Science in School
The European journal for science teachers

ISSUE 68 – June 2024 **Topics** Chemistry | General science | Science and society | STEAM

Lab disasters: creative learning through storytelling

Paula Havaste, Jasmina Hlaj

What can go wrong in a chemistry lab? Explore lab safety and consolidate the new knowledge by creating a fun horror story about a lab disaster.

This article was adapted from the Lab Disasters activity on the OTA e-learning platform.

Lab disasters is a storytelling exercise about chemistry and laboratory safety. It can be used in the classroom or online, and it is strongly inquiry-based learning.

The exercise was prepared for chemistry lessons with students aged 10–14, but it has also been found to work with students older than 14. Even adults find this exercise fun and educational. The activity addresses general safety with a focus on safety in the laboratory (lab). The students first consider safety by examining an artwork, then then reflect on lab safety precautions, and finally tell a horror story about a lab visit where everything goes wrong.

The activity outline is based on the three-stage model,[1,2] in which three distinct activity stages – motivational, investigational, and consolidation – are used to promote learning.

The three-stage model

1. Motivational stage

In this stage, a link is established between a topic from the curriculum and real-world examples that are relevant or engaging from students' perspectives, for example, something linked to a phenomenon in nature or from students' everyday lives. Setting the first stage properly is one of the crucial points when planning school lessons. If students are presented with an issue that is interesting to them, they are more likely to actively engage with the content of the lesson.

2. Investigational stage

This stage is a natural follow-up of the first stage, where students take matters in their own hands, with increased motivation to complete the task and find solution(s).
Teachers should establish a focus on the topic, set objectives of the learning unit, and lead the process with an appropriate teaching method(s), for example, resource-based learning, inquiry-based learning, or setting small-group tasks. Students should be presented with all necessary information, so they can follow tasks with as little intervention as possible, and this is also the stage where a space for open questions should be established.

3. Consolidation stage

This stage involves reflecting on the issues through methods such as discussion, argumentative debate, and role play, and deriving relevant decisions by considering the issue. Students are expected to link the scientific topic to the issue that was presented to them in the motivational stage and end the lessons with a meaningful conclusion, whether it is a presentation for the class, a consensus decision, or a report on the experimental results.

Activity 1: Motivational stage

In this activity, students connect chemistry with art through storytelling by examining classical paintings.

This activity should take around 15 minutes.

Materials

- Computer with internet connection for viewing paintings
- Pen and paper
- Classical painting showing a laboratory environment, such as
  The anatomy lesson of Dr Nicolaes Tulp, Rembrandt van Rijn
  An alchemist in his laboratory, David Teniers
  The alchemist, Mattheus van Helmont
  The alchemist's studio, Thomas Gérard
  The alchymist, in search of the philosopher's stone, discovers phosphorus, and prays for the successful conclusion of his operation, as was the costum of the ancient chymical astrologers, Joseph Wright of Derby
  An alchemist, Pieter Bruegel
  Trouble comes to the alchemist, unknown artist

An alchemist in his laboratory. Oil painting by a follower of David Teniers the younger.
Image courtesy of Wellcome Collection, Public Domain

Procedure

1. Introduce the topic by explaining that this is an activity about lab safety, in which students will begin by finding safety risks in a classical painting, then consider modern safety precautions, and finally write a fictional story about a lab disaster caused by the failure to follow safety precautions.
2. Present the chosen painting to the students.
3. Either the teacher provides some context, for example, information about the scene and the date the painting was made, or students are encouraged to research this themselves. It might be relevant for the teacher to mention how science and medicine often used to be done in people's homes or in small private workshops.
4. Ask the students what they think about the environment depicted in the painting for doing scientific experiments. Does it seem safe?
5. The students list any safety concerns they notice in the painting, either alone or in small groups. Are there any current-day lab safety guidelines it seems were not followed when the painting was done?
6. Conclude the activity with a class discussion on the safety risks in the painting.

Activity 2: Investigational stage

Because hazardous substances and compounds are handled in the lab, it is important to take safety precautions. In this activity, students discuss and recap lab safety precautions. Ideally, the activity should be carried out in a school science lab.

This activity should take around 25 minutes.

Materials

- Pen and paper
- Safe science lab (ideally a real one in the school, otherwise you can use pictures)
- Whiteboard/blackboard/digital whiteboard

Procedure

1. Introduce the task: to identify the safety precautions required when doing lab work and explain why they are necessary/what the risks are if they aren't followed. This will be used as the basis for a horror story about lab disasters in the next activity.
2. Ask the students to consider and list the necessary safety precautions for working in the lab. This can be done

individually or in groups and should involve engaging with the lab environment and not just listing rules from memory. The following are suggestions only; teachers can come up with their own tasks:

a. Have students walk around the room and take pictures of or write down five pieces of safety equipment (e.g., safety glasses, lab goggles, fire extinguishers, eyewash) and for each one, they should note what disasters the equipment can help prevent.
b. Ask students to list five safety risks related to unsafe behaviour (e.g., long untied hair, wearing open-toed shoes, running with equipment, eating in the lab) rather than pure chance or faulty equipment.
c. Ask students to look around the lab (or at the photo of a lab) and identify as many safety risks as possible like they did for the painting. What safety precautions can mitigate each risk? This can also be done as a competition; which student or group can identify the most risks?
d. Split students into groups of 2-3 and ask them to write a short list of safety rules for the lab. Gather all the lists and ask the students to vote for the six best.
e. Ask students to list the safety breaches in the Find the Errors image, and what problems they could cause.

3. Bring the class back together for a discussion of what they found. List all the safety precautions (and equipment) identified on the board, and for each one, briefly discuss what could go wrong if they are not followed.

Discussion

Hopefully, the students will have come up with something like the following list (or the safety list used by the school). The teacher can add any important rules that the students have missed. If the lab safety summary is insufficient, more information about lab safety guidelines can be found online.[3]

Find the errors: what lab safety breaches can you spot in this image?
Image courtesy of the author

Lab safety precautions

- Working alone in the lab is not allowed.
- You must be familiar with the safety guidelines and know where the first-aid and safety equipment can be found.
- General lab safety equipment includes a bottle of eye-wash, an emergency shower, and fire extinguishers.
- Wear safety glasses, an appropriate lab coat, and lab gloves in the lab. You must wash your hands upon entering and exiting the lab.
- Eating or drinking in the lab is forbidden.
- Long hair must be tied back and closed shoes should be worn.
- Maintaining good order reduces the risk of accidents.
- You must focus on your work and only use undamaged equipment.
- Always look up the hazards of any chemicals being used.

Safety gloves

Image: Bee Naturalles/Unsplash

Activity 3: Consolidation stage

In this final activity, the students consolidate what they've discussed about lab safety through a fun exercise where they tell a story about a lab disaster.

This activity is expected to take around 40 minutes, depending on the size of the class.

Materials

- Pen and paper or a board for the teacher to write the story on

Procedure

1. Introduce the task, which is to write a fun story about a lab disaster that happens when someone ignores the lab-safety rules.
2. Ideally, the class creates the story together, with each student adding one sentence, which ensures everyone is engaged and makes the story vivid and surprising. However, it is also possible for each student to write their own story or for students to work in groups and then share the stories at the end.
3. Establish the order the students will be called on (seating order is easiest).
4. Set the scene and then call on the first student.
5. Each student in turn contributes one sentence, which the teacher writes down, or alternatively all students should write down the story as it unfolds, so that they all have a copy at the end. The teacher works as a scribe, but decisions about the storyline are strictly out of their hands.
6. At the end, the teacher or one of the students can read out the whole story.

Demonstration of a dust explosion in a lab

Image: deradrian/Flickr, CC BY-SA 2.0

Discussion

This fun exercise, where students invent a disaster scenario, encourages them to really engage with the purpose of safety precautions and what can go wrong if they aren't followed. The stories can be very strange and dark, and usually in the end not only the lab, but the whole world explodes. The teacher should not try to prevent crazy ideas, but let the students be very creative with their story. By the end of this activity, students are expected to understand the importance of precautionary behaviour in the lab. «

Online teaching advancement (OTA) – Science through Art

This activity was developed by OTA – Science through Art, an Erasmus+ project.

The consortium consists of six organizations from four different European countries:

Slovenia: the Education Centre Geoss is the coordinator of the project, with partners Litija Primary School and the National Gallery of Slovenia;
Finland: Heureka Finnish Science Centre;
Cyprus: Innovade research organization;
Italy: CESIE study centre.

Partners of the project prepared materials for primary/secondary school teachers of science subjects in formal education.

More than 100 activities, covering more than 60 subjects from chemistry to mathematics and physics, for students aged 12–14 were developed. The activities embody the STEAM approach: scientific subjects are connected with various arts and art expressions, and the activities are based on experiential learning and are interactive and connected to societal issues or phenomena.

You can view all project results on the OTA e-learning platform: https://elearning.ota-project.eu/

Acknowledgments

This article is inspired by the Erasmus+ project OTA – Science through Art. The content in the article is strongly linked to the project's results, which were developed by the consortium of the project and funded by the European Union.

References

[1] Sormunen K, Keinonen T, Holbrook J (2014) Finnish science teachers' views on the three stage model. *Science Education International* **25**: 43–56.
[2] The OTA Learning Methodology: https://elearning.ota-project.eu/methodology/
[3] General laboratory safety manual: https://uh.edu/ehs/manuals/files/laboratory-safety-manual.pdf

Resources

- Discover simple adaptations of experiments to make chemistry accessible to students with vision impairment: Chataway-Green R, Schnepp Z (2023) Making chemistry accessible for students with vision impairment. *Science in School* **64**.
- Read an article on how to run effective demonstrations in science lessons: Walsh E (2021) The art of science demonstration. *Science in School* **55**.
- Learn how to spot pseudoscientific fake news in the media: Domenici V (2022) Fake news in chemistry and how to deal with it. *Science in School* **59**.
- Read about the colour blue in nature and the chemistry behind it: Bettucci O (2022) Colour in nature: true blue. *Science in School* **60**.
- Explore chemical reactions using tea: Prolongo M, Pinto G (2021) Tea-time chemistry. *Science in School* 52.
- Explore viscoelasticity by making slime: Ospina V, Ospina C (2024) Beyond solids and liquids: the science of slime. *Science in School* **67**.
- Estimate the CO_2 absorbed by a tree in the schoolyard: Schwarz A et al. (2024) How much carbon is locked in that tree? *Science in School* **67**.
- Explore how colours arise through reflection, absorption, and transmission: Félix RC, Paleček D, Correia TM (2024) Colour science with lasers, gummy bears, and rainbows. *Science in School* **66**.
- Take the mystery box challenge to learn about the nature of science: Kranjc AH et al. (2022) The mystery box challenge: explore the nature of science. *Science in School* **59**.

AUTHOR BIOGRAPHY

Dr Paula Havaste is theme leader and science communication specialist at Heureka, the Finnish Science Centre. She is also a writer with non-fiction books about science history, text books for schools, and historical novels. She strongly believes in the creativity of young people.

Jasmina Hlaj is an expert associate at the Education Centre Geoss in Litija Slovenia – the coordinator of the project and leader of the output for OTA Methodology development.