ADAPTATIONS AND HABITATS: A MICROSCOPE LESSON PLAN.

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Time: ~1.5 hours
Grade Level: Grade 5 to 7.
(Kids work in groups of 2 or 3).

Materials: pencils, handouts (attached)
Equipment: Dissecting microscopes, pipettes, petri plates. Access to pond water.
Staff: 1 biologist

This activity has been designed to get students to understand and apply the concept of adaptations to habitats. As well, they will implement lab procedures by collecting samples of aquatic microorganisms, and then attempt to examining these samples using a dissecting microscope. Note that this activity is currently paired with the Choose Your Own Adventure writing exercise, as part of one of the SCLS\(^1\) field trips.

1. Set up and supplies.

Per student:
1 large Falcon tube (50ml variety)
1 plastic pipette
1 or 2 small plastic petri dishes
Activity handouts: petri dish note and illustration sheets and aquatic life cartoons
Writing utensils, including coloured pens for illustrations.

Per group of 2 or 3:
Test tube rack
Dissecting microscope (one capable of 10X and one higher magnification setting is suffice)

Other:
Paper towels – this activity can get messy.
Power point
Blackboard or whiteboard
A place to wash hands!
Access to a riparian system


Microbe icon by Aaron Schleichkorn. For more information about the lesson, please contact David Ng at 300-2185 East Mall, University of British Columbia, Vancouver, BC, V6T1Z4 (db at mail dot ubc dot ca)
2. Introduction (<30 minutes)

Instructors will begin with an introduction on adaptations of living organism to their environment. They can start by asking students, if they know what a “habitat” is, and also whether they can provide a number of examples. From here, the instructor can focus on a few. For example, in our slide show, we refer specifically and provide a little bit of description for the following:

**Temperate Rainforest:** Not too cold or hot. LOTS of rain.

**Desert:** Extreme hot and cold. Super dry.

**Aquatic:** Salt and fresh water differences. Temperatures depends on depth and size.

**Arctic and Antarctic:** Super cold. Lots of snow.

At this point, we can talk about adaptations and highlight a general definition for this term. In essence:

**AN ADAPTATION IS A CHARACTERISTIC OF A LIVING ORGANISM THAT ALLOWS IT TO SURVIVE AND FUNCTION IN ITS HABITAT.**

We don’t want to give too much away, since we want the students to think about this a bit more deeply, but a good human example is the fact that we have opposable thumbs, which allows us to do all sorts of interesting things (in a way, our habitats includes our smart phones!)

Now, shift back to our four habitats, and split the class into four big groups. Assign each group one of the habitats, and ask them to spend 5 minutes thinking about the sorts of adaptations that exist for that particular habitat. Tell them that they will be reporting their answers to the rest of the class.

As student groups report their answers, you can discuss and encourage right answers, as well as bring up any other ideas that they may have missed. For example:

**Temperate rainforest:** Natural colours that blend well in forests. Trees tend to have broad leaves to capture sunlight, as well as grow tall to ensure access to sun.

**Desert:** Thick skin to prevent loss of water. Systems to store water. Large surfaces to radiate heat away. Large surfaces to flap for fanning.

**Aquatic:** mechanisms to pull oxygen from liquid. Body shape for movement in water. Plants are buoyant so as to make sure they can reach sunlight.
Arctic: white coats to avoid predation, or be a more effective predator. Mechanisms to prevent organism from freezing (i.e. special coats). Ability to migrate large distances when food is scarce. Plough like structures to clear snow.

Then you can show a video of a cool adaptation to highlight how sophisticated some of them are – e.g. Suriname toad, camouflage octopus. Students can then further reflect and share thoughts on this adaptation.

3. Preparing for microscope activity – Sample Collection! (15 minutes)

Explain that we’re going to collect microorganisms from an aquatic habitat, all the while thinking about the conditions of the habitat and how our microorganisms appear suited for such a living.

PROTOCOL:
1. Each student takes a Falcon tube as they exit the lab and will walk en mass to a nearby riparian system. If one isn’t within easy walking distance, you may need to obtain a bucket sample beforehand. In our case, we collect water samples from the Beaty Biodiversity Museum pond.

2. Do encourage the students to get their hands dirty, and task them with obtaining their water samples from different places – this includes difference depths (for example, there may be different organisms near the surface than those closer to the muddy bottom).

3. Make sure the students do not shake the tubes! We find that such vigorous shaking will lead to less activity when viewed under the microscope.

4. Ask the students to note the characteristics of the pond, such as depth, temperature, presence of plants, light level. In a way, they are making sure they have this information for their specimen collection sheets.

5. When students return to the lab, they can place their Falcon tubes on their racks. Tell them that they can wipe their hands with paper towels, but that it is not necessary to wash them since they will be handling the samples anyway for the next 30 or so minutes.

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2 Check out https://www.youtube.com/watch?v=mZ7b4spjXlw or https://www.youtube.com/watch?v=YVvn8dpSAT0
When everyone is settled and seated, next go over microscope etiquette. A demonstration works well here, and key points to be covered include:

Proper carrying technique of microscope by holding neck and bottom

Showcasing the fact that dissecting scopes will have two light sources – one for light above, and one for light below. We will use the lower light source for our observations.

Highlight how the two lens work together (objective lens – near the sample; eyepiece lens – by the eye). In our case, the eyepiece lens is 10X, and our objectives range from 1X to 4X, translating to a total magnification range of 10X to 40X.

A rookie mistake is to not start on the lowest magnification setting. You can explain the value of doing this by talking about how you might want to find a boat in the water using google maps. In other words, it’s way easier to find something small, when you first start zoomed way out, and then make your way closer (zooming in) to your target.

In general, if the image is blurry, start with the coarse focus until things look sharpish. Then adjust carefully with the fine focus knob if available.

Show them how to pipette droplets of the water sample onto Petri dish (see image below). This works much better than flooding the petri plate with pond sample, because most of the coolest microorganisms are mobile. Working with small droplets, in a way, cages them so that they are easier to view when found.
Draw the organisms on the specimen handout and make notes of adaptations for living in the pond. Also don’t forget to write down the observations of pond characteristics here.

Note that if you don’t have access to microscopes, you can actually make use of an overhead projector. By moving the projector further away from the wall, you inadvertently create a way to magnify the image being projected. This will actually work quite well, especially to observe mobile organisms. Of course, with this DIY option, you won’t be able to make out internal structures.

4. And now the hunt begins! (30 - 40 minutes)

At this point, the students are free to start looking for microorganisms. In general, a lot will depend on the pond sample, as well as the time of year. Warmer months tend to produce more exciting results. If you have a less exciting sample, you and other instructors may need to circulate to help the students find something. Encourage sharing of results (i.e. if someone finds something cool, let the whole class know).

Note that a variety of organisms can be found, that range from really small (i.e. small swimming blobs at the highest magnification) to relatively large (you can kind of see them with just your naked eye). Unless, you’re an expert, it’s actually pretty difficult to properly identify all of the different things you might find. We tend to use the guide from http://www.microscopy-uk.org.uk/index.html?http://www.microscopy-uk.org.uk/pond/ to help, but in many respects, no specific knowledge of the exact identity works well enough.

5. Clean up and wrap up (10+ minutes)

For clean up, do the following:

Dump remaining pond samples into a centralized bucket for putting back in the pond.

Place pipettes, Petri dishes and (now empty) Falcon tubes in the biohazard waste, or garbage bags if you’re doing this in a classroom. If supplies are limited for you, you can wash plasticware and re-use.

Turn off and put away microscopes.

Wash your hands thoroughly with soap and water.

After all of these steps, and if there is time left over, you can guide a short class discussion of observed adaptations.