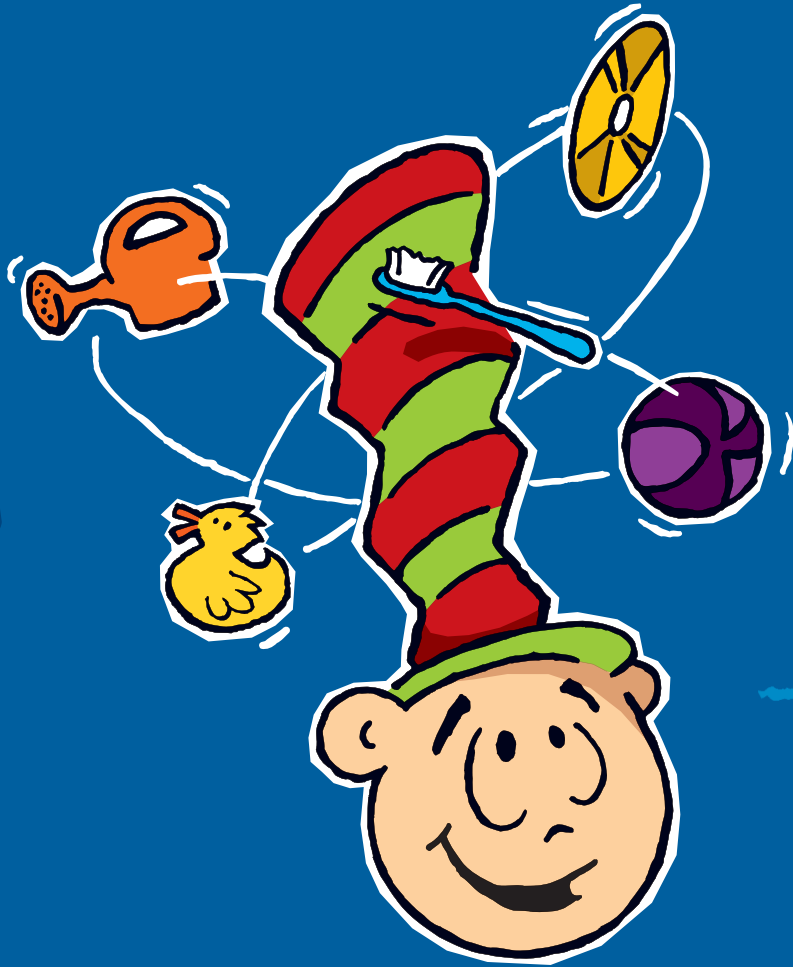




Olly's Cool Box of Plastics

Five simple experiments using a fascinating material



My name is **Olly**.

I like plastics and I enjoy doing experiments. This is why you find me in this book.

I'm going to introduce you to the exciting world of plastics and together we'll learn all about them by doing some exciting experiments. Let's get started!

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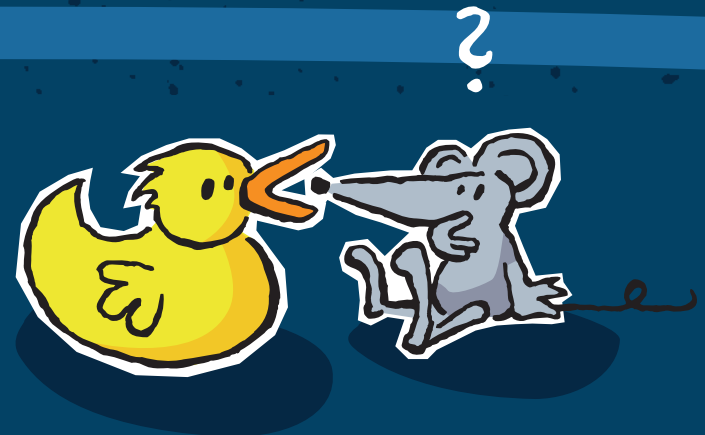
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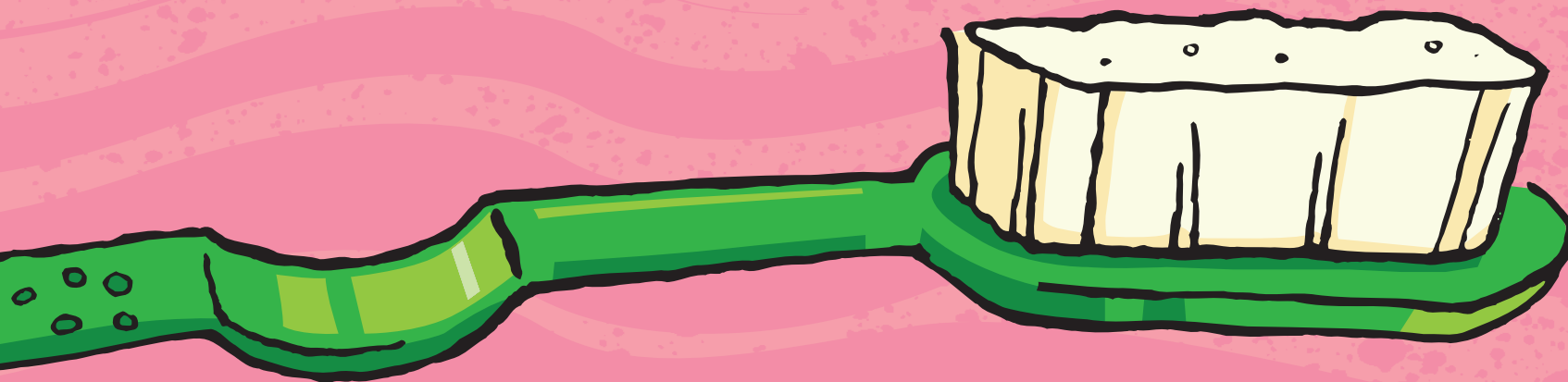
Fairy tale and fairy tale contest

50





What are things
made of?



This is a toothbrush. Of course, that's fairly obvious and you certainly know what it is used for. Every morning and every evening you hold it in your hand and use it to clean your teeth. But do you know what a toothbrush is made of? Let's begin with the handle: is it made of glass? Of course not! If it was the toothbrush would break if you dropped it. We all know that toothbrush handles are made of another material: plastic. But what are the bristles made of? We have never seen one made

of wood, metal, or glass. Toothbrush bristles are also made of plastic that has different properties to the handle.

Today, plastics are as much a part of our daily lives as toothbrushes. But before we answer the question of what plastics actually are, let's go back to a time when they did not exist at all.

How people used to brush their teeth in the past

In the past, people did not brush their teeth at all. However, that was a long time ago and besides, they did not eat as many sweets as we do today.

The toothbrush actually started out as a small stick called a toothpick. Across many centuries, our ancestors cleaned their teeth with small, thin wooden sticks they produced from branches or tree roots. But they had to be very careful, as they could easily harm themselves with the small and pointed ends.



About 250 years ago, when the toothbrush was invented, it already looked very similar to the toothbrushes of today. It had a handle and a brush head, and was a great improvement on the toothpick.

But what materials were the toothbrushes produced with in those days as plastics did not yet exist? They used the materials around them, wood for the handle and pig bristles for the brush head. However, wood has some disadvantages; if not carefully processed, it might splinter causing injury. Also, wood is porous (i.e. its surface is dotted with tiny holes, allowing bacteria and microbes to get into the wood and potentially be a health risk as it may cause infection).

long, long ago...



...for a long time





Pig bristles also had their disadvantages: bristled pigs did not exist in Europe and the bristles had to be imported from distant countries. The bristles had to be sorted by colour and length. Nobody wanted a toothbrush with black bristles so they were lightened by bleaching. But this treatment also made the bristles porous and food residues easily stuck in the tiny holes of the bristle surface. This allowed bacteria to grow, creating a further health risk.

This all changed with the discovery of plastics. Today, toothbrushes are mostly made of different plastics. They have coloured handles and do not splinter.



The handle is strong, has an even surface, and some toothbrushes even have slightly bent handles. The brush heads can be produced with different degrees of hardness: softer bristles for children, and harder ones for adults. And to protect the gums, all bristle tips are rounded. Thanks to the use of plastics, everybody can now choose the toothbrush that best suits their teeth and gums.

But what are plastics? Where else are plastics used? How are they produced? You will find answers to these questions in the next chapter!



until at last...



and today



Where do plastics come from?

Trees supply us with wood; metals such as gold, silver or iron come from inside the earth. But where do plastics actually come from? Most plastics are produced synthetically or artificially. This means that unlike wood or metal, which we find in nature, plastics are produced by humans from other raw materials. However, these raw materials are also supplied by nature.

Of course, plastics do not simply grow in nature like wood or vegetables.
So, where do they come from?

The raw material crude oil

If you want to produce something, you first need raw materials. For instance to paint a picture, you need paper and pencils. If you want to build a house made of Lego bricks, you need Lego bricks.

Now, what are the raw materials for baking a cake? You surely know the ingredients: flour, butter, sugar, eggs, perhaps also chocolate, raisins and so on. But these are not yet the actual “raw materials” of the cake. Flour, for example, is made from wheat grains, butter from milk, sugar from sugar beet, chocolate from cocoa and milk. Only the eggs come directly from the hen.

While baking, the characteristics of the ingredients change. The flour, eggs, butter, and sugar “stick” together when they are mixed and heated in the baking oven. Finally, we get a cake. In the cake, the individual raw materials can no longer be identified in their original form.

In order to bake a cake, you need specific ingredients or base materials. The same applies when producing plastics.



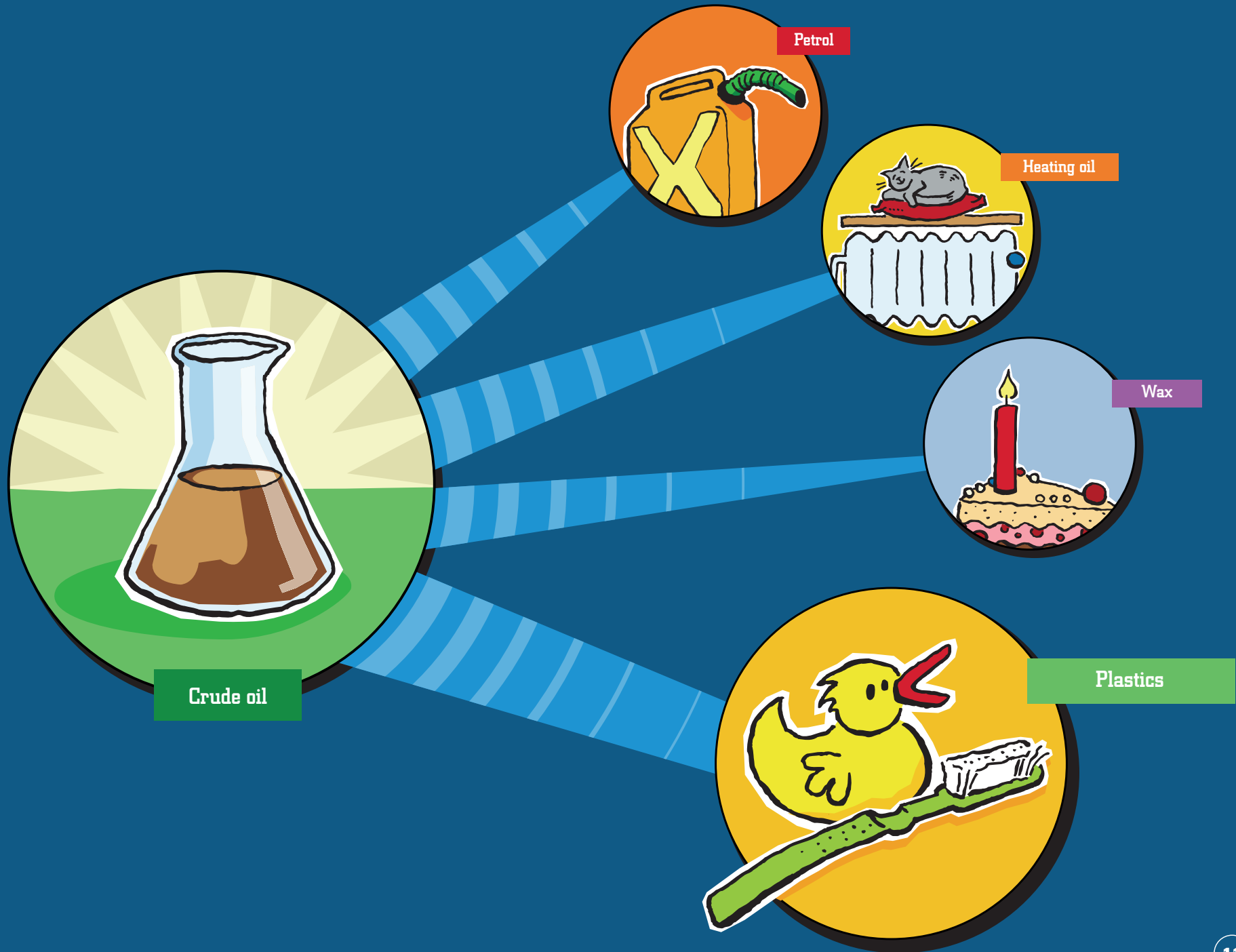
Now, what raw materials are plastics made of?



The most important raw material for plastics is crude oil. It can be found deep in the earth, and is a very dark brown liquid. It is also different from the cooking oil you know. It is unsuitable for human consumption, i.e. you cannot eat it. The raw material crude oil can be separated into liquids with totally different characteristics. This is done in special factories, called “refineries”. Some of the liquids are highly fluid like petrol and mainly used to drive cars and other more viscous oils like heating oil are used to heat our houses. They even produce more soft materials, such as wax, that provide the base material for the production of candles.

Petrol for cars, heating oil and candles all deliver energy, heat, or light. Actually, the majority of crude oil is used for heating and driving – in short, to produce energy.

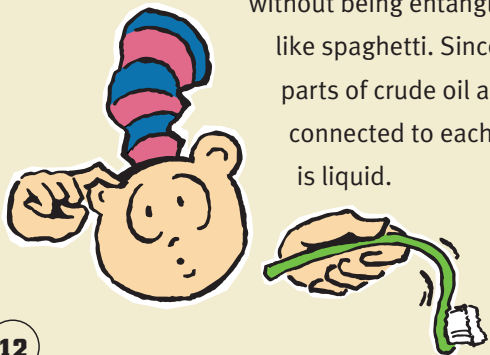
The raw material crude oil can also be used to produce plastics, which in turn is the base material for toothbrushes, Lego bricks, dolls, phones, and much more.



From crude oil to plastics

Liquid crude oil is a raw material for toothbrushes, is that right? A toothbrush is rigid, has a solid handle, and the bristles are not liquid either! Right! To produce a plastic from crude oil, it needs to be changed into a solid. This works similarly to what we know from the ingredients when baking a cake. Scientists call it a “chemical reaction”.

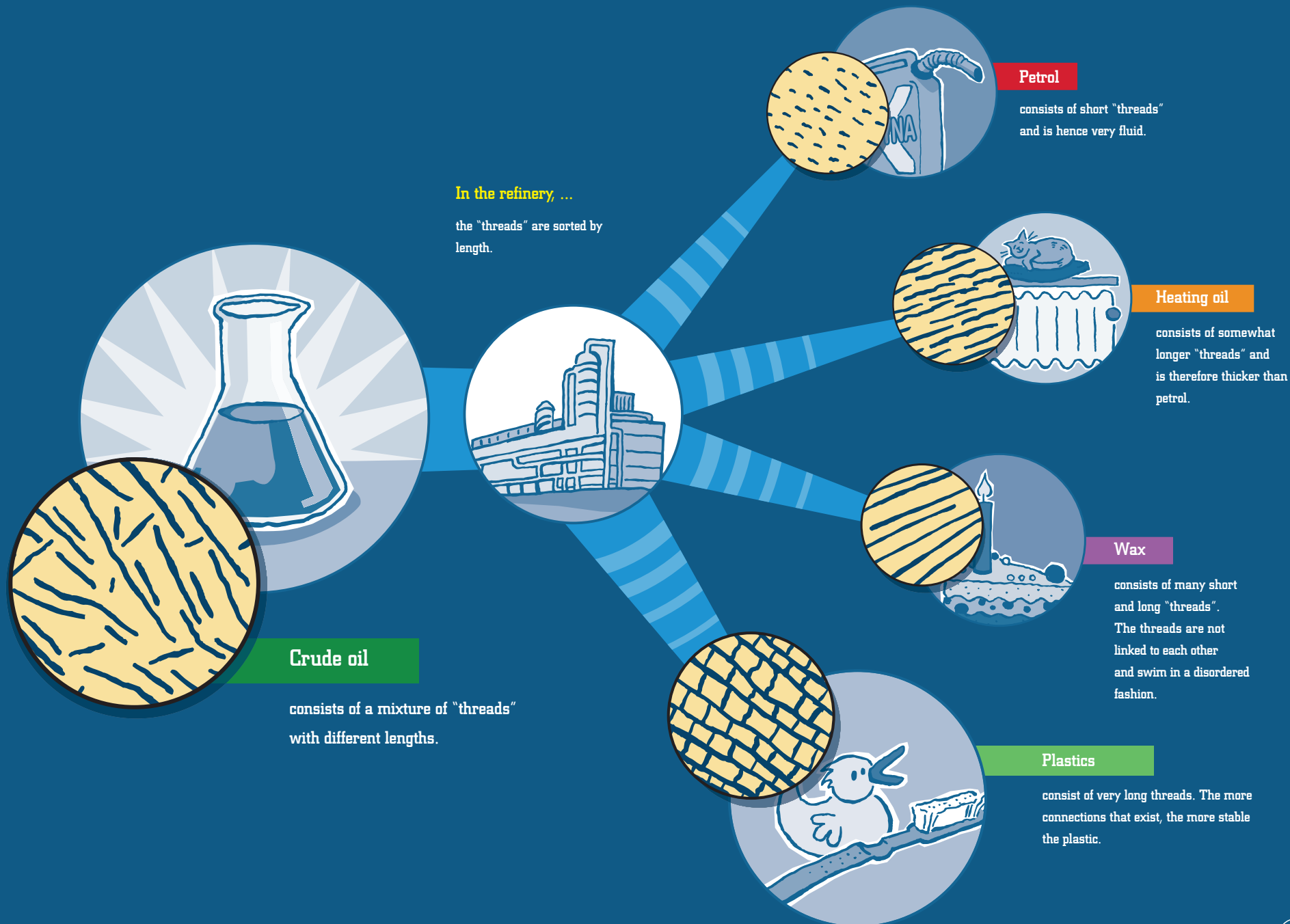
To understand what exactly happens during this reaction, imagine a giant magnifying glass that you can dip into crude oil or even into the toothbrush. You would then be able to see the tiniest parts that form crude oil and also the toothbrush. What do you think you would see? Crude oil consists of many, many small components. These components look like thin threads. Some “threads” are longer, some shorter. Yet, what they all have in common is that they only touch each other without being entangled or knotted, like spaghetti. Since the tiniest parts of crude oil are not tightly connected to each other, crude oil is liquid.



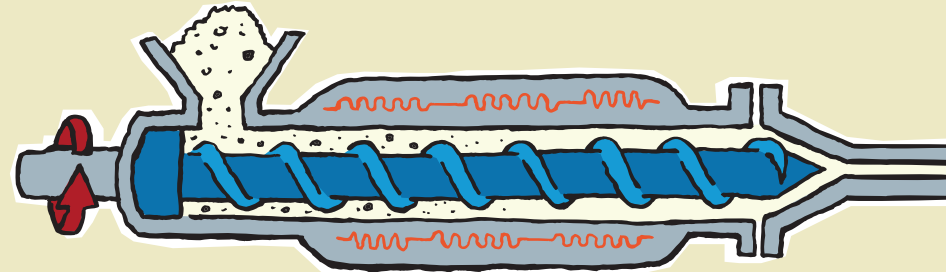
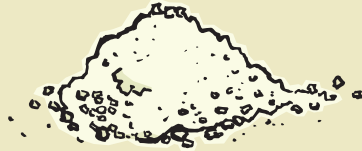
The individual components can slide over each other. Do you still remember the refinery? Here, the crude oil is first distilled. This means it is heated and individual components are sorted by “thread length”. All components with short “threads” are separated together. The same happens to the components with longer “threads”, leaving behind the very long “threads”. The shorter the “threads”, the thinner the liquid: petrol, for example, consists of short “threads” and is therefore very fluid. The wax used for candles consists of very long threads.

The individual threads of a toothbrush are even longer and they are connected to each other. These connections have a similar effect to thread length; the more connections and the longer the chains, the more rigid and solid the material gets. While the plastic used to produce the solid handle of a toothbrush contains many connections, the plastic used for the soft bristles has significantly fewer connections.

To better understand what is going on here, you will find two tests in the experiments section, where you can produce a plastic on your own. See “Let’s produce plastics” and “Production of foamed plastics”. There are still many possibilities to produce plastics with a range of characteristics from crude oil. Plastics are able to protect fragile things, absorb water, and even clean dirty water. They can dissolve and do many other things. You will learn about some of these various characteristics while conducting the experiments “Just normal plastic films?”, “What happens to the water?”, “Production of foamed plastics”, and “A pocket-size sewage plant”.



At the start of their life plastics are produced in small pellets or granules.



The pellets or granules are heated and melted in a machine.



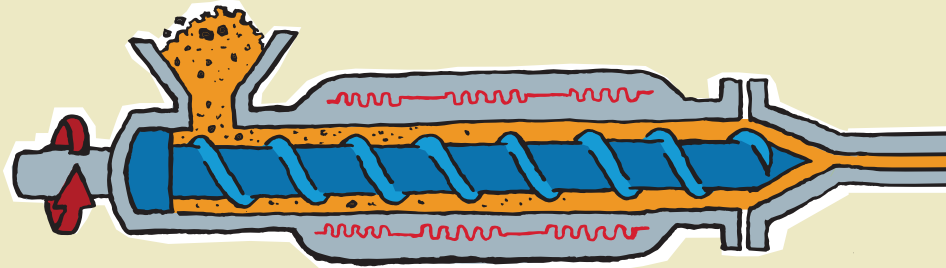
How do plastics get their shape?

Joining the individual components (“thread”) of crude oil allows a new material to be developed – plastic. Of course at this point, it does not yet have the shape of a toothbrush, it is more or less a shapeless mass.

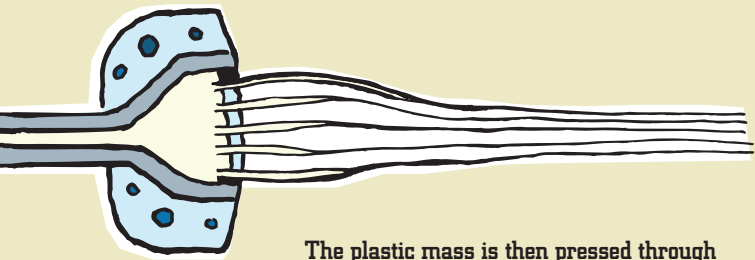
If you want to eat a cake, you must cut it into small pieces first. The same applies to plastic: to be processed, the shapeless mass first needs to be chopped into parts of equal size. These are mostly small pellets (granules).



In the beginning, plastics are produced in small pellets.



The granules are heated and melted in a machine to produce plastic.



The plastic mass is then pressed through small holes and cooled again, creating long threads.

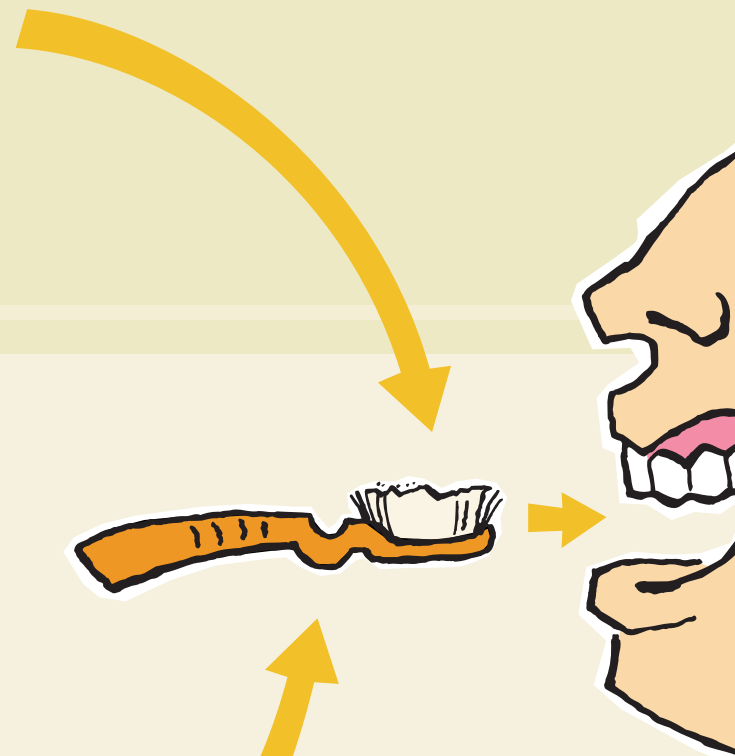


These long threads are cut into small shreds – and the bristles are ready!

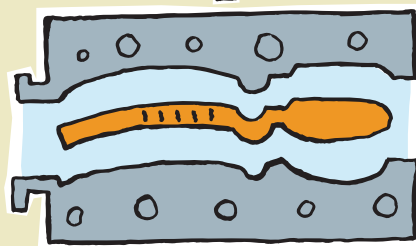
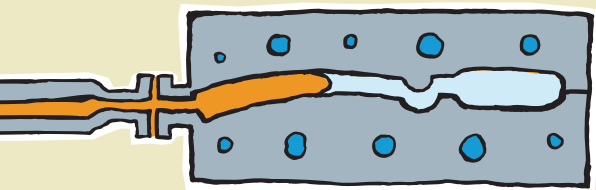


The bristles of your toothbrush are made of such pellets. The granules are first heated and pressed through tiny nozzles using a lot of energy to form long plastic threads, which are then cut into short toothbrush bristles.

The handle of the toothbrush is also produced from the plastic pellets in two steps. First they are melted and then they are pressed by a machine into a mould shaped for the toothbrush handle.



Then the plastic is pressed in a mould and cooled.



And when the mould is opened the toothbrush handle is ready!

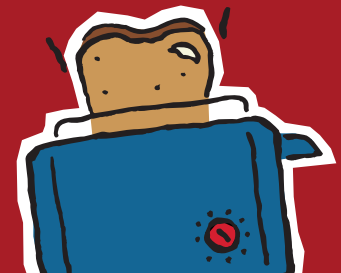


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Do the plastic parts always look the same?
Which characteristics do plastics have? Write them down too!

A large white rectangular area with horizontal dashed lines for writing.





Now, you've already got many examples of the use of plastics. However, there are some applications of plastics that are less well known, e.g. cars.

Did you know that ...

... a car consists of about 5,000 parts? About 1,500 of them are made from plastics, such as the bumper, petrol tank, dashboard, seat upholstery and wheel covers.

Plastics are lightweight, meaning that cars are lighter and consume less fuel. Plastics are also important for safety in the car. Child seats, safety belts, headrests, and even airbags are made of plastics.

How do we get rid of plastic waste?

The time eventually comes when many objects reach the end of their life and become waste – even your yoghurt pot. There are two things you can do with waste: you could bring it to a landfill, which requires a lot of space, or you can recycle the waste to reuse the material if possible. You can do this with glass, paper, metal and also with plastics. For plastics and paper, if you cannot recycle them there is a third solution, which is to use them to produce electricity and heat.



Used yoghurt pots ...



can be collected together with other plastics.

Plastic waste can then be used to produce new plastic. But first, you need to sort, clean, melt together and remould the plastic waste. Who knows – your last toothbrush has perhaps become part of a flower pot already.

But you can use plastic waste to produce electricity and heat that can be used e.g. to heat and light our houses.



The plastics are washed and cleaned.



Then they are shredded, melted together, and remoulded.



And finally, they perhaps become a flower pot!



Before we get started with the experiments ...

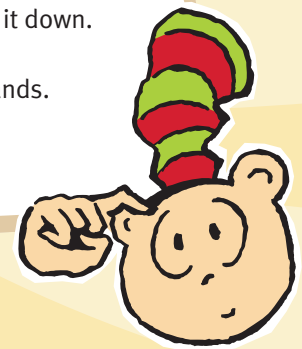
This booklet is different from other books! You've probably realised it already. It contains not only text and pictures, but also instructions for experiments which you can carry out on your own. Most of the objects and materials needed for these experiments can be found in the experiment box "Olly's Cool Box of Plastics", each packaged separately. Researchers experiment to understand the properties of things, now you can become researchers and perform experiments together with your teacher in order to understand the properties of plastics. But before you start, here are some pointers for you.

Every experiment consists of three parts. First there is a list of the things you will need. Then this booklet describes in detail what has to be done. And finally, an explanation of the experiment is given.

It's best to proceed as follows:

- 1 First, carefully read the experiment description.
- 2 Then put the things you need for the experiment on a washable surface.
- 3 Next, perform the experiment exactly as described.
- 4 Very important: carefully observe what happens and write it down.
- 5 After completing the experiment, thoroughly wash your hands.

And now, enjoy experimenting!





Just normal plastic films?

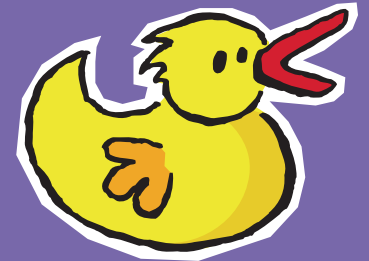
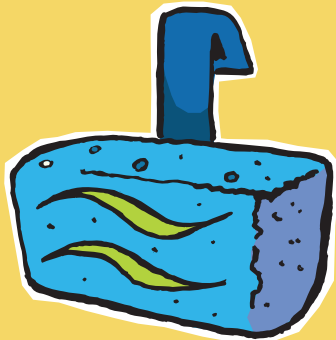


In “Olly’s Cool Box of Plastics” you will find a green, a blue and a red coloured roll of transparent film. All three films look similar to any normal plastics film: they are shiny and transparent. Can you think of further characteristics all three films have in common? Think about it! Only the different colours (green, blue, and red) of the rolls indicate that the films are different. Or are there still more differences? Have a closer look at the films. To check whether these three films have exactly the same features you can now carry out an experiment.

You need:

- 2 pieces of each film, about the size of a saucer
- a green, blue, and red permanent marker
- 3 glasses
- 3 stirring rods
- scissors
- lukewarm water (not cold water!)
- 3 small pots with moist garden soil or compost





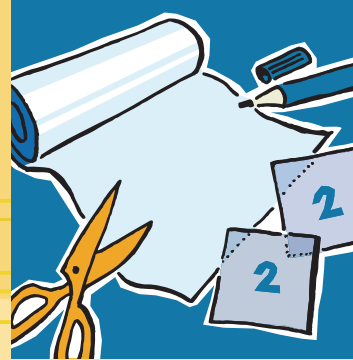


What do you need to do?



1

From the film on the green roll, cut two pieces about the size of a saucer. Use the green marker to write a “1” on each of the two pieces.



2

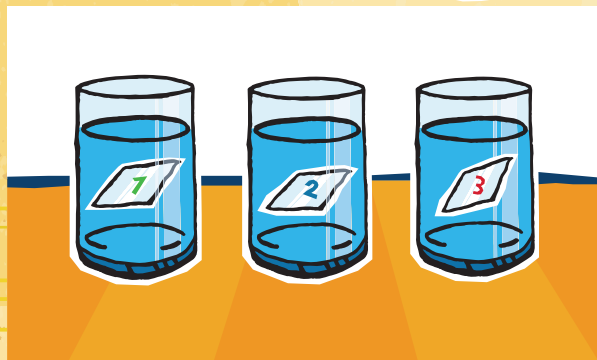
From the film on the blue roll, cut two similar pieces and use the blue marker to write a “2” on both pieces.



3

Now repeat the same with the film on the red roll using a red marker to write a “3” on both pieces. Have another close look at the films.





4

Fill the three glasses with lukewarm water. Then put a piece of film from the green roll (1) in the first glass, a piece from the blue roll (2) in glass number two, and a piece from the red roll (3) in the third glass. Now, use a stirring rod, thoroughly stir each glass. Carefully observe what happens! Note down your observations in the table at the end of the chapter.



5

Now, you still have three pieces of film lying in front of you. Bury them in the three pots with damp soil or garden compost. Use the coloured pens to write on the pots which film (1, 2 or 3) you have buried on each pot. Put the pots in a warm place.



6

Leave the pots alone for five days. Have a close look and see if anything about the films has changed. Again, note your observations in the table included in this booklet.

After completing the experiment, think about which applications films 1, 2 and 3 could have in your home or garden. Write down your ideas.



Explanation of experiment 1

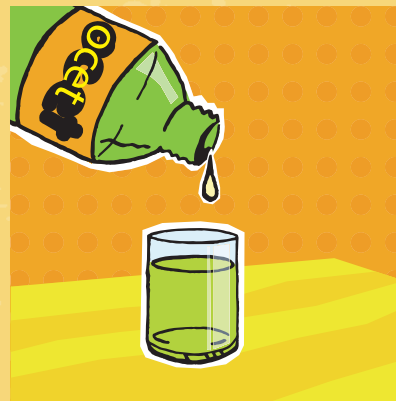
Plastics may look very similar externally, but totally different when looking through a powerful magnifying glass. This is why they have completely different behaviours in water and soil.



Film no. 1

When you observe film 1 you will notice that water rolls off it and it does not dissolve. This makes it an ideal material for shopping bags and waterproof coats.

Let's think more about why water runs off plastic. Have you ever tried mixing cooking oil and water? To explore what happens try this experiment. Mix 2 tablespoons of water and one tablespoon of oil. Pour them into a glass together and stir. What do you see? If you look closely you can see the water droplets and oil droplets are separate and although they are touching each other they don't mix. This is exactly what happens with plastic film and water. Water can touch the film but is not able to mix with it: the water runs off.





Film no. 2

Film 2 dissolves in water. It is clearly different to film 1. Can you already guess what is different here? Let's make another comparison at this point: have you ever mixed water and vinegar? If you look very closely, you will see how both liquids mix with each other. If you have used clear vinegar eventually you will not be able to distinguish between the two liquids. This means that vinegar and water are similar.

If you mix vinegar with water the vinegar has not disappeared. Instead of clear vinegar, try the experiment again using coloured vinegar. This time you will notice the mixture of water and vinegar will be coloured. It is the same with film 2; it dissolves in the water but does not disappear. Check it out and carry out the additional experiment described on the next page.

But what would you actually need a film that dissolves in water for? Of course, not for umbrellas! But there are things that are packed and wrapped in such film. In the same way as the film dissolves gradually in water, there are substances that gradually come in contact with water, such as bath salts, dishwasher tablets, toilet blocks and dyes.



Film no. 3

Why does film 3 dissolve in garden soil or compost? You may have heard that garden soil is populated by microorganisms. They are too small to be seen with the naked eye but like all living things, they need food. Film 3 consists of starch, which can also be found in foods such as potatoes and flour. If you bury film 3 in the soil, it is simply “eaten” by hungry microorganisms.

Films like this that are eaten by microorganisms, are used by farmers and gardeners. You can also use them to package food and for carrier bags, but you wouldn't use it to package garden compost! Also, bags made of these films can be used to collect food waste that can then be composted, leaving no food or plastic residue. The microorganisms will eat both the food and the plastic to produce compost.



In garden compost, film 3 is simply eaten by hungry microorganisms!



Behaviour in water

Behaviour in garden soil or compost

Own ideas



FILM 1



FILM 2



FILM 3



An additional experiment: just normal plastic films?

You need:

- the glass with the dissolved film 2
- 1 glass of water
- 2 dinner plates



1

What you need to do

Pour some of the water with the dissolved film 2 onto one of the plates so the bottom is just covered.



2

Pour a similar amount of clean water onto the other plate.



3

Position both plates on the window ledge, in the sun or on the radiator.
Wait for a day and inspect the plates. Has anything changed?
Note down your observations.

Explanation of the additional experiment

You certainly know that after it has rained. Puddles on the ground disappear as the water evaporates. However, if you heat water it will evaporate much more quickly than puddles do, leaving behind any dissolved materials.





Where has the water gone?

In „Olly’s Cool Box of Plastics”, which this booklet refers to, you will find a container labelled “superabsorber”.

It contains a white, fine-grained material that although it looks similar to sand, is a plastic. It also has characteristics that are totally different from those of sand. You can observe them in the experiment below.

You need:

- 3 soup plates
- 1 small stone
- cotton wool
- 1 measuring spoon
- the superabsorber
- cold water



What you need to do



1

Put the stone on one of the plates and the cotton wool on the other plate. Pour one measuring spoon of superabsorber on the third plate.

Now, fill the measuring spoon with water and pour the entire contents over the stone.



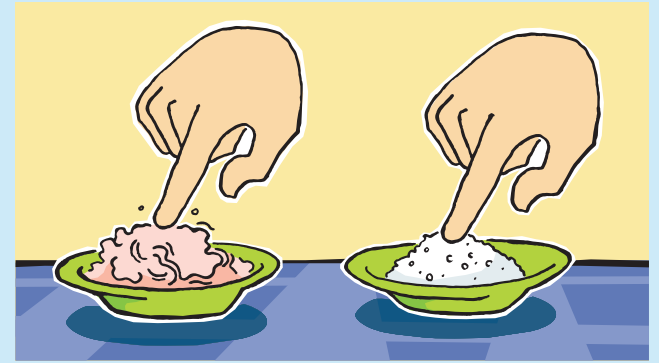
2

Then, fill the measuring spoon again with water and pour it over the cotton wool.



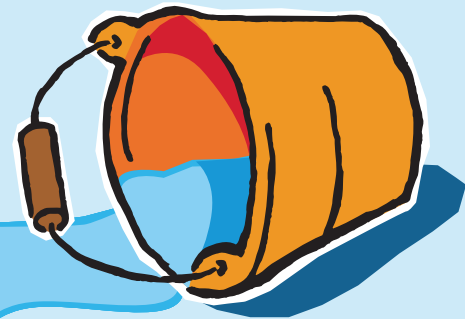
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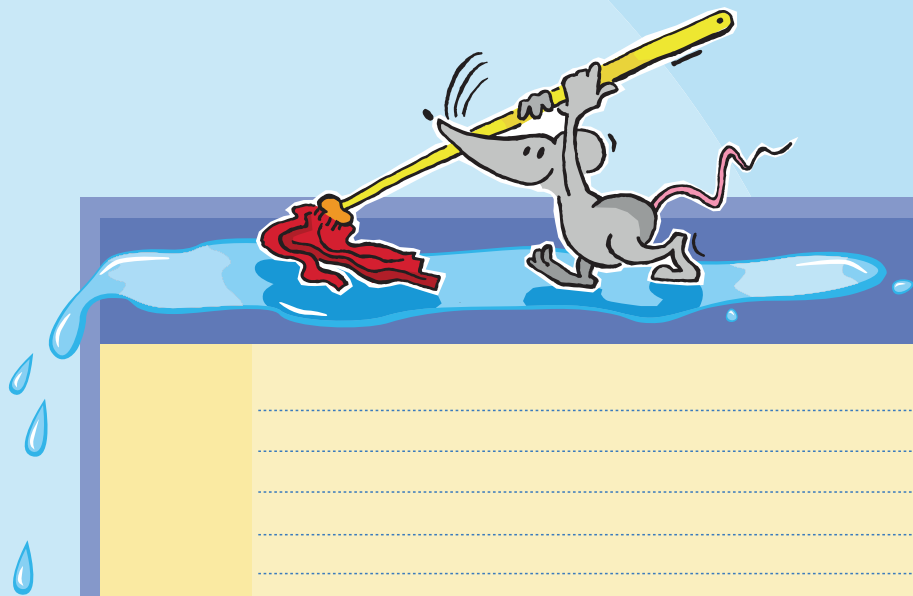
Finally, pour the same amount of water over the superabsorber. Observe exactly what happens to the water! Note it down on the next page!



4

Press your fingertips on the cotton wool and then on the superabsorber. Do you feel any difference? Use the measuring spoon to pour water on the superabsorber until the granules are no longer able to absorb water. Write down how many measuring spoons of water you have been able to pour.





My observations:



Explanation of experiment 2

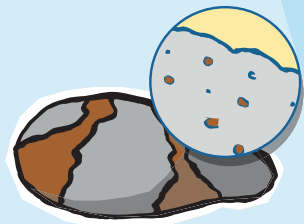
Do you remember the invisible threads in plastics?

You have learned that it is possible to produce threads which can be connected to each other. You can also produce such threads in a way that they retain water.

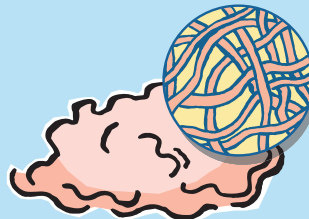
The stone, cotton wool, and the granules of plastic cannot absorb the same amount of water.

What is the reason that the different materials absorb different amounts of water? And where has the water actually gone when it has been absorbed?

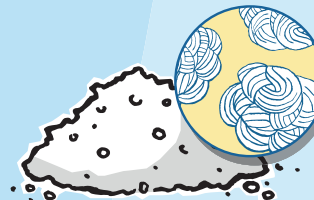
The absorbing capacity of a material depends on the type and size of its surface. If you run your hand over the stone and cotton wool, you will notice that their surfaces feel completely different. Stones mostly have an even surface; cotton wool is not even and feels soft.



The stone has a smooth surface and hardly absorbs water.



Cotton wool consists of many thin threads. Together, they make a large surface area which is able to absorb more water.

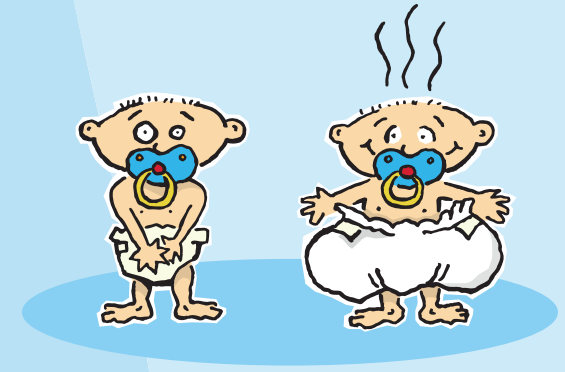


The superabsorber takes a super amount of water. The threads are very tiny and densely wrapped and combine with water.

It is clearly more absorbent. Now, have a close look at the cotton wool: it consists of many thin, visible threads. Together, these threads make a very large surface – a lot larger than that of the stone. The water settles on these threads. If you press your finger on the wet cotton wool, the water is released again; therefore it is not held tightly by the cotton wool.

And why can the superabsorber absorb so much water?

Here, again, the surface plays an important role. Actually, the granules seem to be even and have a smooth surface like the stones. Do you still remember the powerful magnifying glass when talking about plastics earlier? If you had this magnifying glass, you would be able to see long, densely wrapped threads made of plastics in the granules.



Unlike the threads in the cotton wool, the plastic threads are produced in a way that can combine with water. This is why the granules do not release the water when you press on them.

Do you have an idea of what the superabsorber can be used for? It is used, for example, in babies nappies! The nappies contain many superabsorber granules and are therefore able to retain wetness.



How to produce a plastic



In the first two experiments, you have already learnt about some of the properties of plastics. In the new experiment, you can produce a plastic on your own. For this purpose, you will find two base materials in ‘Olly’s Cool Box of Plastic’: craft glue and a liquid called “borax solution”.

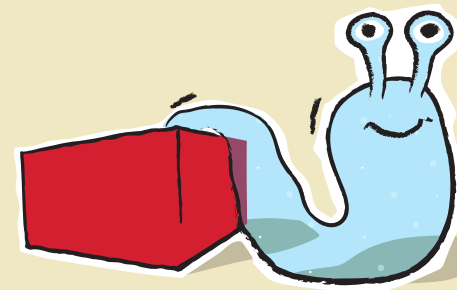
Do you still remember the chapter “From the raw material mineral oil to plastics”? As you may have noticed this experiment does not start with the raw material mineral oil. The craft glue is already a plastic that has been made of mineral oil. In this experiment, you will use the borax solution to change the properties of the glue, and to produce a new slimey.

You will need:

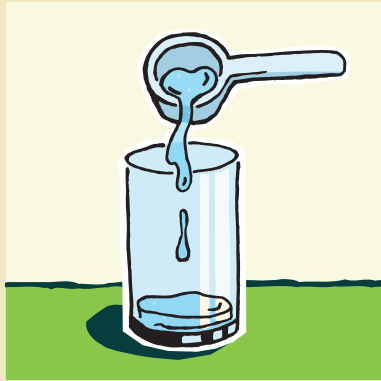
- craft glue
- 1 measuring spoon
- borax solution
- 1 cup
- 1 stirrer



You will best store your slime in a small, air-proof box, to prevent it from drying.

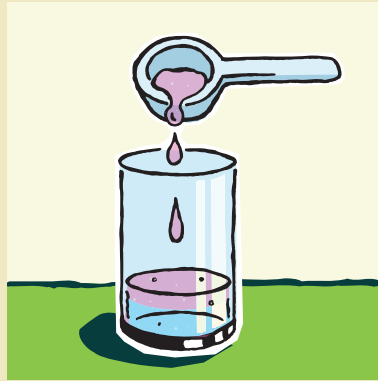


How to produce your own slime



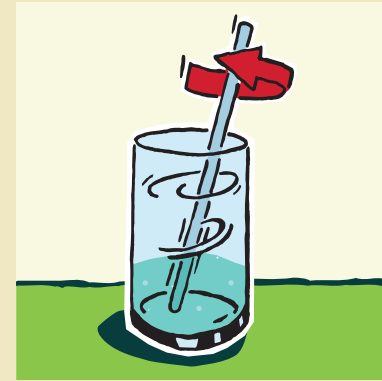
1

Fill a measuring spoon of craft glue in the cup.



2

Add a measuring spoon of borax solution and stir it well. Do you notice any change?



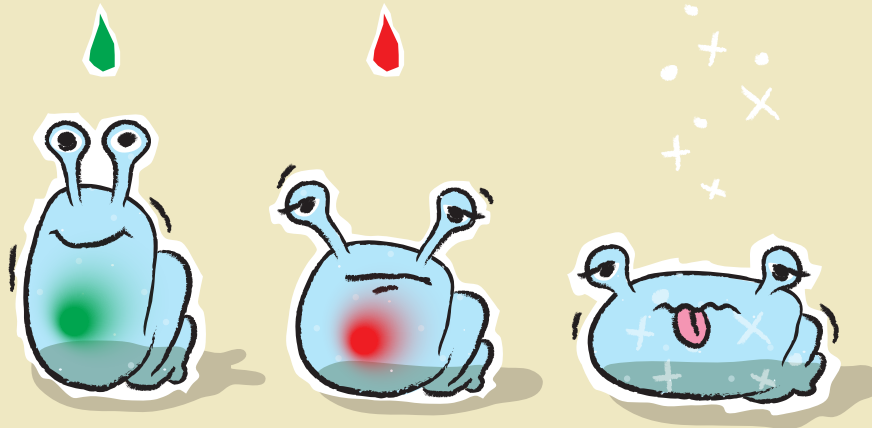
3

Describe your observations and note them down. Put the slime out of the cup and add some water. Now you can deform the slime.

Afterwards, wash your hands thoroughly!

Add some drops of food colourant to get a colourful slime.





If you leave your slime unobserved for a longer period of time, it will become scared and it will separate out.



Give your slime its own name and write down what you observed while it was forming.

NAME

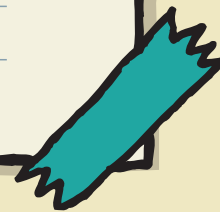
SMELL

WHERE DOES IT LIVE?

FAVORITE CUSS WORD

CV: HOW DID IT'S PROPERTIES DEVELOP?

HOBBIES: WHAT ARE ITS PROPERTIES?





Explanations related to experiment no. 3

You certainly remember the toothbrush. The hard handle was made from another plastic than the soft brush head. In order to understand why the materials have these properties, we will have to look once again through our giant magnifier. Let us start with the base material craft glue: like most of the plastics, it consists of very long “threads” that lie close to each other. You will certainly know many examples of thread-like materials lying next to each other. Often, you can see them with the naked eye – like e.g. hair. Hair is easy to move and deform, as the single strands are not connected to each other. If you use hair spray or gel, however, the single strands are connected to each other, and the hair becomes more difficult to comb. Also wooden sticks, lying loosely next to each other, are easy to move. But what happens, if you tie two sticks up? Like the two outer rails of a ladder. The wooden sticks can no longer be moved so easily. They become more immovable. Likewise, the ladder becomes ever more stable with every rung connecting the outer rails. Yet, what have the ladders and hair strands to do with our experiment? The craft glue consists of long “threads”.



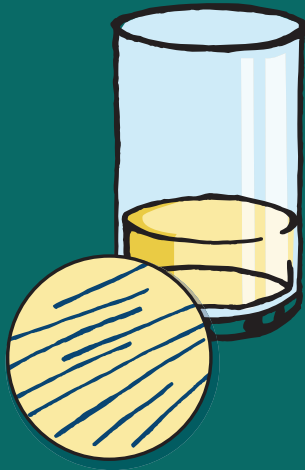
**Long sticks alone are pretty shaky.
Would you use such a thing as a ladder?**

If you add borax solution, connections are formed between these threads. The borax solution remains between the threads and sticks them together. As you have certainly noticed when stirring, the craft glue became harder and harder. The two base materials have formed a rubber-like material. By adding food colourants, you can also change the colour of your plastic. The plastic manufacturer does almost the same thing. He puts together more or less of the “ingredients”, making the plastic more or less soft, and adds colourants to get the colour he wants. He can even add other materials to modify it even more.

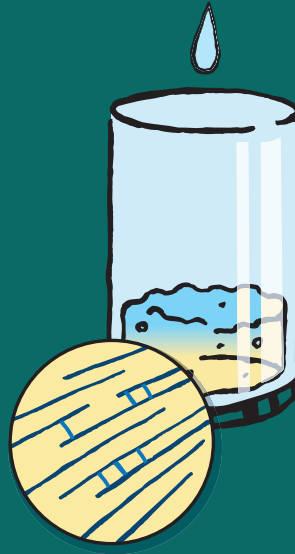
Adding some connections between the long sticks makes them more stable: The borax experiment works in a very similar way!



Explanations about your slime:



Craft glue consists of long threads which are not connected to each other.



Adding borax solution will establish connections between the threads. The slime gradually becomes gooey.



Adding even more borax solution will create more and more connections. The more connections it has, the more solid becomes the slime.





Let's produce foamed plastics

You have certainly held in your hands that white packaging material called foamed plastic. It is often used to package fragile objects such as computers or electronic parts for transport or shipment. You guessed it already: the foamed material is also a plastic.

In this experiment, you will learn how foamed plastic can be produced. In “Olly’s Cool Box of Plastics” you will find the base material needed to produce foamed plastic. For this experiment, you will need boiling water. Therefore, it is safer if your teacher shows you the experiment.



You need:

- Polystyrene
- 1 metal mould
- 1 wooden stirrer (e.g. a cooking spoon)
- 1 saucepan with water
- 1 hotplate
- 1 spatula
- 1 large spoon
- 1 container with cold water
- 1 watch



What you need to do



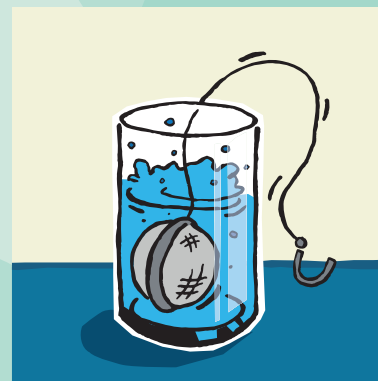
1

Fill the half of the metal mould with 2 measuring spoons (20 ml) of polystyrene and close it firmly using the clips and screws provided.



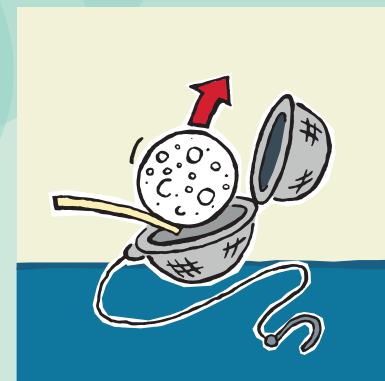
2

Boil water in the saucepan, then add the metal mould, making sure it is completely immersed, keeping it boiling for about 20 minutes.



3

Using the large spoon carefully take the metal mould from the boiling water and place it into cold water. Caution! Allow to fully cool before touching it.



4

After cooling carefully open the metal mould and, if necessary, use the spatula to ease the contents out of the mould.

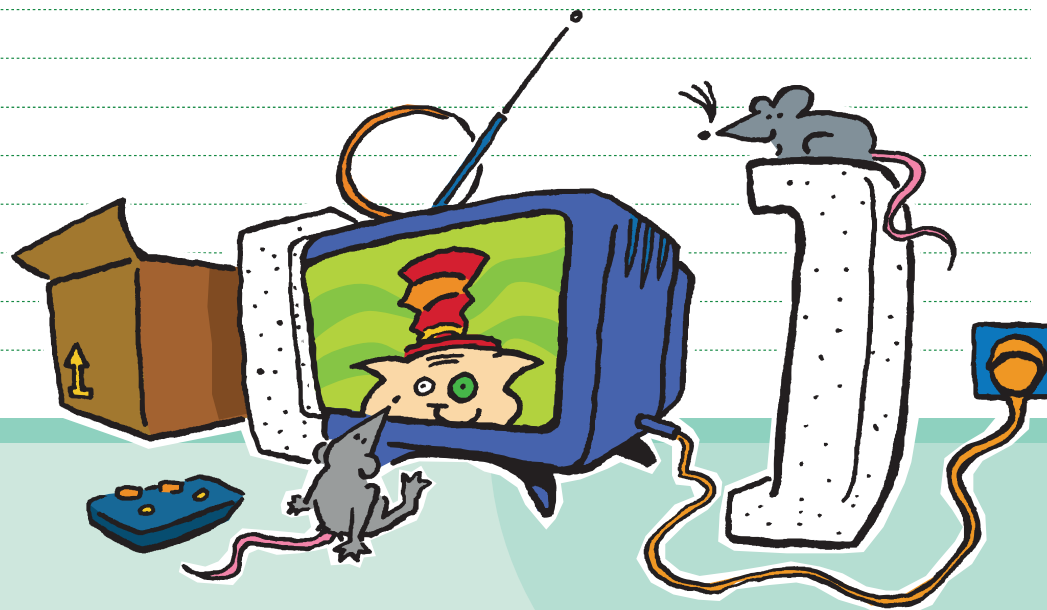
Look at the new material. Which characteristics does it have now? Compare it with the starting base material. Write down any differences you can see.



Additional experiment with safety helmet

In “Olly’s Cool Box of Plastics”, you will find a miniature crash helmet. Take a soft-boiled egg, fasten it in the helmet, and drop it on the floor. What happens? What would have happened if the egg had been dropped without the helmet?

My notes:



Explanation of experiment 4

If you leave the metal mould containing the polystyrene granules in the boiling water long enough, a new foamed, lightweight plastic is produced.

It can be used to protect fragile objects against damage from impacts and crushing. It is also semi flexible, you will see this if you press it with your fingers. This property is very important in products such as crash helmets. Should you have an accident and fall off your bike the helmet filled with foamed material will protect your head by absorbing the impact; your head will remain unhurt.

Foamed plastics are also used as packaging material as they are so lightweight. But foamed plastics have another characteristic: they are very good insulators. You've perhaps already seen ice cream or even hot food packaged in foamed plastic containers.

Now, what is the difference between foamed plastics and the polystyrene granules your teacher poured into the metal mould? You've certainly noted that foamed plastics need a lot more space than the polystyrene granules. Your teacher partly filled the metal mould with the granules. After boiling, it is totally filled with foamed plastics. Why is that so? Have a very close look at the foamed plastic! You will

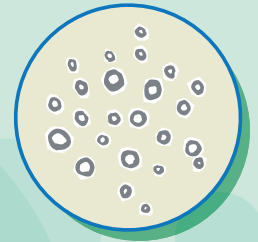
see that it consists of larger granules.

These are polystyrene granules. They expanded and connected with each other when heated in boiling water. But how did the granules expand? With water?

Think of a facecloth. When it soaks up water, it becomes heavier. Yet, the foamed plastic is very light. Can you think of something that is very light? That's right – air. Foamed plastics consist mainly of air. But how do you get the air into the plastics granules?

This is a two-stage process: first, the plastic granules containing a foaming agent (pentane) are foamed by heating. This happens when heated in boiling water. After cooling down and demoulding, air flows very slowly into the foamed material. You cannot see it but you will notice that the foamed plastics are still very soft after demoulding, and will become much harder after a couple of hours.

This is like comparing a fully or partly inflated balloon. Once foamed the material is better able to protect against impact and crushing and is a better insulator against cold and heat. This is why you will find foamed plastic in safety helmets for bicycles, insulated containers and packaging.





A pocket-size sewage plant

We all need clean water every day: for drinking, brushing teeth and bathing, for washing the dishes or doing laundry. Soap, toothpaste, cleaning agents, and many other substances make the water “dirty”. Therefore, it needs to be cleaned again in a sewage plant. Dirty water is also produced in factories and companies: dye works, where textiles are coloured, paper manufacturers, dry cleaners, and car washes need a lot of water.

This experiment shows you how to clean dirty water. In “Olly’s Cool Box of Plastics”, you will find a membrane made of plastics. Similar to a sieve, you can use a membrane to filter water. This experiment will show you the exact difference between a sieve and a plastic membrane.

You need:

- 1 glass of water
- 4 empty glasses
- garden soil or compost
- 1 measuring spoon
- 1 tea strainer
- 1 coffee filter with filter paper
- 1 membrane made of plastics
- 1 syringe



What you need to do



1

Fill a glass with water. Then, pour a measuring spoon of garden soil or compost into the glass and stir it. The water becomes dirty and murky. Note: it is no longer suitable for drinking!



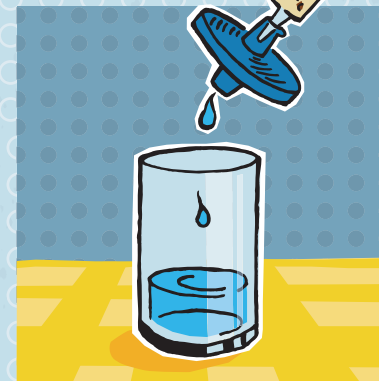
2

Put the tea strainer on an empty glass. Pour the dirty water through the strainer. Observe carefully and write down if the sieved water has become cleaner?



3

Put the coffee filter with the filter paper on another empty glass. Take the glass of water that has run through the tea strainer. Pour the water through the coffee filter. Again, observe carefully and note down if the filtered water has become cleaner?

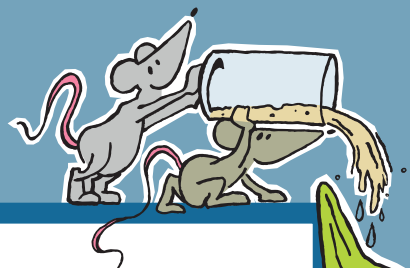


4

Now, take some of the water poured through the filter paper and fill the syringe with it. Connect the syringe to the white side of the membrane making sure it is attached firmly. Press the plunger slowly to push the water through the membrane. Collect the running water in an empty glass. How does the water look now? Again, observe carefully and write down what you see.



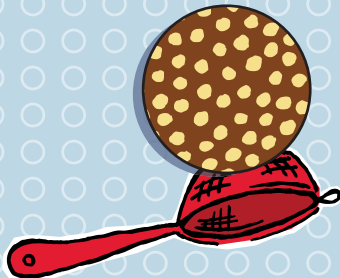
My observations:



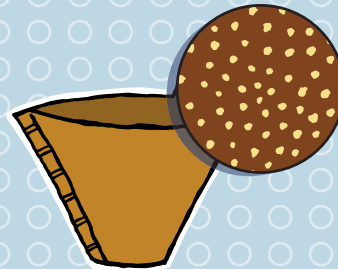
Explanation of experiment 5

If you pour dirty water through a sieve or filter, the dirt is retained in it. Filters and sieves have tiny pores. They are very small holes where water can run through. The smaller the pores, the more dirt particles are retained. If you want to get completely clean water, the pores must be very tiny. Usually, a sieve has pretty big pores which you can see with your naked eye. They can hold back only the large dirt particles. The paper coffee filters have significantly smaller pores that cannot be seen with the naked eye. These pores can retain even smaller dirt particles. This is why the water became considerably cleaner. Yet, the pores are still not tiny enough to hold back all dirt particles.

There are plastic filters with very tiny pores which do not let dirt particles run through. Only water runs through the pores. Such fine filters are called membranes. In the experiment, such a membrane is used. By the way, there are even finer membranes that can be used to filter dirty water for drinking, as these retain the smallest micro-organisms which could otherwise make you sick. So where do you think you would need to use these membranes? One obvious application is where there is no access to clean drinking water.



The sieve has very large holes, which can retain only large dirt particles.



Coffee filters have smaller pores. They are able to hold back smaller dirt particles.



The membrane is a filter made of plastics with tiny pores. They can retain all dirt particles.

That's it!
I hope you enjoyed my
experiments!
And now I've got a fairy tale
for you and, at the very end,
a contest with many great
prizes.



The Plastic Princess

Once upon a time there was a King who ruled over a great kingdom, where people lived well and did not want for anything as he was a good and gentle ruler. But he was also very vain.

Every year, on his birthday, he arranged a great party. He served delicious meals and drinks, and all his guests were able to assure themselves of his richness. The King was overjoyed when the guests showed him how much they admired him.





At his birthday party, he called his three daughters together. When they hurried to him, he said to them: "I am a mighty ruler and my people adore me, my guests admire me. But now, I would like to hear from you how much you love me. Name something that means just as much to you as I do, so that I can better evaluate your love." "The oldest daughter did not think twice and answered: "Dear dad, I love you as much as all the gold we have in our kingdom." The King was all smiles and imagined the chest full of gold standing in his treasure chamber and whose value was immeasurable.

Now, it was the second daughter's turn: "Dad, I love you like salt." The King was startled, as salt was not expensive at all. Wasn't he worth more to his second daughter? But since the King knew that his daughter was very smart, he thought for a while. All people need salt to live – the King knew this. Finally he came to the following conclusion: "It does not look as beautiful as the gold shining in my chests, you cannot make jewellery out of it, but it is nonetheless very precious." And he thanked his daughter for her love.

Now, all were eagerly waiting for the answer of the youngest daughter: the King always attached particular importance to her opinion. Although very young, she sometimes showed far-sightedness that exceeded that of her older sisters. But in particular, the King appreciated her honesty. He did not remember her having ever been dishonest to him, and he therefore was particularly fond of his youngest daughter.

As the youngest princess loved her dad more than anybody else, she had thought of something very special for him. And she said to him: "My dear dad, I love you like, like, well ... like plastic."

After she had said this, everybody was in shocked silence. The sisters hardly dared to breathe, looking spellbound to the King. The King was so angry he turned purple and foaming at the mouth he said to his daughter, "What do you mean you love me like plastic? Isn't there anything better you can think of?! Plastic bags, plastic buckets, disposable tableware – these are the things you like just as much as me?" And in his anger, he called his closest servant: "Banish her from my kingdom this very day, so I don't have to see her any longer!" Without turning back, the King strode from the hall. The party was ended and all guests left the castle sorrowfully.



On the same day, the Princess – as ordered by the King – was banished from the kingdom. She could not bring herself to say goodbye to anyone. It broke her heart to leave forever her sisters, all her friends, her horses, and the familiar environment, but especially her father. The first day, she walked lonely through the foreign land where the servants had abandoned her. She met only a few people, whose language she was not able to understand. At night-time she tried to get to sleep underneath a copper beech tree but could not rest because of her sadness and longing for her friends and family. How would she be able to explain to her father what she meant with the sentence, “I love you like plastic”? But it was too late now! He would certainly not forgive her!

One night – she could not get a wink of sleep – she suddenly felt a gentle breeze. She sat up and there she saw a wonderful fairy standing next to her sleeping place. The princess confided all her problems to the fairy. Sobbing her heart out, she spoke about her father’s birthday party and how she had said to her father: “I love you like plastic”. The fairy nodded understandingly. “Many people haven’t realised the value of plastics so far. Your father is certainly one of them. But I’ve got an idea how I can help”. As soon as she had finished the sentence, the fairy disappeared. The princess rubbed her eyes and thought she had had a dream. Then, she fell asleep until the following morning, when she was awakened by the squirrels rustling above in the copper beech tree.







Since his birthday, the King had always been in a bad temper. He was scared, but also deeply offended.

He also missed his youngest daughter, who had cheered him up so often with her lovable nature. But most of all, he missed the conversations with her, where he could rely on her judgment. Every morning he went to his office early, from which he had a fantastic view of his kingdom, but now he found that he wasn't able to appreciate this view. He walked over his valuable, handwoven carpet, to his magnificent mahogany desk, and sat on his hand-carved leather chair. Every morning the first thing he did was reach for his phone to give urgent orders. Without raising his eyes, he grabbed for the handset, but – what was this? Instead of the handset, he held a bundle of loose wires in his hand. Instead of the phone, there were only metal parts and copper wires lying on the desk. The rest of the phone was missing!

Feeling confused, the King looked around his office. Everything had somehow changed. On taking a closer look, where he expected to see the screen of his computer on his desk, he found only a glass plate. The same had happened to his television. Where could he hear the latest important news from his kingdom? The place on his desk where his servant usually put the bottle of mineral water was now covered by a large pool of water. He stopped short, realising that lately they have been using plastic bottles instead of the far heavier bottles made of glass. Now he started to understand what had happened: overnight, all things made of plastic had been removed from his office! Only from his office? He realised that he had been searching for his toothbrush in the bathroom – but in vain. Suddenly, he heard raised voices coming from the entrance hall of his castle.





The king slowly stood up from the chair and left his office. He saw a crowd of upset people in the hall who all seemed to talk at the same time. He struggled to catch some words. The cooks were desperate because all the food was lying in a mess: all containers made of plastic had disappeared. The chambermaids who scrubbed the floors every morning didn't have any cleaning buckets any more. Some reported that the entire traffic system had broken down in his kingdom. The cars weren't able to drive: dashboards, bumpers, all parts made of plastics had completely disappeared. Some fishermen at sea were particularly hit : they were in distress because their plastic boats had vanished into thin air. The entire kingdom had a power cut, as all cables had disappeared from the face of the earth. The king could not bear to hear of the hardship that had befallen his kingdom, and went to his office. He sat down on his chair again, deep in thought.

All his gold treasure wouldn't help him here. And even the salt, which was essential for people to live, wouldn't bring him back the missing plastics. And now the king realised that he had made a bad mistake: how could he have punished his youngest daughter so hard? Didn't she love her father just as much as his other daughters – if not even more? At this point, the king did something he hadn't done for a very long time: he laid his head on the desk and cried bitterly, until he fell into a very deep sleep.

Many hours later, he woke up feeling very thirsty. He took a bottle of mineral water and poured himself a glass – but what happened? The plastic bottle was intact. The king looked around: everything was as it should be. Even the phone was in its usual place. He took the handset. Very sheepishly, he gave the first and only order of the day: everyone was expected to help to find his daughter!



A big search began, and everybody that was able took part. Eventually, she was found in a small forest in the neighbouring country, sitting under a copper beech tree and watching the squirrels. The same evening, she was brought back to the castle. In return for finding his daughter, the King arranged a party – even bigger than his own birthday party. Everybody danced and laughed, and the most delicious dishes were served. And guess which material the cutlery and tableware were made of... The king promised to himself he would never again ask such vain questions.



Fairy tale contest

Draw — either with your entire class or individually — a scene from the fairy tale and you could win a cool prize.

Every participant will win an **"Olly" super rubber.**
And the best one will get an **"Olly" T-shirt.**
The nicest pictures will be published.

The closing date is May and October of every year (deadline is 31st of the relevant month). If you or your class feel like participating please send your pictures to:

PlasticsEurope UK
Olly Contest
BPF House
6 Bath Place
Rivington Street,
London, EC2A 3JE

First Prize



... and for all



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