Accompanies Episode 3 of the 13-part video series

Plagued by a Predator

Written by Eric R Russell & Bruce J Russell

In this episode...

The *Cyclops* crew is making a documentary film of their discoveries throughout the pond. In the life-rich weedy shallows they encounter many single celled (**protists**) and multi-celled (**animals**) organisms. A story of **ecology** unfolds and gives them a greater understanding of the **diversity** of the life in the micro world – an **ecosystem** as rich with predators and prey as the African savanna. As they complete their filming expedition, they become potential prey to a predator of the weedy shallows – a **Planarian**, or flatworm. Quick thinking allows them to escape, and they get to watch how the Planarian hunts and feeds in the process.

EXPLORATION GUIDE & JOURNAL

Pond Ecology: Weedy Shallows

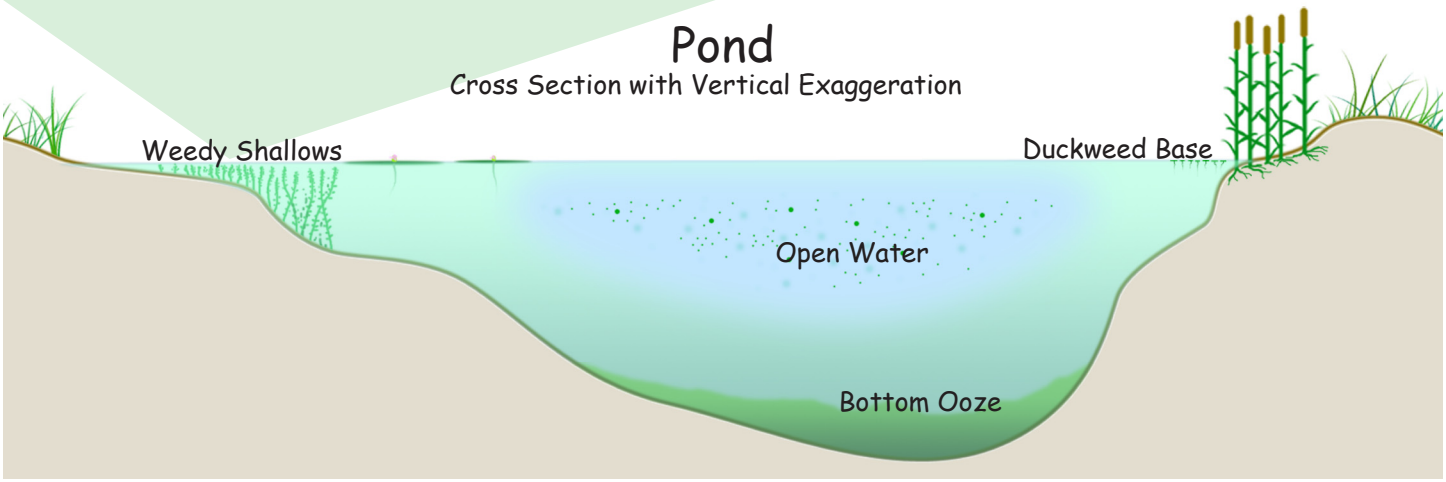
The Log of Captain Jonathan Adler

Day 9: 10:15 hours... Lights, camera, action! The film is rolling! We are now several days into the production of a documentary motion picture. When finished, our film will feature the numerous kinds of microscopic organisms found throughout the pond.

We are currently navigating our way through the dense and treacherous weedy shallows. Because of the aquatic plant life and plentiful sunlight, this region offers safe haven for an abundance of microorganisms.

Again and again we see (and film) the relationship between organisms that hunt – and organisms that graze. The hunters, or predators, capture and devour the others. The lion feeds on the zebra.

The grazers, or prey, do not hunt. Some are green and use photosynthesis to harvest energy from sunlight. Others suck up decomposer bacteria from rotting leaves and decaying micro animals. The zebra eats the grass.



MS Cyclops

Vehicle Dimensions

LENGTH	1 mm
BEAM	.65 mm

Vehicle Mission

Maximum speed	10 centimeters per minute
Maximum depth	2.5 meters
Mission duration	60 days

The microsubmersible *Cyclops* is designed for extended exploration of freshwater ponds, streams, and wetlands. The vehicle carries a standard crew of four.

- Captain
- Ship's Naturalist
- Helmsman/Navigator
- Engine Master

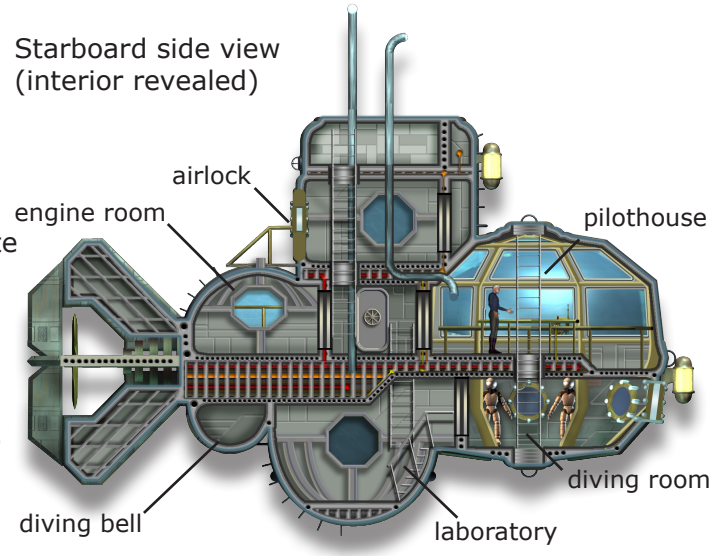
There are two onboard auxilary craft for specialized exploration: a *diving bell*, and a terrestrial *crawler/rover* (disassembled).

The glass enclosed pilothouse is a unique feature that allows for optimal observation of the surrounding aquatic environment.

Manipulator grabbers (claws) facilitate rapid making-fast and retrieving samples for study.

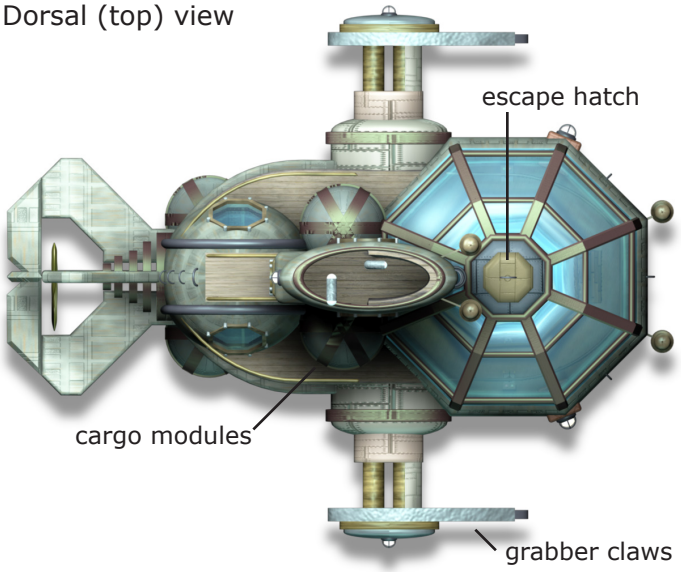
What if you were a scientist onboard the *Cyclops*? Imagine what the pond environment looks like to these micro sized explorers, only 50 microns (*µm)* tall. What unique problems might they encounter because of their size? How would they acquire repair materials, such as glass? Where would they find food, fuel, or oxygen?

Starboard side view
(interior revealed)



Micro Submersible Cyclops: 1000 *µm*

Dorsal (top) view



Contents of this guide...

Euglena: 50 *µm*

About the Organisms

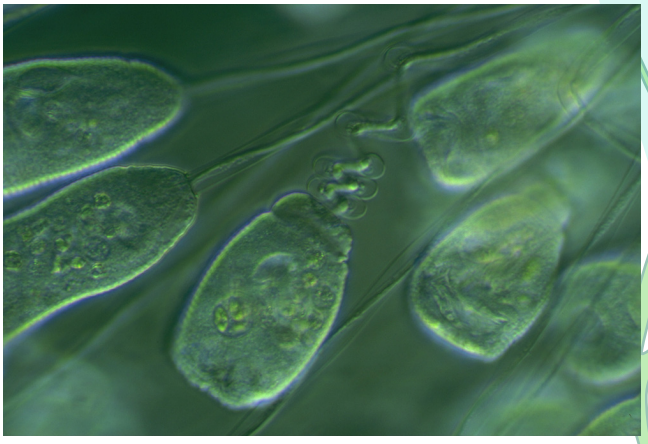
What are protozoans? What is algae?

Three varieties of free-living single-cells populate the freshwater micro world of ponds, streams, lakes, and wetlands.

- **Bacteria**
- **Protozoans**
- **Algae**

Bacteria are simple single cells. They can be long strands, short rods, or strings of cells. A bacterium has no nucleus. Bacteria are one of the simplest forms of life on earth. They decompose dead planets, animals, and other single-celled organisms.

Protozoans and **algae** are also single celled organisms, but they are far more complex than bacteria. These cells have a nucleus, just like the cells in multi-cellular organisms (plants and animals). Protozoans are classified by how they move: ciliates, flagellates, and amoebas. Algae contain green chloroplasts and acquire energy through photosynthesis.



Vorticella

Vorticella is a ciliated protozoan that attaches to objects in the water by a **contractile stalk**. Vorticellids are found in clusters often large enough to be seen with the naked eye.

Vorticella uses a ring of rapidly beating **cilia** to create a feeding vortex, a whirlpool that pulls bacteria and small algae cells into its mouth.

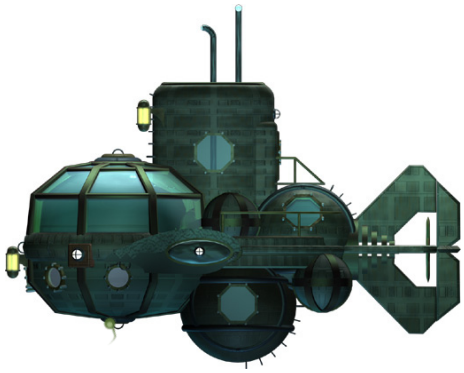
EXPLORATION GUIDE & JOURNAL

The Log of Captain Jonathan Adler

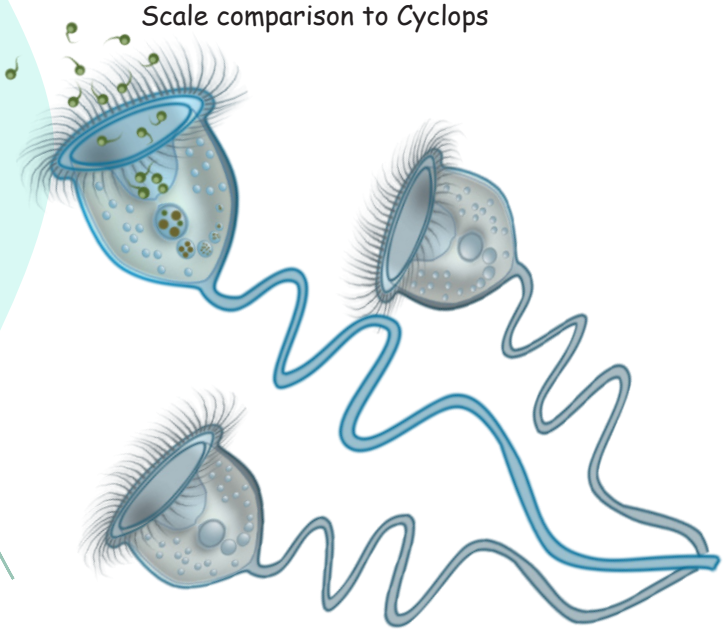
Day 9: 7:30 hours... Deeper into the weedy shallows now.

When complete, our documentary will reveal that the micro world is a living dance of predators and prey, of survival at all costs. Let us hope that we finish it before becoming prey ourselves!

17:30 hours... **SPROING!** We've just observed a most amazing microorganism that tethers itself on a spring-loaded stalk. When danger approaches the cell instantly retracts the stalk, jerking itself quite suddenly out of harm's way. After a time the stalk relaxes and the cell resumes feeding – a process of drawing in small algae and bacteria that become caught in its whirlpool-like feeding vortex.

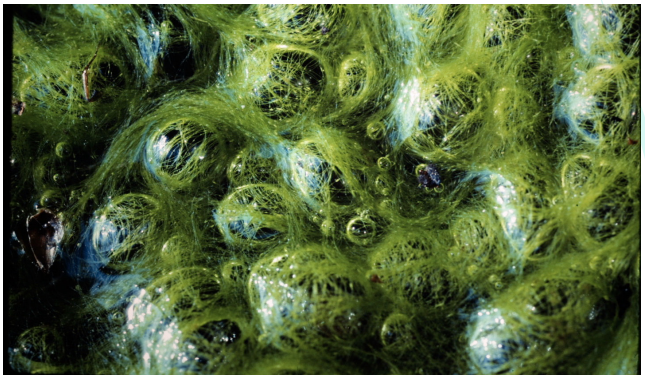


Scale comparison to Cyclops



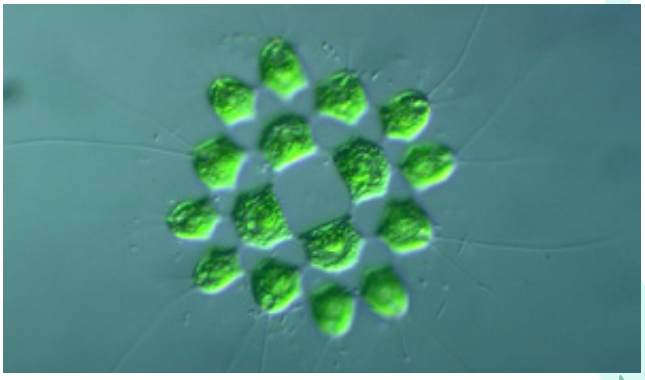
Spirogyra

Spirogyra is a common thread alga made up chains of cells, each with a spiraling chloroplast and clearly visible nucleus.



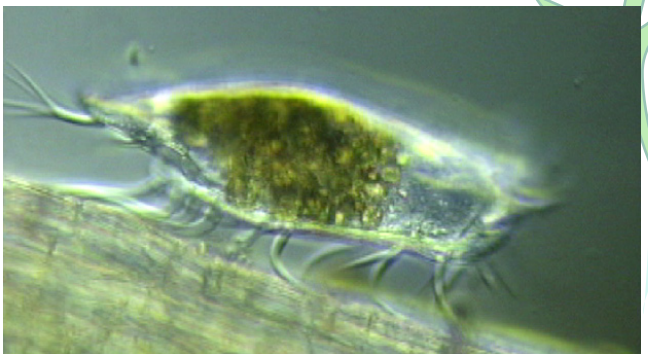
Gonium

Gonium is a simple algae colony made up identical cells. Each *Gonium* cell is **photosynthetic**, obtaining energy from sunlight and giving off oxygen as a waste product. *Gonium* has a single **flagella** – a whip-like strand for moving through the water. This is how the colony orients itself into the best position for collecting sunlight.



Euplotes

Euplotes is a ciliate whose **cilia** are fused into appendage-like structures called **cirri**. The cirri allow *Euplotes* to walk over surfaces, hunting for small green algae cells. It's favorite food is *Chlamydomonas*. *Euplotes* holds its food in a food trap before engulfing and digesting it.



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The Log of Captain Jonathan Adler

8:15 hours... We are encountering so many new organisms that our camera is rolling constantly!

We spy a type of algae made up of cells that connect to each other end-to-end, creating extremely long strands, like hair. The green chloroplast in these cells is spiral shaped, which likely allows it to receive sunlight for photosynthesis no matter where the strand is drifting in relation to the sun.

Nearby we film a busy cluster of green colonies. The individual green cells have two flagella each, and are able to keep their small colony of sixteen cells facing the sun for efficient photosynthesis.

And then a big surprise – a ciliated microorganism that walks! This beasty patrols stems and branches of pond plants, hunting algae. Its legs appear to be specialized cilia that are fused into limbs.

Scale comparison to Cyclops

Amoeba

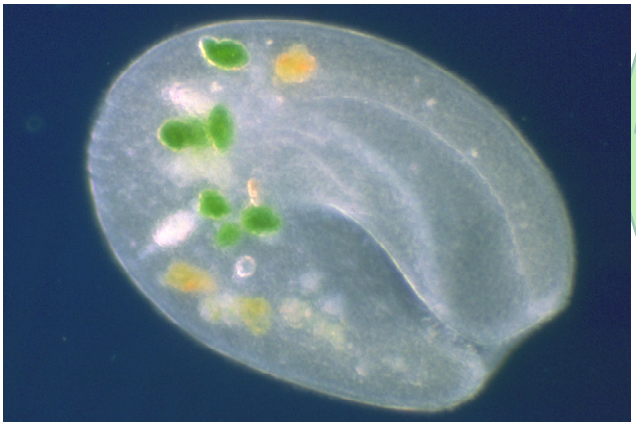
Amoeba moves and engulfs food by cell extensions called pseudopods. There are many different kinds of **amoebas**, some very tiny, others large enough to see with the naked eye.

Euglena

Euglena is a photosynthetic **flagellate**. There are many kinds (species) of euglinids found in virtually all freshwater environments.

Bursaria

Bursaria is a giant **ciliate** easily visible to the naked eye. Bursaria travels mouth first, engulfing smaller cells in its path.



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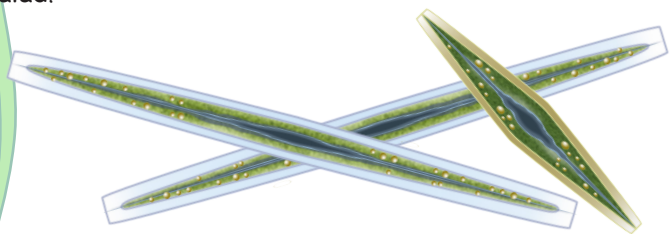
The Log of Captain Jonathan Adler

10:35 hours... Diatoms surround us! Every cell of this single-celled algae encases itself within a house of glass. Equally as fascinating is how it buoys itself to hold position at the best depth for photosynthesis; it uses lighter-than-water oil droplets! Ingenious!

Glass, as we know, is made of silica. Where might the diatoms extract silica for making their glass houses? And that oil – we know is very high in carbon; from where, we wonder, do they get it – or how might they synthesize it?

Some time back we discovered many uses for these interesting cells. All of the windows and portholes aboard the Cyclops are made from glass harvested from diatoms. We use the oil droplets for fuel and machinery.

Some are green, and some yellow – but I must tell you that the chloroplasts of all varieties make a delicious salad!



12:00 hours... We are filming so many different species of single-celled organisms! How do these free-living protozoa move about? Our film has revealed that all independently living cells fall into one of three groups.

The Amoeboids: Amoebas and their relatives move by extending blob-like appendages that flow like living putty.

The Flagellates: A long whip-like strand, or bundle of strands, wave rapidly, pulling the cell through the water like a propeller.

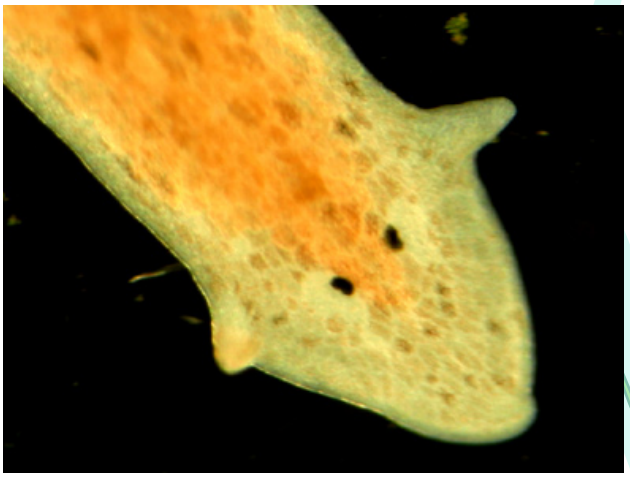
The Ciliates: These cells are usually covered in a coat of small hairs that move wave-like, in any direction, to move the cell. This is the most diverse family of single cells. Some have cilia adapted for walking, others for feeding. Ciliates are the speedsters of the microscopic world, and most are much faster than the Cyclops at full-steam!

Planaria

Planaria is a voracious predator of the pond's weedy shallows. This habitat provides hiding places for this flatworm, a versatile feeder able to seek out and scavenge dead organisms, as well as hunt live prey.

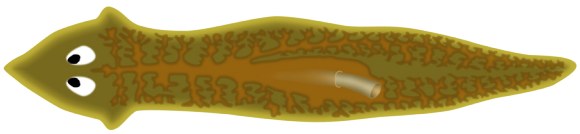
You will never forget Planaria once you have looked into its crossed "eyes." Planarians belong to a group of invertebrate animals that also includes flukes and tapeworms.

Planaria's "eyes" are light sensitive pots that allow planarians to avoid direct sunlight, thus they spend most of their time on the underside of rocks and leaves.



The ear-like projects are loaded with chemical receptors. Moving its head from side to side allows a planarian to sense the gradient of chemical signals diffusing out from a food source, allowing it to home in on food.

Planarians and their relatives have mouths located in the center of the bellies. A feeding tube extends through the mouth opening and sucks in the food, which is distributed through the worm's three-branched intestine.



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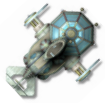
The Log of Captain Jonathan Adler

15:15 hours... Our demise may be at hand! A predatory flatworm has caught our scent, probably sensing the excess carbon dioxide from our air filtration system. We are trying to evade the beast, but to no avail. We can neither outrun it, nor out-maneuver it in the aquatic weed forest. At every turn the worm sways its enormous head from side to side, using its ear-like chemical detectors to track our every move. I fear that unless we find a way to distract the monster, and soon, we shall become this flatworm's afternoon snack!



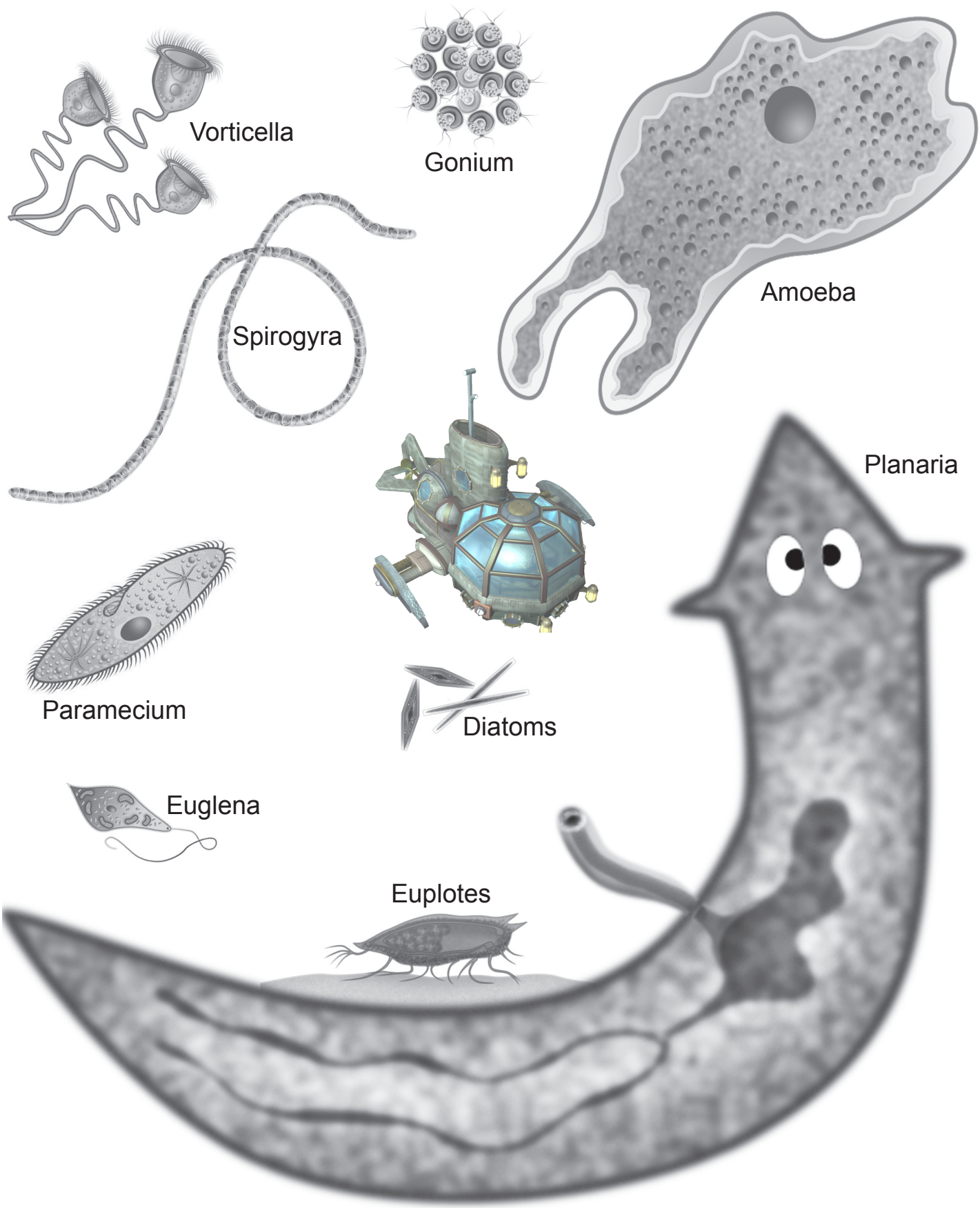
I am moments from making a fateful decision – the command to abandon ship. Perhaps if the predator captures the Cyclops, we can escape in diving suits. Just then Barron, my sturdy engine master, calls out from the engine room! He has sighted a clutch of aquatic snail eggs! Could this be the distraction we've been hoping for?

The monster is nearly upon us! We adjust course and steer toward the snail embryos. The worm wags its head, seeking the strongest signal that indicates an easy meal. Will it be us, or the baby snails?

Much to our relief, the worm has detected the snail eggs. We withdraw to a safe distance from where we observe the fascinating yet gruesome process of the worm devouring the baby snails.

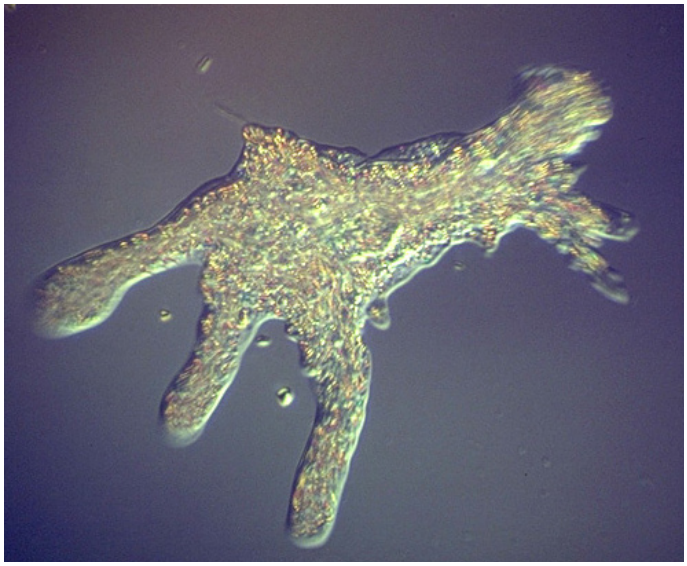
From the flatworm's underside emerges a muscular feeding tube. The tube has a mouth-like opening that swallows the baby snails whole, then takes them into its body where they digest in its 3-branched intestine.

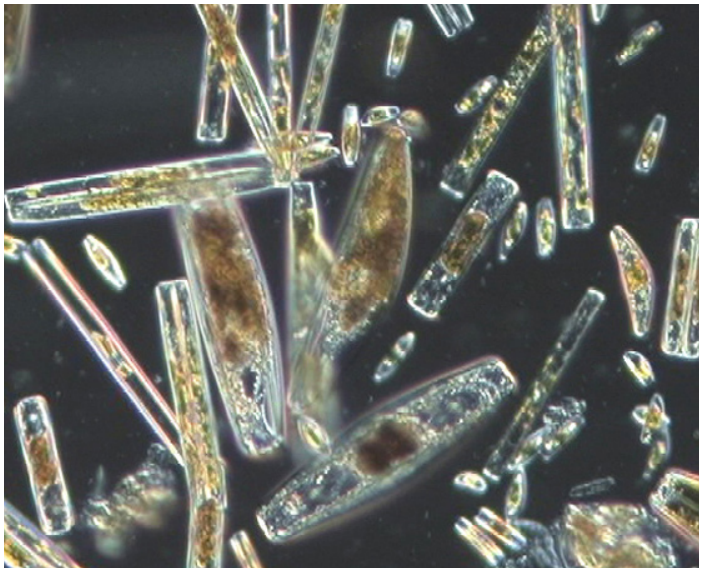
Key to Organisms



Gallery of Organisms in this Adventure

The crew of the Cyclops encountered many single celled organisms, and one giant predator animal in this adventure. They learned that organisms in the micro world move about by different methods. The method they use for moving may help them find food, or escape from predators.





For identification key visit
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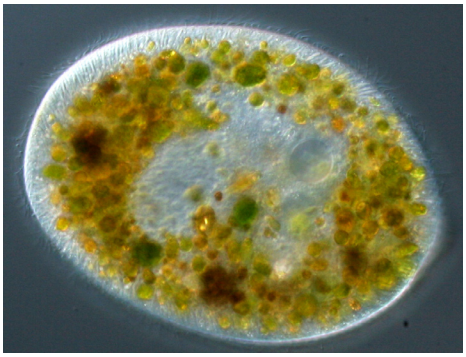

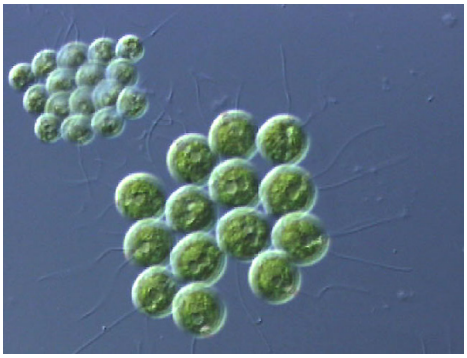

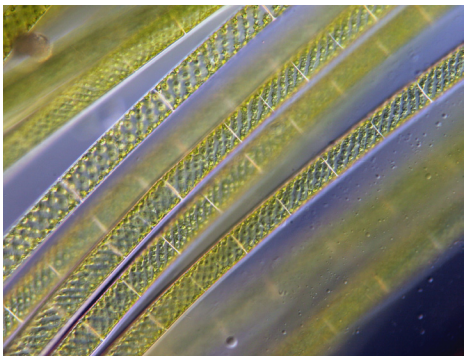

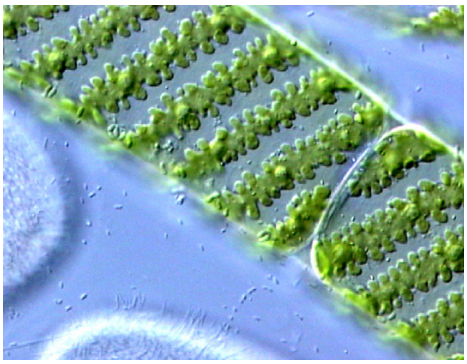

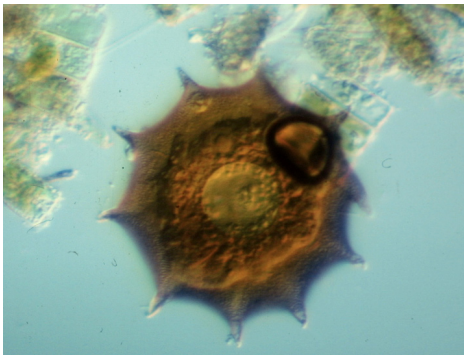

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