Mini water bomb

What you will need:
Material included in the kit:

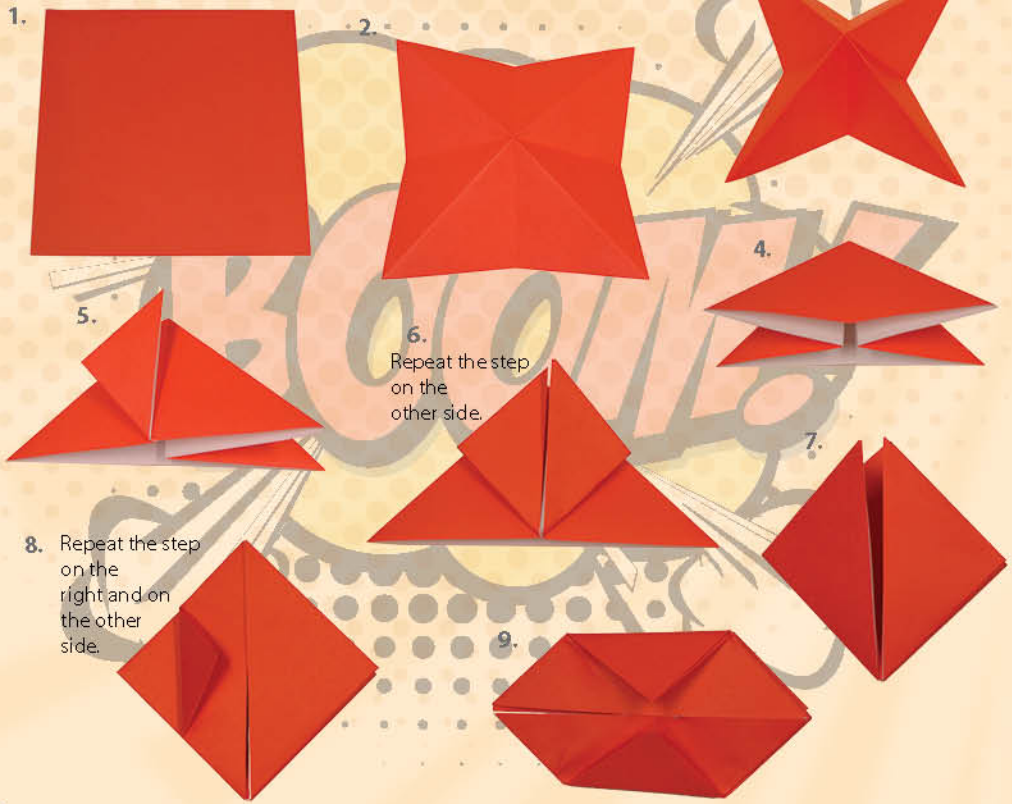
- Small measuring cup
- Origami sheet*

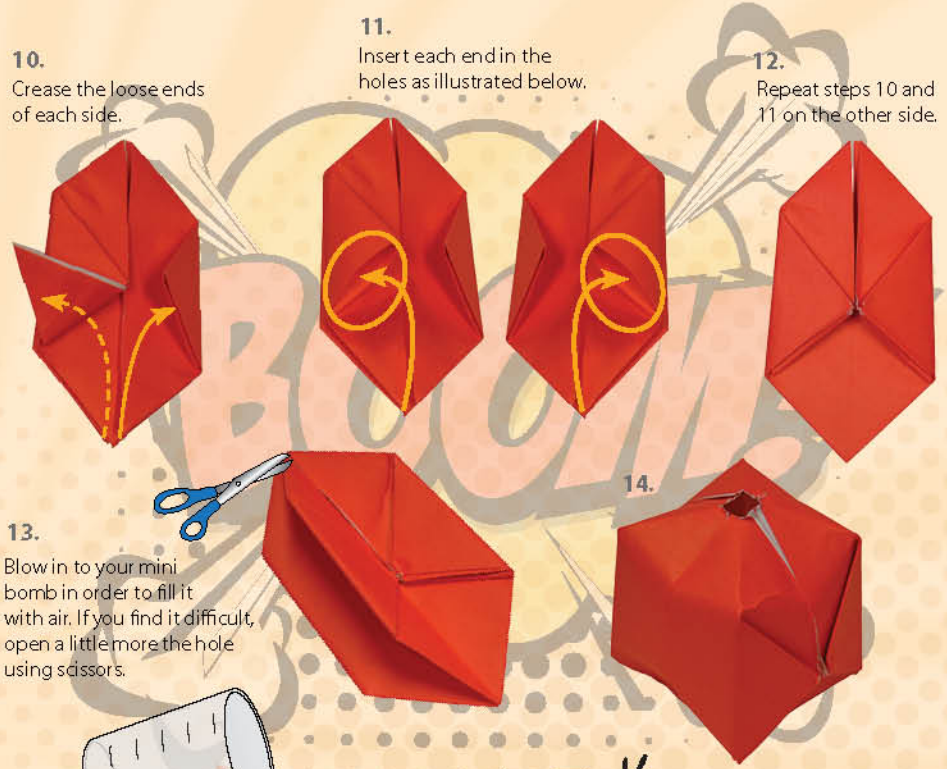
Extra items you will need:
- Scissors
- Water

*Note: you can use other any other sheets of paper if you cut them in square shape first.

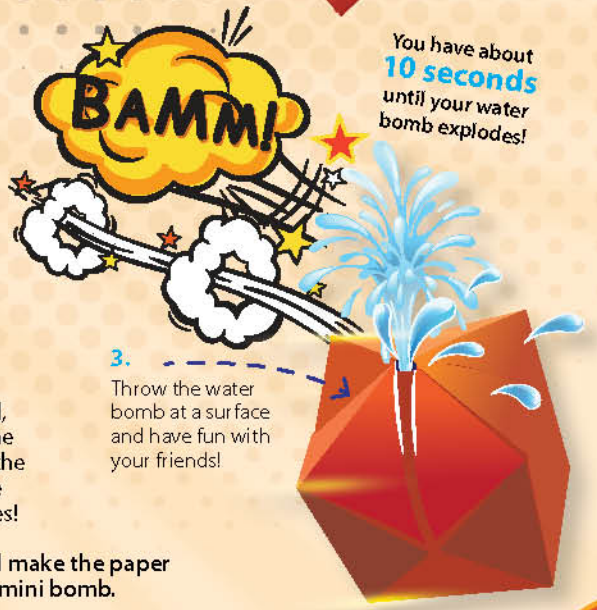
Steps:

1. Fold the origami sheet as illustrated below:





2. With the small measuring cup, pour water into your mini bomb. Hold it from below so it doesn't get damaged while filling it.



3. Throw the water bomb at a surface and have fun with your friends!

What happened?

Although the mini water bomb is ready to explode as soon as you put the water inside. But, with the sheet of paper folded, it becomes more resistant to withstand the water. When you throw your mini bomb, the energy created with the impact forces the water to come out and the bomb explodes!

If you are not fast enough, the water will make the paper more fragile until it ends up ruining the mini bomb.

Experiment 11
Explosive geyser

OUTDOOR EXPERIMENT

Extra items you will need:
- Soda, ideally *Diet Coke*
- One package of *Mentos* candy
- Adhesive tape
- Scissors

Always ask an adult for help!

Steps:

1. Place the bottle of soda on a flat and stable surface.

2. Open the *Mentos* package and think of a way to drop them in the bottle all at the same time.

You can make a cylinder of *Mentos*: with the scissors (and the help of an adult), cut a strip of tape and, one by one, fasten the sweets on their edges to the tape, as shown. Then attach another strip of tape to the other side of the sweets, so that they are securely attached.

3. Open the bottle and drop the cylinder of candy (*Mentos*) inside.

4. Now, move away from the bottle.

Boom!

CAUTION: when you complete the experiment, throw away all food products used.

Observe your geyser!

What happened?

In this experiment we can simulate a geyser, because soft drinks with gas (carbonated) include a high quantity of dissolved carbon dioxide, in equilibrium and under pressure, ready to escape when the pressure at the surface (free from the solution) decreases.

This way, when we open the bottle the gas tends to escape to the outside.

DID YOU KNOW...
That scientists can't yet define if this is a chemical or physical phenomenon?

When we add sweets to a soft drink, we are creating a kind of release nuclei of carbon dioxide (which is dissolved).

This happens because these candies are porous and rough. When we add any porous object (for example, salt) to a liquid with gas we can observe a higher release of carbon dioxide, creating the effect of a geyser.

Geysers are characterized by intermittent discharges of water that are violently ejected and accompanied by steam. These water jets can reach hundreds of feet high!

Secondary volcanism can also be seen as real explosions and are examples of chemical reactions that happen due to heat. These phenomena are also examples of chemical transformations by the action of heat.

Image 8. Geyser.

DID YOU KNOW...
In Yellowstone National Park, there are about 500 geysers?

WOW!

oH...

Observe the *Mentos*!

If we observe the *Mentos* with a magnifying glass, we find that its surface is porous and rough; due to these irregularities, gas is released.

Image 9. *Mentos*.

When we put *Mentos* into the soft drink bottle, the bubbles of carbon dioxide start appearing at the surface of the sweets. All these bubbles are created so fast that they force the soda right out of the bottle!

Experiment 12
Fireworks

What you will need:
Material included in the kit:

- Colorings
- Large measuring cup
- Pipette droppers
- Small measuring cup

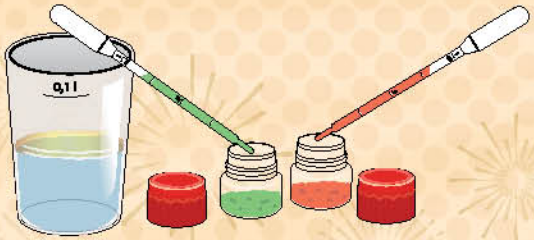
Extra items you will need:
- Water
- Cooking oil
- Small sheet of paper

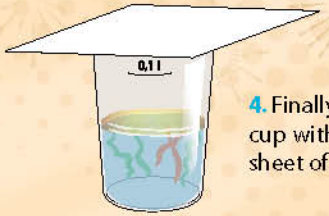
Steps:

1. Fill half the large measuring cup with water.

2. Measure 10 ml of cooking oil using the small measuring cup and add it to the large measuring cup.

3. With the pipette dropper, carefully add some droplets of coloring to the cup. You can start by adding 3 droplets of each color.





4. Finally, cover the cup with the small sheet of paper.

Scientist, observe the fireworks!

ATTENTION: when you complete the experiment, throw away all food products used.

What happened?
Oil floats at the surface of water. When you add the drops of coloring to the cup, they get stuck for a few seconds in the layer of oil. Then, the colored drops move from the oil layer to the water layer. When reaching the water, they explode and create a firework effect.

Why does this happen?
Water is more dense than oil. When the coloring drops are released from the oil, they sink (because they are also more dense than the oil) and will pass through the layer of oil. When they reach the water they are dissolved, creating the fantastic effect of fireworks!

Image 10. The color of the fireworks according to the metallic compound that is used.

Density is a measure of matter that depends on the weight and volume of the object. It helps us quantify the amount of matter, consisting of atoms, molecules or ions, present in a given volume of an object/substance.

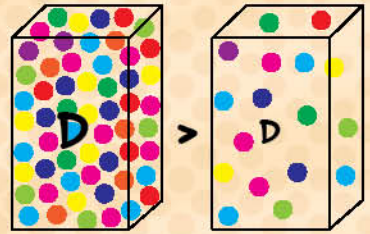


Image 11. Density representation of different objects with the same volume.

In fact, fireworks are explosives which contain a fuse to start the combustion. During fireworks, many chemical transformations occur and create new substances, evident by the release of light, color, sound, and heat. In general, the heat released from the explosion of this combustion reaction is absorbed by the atoms of the metals present in the interior of the sparks. These will release excess energy under the shape of visible radiation, that is, colorful light!

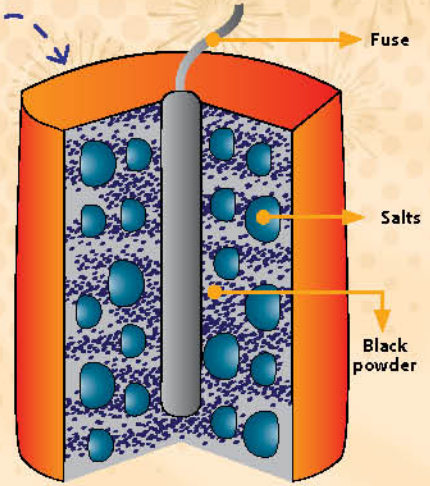


Image 12. Fireworks are mainly contained by the shell.

Experiment 13
The combustion of starch

OUTDOOR EXPERIMENT

What you will need:
Material included in the kit:

- Candle

Extra items you will need:
- Corn starch
- Strainer
- Teaspoon
- Plate
- Match/lighter

Always ask an adult for help!

Keep a safe distance while you carefully observe the result of experiment.

Steps:

1. Ask an adult to light the candle and place it on a plate.

2. Now ask your assistant to hold the strainer about 4 inches over the candle, and with the other hand, to add a spoon of corn starch to the strainer, sprinkling it over the candle.

What happens? Can you excite the flame?

ATTENTION: when you complete the experiment, throw away all food products used.

DID YOU KNOW...
That the color of a flame indicates its intensity? A stove flame is blue and a candle flame is yellow. A blue color means that the flame is more intense than the yellow one.

Image 13. The flame of a candle is different than the flame of a stove.

Starch is a large molecule that results from the bonding of smaller molecules of glucose. Glucose is a simple sugar and as we have already seen, the main combustible of our cells (cellular respiration).

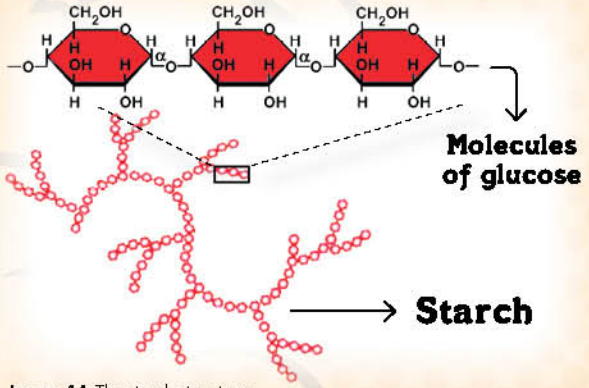


Image 14. The starch structure.

What happened?
In order for **combustion** to happen there has to be a good mixture between the **combustible** and the **oxidant**.

It is what happens in this experiment: the corn starch, as it is sprinkled, starts a combustion process much quicker since the exposed surface is larger. This way, it can excite the candle's flame!

Combustion reactions occur between an **oxidizing** agent and a **fuel**, releasing energy in the form of heat, in the presence of an activation energy.

That combustions can be **spontaneous**, **rapid** or **explosive**!

The combustions may present a flame formation.

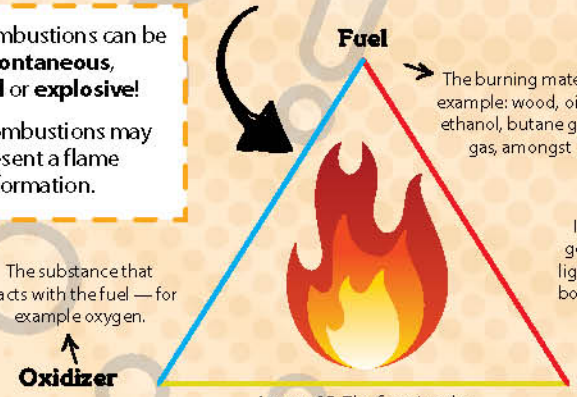


Image 15. The fire triangle.

Image 16. Combustion reaction.

Experiment 14
Mini rocket

OUTDOOR EXPERIMENT

What you will need:
Material included in the kit:

- Small measuring cup with lid
- Mini-rocket decorative elements (page 35)
- Fizzy bomb (Experiment 3)

Extra items you will need:
- Scissors
- Warm water from a tap
- Paper towel
- Adhesive tape

Always ask an adult for help!

Citric Acid
WARNING
Hazard Statement: Causes serious eye irritation.

Note: if you do not have any fizzy bombs from experiment 3, you must conduct this experiment first.

Steps:

Part 1 – Personalize your mini rocket:

1. Photocopy page 35 of this book. Then, with scissors and help of an adult, cut out the decorative elements and decorate the small measuring cup as you like. This is your rocket!

BAMM!

Part 2 – Build your mini rocket:

1. Hold your mini rocket and fill it in with about 10 ml of warm water.

2. Tear a piece of a paper towel to cover the rocket's opening.

3. Place the fizzy bomb over the piece of paper towel.

4. Make sure the cup (rocket) is closed tightly with the lid, you should hear a click when it's secure.

5. Count to 3 and carefully turn the rocket upside down over and set it on a flat surface!

1...2...3 BOOOM

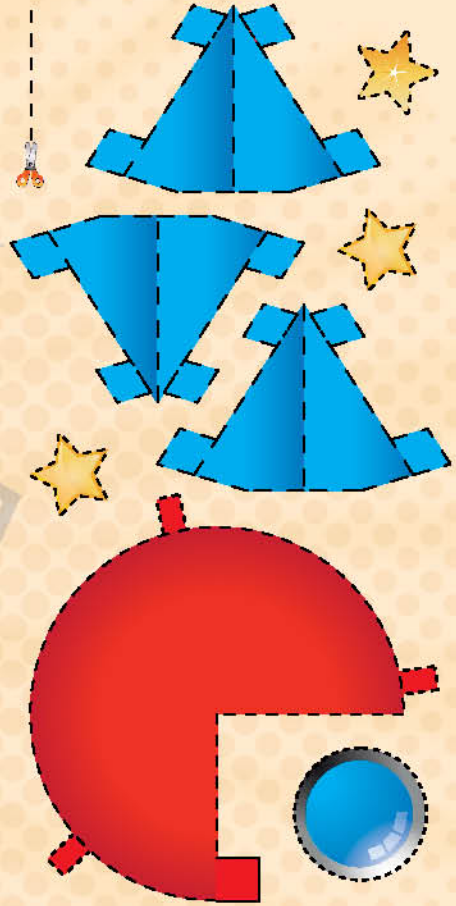
Can your mini rocket stay in the air?

What happened?

Once again, when your fizzy bomb comes in contact with water, a **chemical reaction** between sodium bicarbonate and citric acid (components of your fizzy bomb) happens.

This reaction is characterized by the **release of a gas**, carbon dioxide, which causes the **increase in pressure** to cause your rocket to be launched!

Mini rocket decorative elements



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