Evolution and Biodiversity Laboratory
Identifying Microorganisms in Aquatic Samples

Being able to identify organisms is important if you wish to discover what is already known about their natural history, ecology, and environmental tolerances.
Dichotomous keys and other identification sources are available at your station to help you identify different types of protists, plants, and animals in cultures provided for you.

Today you and your team will learn

- proper use of the microscope
- to recognize and identify some common aquatic microorganisms
- some useful collection techniques

Your team will then confer to discuss your literature search findings and use them to devise a research project. At the end of today's session, your team will submit a well-designed project outline including your

- overall hypothesis
- experimental (null and alternative) hypotheses
- predictions
- data collection protocol

Identification Guide

This guide will help you narrow organism identification at least to the level of Phylum, and possibly to an even less inclusive taxon. (You will not be able to identify all observed organisms to species level.) Do the best you can.

Use all information sources at your disposal

- **Identification keys and other resources provided in lab**
- **YouTube videos**
- **Google image search**
- **etc.**

For example, if you identify a diatom, an image search (key words: "diatom" "freshwater" "Miami" "Florida") might yield its identity. If you find something you can't identify, ask your instructor for help.

Type of body symmetry can help you make a preliminary identification. **Figure 2** shows the three basic types of animal symmetry.

- **asymmetry** – no plane of symmetry; no anterior/posterior; no dorsal/ventral
- **radial symmetry** – central plane of symmetry; body divisible into similar wedges
- **bilateral symmetry** – body halves form mirror images of each other

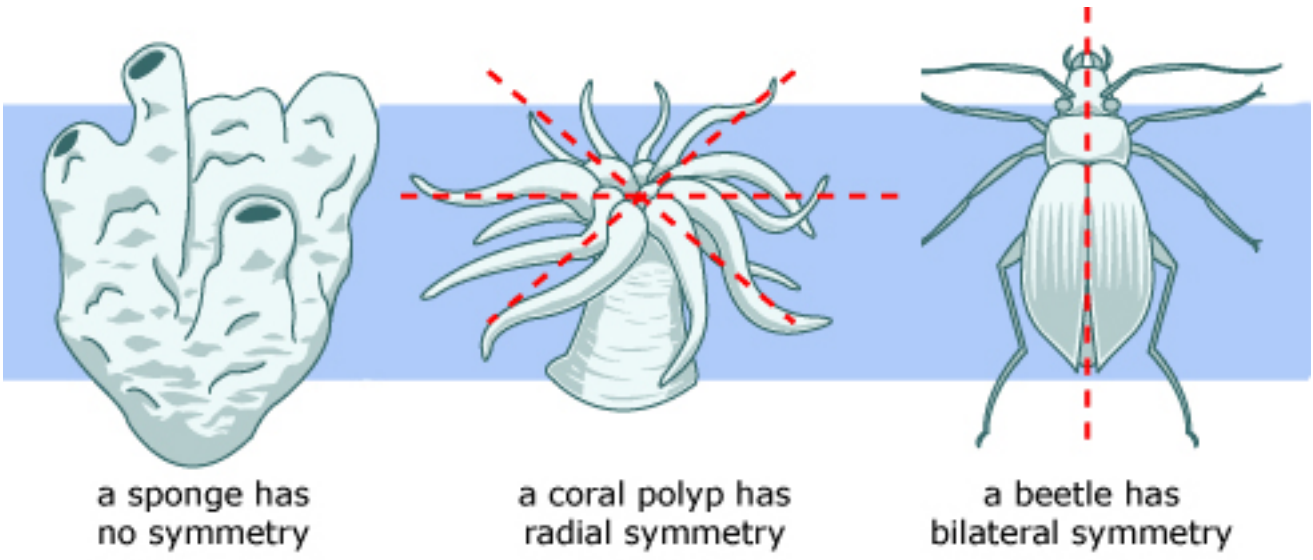

Figure 2. Animals can exhibit one of three types of body symmetry: asymmetry, radial symmetry, or bilateral symmetry.

1. Protists

Protists are a vastly diverse assemblage comprising several Kingdoms. Those you see today will be very small and often highly motile. Most common in daytime samples will be **diatoms** and small **flagellates**. But the occasional ciliate or amoeba will appear.

A useful image gallery, complete with taxonomic information and other facts about many common protists can be found here:
http://megasun.bch.umontreal.ca/protists/gallery.html
(*Merci*, University of Montreal!)

2. Animalia, Porifera - The Sponges

Sponges are the simplest animals. Different species can be found in either freshwater or marine habitats. Because sponges lack true tissues or true body symmetry (Figure 2), they do not have a head, tail or any recognizable anatomical structures. A sponge will usually resemble an amorphous blob with slightly greater organization than pond sludge. You can find a variety of freshwater sponge images as **http://tinyurl.com/porif**

3. Animalia, Cnidaria - Radially Symmetrical Diploblasts

Cnidarians can be found in either freshwater or marine habitats. They

- are **radially symmetrical**
- have two true tissue layers (endoderm and ectoderm) (i.e., they are **diploblastic**)
- have an **oral** (mouth) and **aboral** (away from-mouth) end
- have a mouth surrounded by **tentacles** equipped with stinging **nematocysts**
- exist as either a sessile **polyp** or a free-swimming **medusa** (Figure 3)

The most common freshwater Cnidarians are hydras, which exist as polyps.
Marine habitats may harbor small medusae, the "jellyfish" life cycle stage.
Find images here:
http://tinyurl.com/pondhydra and **http://tinyurl.com/fwmedusa**

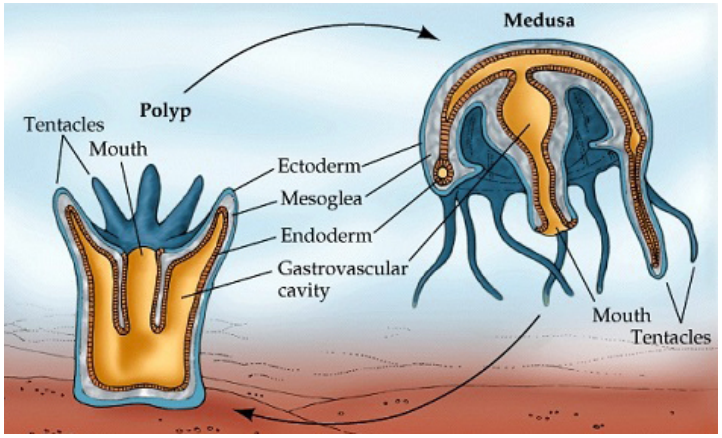

Figure 3: Cnidarians may alternate between a polyp (sessile) and medusa (free-swimming) life cycle stage. The two are essentially upside down versions of each other. The mouth is surrounded by tentacles equipped with stinging nematocysts. The gut is incomplete: there is no anus. Food goes into the mouth, is digested in the simple gut, and what's left comes back out the mouth.

Aren't you glad you have a complete gut?

4. Animalia - Flatworms

Flatworms exhibit a diverse and ancient body plan, and not all are closely related to each other. You will learn more about this in the biodiversity section of BIL 160. You can recognize a flatworm by its

- **dorsoventrally flattened** (i.e., flattened from "back" to "belly") body
- distinct head that guides the worm's movements

View a flatworm in action at **http://www.youtube.com/watch?v=_jjzQrR5PLQ**

5. Animalia, Rotifera - The Wheel Animalcules

Most rotifers are about the size of a large protist, yet they have three true tissue layers (**ectoderm**, **endoderm**, **mesoderm**). Recognizable rotifer characteristics:

- **Corona of cilia** surrounding the mouth resembles two small wheels when feeding
- Rhythmic opening/closing of **mastax** while feeding
- Sticky pedal disk with small "toes"
- Superficially segmented lower body

The corona can be used like a little propeller when the rotifer decides to pull up its sticky pedal disk and swim. Check out the dramatic video of rotifers at
http://www.youtube.com/watch?v=YF8OJt_pujc
(Yes, that's the rotifers singing. They do that.)

6. Animalia, Nematoda - The Roundworms

Nematodes are very thin, symmetrical worms. Recognizable nematode characteristics:

- no evidence of body segmentation
- tapered at both ends
- unique "**sine wave" movement** (body wall has **only longitudinal muscles)**

Nothing else moves quite like a nematode, which makes them easy to recognize.
You can see them swimming at
http://www.youtube.com/watch?v=SpgjnXEFadg

7. Animalia, Annelida - The Segmented Worms

Earthworms are the most familiar members of this diverse phylum. You can identify a segmented worm by the noting

- ringlike bands, the **body segments**
- paired bristles (**setae**) on each segment
- "**peristaltic" movement**: alternating regions of the body constrict and widen to anchor the bristles and pull the worm along its substrate.

View annelids here:
http://www.youtube.com/watch?v=X7O7UFOmRuk and
https://www.youtube.com/watch?x-yt-cl=85114404&x-yt-ts=1422579428&v=9Q9gh1k99rY

8. Animalia, Mollusca - The Mollusks

Mollusca includes forms as diverse as **chitons**, **snails** and **slugs**, **clams and other bivalves**, **octopus**, **squid**, and the **Chambered Nautilus**. Most are relatively large; the only mollusks you are likely to see in your samples would be larval forms.
Adult mollusks can usually be identified by the presence of

- **distinct head**
- **muscular "foot"**

But the larvae look quite different from adults. Find a gallery of larval mollusks here: **http://tinyurl.com/ku2hjux**

9. Animalia, Tardigrada – The Water Bears

Tardigrades can be recognized by

- **segmented** bodies
- appendages ending in **clawlike bristles**
- **chitinous cuticle** covering the skin
- **reduced head**
- **lumbering movement**, like a tiny bear

Tardigrades are perhaps most famous for their ability to survive extreme environments, such as complete vacuum, almost 100% desiccation, and extreme cold. This makes them of great interest to the folks at NASA, who would like to find out how tardigrades survive conditions like those of deep space.
Check them out here: **http://www.youtube.com/watch?v=6H0E77TdYnY**
Water bear meets *Paramecium* at: **http://www.youtube.com/watch?v=iLj4tBp00wo**

10. Animalia, Arthropoda - The Arthropods

This most diverse of all animal phyla contains hundreds of thousands of species. Beetles alone comprise more than 350,000 described species! Arthropoda includes **horseshoe crabs**, **arachnids** (spiders, ticks, mites), **insects**, **crustaceans**, and other, less familiar, forms. Arthropods can be recognized by:

- **segmented body** (segments in many taxa are fused to form larger body regions)
- distinct **cephalization** (head at the anterior of the body)
- distinctly **jointed appendages**
- thick, chitinous **exoskeleton**

Some common arthropods you might find in your samples…

- Copepods (adults and larvae): https://www.youtube.com/watch?v=Havd17RNo_c
- *Daphnia*: https://www.youtube.com/watch?v=2g-04Uk0ut0
- An ostracod: https://www.youtube.com/watch?v=4i4U1D89vVs
- A mosquito larva: http://tinyurl.com/lkpgyle
- A variety of crustacean larvae: http://tinyurl.com/mt73crz

11. Animalia, Echinodermata - The Spiny-Skinned Animals

Adult echinoderms are relatively large. The only echinoderms you will likely find in an aquatic sample are larval forms.

Echinoderms are strictly marine. Their lack of an excretory system makes osmoregulation in freshwater or brackish water impossible for them, so you will find them only in oceanic ecosystems. View a gallery of various echinoderm larvae here: https://www.youtube.com/watch?v=p-9h2Jm2xPM and https://www.youtube.com/watch?v=3p37SvW9mso

12. Animalia, Chordata - The Chordates

This familiar group includes the **sea squirts** (Urochordata), the **lancelets** (Cephalochordata) and the **vertebrates** (Vertebrata). Adult chordates are generally much larger than what your sampling technique will collect. But it is possible you might find larval fish or even small tadpoles (frog larvae). Even as larvae, all Chordates have

- dorsal, cartilaginous support rod, the **notochord**
- **dorsal, hollow nerve cord**
- a muscular, **post-anal tail**
- **segmentally arranged muscle bundles**
- **pharyngeal gill slits**

IN THE COURSE OF COLLECTING SAMPLES FOR YOUR TEAM RESEARCH PROJECT, *DO NOT COLLECT ANY VERTEBRATES, SUCH AS TADPOLES OR FISH, AND BRING THEM TO THE LAB.*

If you find one in a sample

- **Record its presence in that sample**
- **Gently release it where you found it**