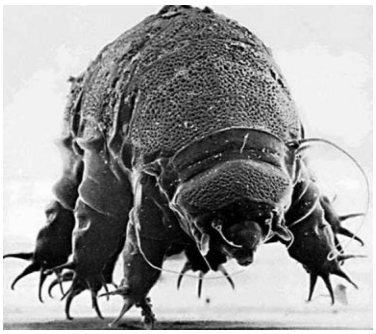
Microscopic Kingdoms Lab (a.k.a. The Water Bear Lab) SB3a-b; SB1a; SB4a

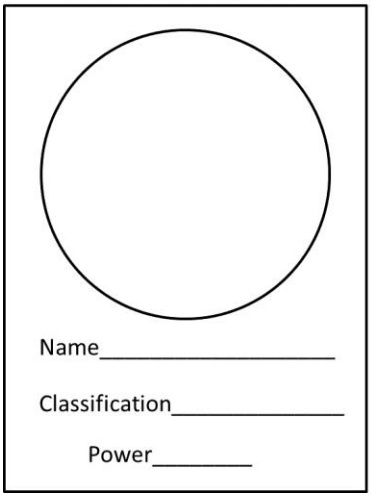
Despite their small size and ubiquity, microscopic organisms are absolutely crucial for life on this planet. Bacteria, or prokaryotes, are essential because they break down dead organic material, allowing raw materials once locked up in animal and plant bodies to recycle through ecosystems. They are in your body helping you to digest your food. They are the only organisms that can covert nitrogen gas into a usable form for producers. In aquatic ecosystems, the bacteria themselves become food for protozoans such as paramecium and amoeba, and these organisms in turn, feed the insects, crustaceans, and baby fish. This builds up food chains and creates an aquatic community. The green and yellow algae (diatoms) are examples of microscopic autotrophs that convert solar energy into complex molecules that can be passed on to consumers. The elusive water bear, or tardigrade, is one of the toughest animals on this planet. They can survive temperatures as low as temperatures as low as -328 °F and as high as 304 °F; freezing and/or thawing processes; changes in salinity; lack of oxygen; lack of water; levels of x-ray radiation 1000x the lethal human dose; some noxious chemicals; boiling alcohol; low pressure of a vacuum and up to 6x the pressure of the deepest part of the ocean. Despite their peculiar morphology and amazing diversity of habitats, relatively little is known about these tiny animals. The same principles of this lab apply to a forest, grassland, or ocean ecosystem. The simple fact is that microorganisms create the ecological foundation for life on planet earth. The relevance of this lab and the organisms you will view, extend well beyond ecological and morphological applications. In fact, most medicines come from other organisms, most of which are microscopic and obscure. The purpose of this lab is to explore the biodiversity of microscopic life in freshwater aquatic ecosystems and to understand how structures and functions vary between the six kingdoms of life. May the quest continue…



1. Examine the water samples available for this lab and describe the appearance of at least three different samples. Note if they is any movement or other signs of life that are visible. Please be descriptive in your qualitative data.

You will have to find organisms moving in sample and then use plastic pipette to capture the organisms. Now place the sample into a Petri dish. Place the dish under a stereoscope and turn on the bottom and/or side light source. You may need to "detain" the organism. This is the exploratory portion of the lab. We will all be working together to survey and document the various water samples. Take your time and enjoy the microscopic diversity. Eventually, you will want to compile nine sketches detailed in question 2.

Field of View Template



2. Make at least nine sketches of different organisms using the field of view template. Copies might be provided. Be sure to label the sketches and list the power of magnification that was used and identify the specimen using the posters around the room or scan the below QR code. Classify each into the appropriate kingdom. Take your time and enjoy viewing the diversity of microscopic life.

QR code for the identification guide

Now take a smaller sample, one that you know has a microorganism, and prepare a slide with slide cover to view under higher magnification using the microscope. Remember to start on the lowest magnification and slowly increase by turning the objective lens while maintaining the same field of view. You may need to "detain" the organism. Be patient and explore the samples thoroughly.

Next, visit some other groups and look at their sketches and/or microscopes. We will discover many amazing organisms, if we all work together. Again, take your time and enjoy viewing the diversity of microscopic life.

3. Describe some of the other organisms that other groups observed that you did not. What traits and characteristics do all of these organisms have in common?

Prepared Slides*: In this section of the lab you will view additional slides (4-8 slides depending on the year) that have been prepared for you. These organisms are often difficult to observe, so this will give you the opportunity to create another series of labeled sketches for some new microscopic organisms without having to chase or detain them. Unfortunately, there is not a slide for the water bear, so hopefully we were successful this year and you have already viewed this amazing creature. Again, use the field of view template for all sketches.*

4. Many of these organisms are motile, which means they can move. What three types of extra-cellular structures allow organisms to move through the water? Which internal cellular organelle also helps organisms to move?

Brine Shrimp*: You will now have an opportunity to view brine shrimp under the stereoscope and microscope. Simply capture a shrimp from one of the beakers or tanks and start exploring. Make a sketch of the shrimp.*

5. There are many brine shrimp species. The scientific name for this species is *Artemia salina*. Use your textbook to define and describe binomial nomenclature. Based on the aforementioned scientific name, what is the genus and species for the brine shrimp you viewed today?

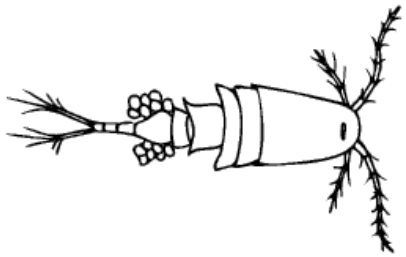
6. Some of the organisms you viewed today were autotrophic. What evidence could suggest that they are autotrophic? Write the chemical equations for the processes that these autotrophs use to obtain energy.

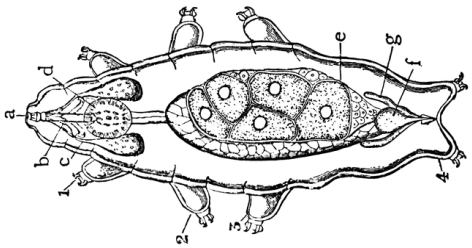
7. Which of the six kingdoms could contain microscopic organisms?

8. Did you observe any prokaryotes in your samples? Explain why or why not and defend your answer.

9. *SB2 Connection*: Despite their simplicity, many of the organisms that you observed reproduce sexually. Identify and explain five mechanisms through which variation can occur in sexually reproducing organisms.

10. Examine the two organisms below (left= copepod; right= tardigrade). Are these organisms uni-cellular? Please defend your answer and be sure to reference structures in the below diagrams. Propose an explanation for why these two organism are so different, despite living in the same aquatic environment.





11. Write an essay that identifies and discusses major differences in the various structures found in the six kingdoms and the specific functions of those structures. At minimum, consider the following in your essay: differences in cell organelles, mode of reproduction, presence/absence and structure of cell walls, means of obtaining energy, heterotrophic/autotrophic, presence/absence of specialized tissues, number and type of cells, aerobic/anaerobic, niche in the environment.

The quest for the elusive water bear continues…

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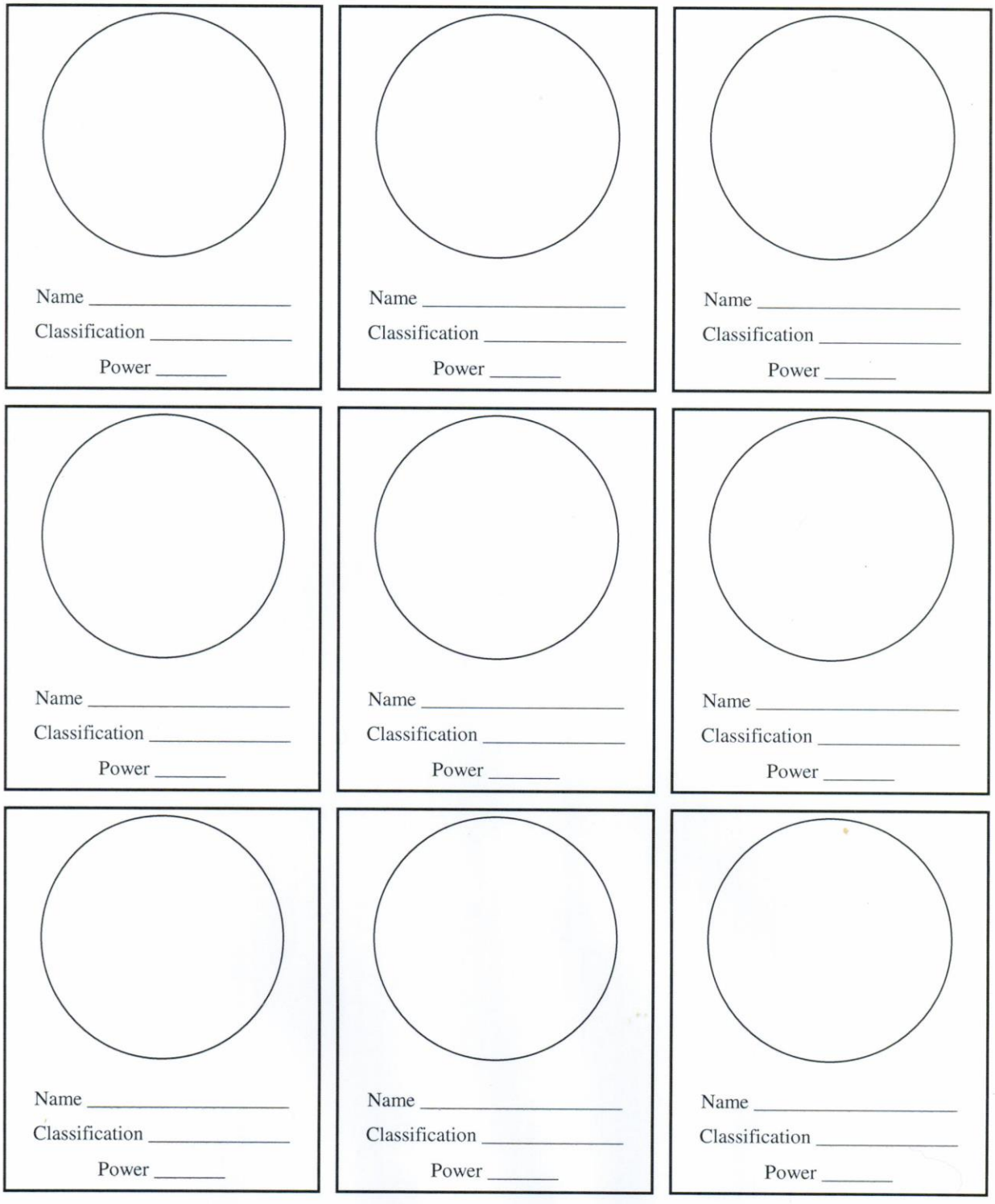
Use this worksheet to document the various organisms your group finds in the pond water samples. Use the identification guides provided to help you identify each organism.



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