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Fall 2021 TIPS
4th Grade Unit
Where Does Our Water Come From?

# Unit Abstract

Water is essential to all living organisms. Without water all human life on earth would cease to exist. With this is mind, it is important for students to understand where their water comes from and why it is safe for them to drink. This unit is intended for 4th grade students and will explore the story of water, from the oceans, to the clouds, to the rivers, and to the faucets of our students. Students will learn how water gets from nature to their sinks, all the possible water containments, and why their water is safe to drink. The whole unit should take 4 weeks with three lessons per week.

This unit does require the purchasing of materials. Every material can be purchased at the dollar store except for materials in Lesson 7-9. All other materials are priced at $1. A total cost breakdown for each lesson is provided; the total cost for a group over the course of the whole unit would be approximately $100 for a classroom of 30 students.

# Unit Content

## Module 1

In Module 1, students are introduced to the driving phenomena of the lesson: running water, and start to explore where our water comes from. In order to do this, students learn about the water cycle. The water cycle is incredibly important to our ecosystem for without it, we would not have a replenishing water ecosystem. Water doesn't necessarily start anywhere, but for the purpose of this mental exercise, let us pretend that water starts in the oceans (the biggest bodies of water in the world). As the sun's heat bears upon the water, the water molecules at the surface of the water begin to heat up, and, slowly but surely, move faster than the water molecules below them. These molecules move so quickly that eventually they break apart from the rest of water and "evaporate" up into the air (a single water molecule is lighter than air, it will float up into the sky) (NatGeo, 2021). Once up in the cooler air of the atmosphere, the water

molecules will cool down and become attracted to each other (due to the slight positive charge of the hydrogen atoms and the slight negative charge of the oxygen atoms) (USGS, 2021). I like to tell my younger students that water is "sticky" and show them how water will stick to fingers or hands after washing (demonstrating the stickiness of water). These attracted water molecules condense together into clouds (condensation). Finally, when these clouds of condensed water vapor become saturated enough (and grey enough) with water, they will release their contents upon the earth (precipitation). Eventually this rain water will make its way back to the ocean and the process will start again. I should note that this process does not start with an ocean, it can start with any body of water (small or large) that has the ability to evaporate into the atmosphere (as is demonstrated in the first and second lesson of this unit).

In the first lesson of Module 1, students will create an initial model of how they think water gets to them from the faucet. This initial model will help guide them throughout the whole unit and they will return to their model to modify and change their thinking throughout the unit. Then they will come up with questions that they think will help them to solve the overarching question of "where does water come from." Finally, students create a model of the water cycle inside a plastic bag and along with an open cup of water, will leave the two on a windowsill or wall with sunlight. In the second lesson students will observe their cups and baggies. They should see that water has evaporated from their cups and the water level is lower, and that water has evaporated in the baggies but was trapped inside the bag and condensed into a cloud at the top. In the third lesson, the teacher will bring in cotton balls, a strainer or colander, a clear container underneath for the strainer to sit in, black food coloring (optional), and something to pour water with. The cotton balls will go inside the strainer and the strainer will sit atop the clear container. One by one students can come up and pour a little bit of grey color water on top of the cotton balls. Eventually the cotton balls will turn grey and start dripping into the container below, demonstrating as clouds fill up with water they will begin to rain. After this experiment, in the second half of the third lesson, the teacher will lead a discussion about what the students have learned and how it relates to their question of "where does water come from." Students should be able to explain the water cycle using the information from the evaporated and condensed water from the cups and baggies experiment, and the precipitating water from the cotton ball and colander experiment.

# Module 2

Once students understand the basic principles of the water cycle, we want them to start to question where their own water comes from. In Module 2 students will explore the greater Philadelphia area using maps to understand the Delaware River Watershed. Most of our water comes from the Delaware River Watershed. A watershed is a land area that directs water towards a centralized body of water, think the valley between mountains collecting rainwater at the basin and creating a river ( (NOAA, 2021). After a rainfall the water will eventually flow to streams, rivers, and lakes, this is accomplished through water run off. The most common form of run-off is direct run-off, where rainwater flows towards an established body of water by the process of gravity (like a river). In Philadelphia we get all of our water from two major rivers, the Schuylkill and the Delaware River. In our seminar with Professor Howarth, we discussed at length the health hazards that come with water runoff. Whatever has collected on the ground, primarily trash, or whatever chemicals may be on the groud from roadways, industrial factories, or farming can make their way into our drinking water sources (the Delaware and Schuylkill Rivers). Containments in the water may include: microbial contaminants (viruses, bacteria, and parasites) from sewage treatment plants, septic systems, or agricultural livestock and wildlife; salts and metals from industrial run off and roadways, oil and petroleum byproducts from gas and oil production; pesticides and herbicides from farms, golf courses, or lawns; and even some radioactive contaminants (PWD, 2020)

If ingested many of these contaminants could cause serious illness, cancer, or even death. In 2014, 7,500,000 illnesses in the US were a result of waterborne transmission (Collier, et al., 2021). Take for example, giardia. Giardia is a tiny parasite which can cause severe diarrhea in animals and humans (CDC, Parasites - Giardia, 2021). Giardia occurs in fecal matter and can find its way into our water sources through various forms such as farm water run-off (CDC, Giardia and Drinking Water From Private Wells, 2021). Without our water filtration systems put into place by the EPA we would have many more cases of giardia each year (EPA, 1989). According to the PA Health Department, in 2016 they were recording between 650 and 1100 cases of giardia per year (PA.DOH, 2016). In 2016 Pennsylvania's population was 12.78 million. If we look at other countries with similar or even smaller populations Belgium (11.33 million), Bulgaria (7.128) they had 1,998 and 1,368 cases respectively (ECDC, 2018). Without adequate filtration systems, giardia could resurge and once again become a problem. It is for this

reason and many other contaminant concerns that we need to clean our drinking water thoroughly and properly.

In Module 2, students will figure out where the water goes after it rains and why we need to clean it so thoroughly. The concept of a watershed will be introduced and students will understand that within a given region, all water run-off will eventually lead to centralized locations. In the fourth lesson, students will crumple up a piece of square aluminum paper, uncrumple it and tape it down to a piece of paper. It should look crumpled with lots of peaks and valleys. Students will use a blue, black, green, or purple marker to mark the tops of all the ridges. They will then spray water along the tops of the mountains and they should be able to see the water picking up the coloring and running down the mountains and into the valleys. The students can make the connections that the water raining on the mountains will lead down to rivers and streams. In the fifth lesson students will use the provided map template for Eastern Pennsylvania, New York, and New Jersey to color in the Poconos Mountain Range and the Appalachian Mountain Range, the Delaware and Schuylkill rivers, and Philadelphia. Students will research where the most rainfall occurs. Students should come to the conclusion that it rains the most in the mountains, all that water flows down into the rivers, and that water comes to Philadelphia. Finally, students will brainstorm all of the sources of water contamination that can make water polluted: oil and salt from roadways, fertilizer and manure from farms, combined sewer overflow, trash that washes into storm drains. In the sixth lesson students are given two different water samples to taste test (one from the schools drinking fountain and one from a bottled water company of your choice). The students compare the two and think about why the water tastes different (or the same). The teacher will make the point that taste may be coming from minerals that are not harmful and do not necessarily mean that the water is dirty. At this point students should start thinking about cleaning the water that is in the rivers that they are drinking. The teacher will put up a slide showing dirty river water under a microscope. Students will brainstorm different ways they can clean their water and the teacher will guide their brainstorming towards the idea of a water filter.

## Module 3

According to the City of Philadelphia, there are three water treatment plants: Baxter, Queen Lane, and Belmont. Baxter takes water from the Delaware River and Queen Lane and Belmont both get water from the Schuylkill River. The process of cleaning and filtering water comes in 8 steps. Step 1: put the dirty water in a large tank and allow all the large sediment to fall to the bottom (this is called *gravity settling*). Step 2: add the chemical *sodium hypochlorite* which will disinfect the water and kill most disease causing organisms. Step 3: add a coagulant to make incredibly small suspended sediment clump together; also add Lime to adjust the PH level of the water. Step 4: another gravity settling to allow the newly coagulated material to settle at the bottom. Step 5: another round of sodium hypochlorite to disinfect the water. Step 6: filter the water through various filters (sand, charcoal, and gravel) which will remove the various sediment and dead bacteria and viruses. Step 7: fluoride is added to the water to prevent tooth decay, Zinc Orthophosphate is added to minimize pipe corrosion and Ammonia is added to keep the disinfectant in the water and reduce the chlorine taste and odor (from the hypochlorite added in step 2 and step 5). Step 8: send the water off through the pipes to the residents of Philadelphia (PWD, 2020).

In the 3rd Module students will explore the idea of water cleaning and filtration. In the seventh lesson students will make their own water filter. This can be accomplished by having the teacher cut off 1-liter bottle heads about 5 inches from the top, attaching cheese cloth to the lip of the bottle, and placing the top half of the bottle lip-side down into the now-exposed second half the bottle. The students can then fill up the filter with wood chips, sand, rocks, and activated charcoal. Muddy water (teacher-made) can then be passed through the filters and students can evaluate how well their filter worked. Students can then compare their filters to pictures of cross-cut filters to find the similarities and the differences. In the eighth lesson students will retry their water filter using the information they learned from the last class. In the ninth and final lesson students will explore the idea of chemical filtering. Students will be introduced to the idea of Iodine and will watch the teacher use Iodine on water. Permission slips will be needed ahead of time for this, but you could have two different bottles, one with Iodine one without and you could have the students taste it, since Iodine leaves a distinct taste in the water.

## Module 4

In the 4th and final module students will have three class periods to work on a project to demonstrate what they have learned throughout the unit about how water gets to them. Students may work in groups or by themselves, they can create models, write a story, draw a cartoon or comic, or even create a poem or play that demonstrate how the water cycle works, how water gets to Philadelphia, and how that water is cleaned. No lesson plans are provided for this module since the outcomes of these lessons are very much up to the teacher and their students. I stress that while no lesson plans are provided this module is the most important module. This is when students compile all of their thinking and learning into a cohesive idea. They will learn team working skills if they are working in a group and they will develop confidence by presenting their ideas to the class. Please to do not skip this last module.

# Pedagogical Approach

This unit will utilize the *phenomena-based learning approach.* Phenomena based learning is an approach to teaching where students are presented with an initial phenomenon which they cannot explain (NGSS, 2021). The rest of the unit is spent asking and answering questions and completing experiments to help them figure out a way to explain the phenomenon (NGSS, 2021). In this unit, the phenomenon is very simple, it is a faucet turning on and the water coming out. That is an amazing achievement, since for most of humanity's existence, this has not been the norm, and still for some today it is not the norm. The students will be tasked with explaining how the water got there, and how we know it is safe to the drink.

In the first lesson students will be introduced to the phenomena and will be tasked with brainstorming together an explanation to the phenomena without any prior knowledge. This is called an "initial consensus model." As students explore the water cycle, water run-off, and water filtration, they will revisit this initial explanation throughout the unit to update their thinking and keep track of what they have learned. Finally at the end of the unit, students will sum up everything they have learned in some sort of final project. This can be a story, a comic book, an experiment, a model, or anything they can think of which demonstrates their learning throughout the unit.

# Teaching Strategies

**Modeling**: Students will create three models during the unit, a model of the water cycle, a model of a mountain range, and a model of a water filter. These models allow students to visualize the scientific concepts of evaporation, condensation, precipitation, run off, and filtration in a tangible form.

**Compare and Contrast:** in two lessons students will be tasked with comparing different maps of the Philadelphia Tri-State Area as well as comparing different water samples collected from Philadelphia. These activities will encourage students to analyze and think critically about the water they are drinking and the geographical region they are a part of.

**Cooperative learning:** Throughout each lesson students will be asked to work with the people around them. Additionally, students will have the opportunity to work in groups during the mountain range and water filter activity.

**Inquiry Based Instruction:** Each lesson will start with a question which the students are tasked with answering by the lesson's closing. By answering these questions students will gain a better understanding of how to answer the overarching unit question and how to explain the unit phenomenon.

**Anticipation Guide:** Students will ask questions about the phenomenon at the beginning of the unit. These questions will help guide their inquiry as the teacher weaves their questions into the various lessons. By having students brainstorm their own questioning, this empowers their own learning and makes these lessons feel more real to them.

# Resources


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NGSS. (2021). *Phenomena*. Retrieved from NGSS: https://www.nextgenscience.org/resources/phenomena

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PWD. (2020). *2019 Drinking Water Quality Report.* Philadelphia: Philadelphia Water Deparment.

USGS. (2021). *Water Cycle for Kids*. Retrieved from The USGS Water Science School: https://water.usgs.gov/edu/gallery/watercyclekids/condensation-clouds.html#:~:text=Condensation%20happens%20because%20of%20temperature,condensation%20happens%20and%20clouds%20form.

# Classroom Activities/Lesson Plans

The following nine lesson plans are intended for 45-minute blocks. At the end of the lessons are printouts for the various worksheets needed, along with the various pictures or diagrams needed throughout the unit.

## *Module 1: The Water Cycle*

| Lesson 1 | |
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| Question | How does water get up into the sky? |
| Objective | SWBAT set up an experiment to observe the evaporation of water. |

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| Standard | 3.2.4.A5: Use models to demonstrate the physical change as water goes from liquid to ice and from liquid to vapor. | |
| Vocabulary | Evaporation, condensation, precipitation | |
| Materials | Per student:<br>-1 plastic bag<br>-1 plastic cup<br>-1 marker that can be used with the plastic baggies and cups<br>-Enough water to fill each baggie and cup ¼ of the way full.<br><br>Total cost: 3 box of 10 bags ($3) + 3 sleeve of 10 cups ($3) = $6 | |
| Time | Teacher DO | Student DO |
| 5 mins | Teachers ask: "where does our water come from. | Students brainstorm ideas and share out with the class. |
| 10 mins | Shows video of water running from faucet.<br>Discuss how clean running water is a new phenomenon and many people still don't have access to running water. | Students work together to draw or write an explanation for where their water comes from. |
| 5 mins | Teachers asks for volunteers to share out ideas. | Students share out their models and the class discuss which ideas they agree with. |
| 5 mins | Ask students to brainstorm questions. | Students brainstorm other questions that might help them answer the unit questions. |
| 2 mins | Teacher tells students that in order to understand where water comes from, they must understand the water cycle. Teacher puts picture of water cycle on the board. | Students observe the picture of the water cycle |
| 3 mins | Teacher passes out plastic cups and baggies and markers. | Students engage in a VERBAL notice and wonder about the water cycle picture as the teacher is passing out materials |
| 5 mins | Teacher puts water into all the plastic baggies and plastic cups.<br><br>Closing Question: What do you think is going to happen to the water? | Students write their names on the plastic bags and cups and mark the water level on the cup. Students or teachers put cups and baggies on window sill or in a place that will receive sunlight.<br><br>Students discuss the closing question. |

# Lesson 2

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| Question | Where did our water go? | |
| Objective | SWBAT observe the lowered water level in their open water cup<br>SWBAT observe a condensed fog within their plastic bags<br>SWBAT determine the water left the cup and went up into the sky<br>SWBAT determine that water did not leave the bag because it was closed | |
| Standard | 3.2.4.A5: Use models to demonstrate the physical change as water goes from liquid to ice and from liquid to vapor. | |
| Vocabulary | Evaporation, condensation, precipitation | |
| Materials | Per student:<br>-Baggies and cups from Lesson 1<br>-Worksheet 2<br><br>Total Cost = No cost, reuse materials from last class | |
| Time | Teacher DO | Student DO |
| 5 mins | Teacher introduces lesson by asking students to remember what they did last class. | Students share out their water in the baggies and the cup of water.<br><br>Possible answers:<br>We worked with water<br>We put water in cups<br>We put water in cups and |
| 10 mins | Teacher passes out water cups and baggies.<br>As teacher is passing out water cups, students can pass out Worksheet 2.<br>*Instruct students to NOT shake their bags. | Students to observe what is happening inside of their bags and the water.<br>Students fill out the "notice and wonder" chart about their baggies and cups on Worksheet 2. |
| 10 mins | Teacher leads class in discussion about their cups.<br>Questions to ask:<br>Where did the water in the cup go?<br>What is happening inside of the bag?<br>Is the water able to escape the bags?<br><br>When applicable introduce class to vocab words. | Students should begin to understand that the water inside of the bag was not able to evaporate because the bag was closed. Instead, the water condenses at the top of the bag and turns into a cloud. The water in the cup was able to evaporate and escape the cup because there was no top on the cup.<br>Students should come to the |

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| | | conclusion that the water went up into the sky. |
| 15 mins | Walk students through the Worksheet 2 showing them where the evaporation, condensation, and precipitation is on their worksheets. | Students will complete Worksheet 2 in which they will diagram their bags |
| 5 mins | Clean up time/Closing question: What happens when a cloud fills up with water? | Clean up time. If students want, they can take their cups and baggies home with them. Students discuss the closing question. |

| **Lesson 3** | | |
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| Question | What happens when a cloud fills up with water? | |
| Objective | SWBAT use a model to explain how rainclouds form | |
| Standard | 3.3.4.A4 Describe phase changes in the forms of water on Earth. | |
| Vocabulary | Evaporation, condensation, precipitation | |
| Materials | Whole class:<br>-Colander or strainer<br>-large bowl<br>-cotton balls<br>-blue water (water + food coloring)<br>-1 TBSP measuring spoon<br><br>Per student<br>-Worksheet 3<br><br>Total Cost: 1 bag of cotton balls ($1) + 1 box of food coloring ($1) = $2<br>*I am assuming you can bring in 1 TBSP spoon, bowl, and colander/strainer from home please. | |
| Set Up | Put strainer/colander in bowl and put enough cotton balls in strainer to fill to the top. Put this aside, you will use this after the opening discussion. | |
| Time | **Teacher DO** | **Students DO** |
| 5 mins | Teacher asks class what happens when a cloud fills up with water? | Open Reponses from students accepted. |
| 5 mins | Teacher explains that they are going to do a whole group experiment. | Students observe model<br>Students conclude cotton balls are model of clouds |

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| | Teacher brings out bowl with colander and cotton balls.<br>Teacher asks students what the cotton might be in real life. | |
| 3 mins | Teacher asks students where all the water from their cups went.<br>Teacher pours 1 TBSP of blue water all over cotton balls.<br>Teacher asks the class where did the water they just poured on the cotton balls come from in real life? | Students connect the water from their cups evaporated up to the sky<br><br>Students theorize the added water came from evaporated water from their cups or other water sources. |
| 7 mins | The teacher invites the students to come up and one-by-one pour a little bit of water over the cotton balls. After all the students have poured water, observe the cotton and the bowl underneath it. | Students should see that the cotton balls have soaked up the water and they have started to drip water into the bowl below them |
| 5 mins | Leads discussion about what is going on with the cotton balls and the water.<br><br>Questions to ask:<br>What is happening to the cotton balls when they get wet?<br>What do the cotton balls represent in real life?<br>What happens to clouds when they get wet? | Students should come to the understanding that the cotton balls represent a model of the clouds. When the clouds get very "heavy" with water, they start to "drip". When the clouds get filled up with water, they will start to rain. |
| 10 | Teacher passes out Worksheet 3 | Students complete Worksheet 3 by drawing two diagrams, first the model and then what the model represents in real life (in this case a rain cloud precipitating. |
| 5 mins | Teachers leads class in discussion of work. | Students discuss their diagrams and share out with the class. |

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| | Questions to consider:<br>What do you think the model represents?<br>How can we use this model to understand how rain happens? | |
| 5 mins | Closing Question:<br>Where do you think the water goes after it rains? | |

*Module 2: Watershed and Water Pollution*

| **Lesson 4** | | |
|---|---|---|
| Question | Where does water go after it rains? | |
| Objective | SWBAT create a model to show demonstrate rainwater runoff<br>SWBAT conclude rainwater runs into the rivers | |
| Standard | 3.3.4.A6: Identify basic landforms using models and simple maps. | |
| Vocabulary | Watershed, run-off | |
| Materials | Per student:<br>-4 pieces of masking tape or scotch tape,<br>-1 blank piece of copy paper,<br>-1 piece of aluminum foil 8x8 or 9x9<br>-Worksheet 4<br><br>Per table:<br>-1 spray bottle filled with either blue or clear water. (blue water if you really trust your ability to manage your students.)<br><br>Total cost: 2 rolls of aluminum ($2) + up to 8 spray bottles ($8) = $10 | |
| Prep | Cut aluminum foil into squares for each student | |
| Time | Teacher DO | Students DO |
| 5 mins | Teacher reminds students that last week they learned how water moves in the air around them.<br><br>Teacher asks:<br>“Where does the rain go after it falls?” | Turn and talk<br>Share out answers with class |

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| 5 mins | Teacher shows students the experiment for the day. Students will be creating mountain models. Students are to crumple their piece of aluminum foil, un-crumple it, and spread it out on their copy paper. They tape their aluminum foil to their paper. The aluminum paper should NOT be smooth, there should be little "mountains" | Students watch the demonstration and asks questions if need be. |
| 7 mins | Teacher/students pass out tape, copy paper, and aluminum foil to students. | Students build their mountain models by crumpling their aluminum foil, spreading it out, and taping it down to their copy paper. |
| 5 mins | Teacher passes out spray bottles | Students start spraying their "mountain models".<br>They should see the water collecting in the basins or running off of their papers. |
| 5 mins | Teacher leads discussion about where the student's water is going after they spray their mountains. | Students discuss what is happening with their mountains. |
| 10 mins | Teacher passes out Worksheet 4 for students to complete | Students diagram their mountain models and show where the water is flowing in Worksheet 4. |
| 7 mins | Teacher closes out lesson by engaging in a discussion that confirms the students knowledge that the water is flowing towards rivers, lakes, and streams.<br><br>Closing Question: are there mountains and rivers around where we live? | Students discuss where their water is flowing in their models.<br><br>Students answer closing question |

| **Lesson 5** | |
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| Question | Where are the mountains and rivers around us? |
| Objective | SWBAT identify the mountains and rivers around Philadelphia<br>SWBAT trace the path their drinking water takes to Philadelphia |

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| Standard | 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. | |
| Vocabulary | Watershed, run-off, topographic, pollution | |
| Materials | Worksheet 5<br><br>No cost | |
| Time | Teacher DO | Students DO |
| 3 mins | Teacher introduces lesson by asking the class if there are any mountains or rivers around them. | Students answer if they know about any mountains or rivers around them. |
| 2 mins | Teacher passes out Worksheet 5 | |
| 3 mins | Teacher asks students to guess where Philadelphia is on the map in Worksheet 5<br><br>Teacher shows students where Philadelphia is on the map. | Students mark Philadelphia on the map in Worksheet 5 |
| 2 mins | Teacher puts topographical map of Pennsylvania up on the board.<br><br>Teacher overlaps the topographic map with the water map. | Students compare the map on Worksheet 5 to the topographical map on the board.<br><br>Students observe the two maps overlapped. |
| 5 mins | Teachers asks the students where the mountains are on their own maps.<br><br>Teacher labels the Schuylkill River | Students use any writing material to fill in where the mountains are on their map.<br><br>Students label the Schuylkill River |
| 5 mins | Teacher shows students how to use arrows to demonstrate water flow. Teacher draws arrows along the Schuylkill and Delaware rivers point south indicating water flow. | Students add arrows to their maps indicating the directional water flow of the Schuylkill and Delaware rivers. |
| 3 mins | Teacher labels the Poconos Mountain range and the Appalachian Mountain Range. | Students label the Poconos Mountain Range and the Appalachian Mountain Range. |
| 5 mins | Teacher leads students in discussion about where on the map there might be the most rainfall. | Students turn and talk and discuss where it rains the most in Pennsylvania.<br><br>Students share out their guesses |
| 3 mins | Teacher puts up the annual rain map of Pennsylvania | Students mark the highest rainfall on their map. |

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| 5 mins | Teacher leads students through a discussion comparing all three maps | Students should come to the conclusion that it rains the most in the mountains, all that water flows down into the rivers, and that water comes to Philadelphia. |
| 2 mins | Teacher takes down topographical and rainfall maps and puts up the factory and farm map. Teacher explains to the students that these factories and farms and very close to the rivers that lead to Philadelphia. | Students label various factories and farms close to the Schuylkill and Delaware rivers |
| 3 minutes | Teacher leads discussion in which students brainstorm how their water could become contaminated. | As a close out, students brainstorm different ways their water sources could be |
| 2 minutes | | Students answer last question on their worksheet. |

| **Lesson 6** | | |
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| Question | Does all water taste the same? | |
| Objective | SWBAT taste test different water samples to determine if all water is created equal.<br>SWBAT develop a hypothesis for how water is cleaned | |
| Standard | 3.3.4.A4 Recognize Earth's different water resources, including both fresh and saltwater. | |
| Vocabulary | Watershed, run-off, pollution, industrial waste, farm waste | |
| Materials | Per student:<br>-2-3 different water samples (at least one from a safe drinking water source at your school, and one bottled water source)<br>-2-3 small plastic cups for each student (these can be small "shot" cups<br>-Worksheet 6<br><br>Total cost: 3 sleeves of small cups ($3) | |
| Prep | You can prepare all the cups ahead of time, 2-3 cups of water per student | |
| Time | Teacher DO | Student DO |
| 5 mins | Teacher introduces the lesson by asking students if they think all water tastes the same. | Students turn and talk to the people next to them to answer the question. Students share out with the class. |

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| 5 mins | Teacher passes out Worksheet 6 and explains to the students they will sample the water and make a guess as to the origin of the water. | Students write their names on the worksheet and look over the worksheet. |
| 5 mins | Teacher passes out water sample cups | Students sample the water and make their guess as to the origin of each water cup |
| 5 mins | Teacher polls the class on the origins and then reveals the answer to the class. The teacher explains that both water came from a river, stream, lake, or underground spring, however one was cleaned in Philadelphia and the other was cleaned wherever the bottled water company is located (outside of Philly, upstate New York, or somewhere very far away). | |
| 5 mins | Teacher shows picture of dirty river water and explains that this water eventually looks the water the students just drank. The teacher asks the students how they think the water can be cleaned. | Students share out ideas on how to clean water. |
| 5 mins | Teacher assists students with brainstorming ideas for water cleaning | Students brainstorm ideas for water cleaning using provided drawing space in worksheet 6. |
| 10 mins | Teacher asks students to share out ideas. Teacher engages class in a discussion eventually pushing them towards the idea of passing water through a system of materials to pull out all the impurities.<br><br>Questions to ask:<br>Does anybody have a fish tank? Do you know how that water is cleaned? Could it be the same?<br><br>How could we trap all the dirty stuff in the water?<br><br>Has anybody made pasta before, perhaps for mac and cheese? How do you separate the cooked pasta from the hot pasta water? | Students share out their brainstormed ideas.<br><br>Students come up with general idea on how to filter water |

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| 5 mins | Closing Question: why is dirty water bad? | Students answer closing question |

*Module 3: Water Filtration*

| Lesson 7 | |
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| Question | How can we clean water? Pt 1. |
| Objective | SWBAT build and test their own water filter.<br>SWBAT compare and analyze different water filters to determine the best measurements of materials. |
| Standard | 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.<br><br>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem |
| Vocabulary | Filter, charcoal |
| Materials | Per group of 4:<br>-1 tall cylindrical water bottle at least 1 liter big cut in half<br>-4 party cups (or different brand of similar size) each filed halfway up with woodchips, sand, pebbles, and activated charcoal*<br>-5 cotton balls<br>-dirty water (take dirty and mix it with water, or if you want to be fancy, go to the Schuylkill or Delaware River and bottle some dirty river water and bring it back to your classroom)<br>-plastic spoons<br><br>*This lesson is adapted from Hungry SciANNtist via YouTube. Video can be found on YouTube by visiting their YouTube channel and searching for "water filter"*<br><br>*You can purchase these materials at Lowes, your local hardware store, or Amazon. Make sure you get activated charcoal designed for plants and not for fish tanks. A 24-32oz bag should last you enough for both this experiment and Lesson 7. |

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| | Total cost: 8 1 liter bottles ($16) + 2 sleeves of party cups ($2) + activated charcoal ($10) + hickory wood chips ($8) + 50lb sand *smallest they have ($5) + .5 cu ft pebbles ($10) + 1 bag of cotton balls ($1) = $46 | |
| Prep | Cut all the bottles in half<br>Fill enough solo cups **halfway** so that each group of four will have one of each (woodchips, sand, charcoal, and pebbles.<br>Save the rest of the woodchips, charcoal, pebbles, and sand for Lesson 7<br>Make a model using all five materials | |
| Time | Teacher DO | Student DO |
| 2 mins | Teacher opens showing off their dirty water. Teacher explains that today they are going build their own water filter to clean the dirty water. | |
| 3 mins | Teacher passes out Worksheet 7. While passing out the worksheet the Teacher lists the five materials the filter will use (cotton balls, charcoal, wood chips, sand, and pebbles) | Students look over worksheet |
| 3 mins | Teacher brings out each of the five materials to show the class.<br>Teacher shows a premade model to the class.<br>Teacher explains that they will measure each material using plastic spoons and they will plan out how many spoon-fills of each material they will use. | Students observe all five materials and the model. Students ask questions if need. |
| 5 mins | Teacher assists students in the planning section of Worksheet 7<br>Teacher explains that students will make another filter next lesson using the information they learn from today. | Students complete the planning section of Worksheet 7. Students will decide how much of each material to put in their filter. |
| 3 mins | Teacher will pass out filter materials. | |
| 10 mins | Teacher will assist students with adding their materials into their water filters. | Students will start measuring and adding the materials to their filters. When students are done, they will diagram their water filter in the provided space on Worksheet 7. |
| 5 mins | Teacher will give students dirty water to test out their water filters | Students will slowly pour their dirty water over the top of their filter until all of the water has been filtered through. |

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| 5 mins | Teacher collects each water filter and displays them for everyone to see. Teacher will engage the class in a discussion on which water filter worked the best and why. Ask the group with the cleanest water to share out their measurements for each material. | Students will determine which measurement of materials produced the cleanest water. |
| 3 mins | Teacher will assist students in editing their materials list for next time. | Students will create a new plan for their next water filter next week. |
| 3 mins | Teacher collects Worksheet 7 | |
| 3 mins | Closing question: how will you change your next water filter? | |

| **Lesson 8** | |
|---|---|
| Question | How can we clean water? Pt 2. |
| Objective | SWBAT build and retest their second design of a water filter |
| Standard | 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.<br><br>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem |
| Vocabulary | Filter, charcoal |
| Materials | Per group of 4:<br>-1 tall cylindrical water bottle at least 1 liter big cut in half<br>-4 solo cups (or different brand of similar size) each filed halfway up with woodchips, sand, pebbles, and activated charcoal*<br>-5 cotton balls<br>-dirty water (take dirty and mix it with water, or if you want to be fancy, go to the Schuylkill or Delaware River and bottle some dirty river water and bring it back to your classroom)<br>-plastic spoons<br>-**Worksheet 7**<br>-Worksheet 8 |

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| | *This lesson is adapted from Hungry SciANNtist via YouTube. Check the appendix for the video link to watch their video.*<br><br>*You can purchase these materials at Lowes, your local hardware store, or Amazon. Make sure you get activated charcoal designed for plants and not for fish tanks. A 24-32oz bag should last you enough for both this experiment and Lesson 7.<br><br>Total cost: 8 1 liter bottles ($16) + 2 sleeves of party cups ($2) + activated charcoal ($10) + hickory wood chips ($8) + 50lb sand *smallest they have ($5) + .5 cu ft pebbles ($10) + 1 bag of cotton balls ($1) = $46<br><br>**However, you should have left over charcoal, pebbles, and woodchips so the cost would be 46 – (10+8+10) = $18** | |
| Prep | Cut all the bottles in half<br>Fill enough solo cups **halfway** so that each group of four will have one of each (woodchips, sand, charcoal, and pebbles.<br>Save the rest of the woodchips, charcoal, pebbles, and sand for Lesson 7<br>Make a model using all five materials | |
| Time | Teacher DO | Student DO |
| 3 mins | Teacher passes out Worksheet 8 and gives students their Worksheet 7 from previous lesson. | |
| 2 mins | Teacher instructs students to look over Worksheet 7 and find their plan for their next water filter. | Students find their plan for their next water filter. |
| 5 mins | Teacher assists students in copying their plan from Worksheet 7 to Worksheet 8 | Students use Worksheet 7 to complete the planning section on Worksheet 8. |
| 3 mins | Teacher passes out materials for water filter | |
| 10 mins | Teacher will assist students with adding their materials into their water filters. | Students will start measuring and adding the materials to their filters. When students are done, they will diagram their water filter in the provided space on Worksheet 7. |
| 5 mins | Teacher will give students dirty water to test out their water filters | Students will slowly pour their dirty water over the top of their filter until all of the water has been filtered through. |
| 5 mins | Teacher collects each water filter and displays them for everyone to see. Teacher will engage the class in a discussion on which water filter worked the best and why. Ask the group with the cleanest water to | Students will determine which measurement of materials produced the cleanest water. |

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| | share out their measurements for each material. | |
| 5 mins | Teacher asks the class if they think this water is safe to drink. Ask them why and try to steer them towards germs and the idea of microscopic life in water.<br><br>Questions:<br>How do we know this water is safe to drink?<br>Is clear water always safe to drink?<br>Are all clear liquids safe to drink?<br>What could still be inside of this water? | Students engage in a discussion about the safety of their "cleaned" drinking water. |
| 5 mins | Watch provided video in slide deck about microorganisms in dirty water. Ask the class do they think their water filter cleaned out all those microorganisms? | Student watch video<br>Students think about if microorganisms are in their "cleaned" water |
| 2 mins | Closing question: what could we do about the microorganisms? | |

| Lesson 9 | |
|---|---|
| Question | How do we get rid of those microorganisms in the water? |
| Objective | SWBAT use a chemical to get rid of all the microorganisms in the water<br>SWBAT compare microscoped dirty water and clean water |
| Standard | 3.4.4.B1Describe how technology affects humans in various ways. |
| Vocabulary | Filter, iodine |
| Materials | Per student:<br>-2 plastic cups<br><br>Whole class<br>-two 1 liter bottles filled with clean drinking water<br>-tincture of iodine<br>-provided permission slip<br><br>Total Cost: two 1-liter bottles ($4) + tincture of iodine ($6) + 3 sleeves of 10 cups ($3) = $13 |

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| Prep | At least 1 week in advance send home the permission slip. This will allow your students the opportunity to taste the iodine water. It has a distinctive taste and will be interesting for your students if they are able to. Make sure none of your students have a iodine allergy. | |
| Time | Teacher DO | Student DO |
| 5 mins | Teacher replays the video from last class showing the dirty water under a microscope. | Students watch video |
| 5 mins | Teacher engages student in a discussion about how they might get rid of those microorganisms, steering them towards the idea of chemicals.<br><br>Questions to ask:<br>Is pool water clean?<br>Do you think they put something in pool water?<br>Can we put something in our water? | Students discuss how to get rid of microorganisms |
| 2 mins | Pass out cups to all students | |
| 3 mins | Bring out both 1 liter water bottles and the iodine tincture show to the class. Put 5 drops of iodine tincture into one water bottles. Explain that even though these are both clean to drink, we can use this chemical to clean dirty water, and today they can taste the water to see what it would taste like. | |
| 5 mins | Teacher passes out both samples of water. | Students taste both samples of water |
| 5 mins | Teacher shows the provided video from the slide deck about clean drinking water under a microscope. | |
| 5 mins | Teacher leads a discussion where the students compare the two videos | Students compare the two videos on the different water. |
| 5 mins | Together the teacher and the student recap the whole unit, explaining how the water got into the sky, down onto the mountains, down into the rivers, into the water treatment plants, and finally into their taps. | |
| 10 | Teacher assists students in diagraming the whole water system in Worksheet 9 | Students work on diagraming the whole water system in Worksheet 9. |

# Appendix

Lesson 1 & 2:

3.2.4.A5: Use models to demonstrate the physical change as water goes from liquid to ice and from liquid to vapor.

Lesson 3:

3.3.4.A4 Describe phase changes in the forms of water on Earth.

Lesson 4:

3.3.4.A6: Identify basic landforms using models and simple maps.

Lesson 5

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.

Lesson 6:

3.3.4.A4 Recognize Earth's different water resources, including both fresh and saltwater.

Lesson 7 & 8:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem

Lesson 9:

3.4.4.B1Describe how technology affects humans in various ways.

Worksheet 2

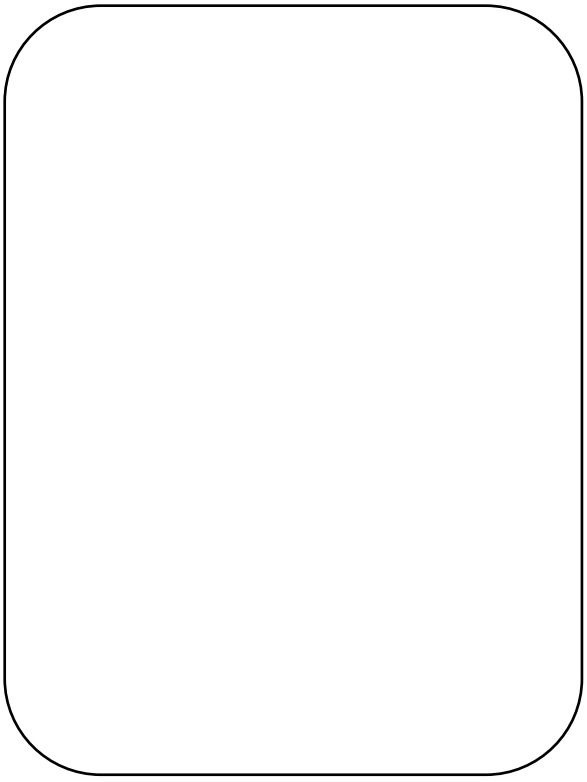
Name_____ Date__/__/__

## Vocabulary

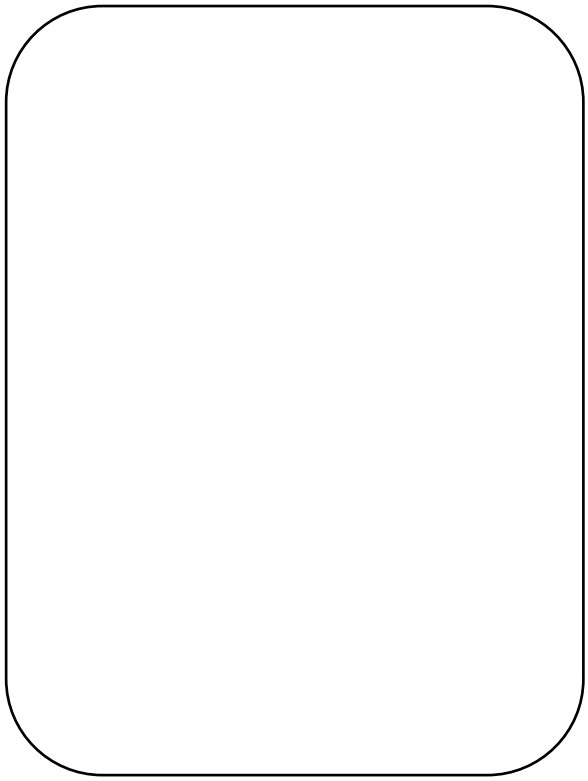
Evaporation Condensation Precipitation

What do your bag and cup look like now?

Cup



Plastic Bag



What happened to your plastic bag and your cup?

_____

_____

Worksheet 3

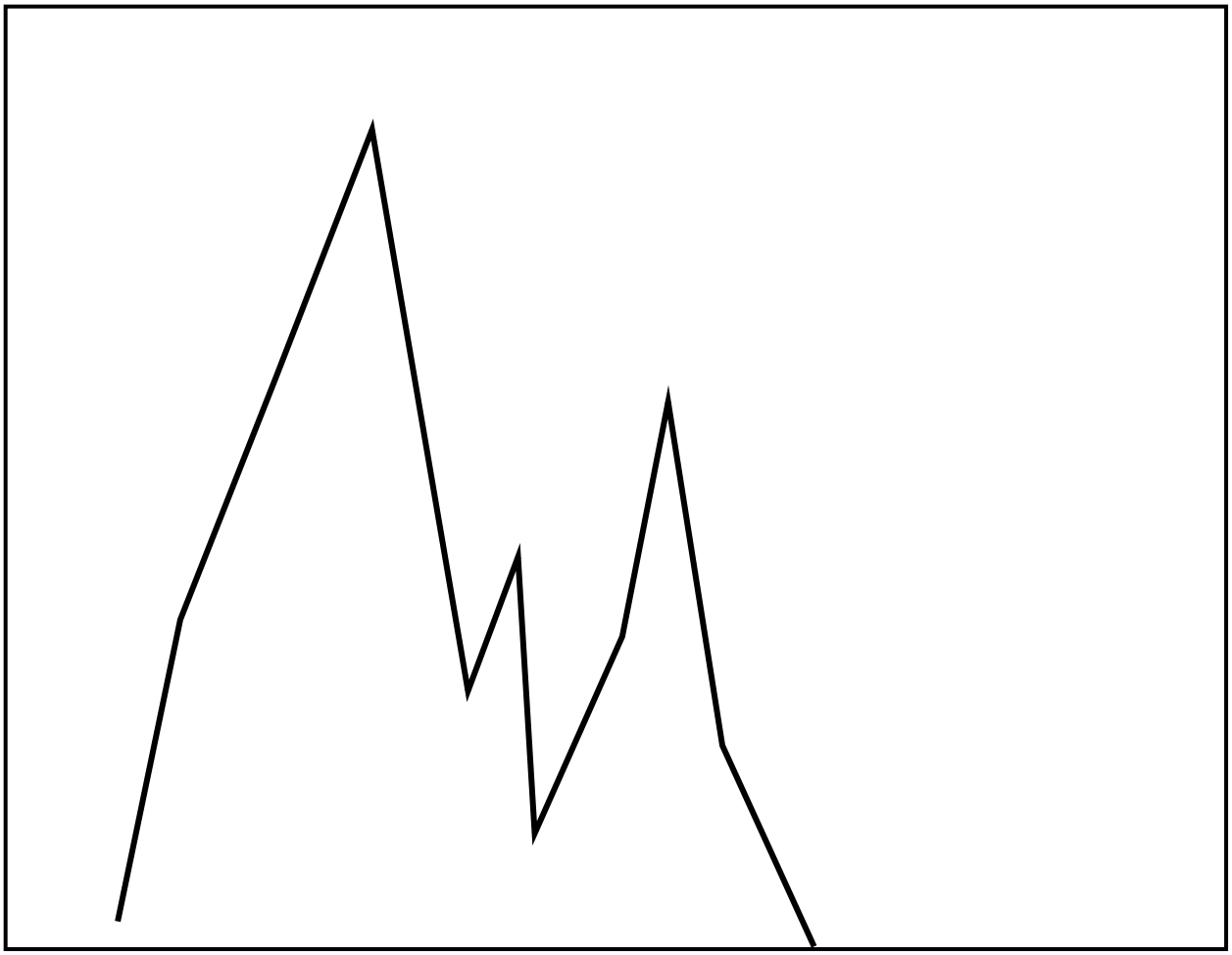
Name_____Date__/__/__

1 Draw a picture of the experiment.

2 Draw the experiment in real life.

Name_____ Date__/__/__

Complete this picture to show where the rain water goes after it rains.



Where did the rain water go?

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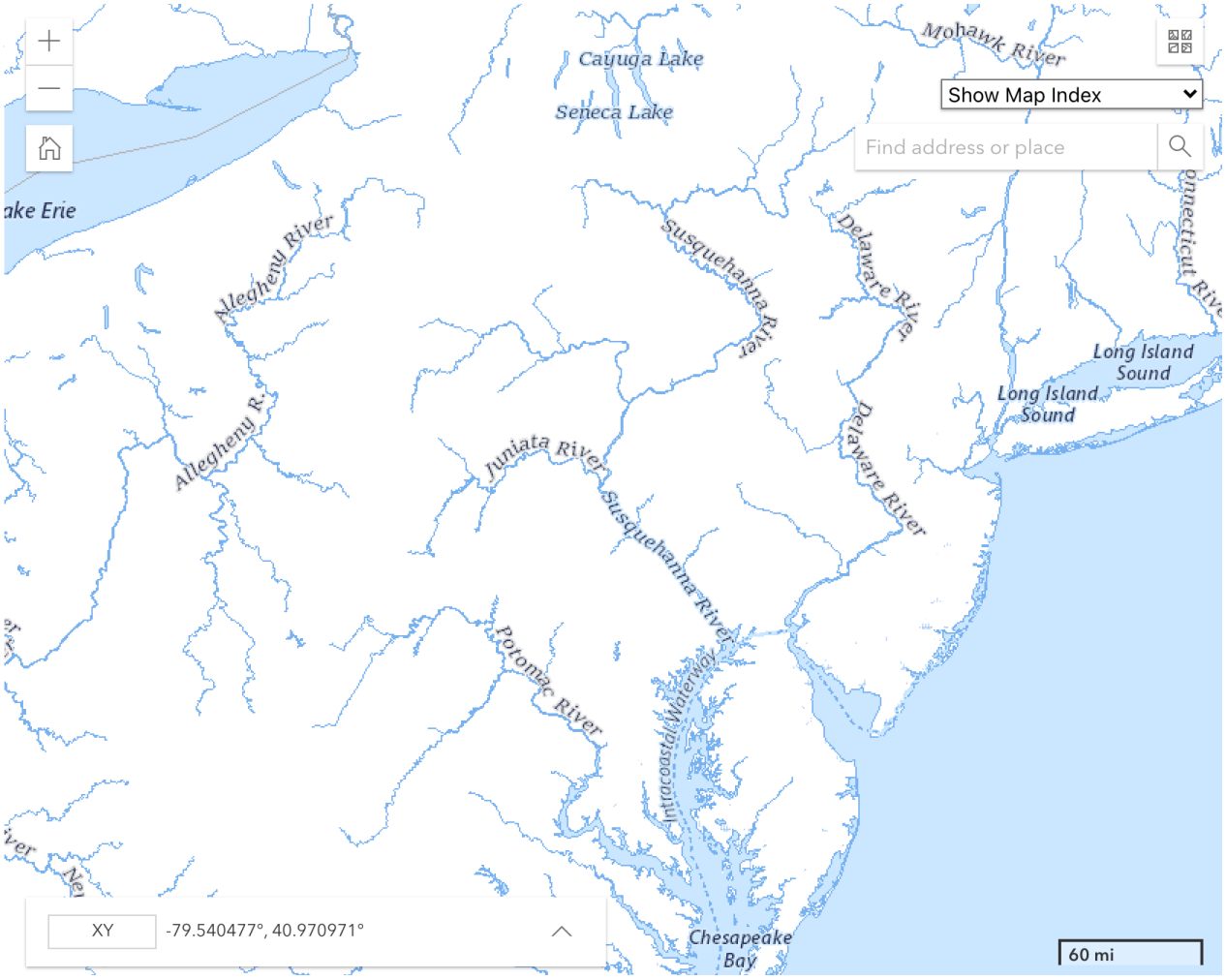
Worksheet 5

Name_____ Date__/__/__

This is a map of the Pennyslvania, New Jersey, and New York waterways.




How might this water get dirty?

_____

_____

Name_____ Date__/__/__

Circle the water sample you think is from the bottle of water:

Sample 1 Sample 2

How do you think we can clean dirty water? Draw your idea for a water cleaning design here:

Name_____ Date__/__/__

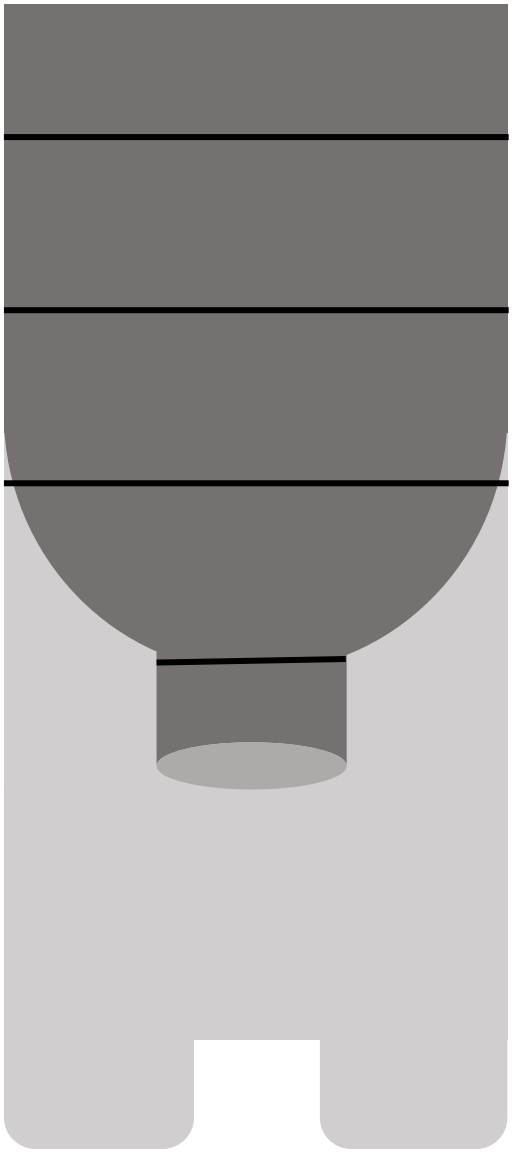
Plan out how many spoonfuls of each material you are going to use and where you are going to put them.

_____ spoonfuls

_____ spoonfuls

_____ spoonfuls

_____ spoonfuls



What would you change about your design for next time?

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_____

Worksheet 8

Name_____ Date__/__/__

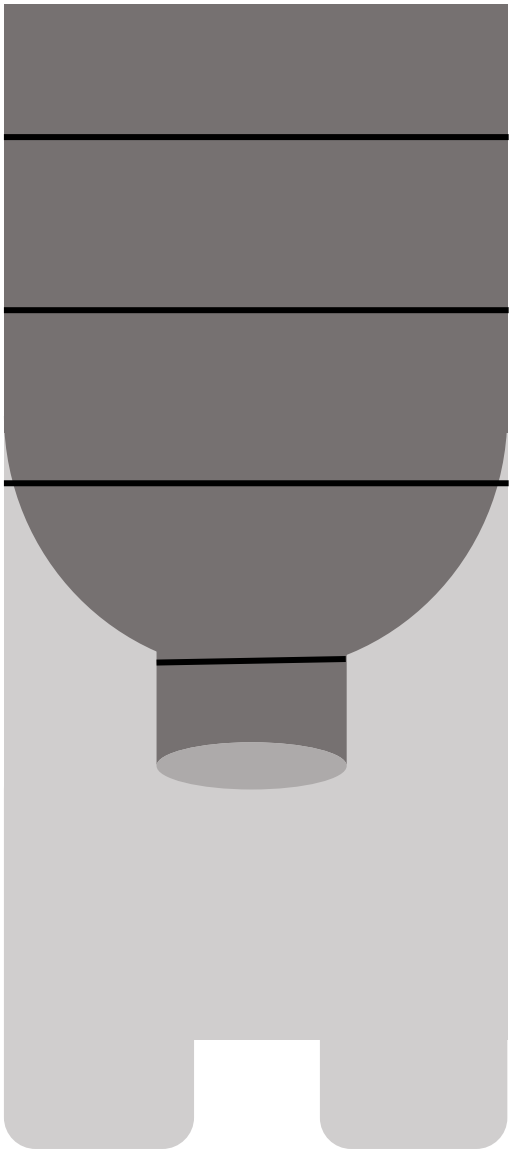
Plan out how many spoonfuls of each material you are going to use and where you are going to put them.

_____ spoonfuls

_____ spoonfuls

_____ spoonfuls

_____ spoonfuls



How does your filter work to clean out the water?

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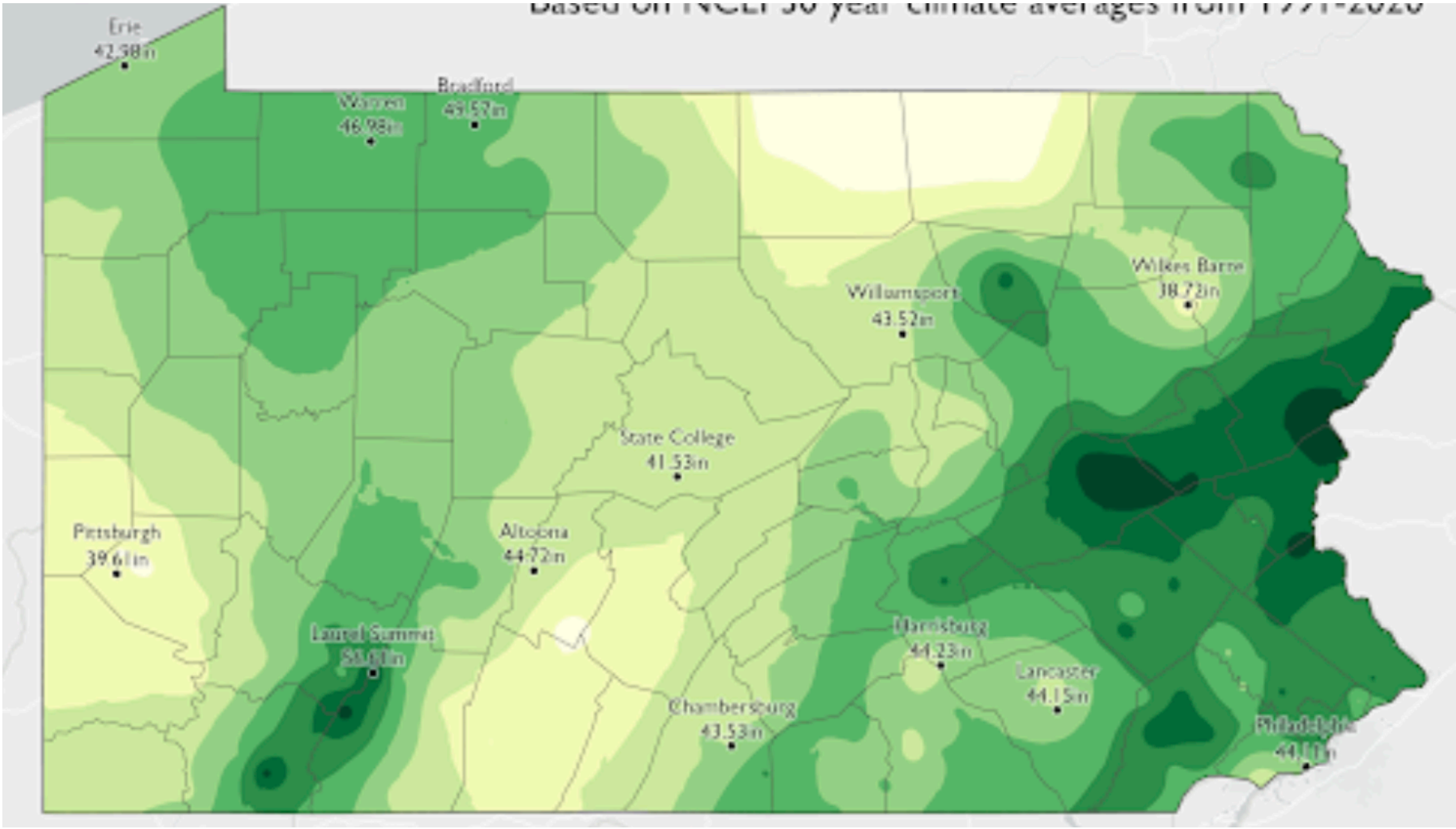
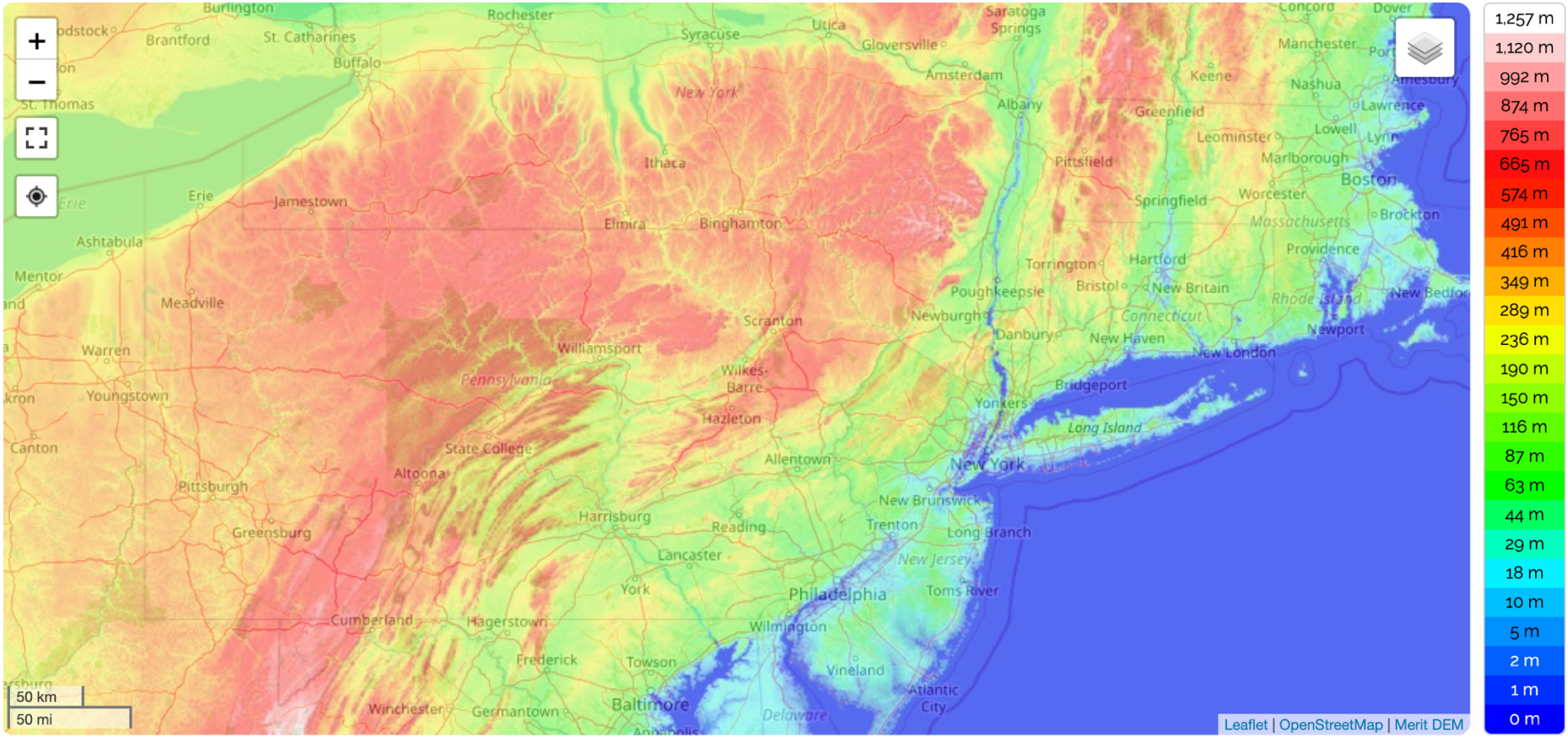
# Lesson 5 Average Rainfall



# Lesson 5 Topographical map




Pennsylvania, United States (40.96999 -77.72788)

# Lesson 5 factory and farm