SPACE BEARS - TARDIGRADE FACTS

Tardigrades are micro-animals also called Moss Piglets or Water Bears. There have been about 1500 known species of tardigrades discovered so far. Researchers believe there are many more undiscovered species. They first emerged 600 million years ago, about 400 million years before dinosaurs emerged.

NAME
Their Phylum is called "Tardigrada" which means "slow stepper", a name coined by Italian biologist Lazzaro Spallanzani in 1777. The name Water Bears come from German zoologist Johann August Ephraim Goeze who named them Little Water Bears (Kleiner Wasserbär) in in 1773.

TAXONOMIC BREAKDOWN
Kingdom: Animalia
Phylum: Tardigrada
Class: Eutardigrada
Order: Apochela
Family: Milnesiidae
Genus: Milnesium
Species: M. tardigradum

Clade: Ecdysozoa**,** a clade of all segmented and molting animals that includes nematodes and arthropods.

SIZE
Between 0.05 millimeters to 1.2 millimeters in length (.002 to .04 inches; the biggest ones are just barely visible to the human eye.)

LIFE SPAN
Most live a few months, but researchers believe some species could live up to a century. They can enter a state called cryptobiosis which can look like death, but is a kind of near-death dormancy. They have developed adaptations to survive extreme conditions. See **CRYPTOBIOSIS** below.

HABITAT
Everywhere on Earth. They have been found everywhere from the Arctic, to the equator, and to Antarctica. Their habitat range extends from tops of mountains to the canopies of trees, to intertidal zones, to the bottom of the deepest parts of the ocean floor. They are aquatic, but appear to be terrestrial because they live in the films of water covering moss, lichens, leaf litter, sand, soil, and other substrates. In New Mexico, we can probably find them in moss or lichens, or in soil.

They can live in extreme cold under the ice in antarctica enduring temperatures as cold as -328°F (less 200°C), and can endure extreme heat inside of volcanic vents with temperatures as high as 300°F (148.9°C). They can endure extremes beyond those found on earth including pressure far greater than that found at the bottom of the ocean, and the radiation, -455-degree temperature, and vacuum of outer space.

DIET
Tardigrades are omnivores. Most species eat the liquids inside of algae and plant cells. A few species eat the liquids inside of other microscopic organisms.

MORPHOLOGY (the physical form or structure of a living organism)

- Their body has five sections with a well-defined head and four fused body segments.
- Each body segment has a pair of short, stout, legs positioned on opposite sides of the body with four to six, curved, sharp claws on each foot.
- The first three pairs of legs are directed downwards and used for the purpose of locomotion. The fourth pair are attached at the rear.
- Their mouths are round with stylets (like teeth but shaped like spears) they use to pierce algae or other cells. They have muscles in their heads that act like cheek muscles enabling them to suck the liquid out of the cells they pierce.
- They have a digestive system that includes a mouth, a sucking pharynx, esophagus, stomach, intestines, and anus. Yes, they poop.
- They have simple, but well-developed muscles, but no skeleton to support them.
- They have a solitary gonad (reproductive organ.)
- They have a dorsal brain on a paired ventral sensory (nervous) system with ganglia (bundles of nerve cells.)
- They do not have a heart, or lungs. Their body is a hemocoel, an open body filled with fluid contacting each cell. The fluid is pumped around their cells through movement delivering the required nutrition and gases.
- Tardigrades have a cuticle (a flexible, rugged skin) through which they “breathe,” and which they molt as they grow.

REPRODUCTION

Tardigrades are oviparous – they lay up to 30 eggs at a time that can take between 14 - 90 days to hatch. Some tardigrade species have males and females. The female’s eggs are fertilized by males either inside of the female’s body, or externally after she has laid the eggs in a casing of her molted cuticle. Some tardigrades are parthenogenetic, laying eggs without mating. A few tardigrades are hermaphroditic (both male and female,) and are able to lay eggs that can develop without being fertilized.

CRYPTOBIOSIS

In extreme conditions such as when their lichen or moss environments dry out, they curl up and dry out forming what is called a “tun”, which looks like an oblong, bumpy capsule. When exposed to more extreme environments with extreme radiation or temperature extremes, they enter cryptobiosis, forming a hard protein shell that protects their DNA from radiation, and produce “tardigrade antifreeze” called cryoprotectant to prevent ice crystals from forming inside their cells. If there is too little or no oxygen in their environment, they survive on .01 percent of their normal requirement and produce tiny amounts of oxygen with their muscles. When rehydrated, oxygenated, or brought back into favorable conditions, they regain their lively state. Because they can adapt in such extreme ways, they have survived for at least 10 days in the vacuum, radiation and temperatures of space. They have endured many extreme experiments in laboratories and have been resuscitated afterwards.

An Israeli mission to the moon carrying live tardigrades in Tun state crash-landed in 2019. There has been debate among tardigrade experts on whether the tardigrades survived or not, and so they have carried out numerous experiments with mixed success to try to determine whether it is possible, including shooting tardigrades out of a gun to simulate crash impact (with mixed results.) We still do not know whether those lunar tardigrades are alive or not.