New Materials and Irreversible Changes

Contents

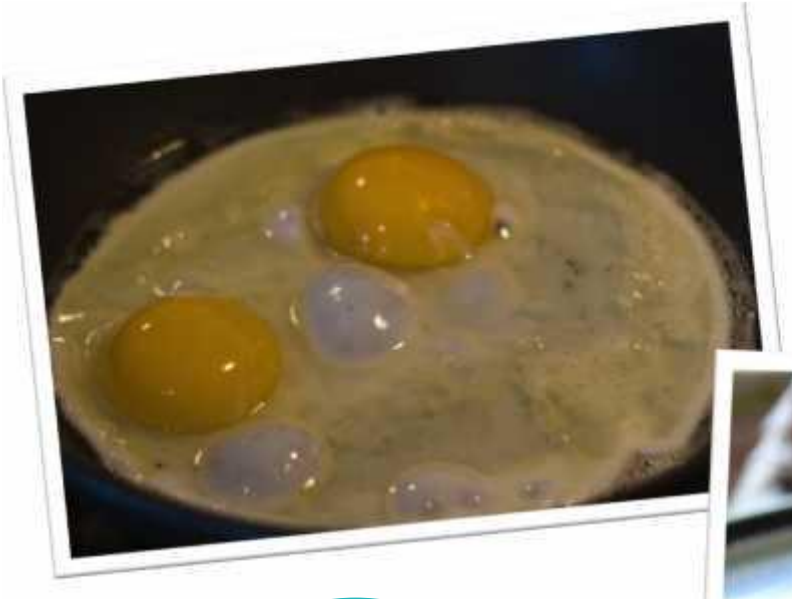
LO: To understand irreversible changes

An irreversible change us where the material cannot be returned to its original form.

Examples of irreversible changes are heating, mixing, burning and rusting.

In most cases a new material is formed.

What happens when you heat up an egg?

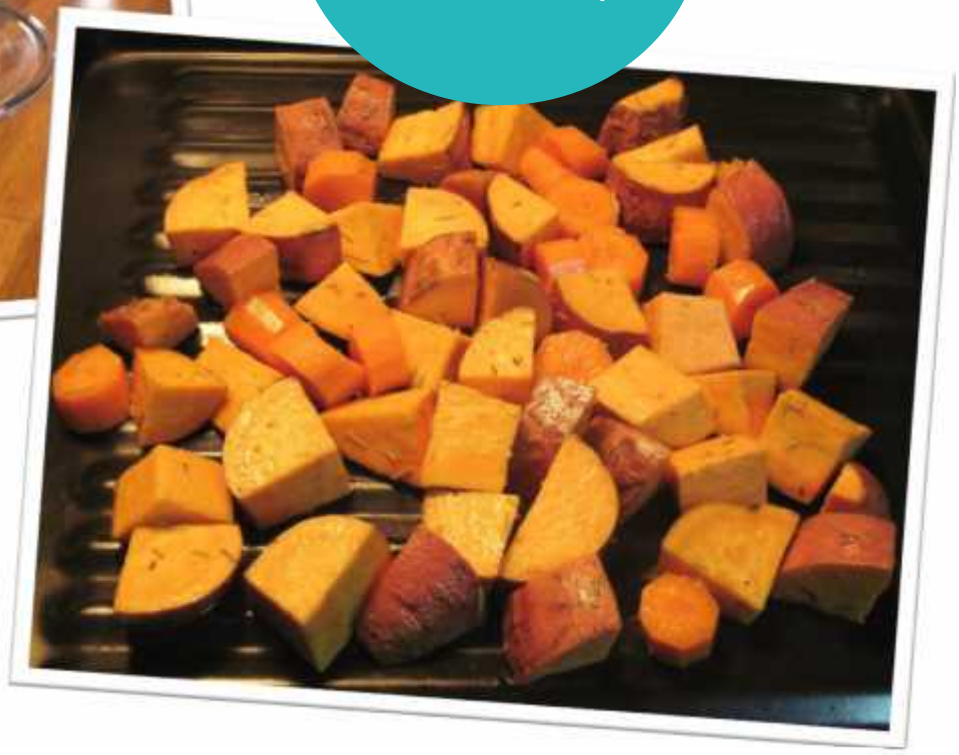


What changes do you notice?

Can the changes be reversed?

What happens when you heat sweet potatoes?

What changes do you notice?



Can the changes be reversed?

What happens when you mix bicarbonate of soda and vinegar?

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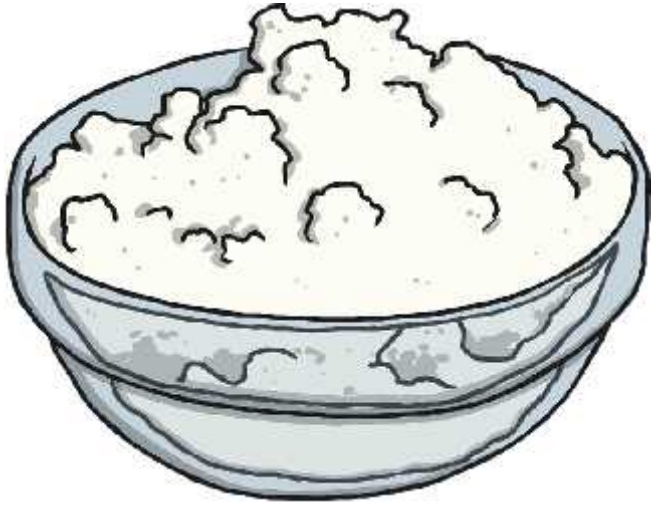
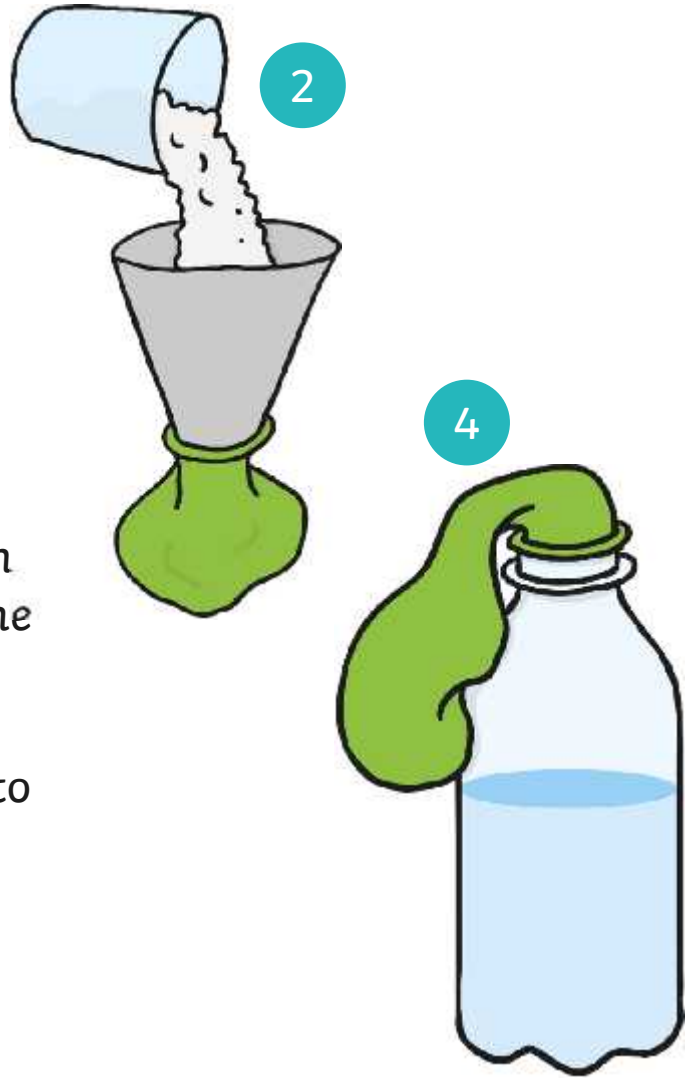


Activity

1. Wear safety glasses.
2. Place 50g of bicarbonate of soda in a balloon (use a cardboard cone).
3. Place 50ml of vinegar in a bottle.
4. Carefully stretch the neck of the balloon over the bottle without letting any of the bicarbonate of soda spill in the bottle.
5. Lift up the balloon to tip the powder into the vinegar.
6. Repeat with double the bicarbonate of soda and vinegar.



What happens when you mix plaster of Paris and water?

What happens when you place bread in front of a heat source?

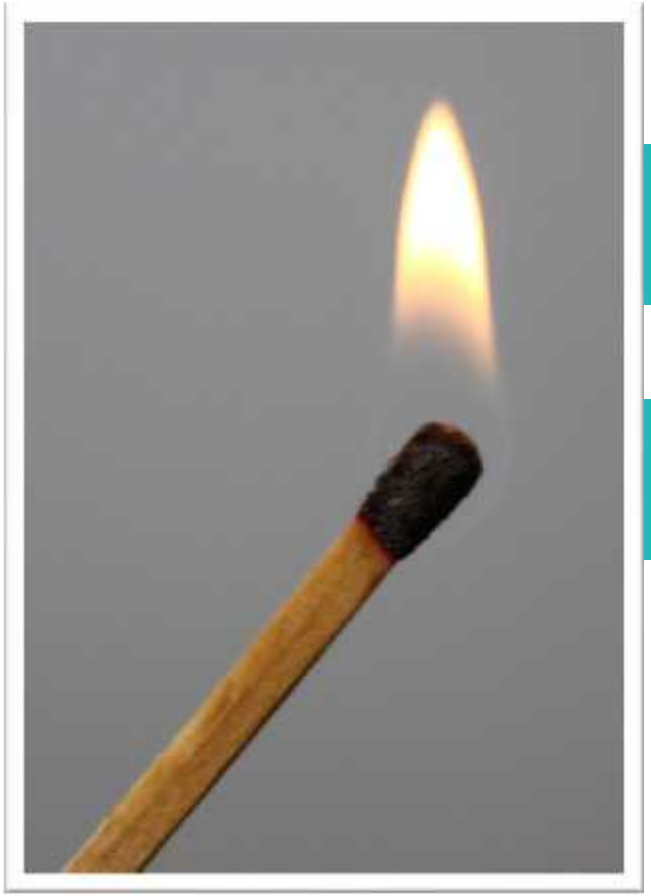
What happens when you burn a candle?

What part of the candle burns?

Blow out the candle and hold a flame back to the wick without touching it what happens?

What does this tell you about what is burning?

What happens when you burn a match?



What do you notice when the match burns?

What do you notice is left after the match has burned?

Why are some of these nails rusty and some not?

Do all metals rust?

What are the conditions that cause some metals to rust?

How could you test these ideas?

Carry out a fair and reliable test

What question will you test?
Do all metals rust?
What are the conditions that cause some metals to rust?
How could you test these ideas?

How will you ensure the test is fair? Which metals rust?

What will you change?	What will you observe?	What you will keep the same?
The metal	Whether rust forms	The place where metals are left Length of time given for the metal to rust

How will you ensure you test is fair?

How does salt affect how metal rusts?

How will you ensure the test is fair? Which metals rust?

What will you change?	What will you observe?	What you will keep the same?
The amount of water	Whether rust forms	The place where metals are left Length of time given for the metal to rust

How will you ensure you test is fair?

How does salt affect how metal rusts?

How will you ensure the test is fair? Which metals rust?

What will you change?	What will you observe?	What you will keep the same?
The amount of salt near each piece of metal	Whether rust forms	The place where metals are left Length of time given for the metal to rust

How will you ensure you test is fair?

How does salt affect how metal rusts?

Apply your learning

Apply what you have learnt about rusting.

What are the problems caused by rusting?

How might you prevent rusting?

Can you find out how rusting is prevented?

Ruth Benerito

Ruth Benerito is famous for inventing wrinkle free cotton.

What can you find out about Ruth Benerito

What problems did she solve?

How did her invention improve people's lives?

Leo Baekeland

Leo Baekeland is famous for inventing bakelite, one of the firsts plastics.

What can you find out about Leo Baekeland?

What problems did he solve?

How did his invention improve people's lives?

Spencer Silver

Spencer Silver is famous for inventing the glue used for post-its.

What can you find out about Spencer Silver?

What problems did he solve?

How did his invention improve people's lives?

Madame C.J. Walker

Madame C.J. Walker is famous for inventing and selling cosmetic products

What can you find out about Madame C.J. Walker

What problems did she solve?

How did her invention improve people's lives?

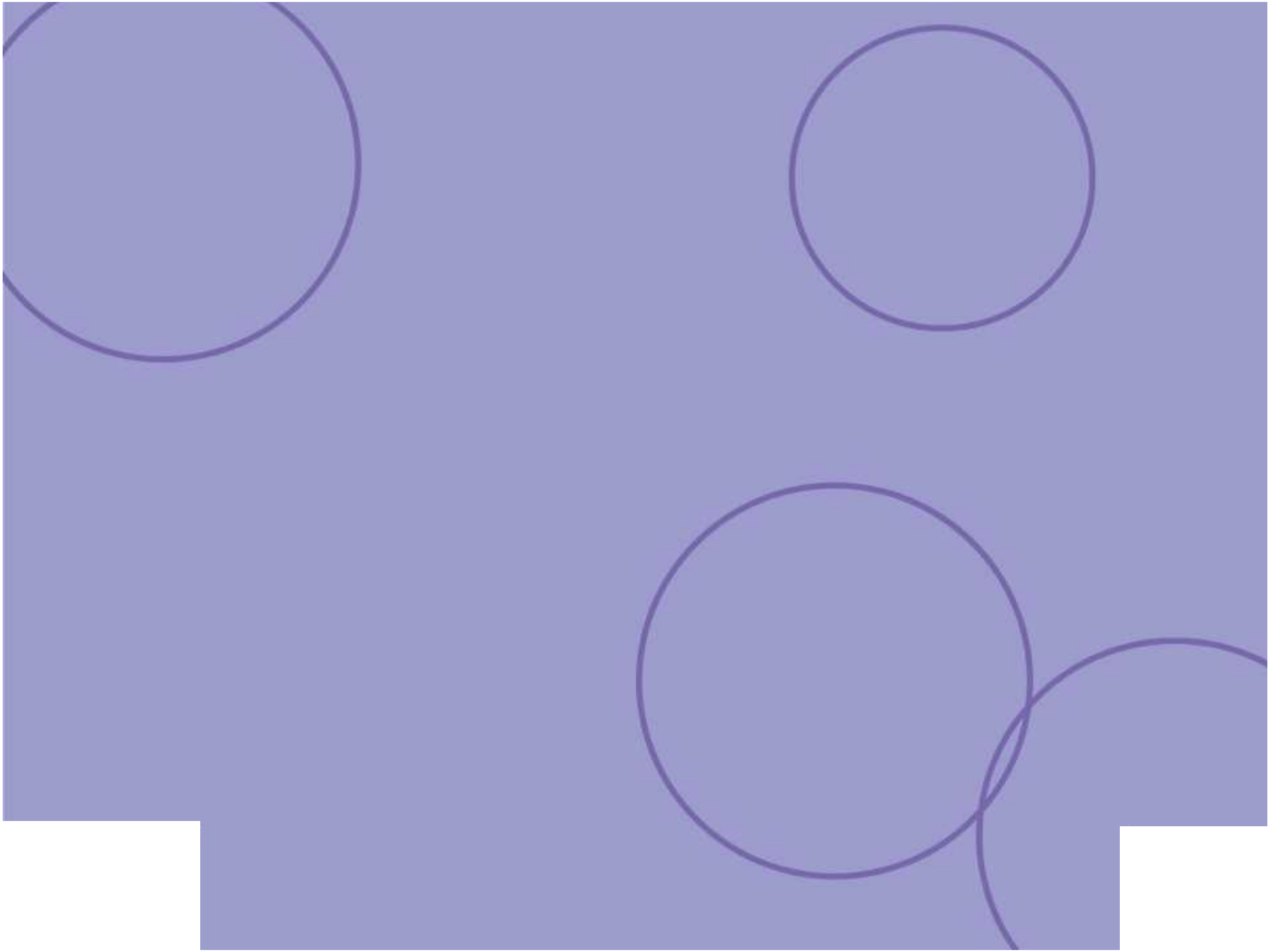
Harry Brearly

Harry Brearly is famous for inventing stainless steel.

What can you find out about Harry Brearly?

What problems did he solve?

How did his invention improve people's lives?



Ruth Benerito

Ruth Benerito was an American scientist who is best known for inventing cotton fabrics that didn't crease as much as traditional cotton.

Ruth was born in New Orleans in 1916. Her father made sure she got the same education as was available to boys, and she went to University to study Chemistry (the science of materials).

During the 1930's, new materials for clothes such as nylon and polyester were becoming increasingly popular. This was a concern to cotton growers, who feared that people would no longer buy cotton. The new materials were not as long lasting or as comfortable as cotton, but were much easier to look after.

In the 1950's Ruth Benerito came up with a way to make the cotton wrinkle-free and more durable. Her research also led to improving the stain and flame resistance of cotton.

Ruth Benerito received numerous awards for her work and she died in 2013, aged 97. She, herself, played down her contribution, saying the work of scientists before her was also important. "Nature made cotton pretty good to begin with," she insisted, "I just gave it a little boost."

Questions to consider

How do you think Ruth Benerito's work affected the cotton growers?

What effect did her work have on family life?

Madame C.J. Walker

Sarah Bleedlove, known as Madame C. J. Walker, was an American business woman, who is regarded as one of the first millionaires. She made her fortune by developing and marketing beauty and hair products for black women.

She was born in 1867. Her parents were slaves on a plantation, but she was born into freedom under new laws. Both her parents died when she was five or six. She went to live with her older sister, was married at 14, and widowed at 20 with a 2 year old daughter. She moved again to live in St Louis where her brothers lived, and she became a washerwoman.

Working among the chemicals and fumes caused Sarah and her co-workers to lose their hair, so she began to create products to help her hair. She moved again and in 1906 married Charles Walker. He persuaded her to use the name Madam C. J. Walker because it would appeal more to customers. The business continued to grow and in 1910 they built a factory in Indianapolis.

Madam C. J. Walker helped other black women to start their own businesses.

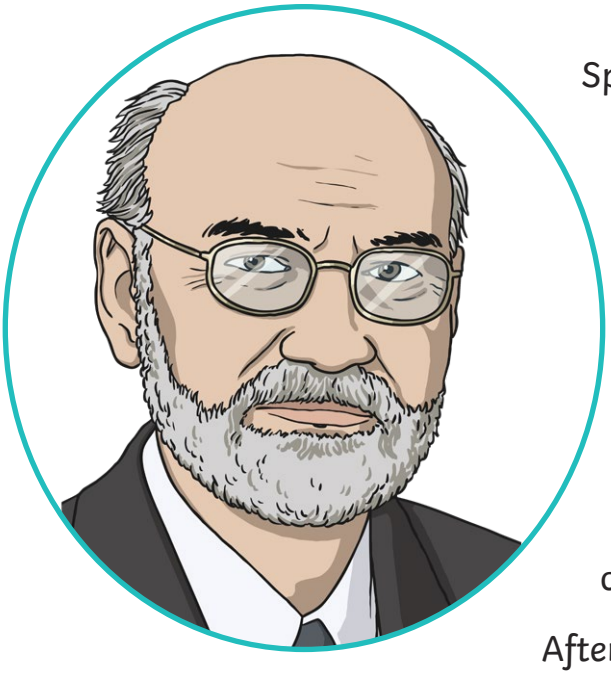
Questions to consider

How is Madam C. J. Walker different to other scientists you have found out about?

What made her successful?

What difference did she make to the lives of other people?

Spencer Silver



Spencer Silver worked for the Minnesota Mining and Manufacturing company (now called 3M). In 1968 he invented a glue that would not leave any marks when it was moved from one place to another. However, the company wanted a stronger adhesive, and felt his invention was useless, so he was given other work to do.

Six years later, Spencer Silver showed the glue to a colleague, Art Fry, who thought he could use the glue on bookmarks that kept falling out of the church hymn books.

After this, Silver and Fry used these removable bookmarks in their own office for some time, and it wasn't until 1977 that they persuaded the executives at 3M to start using them. A year later, 3M began testing "Press 'n' Peel pads, and finally, on 6th April 1980, Post-Its were introduced into American shops.

Silver's adhesive was later used in a variety of products including medical bandages and decorating kits.

Questions to consider

Why do you think it took so long to find a use for Silver's low-tack glue?

What effect did Silver's invention have on people's lives?

Compare the impact of this low-tack glue with any other inventions you have found out about.

Can you think of a use for a low-tack glue?

Leo Baekeland

Leo Baekeland was born in Belgium but went to work in America as a scientist.

In 1893 he invented a the first photographic paper which was sold successfully. Although it was not a good time for new inventions, he eventually made a lot of money from his invention. When he was asked why he entered his particular field of science, synthetic resins (man made materials), he is reported to have answered "to make money".

His most significant invention was made in 1907, when he came up with the first mouldable plastic, which he called Bakelite. Bakelite was used in many products because it had excellent electrical insulation and heat resistance. The new plastic could also be produced in bright colours.

Bakelite was eventually succeeded by new plastics, but it was used in over 15,000 different products. There is even a museum for Bakelite products in England.

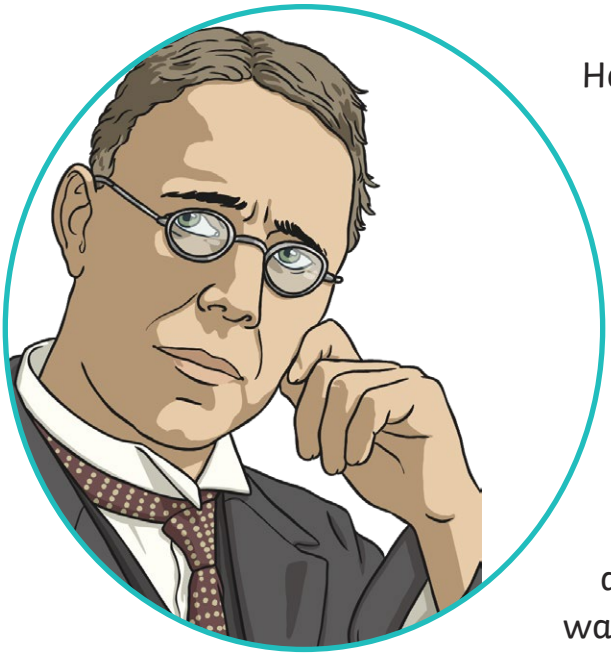
Questions to consider

What do you think of Leo Baekeland's motivation for working as a scientist?

What effect did Bakelite have on people's lives?

How do you think Bakelite changed the way manufacturers made new products?

Harry Brearly



Harry Brearley was born in Sheffield, England in 1871. He left school aged 12 and joined his father as a labourer in one of the city's steelworks. Later, he started working in the company's chemical laboratory.

By his thirties, Harry Brearley was well known for his ability to solve problems with working in metals. Before the first world war, he started to develop solutions to the problems of gun barrels eroding due to the high temperatures. By adding chromium to the steel, he developed what was initially called a non-rusting steel.

Probably due to the significant cutlery industry in Sheffield, this stainless steel, as it became known, was used in cutlery, saucepans and other food related products.

Brearley was one of a line of metallurgists who tried to solve the problem of corrosion in steel by adding chromium to steel. On the 13th August 1913 Brearley created a steel with 12.8% chromium and 0.24% carbon, which is argued to be the first ever stainless steel.

There are several stories involved with this discovery, some of which may not be true. One is that he made his discovery by throwing steel into the rubbish and finding it didn't corrode. However, it is more likely he did so by carefully testing his new material using lemon juice and vinegar.

Questions to consider

What were the reasons for Harry Brearley trying to find a solution to erosion and corrosion in steel?

How do you think other scientists helped Brearley create stainless steel?

What do the stories about Brearley's work tell you about science?

What difference did he make to the lives of other people?

Science KS2: Y5 New Materials and Irreversible Materials Teacher's Notes

This document is gives guidance to the main areas of study in the Year 5 New materials and irreversible materials requirements.

Curriculum 2014

Year 5 Statutory Requirements

Pupils should be taught to:

- explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.

Notes and Guidance (Non-statutory)

Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.

Progression

Content	Vocabulary
Heating – irreversible changes (eggs and sweet potatoes)	Most of the vocabulary for the work on materials is used in the reversible changes and dissolving section of the learning.
Mixing – irreversible changes (vinegar and bicarbonate of soda, plaster of paris and water)	
Burning – irreversible changes (toast, candles, matches)	
Rusting – irreversible changes (iron nails etc)	
Famous scientists and their impact – Ruth Benerito, Leo Baekeland, Spencer Silver, Madame C. J. Walker, Harry Brearley	

New materials and irreversible changes in the curriculum

This unit stands on its own as a Science unit, although teachers may want to use it alongside other Y5 learning on materials. Some of the scientists mentioned at the end of the unit could be integrated into other areas of the curriculum such as history or PSHE. The 2 scientists mentioned in the non-statutory guidance are American, as are 2 of the other examples. Only one is British. Teachers may wish to use their own examples, which may link to local history or geography.

Useful websites

	Information about the changes to an egg when it is fried.
	Activity with bicarbonate of soda and vinegar.

Year 6 Science lessons about The Human Body

Introduction	Brief explanation of irreversible changes
Lesson 1	Heating (irreversible changes) – good examples from cooking examples – eggs, sweet potatoes
Lesson 2	Mixing (irreversible changes) – examples from cooking/ using ingredients examples – bicarbonate of soda & vinegar, plaster of paris and water
Lesson 3	Burning (irreversible changes) – examples from cooking and burning fuels examples – candles, matches (wood), toast
Lesson 4	Rusting (irreversible changes) – rust forms when iron mixes with oxygen when it becomes wet Opportunities for fair and reliable testing.
Lesson 5	Scientists who made a difference: Spencer Silver, Ruth Benerito,

Powerpoint Slide Notes

New Materials and Irreversible Changes

1	Title - A task setting PowerPoint Pack about New Materials and Irreversible Changes
2	Contents
3	Introduction Teachers may want to do the learning about rusting over several weeks, so may wish to start this before the end of the unit.
4	Lesson 1: Heating (irreversible changes) Teachers can cook an egg in a variety of ways. Teachers may also note that beating an egg (mixing the yolk and white) is irreversible. Frying an egg is a chemical reaction/change since the protein in the egg white becomes a denatured solid and turns white, which cannot be reversed by physical means. In general, the properties of the cooked egg are completely different compared to the properties of the raw egg. (http://uk.ask.com/question/is-frying-an-egg-a-chemical-reaction)

5	Lesson 1: Heating (irreversible changes) Teachers can cook sweet potato in a variety of ways. Sweet potatoes can be eaten raw or cooked which gives a great opportunity to compare taste and texture. Roasting in an oven is usually at a higher temperature (about 200C) and is without water so will concentrate flavour. Boiling in water is at a lower temperature (100C) and being in water flavour can be diluted.
6	Lesson 2: Mixing (irreversible changes) Use small amounts to make this exciting mix – a class that is often used with model volcanoes
7	Lesson 2: Mixing (irreversible changes) This activity shows that gas is produced by the reaction between bicarbonate of soda and vinegar. It is possible to notice that heat is used in this reaction, which is why the bottle will become cold. The gas produced is carbon dioxide. The chemical reaction is too complicated for KS2 children but water is one of the other 3 products. Further details can be found at http://www.webinnate.co.uk/science/week2.htm
8	Lesson 2: Mixing (irreversible changes) Mixing water with plaster of paris returns the mixture to gypsum.
9	Lesson 3: Burning (irreversible changes) Toast a piece of bread. Ask children to describe the changes.
10	Lesson 3: Burning (irreversible changes) Light a candle. Ask the children what they think is burning. They will usually say the wick. In fact it is wax vapour that burns. This can be shown by blowing out the candle and bringing a flame back towards but not touching the wick. It relights as long as vapour is still being given off. This is also why it can take a few seconds to light a candle as the wax has to melt and then become vapour before it lights. The candle (a hydro-carbon – made of hydrogen and carbon) mixes with oxygen in air to form water and carbon dioxide. If it burns without enough oxygen it makes water and carbon monoxide , which is odourless and poisonous.
11	Lesson 3: Burning (irreversible changes) Teachers will want to check with school policies as to who is allowed to light the match and where the children should be stood. There are 2 materials in the match. An explanation of how the matchhead burns can be found at http://www.pa.msu.edu/sciencet/ask_st/092596.html but this may be too complicated for some KS2 pupils. Teachers may wish to focus on the burning of the wood. Wood is simialr to wax in that it is made of hydrogen and carbon (and nitrogen and oxygen) so the burning produces water and carbondioxide as well as some other gases. Some of the carbon is left behind in the form of charcoal. A video of a match burning can be found at http://www.telegraph.co.uk/men/the-filter/virals/10591682/What-really-happens-when-a-match-burns.html showing the phosphorus burning.

12	Lesson 4: Rusting (irreversible changes) Some questions to get started
13	Lesson 4: Rusting (irreversible changes) Here are some questions the children could test. What other ideas do they have? Rusting is when iron turns to iron oxide. Steel, which is made from iron, also rusts, but stainless steel does not. Water and oxygen are both needed for rust to form. Salt increases the speed at which iron rusts.
14	Lesson 4: Rusting (irreversible changes) Ask the children to consider how they will conduct a fair test? Teachers should note that it may take some time for any rust to form (the damper the better) so teachers may wish to look at rusting over a few weeks.
15	Lesson 4: Rusting (irreversible changes) Ask the children to consider how they will conduct a fair test? Teachers should note that it may take some time for any rust to form (the damper the better) so teachers may wish to look at rusting over a few weeks.
16	Lesson 4: Rusting (irreversible changes) Ask the children to consider how they will conduct a fair test? Teachers should note that it may take some time for any rust to form (the damper the better) so teachers may wish to look at rusting over a few weeks.
17	Lesson 4: Rusting (irreversible changes) Here are some questions the children could test.
18	Lesson 5: Ruth Benerito Use in tandem with the information sheet
19	Lesson 5: Leo Baekeland Use in tandem with the information sheet. The Bakelite museum is in Somerset (http://www.bakelitemuseum.co.uk/)
20	Lesson 5: Spencer Silver Use in tandem with the information sheet
21	Lesson 5: Madame C. J. Walker Use in tandem with the information sheet
22	Lesson 5: Harry Brearley Use in tandem with the information sheet