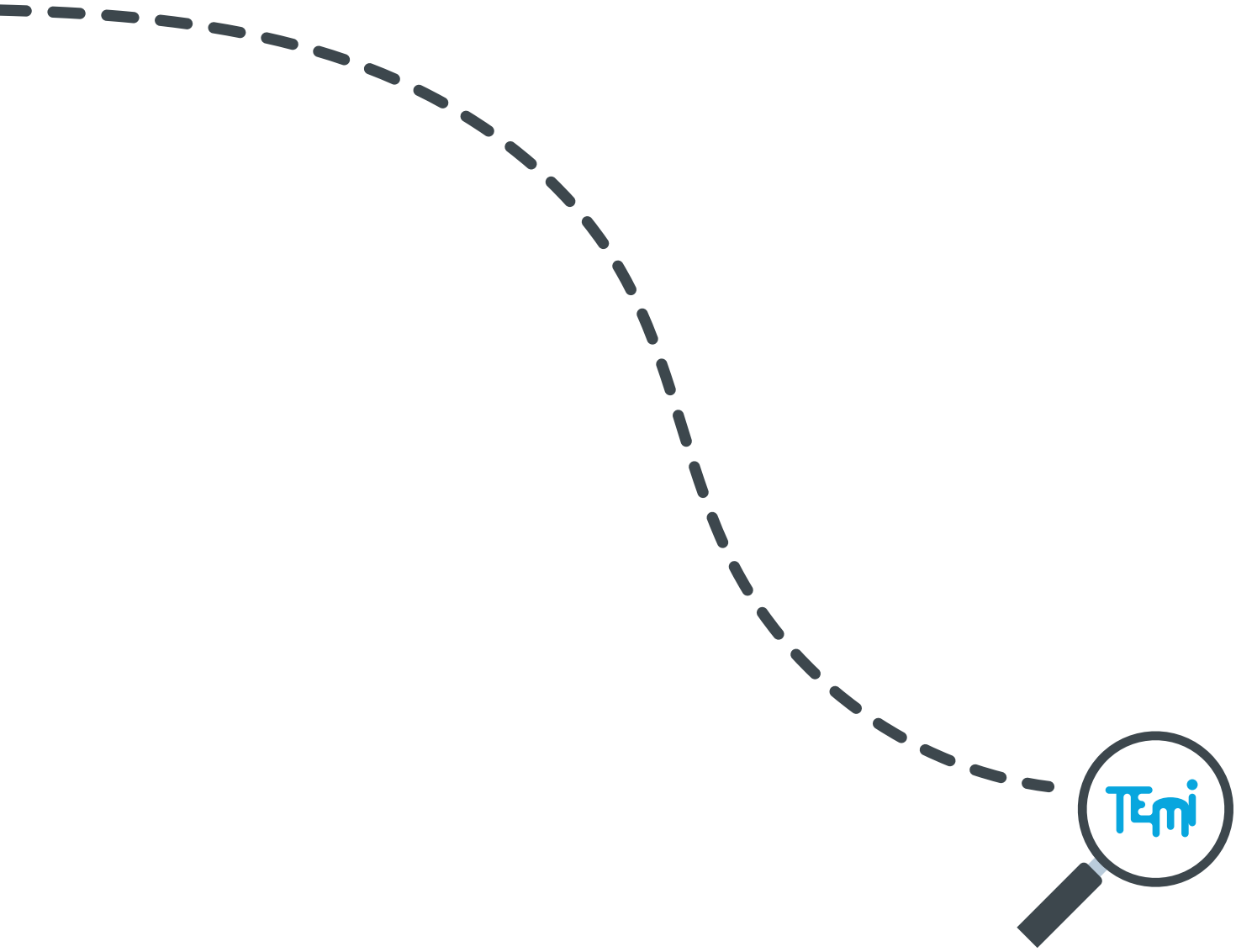
The Book of Science Mysteries

Gelli Baff®

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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Gelli Baff®

What's the mystery?

Sarah and Philip were taking a bath with Gelli Baff, a crystalline powder which is dumped into a bathtub filled with water. The viscous hydrogel was great fun. Now they want to drain the bathtub. How can they force the viscid stuff to go down the plughole?

DOMAIN(S)

Chemistry.

SUBDOMAIN KEYWORDS

Superabsorbents, polymers.

AGE GROUP

On a submicroscopic level: **16** to **18** years old.

On a phenomenological level: **6** years **and older**.

EXPECTED TIME FOR THE MYSTERY

Approximate time for teacher preparation:
20 min.

Approximate time in classroom:
two individual **50 min.** lessons.

SAFETY/SUPERVISION

The superabsorbent can be used by kids. There are no safety restrictions or regulations except that the substance should not be eaten!

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

- Coloured superabsorbent for the bathtub (e.g. Gelli Baff)
- Nappies
- Uncoloured superabsorbent polymer
- Toothpastes
- Hair gels
- Crystal sugar
- Crystal soda
- Vinegar essence
- Lemon juice
- Citric acid
- Salt
- Sea salt
- Powdered sugar
- Plastic bowls
- Measuring glass
- Measuring container
- Porcelain cup
- Matches
- Spoons
- Stirrers, etc.

LEARNING OBJECTIVES

Students will learn about swelling reactions, balanced reactions, and polymerisation.

Students should be able to describe how a superabsorbent works and establish a relationship between superabsorbents and polymers. Students should be able to describe how the gel becomes liquid again. Students should realise the relationship between the absorption ability of the absorber and the salt concentration of the liquid.

Guidance notes for teachers

THE 5E MODEL

Engage

CAPTURE STUDENTS' ATTENTION

Tell the students the story about the two kids bathing in Gelli Baff. Make the story more personal if you like (maybe tell the students about your nephews or neighbours). It is recommended that you have a big beaker or transparent bowl filled with Gelli Baff. Put your hand in to show the students the consistency while you relate details about the viscous substance. It might also be interesting to put the powder into the water in front of the kids and let them see what happens.

Explore

COLLECT DATA FROM EXPERIMENTS

Students can try out the Gelli Baff on their own. For some, it will be a matter of trial and error. Make sure then that the trial is systematically organised (control of variables). The students have several different materials to work with. A material table is appropriate for this phase. You can design it with more or less material on it. The more material, the more complex the explore phase gets.

Perhaps you use an experiment with nappies beforehand to develop some knowledge about superabsorbents. Test the amount of tap water and salt water that can be absorbed by a nappy.

Explain

WHAT'S THE SCIENCE BEHIND THE MYSTERY?

The main ingredient is the sodium salt of polyacrylic acid. This has the chemical formula $[\text{-}CH_2\text{-}CH(CO_2Na)\text{-}]_n$ and has broad application in consumer products. Polyacrylic acid cross linkers can absorb about 1000g of water per gram polymer. Water molecules can group strongly around the ionic endings because the polymer can spread out. Hydrogen bridge links stabilise the structure. Adding sodium chloride balances the charges of the carboxylate group. The electrostatic repulsion decreases and the gel no longer absorbs water. The dispersed molecules enmesh again. Adding acidic substances causes the same effect.

With younger students, stay on the phenomenological level.

Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

Superabsorbent polymers are also used in cosmetics like hair gel or some toothpastes. Students can experiment with these products and compare them with Gelli Baff.

Superabsorbents are also used in fire protection. Students can test whether or not Gelli Baff is flammable.

Students can also compare Gelli Baff with the contents of nappies and find out which of the super absorbers can hold more water. They can find out if there is a difference when using tap water, purified water, or water with 0.9 % sodium chloride (to simulate urine).

Students can figure out how super absorbents can be produced.

Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

The students should now be able to figure out what the second powder (sodium chloride) in the package is and explain how the liquefaction reaction works.

After experimenting, the students can pick the best product (e.g. nappies) and describe why this product holds the largest amount of liquid. Using this knowledge, they can develop product adverts.

Older students can describe how polymerisation reactions run and how super absorbents are produced. Additionally, they can discuss whether Gelli Baff is a harmless and funny toy or a pollutive product.

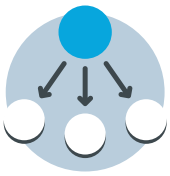
THE 5E MODEL

Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

The teacher can act out the story of Sarah and Philip, maybe together with two students acting the parts in the secret. They come into the 'bathroom' and want to have fun. The bathtub (a large plastic box or beaker) is already filled with water and the teacher adds the Gelli Baff powder.

Now he or she can 'bathe' and let the students feel the gel. When everyone who desires to do so has felt the gel, the teacher can ask a student to drain it. Now the "how" question has to be developed: this starts the exploration.



GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

The mystery is a guided enquiry (level 2) where the students have to choose the method they use to liquefy the Gelli Baff. The enquiry skills they can develop with this mystery are planning and conducting experiments, recording observations systematically, giving priority to evidence, formulating explanations from evidence, and transferring knowledge to extended tasks.

Solving the mystery: by experimenting with different substances to liquefy the Gelli Baff, they discover the salt and acids as solutions to the task. Thus they are led, for example, to the reaction of polyacrylic acid and sodium chloride as well as to the mechanism of swelling reactions.

Resources

Look for the **"Forest fires, polymers, and the chemistry of nappies"** and **"Experimenting with FAVOR®-Superabsorbents"** on the TEMI Slideshare page www.slideshare.net/temiEC/

Gelli Baff®

STUDENT WORKSHEET

The mystery is about a coloured crystalline powder, which is dumped into a bathtub filled with water. The Gelli Baff turns into a viscous hydrogel, which is great fun!

The challenge starts after bathing: how can you get the viscous Gelli Baff to go down the drain?

Come up with a solution to the mystery.
Log your ideas, observations, procedures, and results in your exercise book.

Engage

WHAT'S INTERESTING?

Task: Sarah and Philip took a bath in Gelli Baff. They put the crystalline powder into the bathtub; with the water, it forms a colourful and viscid gel. It was a lot of fun to bathe in, but now it is time to drain the bathtub. How can they force this viscid substance to go through the plughole?

Explore

WHAT'S HAPPENING?

Task 1: Come up with different hypotheses for how you could initiate the liquefaction (i.e. how could you turn the Gelli Baff into a liquid?).

Task 2: Explore how you can make the Gelli Baff liquid. Use the materials provided: crystal sugar, crystal soda, vinegar essence, lemon juice, citric acid, salt, sea salt, and powdered sugar. Test the materials systematically.

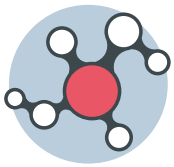
Task 3: Try to find alternatives to Gelli Baff to create a similar bath.

Explain

WHAT'S CAUSING IT?

Task 1: Create an explanation for the balanced reaction that takes place.

Task 2: Explain the reaction of sodium salt of polyacrylic acid, the main component of the Gelli Baff, with the substance that makes it liquid.



Extend

WHAT'S SIMILAR?

Task 1: Super absorbent polymers are also used in cosmetics, such as hair gels or in some toothpastes. You can also explore whether these products behave in the same way as the Gelli Baff.

Task 2: Super absorbent polymers are also used in fire protection. You can test whether Gelli Baff is flammable.

Task 3: You can also compare Gelli Baff with nappies to find out which superabsorbent polymer can hold more water. Be sure to conduct your experiment using saltwater as well.

Task 4: Try to come up with a method of discovering what the mysterious second powder in the original Gelli Baff package is.

Evaluate

WHAT'S MY UNDERSTANDING?

Task: Design a product advert about a super absorbent polymer for nappies, cosmetics, or other products. Give reasons for why your product is the best on the market. Use your knowledge about polymers and balanced reactions.