Why is Protecting Our Water So Important?

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This curriculum unit is recommended for:
4th grade/5th grade Science

Keywords: Creeks, waterways, Charlotte Mecklenburg streams, streams, pollution, macroinvertebrates, water quality

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit. (Insert a hyperlink to Appendix 1 where you've stated your unit's main standards.)

Synopsis: This unit will explore the water quality of streams within our community, more specifically the stream within our school's campus. Students will explore stream health and what it means to have good or poor water quality. They will explore the organisms within our streams and come up with viable solutions to make sure these organisms are able to survive in their habitat. While exploring, students will conduct hands-on learning experiences that allow them to collect data and make observations regarding the stream's health. As a result, students will create a project encouraging humans to take care of their environment and promote good water quality within our waterways. Students will explore and explain the common pollutants created by humans and determine solutions or alternative activities in order to prevent pollution.

I plan to teach this unit during the coming year to 22 students in a 4th Grade Science classroom.

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Katelyn Gardepe

Introduction

My school is located in an affluent, suburban neighborhood in South Charlotte. The population of the school is made up of approximately 74% White, 10% Hispanic, 9% Black, and 4% Asian. About 13% of the students are Selwyn are receiving free and reduced lunch services. We are blessed to have a large amount of support from families within our school community.

Selwyn is fortunate enough to be part of the SouthPark Campus, which includes an elementary school, middle school, and high school. The property of the campus stretched across 120 acres of wooded, hilly terrain. Our campus is intersected by two creeks and nature trails which are occasionally utilized for science lessons within the schools.

This year, my class is made of 22 wonderful little beings. I have the pleasure of teaching them all subjects areas, whereas in the past we have departmentalized teaching only two subjects to each student group. Because of Covid-19, we will keep our homerooms this year and I will teach these same students for the extent of the day. There are a lot of pros and cons to these different frameworks, but I am excited to have the flexibility of time with my students- which I also believe will be helpful with teaching this unit.

As a school, our student demographic is extremely bright. About 50% of the students in our school are considered Gifted and Talented, receiving additional Talent and Development services as a certified TD student or considered TD Catalyst (gifted but did not achieve certification). It is probably safe to say that half to about two-thirds of my students fit into this category. One thing that I have learned about these students throughout the years is that they are easily bored with textbooks and fill-in-the-blanks. Our TD students need, and thrive, through problem-based learning activities and hands-on creations. While true for TD students, I do believe all of my students experience a different level of engagement when their assignment is geared towards something they can relate to or something they can physically touch.

Within this unit, I would like for students to gain an understanding of the importance of taking care of our environment. While researching, I thought it was very important for students to know that pollution really comes from things that we, as people, do every day without thinking anything of it. I think exploring the water quality in Charlotte will allow students to make connections to their own lives. When students discover the effect that this pollution has not only on animal and plant life, but also on themselves, I hope it will encourage them to become problem solvers. Students will be encouraged to create strategies that will help their own families, and others in the community, to be more aware of what they are putting into the water here in Charlotte.

In the fourth grade, students learn a lot about an organism's ecosystem and how it is affected by environmental changes and impact from human interactions. This year, students will explore a variety of standards focused on how what we do effects the ecosystems around us. Throughout

this unit, we will focus on the following standards from the North Carolina Standard Course of Study for Science:

4.L.1.1 Give examples of changes in an organism's environment that are beneficial to it and some that are harmful.
4.L.1.2 Explain how animals meet their needs by using behaviors in response to information received from the environment.
4.L.1.3 Explain how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens, planting trees and shrubs to prevent flooding and erosion)

Using a variety of resources from the web, I want to create a hands-on unit for students to discover the problem in our local stream and then analyze it to create a solution. On the Maryland Department of Natural Resources website, they have a great activity for students to conduct a Stream Study of their own. The activity requires students to assess the stream in three different ways:

1. Physical Assessment: Students will assess the streams habitat through observable characteristics.
2. Biological Assessment: Students will use the biology of the stream (the living animals) to indicate a rating of stream health.
3. Chemical Assessment: Students will use chemical testing to test the water in the stream for pollutants and overall stream health.

I plan to implement a version of this Stream Study within my unit to help students make discoveries on their own, in a very hands-on way. This will help students assess the effect that pollutants have on our streams and the organisms which live there. Students will then be encouraged to look for answers. Is our stream safe? Why or Why not? How can we change what is happening to the stream? Why are the organisms living/dying? What changes can humans make to help improve the stream health?

At the end of this unit, students should understand how we, as humans, effect stream health and what we can do to improve stream health moving forward. This will give students a look at an aquatic ecosystem and how it's population can be effected rather quickly. Students can then apply this knowledge to other ecosystems, creating a project of their own. This project would focus on another type of ecosystem, its challenges, and student-made solutions to help the organisms living in them.

Content Research

What is a stream?

"A stream is the central component of a landscape where water drains downslope to the lowest point via a network of drainage channels." [1] Streams could have been naturally created over centuries of time, but the process can be easily interrupted by human intervention. Many species and plant life depend on streams. These bodies of water allow for human recreation, drinking

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water, irrigation, and more. Streams may be referred to as the Earth's Circulatory System. They allow for the flow of water from one place to another as they carry sediment, nutrients, and other materials into the larger bodies of water on this planet. It is important to keep our streams clean so that we, in turn, can keep humans and other organisms healthy and safe. In order to assess the health of a stream, one must first recognize the history of the stream, the area through which it flows, and the potential impact of various human activity on the specific body of water. (Encyclopedia n.d.)

What is a Healthy Stream?

There are many factors that can impede the health of a stream or waterway. The natural environment will tell much about the potential health of a waterway overtime. The shape of the land and the type of soil can play a huge part in the characteristics of a stream. As you might imagine, a fast-flowing stream in the middle of a steep mountain will take on different characteristics than one that flows slowly through a flat piece of land. The speed, or lack thereof, of the water, can allow and/or prevent some harmful additions to the water. Vegetation around the stream helps to create stability for the stream and the organisms that live in it. The climate in an area, and the amount of precipitation and area sees, has a great impact on the amount of water that will be delivered to the stream. (Schlesinger 2016)

Human activity can play a huge part in helping or hindering the health of a stream. All of the above natural factors can be influenced and changed if man step in and create obstacles. For example, building dams, removing the vegetation around streams, and pumping water from a stream can be harmful to the stream health. In order to compute the stream health and work towards a solution for a healthier future, one must understand the different human activities that could have potentially impacted the stream over time. (Smithsonian Environmental Research Center n.d.)

One way to assess the health of a stream is to test its water quality. To do this, the assessor should look at 6 main categories: sediment, nutrients, bacteria, temperature, dissolved oxygen, and toxic chemicals.

Sediment comes from erosion around the area and can cause organism and their eggs to get inadvertently covered and killed. In addition, the covering of these organisms can also have an impact on the aquatic food chain, preventing some organisms from accessing their food source. Measuring the amount of sediment in a stream can help you to determine whether or not the sediment is at an appropriate level or high enough to impede on the organisms within the environment. (Encyclopedia n.d.)

Nutrients are chemicals that are typically at low levels in fresh water. If nutrient levels become too high, it can cause an overly abundant amount of vegetation in the area and impede on the aquatic environment. The excessive amount of aquatic plants can take away from the amount of dissolved oxygen within the stream. Fish and other organisms need this dissolved oxygen to survive. If the vegetation grows to heavily in an area, it can also prevent humans from getting the resources they need from the waterway. These overgrown plants can clog pumps that withdraw water or choke waterways that are used for recreation. The two main nutrients that can

cause this overgrowth of plant life are phosphorous and nitrogen. For this reason, these nutrients must be monitored closely to prevent overgrowth. (Encyclopedia n.d.)

Bacteria is monitored in a stream for more obvious reasons. The bacteria typically found in the waterways are that of fecal coliform pollutants. These bacteria can typically come from human-caused pollution because they come from warm-blooded animals, including humans themselves. This type of pollution can also be caused by runoff from yards and streets during a rain shower. If humans do not pick up their animal feces, it often runs off into the waterways and pollutes our streams. Bacteria in the water can cause diseases in various organisms, minimizing the stream health. (Encyclopedia n.d.)

The temperature and dissolved oxygen levels are another indicator of a healthy stream. Fish need cold water and high dissolved oxygen levels in order to survive. If the levels are too low or the temperature is too high, fish are unable to survive. Because of this, these levels are extremely important to the health of a stream. (Encyclopedia n.d.)

Chemical levels are also necessary to monitor within a stream. If the levels are too high, organisms within the stream are unable to survive. In addition, even a low level of chemical can sicken a human who drinks the water or eats the fish from it. Chemicals can come from all sorts of outside sources. The product can come into the stream through manufacturing or construction that is taking place in the neighborhood, pest control used around a house, agricultural or city operations, and regular household cleaners. While the intention is that chemicals are monitored closely and kept in a safe and controlled area, it is not uncommon for chemicals to find their way into the water through any of the above-mentioned activities. During a stream health assessment, if chemicals are found to be present, the assessor must then look to identify the specific chemical that is present and identify the toxicity level for that chemical. (Encyclopedia n.d.)

Lastly, perhaps one of the most apparent indicators of stream health would be the aquatic life. In a healthy stream, there is a great variety of organisms with high populations. In a stream with poor water quality, there may only be a few species of organisms and the population is slim. This is because the water quality has a great impact on the ability for an organism to survive and flourish in its environment. Some species are more sensitive to water pollution, while others may tolerate it better. The mixture of both types of organisms can speak volumes about the health of a stream. Vegetation around the stream also helps these organisms to flourish by preventing sediment and other outside pollutants to enter the water way. (Smithsonian Environmental Research Center n.d.)

Creeks in Mecklenburg County

Fun Facts about Mecklenburg Creeks to share with students:

- Mecklenburg Country has 3,000 miles of creeks and streams.
- Mecklenburg County has 126 named creeks.
- Every creek in Mecklenburg County starts in Mecklenburg County, except for two.
- Irwin Creek was used as a city water supply from 105 until the drought of 1911.

- Little Sugar Creek was so polluted during the middle of the 20th century that the city dripped orange-blossom scented perfume into the water to try and mask it's odor.
- The two most prevalent pollutants in Mecklenburg's creeks are bacteria from feces and sediment from storm-water run-off.
- Sewer overflows are a big cause of bacterial pollution. Most Charlotte-Mecklenburg sewer system overflows are caused by grease clogs in the pipes.
- One inch of rain onto one acre of pavement will produce an estimated 27,000 gallons of storm-water runoff.
- An estimated 25 percent of all the land area in Mecklenburg County is impervious surface. This includes streets, roads and highways. So one inch of rain onto all of Mecklenburg produces some 2.4 billion gallons of storm-water runoff.
- If you put 2.4 billion gallons of water onto gallon milk jugs and stacked them up, they would reach to the moon and halfway back! (Keeping Watch n.d.)

Macroinvertebrates

What are macroinvertebrates? The word "macro" means big (or in this case, big enough for the eye to see without using a microscope). The word "invertebrate" means without a backbone. Aquatic macroinvertebrates are organisms, without a backbone, that are visible to the naked eye. Some macroinvertebrates spend their entire life in the water, while some may just live in the water until they are mature enough to move to land. (Extension Utah State University 2020)

Macroinvertebrates can tell us a tremendous amount about our stream health. The diversity and concentrated population of these organisms in our streams allow us to assess levels of toxicity and pollution within their habitat. In examining the stream health, we categorize these organisms into three groups: pollution sensitive, moderately pollution sensitive, and pollution tolerant. Pollution sensitive organisms are those which do not tolerate even a minimum level of pollution. These organisms need good water quality to survive. When organisms from this category are found in a stream it tells us that our stream is relatively healthy and well taken care of. Moderately pollution sensitive organisms are those which can handle a small amount of pollution and fair water quality. If we find organisms from this category, such as the caddisfly, crane fly, damselfly, dragonfly, mayfly, or crayfish, it allows us to assess the water quality as fair. Lastly, the pollution tolerant organism can tolerate most pollutants in the water. With that said, if organisms from this category, like the Midge, are found in the water, it is safe to assess the water as having poor quality. (Environment n.d.)

Different types of organisms have different requirements to survive. Some of these organisms may need cooler temperatures, high dissolved oxygen levels, or specific habitats to flourish. Each stream has its own story and not all organisms are able to take part. The life in the stream allows us to tell their story and consider ways in which we can change the story in order to create a happy ending for all organisms.

Getting in the Creek with Students

So how do we examine these critters with our students? How do we let them take the lead and draw conclusions about the health of the stream? First, we must get them in the water! To do this, let us start with what you will need:

1. Make sure everyone is wearing closed-toed shoes that can get wet or water shoes.
2. Nets are great tools for the students. If you have access to nets, great! If not, students do not need to have them in order to explore the stream.
3. Have some type of container for students to put their creatures in while the analyze the species. This should be a container that can also hold water, therefor not mesh.
4. Be sure to bring the species ID sheets that are attached in this unit. It is important for students to be able to use their reasoning skills to determine the species of each organism.
5. Bring sanitizer! Students should be sure to use sanitizer when they are done exploring the creek. (Butler Soil and Water Conservation District n.d.)

Rules for Exploring the Creek

Be sure to create some ground rules for the students to follow. Here are some ideas that you can use and adapt as you see fit for your classroom:

1. Students must not go beyond knee level in the water. The level of the water can quickly change, and we want to make sure everyone is safe.
2. When you find an organism, be gentle and do not hold them too tight.
3. Always use wet hands to touch a critter from the water. They need the water to survive!
4. Once you put hand sanitizer on, do not touch the critters. They can absorb the sanitized and it can kill them.
5. Do not keep your organism out of water for too long. Be sure to pick it up, look, and if you need more time- transfer it to one of our holding containers with water. Many of these organisms need water to breathe.
6. If you turn rocks over, please be sure to put them back the same way you found them. These are the homes of these organisms and we do not want to make it hard for them to live there again.
7. Do not kidnap the critters! We will always put the organisms back where we found them so that they can live a long life. This is their home and we are not going to take them from their homes. (Butler Soil and Water Conservation District n.d.)

Where Should We Look?

Have students look in the areas where the water is shallow but moving fast over the rocks. This is called a rifle. Rifles help to create oxygen for the organisms and are usually the best place to start looking for organisms. Have students carefully pick up rocks and explore what is beneath them. Remind students to be careful about the movement of the rock and to remember to replace the rock in the exact spot when they are done. By doing this, students are helping to not interrupt the habitat of these organisms and hopefully contribute to their well-maintained environment. (Butler Soil and Water Conservation District n.d.)

You may also want to look in the larger pools of water where the water is slow moving. Fish and other creatures like to hang out in these areas because they feel protected. Fish, especially, love to hang around tree routes to help them feel safe. Additionally, other organisms like to hang

around the plants and vegetation. Each habitat provides a different type of resource for the organisms and each has their own preference of environment to help them survive. (Butler Soil and Water Conservation District n.d.)

How Can We Help Preserve Our Streams?

In 1972, the Clean Water Act was established to control pollution from industrial and sewer pipes. At the time, the ordinance provided relief for the stream water where businesses were once piping all their waste. However, today, the streams see a much similar situation. Stricter ordinances, a growing greenway system, and creek restorations in Mecklenburg County allow for some hope, but we, humans, need to do our part to help in this. (Newsome n.d.)

Urban areas like Mecklenburg County are already at risk, without human interaction. Because these areas have a lot more impervious surface than rural or suburban areas, the groundwater runoff creates a much larger problem. The impervious surface does not allow for absorption of liquids, therefor it is more likely to run off into the streams and waterways surrounding it. In its path, the runoff takes all the pollutants and toxins from the surface and carries it into our water. Because of this, WE must be more mindful and do better at protecting our environment.

Humans have a lot of control over what goes into our waterways. Activities or occurrences like forest fires, road construction, coal mining, residential or commercial construction and much more have a large impact on our water systems. To control the pollution in our city, we must take a hard look at what we are doing and how we can be more careful about the effects of our behaviors.

One way we can help is by working to prevent erosion. Planting trees and bushes around the waterways within the city and in our own backyards will help to keep the pollutants out. Cleaning up pet feces as quickly as possible will prevent the toxins from slowly making their way to the creeks. Many of us use chemicals for cleaning around the house or even chemicals or fertilizers in our gardens. While these fertilizers help the crops and grass grow, they also release nutrients into the waterway that promote the growth of algae. Algae can block light, create low oxygen zones and prevent the survival of many fish and invertebrates in the water. Lastly, do not dump cooking grease or oil down the sink and be sure to take any hazardous chemicals to a recycling center to discard. Always remember that whatever comes from upstream will eventually flow downstream. While we think a pollutant is contained where we leave it, it likely is not. (Newsome n.d.)

Content Vocabulary

Dissolved Oxygen (DO): A measure of the amount of oxygen available for biochemical activity in each amount of water. Adequate levels of DO are needed to support aquatic life. Low DO can result from inadequate waste treatment.

Ecosystem: The interacting system of a biological community and its nonliving surroundings.

Fecal coliform bacteria: A group of organisms found in the intestinal tracts of animals. Their presence in water indicates pollution and possible dangerous bacterial contamination.

Food Chain: The transfer of food energy from the primary source, plants, through a series of organisms with repeated eating and being eaten.

Groundwater: A supply of freshwater under the earth's surface which forms a natural reservoir.

Habitat: The sum of environmental conditions in a specific place that is occupied by an organism, population or community.

Impaired: Weakened or damaged. Relating to water quality it means it is not suitable for the uses it is assigned to.

Infiltration: the action of water moving through small openings in the earth as it seeps down into the groundwater.

Macroinvertebrates: a water bug that we can see with the naked eye

Non-point source pollution: A type of pollution whose source is not readily identifiable—such as, pollution caused by car exhaust.

Nutrient: Substance which is necessary for growth of all living things

Point Source Pollution: A type of pollution that can be tracked down to an easily noticeable cause—such as discharging pipes, people putting chemicals and trash into the water.

Pollutant: Something that makes land, water, and air dirty and unhealthy.

Pollution: the presence of waste that makes the world around is dirty and contaminated.

Runoff: Water from rainfall that flows off rooftops, streets, parking lots and other paved surfaces.

Sediment: Soil, sand, and minerals washed from land into waterways.

Seepage: Water that flows through the soil

Sewage: The organic waste and wastewater produced by residential and commercial establishments.

Storm Sewer: A system that collects and carries rain and snow runoff to a point where it can soak back into the groundwater or flow into surface waters.

Tributary: A river or stream flowing into a larger stream, river, or lake.

Turbidity: A cloudy condition in water due to suspended silt or organic material.

Urban runoff: Storm water from city streets, usually carrying litter or organic waste.

Wastewater: Water carrying dissolved or suspended solids from homes, farms, businesses, and industries.

Water Pollution: the addition of enough objectionable material to damage water quality.

Water Quality Standard: A management plan that considers (1) what water will be used for, (2) setting levels to protect those uses, (3) implementing and enforcing water treatment plans, and (4) protecting existing high quality waters.

Watershed: All the land that serves as a drainage for a specific stream or river.

Waterway: A natural or man-made place for water to run through (such as a river, stream, creek, or channel)

Teaching Strategies

Hands-On Learning: Students will get their hands dirty as they explore the creek on the school grounds. Students will look for possible pollutants around the stream, work to make the stream on our campus healthier, and explore the various organisms which live in it. We will literally step into the stream to gather observations and data about the water quality!

Note-taking: Students will take notes as they participate in observing the stream, throughout our class instruction, and while working with their partners to analyze their findings.

Graphic Organizers and Lab Sheets: Students will use various graphic organizers to help them gather their data and findings. Students will study various organisms and use their information to determine the type of organism with the graphic organizer given.

Cooperative Learning: Students will work together to make observations of the water quality and while preparing a presentation on how we can help to prevent further damage to our water systems.

Crossover Learning: Students will take their knowledge from the classroom and bring it to the creek with us! Students will learn the needed content in the classroom to then make discoveries as they explore the organisms and environments around the creek.

Instructional Conversation: Students will spend time working together to come up with "big" ideas and create solutions to the problems are streams, and organisms within them, are facing.

Inquiry-based Learning: Students will work to determine the "problem" with the streams, what we can do to fix these problems, and how we can encourage others to do these things. Throughout the whole unit, students will be building on their inquisitions as they answer "big

questions" posed to them about their work. Students will be encouraged to observe and analyze their findings, share their work with others, and become problem solvers in our search for solutions.

Partnered Instruction: Learning from a peer is so valuable. Throughout this unit, students will work together to analyze the stream and the macroinvertebrates within it. Students will work together to examine the environment around the stream and the possible pollutants or toxins that could be affecting it.

Instructional Activities

Day 1: What are ecosystems?

Materials needed: Science Journal, access to a Science textbook or online resource

Ask your students to write down everything they know about ecosystems in their notebook. *What are ecosystems? Why are they important?* Create an anchor chart poster and jot down ideas to share with the class. Students responses may vary. Ecosystems include both living and non-living things. The non-living parts include soil, rocks, water, light, air, etc. The living parts include all plant and animal life in the area.

Give students the ecosystems matching task cards. Have students work with groups to match the description cards with the correct ecosystem cards. Students can use the internet or their Science textbook to help make these connections. When students are finished, go over the matches as a class. Ask students, *"What is it that makes an ecosystem different from another?"* and record students answers.

Day 2: The difference between aquatic and terrestrial ecosystems.

Materials needed: Science Journal, a notebook to bring to the creek

Tell students that for the next few days they are going to learn about one specific ecosystem. Take students (with their notebooks) on a walk to the creek. Have students pay attention to their surroundings as they walk there. Once the class is at the creek, have students look around.

Ask students, *"What type of ecosystem do you think we are exploring today?".* Students may say that this is a stream or creek. If they do not say it, tell students that this is an aquatic ecosystem. This means that this ecosystem is a water-based ecosystem. There are two types of ecosystems, aquatic and terrestrial. A creek is an aquatic ecosystem. *Ask students if they can think of any other aquatic ecosystems.* They may say a pond, the ocean, a river, or a lake.

Ask students, *"Can anyone think of what a terrestrial ecosystem might be?"* A terrestrial ecosystem is an ecosystem on land. Ask students, *"Can you give me an example of a terrestrial ecosystem?"* Students may use many of the examples from yesterday's activity. They might say tundra, taigas, temperate deciduous forests, tropical rainforests, grasslands, and/or deserts. They may even say something much simpler like a meadow, the mountains, or a forest.

In their notebooks, have students look around and write down any characteristics of the creek that they might see. Then, head back to the classroom.

As you return to the classroom, have students write down the definitions for aquatic and terrestrial ecosystems. Allow them to recall the information from earlier to help the class come up with an accurate definition. Once their vocabulary is written down, ask students to share their observations from the creek. Create an anchor chart with their observations to refer back to throughout the unit.

Day 3: Preparing for the creek

Materials needed: Science Journal, Large bags or bins for bringing materials to the creek, kick nets (simple fish tank/aquarium nets will do), plastic collection jars (one for each group), laminated macroinvertebrates chart, You Tube video: How to Sample Stream Invertebrates with a Kick Net

*Prepare the bags of supplies beforehand with a laminated macroinvertebrates chart, a collection container, and a kick net.

Tomorrow, students will take another look at the creek. This time, students will conduct sample collection as they explore the organisms within the creek. Before venturing off to the creek, be sure to explain the rules of the creek to the students. During this time, tell students that when we are in the creek, we are in the space in which these organisms live. This is called their habitat. It is their home. We need to be respectful of their home as we would want someone to be respectful of our home. Have students write down the definition of habitat in their science notebook.

Discuss the rules of the creek with the students. Ask them to talk with their groups about why they think it is so important to follow these rules. Share as a class.

Rules of the Creek

1. You may not go beyond knee level in the water. The level of the water can quickly change, and we want to make sure everyone is safe.
2. When you find an organism, be gentle and do not hold them too tight.
3. Always use wet hands to touch a critter from the water. They need the water to survive!
4. Once you put hand sanitizer on, do not touch the critters. They can absorb the sanitized and it can kill them.
5. Do not keep your organism out of water for too long. Be sure to pick it up, look, and if you need more time- transfer it to one of our holding containers with water. Many of these organisms need water to breathe.
6. If you turn rocks over, please be sure to put them back the same way you found them. These are the homes of these organisms and we do not want to make it hard for them to live there again.
7. Do not kidnap the critters! We will always put the organisms back where we found them so that they can live a long life. This is their home, and we are not going to take them from their homes.

Show students the supply bags that they will take to the creek with them tomorrow. Show the You Tube video, How to Sample Stream Invertebrates with a Kick Net. Students will gain an understanding of exactly what needs to be done when they get down to the stream tomorrow.

Give students an example of a macroinvertebrates they could find in the creek and show them how to determine the type of organism using the macroinvertebrates chart. Use the slide provided for today's lesson.

Day 4: What's in the water?

Materials needed: Student supply bags for the creek (created for the last lesson), Science Journal, Macro-Invertebrates Chart, hand sanitizer

**You may also want to prepare some parent volunteers for this lesson since you will be collecting samples from the creek today.

Break students into small groups (3-4 students each). Tell students that they will work with their partners today to collect data about the stream. Specifically, we will be looking at the organisms within the stream. These are called macroinvertebrates or benthic macroinvertebrates. Tell students that the word "benthic" means bottom-dwelling, "macro" means large enough for the eye to see, and "invertebrates" are animals without a backbone. While these organisms are large enough for us to see, they are still quite small.

As you prepare to bring students to the creek, give each group a bag of supplies. Each bag should contain a laminated macroinvertebrates chart, a collection container, and a kick net. Bring students to the creek. When you arrive, have student groups spread out so that they are safely working in their own space.

You will model the collection before students are able to access the water to do so. Remind students of the video they watched yesterday. Remove the supplies from your bag and tell students what each one is/what is does. Follow the directions below to model how students will collect a sample.

1. Standing facing downstream, hold the net upright with the bag resting on the bottom and open upstream.
2. Shuffle your feet vigorously along the bottom while moving sideways across the stream, keeping the net in front of you to catch the dislodged organisms. (If your students are not allowed in the water, have them use a stick to do this.)
3. In soft substrates, repeatedly run the net along the bottom, washing excess mud and organic material from the net.
4. Transfer collected organisms to the collection jar. Have students compare their organisms to the laminated macroinvertebrates chart and record their findings.
5. Release the organisms and repeat, at least 3 times, or as time allows.

Allow student groups to begin sample collection. While students are collecting, encourage them to think about what they notice in the area around where they are collecting. Is the water really clear or cloudy (turbidity)? Is there a lot of plant life or none at all? Are they finding a lot of organisms or very few?

Once students have 3 collection samples recorded, bring students back to the classroom. Collect sampling materials and tell students that tomorrow we will talk about their findings.

Day 5: **What is a community?**

Materials needed: Science Journal, "Ecosystems" book from GetEpic.com

Remind students that yesterday they did really important work as a Scientist. Exploring the creek and taking samples of the organisms allows us to tell a lot about the health of the stream. In the next few lessons, we will look at how healthy our creek is and what we can do to keep it healthy OR make it healthy again. In order to do this, we need to collect lots of data. We will begin with the data we collected yesterday.

Share student findings as a class and record on an anchor chart for students to refer back to. Tell students that all of these organisms, including the plant life they saw at the stream, make up an ecosystem's community. *A community is all the living things that make up an ecosystem.* Have students write this term in their Science notebook.

Take time to discuss the things students noticed about the environment where they took samples. Ask students, **"How might the environment affect the organisms living there?"** *Explain that the vegetation (plants), the water quality, and PEOPLE really make the difference in whether an aquatic ecosystem is healthy or not. These things can prevent animals from being able to survive in their ecosystem OR help them flourish.*

Introduce students to the following terms and have them record the definitions in their notebook:
Producer: makes food
Consumer: uses the food that the producers make or eat other organisms
Decomposer: breaks down wastes and the remains of other organisms

Have students read, "Ecosystems" pgs. 14-19 on GetEpic.com and work to complete the t-chart for today's lesson. They should record examples of producers, consumers, and decomposers using their textbook or the internet. When students are done, share out as a class and allow students to add to their lists with ideas from their peers.

Ask student, **"How could losing a producer, consumer, or decomposer affect an ecosystem?".** Have students discuss this in their groups and write in their journal.

Day 6: **Testing the water**

Materials needed: water testing kits (these are often accessible to borrow from your local water organization or you can purchase a few online), thermometer (if this doesn't come in your testing kit)

**You may also want to prepare some parent volunteers for this lesson since you will be collecting samples from the creek today.

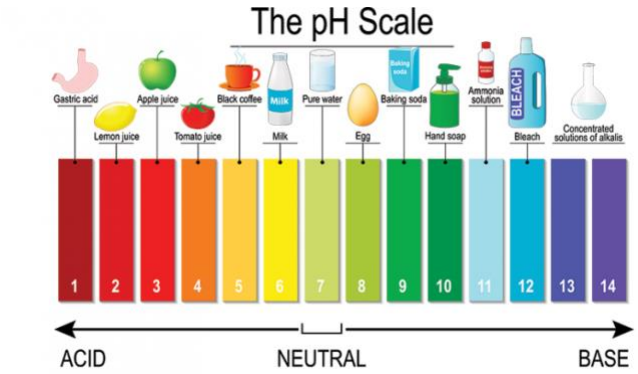
Today, students will test the water at the creek to determine whether the water quality is good or poor. Students will use the testing kits to take samples from the are and make inferences about whether the stream is healthy or unhealthy.

To begin, have students write in their journal to answer the following prompt, *"Today, we will test the water in the creek. We are going to collect data to determine whether the creek is healthy or unhealthy. What do you think we will find? Do you think the stream is healthy and the water quality is good OR do you think the water quality is bad and it is unhealthy? Use evidence from your last sampling and other ideas you have learned about ecosystems to help you respond."* Share out a few responses and take notes on the board.

Give each student group a testing kit bag. Bring students down to the creek and walk them through how they will sample the water. Complete each step as a class.

1. Test the temperature:
    a. Have students take the temperature of the stream. Show them how to do this by putting the thermometer in the water and reading the temperature BEFORE taking the thermometer out of the stream. A partner may need to help.
2. Test the dissolved oxygen.
    a. Tell students that dissolved oxygen is very important for macroinvertebrates and organisms living in the water. Dissolved oxygen (DO) is a measure of how much oxygen has dissolved in the water and is available to the aquatic life. Low DO can be caused by outside pollutants getting into the water. Water receives this oxygen from the air and aquatic plant life. In Charlotte-Mecklenburg, a healthy DO level is above 5 ppm.
    b. Ask students, *"Why might the dissolved oxygen level in a stream be low? What might it be high?"*
    c. Allow students to test the water for dissolved oxygen and record their data.
3. Test the pH levels.
    a. Tell students that pH is a measure of how acidic or basic a substance is. It is often used to measure water quality. Pure water SHOULD have a pH of 7, which is completely neutral (having equal parts of a hydrogen and hydroxide ions). The pH scale runs from 0-14. The more acidic something is, the lower the number. The more basic a solution gets, the higher the pH. It helps doctors to diagnose medical conditions and farmers to measure the pH in soil so that their plants will grow best. (Science News for Students n.d.)
    b. Most organisms prefer a pH of 6.5-9.0. Some can live outside of this range, but many cannot.

c. pH can be altered by many environmental factors, but also by man-made factors. Pollution can alter pH. When it rains, all of the chemicals or foreign substances on the ground can run off into these streams, lakes, and even the sewer systems in which your drinking water comes from! (Fondriest Environment Learning System n.d.)
d. Allow students to test the pH levels and record their data. (Science News for Students n.d.)



4. Test the turbidity.
    a. Tell students that turbidity is basically how cloudy or clear the water is. This can tell us a lot about what kind of outside chemicals are within the water.
    b. Allow students to test turbidity and record their data.

Have students pack up the testing materials. You can keep the water in these containers for further review in the classroom and dump it out once students have completed their data sheets.

Day 7: **Using data to determine stream health**

Materials needed: Science journal

As you begin class, have students think back to their water testing from yesterday. Ask students to talk with their group about the data they collected and make some inferences about the water quality based on this data. Students should record this in their Science Journal.

Share out student ideas about the water quality. Tell students that environments with good water quality should have:

- higher dissolved oxygen levels
- a pH that is neither too acidic or basic- relatively close to the neutral zone (7)
- temperatures should not exceed 89 degrees Fahrenheit
    - Warmer temperatures can lower the dissolved oxygen levels, preventing organisms from being able to survive. However, warmer temperatures can also allow for ripe vegetation around the stream to flourish. Good vegetation around the stream will naturally make the water cooler. Colder temperatures hold more oxygen which is more beneficial for most organisms.

As a group, assess the water quality based on these 3 factors. Make inferences about the health of the stream given your data.

Ask students to think about things that may make our waterways healthy vs. unhealthy. Complete the activity in their Science Journal.

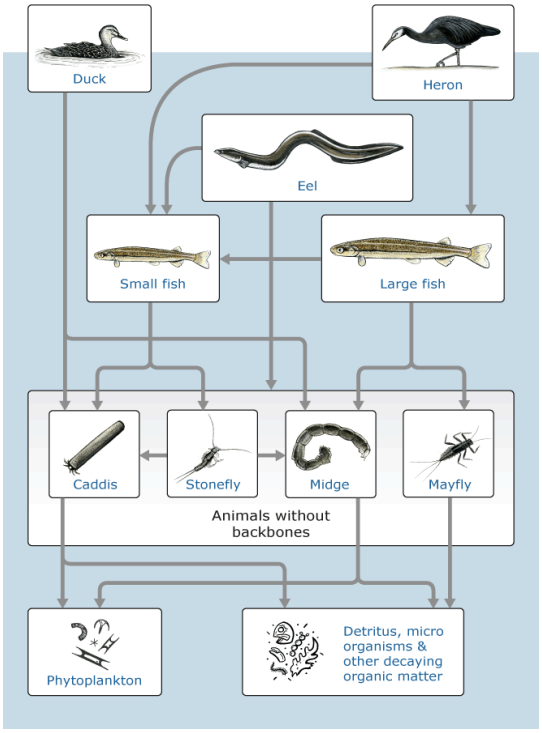
Day 8: **How do organisms in an ecosystem rely on each other?**

Materials needed: Science journal, Ecosystems video from GetEpic.com

Tell students that animals in an ecosystem rely on each other. Watch this video from GetEpic.com on Ecosystems.

Show students the following picture of an aquatic food chain. (TEARA n.d.) Explain that a food chain is the set of steps in which organisms get their food to survive. Show how the animals in this food chain rely on each other to survive.

Ask students, *"What do you think would happen if one of these animals could not survive?"* Students should respond by talking about how the animals rely on each other and if one disappears, it will make finding food for the others even harder. Even if there is another organism and animal could feed off of, it makes less to go around.



Have students create an example of their own food chain. It could be from the stream, an ocean, a pond, or even a terrestrial ecosystem. Hang these up around the classroom.

Ask students to reflect, *"Why do you think good water quality would be important to all ecosystems?"*

Day 9: **What causes ecosystems to change?**

Materials needed: Science journal

Read, "How Ecosystems Work" pages 16-21 from GetEpic.org with students. Discuss reasons that an ecosystem could change and the part that humans take in this change. Some changes are naturally occurring and can be positive for organisms. Some can be negative. Humans have contributed to many negative changes in ecosystems with construction, chemical leaks, and pollution.

Show students the Charlotte Waterways video. This will show the importance of keeping our ecosystems, especially waterways, healthy.

Have students work in groups to complete the graphic organizer in their notebook. Students will research ways in which ecosystems change naturally and how they change by man-made creations.

Allow students to present their work to the class.

As a group, brainstorm ways in which we can keep our ecosystems safe from negative influences. What can we do, as human, to make sure that we are no having a negative impact on ecosystems?

Day 10: **Culminating Assessment**

Materials needed: Science journal, pre-made booklets

Today students will use all of their knowledge from this unit, to create a culminating project. Students will research an ecosystem of their choice and create their own informative booklet about the ecosystem and how to keep it healthy.

Student booklets should include:

- A title page with the name of the ecosystem they chose and their own name
- A page describing the ecosystem and the animals that thrive in that ecosystem
- A page explaining one food chain that exists in that ecosystem and how the animals rely on each other
- A page explaining how the ecosystem can change, what makes it change, and how it affects the animals that live there
- A page telling others what they can do to keep ecosystems clean and safe for the animals who live there
- at least 5 of the vocabulary words they learned from this unit

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Appendix 1

4.L.1.1 Give examples of changes in an organism's environment that are beneficial to it and some that are harmful.

4.L.1.2 Explain how animals meet their needs by using behaviors in response to information received from the environment.

4.L.1.3 Explain how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens, planting trees and shrubs to prevent flooding and erosion)

Appendix 2

Student Name: _____

Science Journal

Use this journal to record all of your findings throughout this unit.

Day 1: What are ecosystems?

Define the following term.

Ecosystem:

Match the ecosystems to the correct description in the column to the right by drawing a line from one box to the other. You can use your textbook or online resources, if needed.

Tundra		This area gets plenty of light. It is rich in nutrients and home to many populations.
Taiga		Many organisms live where the water level changes from high tide to low tide.
Grasslands		It has very cold winters and hot summers. More rain or snow falls here than in the Taiga. Rich soil.
Mild Forest Lands		It has very hot days all year long. It gets very little rain and the plants and animals have adapted to conserve water.
Deserts		Many habitats are at the shore, on the surface water, and under the water.
Tropical Rain Forest		Many winters and summers, plenty of rain or snow, and the trees lose their leaves in winter.
Oceans		Hot and rainy all year long. Poor soil. Variety of plants and animals.
Freshwater Lakes and Ponds		Very cold winters and cool summers. More rain or snow falls than in the tundra.
Saltwater Shores		Long, dark, and very cold winters. Few trees. Ground is frozen beneath the surface.

Day 2: The difference between aquatic and terrestrial ecosystems.

Define the following terms.

Aquatic Ecosystem:

Terrestrial Ecosystem:

Answer the questions below.

On your walk to the creek, what are some physical features you noticed around you? What physical features did you notice in and around the creek itself?

Day 3: Preparing for the creek

Define the following terms.
Habitat:

Answer the questions below.
What do you think the most important rule to follow while at the creek? Why is this important?

Use your macroinvertebrates chart to determine the type of organism pictured below.

www.pestworld.org

This is a _____. I know this because…

Day 4: What's in the Water?

Today you will explore the creek. Use your macroinvertebrates chart to determine the types of organisms you collect. Record your findings below.

	In this space, record the type of organisms you find during each collection.
Collection 1	

Collection 2	
Collection 3	

When collecting, take notes on the condition of the creek. Answer the questions below.

Is the water… cloudy or clear?

Is there… a lot of plant life around the creek or is the area pretty clear?

Did you find… a lot of organisms or none at all?

Day 5: What is a community?

Define the following terms below.
Community:

Producer:

Consumer:

Decomposer:

Answer the questions below.
How might the environment affect the organisms living there?

Read "Ecosystems" on www.epic.org. Complete the chart below by writing at least two examples of a producer, consumer, and decomposer.

Producer	Consumer	Decomposer

How could losing a producer, consumer, or decomposer affect an ecosystem?

Day 6: Testing the Water

Today, we will test the water in the creek. We are going to collect data to determine whether the creek is healthy or unhealthy.

What do you think we will find?

Do you think the stream is healthy and the water quality is good OR do you think the water quality is bad and it is unhealthy? (Answer this question based on what you know about the creek so far.)

Complete the chart below as you test the water.

Temperature	Dissolved Oxygen	pH	Turbidity

If the temperature of an aquatic ecosystem is too high, what could happen to the plants and animals that live there?

Why might the dissolved oxygen level in a stream be low? Why might it be high?

What is an ideal pH for water?

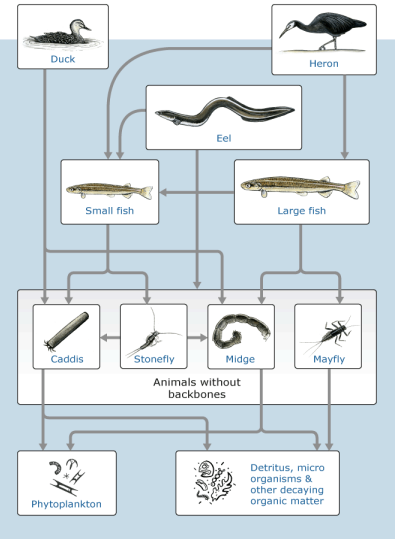
Day 7: Using data to determine stream health

Think about the things that make our waterways healthy vs. unhealthy. What conditions are ideal for a healthy waterway? Use evidence from our unit to support your response.

Day 8: How do organisms in an ecosystem rely on each other?

Define the following terms.
Food Chain:

Take a look at the food chain below.



What do you think would happen if one of these animals could not survive?

Create a food chain of your own.

Explain why these organisms rely on each other in their ecosystem.

Why do you think good water quality would be important to all ecosystems?

Day 9: What causes ecosystems to change?

In the table below, record some ways in which ecosystems can change both naturally and by humans.

Changed by nature	Changed by humans

What can we do, as humans, to prevent our actions from negatively affecting ecosystems?

Day 10: Performance Task

Today you will complete a culminating task for this entire unit. To complete the task, you may use your Science Journal, the resources we have used throughout this unit, and any notes you have taken.

Choose an ecosystem of your choice. You will create an informative booklet about your ecosystem and how to keep it healthy.

Your booklet should include:

- A title page with the name of the ecosystem you chose and your name

- A page describing the ecosystem and the animals that thrive in that ecosystem
- A page explaining one food chain that exists in that ecosystem and how the animals rely on each other
- A page explaining how the ecosystem can change, what makes it change, and how it affects the animals that live there
- A page telling others what humans can do to keep ecosystems clean and safe for the animals who live there
- at least 5 of the vocabulary words you have learned from this unit should be included within your writing

Appendix 3

Key to Stream Macroinvertebrates

Izaak Walton League
Save Our Streams

- **Shells**
  - **Single**
    - Gilled snail — Spiral, open on right
    - Lunged snail — Spiral, open on left
    - Orb Snail — Coiled
  - **Double**
    - Clam — Small, whitish tan or brown
    - Mussel — Large, dark-colored
- **No Shells**
  - **Legs**
    - **No Legs**
      - Leech — Suckers, expands and contracts, soft, slimy body
      - Midge Fly — Distinct head, whitest to clear or red < ½"
      - Aquatic Worm — Small, hair like or looks like earth worm
      - Black Fly — Black head, shaped like bowling pin, <1/4 "
      - Crane Fly — Plump, worm-like, often can see guts
    - **10+ legs**
      - Crayfish — Lobster-like
      - Sowbug — Two long antenna flatter top to bottom
      - Scud — Shrimp-like, swims on side
      - Water Snipe Fly — Many caterpillar like legs, two fringed tails
    - **3 pairs of legs**
      - **3 tails**
        - Mayfly — 3 long tails gills on abdomen
        - Damselfly — 3 oar-like "tails" no gills on abdomen
      - **One or two tails**
        - **No Obvious Tails**
          - Riffle Beetle
            - Larva - Brown, crunchy body, 6 legs, "C" shaped, no gills on belly
            - Adult - Small, dark crawls on bottom
          - Water Penny — Flat, oval disk
          - Caddisfly — Green, tan , orange or white, may have gills on body; May be encased in a house of sticks, stone or leaves
          - Net Spinning Caddisfly — Dark head, tan , gills tufts on belly, 3 armored plates behind head
          - Dragonfly — Large eyes, stocky body, no tail
          - Dobsonfly — Large mouth, "spines" on side
          - Fishfly — 8 pairs of spines, no gill tufts between spines
        - Alderfly — 7 pairs of, "spines" on side, long thin tail
        - Stonefly — 2 tails, gill tufts under arms
        - Mayfly — Two tails, gills on abdomen