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Puddle Study

First Grade

Adapted from "Puddles" 2006, *http://www.microbeworld.org American Society for Microbiology and "Biology Experiment: Microbes from a Hay Infusion" 2006, Wayne Robinson and Jane Yonts. http://www.proscopehr.com/pdf/Microbes.pdf Bodelin technologies.*

This is a great lesson to use while teaching about the water cycle, mapping or living organisms. It also helps students learn to conduct science in the schoolyard. Lastly, it opens students' eyes to the microbial world, a vital part of every ecosystem that is often excluded in learning standards.

Enduring Understandings:
Water exists and serves many functions in our homes, schools and neighborhoods.
Different places on earth have different amounts of water which determine basic habitats.
Water exists in 3 phases in many places in the environment.

NYS Standards: Elementary standards for math, science and technology:
Standard 1 (Analysis, inquiry and design):
- M3.1a Use appropriate scientific tools to solve problems about the natural world
- S1.1a Observe and discuss objects and events and record observations
- S1.3a Clearly express a tentative explanation or description which can be tested
- S2.3b Record observations accurately and concisely

Standard 6 (Interconnectedness)
- Identify common things that can be considered to be systems

Standard 4 (Science)
- 2.1c Water is recycled by natural processes on Earth.
- 5.1b An organism's external physical features can enable it to carry out life functions in its particular environment.

Setting: School and Schoolyard

Duration: 15-20 minutes per day after a spring or fall rain. 30 minutes in class.

Materials you will need
20 or more feet of string
Scissors
Black marker
Ruler
Glass or clear plastic jar
Turkey baster (*if available*) or paper cup
Dried grass
Microscopes for viewing puddle microbes, along with slides and eye dropper (*if available*)
Optional mapping activity:
Clipboards, pencil per pair of students
Simple line map of school building and schoolyard

Setting up the lesson
This lesson will take place a few hours after a rainstorm. It can also be repeated several times after different rainstorms, as each storm may yield different and interesting results.

Lesson

1. Puddle Inventory
While most students typically know where puddles are in their schoolyard, it is still a helpful introductory exercise to conduct some sort of "puddle inventory". You can make a very simple map of a schoolyard by tracing an aerial photo (which can be found easily on GoogleEarth). Then, give the students a copy of the map, head outside and ask them to mark where they find puddles. They can use a different color for large puddles and small puddles, or maybe for puddles on pavement or grass/mud. If you choose not to have the students do a map, you can ask them to tally the number, size and type of puddles in the schoolyard. By looking at the slope and surface of the schoolyard, this inventory can lead to interesting discussions about why some puddles are in some places, why some puddles are large or small, or why some have clear water and others have brown water.

2. Measuring Puddles' Rate of Disappearance
After doing an inventory of puddles in the schoolyard, ask students to choose puddles to compare the rate of "puddle disappearance". Suggest that they choose the 2 puddles that they think will disappear the quickest and the slowest. Do not let them use the word "disappear" for what is happening to the water. The puddle is disappearing, but not the water. Be sure to ask them to think about where the water will go, since it has to go *somewhere.* Their knowledge of the water cycle will likely lead them to say that the water evaporates, but remind them that some of the water will also seep through the bottom of the puddle.

Once they have chosen which puddles they will measure, have them use the string to measure the circumference of the puddle. Have a data recorder write down the size of each puddle, the time it was recorded and the weather conditions (sunny, cloudy, rainy, clear, etc). Then a few hours later (or the next morning), collect the same data.

Once the puddles have disappeared collect the data and discuss what happened and why. You may have to brainstorm with them which variables impact evaporation (temperature and sunlight) or infiltration (impacted by how wet the surface already is, or whether water can seep down). The class may decide to conduct the same experiment after the next rainstorm if they come up with more questions.

3. Collecting puddle water sample
Puddles are, in fact, short-lived freshwater habitats. Such habitats can indeed provide a place for organisms to live. A puddle will likely have several types of microorganisms, like algae bacteria protists and fungi. While many of these may be too small to see without powerful microscopes, children can likely look at strings of algae under a simple microscopes. If the puddle is there long enough, you could have insects and or frogs lay there eggs in the puddle (in fact, puddles can be pesky breeding grounds for mosquitoes!). There can also be other small arthropods like insect larvae, daphnia, water mites, tardigrades or copepods (see simple identification drawings at the end of this lesson).

Using a turkey baster or paper cup, collect a sample of puddle water. Getting dirt from the bottom of the puddle is fine, but try to not have too much sediment in the sample. Put the sample in a clear glass or plastic jar.

4. Hay infusion of puddle water

Once you have collected samples of puddle water, label them with the name of the puddle and the date collected. Then find some dried grass (that has not been sprayed with herbicides or pesticides) and submerge a couple straws in the water. The hay will provide nutrients and sugars for bacteria in the water. Then, the bacteria will provide food for protists in the water, thus increasing the density of protists in the sample. These protists, often being larger than bacteria, can then be observed by students. Once a day use a eye dropper to "blow" bubbles in the water in order to provide oxygen for the protists. After about one week, students can then observe the protists. As this sample contains many species of bacteria, most of which are probably harmless. However, for precaution sake, it is important to avoid touching the sample water and thoroughly wash any surfaces. If the class wound like to continue the growth of the hay infusion, add more puddle water and hay each week. However, do not put too much hay, as this will cause an explosion of bacteria, whose waste will pollute the water. Lastly, hay infusions can also be done on any freshwater sample.

5. Observe and draw puddle microbes, insect larvae and other life!

Using an eye dropper, remove a drop of water from the sample (you can try comparing drops from the top, medium and bottom layers) and place that drop of water on a slide to view under a compound microscope. You can also look into the jar and try to catch visible arthropods like daphnia or copepods. Then, using the identification table on the following pages, ask students to identify and draw the organisms they find. You can discuss what the food chains or food webs in the sample are, or you can make comparisons between the organisms from different puddles.

6. Assessment

Ask students to draw a puddle ecosystem during a rainstorm, 5 minutes after a rainstorm, 2 hours after a rainstorm, and 2 days (or more) after a rainstorm. Use the rubric below to evaluate their responses.

	4	3	2	1
Puddle Microbes and Small Animals	Students accurately draws most of the microbes observed, not using his/her imagination	Student accurately draws the microbes, but only draws one or two of the several seen.	Student incorrectly draws microbes (they are clearly not made up, but or incorrect)	No microbes or small animals are drawn, or only imaginary organisms are drawn
Changes in Puddle over time	Each stage is different in size, and also shows differences in the living and nonliving aspects of the puddle	Each stage is different in size, but no other changes are drawn	The changes are very slight and do not reflect the changes observed during the lesson	Each stage is the same
Complete Ecosystem	The boundary of the puddle is drawn, and the water entering and leaving (evaporation and infiltration) are depicted	There is a clear boundary and only the input or output is drawn.	There is a clear boundary but nothing shows how water enters or leaves	The boundary is unclear and the input and output of water is absent or incorrect.

Freshwater Microbes and small Arthropods

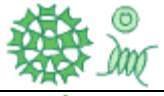
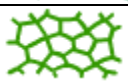
Drawings and information from:
Pond Life Identification Kit: a simple guide to small and microscopic pond life. Wim van Egmond and Dave Walker
Micscape Magazine, November 2000.
http://www.microscopy-uk.org.uk/mag/indexmag.html

Arthropods (invertebrate animals with jointed appendages and exoskeletons)

Ostracods (types of crustaceans)		bean-like shell <2 mm
Copepods (types of crustaceans)		long antennae, tiny eyespot 0.5 - 3 mm
Daphnia ("water fleas")		antennae, large compound eye 0.3 - several mm
Water bears (Tardigrades)		8 stumpy legs body <1 mm
Water mites		8 legs, round body 0.5 - 5 mm
Mosquito larvae (e.g. fly)		Long, slender body, often moves in S-shaped curves 1 - 20 mm

Egmond and Walker. 2000

Algae (microorganisms that may or may not live in colonies. All algae do photosynthesis.)

Flagellated forms (flagella may not be visible)		
Euglenoids		green, flagella (whip-like cilia), free-swimming, red eye spot, body is flexible <0.4 mm
Dinoflagellates		brown, 2 flagella, (1 in girdle), free-swimming, tough armour <0.4 mm
Volvox (type of Green Algae)		Special colonies of cells
Non-flagellated forms		
Blue-green algae (cyanobacteria)		blue-green, often slow locomotion, used to be considered algae but more related to bacteria cells<0.05 mm colonies can be many mm
Diatoms		usually brownish, silica cell wall in two parts, solitary or colonial, some have a slow gliding motion <0.5 mm
Desmids		green, no flagella, mainly solitary, some colonial, various shapes, two semi-cells which are mirror images <0.5 mm
Green algae (Chlorophyta)		Green, may or may not move, not attached to a surface
Water net		a sock-like colony, green algae
Filamentous forms		
Pond scum (Gamophyta: conjugating green algae)		non-branching, green, chains of cells with distinctly shaped cell contents cell with <0.1 mm. length: centimeters
Other non-branching forms		
Branching forms		
Red algae (Rhodophyta)		mainly marine, but some freshwater forms, not always red

Egmond and Walker. 2000

Other Protists (algae are types of protists)

Amoeba		move with pseudopods 0.02 - 5 mm
Shelled amoeba		amoeba with a shell e.g. of sand grains 0.1 - 0.4 mm
Heliozoans 'Sun animalcules'		immobile, spherical with radiating hair-like pseudopods 0.01 - 1 mm
Ciliates - Peritrichs		cylindrical or bell-shaped bodies, undulating membrane of cilia, some stalked, often colonial and attached to animals or plants bell: <0.25mm
Ciliates - Suctoria		on water plants and other animals, adult ciliates have lost cilia, sticky tentacles capture prey <0.7 mm
Other ciliates	 *Coleps*	various, mostly free living forms
	 *Lacrymaria*	cell usually of a fixed shape but can be contractile, or extending neck, cilia of various forms, fixed mouth 0.01 - 4 mm
	 *Paramecium*	
	 *Stentor*	
	 *Spirostomum*	

Egmond and Walker. 2000