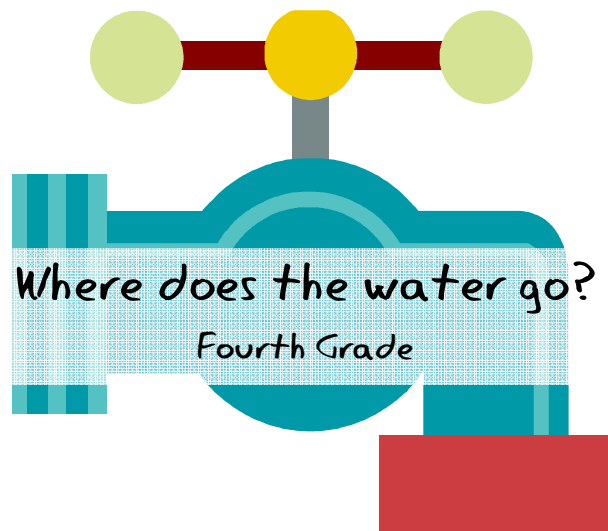


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Enduring Understandings:

- We have different systems for managing, modifying and supplementing “natural” water pathways for human purposes.
- Water moves between different parts of the environment in response to understandable forces.

NYS Standards: Elementary standards for math, science and technology:

Standard 1 (Analysis, inquiry and design):

- S1.3 Develop relationships among observations to construct descriptions of objects and events and to form their own tentative explanations of what they have observed.

Standard 6 (Interconnectedness)

- observe and describe interactions among components of simple systems
- identify common things that can be considered to be systems (e.g., a plant, a transportation system, human beings)
- analyze, construct, and operate models in order to discover attributes of the real thing
- discover that a model of something is different from the real thing but can be used to study the real thing

Standard 4 (Science)

- 2.1c Water is recycled by natural processes on Earth.
- 7.1a Humans depend on their natural and constructed environments.
- 7.1c Humans, as individuals or communities, change environments in ways that can be either helpful or harmful for themselves and other organisms.

Setting: Classroom and nearest wastewater treatment plant.

Duration: A 30 minute class session, a one hour field trip, and a 20 minute follow-up. The first class session should be several days or weeks before the field trip.

Materials you will need:

Large, clear container with a lid (used to put “dirty water”) containing several cups of clear water and 3-4 inches of clean sand at the bottom

One copy of the “who dirtied the water?” story (attached here)

A few tablespoons of various types of fake pollution placed in small containers (can be altered):

Lemon juice, small pieces of litter, vegetable oil, kool-aid, mud, salt, water with food coloring, clear water

Many people never stop to think about where the water that goes down the drain or flushes down the toilet goes. This lesson and field trip has been revealing for students and adults alike! It also helps students trace water through the community, and understand that simple processes involving filtration, gravity and

For model filter:

- Plastic soda or water bottle for every 4-6 students, with bottom cut off and lid removed
- 2 large cotton balls or handful of cotton filling per bottle
- 1-2 cups of sand
- 1-2 cups of gravel
- A handful of small rocks
- Plastic cup for each group of 4-6 students
- Basin or bucket for the filtered water to drain into

For field trip to wastewater treatment plant:

- 1 “wastewater travel log” per student
- 1 “wastewater travel log for chaperones” for each chaperone
- Clipboard and pencil per student
- 4 Compound microscopes with slides and eye droppers (optional)

Story (optional): “*Excuse me, is this the way to the drainpipe?*” by Ellen Fry and Frank Aho. Available for free at http://www.epa.gov/ne/students/pdfs/ww_drain.pdf

- 4 copies of labels to accompany story (attached here)
- 8 envelopes, 4 labeled “town or city” and 4 labeled “the countryside” to accompany story
- Bottle of bottled water and a bottle (identical to the first) of the school’s tap water
- A small cup or glass for each student

Setting up the Lesson

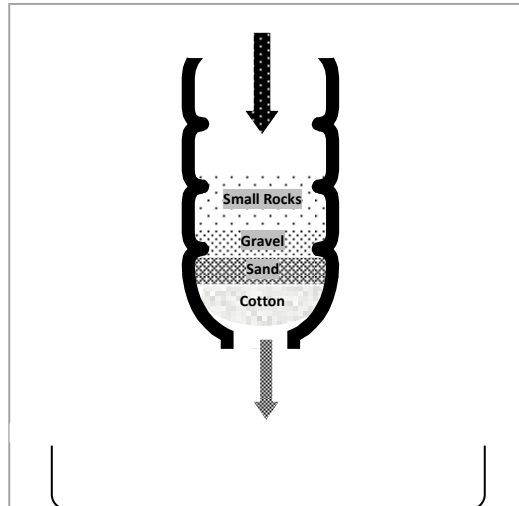
1. Contact your local wastewater treatment plant and ask for a tour. In our experience, wastewater treatment plants have been very welcoming to field trips, and have not charged. If it is possible to walk to the treatment plant from the school, even better.
2. Visit the treatment plant and adapt the attached travel log as necessary.
3. Ask the staff at the treatment plant if they are willing to put a sample of water from the aerobic pool under a compound microscope for students. This is the pool that contains microorganisms that eat the solid waste, and it is fascinating to see them chomping away under a microscope!
4. Prepare the small containers of fake pollution, adjusting the materials and story so that it is most suitable to your community. The attached story was adapted from “Who Dirtied the Water?”, *Water Resources of the Catskills, Module 1* of the Catskills: A Sense of Place.
<http://www.catskillcenter.org/programs/edu/enviredu.html>
5. Print one copy of the “Excuse me, is this the way to the drainpipe?” story by *Ellen Fry and Frank Aho*, and print the attached labels and prepare labeled envelopes.
6. Prepare the materials for the model bottle filters, the student will build the models themselves.

Lesson**1. Begin by making dirty water**

Create student groups that represent each character in the *Who Dirtied the Water* story. Stand in the front of the room with the large clear container half full with clear water and a few inches of sand. Explain that this represents water from a local stream, including the water in and below the stream bed. Now, call up one group at a time and have one student read their paragraph, and another pour the pollution in the stream sample. Continue until the stream sample is completely polluted. Be sure to make the point that while we can see some of the pollutants, we can’t see them all. In reality pollution is rarely visible. Place the closed container in a visible place in the classroom. You can either go directly to the filtering activity, or have the sample sit for several days, weeks or months! The sample will likely change and may become quite smelly, all the better for elementary school students!

Before leaving for the field trip, try filtering the dirty water

2. We implemented this activity after realizing that the first group to visit the wastewater treatment plant did not understand the idea of filtering, which is an important last step in treating wastewater. Ask the students what they know about filters. Many may only be able to relate to a coffee filter that their parents might use at home. Tell that we are going to open up the dirty water and try to filter it. Ask, “Do you think this will get the pollution out”? Explain that some pollution can be filtered out, but some cannot. Give them the materials they need to build a filter and ask how they would construct it.
3. After they have built their filter give them some polluted water and ask them to filter a small amount at a time and write down what the filtered water looks and smells like.
4. Ask them what this polluted water represents, and how polluted stream water might be similar and different to wastewater. A class list of similarities and differences may be helpful. While wastewater may have pollution in it, that would mainly be pollution that is put down a drain or toilet. Wastewater is mainly human waste, soap and other cleansers.



Field trip to the wastewater treatment plant

5. Before leaving give turn on water in a classroom sink or water fountain. Tell them that the class will be following the journey of *that* water. Give students a travel log and have them fill out the first question.
6. If the class is walking to the plant, have them count the number of manholes they see along the way. Explain that these manholes sit above the sewage pipes, and are used to repair the pipes.
7. When they arrive to the plant they should begin the tour at the first stop in the journey of water and follow the water as it gets cleaner. In each box they should draw and describe each stop along the wastewater treatment journey. The chaperone copy has answers that will allow them to help the students.
8. If possible, view and draw the microbes from the aeration pool before leaving the plant.
9. Now that they understand what happens to water that leaves their home and school, ask what happens to water before it arrives to the tap? Where does it come from? Is it treated? The staff of the wastewater treatment plant will be able to answer those questions for the students.
10. If the class is walking, they can count the small plates that cover the valves which connect buildings to municipal drinking water. These are often the size of a jam jar lid.
11. If possible, contact the staff at the drinking water treatment plant and have a similar field trip.

“Excuse me, is this the way to the drainpipe?”

12. Read this story upon returning from the filed trip. As you are reading, relate back to what they saw at the treatment plant.
13. When completed, give each group of students one copy of the labels, one envelope that reads “town or city” and one envelope that reads “countryside”. As them to place the correct labels in the correct envelopes. This can be used on an individual basis, and also can be used as an assessment.

Who Dirtied the Water?

Story adapted from “Who Dirtied the Water?”, *Water Resources of the Catskills, Module 1* of the Catskills: A Sense of Place. <http://www.catskillcenter.org/programs/edu/enviredu.html>

We are going to make some really polluted water. There might not be a place in the world with so much pollution, but this way we can learn all about pollution. We are going to pretend that Wappinger Creek gets really, really polluted. I am going to leave this polluted water in your classroom and we will try to clean it up later after we learn about water treatment.

One at a time, students will read a part of the story and add their pollution.

This is a story about a beautiful creek called the Wappinger Creek. It begins its journey on Mt Stissing near Pine Plains, and it travels south to Millbrook, through Pleasant Valley, on to Poughkeepsie and then it finally empties into the Hudson River at the town of Wappingers Falls. Along its journey, it fills the ground with water, it supplies towns with drinking water and it carries treated water downriver. It also supplies a place for many fish and insects to live, for deer to drink and for people to swim!

But Wappinger Creek was not always so clean...

Once there was a **homeowner outside of town**. “I have a septic system to treat the water that gets flushed down my toilet and goes down my drain. The water sits underground in the septic tank. The solid waste stays in the tank, while the dirty water filters through the ground and is treated by the bacteria living in the ground. Sometimes I dump toxic household cleaners, medicine and paint down the drain.” POLLUTE!

Then there was the **neighbor** for the first homeowner. This neighbor had a beautiful lawn. “My lawn is so green and beautiful- I bet all my neighbors are jealous! How do I keep it clean, you ask? Well, I put a lot of fertilizer (which has lots of nutrients for the grass) and I also put a lot of herbicides (that kill weeds). I also give it a lot of water. I wonder if all those chemicals wash off the lawn when I water?” POLLUTE!

Then there was a public park on Wappinger Creek. **Park goers** enjoyed visiting the park and creek on Sundays. “We like to play with our dog, barbeque, swim and play games. The park only has a couple trashcans and there are full, so we just leave our trash like plastic, leftover food and dirty socks here. Not too many people use the park, so it is no big deal. Plus, someone from the village will probably pick it up for us.” POLLUTE!

There there was a **dairy farmer** that supplied delicious local milk. “In order for my cows to eat enough grass, and produce plenty of milk, I let them eat as much grass as they want wherever they want. Sometimes they eat all the plants living on the edge of the creek, and so when it rains- you know what happens? The soil at the edge of the stream falls off (erodes) into the water.” POLLUTE!

Then there was an **apple farmer** that grows sweet apples. “In order to produce all these New York apples I use some pesticides to kill the insects that eat apples. Sometimes these pesticides go straight into the ground, especially when I spray more pesticides than I really need or when I spray before a rainstorm.” POLLUTE!

Then there was the **Department of transportation worker** who keeps our roads safe in the winter by putting salt on the road so that the snow will not make ice. “I put salt on the roads, especially before and after storms. I try to put as little as possible, but I have to use some salt for the safety of all drivers.” POLLUTE!

Then there was a grocery store built near the creek. This grocery store had a really big **parking lot**. After every rain, oil and rust from cars, litter and salt were washed off into the creek.

Then there were the polluters that were further from the creek. **New York City drivers and electrical companies** produced smoky pollution that traveled up to the sky. That pollution was carried by wind, sat in clouds and then when it rained- do you know what happened? That pollution fell with rain into the ground and eventually into the creek. We call that acid rain

	Before filtering	After filtering once	After filtering twice <u>and adding baking soda</u> (to reduce acidity)
Odor Does it smell?			
Clarity/Color Is it brown or Cloudy?			
pH Is it acidic or basic? Acidic = 0-6 Basic= 8-14 Neutral=7			



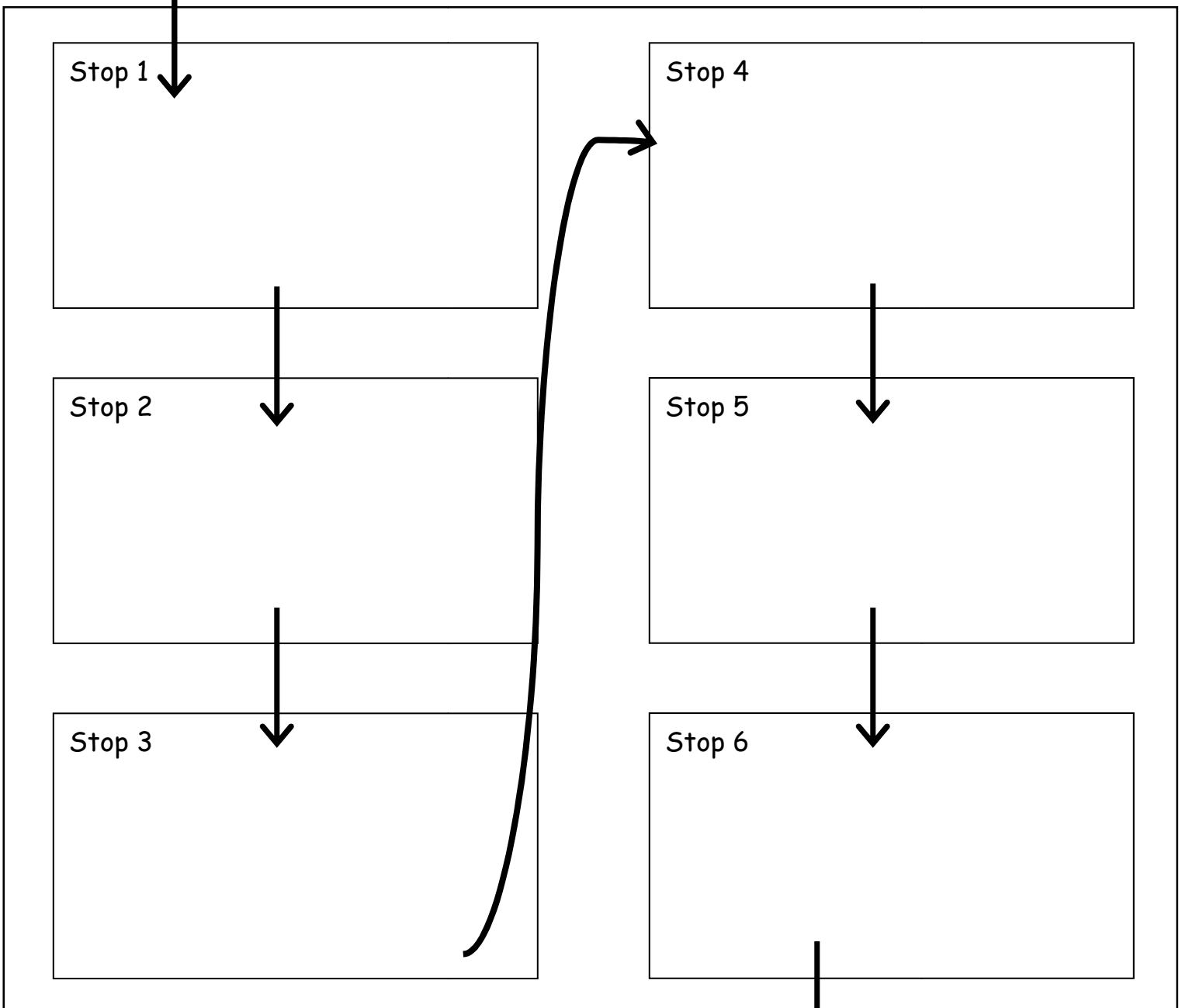
Wastewater Travel Log Millbrook Sewershed



The journey of this drop of wastewater will begin at _____

How many manholes are there on the way to the plant?
Below those manholes are sewer pipes!

The wastewater drop arrives to the sewage treatment plant! Record each
step along the wastewater's journey to getting clean.



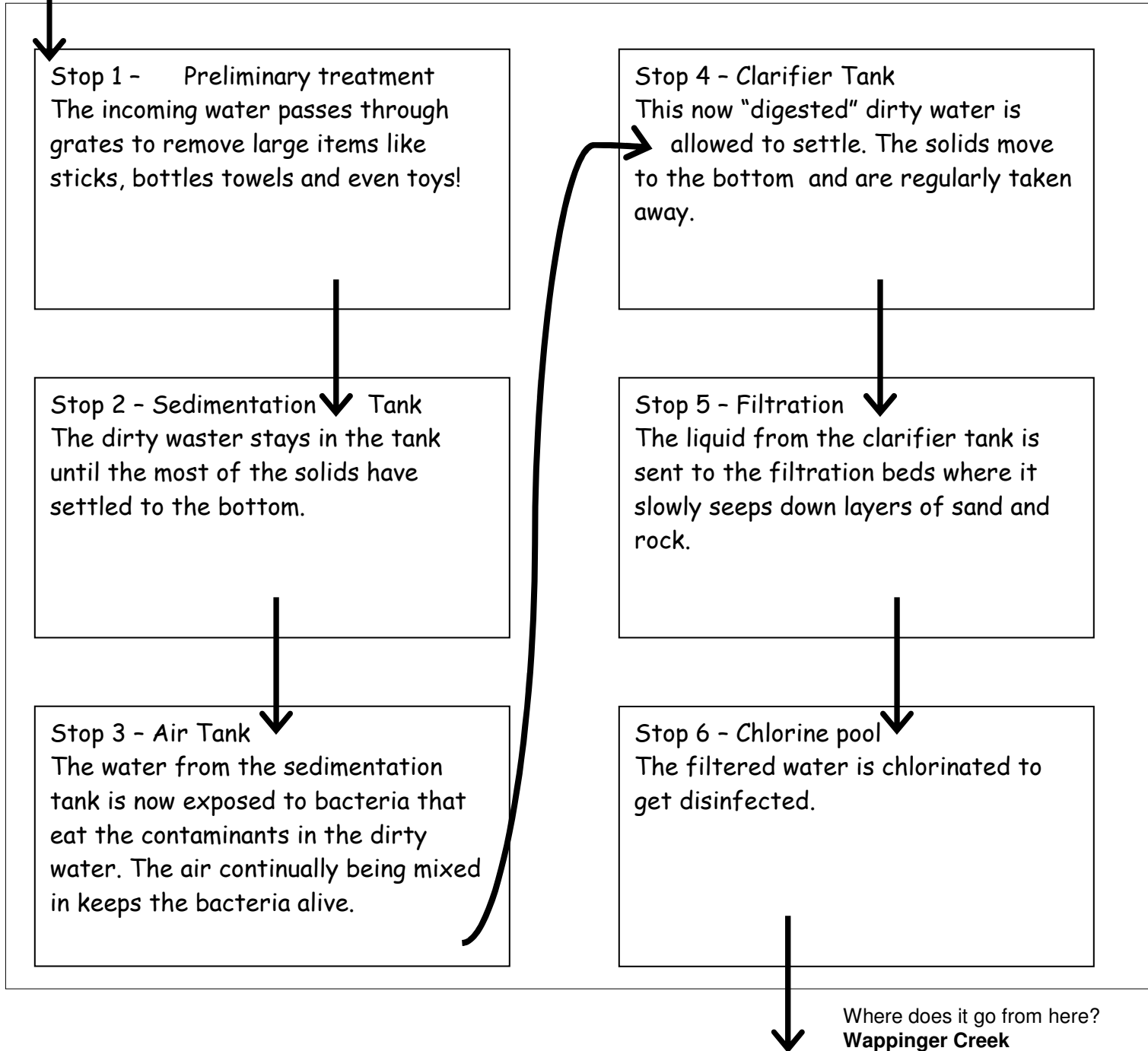
Draw what you see under the microscope

How many drinking water holes are on the way home?
Below these are pipes that bring us drinking water!

Wastewater Travel Log in the Millbrook Sewershed - chaperone copy

The journey of this drop of wastewater will begin at classroom sink

The wastewater drop arrives to the sewage treatment plant!



Labels for the story, "Excuse me, is this the way to the Drainpipe?"

Bacteria

Bacteria

Septic tank for wastewater

Small well to collect groundwater

Water treatment plant

Wastewater treatment plant

Bacteria

Bacteria

Septic tank for wastewater

Small well to collect groundwater

Water treatment plant

Wastewater treatment plant