TEACHER'S GUIDE

Tardigrades in Antarctica and in your School

Aims: These teaching materials are intended to show how tardigrades can be isolated and examined easily in the school laboratory. (They provide an engaging and interesting variation on the usual predictable use of school microscopes, such as cheek cell and onion epidermal examinations).

They will explain the features that make tardigrades so unusual and capable of surviving in the extreme Antarctic environment.

They will provide activities, links and information for further study.

Worksheet 1 – Protocols for isolating and examining Tardigrades in the laboratory
NOTES:

- There are two methods given. The second is likely to be more effective for finding nematodes in the sample. Comparing the two methods is also possible and could yield interesting discussion on the significance of the method used.
- Give yourself 24 hrs to set up the samples in advance whenever possible.
- Many old walls, roofs, trees, damp lawns etc. can provide suitable samples and ideally children should be encouraged to bring their own samples from a variety of sites.

Worksheet 2 – What is a Tardigrade?

Worksheet 3 – Unusual properties of tardigrades and why we look for them in Antarctica.

Worksheet 4 – New Discoveries in Antarctica

Worksheet 5 – Is this the Simplest Ecosystem on the Planet?

Worksheet 6 – Further reading and links on Tardigrades and Antarctica.

ISOLATING TARDIGRADES IN THE LABORATORY - *Method 1*

Apparatus:

A small handful of moss (gathered from a wall, roof or other suitable site), beaker (e.g. 250 ml or smaller), deionised/distilled water, dissecting microscope and/or hand lens, Petri dish, standard lab microscope (with X4 and X10 objectives), fine glass pipette, glass slides and cover slips (slides with a drop well are ideal but not absolutely essential).

Method:

1. Soak a handful of moss overnight in just enough deionised water to cover the sample. Pour away excess water.
2. Squeeze the wet moss sample firmly into an old Petri dish or other suitable container.
3. In good light, use a dissecting microscope or hand lens to carefully examine the water. (A white tile placed under the sample can sometimes be helpful, as can the use of a desk lamp).
4. Tardigrades (also called "moss piglets" or "water bears") are very easy to identify as they have four pairs of small clawed feet and are likely to be moving around actively.
5. Small Petri-dishes can be placed directly under the microscope. Alternatively, for a closer look, remove any interesting object in a drop of water using the pipette. Place it on a glass slide and lower a cover slip over it.
6. Examine at X40 (i.e. with the X4 objective).
7. For a closer look use the X10 objective (but be aware that an active tardigrade is likely to disappear rapidly from view at this magnification).
8. Try drawing what you see with a sharp pencil. Tardigrades can usually be identified by the structure of their mouthparts, the hard exoskeleton and the position and claws of their eight legs.
9. Use a key or the identification sheet to try to identify any creatures that you find. (Other creatures that you might find include Rotifers, Nematodes and Mites).

Record your findings:

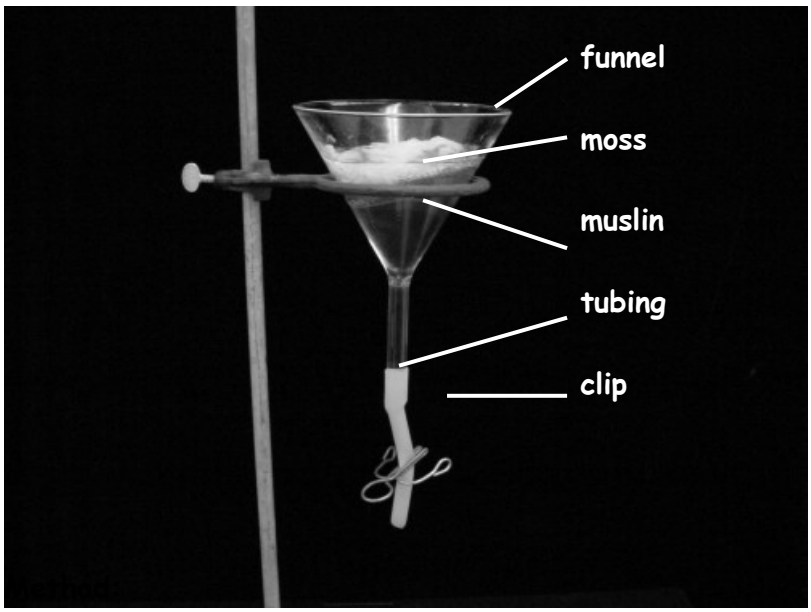
- Record each individual different organism you find.
- Record how many of each type you find.
- Identify each type as far as you are able.

- Compare what you have found with other members of the class.

ISOLATING TARDIGRADES IN THE LABORATORY - *Method 2*

Apparatus:

Baermann funnel. (See picture)
A small handful of moss (gathered from a wall, roof or other suitable site), deionised/distilled water, dissecting microscope and/or hand lens, Petri dish, standard lab microscope (with X4 and X10 objectives), fine glass pipette, glass slides and cover slips (slides with a drop well are ideal but not absolutely essential).



1. Set up the wet funnel as shown. Leave overnight. The organisms in the sample should make their way down into the tubing.
2. Open the clip to run the water into the Petri dish (or other suitable container).
3. In good light, use a dissecting microscope or hand lens to carefully examine the water. (A white tile placed under the sample can sometimes be helpful, as can the use of a desk lamp).
4. Tardigrades (also called "moss piglets" or "water bears") are very easy to identify as they have four pairs of small clawed feet and are likely to be moving around actively.

5. Small Petri-dishes can be placed directly under the microscope. Alternatively, for a closer look, remove any interesting object in a drop of water using the pipette. Place it on a glass slide and lower a cover slip over it.
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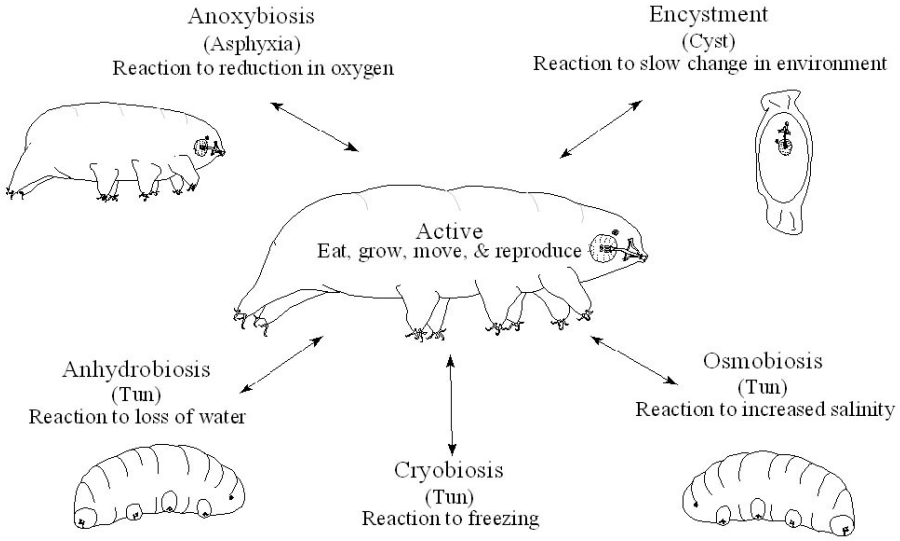
INDESTRUCTIBLE TARDIGRADES?



When environmental conditions become harsh, tardigrades are able to shut down most physiological processes by extreme dehydration. They form a dried out structure called a "tun" and enter into a state called

"cryptobiosis". In this form tardigrades have been shown to possess the following extraordinary abilities:

- Anoxybiosis – The ability to survive without oxygen for many days.
- Low temperature – They have survived at minus 200°C for over 20 months.
- Dehydration – They can lose more than 95% of their water content and still rehydrate successfully. Tardigrades have been identified as surviving in this state for more than 100 years
- High temperature – They have survived temperatures above 120°C (well above that of boiling water!)
- High pressure – 1000 atmospheres pressure does not kill them.
- Radiation – They have survived apparently undamaged after exposure to ionising radiation 1000 times greater than that which would kill a human (and extreme levels of ultraviolet or X-rays).
- Vacuum – They can endure a vacuum so extreme that they would seem to be able to survive long periods in space.
- Environmental poisons – such as hydrogen sulphide, normally extremely toxic to living organisms, cause no damage.

This excellent site on the internet will tell you all about how to collect, identify and study tardigrades:

http://pathfinderscience.net/tardigrades/index.cfm

This site has lots of interesting and useful information too (including a rather sweet video!):

http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artmay99/dwbear.html

YOUR TASK:

What are the extreme physical conditions that a tardigrade might have to endure in Antarctica? Discuss this with your laboratory partner. List these down the side of a page in your notes. (Leave two or three lines between each one)

For each of the conditions that you list, find the property above that would be useful to a tardigrade in Antarctica in surviving the particular problems that you have found. Write the "solution" to the problem alongside the environmental challenge you have identified.