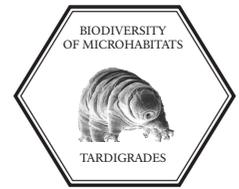


PRE-SITE ACTIVITY

TARDIGRADE INFORMATION



Grade Level: High School

Subject Area: Science

Activity time: 30 minutes

Setting: Classroom

Skills: Analyzing, Categorizing, Collecting information, Communicating, Connecting,

Vocabulary:

• **Bilateral symmetry:** symmetrical arrangement, as of an organism or a body part, along a central axis, so that the body is divided into equivalent halves.

• **Cryptobiosis:** the metabolic state some organisms enter in response to adverse environmental conditions such as freezing, drying, or oxygen deficiency. In this state, all metabolic processes stop, preventing reproduction, development, and repair until environmental conditions return to being hospitable. When this occurs, the organism will return to its metabolic state of life as it was prior to cryptobiosis.

• **Eutardigrada:** a class of Tardigrada without lateral appendices. These species are primarily found in lichens, mosses, and leaf litter, but many species are found in freshwater habitats such as lakes, rivers, and streams.

• **Extremophile:** an organism that thrives in and even may require physically or geochemically extreme conditions that are detrimental to the majority of life on Earth.

• **Heterotardigrada:** a class of tardigrades comprised of two orders: the armored terrestrial tardigrades and the marine tardigrades. Heterotardigrades have a lateral appendage between the head and the shoulder plate.

• **Meiofauna:** animals inhabiting the bottom of a river, lake, or sea that are nearly invisible to the naked eye with dimensions in the range 0.1 to 1 mm.

• **Micrometazoa:** extremely small multicellular animals.

• **Parthenogenesis:** form of reproduction in which an unfertilized egg develops into a new individual; no males are present in the population.

• **Polyextremophiles:** an organism which has several extremophilic features.

• **Tun:** cryptobiotic state of the tardigrade in which the appendages are drawn inward and metabolism stops.

Materials:

- Vocabulary (listed at left)
- ATBI and Tardigrades worksheet (page 2)
- Tardigrade information worksheet (page 3)
- Computer with internet connection

Objectives:

- 1) understand the biodiversity of the Great Smoky Mountains National Park
- 2) learn several characteristics of tardigrades
- 3) learn the vocabulary related to the tardigrade study

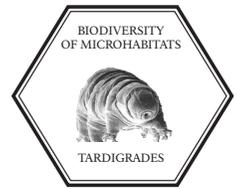
Procedure:

When students visit the Smokies on their field trip they will be collecting, isolating, and viewing tardigrades. This lesson will introduce tardigrades and their characteristics. Read aloud to the students the following information regarding the ATBI and Tardigrades (listed to the right). Students should read individually the vocabulary and definitions worksheet and tardigrade information worksheet. After the students have finished their reading, discuss the characteristics of tardigrades and what adaptations they have in order to live in extreme environments.

To view the Biodiversity podcast video go to

<http://www.thegreatsmoky-mountains.org/eft/10modules.html> Turn the microscope knob that appears on the computer screen to Section 1, Understanding Biodiversity. Click "Watch Video" and view video.





ATBI AND TARDIGRADES

The All Taxa Biodiversity Inventory (ATBI) is a project of Discover Life in America (DLIA) that seeks to inventory the estimated 100,000 species of living organisms in Great Smoky Mountains National Park. The project has developed checklists, reports, maps, databases, and natural history profiles that describe the biology of this rich landscape to a wide audience. The species level of biological diversity is central to the ATBI, but the project is developed within an ecological and conservation context and encourages understanding at other levels of organization, including genetic variation within species and ecosystem descriptions. As of December 2009, discoveries include 907 species new to science and 6,582 species new to the Park.

The Great Smoky Mountains National Park is a 2,200 square kilometer (800 square mile) reserve that straddles the mountainous divide between the states of Tennessee and North Carolina. The park contains some of the highest peaks in eastern North America, and has very complex geology. The park is known for its temperate forest richness and extensive old-growth forests; however, the park is challenged with a number of threats to its ecological integrity. These threats include invasive, exotic organisms in both terrestrial and aquatic systems; very high depositions of nitrogen and sulfur, as well as high ozone levels; and increasing insularity as a result of human development and fragmentation of adjacent natural areas.

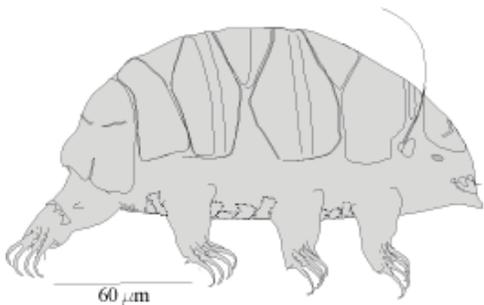
Prior to the ATBI project there were only 3 species of Tardigrades known in the park. Since the ATBI began there have been 55 species of tardigrades found new to the park and 18 new to science for a total of 76 known to be in the park as of December 2009.

TARDIGRADE INFORMATION

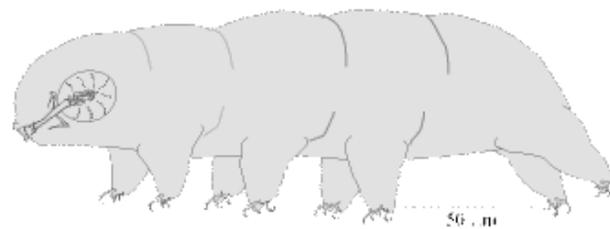
Tardigrades (“water bears”) are members of the phylum Tardigrada. They are microscopic segmented animals with eight legs. These tardigrades were first described by Johann August Ephraim Goeze in 1773 (Kleiner Wasserbär = little water bear). The name Tardigrada means “slow walker” and was given by Lazzaro Spallanzani in 1777. The name water bear comes from the way they walk, similar to a bear’s gait. The largest adults may reach a body length of 1.5 mm, the smallest below 0.1 mm. Freshly hatched juveniles may be smaller than 0.05 mm.

More than 1000 species of tardigrades have been described. Tardigrades occur over the entire world, from the high Himalayas (above 6,000 m) to the deep sea (below 4,000 m) and from the polar regions to the equator. They are polyextremophiles and are able to survive in extreme environments from temperatures of -273°C (close to absolute zero) to temperatures as high as 151°C (303°F). They can survive 1,000 times more radiation than other animals, including humans, a year without water, and even the vacuum of space.

The most common place to find tardigrades are in the sediment between lichen or moss and its substrate (tree, rock, etc.). Tardigrades are most common in moist environments, but can also be found in dry habitats that are periodically wet. The animals must have a film of water around the body in order to be active. Tardigrades are one of the few groups of species that are capable of reversibly suspending their metabolism and going into a state of cryptobiosis in response to drying, freezing, or low oxygen.



Heterotardigrada



Eutardigrada

Water bear, oh water bear,
 On the stones and on the stair,
 I’m sorry I did not see you there.
 Oh water bear, water bear,
 Survival skills are beyond compare
 Our tiny friends are everywhere.
 --Frank Glubbah