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Super Lab Soaps

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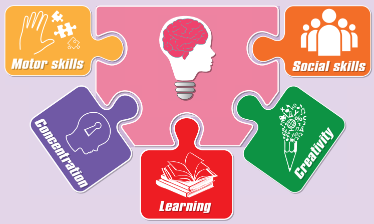
Dear parents and guardians

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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London, United Kingdom.
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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 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 and/or non-reclosable packaging 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 allow chemicals to come into contact with the eyes or mouth.
- The made products (soaps) should not be used anymore if they change their appearence, colour or fragrance.
- Contains fragrances that may cause allergies ((2E)-2-Benzylideneoctanal, Benzyl Salicylate, Allyl Ciclohexanepropionate, (R)-p-Mentha-1,8-diene, Delta-1-(2,6,6-Trimethyl-3-cyclohexen-1-yl)-2-buten-1-one, 2,4-Dimethyl-3-cyclohexen-1-carboxaldehyde, (E/Z)-3,7-Dimethyl-2,6-octadienal, 2-Methyl-3-(4-tertbutylphenyl)-Propanal, (1S,5S)-2,6,6-Trimethylbicyclo[3.1.1]hept-2-ene ((–)--Pinene), 6,6-Dimethyl-2-methylenebicyclo[3.1.1]heptane, p-mentha-1,4(8)-diene, 7-hydroxycitronellal and Lauraldehyde).

GENERAL FIRST AID INFORMATION

- **In case of eye contact:** Wash out eye with plenty of water. Seek immediate medical advice if necessary.
- **If swallowed:** Wash out mouth with water and drink some fresh water. Do not induce vomiting. Seek immediate medical advice.

Write on the provided blank space the telephone number of national poison information centre or local hospital. They may provide you with information about measures to take in case of intoxication.

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

Super Lab Soaps

LIST OF CHEMICALS SUPPLIED

Soap base

INGREDIENTS: AQUA, GLYCERIN, SODIUM STEARATE, PROPYLENE GLYCOL, SORBITOL, SODIUM LAURATE, SODIUM LAURETH SULFATE, DISODIUM LAURYL SULFOSUCCINATE, SODIUM CHLORIDE, STEARIC ACID, LAURIC ACID, PENTASODIUM PENTETATE, TETRASODIUM ETIDRONATE

Blue cosmetic colouring (CI 42090)

INGREDIENTS: FOOD BLUE 2, METHYLISOTHIAZOLINONE, METHYLCHLOROISOTHIAZOLINONE, DIMETHYLOL GLYCOL

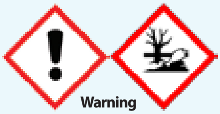
Yellow cosmetic colouring (CI 19140)

INGREDIENTS: ACID YELLOW 4, METHYLISOTHIAZOLINONE, METHYLCHLOROISOTHIAZOLINONE, DIMETHYLOL GLYCOL

Red cosmetic colouring (CI 14720)

INGREDIENTS: FOOD RED 3, METHYLISOTHIAZOLINONE, METHYLCHLOROISOTHIAZOLINONE, DIMETHYLOL GLYCOL

Apple fragrance



Hazard Statement:

H317: May cause an allergic skin reaction.

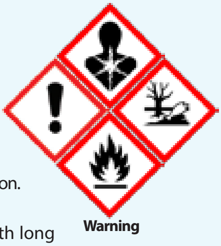
H411: Toxic to aquatic life with long lasting effects.

Precautionary Statement:

P280: Wear protective gloves.

Contains Hexyl Cinnamic Aldehyde, Benzyl Salicylate, Allyl Ciclohexanepropionate, D-Limonene, Delta-1-(2,6,6-Trimethyl-3-cyclohexen-1-yl)-2-buten-1-one, 2,4-Dimethyl-3-cyclohexen-1-carboxaldehyde, Citral and Butylphenyl Methylpropional. May produce an allergic reaction.

Tangerine fragrance



Hazard Statement:

H304: May be fatal if swallowed and enters airways.

H315: Causes skin irritation.

H317: May cause an allergic skin reaction.

H226: Flammable liquid and vapour.

H410: Very toxic to aquatic life with long lasting effects.

Precautionary Statement:

P101: If medical advice is needed, have product container or label at hand.

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. — No smoking.

P280: Wear protective gloves.

P301+P310: IF SWALLOWED: Immediately call a POISON CENTER.

P331: Do NOT induce vomiting.

Contains D-Limonene, Alpha-Pinene, Beta-Pinene, Terpinolene, Citral, Hydroxycitronellal and Lauric Aldehyde.May produce an allergic reaction.

Glitter

INGREDIENTS: PIGMENT GREEN 7, CURRY RED, POLYETHYLENE TEREPHTHALATE, CI 77000, CI 77891, ETHENOXYMETHOXYETHYLENE

KIT CONTENTS

Description:	Quantity:
1. Plastic moulds for soaps	3
2. Soap base	2
3. Plastic film	3
4. Satin ribbons	6
5. Protective gloves	2
6. Glitter	2
7. Tangerine fragrance	1
8. Apple fragrance	1
9. Test tubes with lids	6
10. Yellow cosmetic colouring	1
11. Blue cosmetic colouring	1
12. Red cosmetic colouring	1
13. Wooden spatulas	3
14. Pasteur pipettes	3

1. Introduction

Have you thought about the importance of soap? How would it be if soaps and its derivatives weren't invented? What is the physical state of soap? What hygiene techniques you must have to stay healthy? What are soaps made of? What characteristics allow them to remove dirt efficiently?

With this educational book and the experiments, we intend to give you the answers for all these questions in a clearly and fun way.

Have fun while you learn to make fantastic glycerine soaps!

2. The matter around us

Have you really looked around you? We are surrounded by matter, with different shapes, different colours and different physical states and in constant transformation.

Let's explore some of the characteristics, definitions and curiosities about the matter around us. This way you may understand better some of the concepts of soap making.

2.1. Substances and mixtures

a) Substances

Do you know what a substance is? We use this word so often but probably we don't know its meaning!

Substance is a particular kind of material, composed of only a certain sort of molecules or atoms.

There are simple substances and compounds. The **simple substances** are made up of only one sort of atoms, such as oxygen (formed only by oxygen atoms), or iron (formed only by iron atoms).

Compounds are made up of different atoms, but only by a certain type of molecules.

Water is an example, for it is formed by two hydrogen atoms and one oxygen atom, that is, exclusively made of water molecules (H_2O).

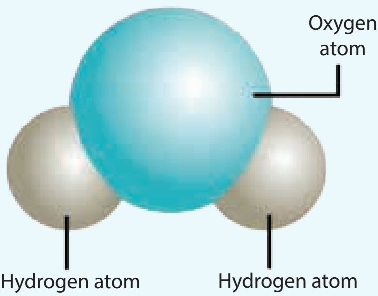


Image 1. Water molecule structure (H_2O).

Another example of a compound is glycerine or glycerol, a soap component that you will get to know later on.

Glycerol is a substance composed by different atoms (carbon, oxygen and hydrogen), but with equal molecules (of glycerol).

b) Mixtures

A substance has to be pure. When it is not pure, it is a mixture of substances. These mixtures can be homogeneous or heterogeneous.

A mixture is **homogeneous** when two substances mix completely and they cannot be distinguished.

The mixture of water with sugar is an example. In this case the sugar dissolves completely in the water, forming an homogenous mixture called **solution**.

In a solution, the substance dissolved and which is a lesser amount is called solute (in this case it is sugar), while the substance in which the solute is dissolved and it is in greater amount is called solvent (in this case is water).

We have a **heterogeneous** mixture when two substances don't mix, as in the case of water and oil. It is said that the substances are insoluble or immiscible.

DID YOU KNOW...
That some liquids don't mix due to the difference in their densities?
Water an oil are an excellent example. In this case oil density is lower than water density. Density is similar to weight, and as the oil weights less than water we say that it has a lower density. If you pour both liquids into a bottle, after a while you will see two layers: oil will stay on the top and water on the bottom.

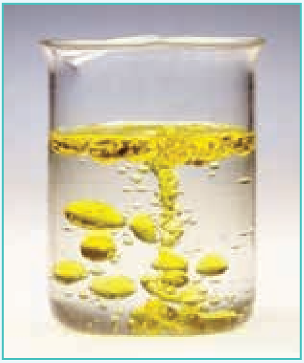


Image 2. Heterogeneous mixture (water and oil).

2.2. States of matter

Generally, particles that make up a substance can organise themselves in different ways depending on its physical state.

These particles can be closer together or further apart depending on the temperature and pressure conditions.

If you change the temperature and pressure conditions, the physical state of the matter can also change.

There are four states of matter:

- solid;
- liquid;
- gas;
- plasma.

Image 3. Soap (solid state).

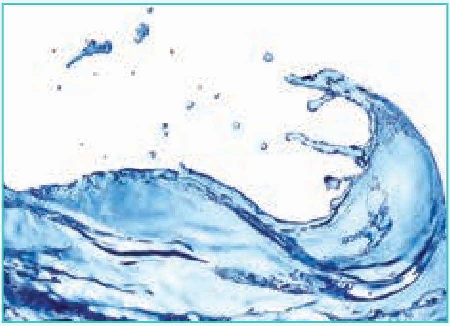


Image 4. Water (liquid state).

Image 5. Water vapour (gaseous state: Steam).

Image 6. Fire (plasma state).

a) Solid state

In solids, particles are close to each other.

Consequently, these materials have a fixed shape of their own.

For example, a gold ring will always have the same shape, wherever it is placed (inside a safe box, on a table, in trouser pockets, etc.).

Image 7. Gold ring.

Generally, solids transform in liquids or gas when heated at high temperatures or subjected to low pressure.

For example, ice (water in solid state) when heated until room temperature passes to the liquid state (liquid water).

Image 8. Ice cubes melting.

b) Liquid state

In the liquid state, matter usually presents its particles farther apart than in the solid state. This allows them to move, endowing the matter with fluidity.

In the liquid state, the matter has constant volume but does not have a shape of its own.

For example, if you pour water from a bottle into a glass, it will take the shape of the glass.

As in every liquid, the water acquires the shape of the recipient in which you pour it into.

Image 9. Water passing from the bottle into the glass.

Another characteristic of the liquid state is the constant volume of matter.

If you try to fill a bottle with 1 L of water and then you pour it in another recipient, it will change shape but the volume will still be 1 L.

c) Gaseous state

In the gaseous state, matter is formed by atoms or molecules farther apart from each other, allowing a great expansion.

In the gaseous state matter does not have a definite shape or volume.

For example, the gas contained in a recipient can be compressed or expanded, therefore its volume may decrease or increase.

Image 10. Sublimated iodine (gaseous state).

d) Plasma state

In Physics, plasma is called the fourth state of matter.

It is made of ionised atoms and electrons in an almost neutral distribution, that is, the number of positive charges (cations) is almost similar to the number of negative charges (electrons).

This small difference of charges makes plasma electrically conductive, that is, it responds strongly to electromagnetic fields.

Plasma has the capacity of adopting the shape of any recipient - it is very malleable, therefore it is used in lamps production, in metal transformation and in spaceships building.

A good example is the Sun's core, where the helium atoms are subjected to a very high temperature and pressure, allowing the electrons to break free from their atoms, becoming ionised.

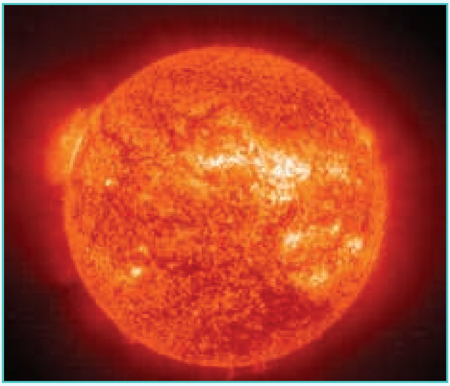


Image 11. Sun.

Another example of the plasma state is a lightning bolt. The plasma conducts electricity at a very high temperature. In this case, air ionisation occurs, conducting electricity from the clouds to the earth, due to a potential difference between both of them.

Image 12. Lightning bolt.

DID YOU KNOW...
That plasma is one of the physical states of matter?
It was discovered in 1879 by Sir William Crookes. This British physicist initially called the plasma radiant matter.

e) Changes of state

As we mentioned before, it is possible to change the physical state of a substance, by altering the temperature conditions and/or the pressure.

Next, you will learn the matter transformation processes, from a physical state to another.

Fusion

Is the process of a substance passing from the solid state to liquid state.

Image 13. Glycerine in solid state and in liquid state (melted).

Solidification

Is the transformation of a substance from the liquid to the solid state. Is the inverse process of fusion.

Image 14. Ice cream which turned into solid state through the solidification process.

Vaporisation
When a substance goes from a solid to gaseous state. There are two types of vaporisation: boiling and evaporation.

The process called **evaporation** is the transition from the liquid to gaseous state. This process occurs slowly and at room temperature: 25ºC (77ºF), such as when clothes are drying and the water evaporates.

The process called **boiling** is the rapid transition to the gaseous state and at high temperatures, such as when we heat a pot of water.

Image 15. Liquid water passing to gaseous state (boiling).

Condensation
Is the change of a substance from the gaseous state to liquid state. When a substance in the gaseous state comes in contact with a surface in lower temperature, changes into the liquid state.

Image 16. Water condensation on a glass.

Sublimation
Is the direct transition of a substance from the solid state to the gaseous state. The reverse process, that is, the direct transition from gaseous state to solid state is called desublimation (deposition).

Image 17. Iodine sublimation.

Ionisation
Is the change from gaseous state to plasma state. The reverse process, that is, the change of plasma state to gaseous state is called deionisation.

Image 18. Ionisation of gas inside of a plasma ball.

For example:

- When we supply energy to a solid, in the form of heat, it will raise its temperature until its fusion point and changes to liquid state.

- If we transfer even more energy, the liquid will reach the boiling temperature and its mass will turn gaseous.

- If we raise the energy transferred to the gas to high temperatures, we will obtain a plasma state.

2.3. Transformation of matter

Did you notice that the matter around us is in constant change?

You can observe all these changes in your everyday life, when a glass breaks, the ice melts or a match burns. These changes can be physical or chemical.

Image 19. Match burning.

Physical transformations are considered to be all transformations that occur without new substances being formed, such as the physical state change that you learned in the previous paragraphs, or as the dissolution of a solute in a solvent (e.g. dissolution of sugar in water).

Chemical transformations occur when new substances are formed, through initial substances (reactants) and originating new substances (products).

An explosion, the soup boiling, the rusting of a nail, the fruit ripening, are a few examples. In a chemical transformation the initial substances are called reagents and the new substances formed are called products.

The soaps you will make are the product of a chemical transformation.

3. Personal hygiene

Hygiene is a set of conditions and practices that improves the human being's individual and collective health. Personal hygiene covers several points that you must take into account in order to stay healthy.

Next, learn about the different types of hygiene that you should not neglect!

3.1. Skin hygiene

Skin care is essential. The skin is one of the most important organs of our body, for it is a protective barrier against external aggressions and possible infections.

Therefore, personal hygiene is an effective way to avoid some diseases, by removing microorganisms/germs that could cause infections in our skin and body.

Image 20. Skin.

Body wash with water and soap allows to remove dust, microbes and other dirt that stick to the natural fat layer of the skin and which is produced by the sebaceous glands.

Image 21. Hand wash with soap.

DID YOU KNOW...
That during hair washing, you should avoid the excessive use of oils?
These make the hair more oily and lead to the development of germs.

3.2. Teeth hygiene

Dental caries are caused by bacteria present in food residuals between the teeth. Teeth are essential for chewing and even for smiling, whereby it is important to have an effective dental hygiene.

Image 22. Teeth hygiene.

You should wash (brush) your teeth after every meal, using high quality toothpaste and a non aggressive toothbrush. You should brush every teeth, the space between them also, and massage the gums gently.

3.3. Food hygiene

To stay healthy is essential that you have a well balanced and varied diet.

Image 23. Fruits.

You should wash properly all the food that you eat raw, as in the case of fruits. You should avoid eating too much candies, sodas and fats, and check the food expiration dates.

Drinking plenty of water every day is also essential to your well-being.

Image 24. Glass of water.

Image 25. Women washing clothes in the river.

3.4. Clothing hygiene

Clothing and footwear should not be too tight. These protect you against cold, solar radiation, rain, snow and dust.

Our clothes can accumulate dirt and microbes easily, therefore they need to be washed and brushed regularly.

4. Soaps

4.1. The origin of soaps

Historians refer to the origin of soap at the early Christian Era.

It is believed that it was in ancient Rome, more precisely in Mount Sapo, that the word "soap" got its name from.

On that mountain, animals were sacrificed as an offer to God and the fat of these animals, mixed with the ashes from the wood of the fires, was drained down the hills to the near rivers, where women washed the clothes.

Women started to notice that it was easier to clean the clothes when these were in contact with those substances flowing in the river.

Later, several chemists started to produce soaps from chemical reactions between vegetable oils, mixed with scented oils, and salt (at the time potassium).

DID YOU KNOW...
That potassium was formerly obtained from wood ash?

There were several physicians that began to understand the utility of soap, mainly in personal hygiene.

The Greek physician Galeno (AD 130-200) described the utility of soap as a medicine for the removal of body dirt and death tissues of the skin.

Since then, several scientists tried to use soap to heal many skin problems, including psoriasis, herpes and scabies.

Image 26. Galeno (AD 130-200).

DID YOU KNOW...
That taking a bath is quite important to remove the microorganisms of the skin, and therefore, reducing the risk of skin infections?

Vegetable soap (without animal fat) started to be produced in Europe since the XVI century. However, in the XVIII century, the soap started to be more usual due to a better understanding of the importance of hygiene in the decrease of diseases.

Modern soaps, like the ones we currently use, started to be produced on large scale due to a greater demand and to the discover of a new production process.

In 1791, Frenchman Nicolas Leblanc (1742-1806) discovered a new process to synthetise sodium carbonate (one of the reagents to produce soaps) out of common salt (sodium chloride).

This process involved the use of salt mixed with a sulfuric acid solution, chalk and charcoal, originating the sodium carbonate (Na_2CO_3), an alkaline salt.

Image 27. Frenchman Nicolas Leblanc (1742-1806).

This process then became the main method of soap making, through the reaction with vegetable fats, for it had the advantage of being an easy and inexpensive process, unlike the process of obtaining potassium from burning wood.

Later, it was revealed that the process discovered by Leblanc produced many harmful chemicals, causing pollution problems.

Later on, in 1811, Augustin Jean Frenesel discovered a new process of sodium carbonate production.

Fresenel began using a saturated solution with common salt (sodium chloride) and ammoniac (NH_3).

This solution reacts with the carbon dioxide (CO_2), originating bicarbonate of soda ($NaHCO_3$) and when heated forms sodium carbonate (Na_2CO_3).

This process turned out to be widely used in the soap industry and is still quite used nowadays.

Image 28. Augustin Jean Fresenel, French physicist.

The first soap bars were produced at the end of the XIX century, when advertising campaigns in the United States and Europe, intended to raise the population awareness of the relation between cleanliness and health.

Image 29. Soap bar.

As time went by, chemical industries developed soap making processes less aggressive to the skin, such as glycerine soaps.

Other industries also helped this development, creating industrial equipments that allowed manpower to be faster and more efficient.

Image 30. Glycerine soaps.

Nowadays, we can prepare our own soaps, using bases and fats from our daily life, adding colours and fragrances and moulding them in various shapes and types.

Discover how soaps are made today by learning some important concepts that will help you to understand the complete process.

4.2. Soap making

As we have seen previously, soaps are made from fats, and these can be of animal or vegetable origin.

Fats are lipids, that is, biomolecules formed by fatty acids connected to an alcohol (glycerol) - called triglycerides.

DID YOU KNOW...
That the essential characteristic of lipids is its insolubility in water?
On the other hand, they present a large solubility in organic solvents, such as ether, acetone, alcohol, etc.

DID YOU KNOW...
That lipids play an important role in biological functions of extreme importance at the structure level (cellular membranes) as well as in energy reserve?

An alkaline salt (base) is added to the fat used to produce soaps and generally is sodium hydroxide. These two combined together cause a chemical reaction, releasing glycerol and originating salts of fatty acids, that is to say, soap itself. This reaction is called saponification.

Fat + Base --> Glycerol + Soap

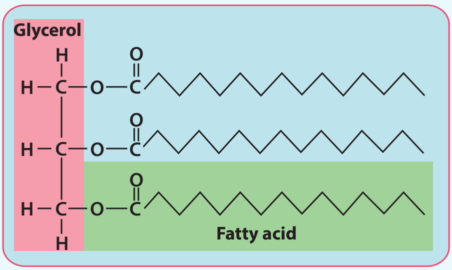


Image 31. Structure of lipids (triglycerides).

a) Saponification

The saponification process (alkaline hydrolysis of fat) is the name given to the reaction that allows to release glycerol from the fatty acids.

This reaction occurs when we add a base or basic solution, generally a salt, and originate fatty acids and glycerol.

The equation bellow shows an example of the alkaline hydrolysis of a triglyceride (oil or fat).

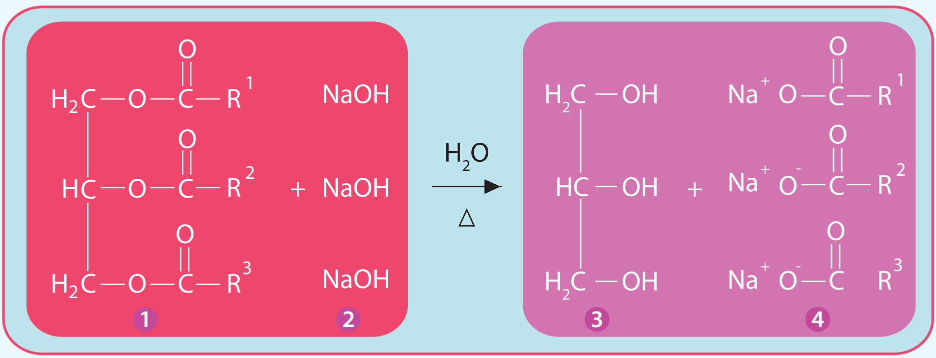


Image 32. Reaction of saponification: soap making. 1 - Triglycerides; 2 - Sodium Hydroxide (salt); 3 - Glycerol; 4 - Fatty acid salts (soap).

Therefore, a soap is a salt of fatty acids, obtained through the reaction of a fat with sodium hydroxide, potassium hydroxide or sodium carbonate, and all three are alkaline bases.

DID YOU KNOW...
That saponification can vary according to the composition of salts and fats used and also in accordance with the method applied to manufacturing?

If we use a soap base with sodium (Na), the soap will be solid.

On the other hand, if we use a soap base with potassium (K) the soap will be liquid and viscous.

DID YOU KNOW...
That although most of the soaps and detergents are designed to be used with water, there are some produced for cleaning with other solvents?
Engine oils are a good example, because water cannot be used. In this case, sodium and potassium are replaced by metals, such as lead.

Image 33. Glycerine soaps.

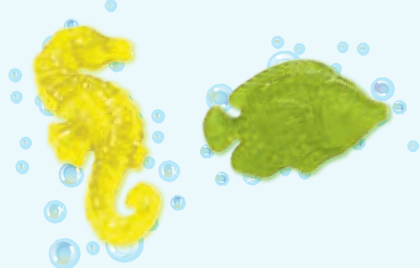
b) Glycerine

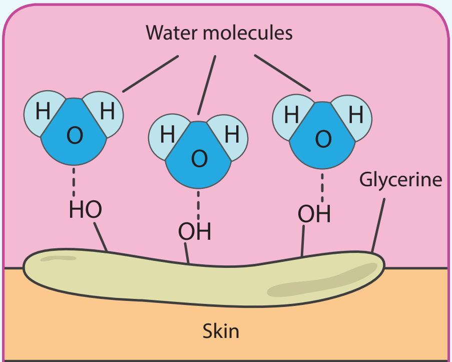
Glycerine (glycerol) is a product of soap making. As you have learned previously, when we mix a salt with fat, the saponification reaction occurs, producing glycerine and fatty acid salts (soap).

DID YOU KNOW...
That glycerol is solid at room temperature and passes to liquid state when heated?
When cooled, glycerol goes back to the solid state.

Image 34. Glycerine soap.

Glycerine is widely used nowadays, often added to creams and beauty products, for it is a good humidifying agent. That is, it creates a layer of glycerine on the skin, avoiding water loss and keeping the moisture of the skin.





Humectancts, such as glycerine, interact with the skin surface and with water, creating a more moistured environment in that area.

Image 35. Interaction of glycerine with our skin.

DID YOU KNOW...
That glycerine is also used in the production of explosives?
More specifically nitroglycerine.

c) Processes of soap making

There are several processes of soap making. Find out which are the most common.

- Cold saponification process:
In the cold saponification, an alkaline solution is made through the dissolution of salt in water.

This alkaline solution is then added to the boiled fats, being stirred and mixed constantly.

This mixture will originate a reaction which results in two different phases: one is soap and the other glycerine.

In this step, pigments and fragrances may be added to give colour and fragrance to the soap.

This soap dough is then placed into moulds to solidify and get the desired shape.

The soap is ready when there is no trace of salt and has saponified all the existing fat, which could take a few weeks.

This process is called cold saponification, because no external heat source is used to perform this reaction.

Image 36. Glycerine soaps obtained through the saponification cold process.

- Hot process of soap making:
This process consists of adding an alkaline solution to a fat, as in the cold process of saponification.

The difference between these two processes lies in the reaction heating, during the mixing of salt and fat.

After the mixture has been boiled and a gel base is formed, soap is removed from the heat source and fragrances and colours can be added, to give soaps some colour and a pleasant smell.

The soap dough is then moulded and can be unmoulded a few hours later, without the need of waiting too long, until de reaction of salt and fat is concluded.

- Melting process:

In this soap making process, a prefabricated soap mass made of glycerine is used.

This soap mass is then melted in double boiler or in the microwave until is liquid.

When it is in the liquid state, colours and fragrances can be added to give them some colour and a pleasant smell.

Then, the soap is poured into the moulds while is still in liquid state. It is left there until it is cooled, solidified and shaped as desired.

You will use this process to make your own soaps!

Image 37. Glycerine soaps made through the melting process.

d) Cleansing action of soaps

Water only by itself cannot remove certain kind of dirt, such as oil traces.

This happens because water molecules are polar and oil molecules are non-polar.

Soap has an important role in cleansing because it can interact with polar substances and with non-polar substances as well.

To understand better this phenomenon it is best to analyse the soap structure.

If we look into the molecular structure of a soap, we will notice that it is formed by two parts with different characteristics:

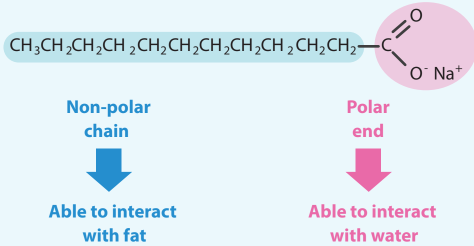


Image 38. Molecular structure of a soap.

It has a carboxylic extremity which is highly **polar**, that is to say, that it dissolves in water. We can say that this molecular extremity is **hydrophilic** (it has affinity for water), which means that it connects to water molecules.

The other extremity presents a **non-polar** character, for being **hydrophobic** (it has water aversion), and therefore it cannot be dissolved in water.

DID YOU KNOW...
That when soap is in contact with the water, the hydrophobic extremities of its molecules assume a conformation that protects them from water contact?

Molecules that present an hydrophilic character as well as an hydrophobic one, can interact simultaneously with water and with substances of hydrophobic character, such as oils and fats.

This is the reason why soaps clean the fats in our skin. The hydrophobic extremities connect to fats and the hydrophilic extremities connect to the water molecules, dragging the dirt.

DID YOU KNOW...
That when water with soap is applied to a dirty surface, it keeps the dirt particles in suspension so that these particles can be washed with clean water?

The following image shows the cleansing process when using a soap.

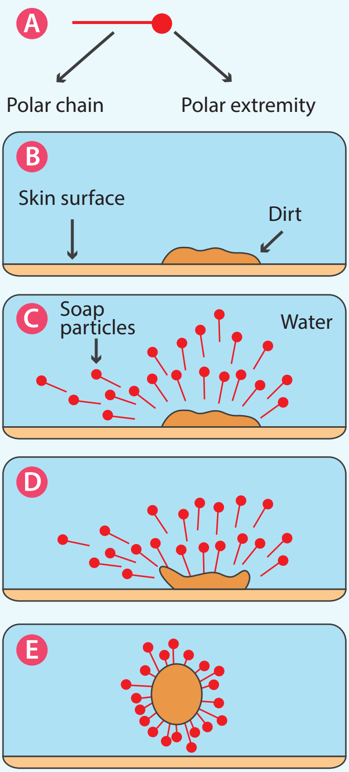


Image 39. Cleansing mechanism of the skin using a soap:
(A) Soap molecule illustration;
(B) Skin surface with dirt particles and fat which don't dissolve in water;
(C) Soap particles added to water;
(D) When the soap particles come close to dirt and fats, the non-polar chain interacts with these particles, and the polar extremity interacts with water;
(E) A complex is formed which can easily be removed with water.

This complex formed around the dirt particles is called **micelle**.

The water used to rinse, interacts with the external part of the micelle, which is formed by the polar extremities of the soap molecules.

Therefore, the micelle is dispersed in water and taken by this one, making it easier to remove dirt and fats with soap.

The micelle formation process is called **emulsification**.

The image 39 illustrates how this process occurs. We often say that soap acts as an emulsifier, because it has a property that can cause the dispersion of oil in water, making the cleansing process easier.

DID YOU KNOW...
That synthetic detergent acts in the same way as the soap?
However, its molecular structure is different.

4.3. Soap decoration

Aside from its essential cleansing function, nowadays the production of soaps also considers its aesthetic function.

Decorating soaps is a common practice, and a large variety of **colours** and different **shapes** are used. This makes soaps more visually attractive, as well as smelly, due to the **scents** that give soaps a pleasant fragrance.

a) Colours

To colour a soap, dyes are added to the soap base while it is in liquid state, and right before pouring it into the moulds for solidification.

Be careful, dyes used in other situations cannot be used in soap making, because of the high risk of skin allergies and serious health problems.

There are several types of colours that can be used. You only have to let your imagination fly!

Below you can discover all the colours that you can make from only 3 primary colours supplied with the kit.

- **Primary colours:**

Colours extracted directly from nature, and which can be combined to create a wide range of colours. There are three primary colours: **cyan**, **magenta** and **yellow.**

They are called primary colours because they are pure, which means that it is not possible to obtain these by mixing other colours.

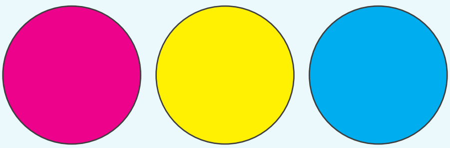


Image 40. Primary colours.

- **Secondary colours:**

Colours made by mixing two primary colours (reason why they are called secondary).

There are three secondary colours: **orange**, **green** and **violet**.

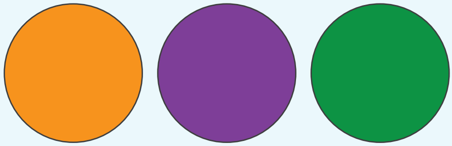


Image 41. Secondary colours.

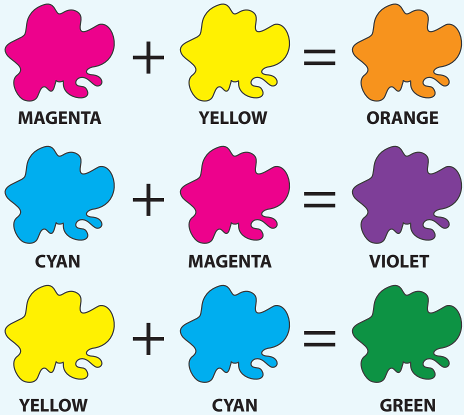


Image 42. How to obtain secondary colours.

- **Tertiary colours:**

There are also tertiary colours resulting from the mixture of a primary colour with one or two secondary colours. Tertiary colours include all the other colours, such as brown, pink, turquoise, etc.

So, with only three primary colours (yellow, magenta and cyan) you will get all the other colours and make super colourful soaps!

Image 43. Colourful soaps.

b) Scents

You may have noticed that soaps usually have a quite pleasant scent, which is due to fragrances added during its production process.

Fragrances can be natural (vegetable or animal), or synthetic (produced in laboratory), existing in a large variety.

When these fragrances are combined together, they increase the variety of perfumes and colognes that is possible to produce.

Image 44. Fragrance bottle.

This is the reason why there is a large amount of fragrances, such as: strawberry, vanilla, apple, tangerine, lemon, jasmine, rose, orange blossom, lavender, mint, etc.

In order to have scented soaps, fragrances are added to the soap base, while it is in liquid state, immediately before pouring it into the moulds for solidification.

c) Shapes

As you have learned in the previous chapters, at the end of the soap making process, the soap is poured into the moulds and stays there until cooled and turned into solid state. In this step, soaps can be created and shaped as we intend. To do so, it is necessary only to pour the soap (in the liquid state) into a mould with the shape we want and let it cool down.

Hence, we can make soaps with any kind of shape, such as: hearts, stars, animals, flowers, fruits, etc.

Image 45. Heart shaped soaps.

Image 46. Star shaped soaps.

Image 47. Fruit shaped soaps.

Image 48. Giraffe shaped soap.

4.4. Environmental impact of soaps and detergents

Everyday, soaps and detergents are used and then drained through the sewerage and consequently dumped in rivers and lakes.

The water movement causes a layer of foam at the water surface, which blocks the entrance of oxygen in the water. That oxygen is essential to fish and other aquatic animals.

Image 49. River water polluted by detergents.

DID YOU KNOW...
That aquatic birds are also harmed by water pollution because of soaps and detergents?
These birds have an oily coat in their feathers. They can float in the water due to the thin layer of air under these. Therefore, when this oily coat is removed by detergents, it is difficult for birds to float and these may even drown.

Despite this, after some time, soap waste end up being decomposed by the microorganisms action living in the aquatic environment. This process is known as biodegradation.

Soaps are made from substances existing in nature (oils and fats) and many microorganisms are able to degrade them. Every soap is biodegradable, unlike synthetic detergents which may or may not be biodegradable.

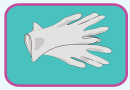
This is the reason why you should always use biodegradable glycerine soaps, so you may protect the environment!

5. Experiments

★ Material included in the kit.

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

Experiment 1
Glycerin soaps



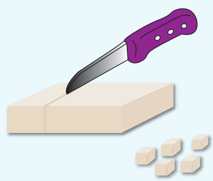
INGREDIENTS: AQUA, GLYCERIN, SODIUM STEARATE, PROPYLENE GLYCOL, SORBITOL, SODIUM LAURATE, SODIUM LAURETH SULFATE, DISODIUM LAURYL SULFOSUCCINATE, SODIUM CHLORIDE, STEARIC ACID, LAURIC ACID, PENTASODIUM PENTETATE, TETRASODIUM ETIDRONATE

ATTENTION: ask an adult for help.

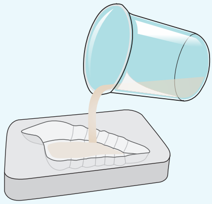
What you will need:
- Soap base ★
- Knife (ask an adult to help you handling it)
- Stove or microwave (ask an adult to help you handling it)
- Kitchen glove
- Glass or cup made of resistant glass (e.g. Pyrex)
- Wooden spatula ★
- Plastic mould for soaps ★
- Plastic film ★
- Satin ribbon ★

Steps:

1. With the help of a knife, remove a little bit of soap base from the box, just enough to make a soap: between 20 and 32 g and cut it into small pieces.



2. Place the soap base pieces inside the glass or cup (the glass must be resistant).



3. Now, you need to heat the soap base so that it melts, passing from the solid state to the liquid state.

The melting point of the soap base, supplied in the kit, is 50-60ºC (122-140ºF). You may heat it in two different ways:

• Double-boil*: place a glass (or cup) in double-boil, and keep stirring it with the spatula until the soap base is completely melted;
or
• Microwave: heat the glass (or cup) containing the soap base, for about 20 seconds. Remove the glass and stir the soap base with the wooden spatula.

Place the glass back again in the microwave for another 10 seconds. Then, remove it to stir again.

Repeat this last step (never leave it heating more than 10 seconds straight) until the soap base is completely melted.

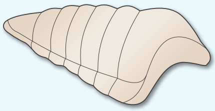
Attention: always use the kitchen glove to touch the glass (or cup) to avoid getting burned!

4. Now that the soap base is in liquid state, you can shape it as you like. Choose one of the plastic moulds included in the kit and slowly pour the soap into it.

Attention: be careful so you don't get burned, for the soap base is quite hot!

5. Wait until it is completely solidified (it could take until 2 hours) and remove the soap from the mould.

Your soap is ready! To save it, wrap it in plastic film and you may also decorate it with the supplied satin ribbon.



In this experiment you made a simple soap, only with a glycerine base.

Although it is not colourful nor scented, this soap has an essential function of cleansing as you have learned before, while you read this manual.

In the next experiments, you will learn how to make colourful and scented soaps!

> ***Double-boil** is a scientific method of slowly and uniformly heating any liquid or solid substance. This is done by placing a small container (with your chosen substance inside) into a larger container filled with boiling water. During this process, the substances are never heated to temperatures above 100ºC because the boiling point of water is 100ºC.

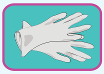
Ideal Formulations
Glycerine soap (20 g)
Soap base - 20 g

Experiment 2
Scented soaps

<u>INGREDIENTS:</u> AQUA, GLYCERIN, SODIUM STEARATE, PROPYLENE GLYCOL, SORBITOL, SODIUM LAURATE, SODIUM LAURETH SULFATE, DISODIUM LAURYL SULFOSUCCINATE, SODIUM CHLORIDE, STEARIC ACID, LAURIC ACID, PENTASODIUM PENTETATE, TETRASODIUM ETIDRONATE, LIMONENE, LINALOOL, HEXYL CINNAMAL, BENZYL SALICILATE

ATTENTION: ask an adult for help.

What you will need:

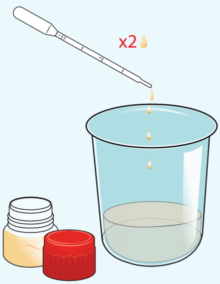


- Soap base ⭐
- Knife
- Stove or microwave
- Kitchen glove
- Glass or cup made of resistant glass (e.g. Pyrex)
- Wooden spatula ⭐
- Plastic mould for soaps ⭐
- Apple and tangerine fragrances ⭐
- Plastic film ⭐

Steps:

1. Repeat steps 1 to 3 of the previous experiment.

2. In this step, while the soap base is still in liquid state, fragrances are added. Choose one of the fragrances supplied in the kit and add 2 drops to the glass (or cup).



Tip: You may choose to combine the two types of the supplied fragrances: tangerine and apple. In this case, you just have to add one drop of each.

3. Mix well with the wooden spatula.

4. It is time to shape your soap. Choose one of the plastic moulds included in the kit, and carefully pour the soap into the mould.

Attention: be careful not to get burned, for the soap is quite hot.

5. Wait until it is completely solidified (it could take about 2 hours) and remove the soap from the mould.

Your soap is ready! To save it, wrap it in plastic film and you may also decorate it with the satin ribbon supplied in this kit.

Aside its cleansing function, the soap you have just made is also scented and it will leave a pleasant scented smell on your skin.

Ideal Formulations

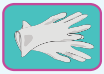
Scented soap (20.1 g)
Soap base - 20 g
Fragrance - 0.1 g

Experiment 3
The world of colours

In the item 4.3 a) of this book, you learned that with the 3 primary colours you can obtain an infinite range of colours.

With this experiment you will be able to make all secondary and tertiary colours, that you might want to use to make colourful soaps.

What you will need:



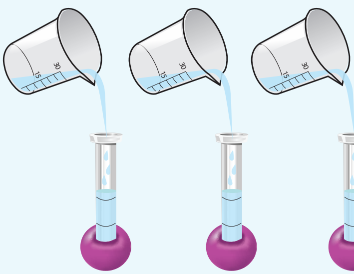
- Play dough
- Pasteur pipettes
- Blue cosmetic colouring
- Yellow cosmetic colouring
- Red cosmetic colouring
- Test tubes with lids
- Water

Steps:

Attention: the colourings included in this kit can stain, therefore, keep them away from clothes and delicate fabrics!

1. Make 3 balls with 3 pieces of play dough. Attach them to the table and place the 3 test tubes vertically on the play dough balls. The play dough will hold the tubes as the image shows.

2. Half fill each tube with water.



Before you start the experiment, carefully read the instructions so you can learn how to use a pipette. The idea of using a pipette is to collect liquid in small amounts from one container and put it in another.

A pipette lets you control the amount of liquid you are adding to something by only letting out a drop at a time. Pipettes are used by scientists when they need a very small amount of liquid in their experiment.

Before you begin with the experiment, you should practice the use of a pipette. The soft and squidgy end of the pipette is called the knob. The other end is called the tip.

1. Start by filling a glass with water. Once this is done, squeeze the knob of the pipette and place the tip into the glass of water.

2. Slowly release the knob of the pipette until you see water filling up the pipette's tube.

3. Now that you have collected the liquid you can release it again in small drops. To do this you need to remove the pipette's tip from the liquid and press the knob lightly. You will see the drops come out of the pipette one by one. You can add as many drops as you like.

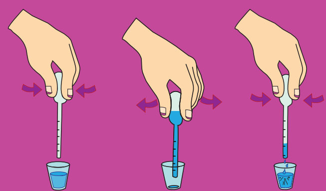


Image 50. Learning how to use a pipette.

3. With the help of a pipette, mix some drops of the colourings in the test tubes. *

Attention: do not use the same pipette to different colourings without washing it well!

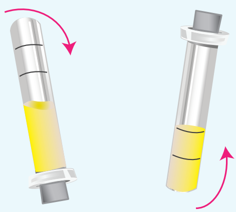
***Tip:** Review the item 4.3 a) of this book and use the colour hive presented below to explore all the colours you may obtain with the 3 primary colours!

Image 51. Colour hive.

Find in the colour hive the colour you want to obtain and mix the colourings in the intended proportion. "2 magenta, 1 yellow" means that you should use 2 parts of magenta for each part of yellow. The order of the mixing does not matter, when it says "2 red + 1 cyan" it is the same as "1 cyan + 2 red".

Tip: To obtain pastel colours and lighter colours, you just have to add some more water to the colour mixture.

4. Place the lids in the test tubes and shake the solutions.



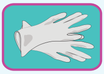
5. Save the coloured solutions that you made in this experiment. In the next experiments we will use these solutions to create super colourful soaps!

Experiment 4
Scented and colourful soaps

INGREDIENTS: AQUA, GLYCERIN, SODIUM STEARATE, PROPYLENE GLYCOL, SORBITOL, SODIUM LAURATE, SODIUM LAURETH SULFATE, DISODIUM LAURYL SULFOSUCCINATE, SODIUM CHLORIDE, STEARIC ACID, LAURIC ACID, PENTASODIUM PENTETATE, TETRASODIUM ETIDRONATE, LIMONENE, LINALOOL, HEXYL CINNAMAL, BENZYL SALICILATE, PARFUM, POLYETHYLENE TEREPHTHALATE, ETHENOXYMETHOXYETHYLENE, METHYLISOTHIAZOLINONE, METHYLCHLOROISOTHIAZOLINONE, DIMETHYLOL GLYCOL CI 14720, CI 19140, CI 42090, CI 16035, CI 74260, CI 77891, CI 77000

ATTENTION: ask an adult for help.

What you will need:

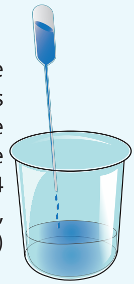


- Soap base ⭐
- Knife
- Stove or microwave
- Kitchen glove
- Glass or cup made of resistant glass (e.g. Pyrex)
- Wooden spatula ⭐
- Plastic mould for soaps ⭐
- Colouring solutions from the previous experiments ⭐
- Pasteur pipettes ⭐
- Apple and tangerine fragrances ⭐
- Plastic film ⭐
- Satin ribbon ⭐
- Glitter ⭐

Steps:

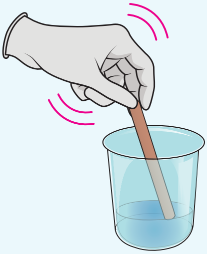
Attention: the colourings included in this kit can stain, therefore, keep them away from clothes and delicate fabrics!

1. Repeat steps 1 to 3 of experiment 1.



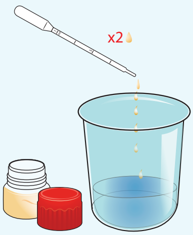
2. In this step, while the soap base is still in liquid state, colourings are added. Choose one of the colourings obtained in the previous experiments 3 and 4 and, with the help of a pipette, add 3-5 drops to the glass (or cup) which contains the liquid soap.

3. Stir the mixture well, using the wooden spatula.



4. Choose one of the fragrances supplied with the kit and add 2 drops to the glass (or cup).

Tip: You may choose combining the two supplied fragrances: tangerine and apple. In this case, you just have to add one drop of each.



5. Stir well, using the wooden spatula.

6. Add some glitter to the soap base and stir well with the spatula.

7. It is time to give shape to your soap. Choose one of the plastic moulds included in this kit and slowly pour the soap into the mould.

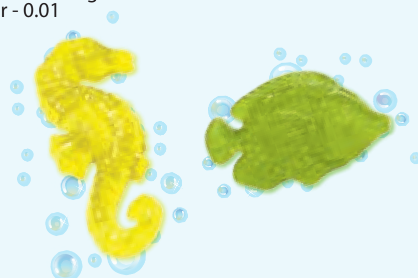
Attention: be careful so you don't get burned, for the soap base is quite hot!

8. Wait until they are completely solidified (it can take about 2 hours) and remove the soap from the mould.

Your colourful soap is ready!
To save it, wrap it in plastic film. You may also decorate it with the supplied satin ribbon.

Aside its cleansing function, the soap you have just made is also scented and it will leave a wonderful scented smell on your skin.

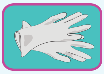
Ideal Formulations
Scented and coloured soap (20.36 g)
Soap base - 20 g
Cosmetic colouring - 0.25 g
Fragrance - 0.1 g
Glitter - 0.01



Experiment 5
Dried flowers soap

ATTENTION: ask an adult for help.

What you will need:



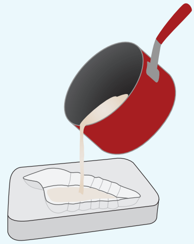
- Soap base ⭐
- Plastic mould ⭐
- Dried flowers
- Fragrances ⭐
- Wooden spatulas ⭐
- Plastic film ⭐
- Pasteur pipette ⭐

Steps:

1. Choose flowers that you like. So that they may dry, place them in between 2 newspaper sheets for 3 weeks. Put a heavy object on top of them, for example a big book.

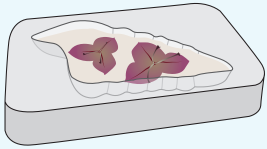
2. When your flowers are dry, melt the glycerine in water bath (double boiler).

3. Add some drops of the fragrance that you've chosen and stir it with the wooden spatula.



4. Pour the glycerine into the plastic mould.

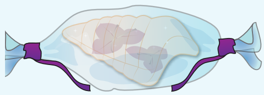
5. Place the dried flowers inside the mould. Do not touch the glycerine as it is hot. If you want to change or rearrange the flowers' positions use the wooden spatula.



6. Let it cool.

7. Remove it from the mould and wait 24 hours, until you don't feel humidity when touching it.

8. Wrap it in plastic film and use satin ribbons to tie it.



9. Your soap is ready. You can label it and offer the soap to someone as a gift.

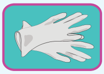
Tip: You can replace the dried flowers by aromatic herbs. You may also add cosmetic colouring to colour your soap.

Image 51. Glycerine soap with herbs.

Experiment 6
Oatmeal soap

ATTENTION: ask an adult for help.

What you will need:

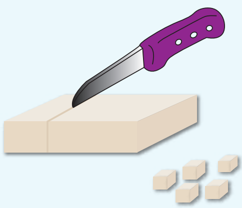


- Kitchen glove ⭐
- Water
- 100 g of soap base
- Knife
- Stove or microwave
- 50 g of oatmeal
- Glass or cup made of resistant glass (e.g. Pyrex)
- Wooden spatula ⭐
- Plastic mould for soaps ⭐
- Plastic film ⭐
- Satin ribbon ⭐

Note: If you don't have any more soap base, you can carry out this experiment with a neutral soap, weighting 100 g.

Steps:

1. With the help of a knife, remove 50 g of soap base from the box, and cut it into small pieces.



2. Place the soap base pieces inside the glass or cup (the glass must be resistant).

3. Now, you need to heat the soap base so that it melts, passing from the solid state to the liquid state.

The melting point of the soap base, supplied in the kit, is 50-60ºC (122-140ºF). You may heat it in two different ways:

- Double-boil: place a glass (or cup) in double--boil, and keep stirring it with the spatula until the soap base is completely melted;

or

- Microwave: heat the glass (or cup) containing the soap base, for about 20 seconds. Remove the glass and stir the soap base with the wooden spatula.

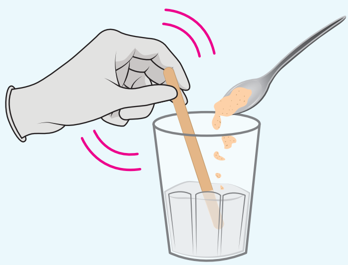
Place the glass back again in the microwave for another 10 seconds. Then, remove it to stir again.

Repeat this last step (never leave it heating more than 10 seconds straight) until the soap base is completely melted.

Attention: always use the kitchen glove to handle the glass (or cup) to avoid getting burned!

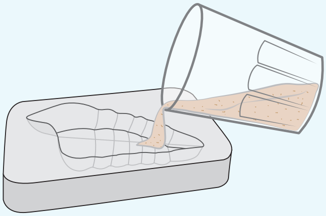
4. Once the glycerine is melted, add the oatmeal little by little, until it's fully integrated. Keep on stirring to help the process.

Note: If necessary, you can heat the glycerine again, to fully integrate the oatmeal.



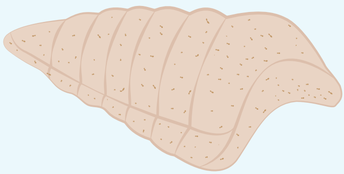
5. Now you can shape it as you like. Choose one of the plastic mould included in the kit and slowly pour the soap into it.

Attention: be careful so you don't get burned, for the soap base is quit hot!



6. Wait until it is completely solidified (it could take until 2 hours) and remove the soap from the mould.

Your soap is ready! To save it, wrap it in plastic film and you may also decorate it with the supplied satin ribbon.

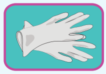


You've just made an oatmeal soap! Oat presents beneficial properties for our skin, being quite used in cleansing and exfoliation.

Experiment 7
Liquid soap

ATTENTION: ask an adult for help.

What you will need:



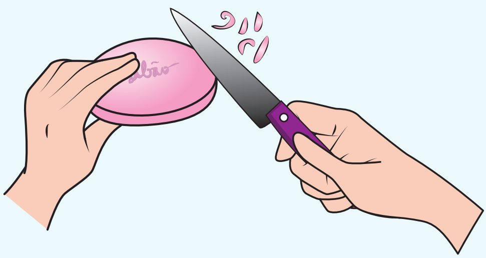
- Soap
- Knife
- Chopping board
- Large flask with lid (capacity for 1.5/2 litres)
- Colouring ☆
- Pasteur pipette ☆
- Water
- Flask for liquid soap
- Funnel

Steps:

1. Start by choosing a soap you like. It must be a new and whole soap.

Attention: steps 2 and 3 require the use of a knife. Ask an adult for help so you don't get hurt.

2. With a knife, cut the soap in thin shavings.

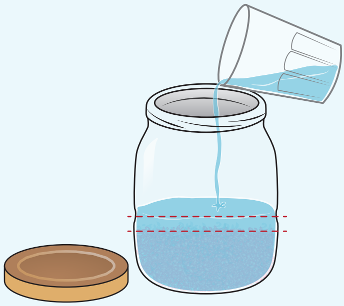


3. Then cut those soap shavings in smaller pieces until you obtain a kind of soap flour.

Tip: Have you seen an adult chopping onion in small parts? It's the same technique you should use for the soap.

4. Now transfer all the soap into the flask.

5. Add water to the flask, approximately 1 finger above the soap. Cover the flask with its lid.

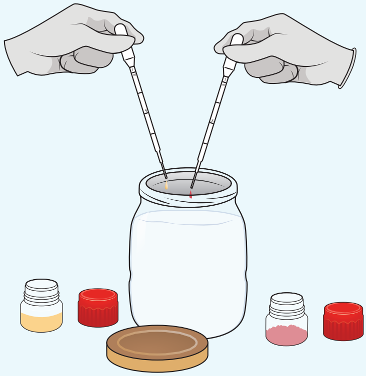


6. Scientist, your soap will have to be set aside for 15 days. However, remember to every two days open the flask, stir the mixture and add a little more of water.

7. After these 15 days you'll have 1.5 litres of liquid soap!

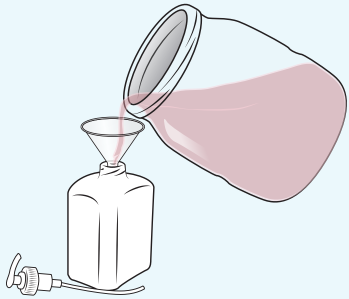
8. Do you want to give colour to your liquid soap? Choose the colour you like the most, among the colourings included in your kit and with the help of a pipette, add drops until obtaining the colour you want.

9. Repeat the previous step, however this time for a fragrance.



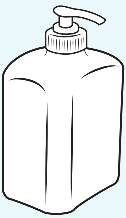
10. Your liquid soap is ready to use! Place a funnel on a proper liquid soap flask's nozzle.

11. Ask an adult for help and fill in the flask with your liquid soap!



12. Your liquid soap can now be properly used!

Note: Save the remaining liquid soap in the flask with lid, until it's necessary again.



Experiment 8
Homemade shampoo

In this experiment you will perform a dissolution in water. You will do this, by using the cosmetic colourings included in this kit, to obtain a colour solution.
You can use these solutions to make super colourful soaps!

ATTENTION: ask an adult for help.

What you will need:
- Camomile tea (4 sachets)
- Natural, without colour nor scented soap scrapings (4 tablespoons)
- Liquid glycerine (1 spoon + ½ tablespoon)
- Water (1 cup + ½ cup)

Steps:

1. With the help of an adult, make camomile tea with about 1 + ½ cup of water.

2. Let it boil for 10 minutes and remove the sachets. Turn off the heat source as well.

3. Put the soap scrapings in the tea while it is still hot.

4. Let the soap scrapings get soft.

5. In the end, add the glycerine and stir it well.

DID YOU KNOW...
That glycerine is one of the soap's components?

Explanation:

The basic composition of a shampoo must have surfactants, preservatives, fragrance oils and a pH regulator. The surfactants are the soap scrapings, which have the same action as a detergent. Camomile tea is the fragrance and glycerine is the moistener and conditioner. With simple ingredients you can also make a shampoo!

Tips:

You may combine colours and fragrances. For e.g., the tangerine fragrance with the orange colouring and the apple fragrance with the green colouring.

You can mix more than one colour in the same soap. For that, you only have to repeat the soap base preparation process twice (with half of the soap base amount in each glass) and use a different colouring on each. Then, you pour the mixtures into the mould one at a time. Careful, do it slowly so that mixtures don't mix completely.

In this kit you have two available fragrances: apple and tangerine. However, you may acquire other fragrances for your soaps and use your imagination to create super scented soaps.

In this kit you find 3 different moulds for your soaps: fish, seashell and seahorse:

Even so, you can use other silicon moulds that you may have at home to make soaps with other shapes.

You can melt again a soap that you made and give it a different shape.

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