Earth's Systems: Processes that Shape the Earth

Grade 2

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Overview:

In this 2nd grade unit, students construct their explanations about a puzzling and historic phenomenon: Why did a town next to a mountain (the town of "Moncton") flood after a dam was built on the opposite side of the mountain? Throughout the unit, students engage in a number of activities (readings, investigations, and watching videos) to gather evidence and revise their models and explanations about how and why the town flooded. Students can learn about how dams affect water flow and landscapes, ice age and glacial moraines, how the structure and properties of different earth materials can affect water flow, and how water can change the shapes and kinds of land quickly or slowly.

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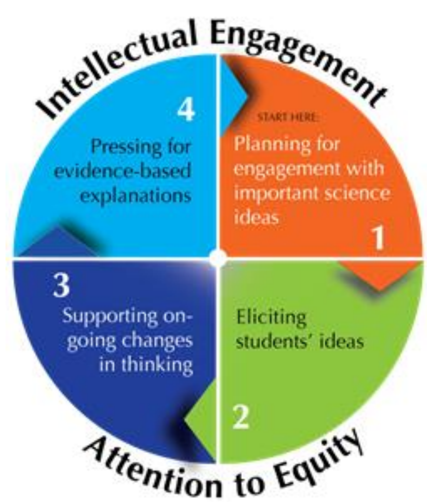
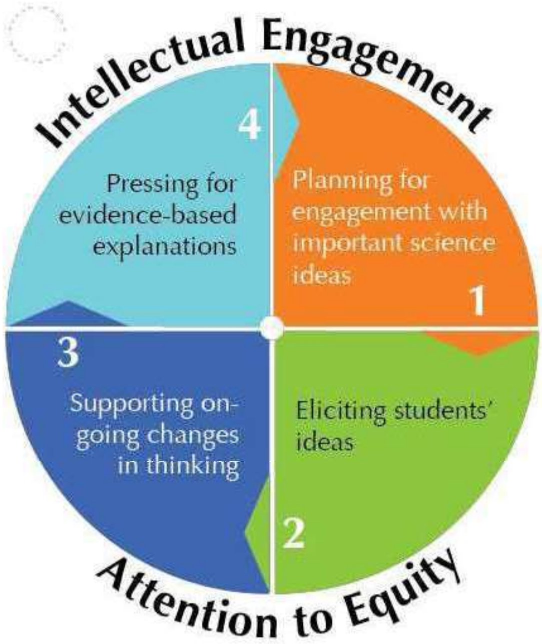
Ambitious Science Teaching Framework



Ambitious Science Teaching

We provide here a vision of ambitious teaching—teaching that is effective, rigorous and equitable. But more than that, we provide a framework of research-based teaching practices that are consistent with this vision and a wide range of tools that can transform how students learn in your classroom. The vision, practice, and tools will furnish a common language about teaching for a group of science educators committed to the improvement of teaching. You will be able to identify "what we will get better at" and how to get started.



Ambitious teaching aims to support students of all racial, ethnic, and social class backgrounds in deeply understanding science ideas, participating in the talk of the discipline, and solving authentic problems. This teaching comes to life through four sets of teaching practices that are used together during units of instruction. These practices are powerful for several reasons. They have consistently been shown through research to support student engagement and learning. They can each be used regularly with any kind of science topic. And finally, because there are only four sets of practices, we can develop tools that help both teachers and students participate in them, anyone familiar with the practices can provide feedback to other educators working with the same basic repertoire, teachers can create productive variations of the practices, and everyone in the science education community can share a common language about the continual improvement of teaching.

The four Ambitious and Equitable Science Teaching Practices are summarized in the below.

Practices	What does it LOOK like?
Planning for engagement with important science ideas	• Planning a unit that connects a topic to a phenomena that it explains (Chemical Reactions – Bike Rusting, Photosynthesis – Seed Becoming a Tree) • Teaching a topic within a real-world context
Eliciting students' ideas	• Asking students to explain HOW and WHY they think a phenomena happens (How did the bike change? Why did it change? What is happening at the unobservable level?)
Supporting on-going changes in thinking	• Using ALL activities/lessons to explain the phenomena. • Giving students opportunities to revise their thinking based on what they're learning
Pressing for evidence-based explanations	• Allowing students to create a final model or explanation about the phenomena • Pressing students to connect evidence to their explanation

Many teachers want to know what their classrooms should look like and sound like—they want to understand how to interact with their students about science ideas and students' ideas. This is especially true now that the *Next Generation Science Standards* are being used in many states.
As a result of the last 30 years of classroom research, we know enough about effective instruction to describe in clear terms what kinds of teaching practices have been associated with student engagement and learning. This research tells us that there are many ways that teachers can design and implement effective instruction, but that there are common underlying characteristics to all these examples of teaching that can be analyzed, described, and learned by professionals. These practices embody a new form of "adaptive expertise" that EVERY science educator can work towards. Expert teaching can become the norm, not reserved for a select few. Ambitious teaching is framed in terms of practices that any teacher can learn and get better at over time. What would we see if we entered classroom of a science educator using ambitious teaching? To give you a sense of what ambitious teaching looks like, we have described below some features common to all science classrooms where ambitious teaching is being implemented (listed on right). These features address everyday problems with learning and engagement that teachers face (listed on left).

Common problems in supporting student engagement and learning	What you'd see in a science classroom where ambitious teaching is the aim
The problem: *Students don't see how science ideas fit together.* Each day is perceived by students to be the exploration of ideas that are unconnected with previous concepts and experiences.	At the beginning of the unit, students are focused on developing an evidence-based explanation for a complex event, or process. Students know that throughout unit, most of the activities, readings and conversations will contribute to this explanation.
The problem: *An oversimplified view of what it means "to know."* Science ideas perceived to be straightforward and learnable within a lesson—either you get it or you don't."	An idea is never taught once and for all, but revisited multiple times. Students' science explanations are treated as partial understandings that have to be revisited over time to become more refined and coherent.
The problem: *Lack of student engagement.* Students' experiences and interests not elicited or seen as relevant. Student ideas treated as "correct" or "incorrect."	Students' ideas and everyday experiences are elicited and treated as resources for reasoning; students' partial understandings are honored as a place to start. They are made public and built upon.
The problem: *Students reluctant to participate in science conversations.* Teachers dominate the talk, ask primarily for right answers, get brief responses from students.	Teachers use a varied repertoire of discourse moves to facilitate student talk. Guides and scaffolds for talk help students feel comfortable interacting with peers.
The problem: *Some students have little support for accomplishing tasks that would otherwise be within their grasp.* Little or no guidance for students' intellectual work. Giving "clear directions" is seen as enough to ensure participation in activities.	There is scaffolding that allows students to participate in science-specific forms of talk, in group work, and in science practices.
The problem: *Invisibility of student ideas and reasoning.* Teacher does not know what students think—their heads are a black box. Cannot then work on students' ideas. Students cannot take advantage of the ideas or ways of reasoning by their peers.	Students' thinking made visible through various public representations (tentative science models, lists of hypotheses, question they have, etc.). The teacher can see how students think and how that thinking could change over time. Students benefit from seeing and hearing the reasoning of others.
The problem: *Illusion of rigor.* Students reproduce textbook explanations, lean on vocabulary as a substitute for understanding. Talk of evidence and claims are rare.	The teacher presses for complete, gapless explanations for unique real-life events or processes, and press for the use of evidence to support claims.

As you will see, ambitious teaching is not a "method," and the teaching practices are not scripts. It is a set of principled practices that must be adapted to your classroom needs. Coaches and other teachers can work with you to do this ambitious work.

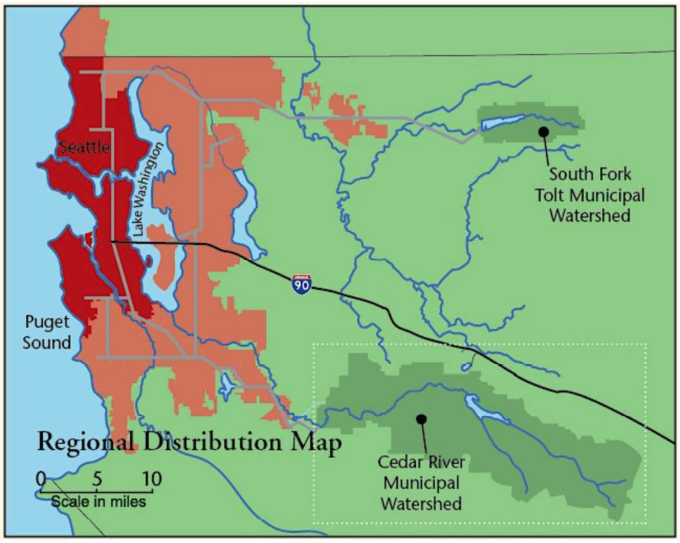
TEACHER BACKGROUND AND EXPLANATION

Using a Phenomenon

This unit is centered around explaining a local phenomenon related to water, dams, and Earth materials which students may have some familiarity with if they have ever attempted to build a dam at the beach with sand, made mud pies in the soil, or played with water in the bathtub***.*** In exploring this phenomenon, students will learn about where their water comes from and also explore a historical puzzling event that resulted from rerouting and controlling this water flow near a small town that became flooded as a result of the location of a dam on the Cedar River Watershed. Students will also be introduced to the cross-cutting concept of observable patterns in the natural world and the stability and change that can occur quickly or slowly with regard to Earth events.

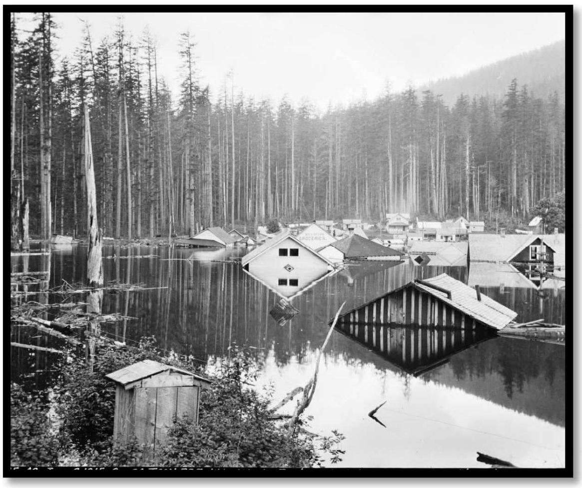
Unit Learning Objectives:

1. **Students will create models to show that water can slowly or quickly change the shape of the land.**
2. **Students will learn how and why water can flow through certain Earth materials more easily than others, including soil, sand, gravel, and clay.**
3. **Students will create a dam using different Earth materials to compare multiple solutions designed to prevent water from changing the shape of the land.**
4. **Students can read and interact with maps to show where places and bodies of water are located.**
5. **Students will read maps about their local watershed and learn where their water comes from.**



The phenomenon of exploring the question ***"What do you think caused this town to flood?"*** provides students with multiple opportunities to build geography skills and engage in science and engineering practices related to understanding the importance of unobservable materials under the Earth's surface.

In what follows, we discuss key science practices that students will engage in over the course of the unit. We also provide a science explanation for the phenomenon written for adults. Students would not be expected to describe the phenomenon in this depth or in these terms, but they may talk or draw about ideas or pieces of ideas that are closely related. The most important focus point is that you and the students are seeking to make sense of what's happening underground on the North side of the dam; this explanation may help you do so and see productive beginnings or "seeds" of science ideas **in** students' ideas. This explanation will also probably raise further questions or ideas to pursue with students or other teachers!

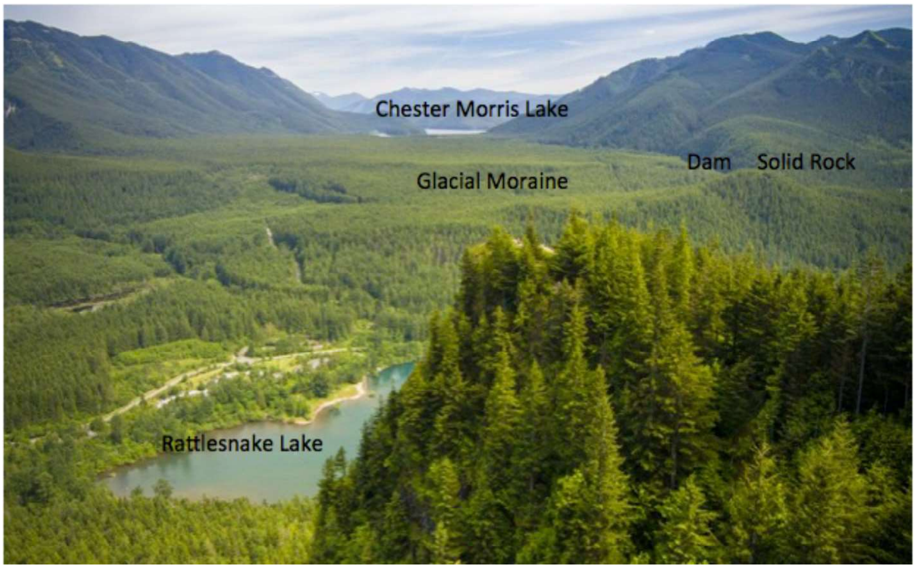


Science Processes

In this unit, students will have opportunities to cyclically engage in several key practices central to science as a discipline. First, students will generate and revise their own *explanatory models* for how the town became flooded over the course of the unit. Like scientists, they will represent and share their ideas about the phenomenon publicly and may change their thinking in the face of new discoveries and evidence. The models they create should be considered dynamic, "living" artifacts; they should be revisited over time so that students can identify what they still agree with, what they no longer agree with, and why, to create the best explanations they can. In doing so, students may move beyond describing things they can see and start to pose ideas about things they *can't* see but that help them make sense of the phenomenon. The unit builds in a space for students to create initial models and revise them into final models – you may choose to have students return to their models or to particular parts of their models at other times as well.

Second, students will have opportunities to design experiments and collect and analyze data **in service of** making sense of the phenomenon. These activities are important for a few reasons. For instance, they allow students to build important science, geography, and literacy skills (e.g., observing the porosity and permeability of different Earth materials, reading about related events in history, or utilizing the different perspectives of a location using maps). In addition, they help students see science ideas as things that can be tested and potentially supported or refuted by evidence. Discussions are integrated into the unit that helps students make connections between their observations/data and their models.

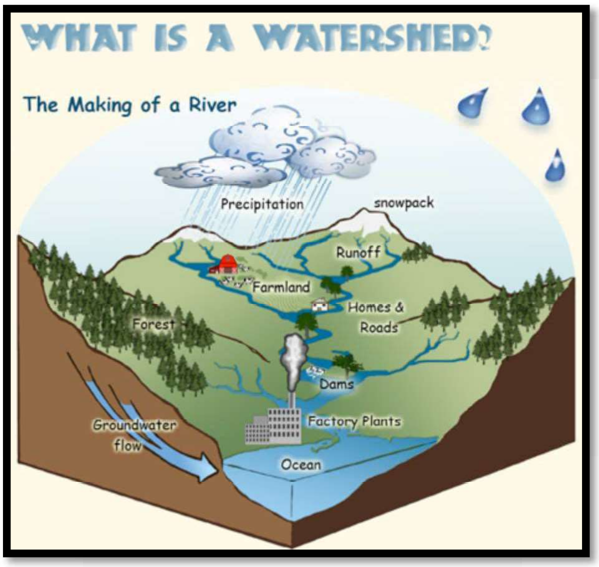
> *Many different sources were consulted throughout the writing and researching phases of this curriculum. This included double-checking sources, intensive research, meeting with watershed experts, and consulting with a Snoqualmie tribal member scholar. The information in this curriculum is intended to meet Next Generation Science Standards, many current social studies standards, Common Core ELA standards, and Washington State Tribal Education regulations and coming standards. For more information please visit http://indian-ed.org/ .



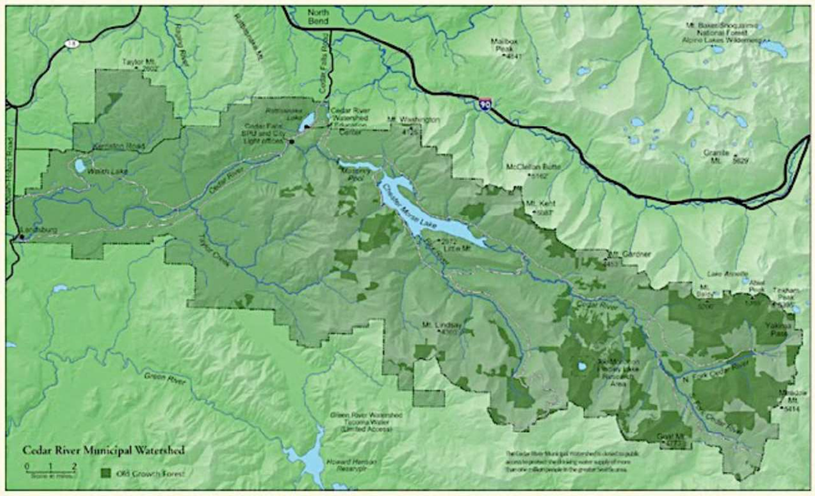
Background Information

The focus of this unit is on understanding the historical story in order to explain and model the science story of how a small town in the foothills of the Cascade Mountains became flooded in a matter of a few months causing all the residents to permanently relocate. But this story begins far before this town existed and well into the ice age that shaped the land around the Puget Sound Region. **The important component that runs throughout this unit is the role of water, in all of its' forms that shapes the land and continues to be present in our daily lives**. Through this unit students will be exposed to a new concept, that they are part of the Cedar River Watershed and all of the activities and choices that emerge from their lives has an impact on the water coming out of their faucets and flowing through the Cedar River on the path to the Pacific Ocean. Students will bring a variety of knowledge on this subject to the discussions, especially if they have experienced the kindergarten "Puddles" unit, which focuses on the water cycle. The background story can also be found by reading through the PowerPoint slides that serves as the students' unit water booklet.

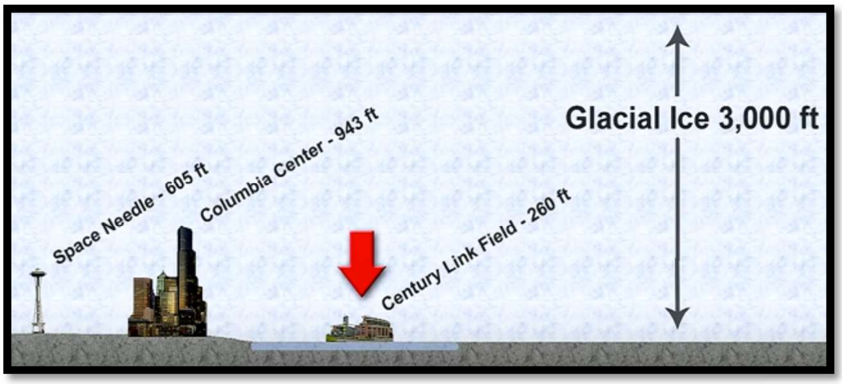
The centrality of watersheds in this story



Watersheds are defined as any area of land that water flows through and collects such as in a lake or river. Most of the water in a watershed always flows downhill towards the ocean, during this journey some water can also evaporate into the air or used by trees and animals. Our water starts from snow and rain, which creates small brooks, then the brooks flow into a river or lake, and eventually flowing out into the ocean. Some of the water in a watershed soaks into the ground or is used by plants and animals to survive. The image, "What is a Watershed?" is also used in the student water unit booklet. The image shows that watersheds can have a combination of both natural and manmade influences that affect the quality of our drinking water.



Our watershed, the Cedar River Watershed is extraordinarily clean because the City of Seattle purchased all the land around the Cedar River in order to preserve the quality of our drinking water. This purchase process took 100 years to complete but looking at the map, the dark green around the Cedar River is owned, protected, and pristine. We are fortunate to enjoy water that comes from a clean source. You are part of the Cedar River Watershed and everything that you do affects the water in the rivers, lakes, and ocean. This means that people need to be careful with the kinds of shampoo, laundry soap, and cleaning chemicals that they use at home because it all goes down the drain and ends up in the ocean and then evaporates to the sky where it can turn into rain or snow again. This rain and snow becomes our drinking water. If our water is healthy then we will be healthy and so will the plants, animals, and the land.

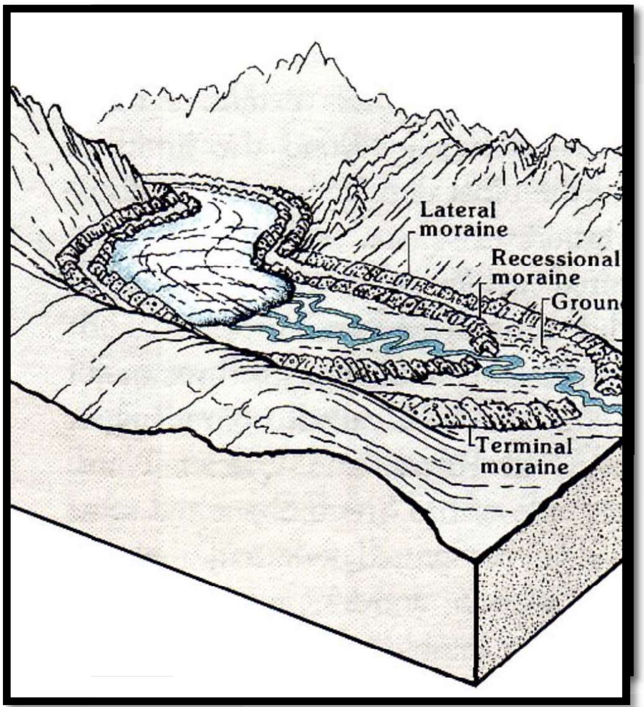


But thinking back even further than 100 years, can you imagine how our watershed was created? What shaped these foothills? Let's travel back in time to a much colder period on Earth.

Ice Age

The land around your school has been covered over by an enormous piece of ice many times in history. Right where your classroom is located there was a huge ice sheet pushing down on the rocks, the soil, and the hills. These huge ice sheets came back **seven** different times to cover the land all around your school. On reason that scientists know this occurred is because of the different kinds of glacial deposits that occurred each time, which produced geologically different layers of sediment that can be dated. Ice sheets and glaciers are very large pieces of frozen water that are extremely heavy, incredibly strong, and usually move very, very slowly. Most tall mountains have alpine glaciers, such as Mt. Rainier, which has 25 glaciers. Alpine glaciers are much smaller than ice sheets and usually form at the top of tall mountains.

Glaciers and ice sheets are made up of ice, snow, boulders, rocks, sand, and soil. This can sometimes make the ice look dirty. Glaciers and sediment are very heavy and that compression on the Earth causes heat. Glaciers and ice sheets move when the heavy ice pushes down, creating heat, and causing some of the ice to melt into water. This meltwater at the bottom of the glacier helps the whole sheet of ice to glide over the land.



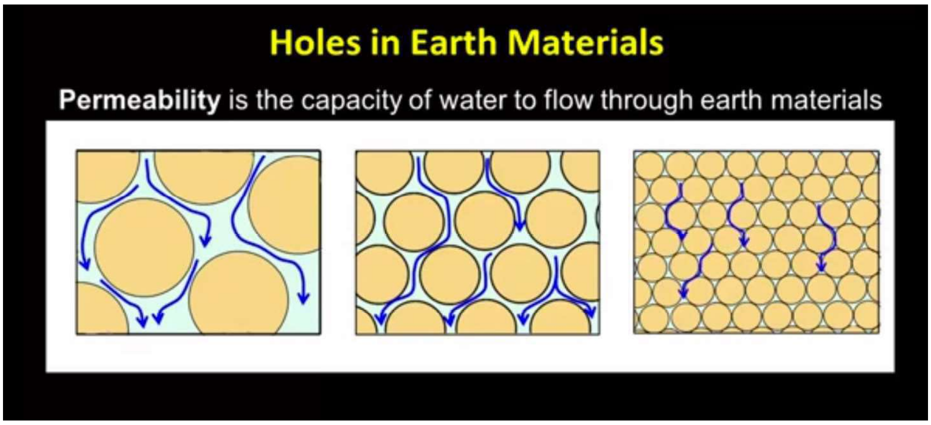
On Earth there are times when the weather has been much colder and other times when the temperature is warmer. When the temperature is colder, huge sheets of ice spread out from the North and South Poles to cover parts of Earth. During this cold time, glaciers on top of mountains also spread out and cover large areas of land. The ice sheets called **continental glaciers** are much, much larger than mountain glaciers and take thousands of years to form. Ice sheets can start to form when the snow falls during the winter but doesn't melt during the summertime and then gets more layers of snow added on top every year. Ice sheets can keep getting bigger and taller if the Earth's temperature is cooler. After thousands of years, the Earth slowly starts to warm again and the ice sheets melt. Sometimes they melt slowly, other times if the ice sheet is smaller such as the Cordilleran Ice Sheet, it may only take a 4,000 or 5,000 years to melt. The Cordilleran Ice Sheet shaped the land around the Cascade Mountains and shaped the Cedar River Watershed.

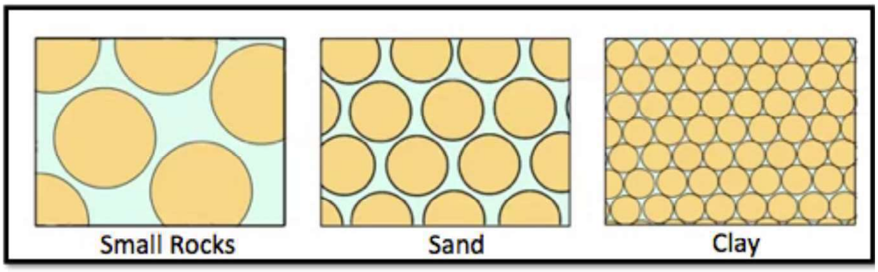
Glaciers are productive agents of erosion. Glaciers can scratch the land and leave behind clues that the land was once covered in ice. Glaciers can also carve out the sides of mountains. As glaciers melt, the rocks and sand that were stuck inside the ice fall out. Sometimes there are big piles of rocks, sand, and soil that a glacier leaves behind. Rocks, sand, and soil are left on the sides or at the ends of glaciers. This pile of rocks, sand, and soil are called moraines. **Glacial moraines are very important to this story because the Cedar River masonry dam was built next to a glacial moraine on one side and solid bedrock on the other side.**

Glacial moraines are all over Puget Sound and near your school. Glacial moraines can be made of rocks, sand and soil. Glacial Moraines have been left on the ground for so long that may times huge trees are growing right on top of them. Look at the labeled photograph on page 3. Do you see the flat area in between two mountains covered in fir trees? That is a hidden glacial moraine. Look behind the moraine, do you see a lake? That is Chester Morris lake, you drink this water. Your water flows down from some taller mountains into the

Cedar River and then into Chester Morris Lake. This water is very, very clean. For a more detailed look at the beginning point of our watershed please look at this online slideshow[1].

Glacial Moraines





Lets take a look inside glacial moraines to see why their "insides" are an important part of this story. Glacial moraines are usually made of largely of rocks (big, small, or a mix of sizes), sand, and some soil. **The glacial moraine in our story is made largely of cobbles and sand. Think about whether water can travel slowly or quickly through sand and cobblestone.**

When we think about building a dam next to a glacial moraine, what are your thoughts? Would you prefer solid rock?

If your answer was solid rock, then you are not alone. There was a group of consulting scientists, geologists, and engineers that provided the City of Seattle with a scientific argument to consider that if the dam was build next to the moraine, that the water would leak through the land. This is because of the amount of space between the small pieces of rocks, sand, and soil that allow water to pass through more easily than clay. **Porosity** is the size of space between the individual grain sizes of Earth materials. **Permeability** is the capacity or amount of water to be able to flow through the grain sizes of Earth materials. Look at the image above, which Earth material looks like it would have more porosity that others. Which one would allow water to flow more quickly through the spaces making it highly permeable?

Students will be learning about and observing these concepts (porosity and permeability) as they draw diagrams, conduct an experiment, and build a dam with these Earth materials (objective 2 &3).

Now that we have covered the ice age and glacial moraines, lets step closer in history to learn about the land and how it was used by the first people that arrived after the ice age to the settlers of the town of Moncton.

1 http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/CedarRiverWatershed/SlideShow/index.htm

History of the Land

After the last glaciers and ice sheets slowly retreated, about 12,000 years ago the First People came to this area. These first people formed tribes and lived all around the watersheds. This land is was and is still their home. There were many tribes that lived all around the Cedar River Watershed. The Snoqualmie Tribe, the Yakama Tribe, The Muckleshoot Tribe, the Wenatchee Tribe, and the Duwamish tribe would all come to the area around the Cedar River to trade different food, clothing, medicine, and other important items. These meetings of all the tribes were also important to meet people to marry and to share stories and news. The Cedar River is a sacred place for these tribes.

Rattlesnake Lake was once a beautiful prairie, similar to the one in the picture. The Native American tribes that lived in the area would take care of the land and harvest flower bulbs, such as Camas. They would roast these bulbs in a big, underground fire pit oven. Then they could eat the bulbs or trade them for a different food during the special meetings. At certain times in the year, the Native American people knew that they had to burn the prairie so the ash would fill the soil with nutrients for the next year's flower bulbs. This burning also helps keep the prairie clear of big fir trees. Every year this cycle of harvesting and burning would take place. The Native American people still do this practice today and teach others how to take care of the land.

In 1855 the Treaty of Point Elliot was signed by the United States Government and 82 Native American Tribal signers, including Chief Sealth, the Duwamish leader. The Native Americans were forced to sign away 64 million acres of land but they were allowed to keep their right to fish for food. The beautiful, sacred prairie land and the land around the Cedar River was given to the settlers, railroad companies, logging companies, and the local governments.

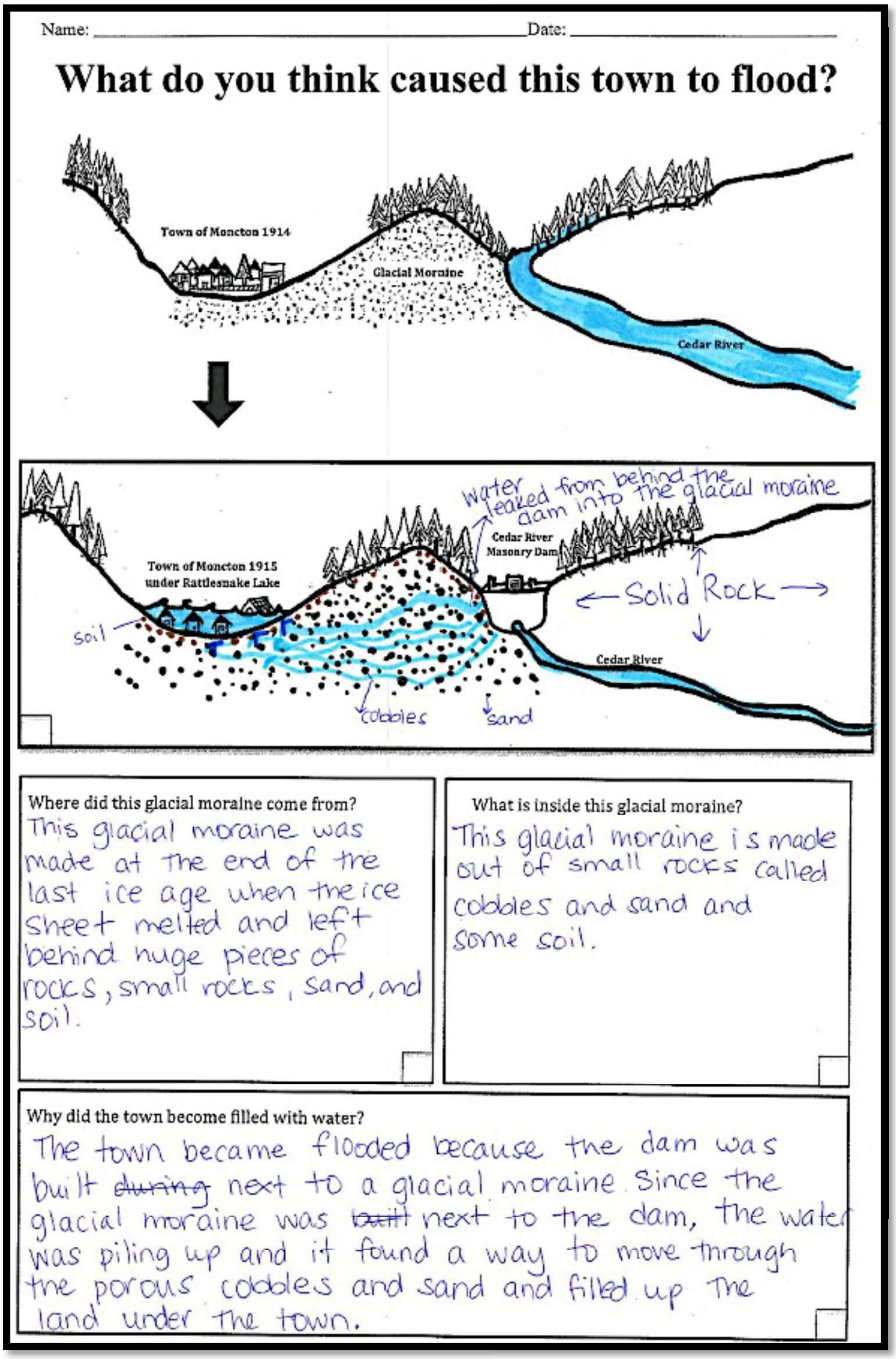
The City of Seattle received its' name in 1852, in honor of Chief Sealth (Si'ahl). Up until 1889, Seattle enjoyed mostly consistent growth but then the great fire burned down most of the commercial district. During the fire, the firefighters had a hard time getting a strong flow of water to stop the fire. <u>One reason for this was because this was a time before Seattle got their water from the Cedar River Watershed</u>. After the fire, the city of Seattle decided to rebuild many buildings but this time using more brick so that it wouldn't catch on fire so easily. This new construction meant that there were many new jobs. Lots of families moved to Seattle to work on these new jobs. But with all these new people moving to Seattle, the city needed more electricity. So they decided to look more closely at the Cedar River and find a way to bring more water and electricity to Seattle.

The town of Moncton was located near the Cedar River and very close to the place that Seattle wanted to get their water from. In the next few paragraphs you will read about how the town of Moncton was created and how the town disappeared.

In 1906, Moncton began as a railroad worker camp and later Seattle City Light and Seattle Water workers. These workers brought their families. There were so many children in Moncton, that the town opened up a school. Moncton had a small indoor swimming pool, a hotel, saloon, restaurant, and 200 people living and working in the town. In 1911, Moncton was renamed **Cedar Falls**. While these people were all living in Cedar Falls, Seattle began to build a new dam and power plant to control the water and make electricity.

Just after the City of Seattle started to build the dam there were a group of scientists and engineers that told the people working on the project to build the dam that there would be a problem with water leaking into the glacial moraine if they continued to build the dam. This group of scientists thought that since the dam was being built next to a glacial moraine that it would cause water to lead through the small rocks and sand very easily. But the City of Seattle ignored this warning and they kept building the dam anyway.

The Cedar River Masonry Dam was finished in November of 1914. There was also a hydroelectric power plant built in which the water flows through to make electricity. But just a few short months later in the spring, the people of Moncton/Cedar falls began to notice springs popping up around the town and puddles appearing out of the ground. One night the water rose six inches and the wooden sidewalks began to float. **The glacial moraine had filled up like a sponge by the early spring (porosity leads to permeability) (objective 2).** During the month of May the water rose one foot per day. By the summer of 2015 most residents had to evacuate and eventually the City of Seattle paid the residents for the loss of their homes and land, a total of $47,658.03. In 1916 the City of Seattle sent a crew to burn the remaining buildings and homes. Today the town of Moncton does not have residents, only crews of workers who work on or near the dam.



Name: ______________________ Date: ______________

What do you think caused this town to flood?

Where did this glacial moraine come from?

This glacial moraine was made at the end of the last ice age when the ice sheet melted and left behind huge pieces of rocks, small rocks, sand, and soil.

What is inside this glacial moraine?

This glacial moraine is made out of small rocks called cobbles and sand and some soil.

Why did the town become filled with water?

The town became flooded because the dam was built ~~during~~ next to a glacial moraine. Since the glacial moraine was ~~built~~ next to the dam, the water was piling up and it found a way to move through the porous cobbles and sand and filled up the land under the town.

This model scaffold worksheet is an example of what a completed model may look like. Students can be prompted to create modeling conventions such as color choice, labels, arrows, and symbols. This example provides you with one way to model the phenomenon. Students will naturally infuse their creativity and ideas, creating a wide variety of examples that can be shared and used for instructional purposes. The small boxes are intended to be for assessment purposes. For example prior to making copies you could add a 2 above each box signaling to students how much each section is worth and then their score would go in the box. Bonus points can be added as well or allow students to create the grading scale using numbered scores that they think would be appropriate for each box.

Why study water?

Water is the most important substance on Earth for sustaining plant and animal life. If there is no clean water on Earth then life could not thrive or eventually survive. In most parts of the world, water is a scarce resource. That might seem strange, because there is so much water on Earth. Almost all of the water on Earth, more than 97 percent of it, is saltwater in the oceans. The rest is called fresh water, because it does not have a high salt content. Most of the world's fresh water is frozen solid in large glaciers in Antarctica and Greenland. Almost all of the fresh water that is available for human use is either contained in soil and rock below the surface, called groundwater, or in rivers and lakes. **Rainfall or snowfall is the only way that water supplies are replenished.** During times of drought, when rainfall is below average for a number of years, water supplies can become dangerously low. Even when rainfall is adequate, water from rivers and lakes might be unusable because of pollution. As the population of the United States continues to grow in the future, water shortages will become more common, because the supply of available water remains the same. Water conservation will become more and more important as time goes on. In some areas, groundwater cannot be used because when it is removed from the ground, nearby wetlands would be damaged by drying up.

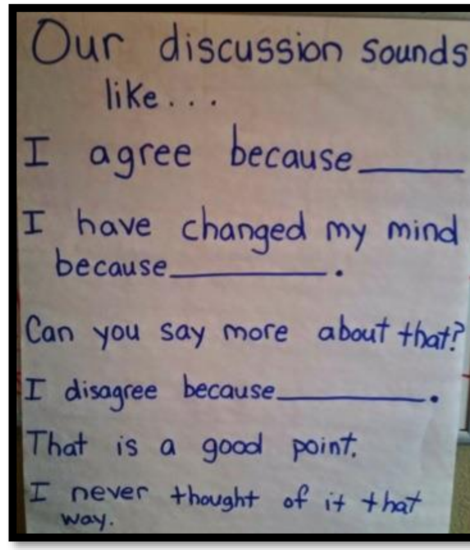
Many substances that are hazardous to human health can enter water supplies. Chemical waste from factories are sometimes dumped into rivers and lakes, or directly into the ground. Pesticides (chemicals that kill insects) applied to farmland enter surface water and groundwater, often in large quantities. Leaks from underground storage tanks for liquids like gasoline go directly into groundwater. Salt put on icy roads in winter pollutes water also, although it is not as hazardous to health. Once a pollutant enters a water supply, it is difficult to get rid of it. Some pollutants slowly break down into harmless chemicals. Once the input of pollution is stopped, the pollutant gradually travels downstream and is replaced by unpolluted water. The problem is that it usually takes a long time for pollution to clear up in that way.

Water in crisis, You can make a difference

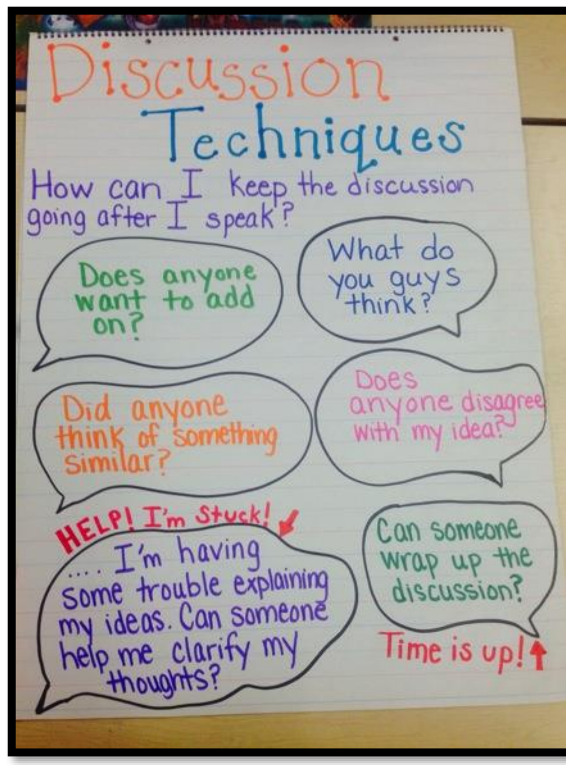
1. **Pick up dog droppings every time, especially near sources of water including storm drains.**
2. **Put a brick, large rock or plastic water bottle filled with sand in the back of your toilet to use less water when flushing.**
3. **Consider using sulfate, paraben, and phthalate free products, which can affect the water quality in the ocean, wetlands, ponds, and eventually our drinking water.**
4. **Consider using environmentally friendly cleaning products such as chlorine free bleach, borax, vinegar, and baking soda to do your heavy cleaning.**
5. **The next time you install new brakes, ask for copper-free brake pads. The copper in our break pads has been found in our waterways and causes death in Salmon populations.**
6. **Teach others about the importance of saving water and making wise consumer choices that affect our water.**
7. **Always take your car to a car wash center as their water and soap runoff is regulated and much safer for the environment than allowing the runoff at home to flow down a storm drain.**

Investigation	Lesson Title	Page # in the curriculum
1	Mini-lessons Maps & Mapmaking • Classroom Maps • Schoolyard Maps	16
2	Where does water come from? • Washington State Map	21
3	Introduction to the Phenomenon • Model Scaffold Worksheet • Agree/disagree T-charts	25
4	Dams • Can you build a dam that doesn't leak? • How does a dam change the water flow? • Building Concerns & Debates (Map of North Wall) Can you build a dam that leaks?	33
5	Ice Age • Puget Sound Ice Sheet • Glacial Deposits • Seattle under glacier • Read Aloud: "Glaciers by Mari Schuh"	38
6	Ice Age created the Cedar River Watershed • Mapping the Cedar River Watershed • Creating a Watershed • Read Alouds: "Follow the Water from Brook to Ocean" by Arthur Dorros & "All the way to the Ocean" by Joel Harper	43
7	Geology of the Cascade Foothills • Soil, Sand, & Silt (Porosity and Permeability) Experiment	49
8	History of the Land • First People (Duwamish, Yakama, Wenatchee, Muckleshoot, Snoqualmie) & Prairies • Town of Moncton (aka. Cedar Falls) • Great Seattle fire creates the need for a dam	59
9	Final Lesson: Putting it all together Understanding the science story behind the flooding of Moncton	63

Setting Norms: Science Discussions



Norm setting is one crucial step teachers can create **with** their students in order for students to feel that their classroom is a safe and accepting place to share ideas. When students feel that they have some agency in creating classroom norms or discussion rules it can create a space for risk-taking, participation, and active engagement with the science content that is needed to reach the performance expectations of the Next Generation Science Standards. Student creativity may be limited due to the emotional climate of the classroom or the type of structures that are in place that privilege certain students and certain types of science ideas. One important piece to keep in mind as we facilitate student science discussions is that students have a rich understanding of the natural and scientific world. Students enter school with an understanding of how the world works and although some of those ideas may be partial-understandings it is important to distinguish their knowledge not as misconceptions but as information that can be incorporated into the lesson as a responsive practice by the teacher.



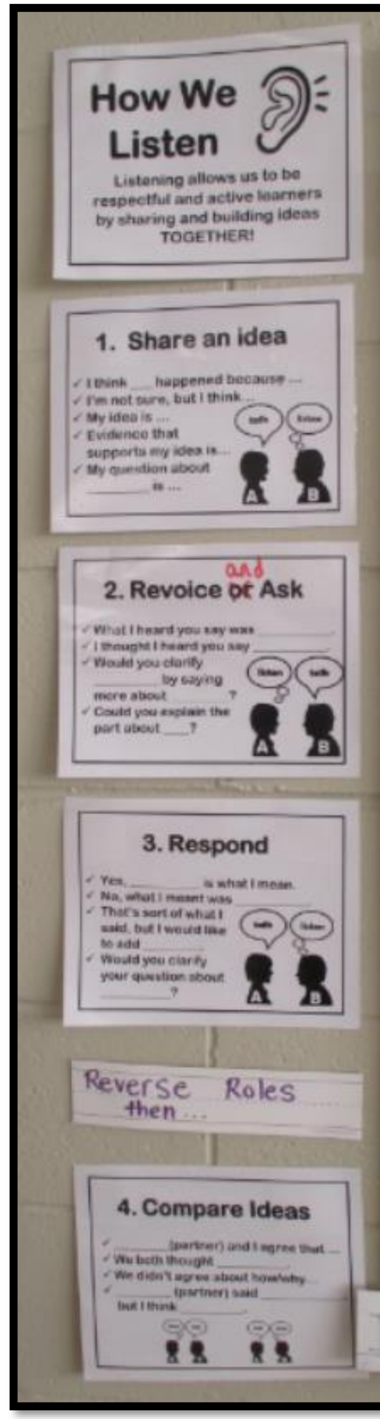
Tip: If you have a behavior or class reward system in place, it can be very motivating for students to consistently be recognized for their efforts throughout the unit and especially during discussions when they practice using listening skills and contributing their ideas. Students can be encouraged to ask questions during this unit and these questions can be recorded onto chart paper displayed and possibly utilized as a guide for discussions during future lessons. Reflect on your own unique personality. ☺Take a moment to think about how teacher behavior, actions, tone/volume of voice, and relationships with students can affect their participation and access to learning.

Student Friendly Learning Objectives:

- **We can create "rules" on a poster for our science discussions.**

Time: 15-20 minutes prior to the start of this unit.

Procedure



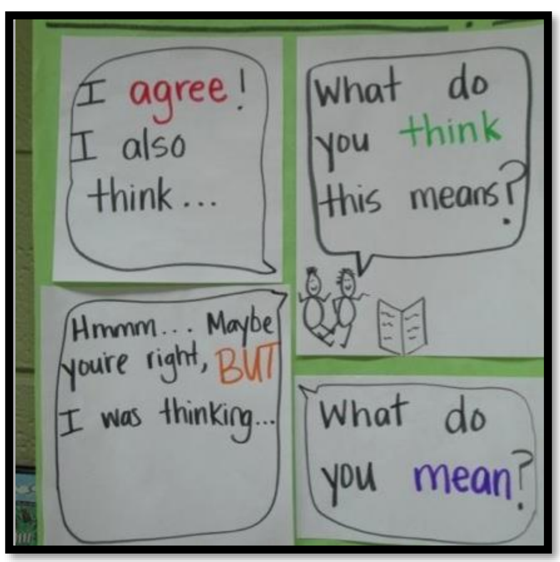
Ground rules should be developed and adapted for every unique context. Appropriate ground rules may depend partially on age, region, and other contextual factors. The following list of common ground rules from equity, diversity, and social justice related classes should serve only as a starting point for your process of creating a similar list suitable to your own situation:

- Listen actively -- respect others when they are talking.
- Speak from your own experience instead of generalizing ("I" instead of "they," "we," and "you").
- Do not be afraid to respectfully challenge one another by asking questions, but refrain from personal attacks such as laughing at others -- focus on ideas.
- Participate to the fullest of your ability -- community growth depends on the inclusion of every individual voice.
- Instead of invalidating somebody else's story with your own spin on her or his experience, share your own story and experience.
- The goal is not to agree -- it is to gain a deeper understanding.
- Be conscious of body language and nonverbal responses -- they can be as disrespectful as words.

It is also important to set a ground rule for how participation will be managed. Do you prefer for students to raise their hands and be called on or for people to speak freely? Remember that some students -- especially those who tend to be introverted -- need more time to process thoughts and speak, so the latter option may exclude them from the discussion.

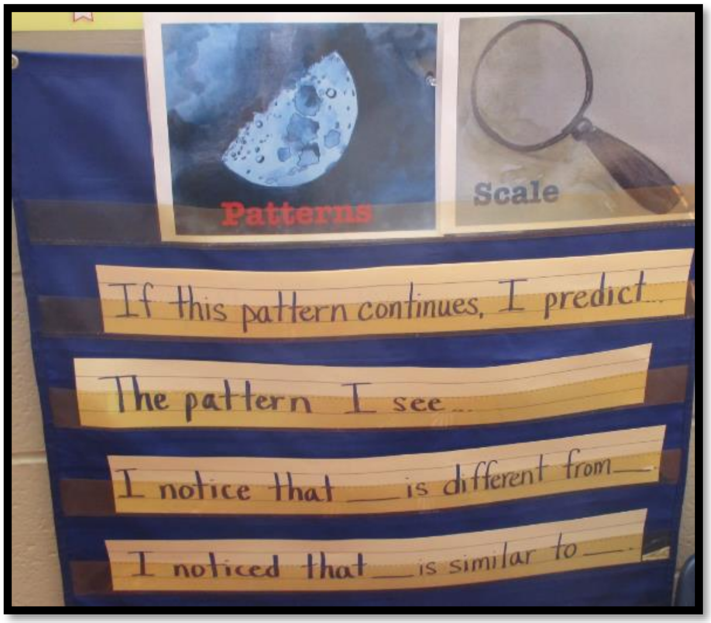
Extension Ideas

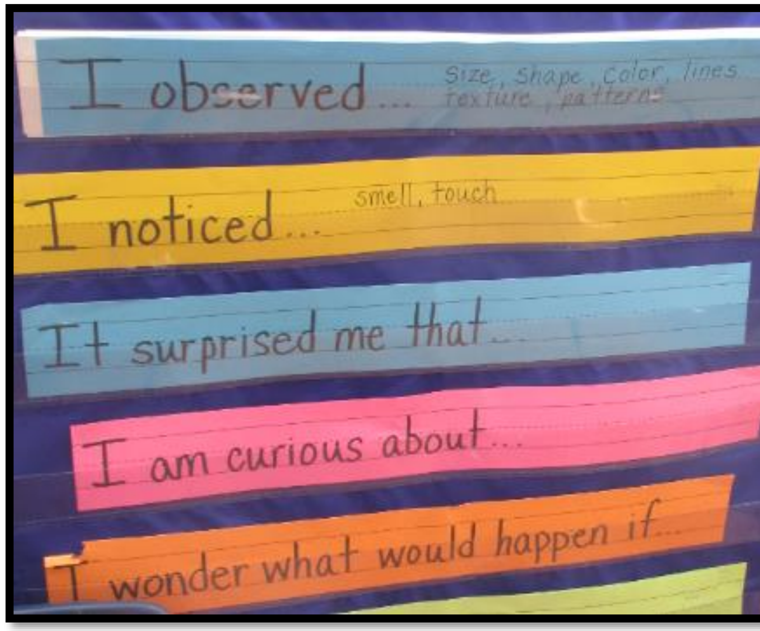
- **Make the class discussion more kinesthetic, invite student to "show" their ideas or practice these discussion norms.**
- **http://ambitioussciencetea ching.org/tools/ visit the ambitious science teaching website to learn more about norm setting for science discussions.**



Getting ready to become scientists

Various sentence stems can be used to help students investigate and think like scientists.





Getting ready for scientific argumentation

It is important for students to collaborate as a scientist community to evaluate and justify various ideas through scientific argumentation. Students can construct claims to answer scientific questions and support their claims using evidence to convince others. We can put the following sentences on the classroom wall to help students understand what the claim is and why they should learn to support their claims.

A claim is an answer to a scientific question.

In order to convince others, scientists use evidence to support their claim.

Stem Storytelling

"We are educated and motivated by **Story**, and a good story telling can change our perspective, give us new insights, shape our dreams and desires."

Throughout this unit and built into each lesson there are teacher science content storytelling notes. These content notes are lesson specific and are intended to be used in a storytelling framework that engages all students, especially narrative learners. These content notes are not intended as real aloud pieces in and of themselves. These storytelling pieces are intentionally placed within each lesson so that the teacher can use the information to weave a STEM story together for and with students. Narrative learning as a concept seeks to shift the focus of learning from the prescriptiveness of a strongly defined curriculum to accommodate personal narrative styles and thereby encouraging engagement and motivation in the learning process.

The importance of storytelling in science has been growing over the last few years as scientists work to communicate with the general public and stimulate more critical thinking about important issues. Scientists and researchers are recognizing that science and storytelling are intertwined.

Scientific American recently investigated the connection between STEM and the humanities in the classroom, discussing how their integration is crucial in engaging girls and young women in the fields of science, technology, engineering, and mathematics. Studies found that while women scored higher than men on both the math and verbal portions of SAT tests, they were less likely to pursue STEM careers. The sum of Scientific American's findings suggests that by integrating literature across content areas, especially in areas focused on STEM, all students will find the material more engaging. Teaching STEM through the lens of literature - whether fiction or nonfiction - allows access to all students to view the material as relevant and meaningful.

http://www.ngcproject.org/blog/storytelling-science-using-fiction-engage-girls-stem

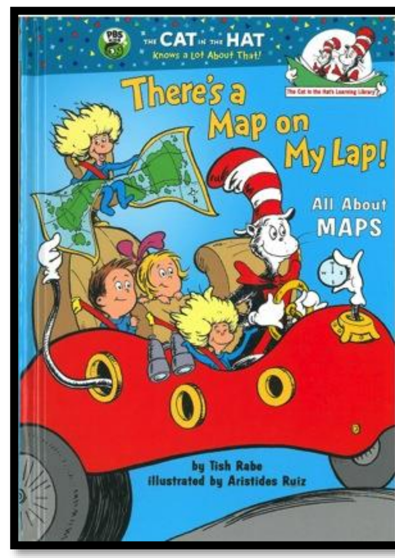
http://blogs.scientificamerican.com/budding-scientist/to-attract-more-girls-to-stem-bring-storytelling-to-science/

http://ww2.kqed.org/mindshift/2015/06/05/could-storytelling-be-the-secret-sauce-to-stem-education/

Investigation One: Maps & Mapmaking

This series of 2 mini-lessons orients students to using maps as a model and tool for understanding how natural and human-made objects are visually represented. Students will engage in whole group and individual mapmaking activities in order to begin <u>developing the geography skills necessary to engage in scientific modeling in this unit.</u> Read aloud a book on maps, such as "There's a Map on My Lap!" throughout these mini-lessons and revisit the map concepts as opportunities present themselves during the map lessons.

*Tip: If you and your students have already completed or engaged in map skill building, please consider adapting these mini-lessons accordingly with your classroom needs. Students will make a cross-section map in this lesson series, which scaffolds and supports their ability to engage with the cross-section map that is the scientific model in this unit.



1. Make a classroom map
2. School Maps, identifying water, & adding labels

Student Friendly Learning Objectives:

- **I can use my ideas about maps to talk with others about maps and map features.**
- **I can draw my ideas using arrows or symbols to make maps.**
- **I can find water on a map.**

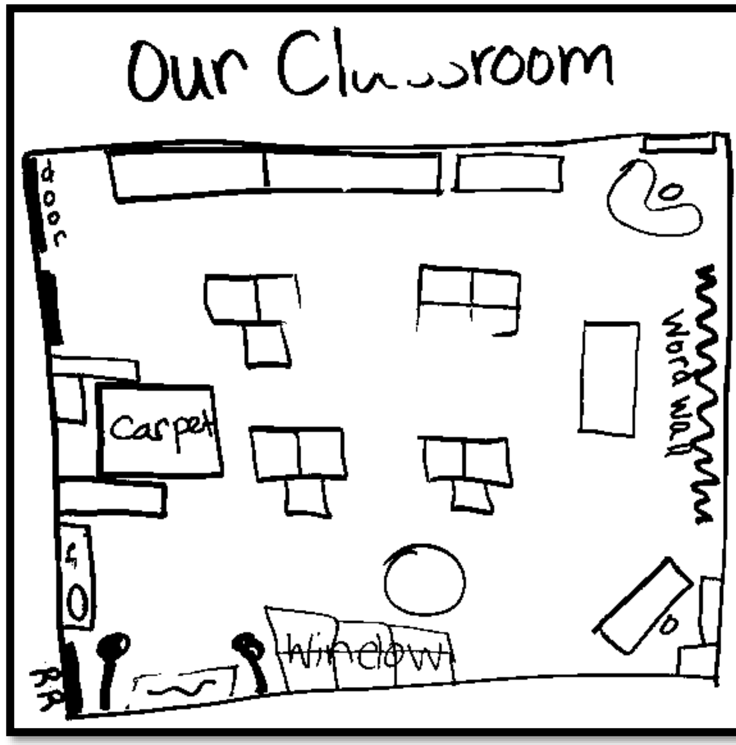
Time: 2-3 Periods, 20 minutes each.

Materials

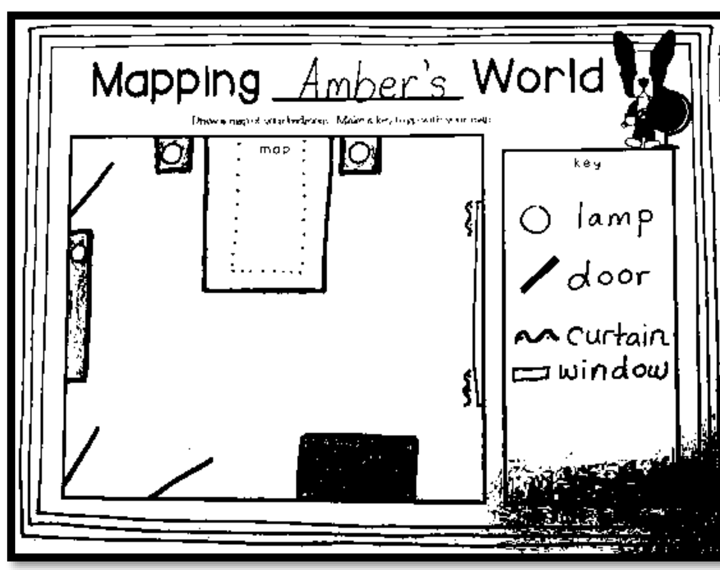
1. **Chart paper, colored chart markers**
2. **Map of your school found on google maps**
3. **Colored Pencils or thin markers**
4. **Large grid graph paper or blank paper**
5. **Read aloud book "There's a map on my lap" or similar books on maps**
6. **Science Folders (or a system of keeping track of student work)**
7. https://www.youtube.com/watch?v=0UqAls-vAW4 There is a map on my lap **Video**
8. **https://www.youtube.com/watch?v=COVJpt9PKjQ Cat in the Hat Map read aloud video**
9. **Maps in PowerPoint guide, 51-61**

Part 1: Make a Classroom Map

1. Gather students on the carpet area, ask students to share what they know about maps. Use a large classroom map if you have one or use the PowerPoint slides #52-55. Share out for 1-2 minutes, incorporating a turn and talk to increase participation by all students.
2. Then show or ask them to find any maps in the classroom. Ask students to make observations about what they see on the map or globe. Record their ideas on a chart paper, utilize GLAD strategies as you see fit. Ask students to engage in a think-pair-share about these questions: **Why do people use or make maps? Can you find water on the map? How do you know that it is water?**



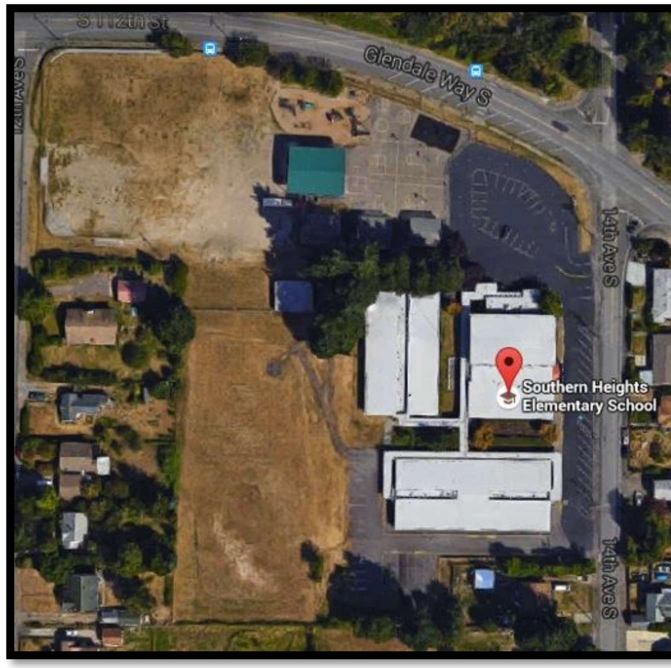
3. Also engaging students in the reasoning behind choices, such as why a globe doesn’t show houses or roads but instead focusing on larger objects. Maps show different perspectives, **Show students using your computer and the document camera the different maps, pausing to ask them questions about identifying water, symbols, land or political features. You may want to only show one or two maps at a time, to space them out during this mini-series.**



4. Using chart paper, draw the outline shape of the classroom for students. Add a small “Legend” or “Key” box in the corner to begin creating symbols for objects in the room. Starting with the white board or door as a focal point. Allow students to add to the map as they identify objects that can be included. Students should also be asked to identify “major” objects such as desks, but not individual books (the reasoning for this can be included in the discussion). **Include water (faucet) in your maps!**

5. Continue to add to the classroom map during this mini-lesson series. Consider asking students to draw a map of their room in their house and adding a title and a legend. Sharing out these maps will help other

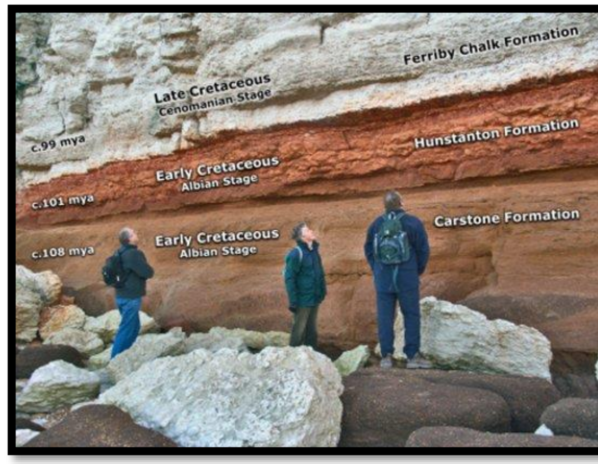
students learn the variation in visually representing a location or place and will allow their teacher to formally assess their understanding of maps at the current point.



Part 2: School Maps

1. **Prior to this lesson type in your school name into google to find and zoom in on a map. Project this map onto your screen so that students can clearly view the map of their school.**
2. Engage students in a whole group discussion about their school map, ask students to identify features of their school such as the playground, buildings, parking lot. Create a legend/Map key with students. **Identify places where there are puddles or water features on the map and add them to your legend/Key.**
3. **Schoolyard Walk: Take students on a short walk of the school grounds**, try to identify objects or features that were not on the map that the class viewed. This is great for discussion as it ties into the idea that maps as models have limitations and can quickly go out of date depending on such changes as the weather or construction projects. **This is important because they can begin to relate map projects to actual features of the land!**
4. Read aloud map book "There's a map on my lap" or related book on maps. Discuss related features (map key, map projections), connect concepts from the book to the classroom maps that students have made.

3. Cross-Section Modeling: Students will use their mapping skills to practice their modeling skills by focusing in on one object, a piece of cake or the cliff. This activity will orient students to the next lesson, interacting with a cross-section of land that contains, water, elevation changes, hills, and trees. In modeling and labeling a piece of cake, connections will need to be explicitly made that this piece of cake was cut away from a whole cake. **Slide # 51,** Show students the slide and the model scaffold for this unit. Tell them that they will be using this worksheet during the whole unit and it is a special kind of map, one that shows both what the top of the land looks like but also what is underneath like rocks, soil, and sand. Sample grouping: Ask ½ of the students to create a model of the cake on a mini-white board and ½ to create a model of the cliff. They should add labels. Sharing out 2-3 student work samples allows the class to see the variations of drawings coupled with labels. Discuss and connect these quickly drawn cross-section models to the model scaffold worksheet. Their model scaffold worksheet is just like being able to taking a slice of cake and seeing what is in the middle and being able to draw what is in the middle and top. Another image is to look at a cliff, which shows the very different kinds of Earth materials that were created long ago during different time periods. The idea being that they will have to use their science brains to think about what they cannot see in the hill next to the town.



2 Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. 1. Develop a model to represent patterns in the natural world. (2-ESS2-2) **Constructing Explanations and Designing Solutions:** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. 2. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1) 3. Compare multiple solutions to a problem. (2-ESS2-1) **Obtaining, Evaluating, and Communicating Information:** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. 4. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)	**ESS1.C: The History of Planet Earth** 5. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1) **ESS2.A: Earth Materials and Systems** 6. Wind and water can change the shape of the land. (2-ESS2-1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** 7. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2) **ESS2.C: The Roles of Water in Earth's Surface Processes** 8. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3) **ETS1.C: Optimizing the Design Solution** 9. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)	**Patterns** 10. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3) **Stability and Change** 11. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1) -- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** 12. Developing and using technology has impacts on the natural world. (2-ESS2-1) -- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** 13. Scientists study the natural and material world. (2-ESS2-1)

Investigation Two: Where does my water come from?

This lesson introduces students to begin making connections that water on a map exists in many forms (oceans, lakes, ponds, rivers, ice) and can be identified on a map as a force that shapes the land. ***The PowerPoint presentation doubles as the student "My Water Book". Prior to this lesson, print out a class set of "My Water Books" use only slides # 1-44 in printing these student books. Double sided, stapled is recommended as students can interact with the text through reading strategies (highlighting) that you choose to employ from your repertoire.**

1. Students will view a Washington State Map & a World Map (PPT #52-53). Teachers will ask the question, "*Can you find all the places that you see water*? "*Look at all of these rivers, where do you think they are flowing)*?" **Call students up to the board to trace rivers, oceans, and lake boundaries.**
2. Students will then engage in a short (2-3 minute) classroom discussion to collectively articulate their ideas verbally and use drawings on the white board to explain their thinking around the different ways that water is represented on the map.
3. **Students will then be asked *"Where does your water come from?"*, the teacher can turn on the faucet if you have access to one in your classroom to draw students' attention or bring in a glass of water for display.**
4. **Different student ideas (hypotheses) will emerge from this second discussion, they can be charted on poster paper and saved for use during the unit. Over time this list will narrow as students learn where their water comes from. Look for partial ideas in student responses as they share out. You can also ask if they think their water comes from a nearby place or a far away place, using the maps to guide their ideas.**

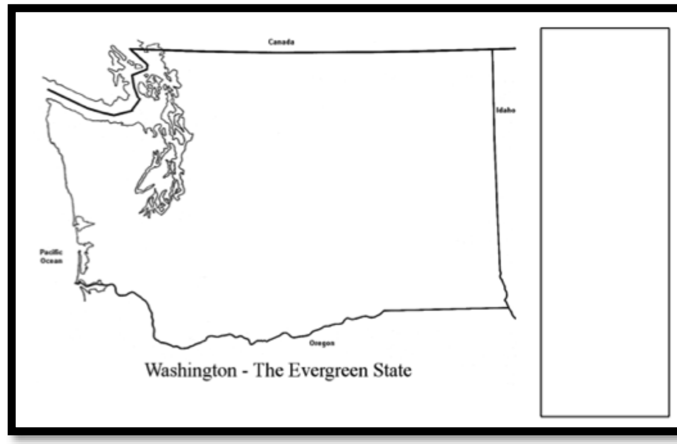
Student Friendly Learning Objectives:

- **I can use my experiences with water to think about where water comes from.**
- **I can listen to other students' ideas and agree or disagree with evidence.**
- **I can identify water on a Washington State map.**

Time: 30-40 minutes

Materials

14. Chart Paper
15. Washington State Map printed for each student on large paper
16. PPT (pages #52-58)
17. Student "My Water Book" page one (slide #1)
18. Book "Water Dance" Thomas Locker



Procedure

Part One

1. Prior to beginning the lesson, on chart paper trace the outline shape of Washington State freehand or using a map underneath. Display the Washington State Map on the board.
2. Ask students to find places on the map that they see water. Ask them to identify the water as a lake, river, sea, or ocean. (The Puget Sound is also known as the Salish Sea)
3. Trace over your outlined map in black sharpie/maker. You and your students will create a map key or legend. Tell students that they will come to the board to help you add some important geographic features (mountains, rivers) to the map that are part of the clues to telling the "Where does my water come from story". Let students know that they will use symbols to represent mountains (brown triangles) and the blue colored lines to represent rivers.
4. Using the printed map as a guide, identify on the map where their school is located, draw this symbol with a star, add it to the legend. Then on the map show students where the Cascade Mountain Range is and have students add brown triangles to the map to represent the mountains going down the middle of the state. Add rivers, with an emphasis on drawing the river flowing down from the mountains and into the Puget Sound or the Pacific Ocean.
5. Give students a copy of the Washington State map template and have them work independently or in partner groups to add mountains and rivers to their map. Students will be using this map throughout the unit. They will add to the map key over time.

Part Two: 25-30 minutes

1. Read aloud “” by Thomas Locker as an introductory component to the discussion. This book can be used in a multitude of ways and you can draw pieces of the poems into student discussion. Extension activities include having students create their own water dance poems “I am the puddle” or “I am the ice”
2. Students will then be asked *“Where does your water come from?”*, the teacher can turn on the faucet if you have access to one in your classroom to draw students’ attention.
3. **Different student ideas (hypotheses) will emerge from this second discussion, they should be charted on poster paper and saved for use during the unit.** Over time this list will narrow as students learn where their water comes from**. Listen carefully for partial ideas in student responses as they share out.** See sample discussion below.
4. **Student Unit Book:** Ask students to write their name on their Water booklet and draw a picture of water on the cover, it can be any picture of any kind of water. **Read slide #2 whole group, “Where does my water come from” about what students will expect in this journey.**

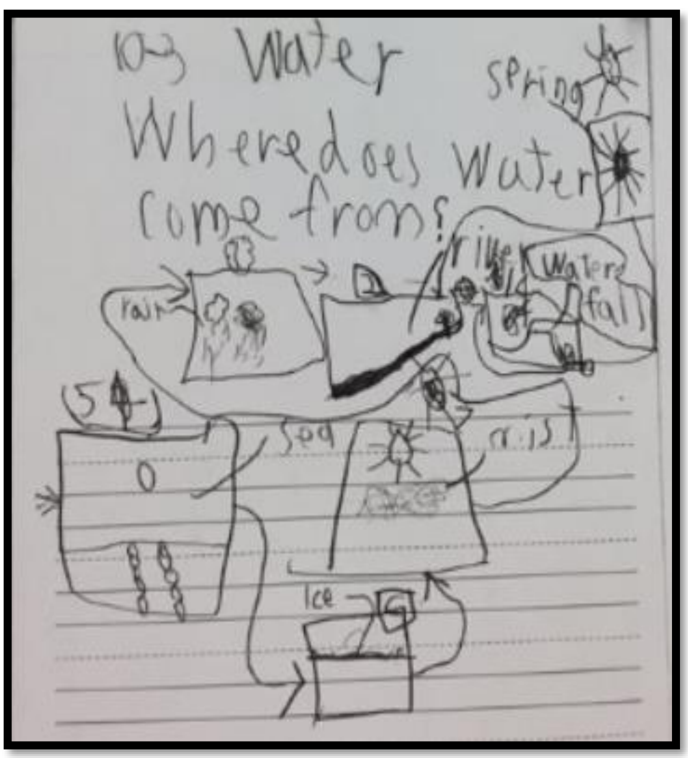
Sample Discussion & Responses

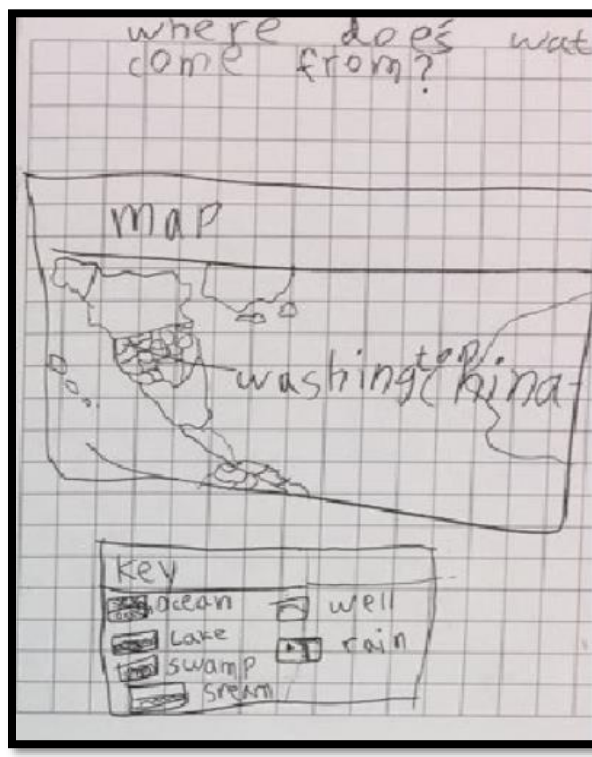
Student Dialogue Examples	**Highlighting/probing for the science story**
“Water comes from the Ocean”	*“Yes, it does. There is lots of water in the ocean, can you find this on a map. Is Ocean water fresh or salty? Does anyone know other places we find water?*
“Our water comes from the sky”	*“Yes, it does. Can you draw that on the board, how does it come from the sky? Are there different ways that is comes to us (rain, snow, sleet)?”*
“There is water in puddles”	*“Yes, we do find water in puddles. Where did that water come from? Can you draw on the board how puddles come to the Earth?”*
“The puddles don’t stay on the ground like the ocean”	*“Wow! What do other people think?” “Does anyone know why the ocean stays but puddles disappear?”*
“That map shows water”	*“Nice observation. Yes there is water on this map. Can you come to the board to trace the water? Which direction do you think the water flows, up or down the mountain?”*
“Why are we learning about water?”	*“Great question. Why do you think it is important to learn about water?”`*

	"We are going to learn about water because it is the most important element to our survival. Humans, plants, and animals need clean water to live, grow, and thrive. We learn about water so that we can understand where it comes from and how we can make good choices to take care of our water."
"I think that the water comes from the mountains, because on the water bottles it always has pictures of mountains on it."	*"That is an interesting idea. Lets talk more about that. Does anyone else think that our water comes from the mountains?"*

***Parts of the water cycle may emerge from this discussion and this may be something that you decide to pursue in an additional mini-lesson or through a scientific read aloud if you think that your students would benefit from such an experience.**

Examples of student work





Investigation Three: Introducing the Phenomenon

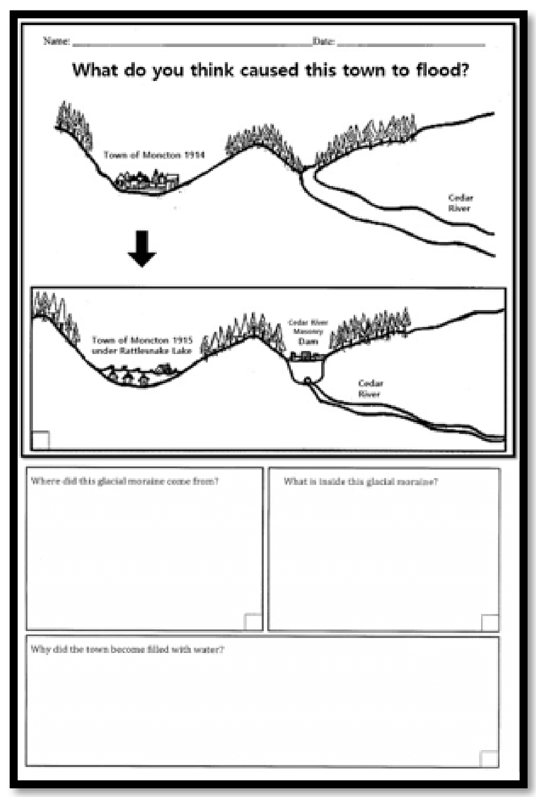
This lesson introduces students to the phenomenon about the flooding of the town of Moncton allowing them to make connections to their prior experiences with water, rocks, sand, and building a dam with soil or sand in their backyard or beach.

Students will view pictures of the town of Moncton before and after the mysterious flooding. Teachers will ask the question, "*Where do you think caused this flood*? or "*Where do you think the flood water came from*?"

- Students will then engage in a short (5-10 minute) classroom discussion to collectively articulate their ideas verbally and use drawings on the white board to explain their thinking. Students will view video during the discussion to further their thinking about the land around the town.
- Students will then work independently or in partners to put their ideas into their drawings on the model worksheet.
- Samples of student work will be shared out to highlight potential hypotheses, 2-3 central ideas are identified and used in further discussions and to guide instructional decisions related to the next learning sequences.

Student Friendly Learning Objectives:

- **I can use my ideas about water, rocks, and dams to think about how they are connected in this story.**
- **I can draw my ideas using arrows or symbols to show my thinking about how this town was flooded.**



Time: 2 Periods, 25-30 minutes each.

Materials

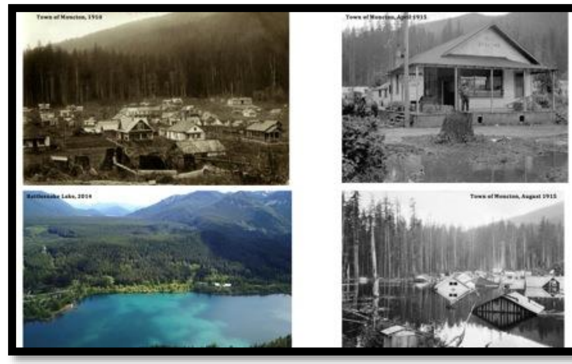
- **Flood Pictures (either printed or displayed though the computer/document camera)**
- **PPT Slide # 37**
- **Model Worksheet, one for each student**
- **Colored Pencils or thin markers**
- **Science Folders (or a system of keeping track of student work)**
- https://youtu.be/IeHvb5euU5Y **Video (Start at 43 seconds Stop at 1:10) play on mute.**
- **Slide Show from Seattle City Light** http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/CedarRiverWatershed/SlideShow/index.htm

2 Earth's Systems: Processes that Shape the Earth
Students who demonstrate understanding can: **2-ESS1-1.** **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** **2-ESS2-1.** **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.** **2-ESS2-2.** **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** **2-ESS2-3.** **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. 19. Develop a model to represent patterns in the natural world. (2-ESS2-2) **Constructing Explanations and Designing Solutions:** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. 20. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1) 21. Compare multiple solutions to a problem. (2-ESS2-1) **Obtaining, Evaluating, and Communicating Information:** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. 22. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)	**ESS1.C: The History of Planet Earth** 23. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1) **ESS2.A: Earth Materials and Systems** 24. Wind and water can change the shape of the land. (2-ESS2-1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** 25. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2) **ESS2.C: The Roles of Water in Earth's Surface Processes** 26. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3) **ETS1.C: Optimizing the Design Solution** 27. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)	**Patterns** 28. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3) **Stability and Change** 29. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1) -- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** 30. Developing and using technology has impacts on the natural world. (2-ESS2-1) -- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** 31. Scientists study the natural and material world. (2-ESS2-1)

Part 1: 25 minutes

Procedure: Introduce the lesson, whole group.

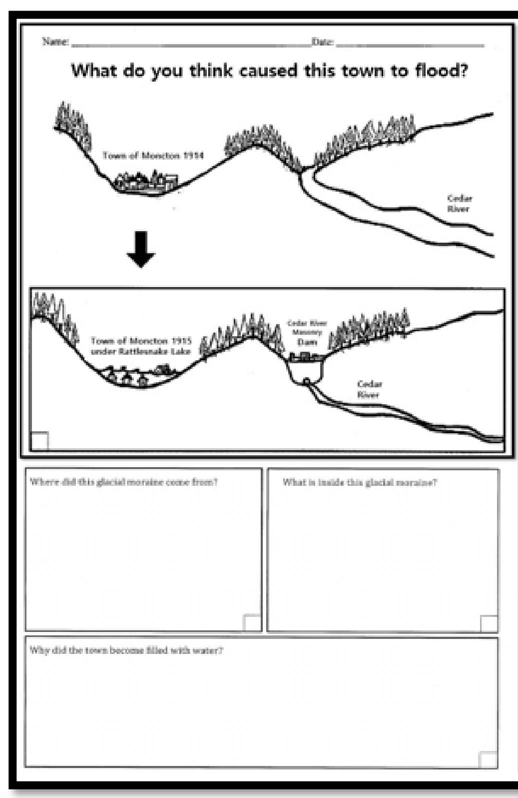


Gather students on the carpet area. Ask students to share what they know about floods (hint: they can occur slowly or quickly) Share out for 1-2 minutes, incorporating a turn and talk to increase participation by all students.

Then show students the 4 photos of the flooding and/or the photo of the “then and now” photo. Ask students to make observations about what they see. Record their ideas on a chart paper, utilize GLAD strategies as you see fit.

Ask students to engage in a think-pair-share about these questions: **What do you see happening? Where did this water come from?**

Explain that in this upcoming science unit we will be learning more about this story and we will learn pieces of the story in each lesson that will help you solve this mystery. Let students know that all of their ideas will be drawn on their model paper and they can also write their ideas down on lined paper if they need more room.



Part 2: 30 minutes

Establish conventions: On their models, let student know that they can add labels, arrows, and color to show or represent certain ideas such as movement. Ask students to co-create conventions that everyone can follow such as the river water will be blue.

- Show students the video that films a panoramic shot of the whole area. Pausing to point out certain areas such as the lake in the background, Rattlesnake Lake, and the shape of the hills. **Play from 43 seconds until 1:10 on mute**. https://youtu.be/IeHvb5euU5Y
- Play the slide show for students to orient them to the area. http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/CedarRiverWatershed/SlideShow/index.htm

- Show students slide # 37. Let students know that they build this town to help support building the railroad across the

Cascade Mountain Range (Show Map slide #52). Ask students to identify what is different about the two images on their model scaffold worksheet.

- Students will now be oriented to the model scaffold worksheet. Engage students in a little storytelling to explain that this is a side image of the hill, <u>similar to when you cut a piece of cake or pie and you can see the inside.</u> Ask: **What are some possible reasons why this flooding may have happened? What would cause it to happen?**

- Tell students that they will be using their ideas about what happened observation skills to tell a science story about how the town became flooded and the land turned into a lake. Students may seem to get the answer quickly, the water flowed through the hill and asking them to
- During this discussion, thoughtful teacher responses to student dialogue can help students stay focused on this particular story and the unit goals.

- **Students will create models to show that water can slowly or quickly change the shape of the land.**
- **Students will learn that how and why water can flow through certain Earth materials more easily than others, including soil, sand, gravel, and clay.**
- **Students can read and interact with maps to show where places and bodies of water are located.**
- **Students will read maps about their local watershed and learn where their water comes from.**

At this time in the unit, do not use these goals to "funnel" or "feed" ideas to students to help them articulate their ideas. Students will be able to reach the unit goals by the end of the lessons and they will need time to experience some of the science concepts needed to understand the science story. Be aware of who is being called on to share ideas paying particular attention to subtle differences in gender, ability, language, and ethnicity and how certain student ideas are privileged. Students may want to share personal stories and they can be guided to make appropriate connections to the video.

Maria*: Did you know that I have built a dam at the park?*
Teacher*: Really! What did you use to build it?*
Maria*: I had rocks and dirt and we made a big wall and poured the water in.*
Teacher*: Can you tell me what happened after you poured the water in?*
Maria*: Well the water went everywhere and the walls weren't strong enough?*
Teacher*: Nice! So you are saying that the walls of the dam or the hills around the water have to be strong so that the water stays in one place. Other ideas or stories? Can anyone add on?*
DeShawn*: I made a dam at the beach with my cousins.*
Teacher*: Okay, what did you use to make your dam?*
DeShawn*: We used sand and some rocks.*
Teacher*: Okay, tell me what happened after you put water behind your dam.*
DeShawn*: The same think that happened to Maria, the water went everywhere. But when our sand was wet it helped more than when we used the dry sand.*

Teacher*: Thank you for adding on, DeShawn. Yes, the kind of materials that you use to build a dam and that will help hold the water back are very important. Lets keep thinking about these ideas, they might help you explain this story.*

- Support students as they transition from the class discussion to working independently to complete the model worksheet. Depending on the dynamics of your classroom you will need to consider if each student will receive a worksheet or if your students will be sharing and completing one worksheet in partner groups.
- Students will then draw their thinking on the model scaffold worksheet (minimum 7-10 minutes). Students can use pencils, colored markers or pencils to add details. Students that finish early can use a post-it note to copy their ideas for display on the class poster for lesson one or have an activity ready for students to complete while they wait for others such as the "Book Basket" full of relevant reading material.
- Have 2-3 students share one of their ideas about how the town became flooded. Ask other students if they had similar ideas. Invite students to ask questions or comment of different components of the student's model.
- **Create a class chart of 2-3 common ideas that students are having. Share out some student work and allow students to explain their ideas (3-5 minutes). Work to facilitate their ideas in a focused and positive manner, even if student work seems unfocused or unfinished as students' explanations of their models can many times explain the meaning behind their modeling.**

Extension Ideas

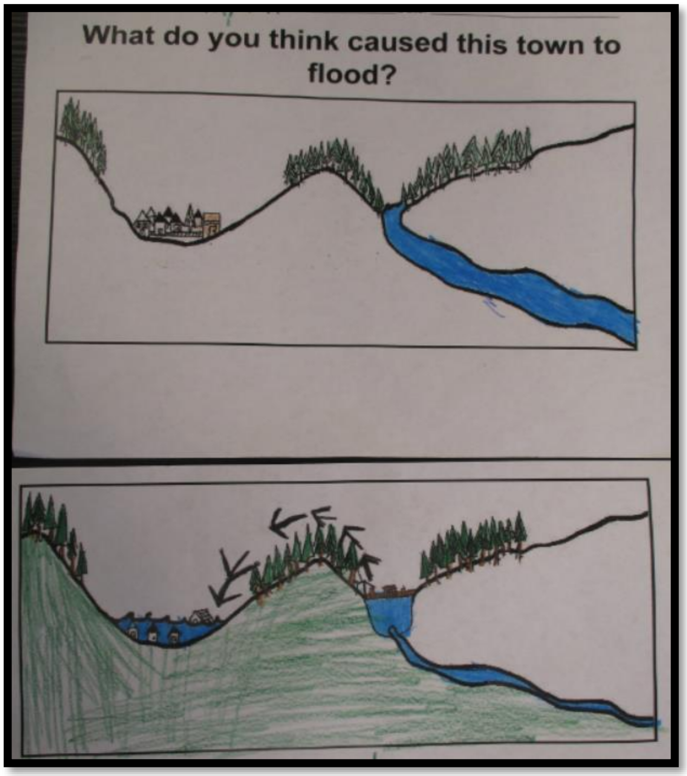
- Pay close attention to student gestures while they are talking. Young students sometimes may not be able to say all of their ideas in words but they use a combination of talking plus gestures and picture drawing. Students who cannot fully participate in the discussion verbally can be given the option to draw their ideas on a mini-white board.
- Incorporate writing opportunities by having students write or draw stories about apple experiences.
- Allow students to add drawings, words, or sentences on post-it notes to the class lesson poster.

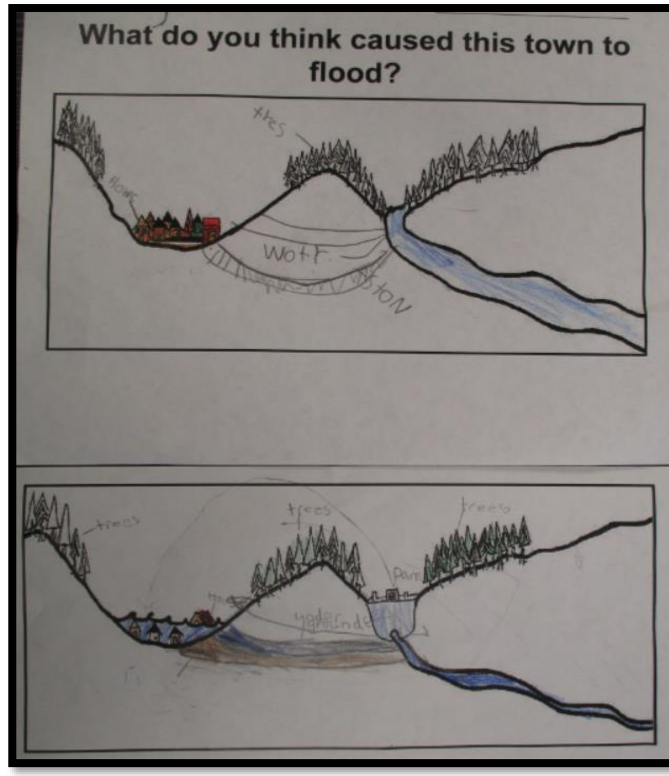
Problem Solving Reflection Ideas:

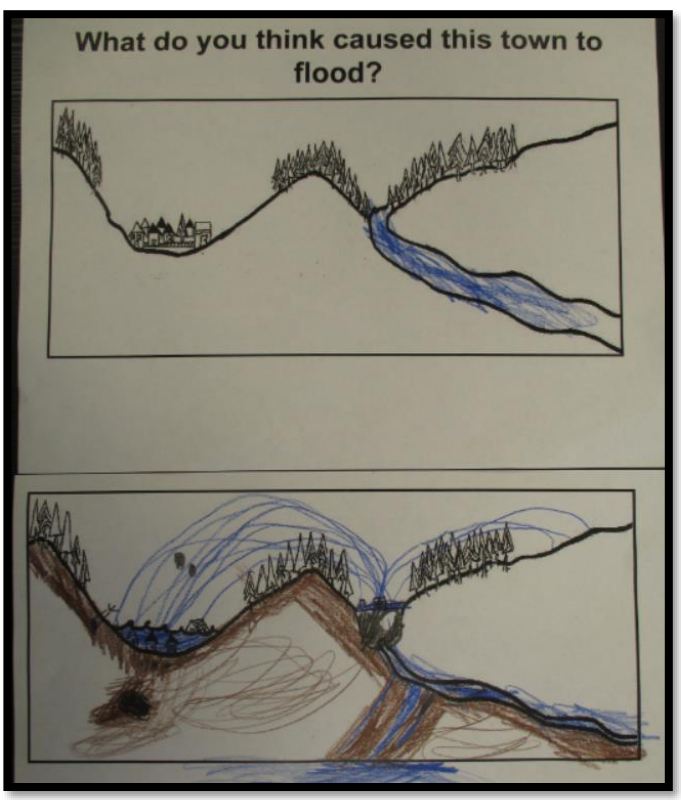
It would be helpful to read these questions prior to each lesson so that you are aware of these issues. Collaborating with colleagues on these questions will help facilitate better instruction and learning.

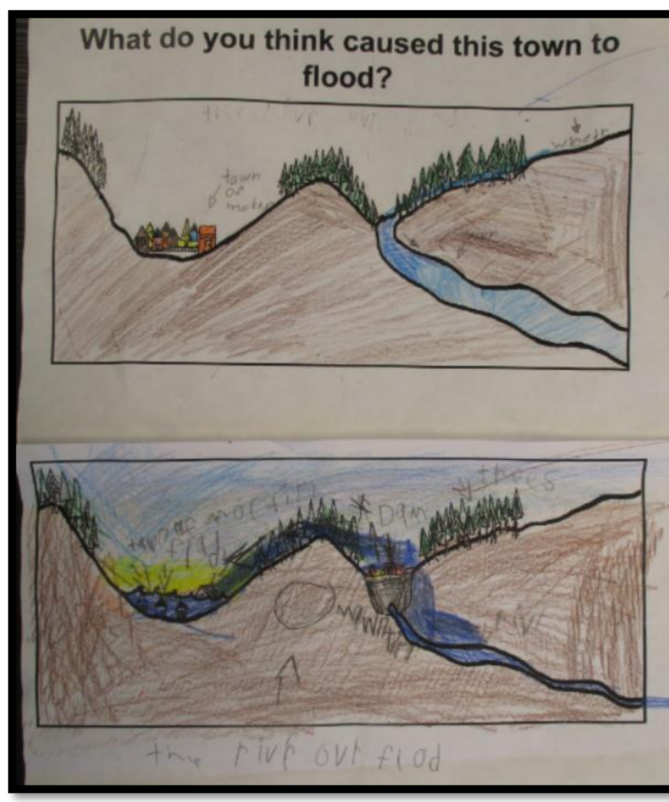
- How to incorporate all students in a discussion when a small group of students seems to have a strong grasp on the concept and have great ideas to share?
- How can you incorporate partner talks as students engage with their peers, stay on task, and share ideas?
- What strategies need to be in place prior to beginning this unit that will enable students to participate appropriately and motivate all learners?
- What social and emotional learning environment components are in place in the classroom to ensure that all learners can feel comfortable and safe sharing their ideas in front of their teacher and peers? If there are few components present, what is one aspect that you as the teacher can put in place to make necessary changes to the learning environment?

Examples of students' initial models

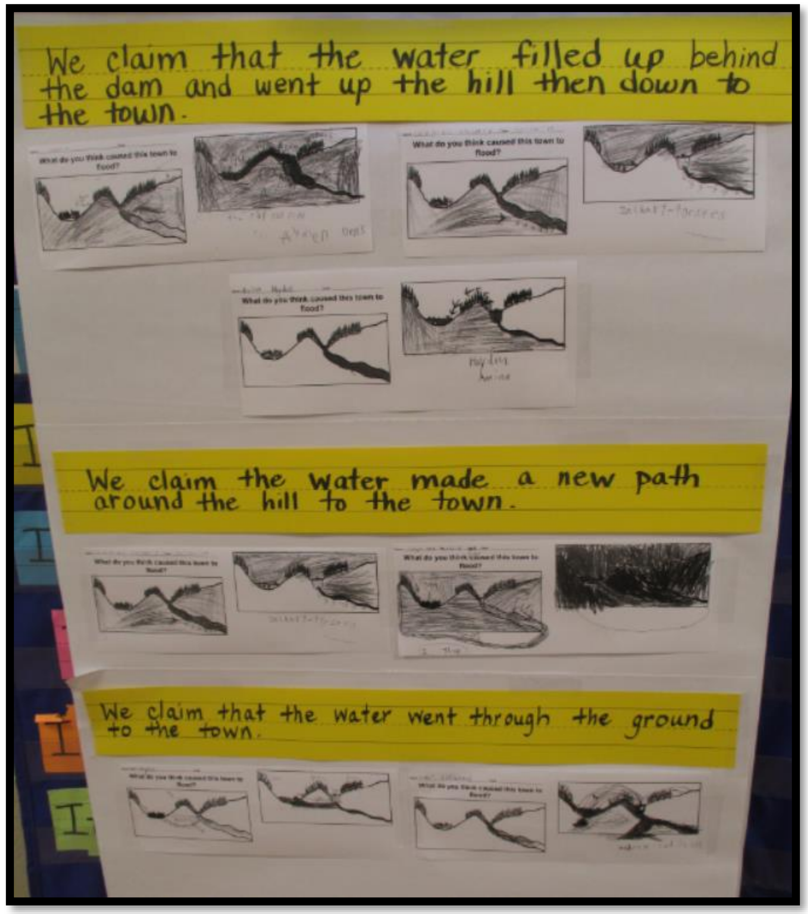








Making T-charts with students' initial ideas [claims] from their initial models about the phenomenon



Students' initial models can provide us with students' initial thoughts about the phenomenon. By making these T-charts, students would be able to revise their initial ideas over time as they learn new things throughout the unit.

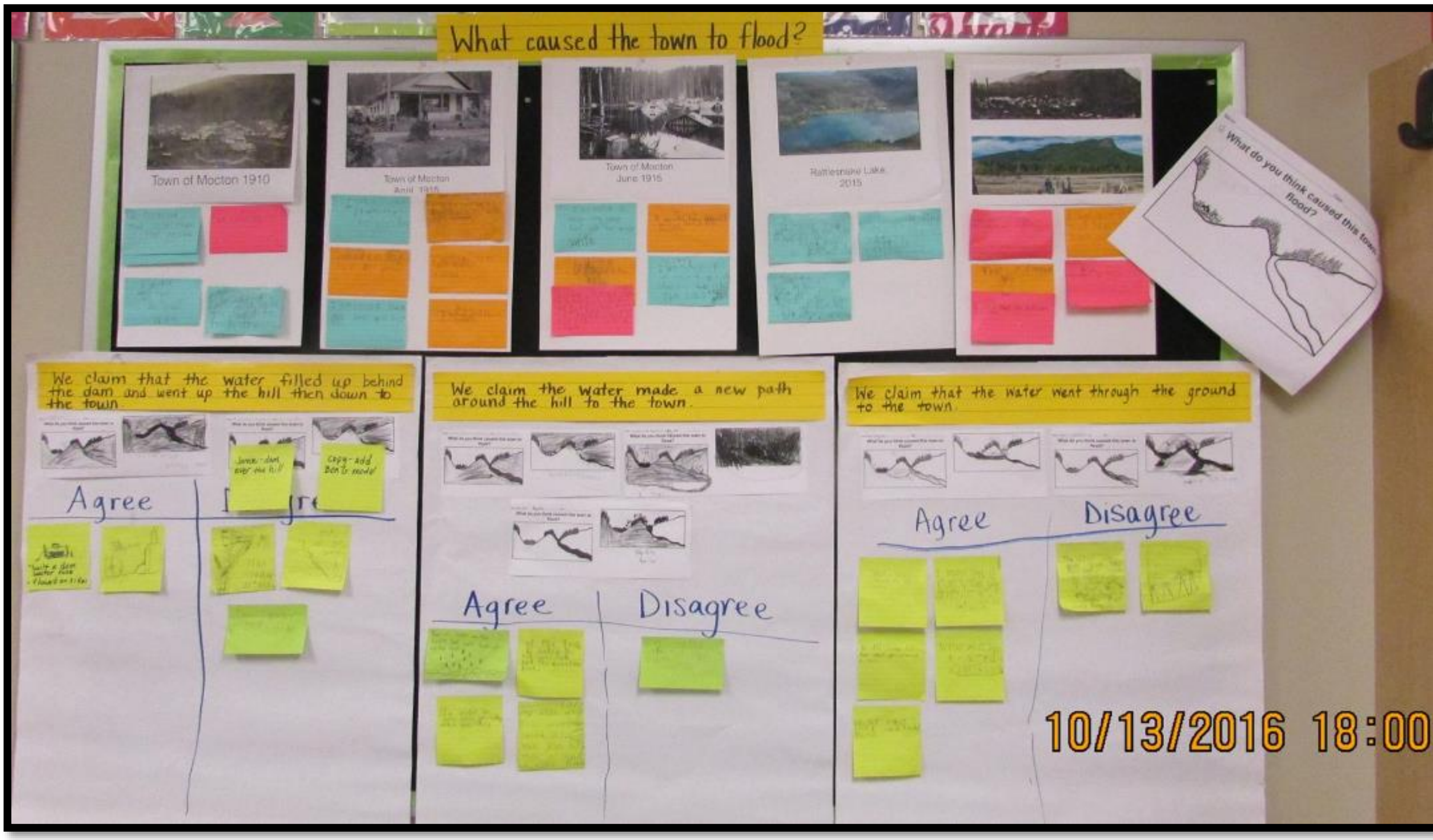
- Closely examine students' initial models.
- Identify big ideas that can explain the flooding in the town of Moncton.
  Three ideas would be good to work with. Examples of those big ideas are shown in the picture on the right side.
  1) The water filled up behind the dam and went up the hill then down to the town.
  2) The water made a new path around the hill to the town.
  3) The water went through the ground to the town.
- Write down each idea in a big poster paper in a form of **"claim"**.
- Copy the students' models and paste the models to the posters, according to the ideas that the models have. Models can go into more than one poster if they include multiple ideas.
- Draw a T-chart on each poster with the labels of "Agree" and "Disagree".
- Students can work on these posters throughout the unit.

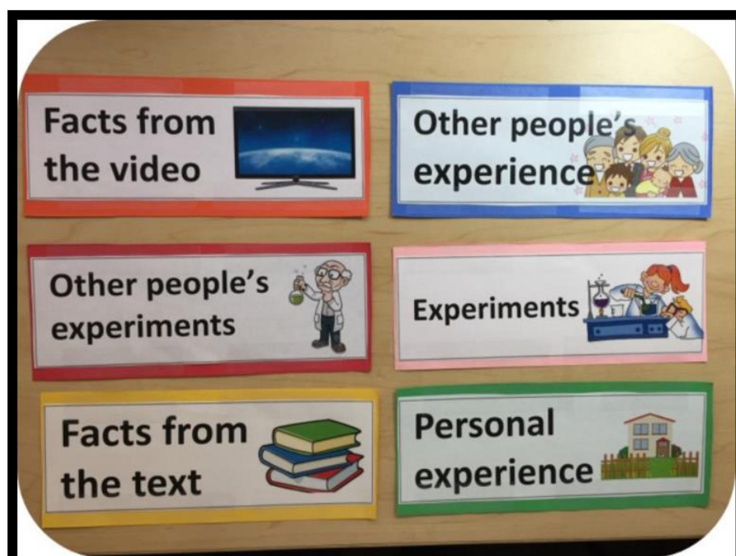
Part 3: 45 minutes (Agree or disagree with the claims on the T-charts based on personal experience)

- Introduce the claims on the T-charts to the students. Emphasize that those are *their* ideas.
- Ask students if their models are on the appropriate posters. (Check whether students think their models include those ideas on the T-charts.) Ask students to move their models if they feel the need.

- Ask students to think about their personal experiences about water that they had on the playground (can be any other specific contexts) and write those down on stickies.
- Whole class discussion: Help students agree or disagree with the claims on the T-charts based on their personal experiences. "Does your personal experience support this claim? Or does it disprove this claim? How? Why? Does it support any other claim? What claim do you think your experience supports or disproves? Why?"
- Help students decide where to put their stickies (personal experiences) on the T-charts. They can put the stickies on the "Agree" or "Disagree" side of the claims.

- In this case, the students' personal experiences become their evidence for supporting or disproving the claims on the T-charts.





- Throughout the unit, students can add evidence from various sources to support or refute the claims on the T-charts.
- The class can revisit the T-charts after some unit activities (experiment, reading, watching video, …) to add evidence to the T-charts.
- Whenever the class revisits the T-charts, use the cards like the ones on the right side to clarify the sources of evidence.
- Students can add stickies with evidence on them to the "Agree" or "Disagree" side of each claim, throughout the unit. You can make them use different colors of stickies for each source of evidence. (e.g., Experiment-pink, Personal experience-green, …)

Investigation Four: Dams

Students will learn about the Cedar River Masonry Dam and engage in building a dam using different earth materials. Students will learn to generate claims and support their claims with observations.

Tip: Planning is important in this lesson! Grouping students according to gender and personality may need to be considered in this lesson. Some girls may do better working in all-girl groups while other students would benefit from co-ed groups. ***The difficulty will be in having enough materials for the groups that you want to create, consider collaborating with a colleague to use their materials and yours to ensure that students have enough construction materials.***

Student Friendly Learning Objectives:

- **I can listen and share my ideas and work with a partner to build a dam.**
- **I can listen and learn about the Cedar River Masonry Dam.**

Part 1: 50 minute lesson

Materials

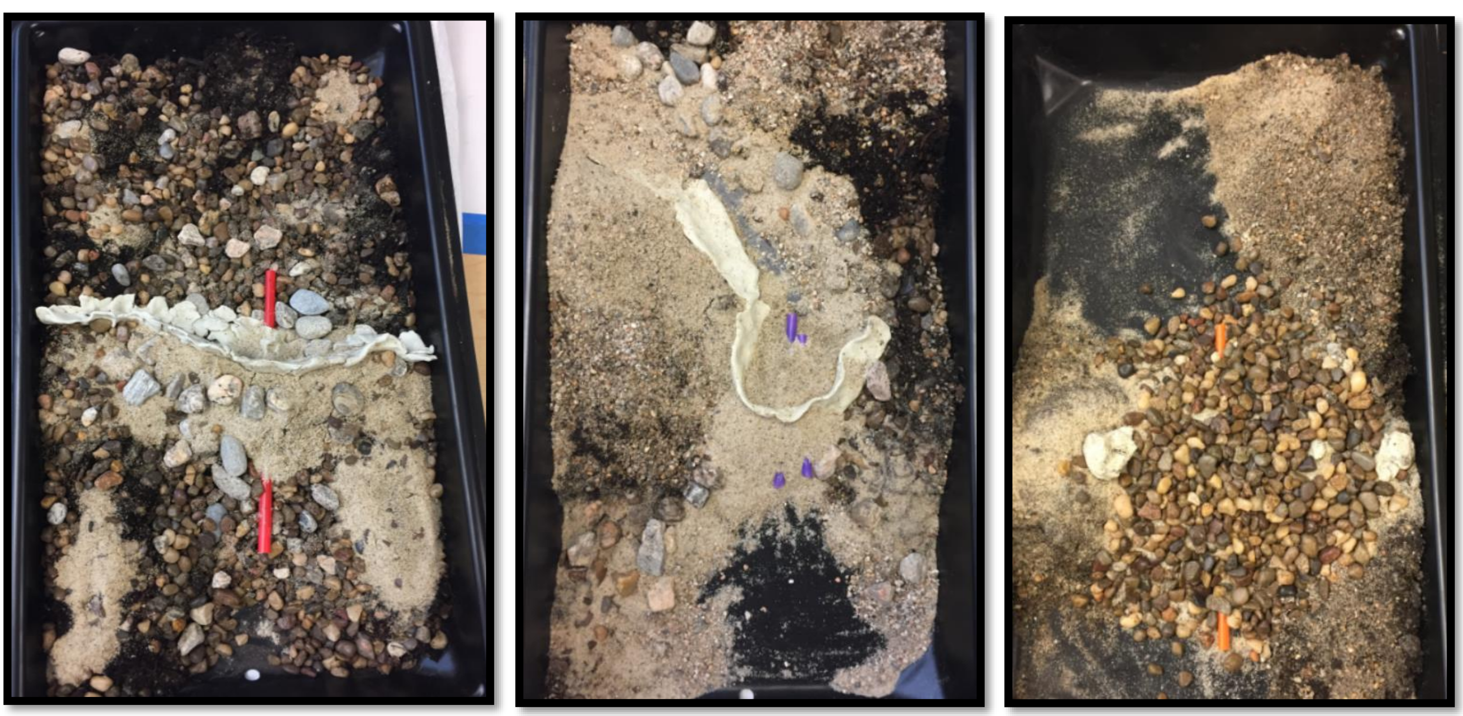
1. **Trays or pans (1 for each group of 2-3 students)**
2. **2-6 cups of each soil, sand, clay, and gravel (you can choose to allow students to use larger rocks they bring in from home or the playground)**
3. **Water**
4. **PowerPoint slides #41-44**
5. **Student "My Water Book"**
6. **Model Scaffold Worksheet**

Procedure

1. Gather students on the carpet and ask students what they know about dams, have they ever built a wall of sand at the beach or park. Spend time eliciting ideas from students about what materials they would need to build a strong dam that lasts for a long time and that can hold back lots of water.
2. Students will then engage in watching the PowerPoint slides #41-44 to see related visuals and learn very basic information about the masonry dam. **Notes below the slides have optional links and interesting storytelling notes.**
3. Ask students to explore the kinds of materials that they can use. It is helpful to let students know that this may be a challenge to share materials and plan for construction. Students may benefit from engaging in construction talk for 2-3 minutes prior to receiving materials.
4. Students will first build a landscape in small groups on the tray. They can build the landscape and see how the water flows in the landscape. Ask students to draw the results in their notebooks.

5. Then, in their notebook, ask students to design their own dams that can control the water flow (by holding back most of the water and letting a little flow go out) with their small group members. Help students predict how the water would flow and ask them to draw it.
6. Students will be working in small groups to build a dam that can hold back water using the Earth materials provided. Students will need the most support working cooperatively. They should not receive lots of directions related to how to build the dam.
7. Watch as students construct their dams and weave in stories or facts from the previous lessons. Such as "remember the Cedar River Masonry Dam is made out of hard rock on the inside and cement on the outside."
8. Students working in groups can test their dam using water to simulate a flow of water. Ask students to write down their observations either on their notebooks or on stickies. Stickies would be easier to gather the observations.
9. Students can demonstrate their dams to the whole class by having students travel in a whole group from dam to dam to view the demonstration. This may be a time when students are critiquing the dam and ask that students use science ideas to explain their thinking in a kind way instead of saying that someone's dam is bad. Let students know that this is something that engineers do before they begin a big construction project, they try out their idea to see what works and what doesn't work. Sometimes engineers can learn a lot about their design just by watching something not work. Help students write down more observations.
10. Ask students to gather back up on the carpet to share what they learned about dams by being able to build one. Let students know that even though their dam failed that sometimes that is the best way to learn and that "productive failure" or making mistakes is the process that engineers and problem solvers go through every time they approach a problem or a new project.

Examples of students' dams

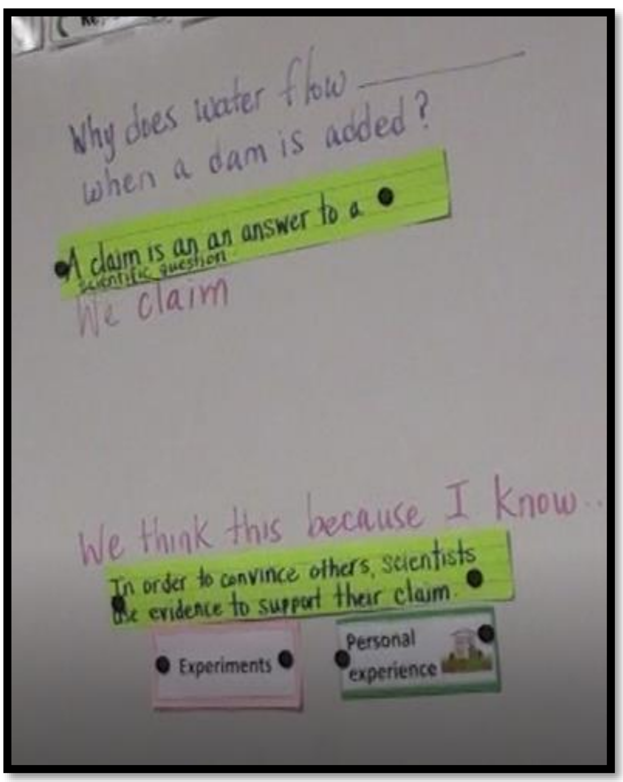


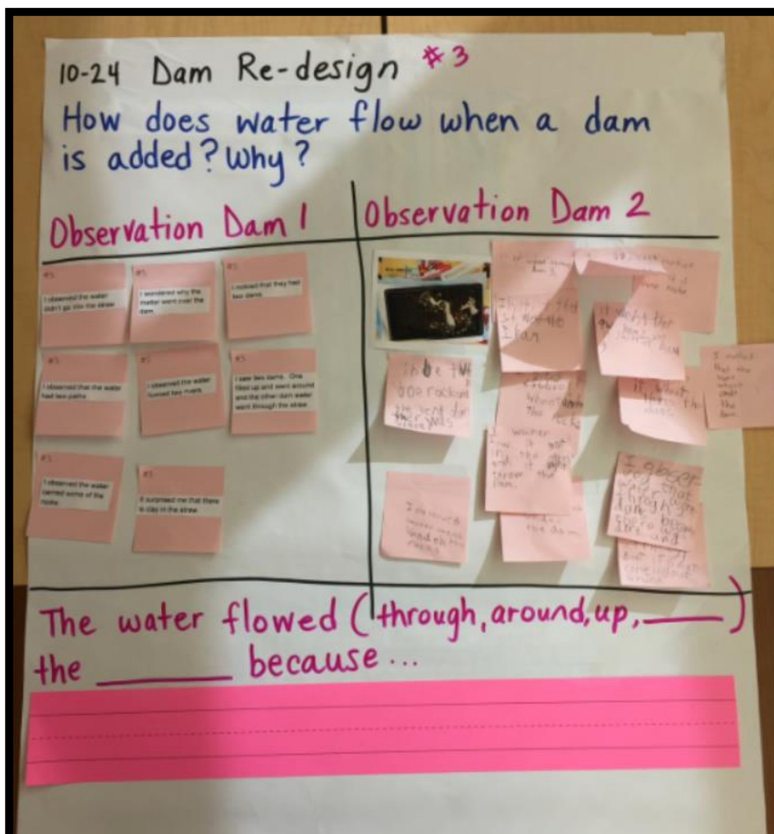
Problem Solving Reflection Ideas

- How to manage students using Earth materials in the classroom?
- Some students will have finished their work early and will need an activity to work on while they wait for others. Directing students to the science book basket or reading their water "My Water Book".

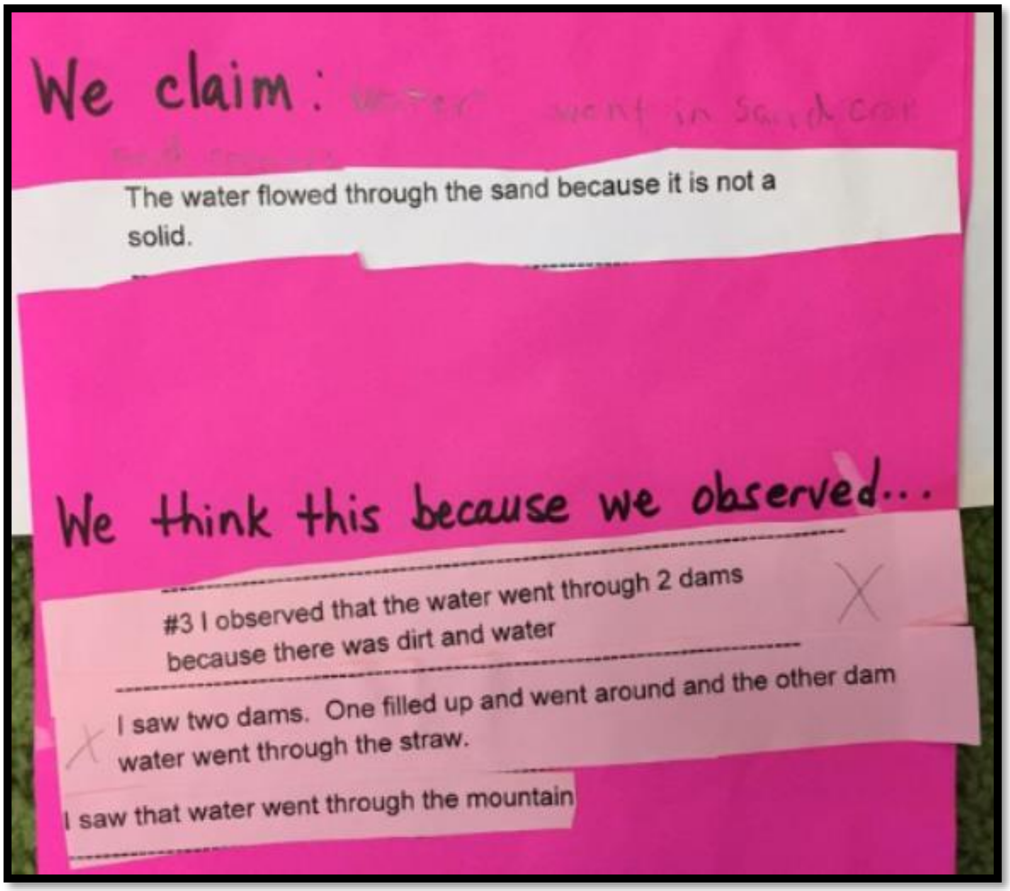
Part 2: 45 minute lesson (Making claims from observations)

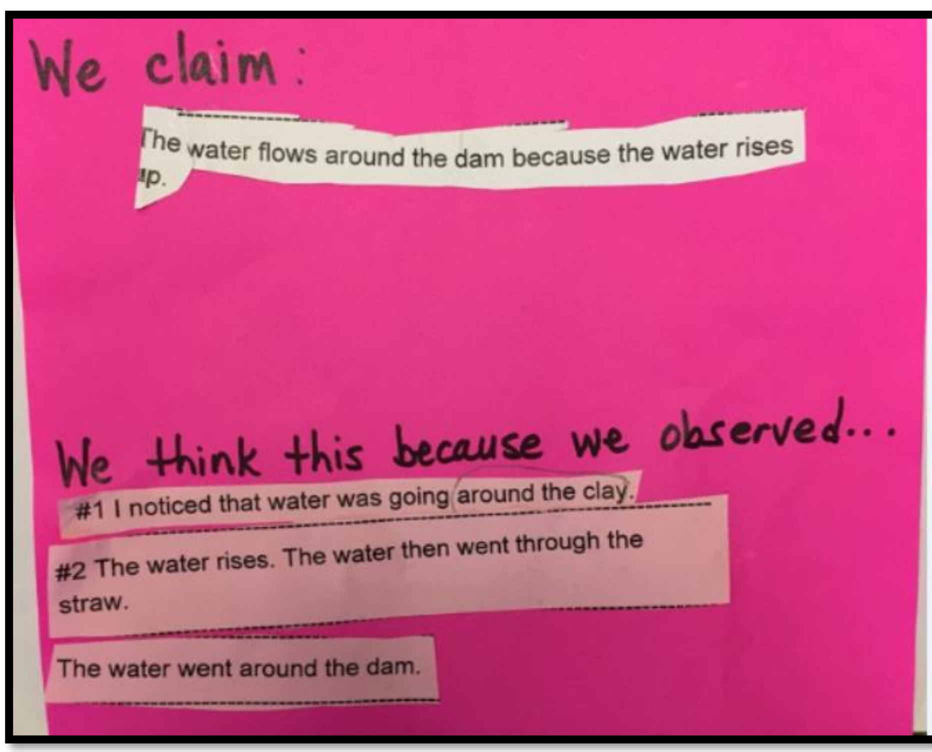
- Students will learn to form a scientific claim from observations. A claim is an answer to a scientific question.
- In this lesson, the scientific question that the students would try to answer is, "How does water flow when a dam is added? Why?"
- Ask students to write down what they have observed from the dam experiment. (In the picture below on the right side, "Observation Dam 1" is students' observation of their small group's dam and "Observation Dam 2" is observation of the dam of one other group.)
- Ask students to generate claims individually or in pairs using the sentence stem of "We claim that the water flowed (through, around, up, _____) _________ because ______________."
- Type up (if the stickies are hard to read) all the observations and claims that the students have generated. Help students work in pairs to pick one claim and choose observations that can support the claim. Ask them to paste the claim and the observations in a paper. (Pictures on the next page)
- Help students share out the claims and observations. The examples of students' observations and claims are on the next page of this curriculum.





Examples of students' claims and observations





2 Earth's Systems: Processes that Shape the Earth		
Students who demonstrate understanding can: **2-ESS1-1.** **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** **2-ESS2-1.** **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.** **2-ESS2-2.** **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** **2-ESS2-3.** **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. 1. Develop a model to represent patterns in the natural world. (2-ESS2-2) **Constructing Explanations and Designing Solutions:** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. 2. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1) 3. Compare multiple solutions to a problem. (2-ESS2-1) **Obtaining, Evaluating, and Communicating Information:** Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. 4. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)	**ESS1.C: The History of Planet Earth** 5. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1) **ESS2.A: Earth Materials and Systems** 6. Wind and water can change the shape of the land. (2-ESS2-1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** 7. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2) **ESS2.C: The Roles of Water in Earth's Surface Processes** 8. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3) **ETS1.C: Optimizing the Design Solution** 9. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)	**Patterns** 10. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3) **Stability and Change** 11. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1) -- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** 12. Developing and using technology has impacts on the natural world. (2-ESS2-1) -- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** 13. Scientists study the natural and material world. (2-ESS2-1)

Investigation Five: Exploring the Ice Age in Puget Sound

In this investigation students will explore through a PowerPoint storytelling session, the ice age that occurred in Puget Sound. In this lesson students will focus on the Cordilleran Ice Sheet that covered all of the Puget Sound Region. Teacher will read the book "Glaciers" by Mari Schuh and engage students in science storytelling using a PowerPoint presentation.

- Students will develop a basic understanding of glaciers and ice sheets.
- Students will use maps to identify and label the Cordilleran Ice Sheet on their Washington State Map
- Students will learn what glaciers can do to the land and what they leave behind. They will use clay and ice cubes to simulate the effect that glaciers have on the surface of the land.

Throughout this unit evidence of learning can be found during the class discussions, in the observations activities, and in student drawings on their worksheets. **Plan ahead for the clay and ice, glacier simulation in this investigation. Make ice using cups and ice cube trays, place sand and some small rocks in each "glacier" prior to freezing the water. Timing is important so that the "glaciers" don't start to melt until the students engage in the activity.**

Student Friendly Learning Objectives:

- **I can learn about glaciers and ice sheets.**
- **I can find and label the Cordilleran Ice Sheet on my Washington State map.**
- **I can learn about how frozen water can change the land after it melts.**

Time: Part One 20 minutes, Part Two 30-40 minutes

Materials

- **Class Chart Paper on display**
- **Books: "Glaciers" by Mari Schuh**
- **Washington State Maps (blackline masters)**
- **Video Preloaded https://www.youtube.com/watch?v=USIAcXfv39k#t=11 video can also be found in PPT notes.**
- **Pencils, colored pencils, thin markers, optional crayons (markers may bleed through)**
- **PowerPoint (Guide slide #2-9)**
- **PPT Student Books (printed and stapled together, pages)**
- **Clay strips, and ice cubes with sand for each student or partner group (ice & sand need to be frozen the night before in order to complete part two of this investigation, put different amounts of sand in each ice cube).**

2 Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.**

2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.**

2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Science and Engineering Practices

Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

14. Develop a model to represent patterns in the natural world. (2-ESS2-2)

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

15. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)
16. Compare multiple solutions to a problem. (2-ESS2-1)

Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

17. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

18. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)

ESS2.A: Earth Materials and Systems

19. Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

20. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes

21. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution

22. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)

Crosscutting Concepts

Patterns

23. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change

24. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

25. Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

26. Scientists study the natural and material world. (2-ESS2-1)

Procedure

Part One: 20 minutes

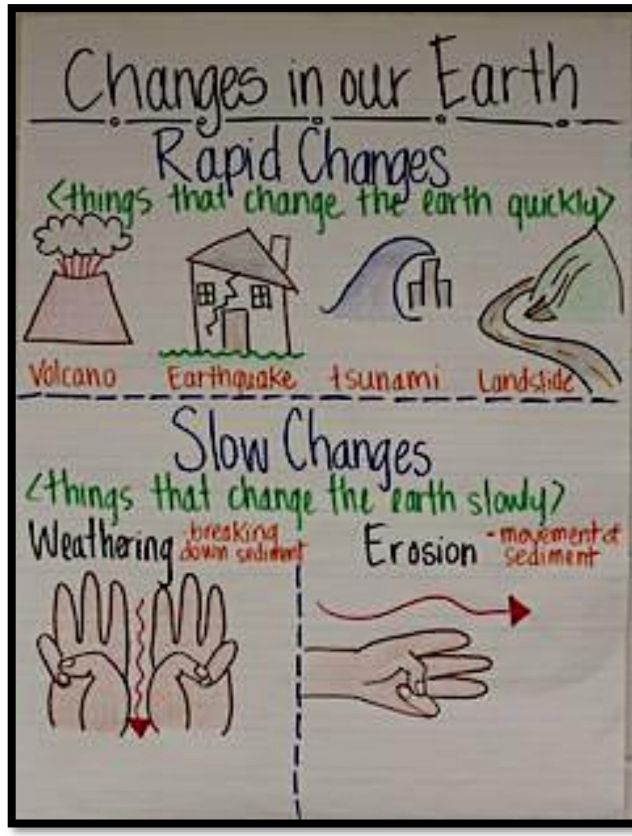
1. Gather students on the carpet and begin the lesson by asking them if they know anything about the ice age in their local area, “Does anyone know about the ice age in Puget Sound?” Students may bring up the movie “Ice Age” and details from those experiences can be used to guide this science discussion (3-5 minutes). Student responses can be recorded on chart paper and saved for use during the unit.

2. **Read Aloud Book:** Teacher will read “Glaciers” by Mari Schuh , on chart paper create a glaciers fact list that can accompany this book. During the book, engage students in identifying important facts about glaciers. This fact chart can also serve as a glossary poster that students can draw using post-it notes and to this visual resource. **How a <u>glacier forms and moves</u> are the key content pieces for this book, consider reading aloud and allowing students to come to the board to model processes or concepts from the book.**

3. Students will then read their “My Water Book” in whole group, partner groups, or independently. They will focus on reading slides/pages 2-9, circling words they don’t understand and underlining words that are important to the story. Let students know that they will be reading this same story the next time you do science, encourage students to write down questions in the margins of their “My Water Book”. **Utilize reading strategies during this time to support readers of all levels.**

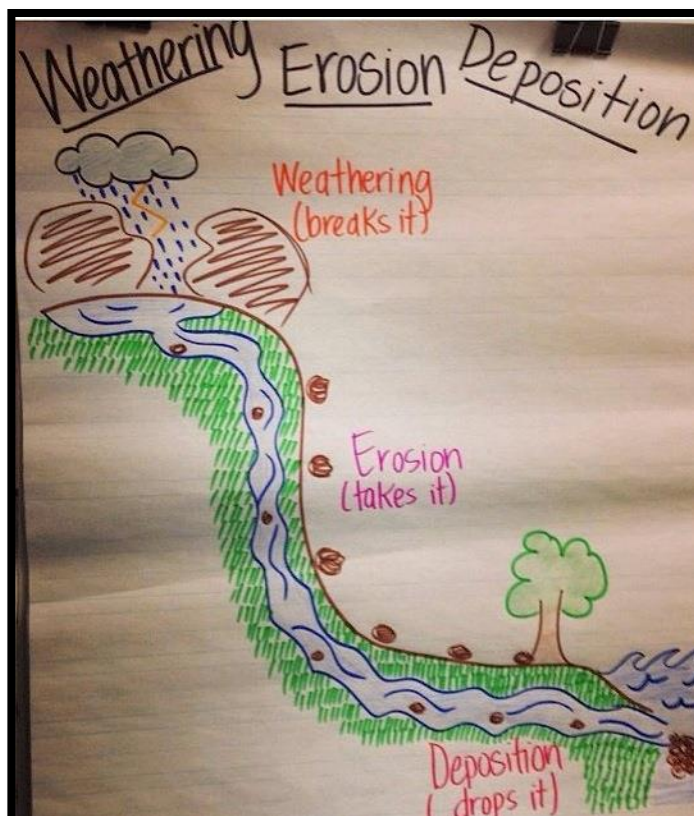
Part Two: 30-40 minutes

4. Use the PPT to guide the discussion for this session. Gather students on the carpet, hold up a model scaffold worksheet and remind them that this lesson connects back to telling the science story about how Moncton flooded. **It is important not to skip this step (incorporating the model scaffold) in the lesson because students need to make the connection between what they are learning and how it directly relates to telling the science story with newly learned content.**
5. In this PPT, students will review the content that was in their read aloud and their “My Water Book”. Focus the most time on the local story of the Ice Age in Puget Sound. This may require orienting students to some of the maps (state, local) that are found throughout the PPT. There are guiding questions located in the PPT on slide #3 What would a huge ice sheet do if it was pushing down on top of your school playground and classroom?



and slide #6 "**What do you think happens to the land when the continental glaciers move over the land? What happens when this ice melts?"**

6. **Clay, Sand, & Ice Experiment**: Inside of the container (tray, paper plate) each student group gets a piece of clay to flatten, which represents the land. Then they need to take their "glacier" (ice with sand) and rub it over the top of the clay. Students will record their observations on a class chart using post-it notes to draw or write their observations. Partners can take turns pushing the ice down on the clay and then recording their observations.
7. Let students know that they will be performing their experiment in a warm temperature room environment and that this may affect their "glaciers", this is similar to the interglacial period that occurs between ice ages as the climate naturally and slowly warms and the ice sheets and glaciers retreat.
8. **If you have time to let the "glaciers" sit on the clay until they melt, setting the trays aside for an hour or two and then coming back to their activity, this will provide students with a more concrete understanding of how temperature affects ice and most importantly how glaciers can leave behind deposits.**
9. Take time to have students share out ideas related to their observations. Tell students that they will use these observations and knowledge about glaciers to understand the next lesson.

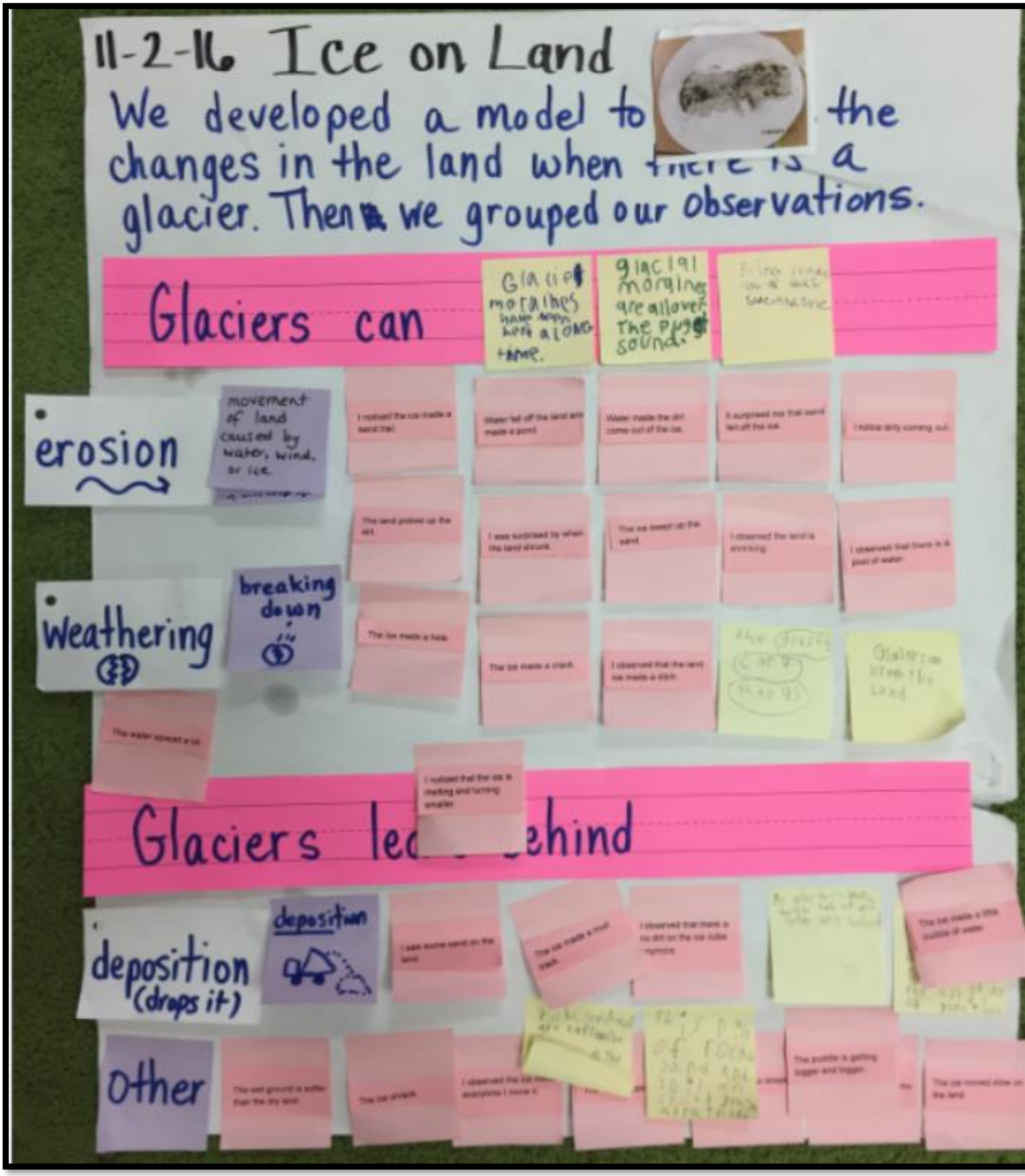


Problem Solving Reflection Ideas:

1. **How to incorporate vocabulary extensions into this lesson for all students, particularly those needing additional support?**
2. **Can I use the Frayer model to teach related vocabulary words?**

Example of summary from these activities

"Glaciers can……."   "Glaciers leave behind………"


11-2-16 Ice on Land
We developed a model to
the
changes in the land when
a
glacier. Then we grouped our observations.
Glaciers can
erosion
movement of land caused by water, wind, or ice
weathering
breaking down
Glaciers
deposition
deposition (drops it)
other

Investigation Six: The ice age created the Cedar River Watershed

In this investigation students will examine the more locally the direct connection between the ice age glacial deposition and mapping the Cedar River Watershed. Teacher will read “Follow the Water from Brook to Ocean” and “All the Way to the Ocean” by Joel Harper to incorporate the interconnectedness of water in all forms on Earth.

- Students will learn that the Cordilleran Ice Sheet left behind glacial moraines.
- Students will develop a basic understanding that the ice age created the Cedar River Watershed
- Students will learn about how glaciers/ice sheets can change the land.
- Students will map their Cedar River Watershed and learn how a watershed works.

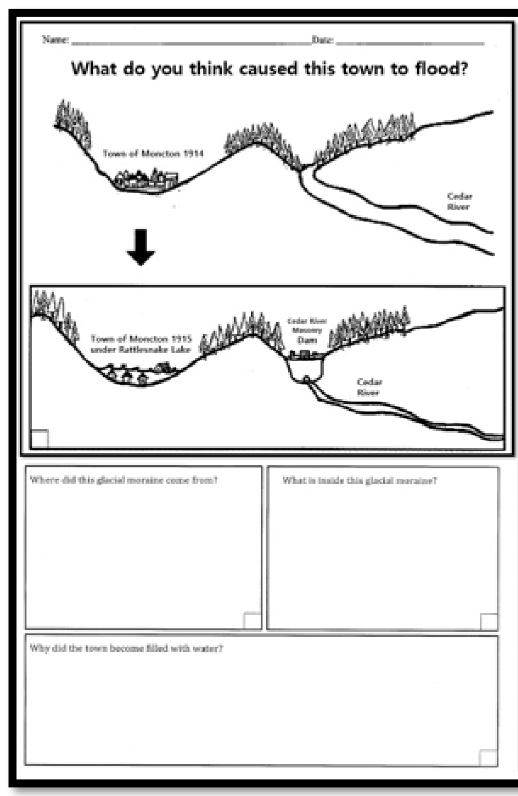
Student Friendly Learning Objectives:

- **I can draw or define a glacial moraine and know where they came from.**
- **I can think about the different kinds of deposits that glaciers and ice sheets leave behind.**
- **I can make a map of the Cedar River Watershed.**

Time: 3 class periods of 25-35 minutes each

Materials

- **Class Chart Paper on display**
- **Book: “Follow the Water from Brook to Ocean” by Arthur Dorros & “All the Way to the Ocean” by Joel Harper**
- **Large, blank white paper**
- **Blue & red markers**
- **Spray bottles with water**
- **Student “My Water Book”**
- **Trays**
- **PowerPoint slides 9-18**
- **New Model Scaffold Worksheet, class set**
- **Washington State maps**
- **Large hand-drawn Washington State map on chart paper.**



2 Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.**

2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.**

2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Science and Engineering Practices

Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

1. Develop a model to represent patterns in the natural world. (2-ESS2-2)

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

2. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)
3. Compare multiple solutions to a problem. (2-ESS2-1)

Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

4. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

5. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)

ESS2.A: Earth Materials and Systems

6. Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

7. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes

8. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution

9. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)

Crosscutting Concepts

Patterns

10. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change

11. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

12. Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

13. Scientists study the natural and material world. (2-ESS2-1)

Procedure

Part One: 25-30 minutes

1. Begin by reviewing the previous lesson (investigation 4) where students learned that their entire school, homes, and city were once covered with a huge sheet of ice. Explain that today they will look at what ice can do to the land and how it shaped the land near Moncton. **More specifically that the ice age shaped the Cedar River Watershed, this is the reason for the flooding.** Be sure to pull out the model scaffold because today they will be learning about some information that they will want to include on their model scaffold worksheets.
2. **Class Discussion (10-15 minutes): Today students will engage in shared reading with the PowerPoint as it is displayed on the screen, students may benefit from having their "My Water Book" to read along with you as each slide is read and discussed.** Read through and discuss **slides 9-12**, incorporating student questions, stories, and ideas that may arise. Students may be asked to share experiences outside of school where they have seen differences in land or surfaces that may have been affected by wind or water.
3. **Show students slide #13-15, let them know that there is a hidden glacial moraine.** Spend time with students looking at these images and answering questions.
4. **Model Scaffold Worksheets:** Pass out the model scaffold worksheets to students and have them add details they have learned about the ice age, glacial moraines, and describe what the material in moraines is made out of (rocks, sand, soil). They should add labels and descriptions to a new model scaffold worksheet; <u>students will use this worksheet throughout the remainder of the unit adding pieces to it after every lesson.</u> Students can be encouraged to add a "map key or legend" to their model if they feel that it would be helpful.
5. **Read Aloud:** "Follow the water from Brook to Ocean" by Arthur Dorros. This book will introduce the concept of a watershed. Read pages 1-21, during the course of a day or a few days during a read aloud time to highlight the concepts in those pages. The rest of the book will be read later in the unit.

Part II: **30-35 minutes**

14. **Class Discussion (5-7 minutes): Today students will read whole group along with the PowerPoint as it is displayed on the screen, students may benefit from having their "My Water Book" to read along with you as each slide is read and discussed.**
15. Begin by asking students if they know what a watershed is and engage them in a brief 1-2 minute discussion about their ideas. Show the 1 minute video <u>https://www.youtube.com/watch?v=QOrVotzBNto</u> this link is also located on your PPT in slide #18.
16. Read through and discuss **slides #17-18**, incorporating student questions, stories, and ideas that may arise. Students may be asked to share experiences outside of school where they have seen water flowing across the land. Remind students that this means they are part of the watershed and all of our activities (driving, using water, playing outdoors) can affect the water in our watershed.
17. **Creating Watersheds by building a 3-D landform: Students will use a model to create a watershed by observing how surface water flow is determined by the shape of the land, students will visually and dramatically observe the physical characteristics of a watershed.**

18. **Tell students that they will see what happens to the rain after it falls in the mountains.** Students will work in partner groups to first crumple up a piece of white paper. Then they will uncrumple it and trace with blue markers all along the ridge lines on the whole piece of paper. Then ask students to chat briefly about what will happen to the blue lines if there is a rainstorm.
19. **Pass out spray bottles filled with water.** Students will simulate a rainstorm by spraying around the entire paper gently. Not too much water at first. Stop students and ask them **Where did your water collect? Ask them to explain why it puddled up at the bottom. (hint: water always seeks to find a place to move downhill towards the ocean.)**
20. **Let students find any large bodies of water, these are lakes. Each student in the group gets to name a lake.**
21. **Ask students** to look for major streams running into lakes. This major stream may have smaller streams that feed into it. Ask students to find the largest stream and count how many smaller streams feed into creating the larger stream.
22. **Traces the watershed ridgeline.** Ask students to trace the major stream all the way back to where it starts at the top of the ridge. (Hint: This should be a path of blue ink) When students reach the top of the mountain, this is the edge of the watershed for that particular stream or lake.
23. **Students can trace the entire edge of the watershed with their fingers, similar to tracing a bowl.** All of the inside, downward sloping area that has been traced is the watershed for the stream and lake.
24. **Have student add 7 small red dots anywhere on their models.** These represent pollution points, such as oil leaks from cars, run-off from farms or factories, chemical spills, soap from car washing, or general littering.
25. **Students will spray the red dots and watch how easily pollutants contaminate the water supply.** Let students know that nature has some methods for filtering out pollutants as water passes through sand and gravel but allow them to imagine if they were fish in the lake where the red pollution flows into. Allow for some discussion about this and let students know that keeping garbage off the street is something they can do everyday to make sure that their watersheds stay clean.

Part III 25 minutes

1. **Take students outdoors on their way to recess to find a storm drain. Some students may need this experience to ground their understanding of the concept. This can occur prior to the lesson or any time during the day.**
2. **Slides # 19-21 focus on orienting students geographically to the Cedar River Watershed. These slides have notes for instruction. Students will be adding the Cedar River Watershed to their Washington State map and interacting with the map of the watershed in their "My Water Book".**

Students may need to be seated during this time in order to use pencils, makers, and or highlighters. Students will be practicing a form of note taking, as the teacher will be using a large hand drawn map of Washington to add the watershed and labels. Consider tracing with pencil prior to beginning the lesson. All directions are located on the notes section of each PowerPoint #19-21.

3. Students will begin thinking about the interconnectedness of all life within a watershed or between the different forms of water as it relates to the water that they drink. As students share their ideas, look for opportunities to incorporate vocabulary and whole group modeling on the board as students can draw/model their thinking.

4. **Read Aloud Book:** Teacher will read "All the Way to the Ocean" by Joel Harper. This book focuses on the water's journey from storm drain to ocean. This book provides an opportunity to allow different students to choose characters in the book and read with the teacher. If you choose students to read with you, it is recommended that the students be strong readers. This book will also serve as a lesson wrap-up activity and can be paired with student questions, ideas, and comments.

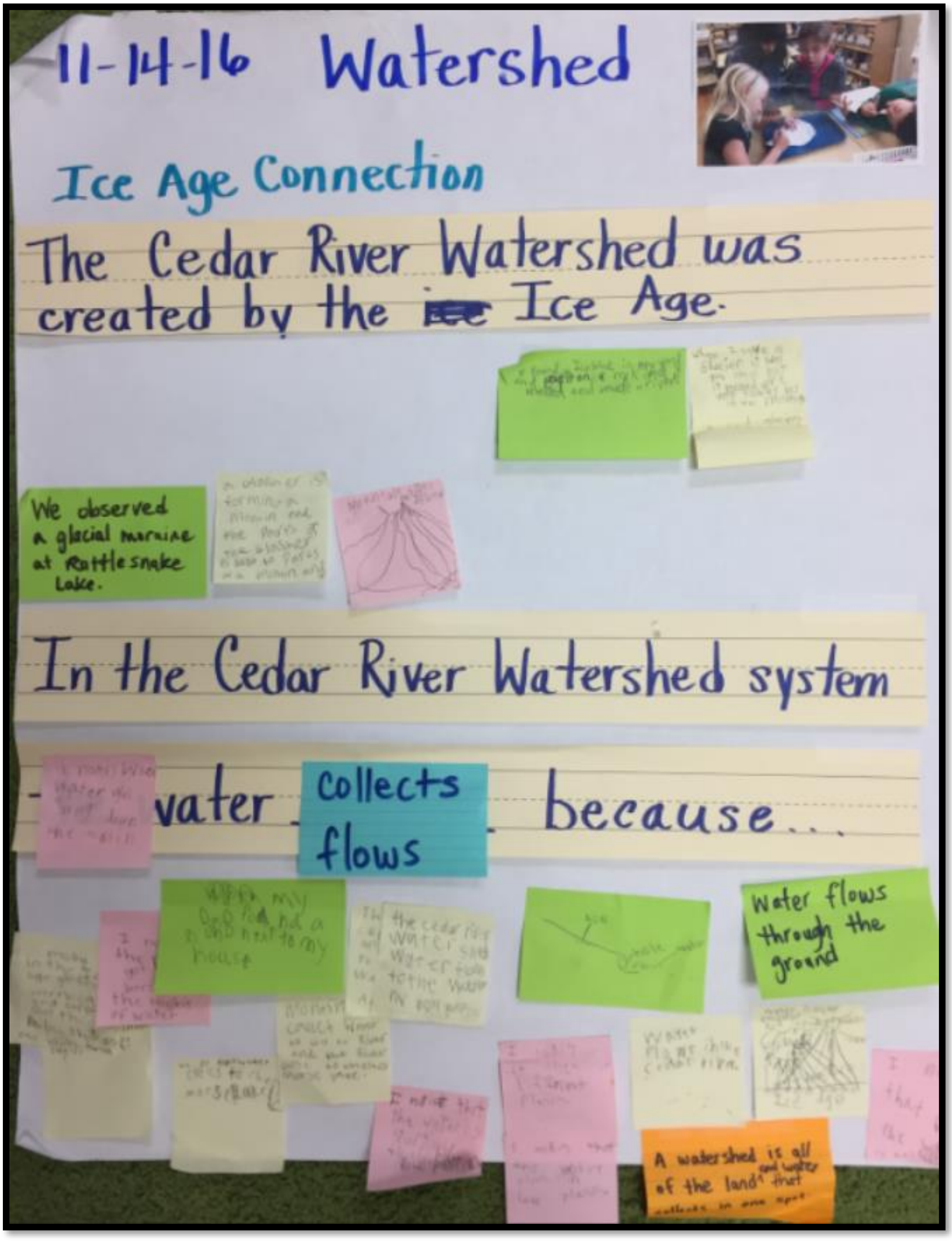
Extension Ideas

1. Consider taking your class outside to safely (gloves) clean up the trash around the school and near storm drains.
2. Service Learning Project: Consider pairing up with your local municipal government organization, water quality department, refuse organization, or related group. These government departments usually have money dedicated for education purposes and they will support classrooms to conduct storm drain stenciling projects/field trips. Email Michelle Salgado msalgado@uw.edu for more information and support!

Example of summary from these activities

“The Cedar River Watershed was created by the Ice Age.” –Connection to the Ice Age

“In the Cedar River Watershed system, the water flows/collects because…………”



Investigation Seven: The Cascade Foothills

This investigation will explore porosity and permeability through a hands-on soil activity. This investigation directly connects to the previous lessons because the ice age created and shaped the local land and left different kinds of Earth material through the glacial deposits. Students will focus heavily on porosity and permeability in an engaging experiment as a means of understanding how the water leaked into the town of Moncton after the dam was built.

- Students will conduct an experiment to learn about how fast or slow water travels through different materials (pebbles, sand, soil, clay).
- Students will explore the topics of permeability and porosity during the experiment and relate the concepts back to their original model scaffold.

***Plan accordingly for the experiment. There are several options such as whole group, small group, and partner grouping that can be arranged for this experiment. But most important is the amount of hands-on time and direct observation that students have with the materials.**

Student Friendly Learning Objectives:

- **I can make observations about how water travels through pebbles, sand, soil, and clay.**
- **I can learn about the underground land near the dam.**
- **I can draw a zoom out box on my model worksheet.**
- **I can use my own words to describe how water moves through pebbles, sand, soil, and clay.**

Time: Part One 25 minutes, Part Two 40-45 minutes (*recommended that this investigation take place on the same day occurring before and after recess or specialist time)

Materials (amount depends on grouping):

- **2 Funnels, 4 coffee filters, 2 larger cups (per student partner group)**
- **I cup of each for each group (gravel, clay, sand, ¼ cup of soil is needed)**
- **Model Scaffold Worksheet (continued from previous investigation #5)**
- **Tray or rag to catch spilled water**
- **Display an online stopwatch for students to take data, type online stopwatch into google**
- **4 cups of water for each group**
- **PowerPoint Slides # 22-25**
- **Video (start at 2:54 end at 5:30)** https://www.youtube.com/watch?v=8mfBomrw0rs

2 Earth's Systems: Processes that Shape the Earth
Students who demonstrate understanding can:
2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**
2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.**
2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.**
2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Science and Engineering Practices

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Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

4. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

5. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)

ESS2.A: Earth Materials and Systems

6. Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

7. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes

8. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution

9. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)

Crosscutting Concepts

Patterns

10. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change

11. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

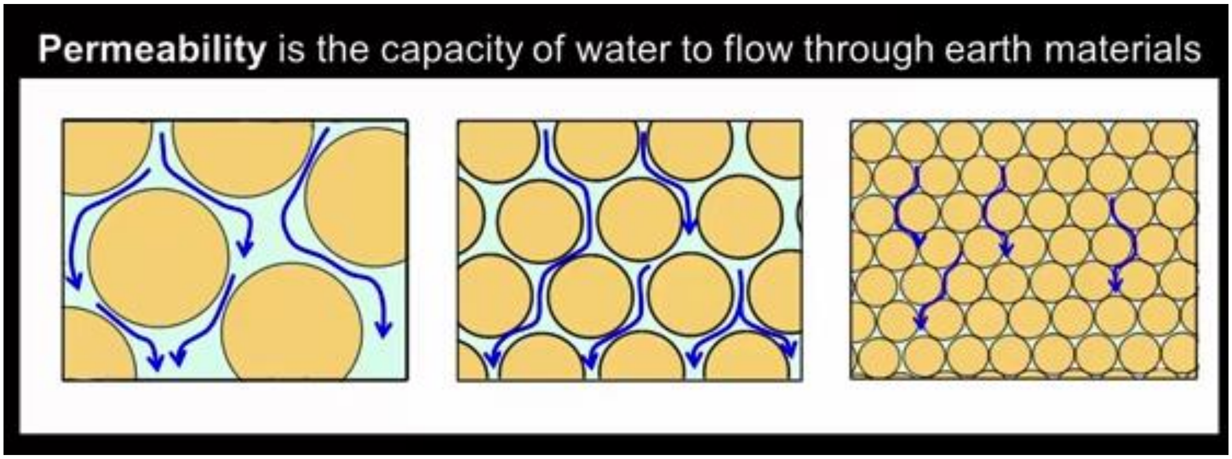
12. Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

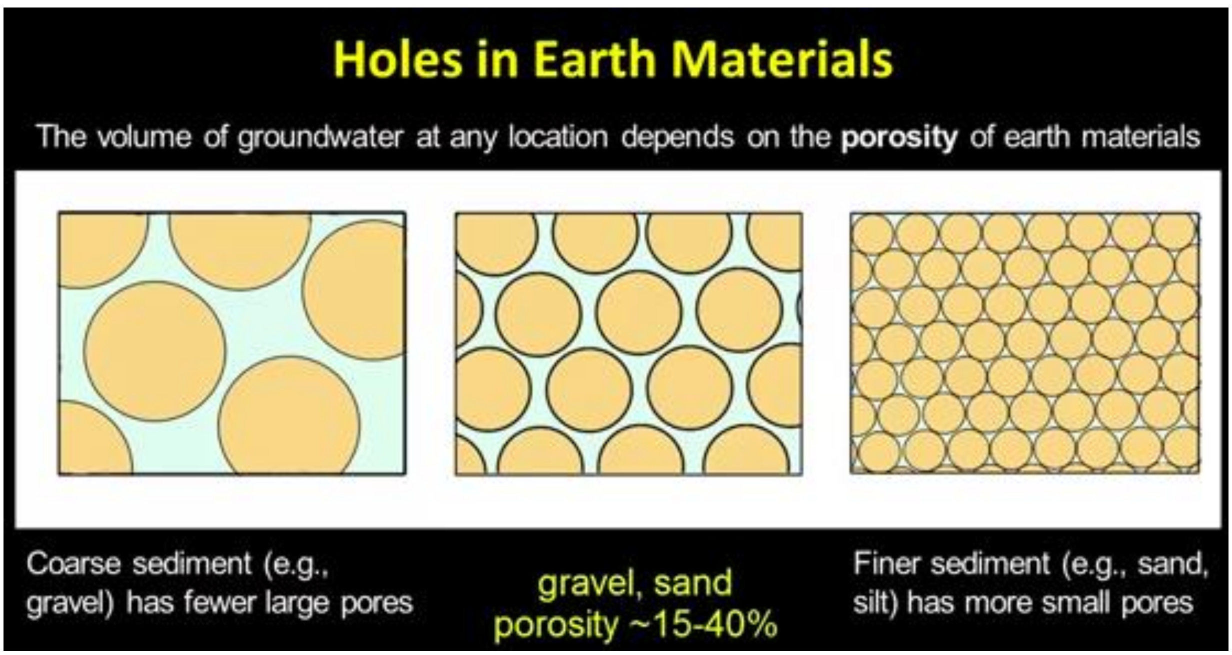
Science Addresses Questions About the Natural and Material World

13. Scientists study the natural and material world. (2-ESS2-1)

Permeability is the capacity of water to flow through Earth materials.



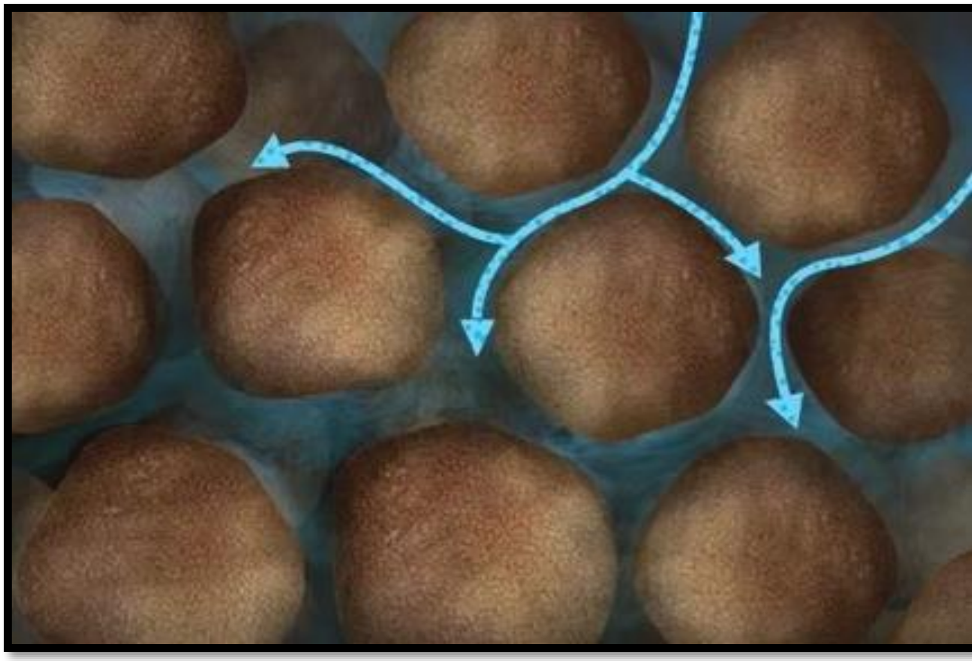
Porosity is the size of space (pores) between the individual grain sizes of Earth materials.



***Students may use their own words to describe porosity and this can be encouraged and appreciated also being used during the lesson, while incorporating the integration of the vocabulary words themselves. Students at this age <u>do not need to memorize</u> the terms or their definitions. <u>But they do need to know that the land on one side of the dam leaks water because it is made out of cobbles and sand but the other side doesn't leak because it is made out of solid rock.</u>**

Procedure

Part One: 25 minutes



1. Classroom Discussion (3-4 minutes): Gather students on the carpet and ask them "What happens when you pour water in soil? sand? A rock? Allow students the opportunity to come to the board and model their ideas. Introduce students to a zoom-in box in their modeling that represents a zoomed-in perspective of what the soil, sand, or rock looks like if water is poured on top. Such as the image on the right, which shows individual pieces of soil with water traveling through the pieces.

2. Then have several clear glass bowls or drinking glasses full of each of the following: soil, sand, pebbles, clay. **Spend at least 5 minutes with students making observations coupled with modeling on the board.** Students may begin to articulate that water soaks into some materials but not others. Let them know that this observation is very important to understanding why the town of Moncton flooded and to keep thinking about this idea.
3. Model for students **(5-6 minutes)** how they will conduct the experiment by putting different materials in each funnel with the coffee filter and then one at a time they will pour the cup of water into the funnel and time how long it takes for the water to pass through. **You will need to discuss with students how to use the timers and when to start and stop the timer. Starting would occur when the water is first poured in and stopping would occur when there is very minimal drip occurring from the top to the bottom part of the water bottle.** Students may need to practice with timers during the whole group demonstration. Show them how to use the table on PPT #22 to record their data.

4. Experiment 15-20 minutes (not including set up time): Group students accordingly at their desks (at least 2-3 students per group) Each group will need the following items at their desk, this can be modeled during the whole group discussion:

- 4 cups of water
- 2 Funnels, changing out coffee filters after each test
- 1 cup of each (pebbles, sand, soil, clay)
- 1 timer
- Tray or rag to catch spilled water

Recommendation: Have students start and continue the experiment in this order and following your directions as they proceed, but also be aware that students need wiggle room to laugh, explore, and observe ☺.

1. Start with the empty funnel and have students pour the water in and one group member timing the procedure while all group members are making observations. Direct students to record data and observations (drawings with arrows) in their chart. **Observations should be focused on the amount of water that comes through the filter, not all of the water amounts will be the same.**

2. Proceed with a funnel and coffee filter filled with just pebbles, time, record data.

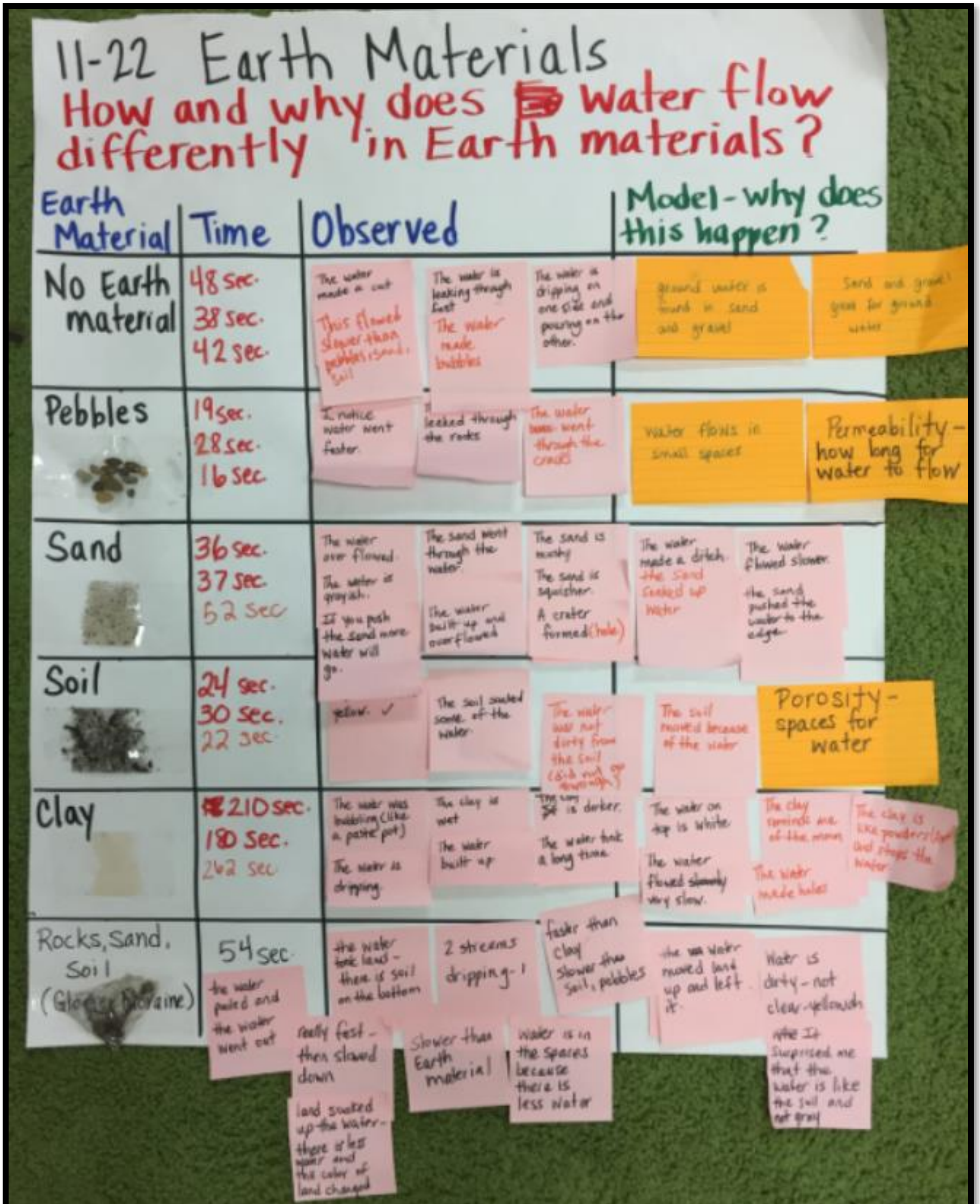
3. Fill funnel with new coffee filter with ½ cup of pebbles, sand, and ¼ cup of soil, time water, and record data.

4. Fill funnel with new coffee filter with ½ cup of clay packed in as much as possible, time water, record data.

Class discussion: Students will bring their data to the carpet for a class discussion. Allow students 1-2 minutes to share their stories related to the experiment, focusing on key details related to how fast the water traveled to some materials but not others. The "fastness" is the timing data.

Ask students **"Why do you think that water traveled faster through some materials but not others?" Their responses will be your opening to delving into porosity and permeability. This can involve students modeling on the board, discussion using data evidence, and showing students a short video clip explaining porosity and permeability. Video (start at 2:54 end at 5:30) https://www.youtube.com/watch?v=8mfBomrw0rs** (Preview the entire video for additional teacher content knowledge development.

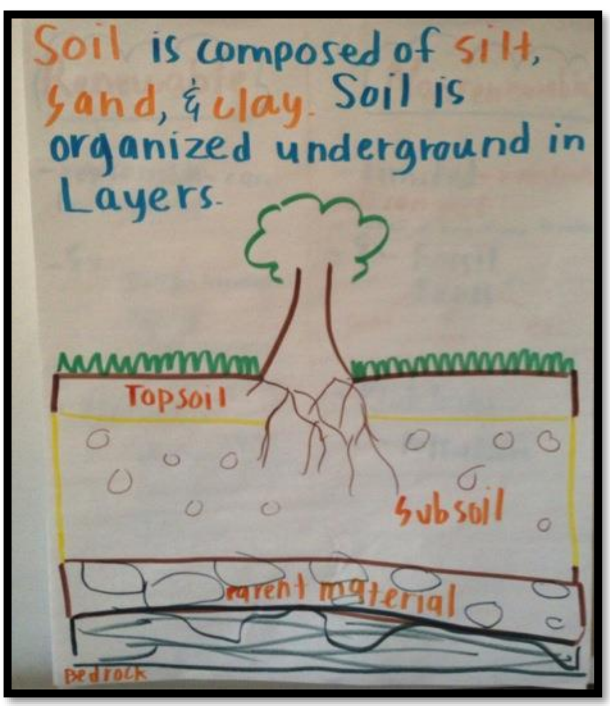
Example of summary from this experiment



Modeling Porosity and Permeability: This is now the time to link these concepts of porosity and permeability to scientific modeling. Use slide #24 for students to engage in modeling either whole group or partner group. Whole group is recommended as students can learn from peers and ideas can be shared out with regard to articulating and modeling each separate concept.

Slide #14: Show students slide number 14-15 and remind them again that the glacial moraine is made largely out of cobbles (small rocks) and sand that is on one side of the dam. On the other side of the dam is solid rock.

Model Scaffold Worksheet: Have students add to their model scaffold worksheets labeling, the moraine, the dam, and the solid rock according to slide #15. They should always be adding these details to the boxed in drawing below the non-flooded drawing. This is a very important step to piecing together the science story.



Problem Solving Reflective Questions:

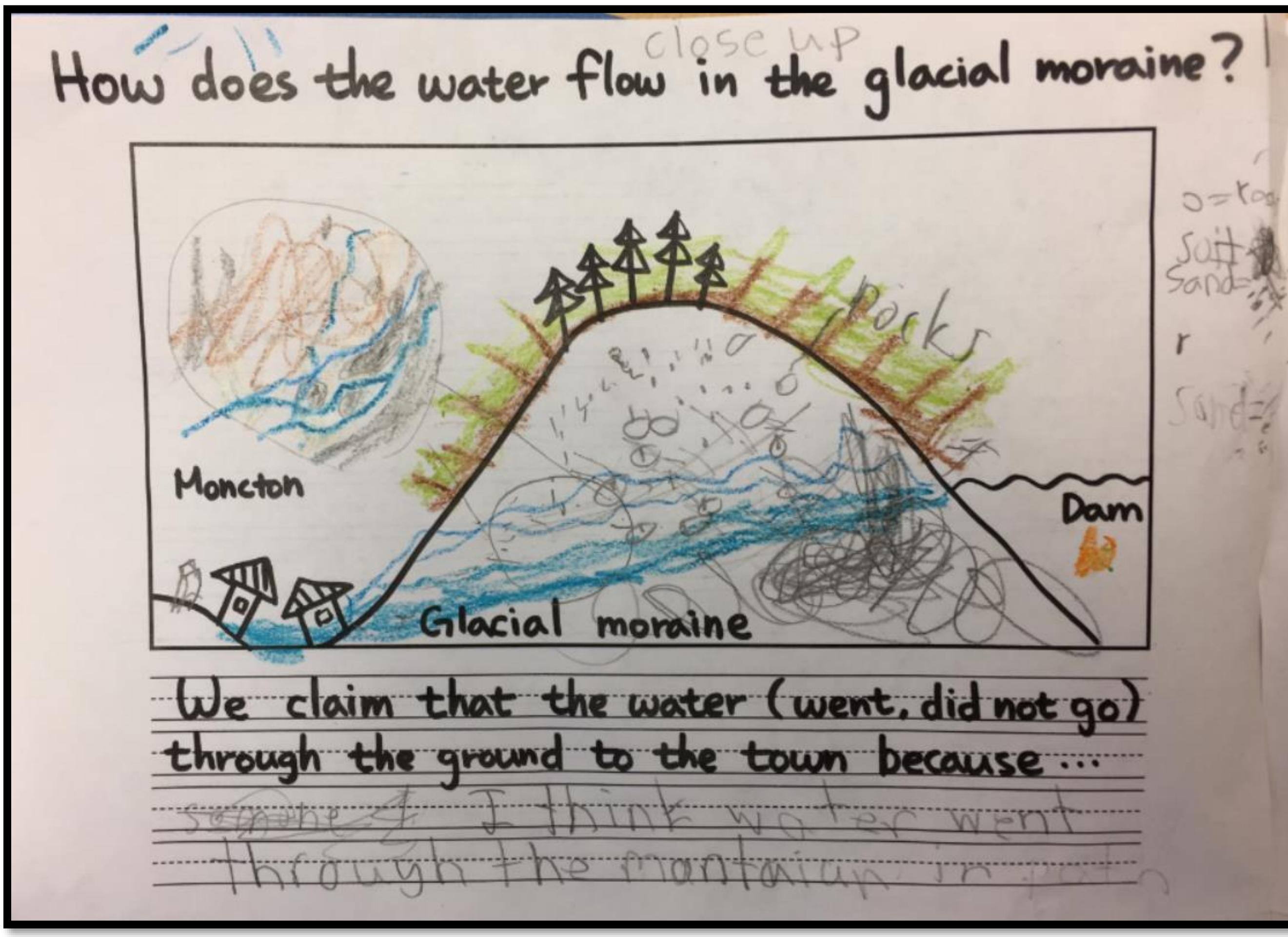
1. How do you engage students in a hands-on experiment and make sure that students are productively engaged?
2. How do you maintain a sense of "order" while also balancing the need for students to have room to "experience" the experiment in a developmentally appropriate manner?

Extensions:

Consider creating posters or visual displays with your students to represent concepts and ideas that need visualizing. Utilize GLAD techniques whenever possible.

Part Two: 45 minutes (Using zoom-in models to think about Moncton flooding)

Using zoom-in models to help students think about why Moncton flooded based on what they learned. Remind students that the mountain between the Masonry Dam and the town of Moncton is glacial moraine. Ask students to first draw what would be inside the mountain. Then ask students to think about "How does the water flow inside the mountain (in the glacial moraine)?" and help them draw their thinking on the models to explain why the town flooded.



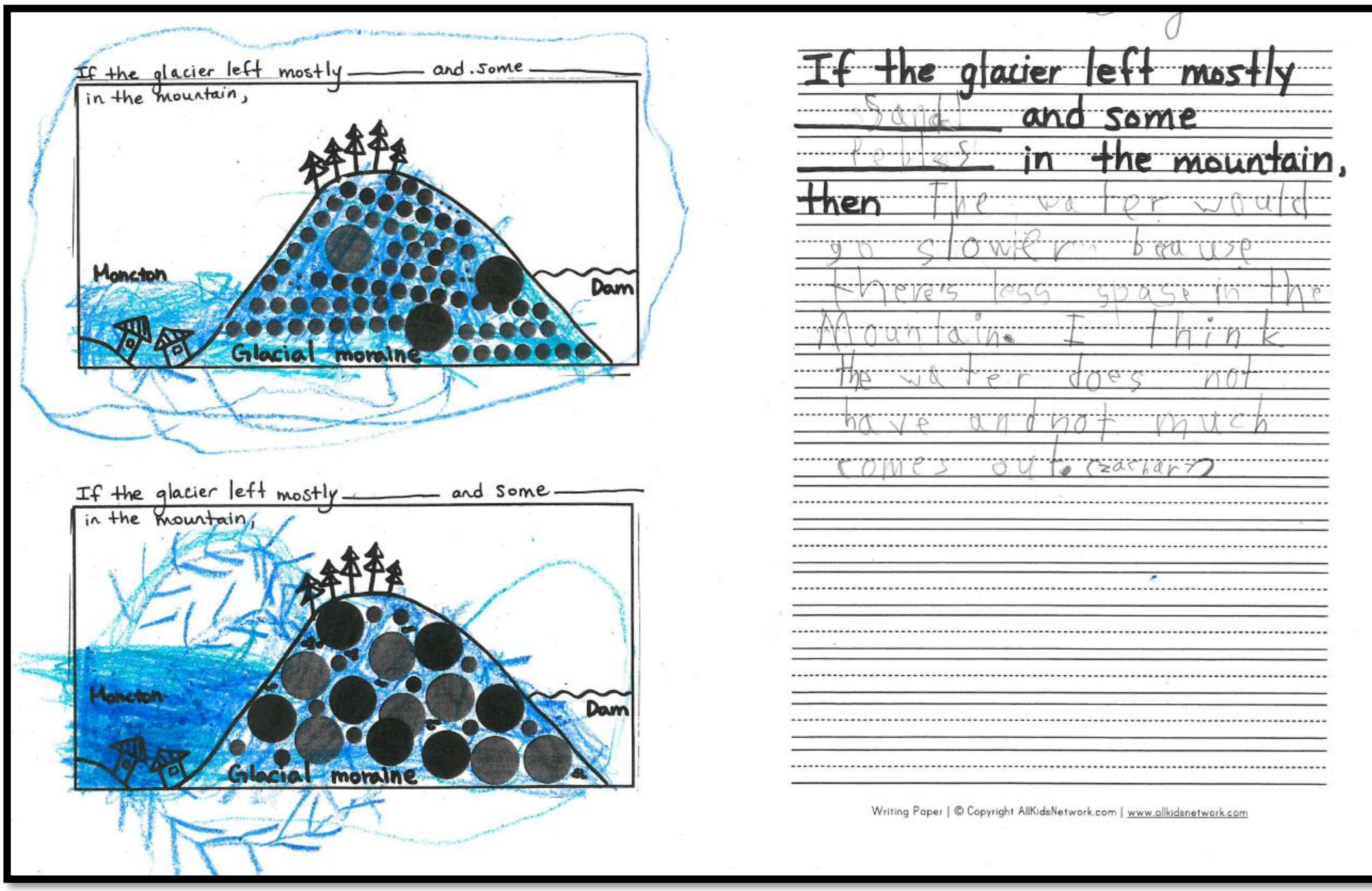
Part Three: 45 minutes (Thinking about conditions)

Helping students think about conditions of the phenomenon—"What would happen if…? What claim would be stronger under a certain condition?"

You can use zoom-in models to help students think about different conditions.

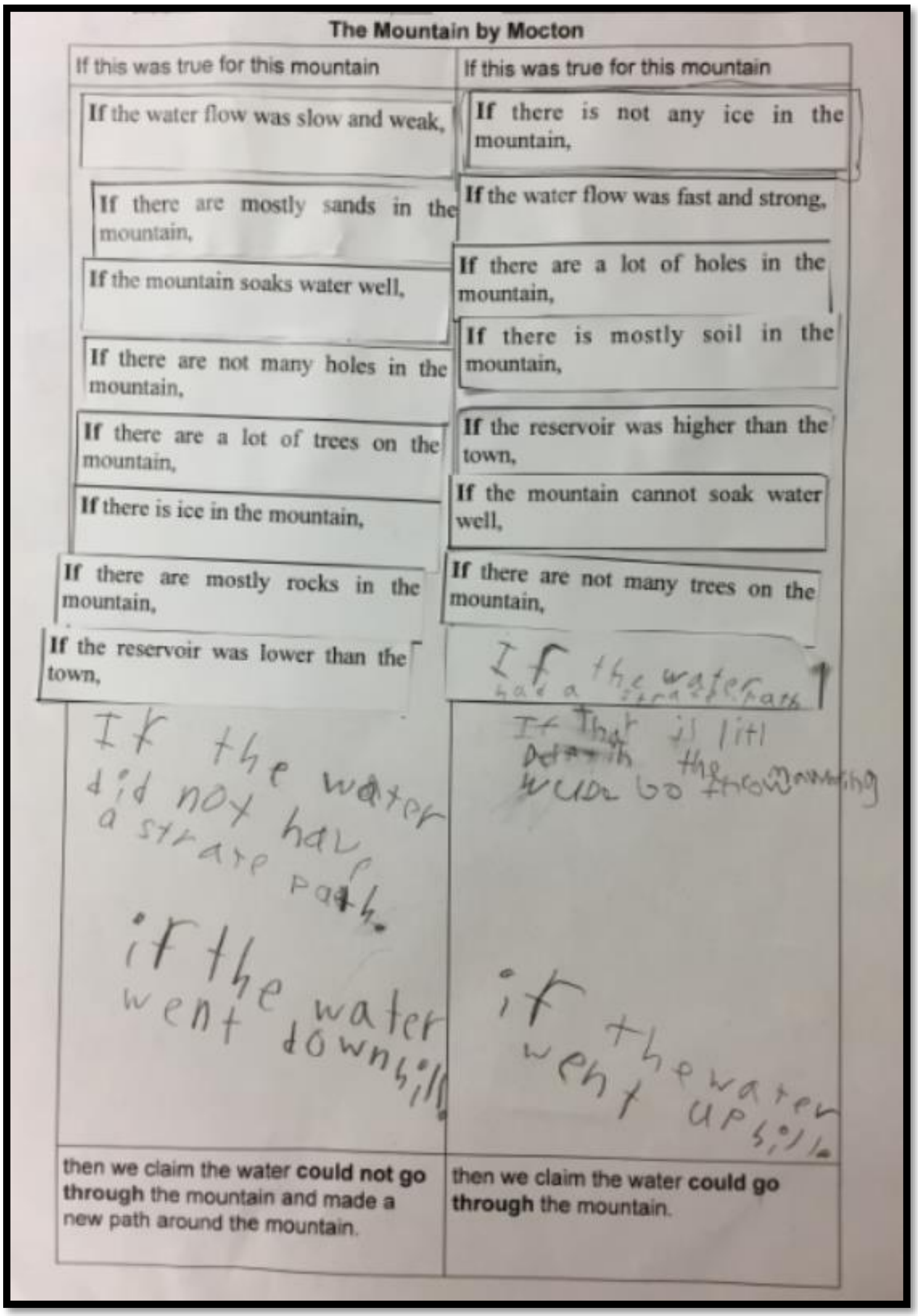
For example, "If the glacier left mostly sand and some pebbles in the mountain, then the water would go __________. I think this because __________." (Picture below)

Whole class discussion to share out claims and thoughts.



Example of conditions to consider about the Moncton phenomenon

"If this was true for this mountain (certain condition), then we claim the water could/could not go through the mountain."



The Mountain by Mocton

If this was true for this mountain	If this was true for this mountain
If the water flow was slow and weak,	If there is not any ice in the mountain,
If there are mostly sands in the mountain,	If the water flow was fast and strong,
If the mountain soaks water well,	If there are a lot of holes in the mountain,
If there are not many holes in the mountain,	If there is mostly soil in the mountain,
If there are a lot of trees on the mountain,	If the reservoir was higher than the town,
If there is ice in the mountain,	If the mountain cannot soak water well,
If there are mostly rocks in the mountain,	If there are not many trees on the mountain,
If the reservoir was lower than the town,	If the water had a strate path
If the water did not have a strate path.	
if the water went downhill	if the water went uphill
then we claim the water **could not go through** the mountain and made a new path around the mountain.	then we claim the water **could go through** the mountain.

Investigation Eight: History of the Land

This investigation will focus on the history of the land from the First People (Duwamish, Yakama, Wenatchee, Muckleshoot, Snoqualmie) and their interactions with the land, the town of Moncton (aka. Cedar Falls) to the Great Seattle Fire, which sparked a need for higher water pressure and more power (electricity). This investigation concludes with the need to build a dam to provide the booming Seattle population with a water supply. This investigation is highly focused on storytelling, interweaving history, geography, science, and land use which all connect back to understanding the complete story behind where our water comes from and how it got to our faucet.

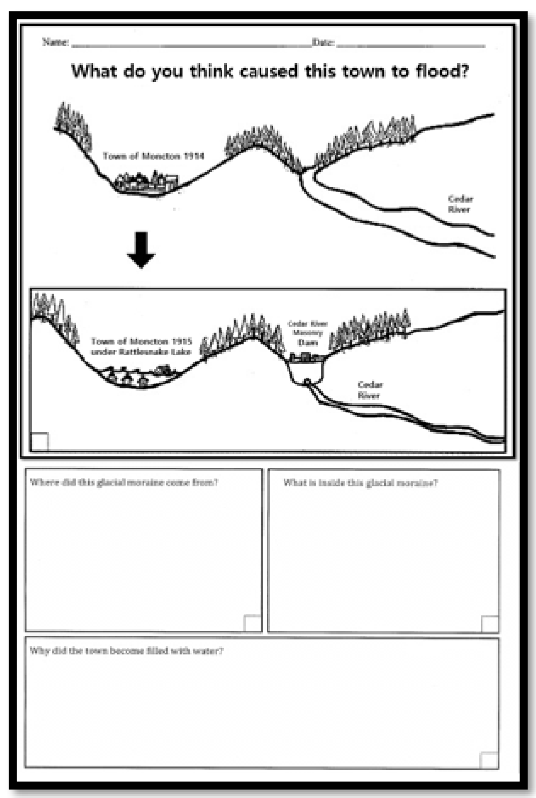
- Students will learn that there were 5 tribes (Duwamish, Snoqualmie, Yakama, Wenatchee, & Muckleshoot) that gathered in the area near present day Chester Morris Lake. Students will learn that this land was and continues to be sacred to these tribes.

- Students will learn about the great Seattle fire while led to the need for a Seattle water supply and how this need led to the construction of a dam near Moncton.

- Students will learn about the town of Moncton and the residents.

Student Friendly Learning Objectives:

- **I can learn about how Seattle's great fire helped create the need for a dam and power plant.**
- **I can learn about how some of the first people lived with the land in the Cedar River Watershed.**
- **I can learn about the residents of Moncton and what happened to their town.**



Time: 2 class periods of 15-25 minutes each (highly recommended not to combine the two class periods)

Materials

1. PowerPoint Slides Part One: #28-33, Part Two #34-40
2. Cedar Falls Rising Video, previewed and preloaded: https://www.youtube.com/watch?v=gDMjBQHXkQE If this video doesn't work for some reason you can enter key words, Cedar Falls Rising. 16 minutes long (but worth it)
3. Student "My Water Book"
4. Optional: Model Scaffold worksheet *

In second grade, students apply their emerging understanding of civics, economics, geography, and history to their communities and others around the world. Students learn about how their community works as well as the variety of ways that communities organize themselves. To develop conceptual understanding, students examine the geographic and economic aspects of life in their own neighborhoods and compare them to those of people long ago. Below are the geography, communication, and history standards for this age level used from the National Social Studies C-3 Framework. These standards are present throughout this curriculum and through the integration of science and social studies, students experience rich opportunities to learn and engage with relevant, interesting phenomenon.

BY THE END OF GRADE 2
D2.Geo.1.K-2. Construct maps, graphs, and other representations of familiar places.
D2.Geo.2.K-2. Use maps, graphs, photographs, and other representations to describe places and the relationships and interactions that shape them.
D2.Geo.3.K-2. Use maps, globes, and other simple geographic models to identify cultural and environmental characteristics of places.
environmental characteristics affect people's lives in a place or region.
D2.Geo.5.K-2. Describe how human activities affect the cultural and environmental characteristics of places or regions.
D2.Geo.6.K-2. Identify some cultural and environmental characteristics of specific places.

BY THE END OF GRADE 2
INDIVIDUALLY AND
D4.1.K-2. Construct an argument with reasons.
D4.2.K-2. Construct explanations using correct sequence and relevant information.

BY THE END OF GRADE 2
D2.His.1.K-2. Create a chronological sequence of multiple events.
D2.His.2.K-2. Compare life in the past to life today.
D2.His.3.K-2. Generate questions about individuals and groups who have shaped a significant historical change.
D2.His.14.K-2. Generate possible reasons for an event or development in the past.

Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.**

2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.**

2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Science and Engineering Practices

Developing and Using Models: Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

1. Develop a model to represent patterns in the natural world. (2-ESS2-2)

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

2. Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)
3. Compare multiple solutions to a problem. (2-ESS2-1)

Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

4. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

5. Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)

ESS2.A: Earth Materials and Systems

6. Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

7. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes

8. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution

9. Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)

Crosscutting Concepts

Patterns

10. Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change

11. Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

12. Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

13. Scientists study the natural and material world. (2-ESS2-1)

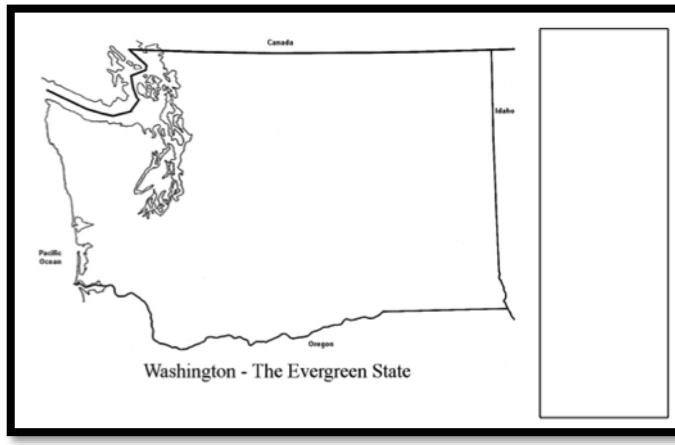
Procedure

Part 1 (10-15 minutes) #28-33

This part entails going through the slides, reading the slide notes and choosing pieces to incorporate into the storytelling. Students would benefit from reading along with you using their student "My Water Book". There are notes on the slides for storytelling support. These slides are intended to expose children to forgotten history of the people who lived in the area before the settlers and who continue to live in the area and many who attend school in Highline School District.

Part 2 (20 minutes + 15minute video) #34-40

The second part focuses on historical and scientific storytelling of the events that led to the flooding of the town of Moncton. Reading the slides with your students, and possibly incorporating this reading into your language arts time will allow you to utilize reading specific strategies to engage readers of all levels. After students have read these slides, allow them to watch the 15 minute video "Cedar Falls Rising" *https://www.youtube.com/watch?v=gDMjBQHXkQE* Then allow them to add ideas on chart paper that was started at the beginning of the unit related to where the flood water came from.



You also have the choice to add to the model scaffold worksheet that students are revising. In that case they can add any new details that emerge during discussion and reading of the slides. Students should now have a better idea of where their water comes from take a moment to mark this knowledge on the large Washington State Map, ask students to create the symbol that will represent the water.

Problem Solving Reflection Questions?

1. How to engage students in a discussion about culturally sensitive and sometimes tension filled topics while also not glossing over history?

*Many different sources were consulted throughout the writing and researching phases of this curriculum. This included double-checking sources, intensive research, meeting with watershed experts, and consulting with a Snoqualmie tribal scholar. The information in this curriculum is intended to meet Next Generation Science Standards, current social studies standards, Common Core ELA standards, and Washington State Tribal Education regulations and coming standards. For more information please visit http://indian-ed.org/

Investigation Nine: Explaining the Phenomenon – Final Models

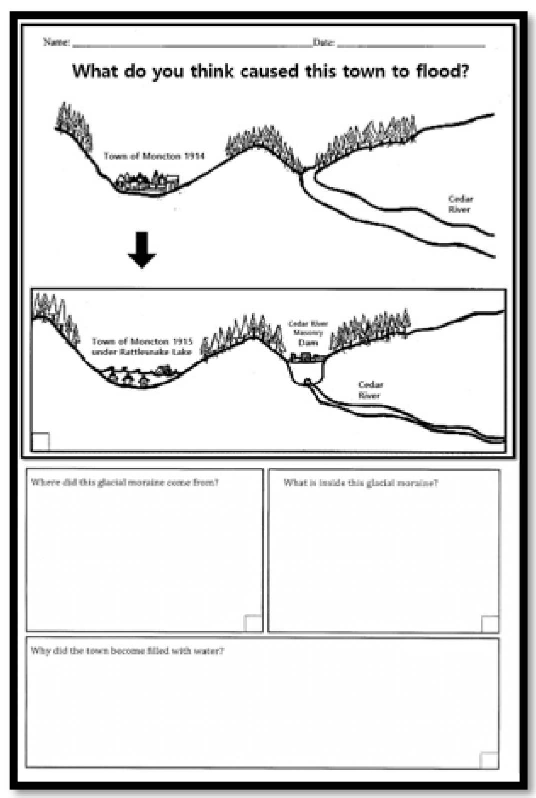
Students will review the activities that took place during the unit and use evidence, observations, and information from each lesson to tell the science story. Students will synthesize information related to the geology of the rocks due to the ice age glacial moraines and the location of the dam, which created the flooding in Moncton. **The little boxes on the model are intended to signify a place where scoring can occur, theses boxes are blank so that teachers can determine the total number of points possible.**

- Students will spend time reviewing the visual resources (posters) that were created during the course of this unit.
- Students will generate a list of items (rubric/checklist) that must appear on the final model in order to demonstrate proficiency or growth during the course of this unit. Optional* With students allow them to create the total number of points possible for each section prior to assessing the final model. Students can also self-assess these models if they are given guidance and an example to work from.
- Students will create a whole class consensus model, either on the board or chart paper.
- Student will work independently or in partners, referencing resources and past work, to complete their final model scaffold.
- Student models will be thoughtfully shared out (7-8 per session is recommended) using their past models to show growth or changes in thinking.

Tip: Prior to this lesson it is helpful to have discussion charts, photos, graphs, and other related items on display around the room for students and teachers to utilize during this discussion.

Student Friendly Learning Objectives:

- **I can model/draw/explain with evidence how the ice age left glacial moraines in the Puget Sound region.**
- **I can use information from several sources to provide evidence that Earth events can occur quickly or slowly.**
- **I can draw a model to explain how glacial moraines and a dam changed the shape of the land.**
- **I can use a map to draw the flow of the water in my watershed model.**



Time: 1 60 minute period (morning preferably) or 2 periods of 25-35 minutes each

Part One: Review Data from the Unit. Allow students time to sort and talk through resources to be used for evidence.

Part Two: Help students take a stand about the claims on the T-charts.

Part Three: Work on the final Model Scaffold Worksheet and share out work.

Materials

1. **T-charts**
2. **Model Scaffold worksheet, either one for each student or one for each partner group depending on grouping preferences**
3. **Colored pencils or thin markers for the model worksheet**
4. **Graph/Charts from the unit**
5. **Student work from the unit that can be used as a reference guide**

Procedure

Part 1

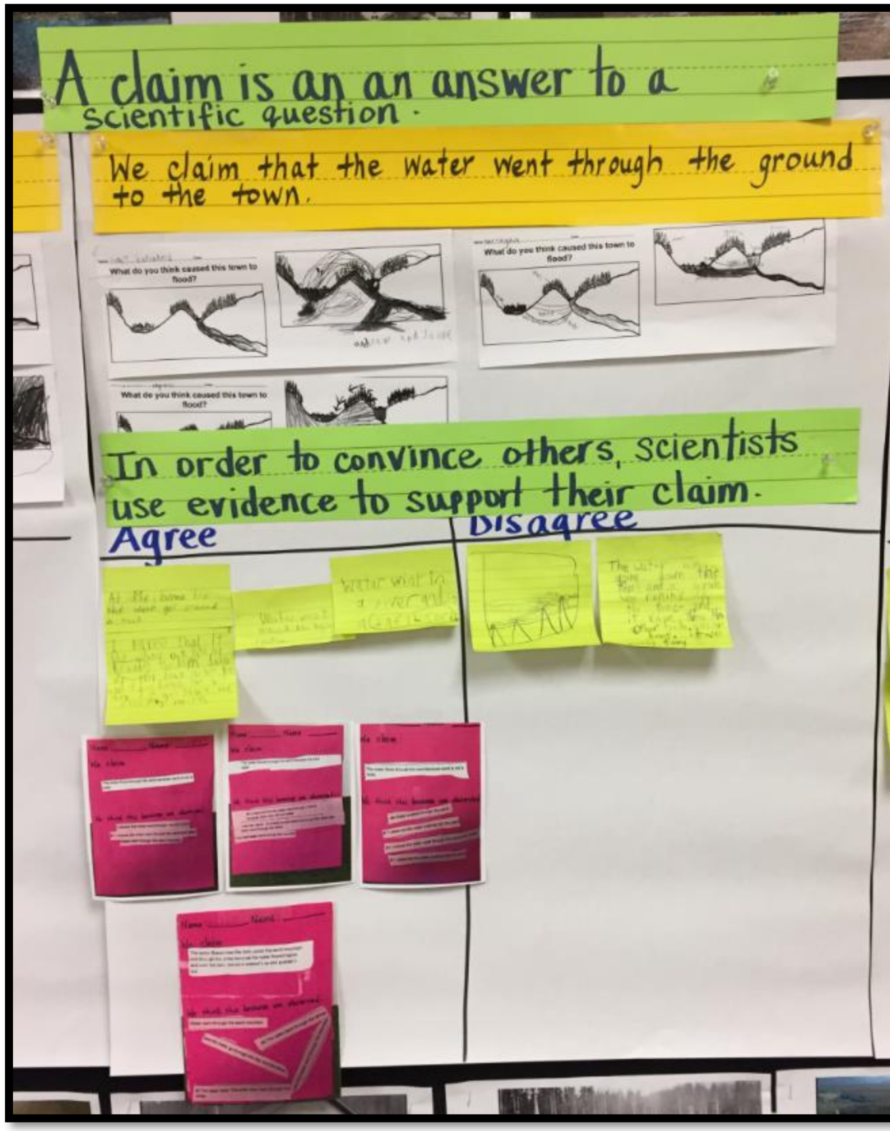
1. Phenomenon: The teacher will start the phenomenon lesson by reviewing with the class all of their hard work and learning that has taken place over the course of the unit, using the display resources you have created with students. Show students their model scaffold worksheets from the beginning of the unit and tell them that they are going to add some of these ideas and some of their new ideas to a new worksheet because they have done a lot of learning, and part of doing science is building on your thinking and having your ideas change. Students will need to reference their “My Water Books” and other materials related to what they have done over the course of the unit, in order to draw upon different activities or readings. Without some representation of what they have done or read, they would have to depend on memory, and each student’s memory is different. So, just as scientists do, the teacher can help students learn how to utilize resources to gather evidence for use on their final model scaffolds.

Part 2 (Taking a stand about initial claims)

The class would have T-charts that have been built on throughout the unit. Students can revisit these T-charts and other summary posters from unit activities to collect evidence to take a stand ("Agree" or "Disagree", why) about the initial claims on the T-charts.

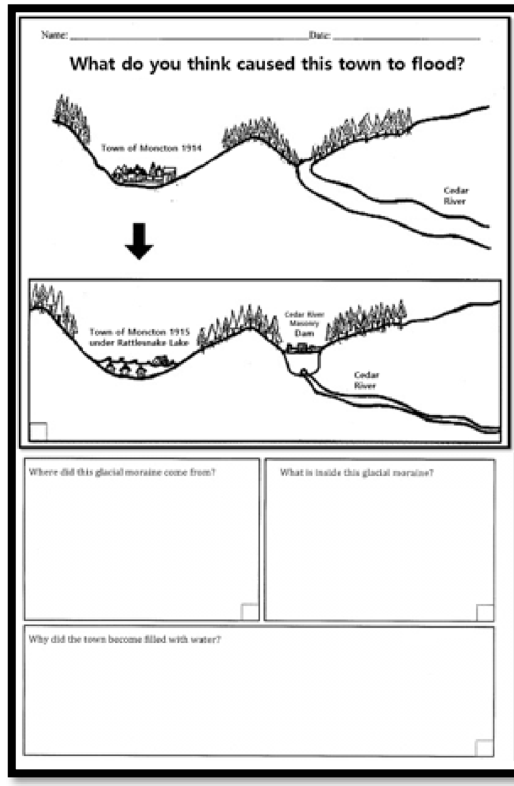
As a whole class, students can share their thoughts about whether they agree or disagree with the claims on the T-charts.

Teachers can encourage students to use multiple sources of evidence to support their stances.



Part 3 (Final modeling)

2. Independent Work: Support students as they transition from the class discussion to working in partner groups to complete the worksheet. **Students should be adding on to the model that they started mid-way during the unit. But if they prefer to start fresh and copy some of their previous ideas it would be a good idea to have a few blank worksheets on hand just in case.** Depending on the dynamics of your classroom you will need to consider if each student will receive a worksheet or if your students will be sharing and completing one worksheet in partner groups. Some students will work best independently. Allow for a quiet working period of at least 10-15 minutes to give all students an opportunity to record their ideas. Students that finish early can read from the "Book Basket" or work on a teacher pre-designated activity.



3. Student Sharing Work: Invite one student at time to the board to share their work. Ask the student to explain their thinking if you feel that they would be comfortable explaining their thinking in front of the group. As the facilitator, you can help guide the student during the discussion and invite other students to help articulate their ideas in "kid language". It is important to be mindful of "kid language" as they may use gestures to explain ideas or even personal stories that may not seem relevant but upon further probing they are actually relating their own experiences to the topic. One of the main focal points of this discussion is to close in on the unit learning objectives.. If students "forgot" to put in an idea, teachers have found it helpful to allow that student to return to their desk to add to their model as they are never truly finished, since new evidence or arguments support changes over time.

Unit Learning Objectives:

- **Students will create models to show that water can slowly or quickly change the shape of the land.**
- **Students will learn that how and why water can flow through certain Earth materials more easily than others, including soil, sand, gravel, and clay.**
- **Students will create a dam using different Earth materials to compare multiple solutions designed to prevent water from changing the shape of the land.**
- **Students can read and interact with maps to show where places and bodies of water are located.**
- **Students will read maps about their local watershed and learn where their water comes from.**

4. When all of the student work has been completed and shared, congratulate the class on finishing their "scientific work" and praise them for sharing their ideas. Tell students that they can continue to look for the way that water shapes the Earth and for ways that humans have impacted water.

5. Read aloud: "Water Dance" by Thomas Locker as students will now have developed a different understanding of water and this book provides them with the opportunity to see and explore water in all of its' forms.

Explanation checklist

The "gotta-have" explanation checklist is a set of ideas or concepts that must be included in the final explanation. This list can be co-constructed with students. This may start with very simple statements or even just terms, but the list should grow over time— added to by students with occasional prompting by the teacher. Again, as the students engage in cycles of reading, activity, and connecting with their everyday experiences, they add to this checklist. If they are missing some key elements of the final causal explanation, it should alert you as the teacher to modify your instruction to address these missing pieces.

The "gotta-have" explanation checklist works best when it is composed of *ideas* or *relationships* that students believe are important to a final explanation, rather than a list of vocabulary words. These items on the checklist are not "giving away answers." They remind students of what is important to talk about or draw out, and these are ideas that they have come up with themselves during the unit.

Sample Checklist that can be added directly to the model or as a separate rubric/scoring guide that accompanies your school/district grading system:

1. I can model/draw/explain with evidence that water can slowly and quickly change the shape of the land.
2. I can model/draw/explain with evidence how water can travel through different Earth Materials.
3. I can model/draw/explain with evidence how to create a dam that prevents water from changing the shape of the land.
4. I can use my model scaffold worksheet to draw observable and unobservable processes that occur both on the surface of the land and below the surface.
5. I can model/draw/explain where this particular glacial moraine comes from, what is inside this glacial moraine, and why the town became flooded.

Helpful advice from our teacher colleagues who have successfully used "gotta-have" checklists:

1. An explanation checklist can be started at the beginning of the unit, but should be added to or subtracted from every few days as the students learn more.
2. Students should co-develop the list with you—it is a representation of their thinking, not yours.
3. Keep away from making it a vocabulary checklist. Including the word "how" sometimes helps you as a teacher express the items as ideas, rather than as words.
4. When students are creating their final explanatory models, make sure they have access to the checklist—it works very well as a common set of ideas that the teacher can refer to as he/she circulates around the room and supports the construction of the final models.

Tools for Productive Talk

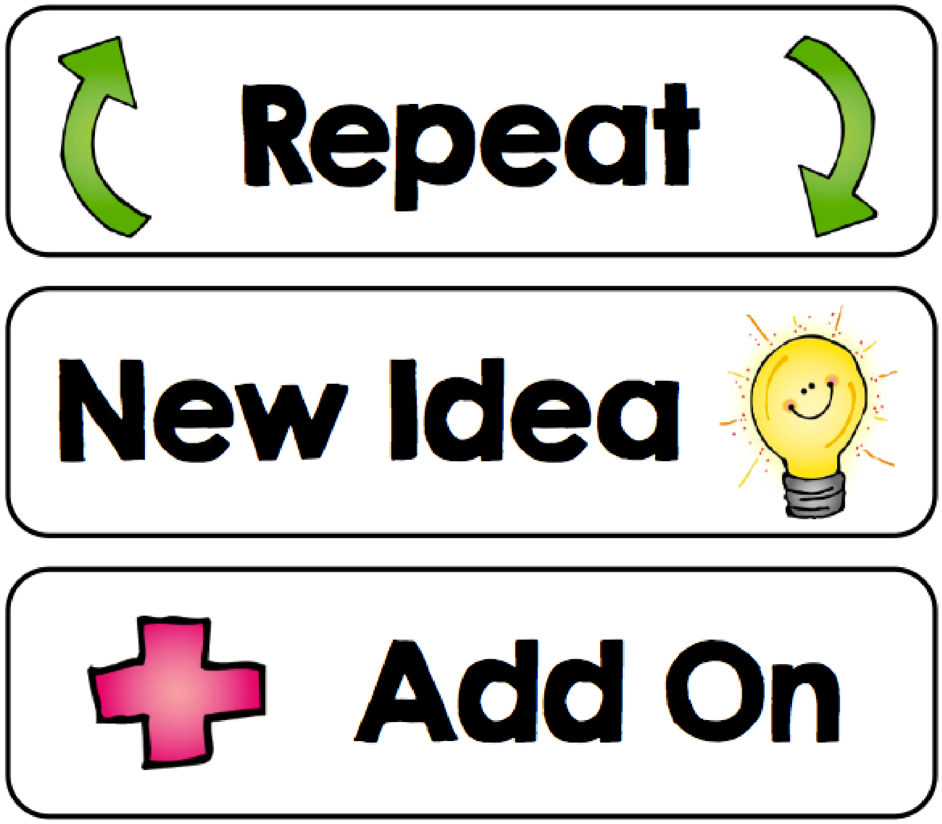
Creating the Environment

Create a learning environment that supports risk taking:

- Mistakes are valued as learning tools
- There is more than one possible answer
- All ideas are okay to share
- Question-asking is welcomed

Teacher Responses

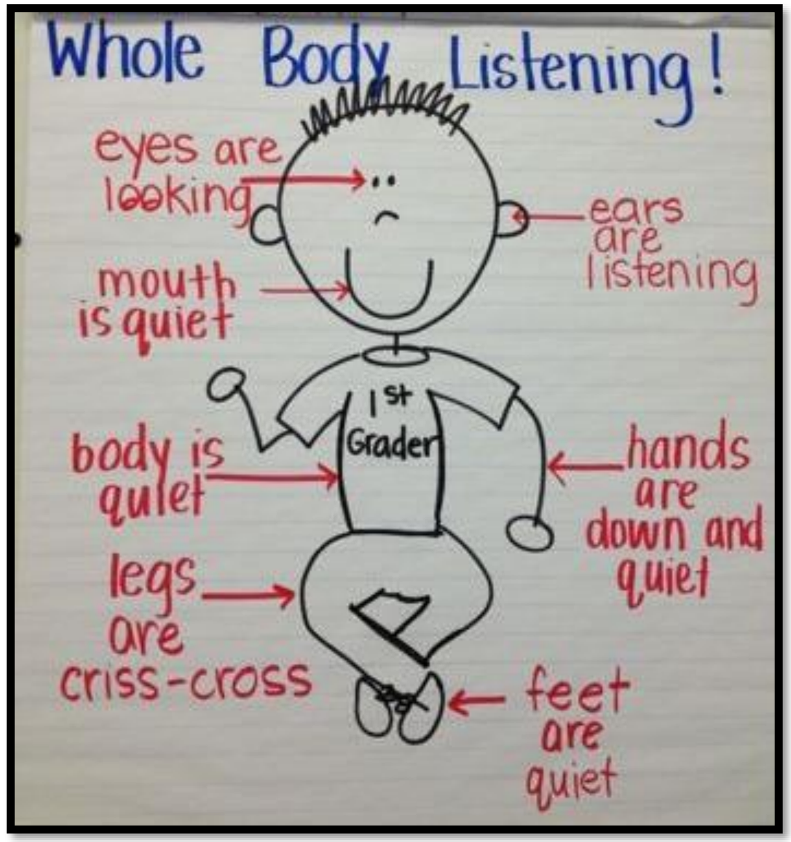
- Ask open-ended questions
- Encourage sharing all ideas, give praise for effort
- Be non-judgmental, use non-judgmental language
- Validate and respect student responses
- Give students wait time after you ask a question
- Point to the discussion stoplight as student share their ideas or keep tallies next to each color.
- Help student build ideas off each other, “Adding On”.
- Use positive redirected language even if an idea seems off task
- Help students be curious, ask “What questions do you have?”
- Help students find puzzles; ask “Is there anything that seems strange?”
- Help students seek out what is hidden, ask “Do you notice anything that seems to be missing?”
- Encourage students to use their observation skills consistently
- Ask students to use or look for evidence to explain their thinking
- Encourage students to look for patterns and cycles



Discussion Stoplight

Utilizing the discussion stoplight during science discussions is a powerful tool for guiding student dialogue and encouraging them to listen to their peers. If you are able to link the discussion stoplight with a classroom behavior system this may result in increased student awareness and participation. Tallying student responses next to each color shows students their thinking and usually the “Repeat” has the fewest tallies and during the discussion teachers can stop and say “who can repeat Alice’s idea” or “It looks like we need to repeat someone’s idea”. Students may grow accustomed to using this stoplight during discussions and it can be helpful to use the stoplight during other subjects or activities during the day such as show-and-tell.

Whole Body Listening

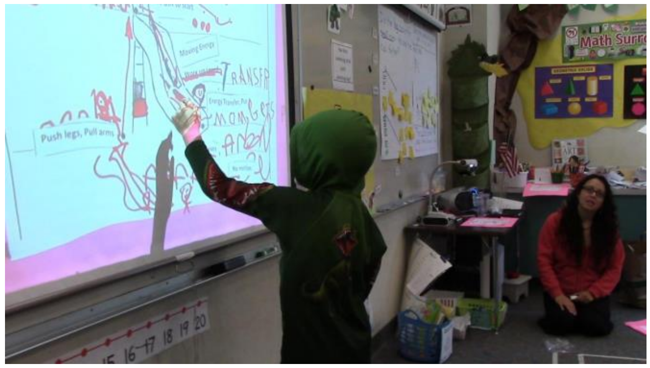


Students will need practice with listening skills throughout the school year in order to participate appropriately during science discussions. Students with special needs will benefit greatly from a focus on listening skills because you will be using consistent language associated with a "Whole Body Listening" poster. Teachers can choose to purchase pre-made posters or have students whole group and individually create a poster. If you have access to the book "Whole Body Listening Larry at School" by Wilson and Sautter, I highly recommend reading this book aloud in September and January. Many students have not been taught how to sit and listen and how to share ideas appropriately. Most students will need to be shown how to listen productively and using a poster, consistent language, and practice through science discussions will greatly enhance their perspective taking skills, listening skills, and discussion skills.

Key ideas for "Whole Body Listening"

- eyes to look at the person talking
- ears to hear what is being said
- mouth by remaining quiet
- hands by keeping them by their side or in lap
- feet by placing them on the floor and keeping them still
- body by facing the speaker or sitting in chair
- brain to think about what the speaker is saying
- heart to care about what the speaker talks about

Sharing Student Work



During science discussions the sharing of student work greatly helps facilitate the science discussion and keeps students focused on the topic. This strategy is part of creating a responsive classroom where we are showing students that we value their work and perpetuates a culture of belonging for students. When student work is shared and displayed on the classroom walls the teacher is sending a message that you value their learning process. It is important to be purposeful about sharing student work because during certain lessons some student work can be highlighted while others work on taking turns, *"This time it will be Grace, Zoe, Steven, and Riley's turn to share, maybe next time it will be your turn to share, these students really worked hard to follow directions and you can see it in their work."*

Vocabulary

Ice Age	**A time on Earth when the climate has been much colder in temperature than is normally observed. A time period when glaciers and ice sheets advance and cover large pieces of land.**
Glacier	**A large mass of ice that moves over the land**
Map	**A model that represents places such as a classroom or a mountain**
Water	**Bearing broad, flat leaves**
Watershed	**The part of the plant that will grow into a new stem, leaf, or flower**
Flood	**When water moves into places that it does not normally cover such as in cities or towns. Floods can happen slowly or quickly.**
Glacial Moraine	**A large hill or mound of till left behind by a retreating glacier.**
Dam	**A structure or barrier made by people or animals that controls the flow of water.**
Glacial Till	**The pieces of rock, sand, and soil that are left behind when a glacier retreats or melts away.**
Ice Sheet	**A large piece of ice that covers extensive parts of the Earth, also known as a Continental Glacier.**
Aquifer	**A large underground freshwater lake.**
Alpine Glacier	**Glaciers that form on top of mountains and flow down into valleys.**
Continental Glacier	**Glaciers that are much large than alpine glaciers. They can cover very large pieces of land, sometimes even whole continents. Continental glaciers cover much of Greenland and Antarctica. Continental glaciers are also known as ice sheets.**
Retreating Glacier	**A glacier that is shrinking in size and moving backwards.**
Erosion	The action of surface processes (such as water flow or wind) that remove soil, rock, or dissolved material from one location on the Earth's crust, then transport it away to another location.
Meltwater	**The water that has melted from ice or from a glacier or ice sheet.**

Recommended Book List

Title	Author
Follow the Water from Brook to Ocean	Arthur Dorros
All the Way to the Ocean	Joel Harper
Glaciers	Mari Schuh
Water Dance	Thomas Locker
All about Maps	Dr. Seuss