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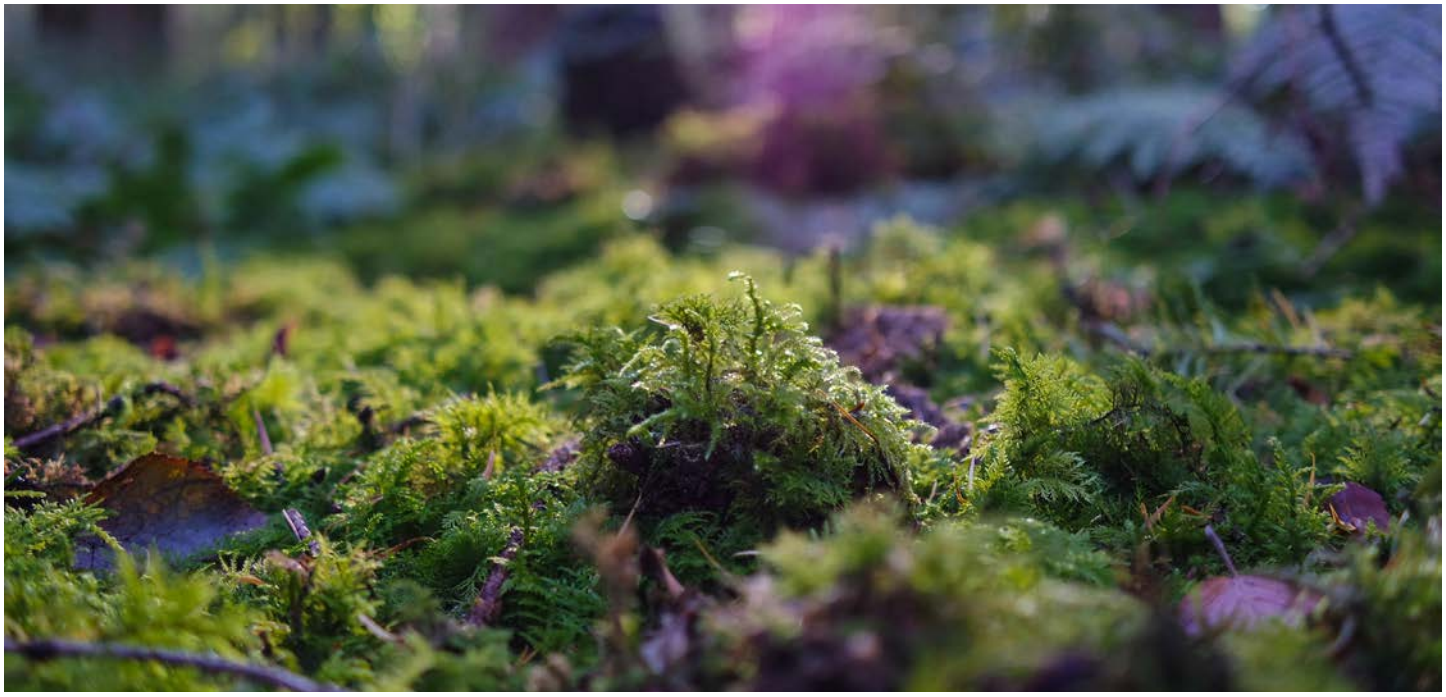

Michaela/Unsplash

Moss Safari: what lives in moss?

Andrew Chandler-Grevatt

Fantastic beasts: Take a microscopic moss safari and learn about the diverse and resilient organisms that live in this challenging habitat.

Squeezing water from moss and observing a few drops under a light microscope will reveal the amazing diversity of organisms living within it. From multicellular organisms, such as rotifers, tardigrades, nematodes, mites, and gastrotrichs, to an array of unicellular organisms, including paramecium, euglena, naked amoeba, diatoms, and testate amoeba. Seeing this for the first time can be awe-inspiring but overwhelming. The Moss Safari activity can help teachers and students make sense of this wonderful microworld.

I developed Moss Safari to introduce the habitat of moss and the organisms that live in it to students. Although I have used this activity with all age ranges, this article focuses on 11–16 year olds. The method of concentrating the organisms in a small sample of water is based upon Hingley's method[1] and was adapted in my research article.[2]

This activity generates awe and wonder and can inspire students to take on further study by realizing science is an

ongoing activity. The direct curriculum links include habitat (microhabitats and extreme habitats), adaptation (including extremophiles), classification, food chains and webs, and characteristics of life. There are a number of other curriculum opportunities that can be emphasized, including using a light microscope, observing and recording from a microscope, the history of the microscope, and the nature of scientific research. Furthermore, moss can be used as a model microecosystem to generate discussion about sustainability in local and global ecosystems (for example, there are often microplastics found in moss). Finally, to add a competitive element, students could go on a microscopic treasure hunt in their school grounds or local community to find tardigrades.

Moss Safari: hunting the moss 'Big Five'

This activity can be done in an hour, but a longer session is beneficial.

Moss Safari can be introduced using the desired curriculum focus. In this example, the focus will be on adaptations and survival in extreme environments.

Using the Moss Safari slides, moss can be introduced as an extreme environment and the Big Five multicellular organisms can be described. Students can be given the Big Five identification sheet. If you have a camera to attach to a microscope, you can demonstrate the procedure (steps 3–16). The teacher infosheet can be used as a source of interesting facts to share with students or research in more detail.
Students should be given at least 30 minutes to do their own safari and use the observation worksheet to record what they observe, including structure, behaviour, and adaptations. The adaptations worksheet can then be used to think about the ecological adaptations in more detail.

Safety notes

Take the usual precautions when using freshwater and biological materials.
Cover cuts or wear gloves, and wash hands thoroughly after the session.

Glass microscope slides and coverslips are fragile and have sharp edges if broken. To avoid cuts, sweep broken glass up using a dustpan and brush and dispose of safely.

Sourcing and collecting moss

Moss grows in most climates, but there are particular times when it can be more visible, such as months with more rainfall. Moss can usually be collected from the local area; in temperate regions, moss cushions often can be found fallen from building roofs. In drier regions, look for moss growing in shady places, such as the base of walls, between paving slabs, on the bark of trees, and within grass.

Bob Blaylock/Wikimedia, Wikimedia, CC BY-SA 4.0

Only a small sample is needed, about the size of a thumbnail (1 cm^3). Students can be sent into the school grounds to collect their own sample, asked to bring a sample from home, or the teacher can bring in moss from their own source to save time.

In drier climates, if moss is not easily found, look for lichen on stone walls, rocks, or tree trunks. However, check that the lichen you are using is not a protected species. Scrape a small sample into a bag to bring to the lab. Also consider looking at indoor houseplants or greenhouses, where moss can be found growing in some damper plant pots. Students should be encouraged to photograph the moss in situ before it is collected, noting the physical features of the habitat.

Preparing a moss sample for observation

A moss sample, unless already sodden from rain or standing water, should be soaked for at least an hour, ideally 24 hours, in rainwater, distilled water, or mineral water. Note that chlorinated tap water can harm the organisms.

Using the moss squeeze concentrating procedure described below (steps 7–10) can maximize the number of organisms in the sample. Technicians can prepare a bulk moss squeeze of 50 cm^3 or more for a whole class to use as a sample.

Materials (per pair of students)

- Moss Safari slides, teacher infosheet
- The student Big Five identification sheet, observation worksheet, and adaptations worksheet
- Small sample of moss (1 cm^2)
- Small Petri dish or similar container
- Mineral water or distilled water
- Blunt mounted needle or forceps
- Pasteur pipette
- Filter paper (small)
- Filter funnel (small)
- Conical flask or similar (up to 100 cm^3)
- Glass microscope slides with concave well
- Glass microscope coverslips
- Light compound binocular microscope with 40× and 100× magnification.
- Tissue to soak up spills

Image courtesy of Andrew Chandler-Grevatt

Procedure

Preparing the moss sample

1. Take the sample of moss (about 1 cm^3) and place it in a small Petri dish (or similar).
2. Cover the sample with distilled water or mineral water, and leave it to soak for 24 hours. Try not to have too much soil or debris attached to the moss; remove this before soaking. Damp or wet moss can be soaked for a shorter time or can be used immediately.

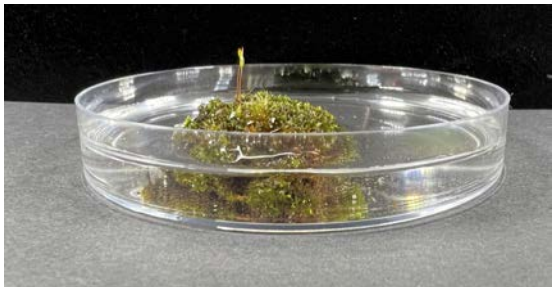

Image courtesy of Andrew Chandler-Grevatt

The simple moss squeeze

3. Take the soaked moss sample and, using a blunt mounted needle (or similar), agitate the moss surface. This will dislodge organisms living within the moss.
4. Using your fingers, squeeze the moss from the base (rhizoid end) to the tips of the stems. Collect the moss squeeze sample in a small dish.
5. Collect the moss squeeze using a Pasteur pipette.
6. To observe the moss squeeze sample immediately, go to step 11. To concentrate the sample, go to step 7.

Concentrating the moss squeeze

7. To observe more organisms on a single microscope slide, the moss squeeze can be concentrated by filtering it to remove some of the excess water.
8. Take a filter paper and place it into a small funnel. Place the funnel in a small beaker or conical flask.
9. Have a plastic Pasteur pipette ready. Pour the moss squeeze sample into the filter paper.
10. Wait until the sample has about 1 cm3 of moss squeeze remaining at the bottom of the filter paper, suck up this residue with the Pasteur pipette. Ensure you are collecting the sample from the filter paper, not the filtrate in the collecting flask.

Image courtesy of Andrew Chandler-Grevatt

Preparing the microscope slide

11. Take one glass concave microscope slide.
    Put 2–4 drops of moss squeeze from the Pasteur pipette into the concave well.
12. Cover the sample with a glass coverslip.
13. Use a tissue to soak up any excess liquid around the coverslip.

Start the safari!

14. To observe the organisms on the slide, it is useful to take a zigzag journey over the coverslip. Using 40× magnification, focus on any items in the top left-hand corner of the coverslip.

15. Search the slide by moving from left to right, if the microscope has a mechanical stage, the slide can be moved using the adjusting wheels. If not, this can be done manually, using a finger on each side of the microscope slide.
16. Stop and focus on any organisms of interest. If the organism is relatively still, it can be studied in more detail at 100×.

A nematode (left) and a tardigrade (right)
Image courtesy of Andrew Chandler-Grevatt

Discussion

Students should be encouraged to ask questions and observe carefully, drawing on prior knowledge of organisms, cells, body systems, and adaptations, or on further research. The following questions can be used to encourage discussion.

Muscinae from Ernst Haeckel's Kunstformen der Natur, 1904

Discoveries made on the safari

- What do you see? How would you describe it?
- Is it a single cell or multicellular organism? How do you know?
- What is it doing? Moving (how)? Feeding (how)?
- Can you identify any specific organs or systems? Mouth, legs, digestive system, reproductive systems (eggs inside rotifers, tardigrades, or gastrotrichs).
- How could you find out what it is if you don't know?

Adaptations

- Moss is a habitat that can experience extreme temperatures and cycles between being very wet and very dry. How do organisms survive this?
- What features does the organism have? How might these help it to survive in moss?
- What behaviour is the organism displaying? How might that help it to survive in moss?

Moss as a habitat

- How does moss compare to vascular plants?
- What shapes do mosses grow in? Why?
- How are mosses adapted to maximizing water uptake?
- How are mosses adapted to living without water in droughts?

References

[1] Hingley M (1993) Naturalists' Handbook 20: Microscopic Life in Sphagnum. Pelagic Publishing, Slough.
[2] Chandler-Grevatt A (2021) Moss Safari: inspiring interest in nature under the microscope. *School Science Review* **102** 49–55.

Resources

- Find free downloadable resources about moss, moss organisms, and education on the Moss Safari website and blog.
- This little book is useful for identifying organisms: Hingley M (1993) N*aturalists' Handbook 20: Microscopic Life in Sphagnum.* Pelagic Publishing, Slough.
- Find detailed information and stunning videos of microscopic organisms on the Journey to the Microcosmos YouTube channel.
- Discover where to find and how to identify mosses on the British Bryological Society website.

- Find information, tips, and ideas for amateur microscopists on the Microscopy-uk website.
- Explore the way structure relates to function with this photomicroscopy project: Varga JP (2023) It's a small world: using microscopy to link science, technology, and art. *Science in School* **61**.
- Check out the fascinating physiology of squid in this hands-on activity: Marra MV et al. (2023) Squid dissection: a hands-on activity to learn about cephalopod anatomy. *Science in School* **62**.
- Learn about toxicology and the physiological effects of drugs by using Daphnia as a model organism: Faria HM, Fonseca AP (2022) From drugs to climate change: hands-on experiments with Daphnia as a model organism. *Science in School* **59**.

AUTHOR BIOGRAPHY

Dr Andrew Chandler-Grevatt is a senior lecturer in science education at the University of Brighton, UK, and is an author and editor for Oxford University Press science textbooks. Andrew's hobby involves using his microscope to observe and learn about the organisms that live in moss and he is passionate about sharing this microworld with others.