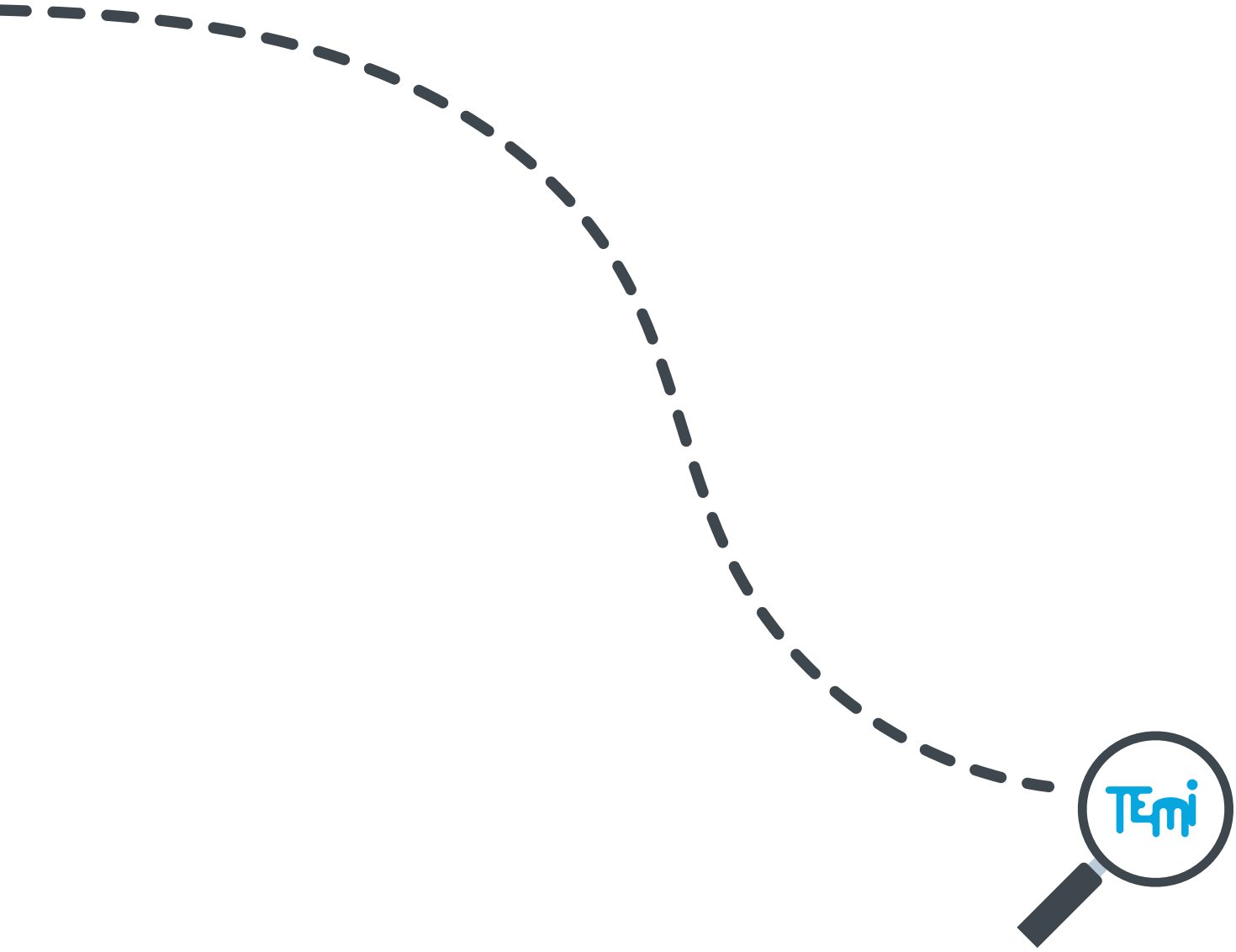

# Chemical seesaw

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**

This research project has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 321403.

**teachingmysteries.eu**

FP7-Science-in-Society-2012-1, Grant Agreement N. 321403

Co-funded by the Seventh Framework Program of the European Union

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## What's the mystery?

A balance is set up with two pieces of iron wool. One piece is set alight: it appears to be getting smaller but, mysteriously, the balance tips the other way.

### DOMAIN(S)

Chemistry.

### SUBDOMAIN KEYWORDS

Chemical reactions, particles, conservation of mass, oxidation.

### AGE GROUP

**11** to **14** years old.

### EXPECTED TIME FOR THE MYSTERY

Approximate time for teacher preparation:
**45 min.**

Approximate time in classroom:
**One 50 min. lesson.**

### SAFETY/SUPERVISION

Be careful when burning the materials in the classroom. Use eye protection.

### PREPARATION AND LIST OF MATERIALS

**For teacher demonstrations:**

- Simple balance (for instructions, see the Resources section).
- Four aluminium trays (two can be stuck on top of the metre ruler). When burning the paper, place two more trays on top and remove these so you have clean trays to burn the iron wool.
- Two pieces of screwed-up paper of equal mass
- Two pieces of iron wool of equal mass. Clean these in acetone first to remove any grease.
- Bunsen burner
- Wooden splint
- Two pieces of magnesium strip
- Tongs
- Gas jar of pure oxygen
- Optional:
- Piece of carbon (charcoal)
- Deflagrating spoon

### LEARNING OBJECTIVES

Students will construct explanations using particles to demonstrate what happens during a chemical reaction.

# Guidance notes for teachers



## Engage

CAPTURE STUDENTS' ATTENTION

Add small pieces of screwed-up paper of equal mass to each tray so that they balance. Use a burning splint to set one piece of paper alight. Quickly ask the students to predict what they think will happen to this side of the balance: will it go up or down? You should see that the metal tray goes up as the mass of the paper decreases. Repeat this process, but use two pieces of iron wool of the same mass. Again, ask the students to predict what they think will happen. This time they will see that the tray with the burning iron wool goes down as the iron gets heavier.

## Explore

COLLECT DATA FROM EXPERIMENTS

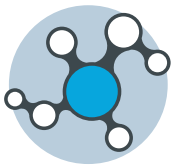
**Explore 1:** students are guided on how to use the construct explanations lifeline. They see the reaction of magnesium burning in air and are shown how to work out the chemical reaction taking place.

**Explore 2:** students use the lifeline to write their explanation as to why the mass of iron increased when it was burnt in air.


## Explain

WHAT'S THE SCIENCE BEHIND THE MYSTERY?

Use particle diagrams to show that oxygen joins with the iron atoms to produce a product called iron oxide. As it contains oxygen atoms, iron oxide has a greater mass than iron atoms. NB: iron oxide has the formula $Fe_2O_3$, so each iron atom doesn't join with one oxygen atom like it does when forming magnesium oxide. You may wish to discuss this with some classes, depending on how much work they have done on chemical formulae.



## Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

Students are asked what they think will happen to the mass of a lump of carbon as it is burnt.

## Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

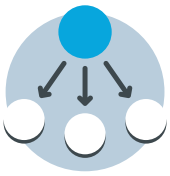
Students write down what they think will happen and why. You can use this output to assess student understanding.

You may wish to demonstrate the reaction to show that the lump of carbon will get smaller. This is because the gas carbon dioxide is produced, which is then lost to the air.

## Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

The engage part of the lesson shows a discrepant event: students will see the mass of the paper decreasing and assume it will be the same when iron burns. Use this to add surprise and intrigue to the lesson so that students are motivated to find out why this happened.



## GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

**Demonstrated enquiry (level 0):** this takes place during explore 1. The teacher goes through how to use the construct explanations lifeline in order to explain the chemical reaction that occurs when magnesium burns.

**Each step is explained:**

» Write down your observations.

» Recall any relevant science ideas.

» Connect idea to observation.

» Does this idea help to explain your observation?

» Write a clear and organised explanation.

**Structured enquiry (level 1):** this takes place during explore 2. The students work without the teacher's guidance to explain why the mass of iron increased when it was burnt in air. They use the lifeline and the guidance they received during explore 1 to do this.

**Solving the mystery:** students are led towards the explanation by using ideas about how atoms are rearranged during chemical reactions.

## Resources

Instructions on how to build the balance equipment:

www.nuffieldfoundation.org/practical-physics/simple-balance-2

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**STUDENT WORKSHEET**

What happens when a substance burns? Burn a piece of paper and it gets smaller and smaller: its mass decreases. But where does all this lost mass go?

Do all substances lose mass when they are burnt?

## Engage

WHAT'S INTERESTING?

**Task 1:** Watch the chemical seesaw. What happens to the mass of iron when it is burnt?

**Task 2:** Was this what you were expecting? Why?

## Explore

WHAT'S HAPPENING?

**Task 1:** Your teacher will burn another metal, called magnesium, in air.
Write down your observations.

**Task 2:** What evidence is there that a chemical reaction is happening?

**Task 3:** What scientific ideas do you know that could explain what is happening in this chemical reaction?

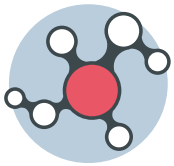
**Task 4:** Write down the explanation your teacher gives you.

**Task 5:** Use the construct explanations lifeline to help you explain why the mass of iron increases when it is burnt.


## Explain

WHAT'S CAUSING IT?

**Task:** Your teacher will explain why the mass of iron increases when it is burnt. Is your explanation correct? If not, improve it.



## Extend

WHAT'S SIMILAR?

**Task:** Carbon is an element, so it only contains carbon atoms. Think about the chemical reaction that happens when it burns in air.

## Evaluate

WHAT'S MY UNDERSTANDING?

**Task:** Conduct the following experiment and explain how this experiment is connected to understanding the