What Was I?

- I was a very small single-celled organism that was photosynthetic. (I could produce food from sunlight.)
- Through photosynthesis, I also produced oxygen, which was added to the ocean and Earth's atmosphere.
- Scientists discovered my fossil existence in layered rock structures called **stromatolites**. These structures formed when I and millions of my friends became trapped and cemented between grains of sand or mud in alternating layers.

Layers of ancient **photosynthetic organisms** from Wyoming, USA (cut slice: 18.6 cm across at its widest)
Photo: James St. John CC BY 2.0

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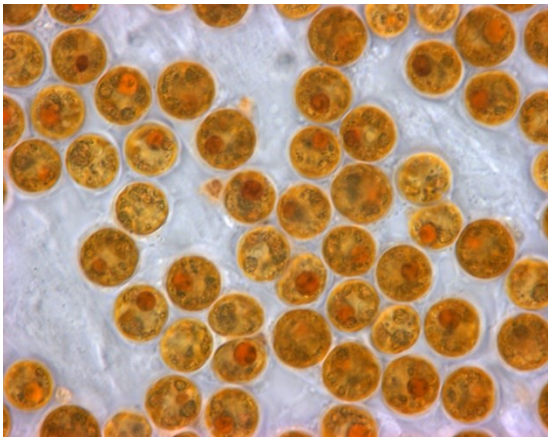
Living Relatives: Cyanobacteria

- Cyanobacteria (blue-green algae) evolved about three **billion** years ago.
- They are the ancestors of all plants and algae and are among the oldest fossils known on Earth.
- Earth's early atmosphere consisted mostly of carbon dioxide, methane and water vapor. There was barely any trace of oxygen! We have these early photosynthetic organisms to thank for adding oxygen to the atmosphere and ocean. This made Earth habitable for oxygen-breathing organisms, like us!



Zooxanthellae (lives with corals and produces food through photosynthesis); found in places with coral reefs, like Hawaiian Islands Humpback Whale National Marine Sanctuary, Papahānaumokuākea Marine National Monument, Florida Keys National Marine Sanctuary, and Flower Garden Banks National Marine Sanctuary
Photo: Todd C. LaJeunesse CC BY-SA 2.0

What Was I?

- I was a multi-cellular organism with a loose collection of cells. I did not move and my body formed irregular shapes.
- My body contained tiny holes, tunnels and chambers. It lacked distinct tissue layers or organs.
- My “skeleton” was made up of crystalline structures.

Brooksella alternata, an ancient fossil from the Cambrian period found in Georgia, USA
Photo: James St. John CC BY 2.0

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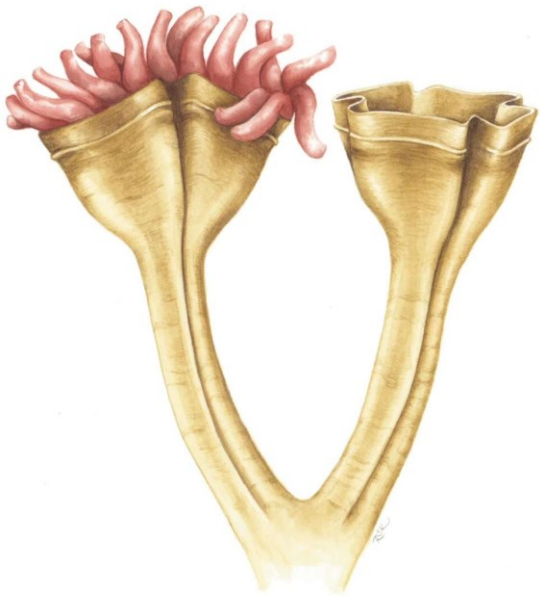
Living Relatives: Sponges

- The first sponges may have appeared as long as 890 million years ago! They were one of the first animals on Earth.
- For many years, scientists believed they were the first animal to evolve. But they now believe an organism like modern comb jellies may have been even more ancient.
- Modern sponges are an important part of deep-sea ecosystems and provide habitat for many other species (like trees on land).

Barrel sponge at Flower Garden Banks National Marine Sanctuary; Photo: NOAA

What Was I?

- I was multi-cellular and also the first known animal predator!
- I evolved specialized cells that became nerves and muscles.
- I probably used stinging cells on my tentacles to catch small planktonic animals.
- Because of my soft body, not many of my species were preserved in the fossil record.



Artist depiction of the extinct ***Auroralumina attenboroughii***, which lived 560 million years ago; Illustration: F. S. Dunn et al. CC BY-SA 4.0

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Living Relatives: Cnidarians

- The group of animals called cnidarians appeared in the fossil record approximately 580 million years ago.
- Cnidarians include jellyfish, anemones and corals.
- They may have evolved from sponges.

Fish-eating anemones at Cordell Bank National Marine Sanctuary; Photo: Michael Carver/NOAA

What Was I?

- I had a rigid external skeleton that was segmented and divided into three distinct parts. In many species, the left half of my body was a mirror image of the right half, which is called bilateral symmetry.
- I also had paired limbs with which I could scuttle across the seafloor. I had a digestive tract and sensory organs, such as antennae.
- Because of my hard exoskeleton, my remains are relatively abundant in the fossil record.

Trilobites evolved about 521 million years ago and died out 252 million years ago. About 22,000 different species of trilobites have been discovered!
Photo: Kevin Walsh CC BY 2.0

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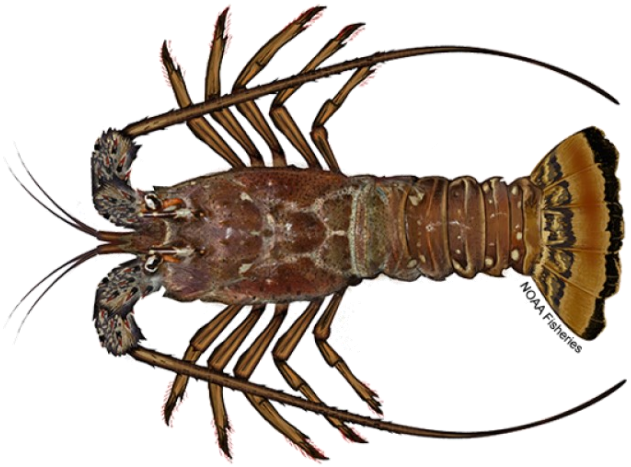
Living Relatives: Arthropods

- Modern marine arthropods are the most abundant group of animals in the ocean. They include crustaceans, like crabs, lobsters and shrimp, sea spiders and barnacles.
- Modern terrestrial (land-based) arthropods include insects, spiders, scorpions, centipedes and millipedes.



A Caribbean spiny lobster, like those found at Florida Keys National Marine Sanctuary; Photo: NOAA

What Was I?

- My name means “big tooth.” I was a huge ocean predator up to 65 feet (20 m) long!
- The left half of my body was a mirror image of the right half, which is called bilateral symmetry.
- I had a spinal cord and complex nervous system and sensory systems.
- I also had gills for breathing and fins with which to swim.
- My huge fossilized teeth are still found near the shore! Locations include near the Mallows Bay-Potomac River National Marine Sanctuary in Maryland.

A fossilized **megalodon** tooth next to modern white shark teeth; Megalodons, an extinct species of shark, first lived around 20 million years ago. They became extinct 3.6 million years ago. Photo: Brocken Inaglory CC BY-SA 3.0

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Living Relative: White Shark

- Fossilized megalodon teeth have been found all over the world, indicating that the huge sharks lived throughout the global ocean in a wide range of environments. These massive extinct sharks could have 7-inch-long (18 cm-long) teeth!
- The largest white shark teeth (also called great white sharks) are less than 3 inches long, by comparison.
- Sharks help maintain the balance of marine ecosystems. They limit the population of their prey, which can benefit the species that those animals consume.

White sharks are important apex predators in the ecosystems of sanctuaries such as Greater Farallones National Marine Sanctuary, Cordell Bank National Marine Sanctuary and Olympic Coast National Marine Sanctuary. Photo: NOAA

What Was I?

- Our group of animals first evolved about 565 million years ago.
- We are uncommon in the fossil record, because we had soft bodies, like our living ancestors do today.
- Like our modern ancestors, we had bilateral symmetry with a head, a tail and stereo senses (such as two eyes).

Fossil of *Plagiostomum whitmani*; the same basic body plan of modern ancestors Photo: D. Drew/Yale Peabody Museum of Natural History CC0 1.0

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Living Relatives: Flatworms

- There are more than 20,000 living species of flatworms.
- Flatworms have bilateral symmetry and a centralized nervous system. A pair of nerve cords runs down the body. Nerves send signals to and from sensors such as eyes, smell and taste receptors.
- Flatworms have the same basic body plan that appeared in their ancient ancestors about 500 million years ago.

Pseudoceros ferrugineus is a widespread species of marine flatworm. You can find them at Hawaiian Islands Humpback Whale National Marine Sanctuary and Papahānaumokuākea Marine National Monument. Photo: Hectonichus CC BY-SA 3.0

What Was I?

- I had an elongated, flattened body with a central notochord and expanded tail fin.
- I also had segmented blocks of skeletal muscles that spanned the entire length of my body.
- Even though I was small, around one and one-half inches, I probably swam eel-like near the seafloor, possibly feeding on particulate material.
- I am the oldest known member of phylum Chordata, which also includes humans and all other vertebrate species.

Fossil of *Pikaia gracilens*, the oldest known Chordate ancestor; Photo: Vassil CC0 1.0

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Living Relatives: Vertebrates

- Animals with a backbone (amphibians, birds, fishes, mammals, and reptiles) have a notochord as embryos.
- Vertebrates are part of phylum Chordata. All chordates share five traits at some life stage, including:
  - Bilateral symmetry (the same on both sides)
  - A notochord (a flexible, rod-like structure that supports the body)
  - A dorsal nerve cord (tube) that connects nerves to muscles and organs

This **hawksbill sea turtle** is a vertebrate Chordate, like all other reptiles, amphibians, fishes and mammals. Photo: U.S. Fish & Wildlife Service