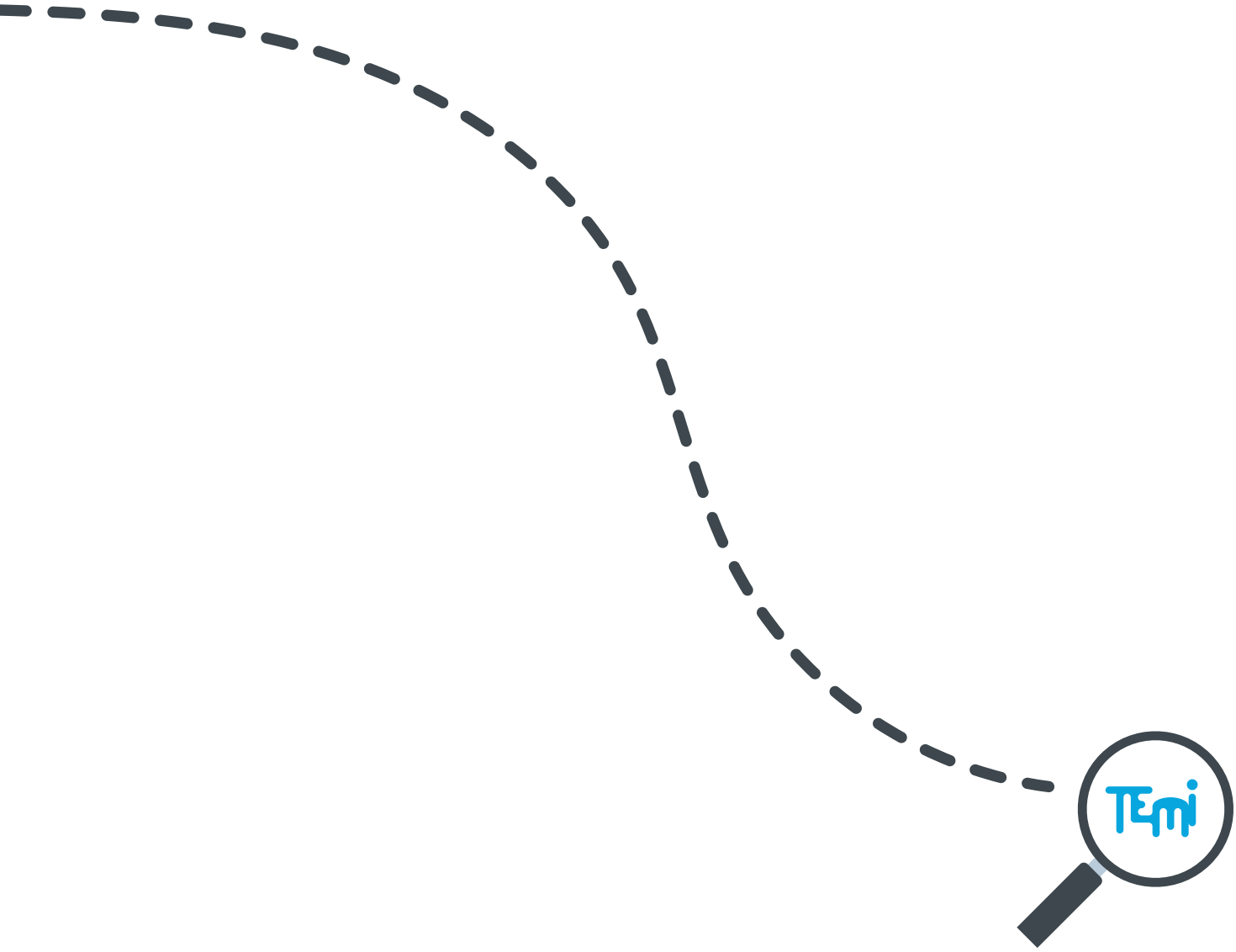
The mystery of Gibraltar

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 mystery of Gibraltar

What's the mystery?

Sailors who were passing through the strait of Gibraltar observed a strange fact. They found that water was pouring into the Mediterranean, a land-locked sea which also has many rivers flowing into it; however, the sea level is not going up all the time. How could this be?

DOMAIN(S)

Chemistry.

SUBDOMAIN KEYWORDS

Solutions and their properties.

AGE GROUP

12 to **16** years old.

EXPECTED TIME FOR THE MYSTERY

Approximate time for teacher preparation:
40 min.

Approximate time in classroom:
two 45 min. lessons.

SAFETY/SUPERVISION

No restrictions needed.

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

- A story about the observations of the sailors
- Salt
- Food colouring.

LEARNING OBJECTIVES

Students learn about the solutions of a particular substance which can have various concentrations and thus various densities. These properties have an impact on the behaviour of the solutions.

Guidance notes for teachers

Engage

CAPTURE STUDENTS' ATTENTION

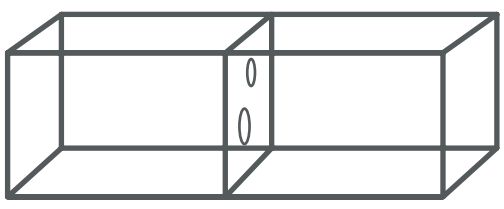
Tell the story about how in ancient times sailors found out that there's a strong current in Gibraltar from the Atlantic to the Mediterranean. They also knew that the Mediterranean is surrounded by land. How can the water flow in and not out?

What factors make water flow (difference in height, temperature, pressure, salinity, etc.)? Do they apply to this case?

Explore

COLLECT DATA FROM EXPERIMENTS

The students can try to explain this mystery with their prior knowledge about salt water and pure water and come to the explanation of difference in salinity due to evaporation in the Mediterranean. The students can prove this hypothesis by demonstrating an experiment with two bodies of differently coloured water: one is pure water (the Atlantic) and the other is a salt solution (the Mediterranean). First, the students can try out pouring these liquids over each other with drinking straws. Second, they can make their own model of the strait of Gibraltar (see below) with a plastic box. Put duct tape over the holes, pour the two solutions into the two halves, and remove the tape: you will see two different layers and currents.



Explain

WHAT'S THE SCIENCE BEHIND THE MYSTERY?

Due to the different densities of the water, the water flows through the holes and forms two layers. There is a current flowing back from the Mediterranean to the Atlantic but it's near the bottom of the sea; thus, the ancient sailors had no way of knowing about it.

Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

This is the way ocean currents work. There are also some other experiments with salt water (the floating egg, the testing of ripeness of fruits, etc.) that can be used to reinforce ideas about the density of different salinities of water.

Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

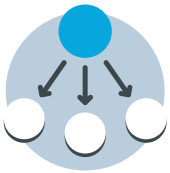
Students are evaluated in a group discussion. The teacher asks questions to see if they have understood the concept correctly and what they learnt from the lesson.

Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

The teacher can first tells the class a story about sailors trying to figure out how does the Strait of Gibraltar work – how come the water seemingly only flows in one direction? Where does it go?

The story should increase curiosity about the subject in students. It is also possible to show a video of ocean currents etc.



GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

Setting up the mystery: tell the class a story about sailors sailing through the strait of Gibraltar.

Demonstrated enquiry (level 0): the teacher shows the class the coloured water model of the strait with the horizontal layers. He or she asks about the explanation and the difference between these two layers apart from the colour. The teacher thinks aloud about the salinity of the sea and that maybe the two layers have different salinity levels. The students record their thinking onto their hypothesiser lifeline worksheet.

Structured enquiry (level 1): students use their hypothesiser lifeline sheet to record their own alternative ideas about why the Mediterranean does not rise infinitely and to where does the water disappears. They also record their tests and conclusions regarding these other explanations.

Solving the mystery: students are led towards the explanation by using ideas about salinity and different densities of differently concentrated solutions of salt and other substances.

Resources

You can see the first experiment here:
TEMI Youtube Channel
www.goo.gl/tUDaq5
playlist > Water density

For an overview of the ocean currents in the Mediterranean:
TEMI Youtube Channel
www.goo.gl/tUDaq5
playlist > Ocean current flow

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STUDENT WORKSHEET

The Gibraltar strait is where the Atlantic Ocean meets the Mediterranean Sea.
But there is something strange going on...

Engage

WHAT'S INTERESTING?

Task: The Mediterranean always seems to be thirsty: there is a strong current flowing into it from the Atlantic through the Gibraltar strait. However, the water has no way out of this sea, since it is surrounded by three continents... or does it?

Explore

WHAT'S HAPPENING?

Task 1: Can water only flow into the Mediterranean and not out? Or is there another way out we don't see?

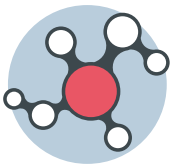
Task 2: How salty is the water in the Mediterranean compared to the Atlantic? Is it important?

Explain

WHAT'S CAUSING IT?

Task 1: The density of water is affected by its salinity. What happens when two different types of water meet?

Task 2: Explain why we'd expect a second current in the Gibraltar strait. Why did the sailors only notice the one flowing into Mediterranean?



Extend

WHAT'S SIMILAR?

Task: The world's oceans have a complicated network of currents. Are they all based on salinity or is there another factor that affects the density of water?

Evaluate

WHAT'S MY UNDERSTANDING?

Task: Why exactly is the Mediterranean saltier than the Atlantic in the first place? What factors account for this?