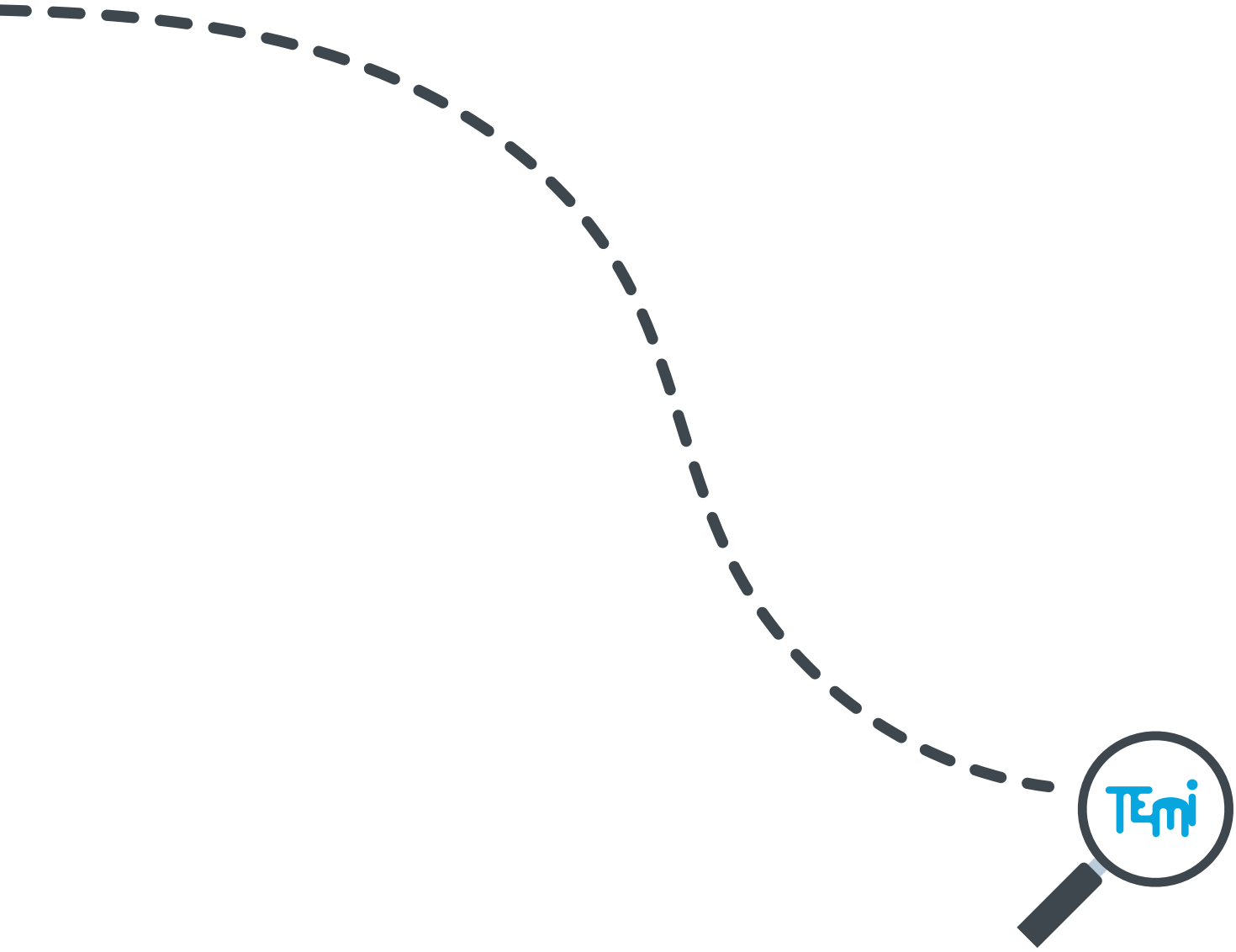
The leaking bag

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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The leaking bag

What's the mystery?

Two beakers will be displayed at the front of the room. Both look identical in that they both contain a plastic zip-lock bag with a starch solution inside. The zip-lock bag is in a clear solution. What the students don't know is that while the solution in one beaker is just water, the second beaker contains iodine.

In beaker two, the colour of the starch inside the zip-lock bag will change. Students need to figure out why this is happening.

DOMAIN(S)

Biology.

SUBDOMAIN KEYWORDS

Diffusion and osmosis.

AGE GROUP

16 to **17** years old.

EXPECTED TIME FOR THE MYSTERY

Approximate time for teacher preparation: **20 min**.

Approximate time in classroom: one **40 min**. lesson.

SAFETY/SUPERVISION

Normal lab safety precautions apply. Care should be taken when using glassware.

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

- Starch solution x 2
- Iodine, zip-lock bag x 2
- Beaker x 2
- Distilled water
- Examples of impermeable (glass tiles), permeable (coffee/tea filters), semi-permeable (Visking tubing) membranes
- Concentrated solutions (e.g. sugar solutions).

LEARNING OBJECTIVES

Students will learn about osmosis and different types of membranes.

Guidance notes for teachers

THE 5E MODEL

Engage

CAPTURE STUDENTS' ATTENTION

The teacher half fills two plastic zip-lock bags with a starch solution. The class will agree that the bag does not allow any solution to leak out. These bags will then be placed in two beakers, both of which contain a clear substance. What the students don't know is that one of the beakers has an iodine solution in it. When placed in the iodine, a colour change will occur. A blue-black colour will spread out inside the bag. Students are asked to record what they observe.

Explore

COLLECT DATA FROM EXPERIMENTS

Why does one beaker change colour while the other doesn't?

What do we know about starch and a blue-black colour?

Why did the iodine move into the bag and why didn't the starch move out?

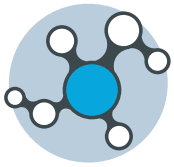
How did the iodine pass through the bag if the starch and water did not?

What would happen if we used different types of bags/membranes?

Explain

WHAT'S THE SCIENCE BEHIND THE MYSTERY?

The bag does not allow water or starch molecules to pass through. However, the iodine molecules are small enough to pass through the tiny pores in the bag. This activity may be used to describe a semi-permeable membrane as well as the effect of diffusion (the iodine will diffuse throughout the starch solution). It does not describe the action of osmosis, as water molecules are not allowed to move through the semi-permeable membrane. This will be explored in the extend section.



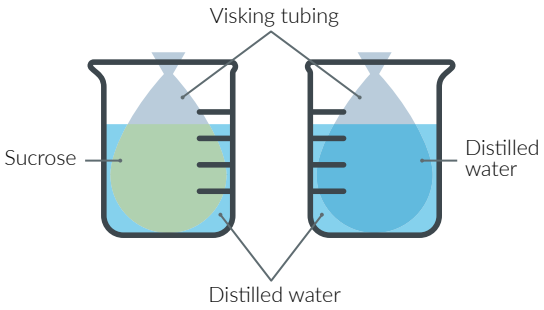
Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

The teacher informs the students that some membranes allow the movement of all molecules, some membranes don't allow the movement of any molecules, and some allow movement of a few molecules. This depends on the size of the molecules.

The students are informed that they must test the three membranes provided (Visking tubing, tea/coffee filters, and glass tiles). All they know is that one is permeable, one isn't, and that one is semi-permeable. The students work in groups of three to devise an experiment that shows the movement of concentrated substances across the three different membranes.

The pupils must recap the difference between high concentrations and low concentrations.



Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

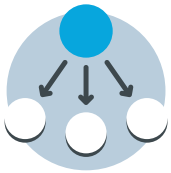
The teacher informs students that this movement of water is called osmosis and that some membranes allow osmosis to occur while others don't. The students should describe in their own words, or by using a diagram, how osmosis works by the movement of molecules from an area of high concentration to one of low concentration. Can you think of any other examples where osmosis is important in our lives? Do plants use osmosis in any way?

THE 5E MODEL

Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

The teacher should present the demonstration to the students by using the zip-lock bags and iodine. As the students will understand the effect of iodine on a starch solution, they may be able to discuss what has happened; however, they will question how the iodine was able to travel through the bag. The focus in this lesson is why certain molecules can move but not others. The students can use different membranes in their experiments to compare permeable, impermeable, and semi-permeable membranes.



GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

Setting up the mystery: ask the students what happens when you spray perfume in a room. What happens over time? Does the smell travel?

Demonstrated enquiry (level 0): teacher-as-model. You show how to carry out an enquiry process which students then copy, explaining your hypothesis and tests by 'talking aloud'. Students record your thinking on their hypothesiser lifeline sheet.

Structured enquiry (level 1): 'we do it'. Students then use their hypothesiser lifeline sheet to record alternative ideas about why the iodine solution was able to travel through the zip-lock bag and to note down their tests and conclusions about other possible explanations.

Solving the mystery: students are led to the explanation by using ideas about the structure of the membrane.

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STUDENT WORKSHEET

You have just seen two plastic zip-lock bags with a starch solution placed in beakers. When we placed the starch solution in the beaker, a colour change occurred in one beaker. Why did this happen? How did the iodine pass through the bag if the starch and water could not? Discuss in your group how the iodine was able to pass through the bag and list your ideas. Finally, test each possibility and deduce what happened.

Engage

WHAT'S INTERESTING?

Task: Observe the demonstration and note any observations you may have.

Explore

WHAT'S HAPPENING?

Task: Why does one beaker change colour while the other doesn't?

What do we know about starch and a blue-black colour?

Why did the iodine move into the bag and why didn't the starch move out?

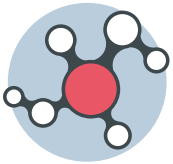
How did the iodine pass through the bag if the starch and water did not?

What would happen if we used different types of bags/membranes?

Explain

WHAT'S CAUSING IT?

Task: The bag does not allow water or starch molecules to pass through. However, the iodine molecules are small enough to pass through the tiny pores in the bag. Other membranes would allow bigger molecules to pass through. Let's explore the different types of membranes you can use.



Extend

WHAT'S SIMILAR?

Task: An experiment to 'investigate the direction of water molecules' movement across different types of membrane between two solutions of different concentrations'.

Having discussed the design of the experiment with the teacher, conduct the experiment and record your observations

What is meant by a high- and low-concentration solution?

Evaluate

WHAT'S MY UNDERSTANDING?

Task: Describe, in your own words or by using a diagram, how osmosis works. Where can we see the effects of osmosis in the real world? What happens to your fingers and toes when you have a bath? How could this 'pruning' be an example of osmosis? How do plants get water and nutrients from the soil?