

# The Bears that Live in Your Own Backyard

*Picture in your mind the toughest animal on Earth. What animal are you thinking of? What environmental challenges does this animal confront? Extreme weather? Predators? Shortage of food?*

## Tough Critters

All animals must find ways to satisfy the basic needs of all living things, such as finding food and water, staying warm, or locating a mate. Think about the adaptations that help animals meet the most difficult challenges of life. What characteristics help animals to survive in very hot or cold environments? What features or abilities help them avoid being eaten by predators? How can animals find and attract mates?

Some very tiny organisms are called *extremophiles* (from **extreme** + **phile**: “having a preference for”). Extremophiles have the ability to live happily in severely inhospitable environments in which most other organisms could not survive.

Most extremophiles are microscopic- often single-celled organisms, such as bacteria. However, one of the largest, most complex and *toughest* extremophiles is a small invertebrate animal called the **tardigrade**. The tardigrade, which grows to around one millimeter in length- about the size of this hyphen- can survive conditions that would kill almost any other organism on Earth. In fact, the tardigrade is the first animal ever to survive being *off* the Earth (without protection) in the vacuum of outer space!

## The Slow-Walker

The tardigrade looks like a short, chubby caterpillar with four pairs of stumpy legs, and claws on its feet. The tardigrade was first discovered in 1773 by a German amateur scientist named Johann Goeze. When Goeze observed this minuscule animal under a microscope he called it *kleiner wasserbar*, which is German for “little water bear”. He gave it this name because the tiny creatures prefer wet habitats such as moist lichens or moss, and when they walk on their eight legs they swing their nose from side to side in a bear-like manner.



Tardigrade on a moss leaf

Later scientists gave it the name “tardigrade” (from the Latin words **tardus**, *slow* + **gradus**, *walker*). Today, those who study these little “slow-walkers” often use the fond nicknames “water bear” or “moss piglet”.

So why is the tardigrade considered to be an extremophile? Although they can easily be found practically anywhere on damp moss, lichens or leaf litter, they have been seen in almost every habitat on our planet- from the highest frozen mountaintops to the mud in the deepest parts of the ocean; from tropical rain forests to the frozen Antarctic. They can live in dry deserts and in boiling hot springs; and there are surely thousands of little water bears in your own backyard!



The Tardigrade is also called a Water Bear or Moss Piglet

### **More Ancient Than Dinosaurs**

Tardigrades have existed on Earth for a very, very long time. Although tiny, soft-bodied organisms like these rarely leave fossils, some tardigrade fossils have been found in rocks that formed 530 million years ago in the Cambrian period, making them some of the most ancient animals on Earth. Some tardigrades have also been found in amber (fossilized tree sap) from the Cretaceous period when dinosaurs ruled the Earth.

## Bears in Space

The tardigrade's ability to tolerate so many extreme environments led scientists to test whether they could survive in the harshest of all environments: outer space. In 2007, some tardigrades were launched into outer space on a spacecraft. The tardigrades were placed outside the spacecraft for 10 days, where the airless vacuum and harsh solar radiation would quickly kill other organisms. When returned to Earth and placed in water, the tardigrades were still alive and able to walk, eat and reproduce.

## Hard to Kill

What makes these fascinating creatures so tough? Tardigrades have the ability, in extreme living conditions, to basically “shut down” their life processes for long periods of time, and then restart them when conditions improve. This ability is called “cryptobiosis” (from the Greek words **crypto**, *secret* + **biosis**, *way of living*.) For instance, if conditions become extremely dry, a tardigrade will lose nearly all of its internal water, and shrivel up into a little ball called a “tun”. Many tardigrades easily exist in this seemingly “lifeless” state for 10 years, and possibly much longer. Once, someone examined a piece of dried moss that had been stored in a museum for 120 years. When they noticed what seemed to be a dead, dried-up tardigrade “tun”, it was placed in some water- and in a short time the water bear “came back to life” and started moving again.



Tardigrade (top) and “tun”, which is really a “living” tardigrade that shrivels up to look like a dry speck of dust. When placed in water, it will come back to life in just a few minutes or hours.

Tardigrades have been known to survive the following extreme conditions:

- Temperatures of over 300° F, well above the boiling point of water (212°)
- Temperatures just above Absolute Zero (about -457°F)
- Repeated cycles of freezing and thawing, which normally destroys most cells
- Lack of oxygen
- Lack of water
- Vacuum environments (zero air pressure and zero gravity) such as outer space
- Extreme high pressure- nearly six times the pressure in the deepest ocean trenches
- More than 1,000 times the level of radiation that would kill other animals
- They can tolerate many toxic chemicals that would kill other life

## Water Bear Life

Some species of tardigrades reproduce *asexually* (meaning they don't need a mate), but most species reproduce *sexually*. They lay eggs which hatch in less than two weeks. Tardigrades are *eutelic*, which means that all adults of the same species have the exact same number of cells in their body. When a baby tardigrade hatches from its egg, it already has the full adult number of cells. Its growth in size does not come from adding more cells, but rather from enlargement of the cells it already has.

Most tardigrades eat plant juices or bacteria, but some live as predators of other microscopic animals. These carnivorous tardigrades are particularly fond of the much larger nematode worms that exist as decomposers in their environment. The water bear will use its claws to grasp the nematode around its middle, bite a hole in the nematode, then suck the juices out of the struggling worm until it dies. Tardigrades are happy to eat several nematodes per day!



Water Bear (top) and a Nematode, also known as a roundworm.

## Finding Water Bears

If you'd like to try collecting your own tardigrades, look around your yard for some patches of moss or lichens. Water bears like the rather fluffy mosses or fuzzy lichens that can often be found in damp, shaded areas, such as on the north side of a rock or tree. Try plucking little bits of moss, or scrape lichens off the surface with the blade of a knife. You might also try some damp, decaying leaf litter. Collect your sample in a paper envelope or other dry container. Place the sample in 1/2 inch of clean water (not tap water, which contains chemicals that harm small organisms; use distilled water, rainwater or bottled water). Wait for a few hours, or overnight.



Pour off excess water from the container, then shake or squeeze the remaining material over another clean container to collect any bits of water that remain. This is where the water bears should be. Try using a magnifying glass or a low-magnification microscope and search the water or solid material carefully. Water bears are nearly transparent, so it might be easiest to see them if you have a dark surface under your container, and a light shining in from the side. Keep in mind that there are other interesting things living in these environments, so you might find lots of other organisms besides water bears.

You can also do a Google search for “water bears” or “tardigrades” and you'll see lots of photos and videos that other people have posted online!