

Week 4 Lesson 3

Tardigrades and other vaccines

Aim: to understand how science can learn from extremophiles and apply this knowledge to help solve a problem and reduce costs.

Key words: denatured, extremophiles, magnification, protein, vaccine, vaccination,

Starter activities

1. The problems with vaccines

Ask students to read the text on the resource 'The problems with vaccines'. They should also use their research homework about tardigrades.

There is a summary about tardigrades on the worksheet if the homework task is not available.

2. Tardigrades and vaccine storage

Show the promotional video below, which describes the problems of traditional freezing methods for sample storage and explains how tardigrades' ability to survive extreme conditions helped scientists to develop a new storage method. Explain that even when all the scientific research has been done and a useful product has been developed, companies still have to make people aware of their product and its potential in order to sell it, recoup their costs and make a profit, hence the tone of the video.

www.youtube.com/watch?v=yJTcHgEZaKg

The clip is approximately 4:30 min long.

Main activities

1. Tardigrades under the microscope

This could be done as a demonstration with the view of the microscope projected on the whiteboard or as a class practical. Prior to the lesson you need to collect clumps of moss.

Tardigrades are widely distributed throughout the UK, although their distribution may be localised. They live in clumps of moss and damp lichen. Moss from roofs and guttering is suitable as well as moss growing on damp tree trunks. Lichen and moss scraped from the grooves in tree trunks is also a possible source.

4.3: Tardigrades and other unusual organisms

Method

Prior to the lesson, collect clumps of moss (they can be dry although damp is better). Soak thoroughly with rain water or distilled water in a shallow dish and leave to stand in 1cm depth of water for several hours or overnight. Tip the standing water away.

Ask students to squeeze water out of the moss clump and collect in a petri dish.

View under a binocular microscope or a compound microscope on low magnification.

If you find a water bear use a pipette to transfer it to a microscope slide.

Support the cover slip with small mounds of Vaseline so the water bear is not crushed.

These microscopic invertebrates move slowly and should be easy to study under the medium power of a microscope.

Ask students to draw a clear outline of what they can see, referring to the diagrams on page 4.

Brine shrimps are another animal which can survive extreme conditions when in cyst form. As an alternative to collecting tardigrades, live brine shrimps and brine shrimp cysts with hatching instructions can be purchased on the internet. There are diagrams of brine shrimps to refer to on page 5.

2. Research vaccine transport and storage

Students carry out further research into the problems associated with the transport and storage of vaccines and into the process developed by companies such as Biomatrix, with a view to presenting a 'Dragon's Den' style pitch of a product which preserves vaccines.

The Biomatrix clip provides a good example of the information to include in a pitch.

www.youtube.com/watch?v=yJTcHgEzAKg

The site below includes information about how tardigrade species protect cell proteins when in extreme conditions.

conservationmagazine.org/2012/12/water-bear-inspires-refrigeration-free-storage/

Plenary activity

1. 20 words

Ask students to describe what they have learnt during the lesson in a limited number of words e.g. 20 words.

Starter 1

The problems with vaccines

Read the following text.

Widespread vaccination of children around the world has reduced the cases of measles by 99%. Sadly, one in five children do not receive vaccinations, particularly in developing countries.

To remain effective vaccines must be stored correctly. They must be kept cool, but not frozen. They must also not become too hot.

Incorrect storage temperatures cause vital proteins in the vaccine to become denatured and the vaccination will not work.

151 million vaccines (\$570 million) are lost each year due to improper refrigeration in developing countries.

Remind yourself about your homework in which you researched Tardigrades, brine shrimps and the resurrection fern or read the following text.

Tardigrades or water bears, are microscopic creatures 0.05 - 1.5 mm long. They are found in the UK, at the Poles, in the Tropics and in hot springs and they are one of the most resilient organisms known.

Tardigrades can survive extreme conditions such as:

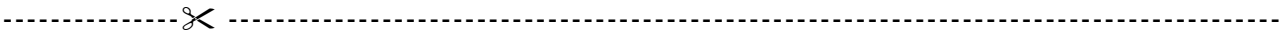
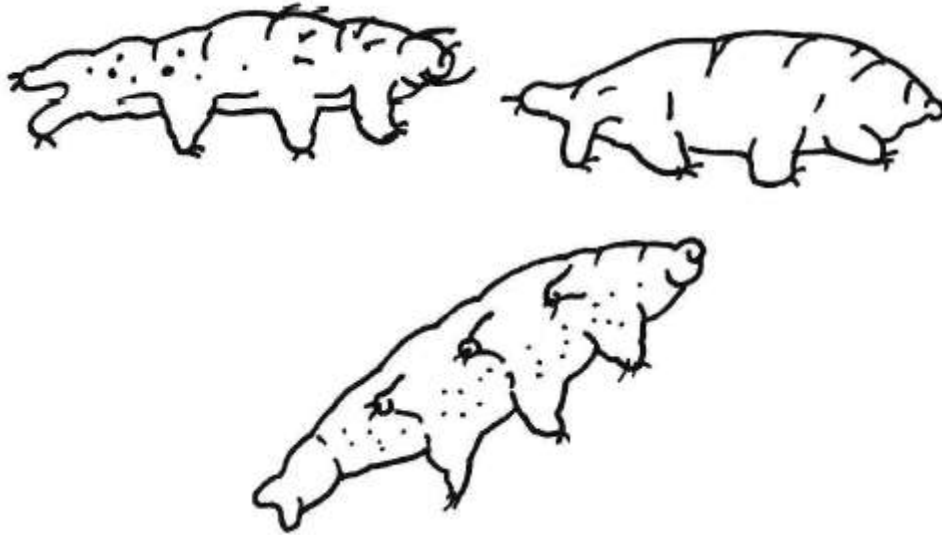
- *a lack of oxygen*
- *freezing*
- *lack of water (for 100 years!)*
- *low pressure*
- *high pressure*
- *boiling in alcohol*

In the UK, they live in damp, mossy areas and feed on moss and microscopic worms.

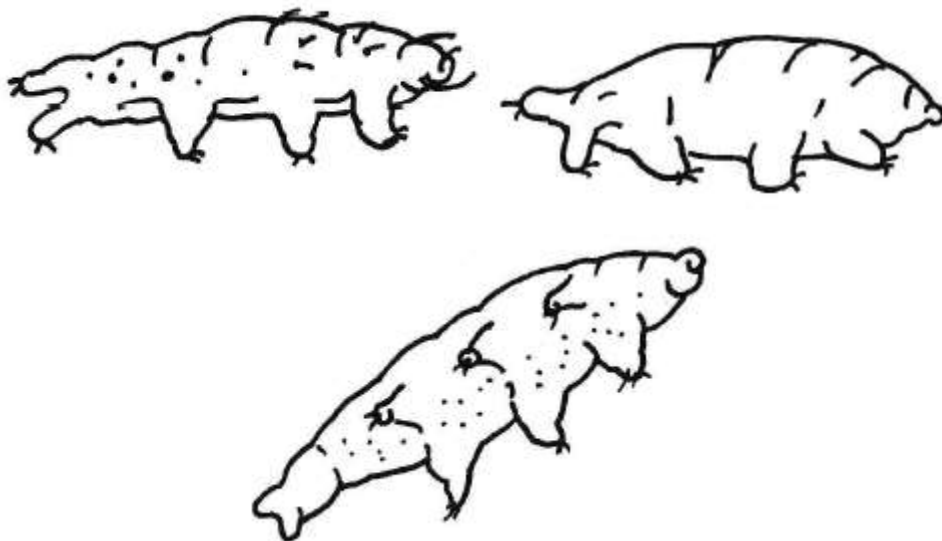
Can we look to nature to help solve the problem of transporting and storing vaccines safely?

Main 1

Tardigrades under the microscope



Tardigrades under the microscope



Brine shrimps under the microscope



Brine shrimps under the microscope

