

STANDARD DEVIATIONS: When the Going Gets Tough, Pt 1

Greetings,

Behold the mighty Tardigrade!



This microscopic animal, also known as the [water bear](#) for its tubby appearance, can survive being frozen, boiled, exposed to extreme radiation and high pressures, being starved for several years and put into the vacuum of space.

Tardigrades are usually about 0.5 mm (0.02 in) long when fully grown. They are short and plump, with four pairs of legs, each ending in claws or suction disks. Tardigrades are prevalent in mosses and lichens.

Tardigrades' bodies have bilateral symmetry and are covered by a thin, un-calcified cuticle. The tubular mouth is armed with stylets, which are used to pierce the plant cells, algae, or small invertebrates on which the tardigrades feed. The body consists of a head, three body segments



each with a pair of legs, and a caudal segment with a fourth pair of legs. No respiratory organs are found.

They must molt multiple times in their life as they grow larger. The eggs hatch after just 14 days, with the young already possessing a full complement of adult cells; they are born with all the cells they'll ever have (eutely). Growth to the adult size occurs by enlargement of the individual cells (hypertrophy), rather than by cell division. Mating occurs during the molt with the eggs being laid inside the shed cuticle of the female and then covered with sperm.



Tardigrades usually live for a few months. However, they have a way of adapting to harsh conditions that allows them to survive **decades**, or longer.

Tardigrades are one of the few species that are capable of [suspending their metabolism](#). While in this state, their metabolism lowers to less than 0.01% of normal. They also desiccate themselves, shedding 99% of their water content. They can go without food or water for more than 30 years, only to later rehydrate, forage, and reproduce.

When the tardigrade begins to dry out, its body activates intrinsically disordered proteins ([IDPs](#)). The proteins encapsulate its molecular components in a glasslike matrix within the body that preserves them during the drying process. In this cryptobiotic state, the tardigrade is known as a **tun**.





{The tun form is stable for decades.}

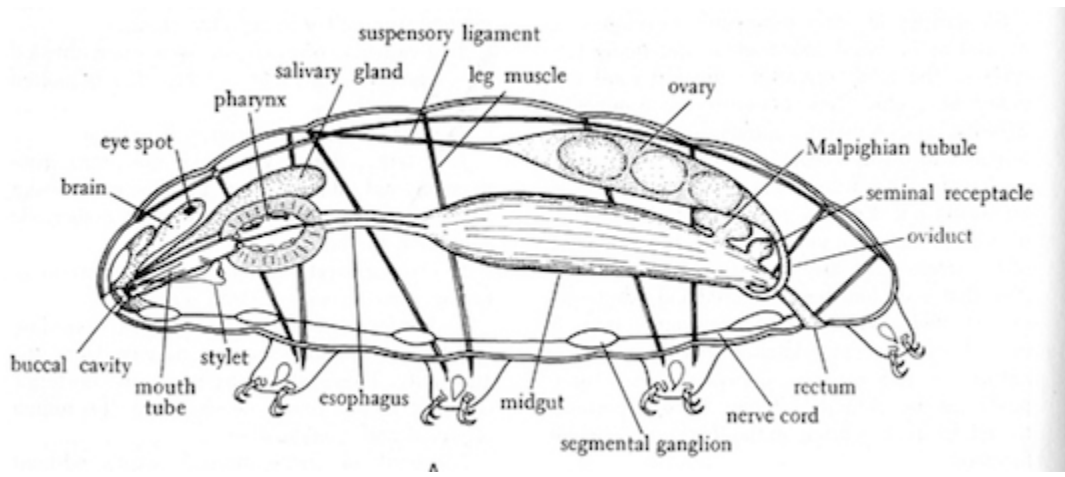
Just how durable is the water bear?

- Temperature. Most sensitive at high temperatures they can survive a short while at temps over 150 C. They last for years at -20 and days at -200 C.
- Pressure. Tardigrades will survive more than 1000 times atmospheric pressure.
- Impacts. They can take a jolt up to 900 meters per second.
- Dehydration. So far, we know that desiccated water bears do fine a decade out at only 3% of their hydrated state.
- Radiation. Tardigrades can withstand 1,000 times more radiation than other animals.
- Tardigrades are the first known animal to survive after exposure to outer space. Experiments in orbit exposed them to the vacuum and radiation of space and most were able to reanimate within 30 minutes.

Fossil evidence shows that they are at least 90 million years old as a species. They appear to be an early sister group to legged worms and arthropods. Their plan has worked pretty well for quite a while.

Also known as moss piglets, tardigrades have evolved a survival mechanism that suspends animation, that stops time, and that defies environmental challenges in order to wait out the bad times. Are they the best at being hardy? Hardly.





{Tardigrade anatomy.}

Have a great week and be safe,
Bryan



