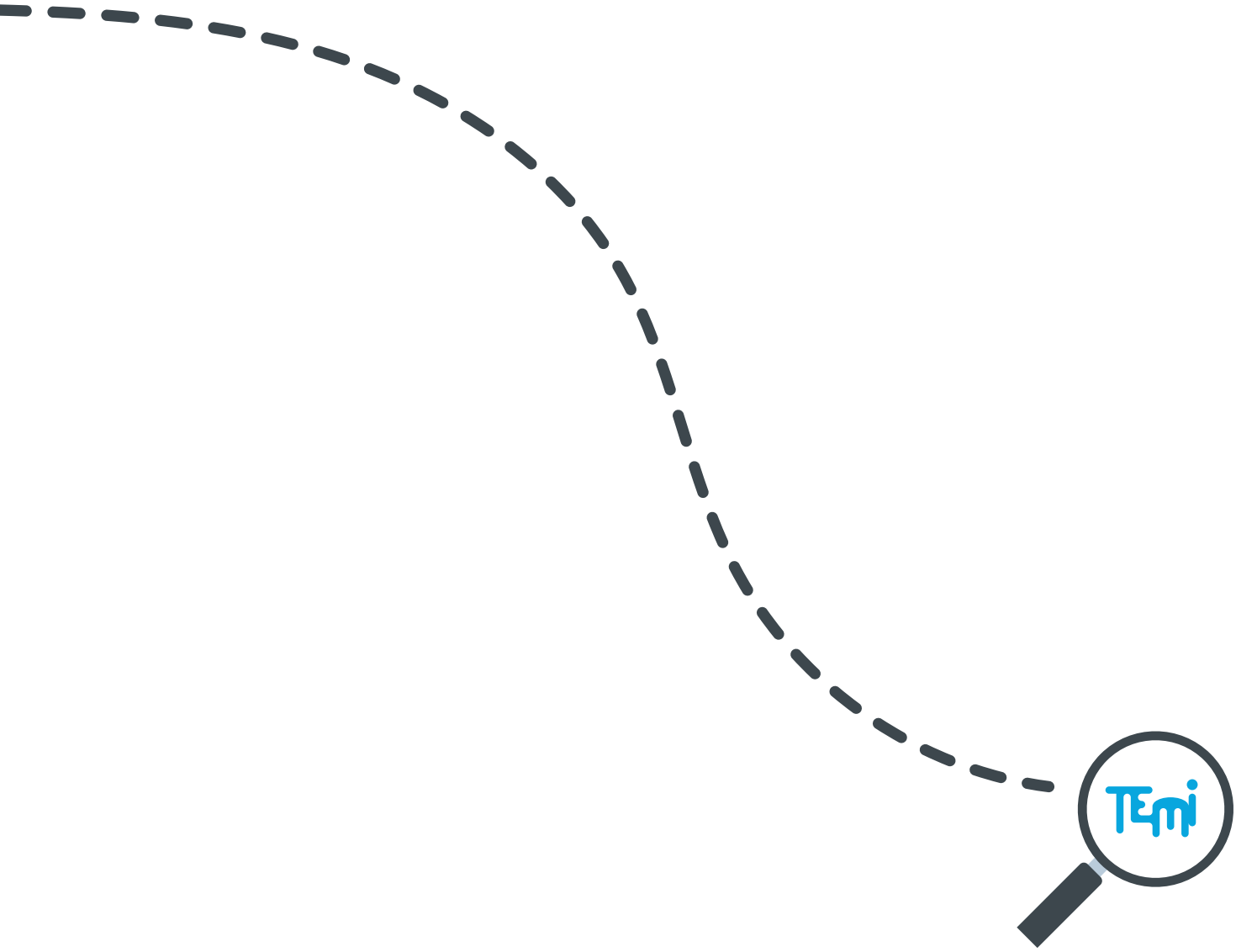
Eating nails

CLASSROOM SCIENCE ACTIVITY TO
SUPPORT STUDENT ENQUIRY-BASED LEARNING



This classroom-tested teaching plan uses the four innovations of the TEMI project, as detailed in the Teaching the TEMI Way (TEMI, 2015).

You should read this companion book to get the most from your teaching. The **TEMI** techniques used in this teaching plan are: **1)** productive science mysteries, **2)** the **5E model** for engaged learning, **3)** the use of presentation skills to engage your students, and **4)** the apprenticeship model for learning through gradual release of responsibility. You might also wish to use the hypothesiser lifeline sheet (available on the **TEMI** website) to help your students document their ideas and discoveries as they work.

To know more about **TEMI** and find more resources **www.teachingmysteries.eu**

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teachingmysteries.eu

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What's the mystery?

Are we really eating nails? How can there be iron in our cereal? The mystery here is the teacher demonstrating that iron filings can be extracted from a sample of breakfast cereal.

DOMAIN(S)

Chemistry.

SUBDOMAIN KEYWORDS

Elements, compounds, mixtures.

AGE GROUP

12 to **15** years old.

EXPECTED TIME FOR THE MYSTERY

Approximate time for teacher preparation:
15 min.

Approximate time in classroom:
80 min.

SAFETY/SUPERVISION

Food used in any lab experiment is not to be eaten.

Care should be taken when using food blender: ensure the blender is switched off at the wall until it is properly set up and ensure the lid is on before blending.

Care is to be taken when handling hot glassware: use tongs or heat-resistant gloves.

Disclaimer: the authors of this teaching material will not be held responsible for any injury or damage to persons or properties that might occur in its use.

PREPARATION AND LIST OF MATERIALS

For a teacher-engaged demonstration:

- Blender
- Breakfast cereal containing added iron
- Strong magnet
- Projector (if available)

For a student-explore activity:

- Beaker
- Strong magnet
- Mass balance
- Weigh boats
- Spatula
- Test tube
- Tongs
- Bunsen burner
- Pestle and mortar
- Iron filings
- Sulphur
- 1.0M HCl

Notes:
Some materials can be found at home (food blender).

Neodymium magnets are more effective if they are available. These can be sourced from science education equipment suppliers. Care is required when handling these powerful magnets.

LEARNING OBJECTIVES

- Students will learn about the properties of elements (e.g. iron).
- Students will understand the difference between a mixture and compound.
- Students will test and observe the properties of a mixture and a compound.

Guidance notes for teachers

THE 5E MODEL

Engage

CAPTURE STUDENTS' ATTENTION

Would you believe me if I were to tell you that I can make the invisible visible?

» Teacher tells the class that he/she is able to separate a particular ingredient in the cereal and make it visible with a 'magic wand' (magnet).

» The teacher will blend two cups of cereal with water. The teacher will let the mixture sit for two minutes and then stir with a very strong magnet (neodymium magnet if available). A projector could be used to show the demonstration clearly.

» The students will be amazed to observe tiny grey particles on the magnet.

Explore

COLLECT DATA FROM EXPERIMENTS

How does our body digest this iron?

Do you think this iron will travel through the intestinal tract as an iron nail would?

» Brainstorm ideas about how the body digests this iron.

» Add 10 ml of 1.0M HCl to 100 ml of the cereal slurry to simulate stomach acid. Heat in a beaker of hot water.

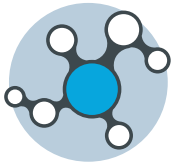
» After the addition of HCl, the acid oxidises the elemental iron to iron(III) ions, which are not as attracted to a magnet. The addition of NaSCN (sodium thiocyanate) solution should turn the slurry red, thus confirming the presence of these iron ions.

Explain

WHAT'S THE SCIENCE BEHIND THE MYSTERY?

» Several breakfast cereals contain iron as a mineral supplement. The iron is in the form of iron powder and can be extracted from a suspension of crushed cereal in water by using a magnet. This discrepant event is intended to show that breakfast cereals are a mixture of various substances that are mingled together but not chemically combined.

» The stomach contains a strong acid, hydrochloric acid, that can break down the iron into iron(III) form (ferric). This is then broken down further before being absorbed into the blood stream. It is then used to transport oxygen around the body.



Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

Comparison of mixtures and compounds (1): Students have to prepare their own mixture and compound samples using the materials and equipment provided.

On completing the investigation, the students should be able to determine the different properties of a mixture and a compound:

» Mixture of iron and sulphur. The iron can still be separated with a magnet (the element retains its property).

» Compound of iron and sulphur. The mixture is heated to form iron sulphide. The iron can no longer be separated by a magnet (the compound has new properties).

Comparison of mixtures and compounds (2):
Students can be provided with different colour plastic building blocks (e.g. Lego). Each colour represents a different element. The students can use these to make concrete representations of the mixture (e.g. two or more different colour blocks not joined together) or a compound (e.g. two or more different colour blocks joined together).

Real-life application
Iron is an essential mineral. It is found in haemoglobin in red blood cells. It is needed for the transportation of oxygen from the lungs around the body. If the body does not have enough iron, it cannot make enough oxygen-carrying red blood cells. This deficiency is called anaemia.

Healthy red blood cells and sufficient oxygen is important to prevent fatigue. Athletes need sufficient oxygen supply in their blood and muscles to maximise their performance and prevent fatigue. Blood doping is a method of increasing the number of red blood cells in the body. This allows more oxygen to be carried to the muscles.

Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

Students should know:

» Elements in a mixture retain their properties: elements do not retain their own properties when in a compound.

» There is a chemical change when a mixture is formed into a compound.

» This conservation of properties may often be used to separate components in a mixture.

Students should be able to:

» Explain why it is possible to ingest table salt (NaCl), even though the two elemental components are highly reactive and poisonous. From the experimental investigation with iron and sulphur, students should know that compounds have new properties: the elements do not retain their own properties.

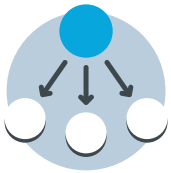
» Carry out an investigation on the iron levels in different cereals and compare the results with the levels shown on the cereal packet labels.

THE 5E MODEL

Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

When extracting the iron from the cereal with the 'magic wand', it is important not to tell the students what they should expect. All the students should know is that the teacher thinks it is possible to make the invisible visible. Allow the students to observe what is extracted from the cereal for themselves.



GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

Students will learn about the following skills through the GRR model:

» Separating techniques.

» Experimental work.

» Predict, observe, and explain procedures.

» Project and group work.

Resources

There are a number of YouTube videos showing how to extract iron from breakfast cereal.
On the TEMI Youtube Channel:
www.goo.gl/tUDaq5
playlist > Extracting iron from cereals

There are also many videos on You Tube about the various ways in which teachers can introduce the concepts of elements, compounds, and mixtures to students. On the TEMI Youtube Channel:
www.goo.gl/tUDaq5
playlist > Building models of elements, compounds and mixtures

An additional short documentary-style video can be viewed on how blood doping works.
On the TEMI Youtube Channel:
www.goo.gl/tUDaq5
playlist > Blood doping

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STUDENT WORKSHEET

You have seen how your teacher separated a previously 'invisible' ingredient from breakfast cereal.
What was this ingredient called?
How was the teacher able to remove this ingredient from the cereal?
Why were the other ingredients not attracted to the 'magic wand'?
You should investigate this observation and the properties of the ingredient using the materials provided.

Engage

WHAT'S INTERESTING?

Task 1: If this grey ingredient is in the breakfast cereal, why do we not see it or at least feel it when we bite into the cereal?

Task 2: Do you think our cereal could rust if it's left out long enough?

Task 3: Iron is often added to foods such as breakfast cereals. Why do we need iron in our diet?

Task 4: From what you have learnt about iron in the diet, what group of people usually require iron the most and why?

Task 5: Is the breakfast cereal used in the first demonstration an example of a mixture or a compound? Explain your reasoning.

Explore

WHAT'S HAPPENING?

Task: How does our body digest the iron from breakfast cereal? Would it be possible to digest an iron nail?

Teacher Demonstration:
Help your teacher to design an experiment to show how our bodies digest the iron from food, such as breakfast cereals.

Explain

WHAT'S CAUSING IT?

Task: Several breakfast cereals contain iron as a mineral supplement. The iron is in the form of iron powder and can be extracted from a suspension of crushed cereal in water using a magnet. This discrepant event is intended to show that breakfast cereals are a mixture of various substances that are mingled together but not chemically combined.

The stomach contains a strong acid, hydrochloric acid, that can break down the elemental iron into an iron(III) form (ferric). This is then broken down further before being absorbed into the blood stream. It is then used to transport oxygen around the body.

Extend

WHAT'S SIMILAR?

Task: **Compare a mixture of iron and sulphur to the compound iron sulphide.**
How you will do it...

Using a pestle and mortar, grind up a mixture containing 6g of iron and 4g of sulphur.

Wrap a magnet in paper and bring the magnet close to the mixture. What happens? Record your results.

Remix the iron and sulphur using a spatula and place the mixture in a test tube.

Heat the test tube until the mixture glows red (**this is to be done in a fume cupboard with teacher supervision).

Continue heating until the mixture stops glowing.

Allow the test tube to cool. Wait until your teacher has visited your station and then carefully remove the grey solid that has been formed for closer examination.

Bring a magnet close to the grey solid. What do you notice? Record your observations

Activity
Use the coloured Lego blocks to represent various elements, compounds, and mixtures.

Evaluate

WHAT'S MY UNDERSTANDING?

Task 1: What is the difference between an element, a compound, and a mixture?

Task 2: Table salt is made up of a very reactive metal and a poisonous green gas. Can you name these two elements? Briefly explain why it is possible to ingest table salt even though it is made from these harmful elements?

Task 3: How could you compare the iron levels present in various breakfast cereals?

Task 4: Briefly explain how blood doping works.