

Water, water everywhere... Nor any drop to drink.

Samuel Taylor Coleridge, *The Rime of the Ancient Mariner*

Julie McCann

Introduction

Water does not resist. Water flows. When you plunge your hands into it, all you feel is caress. Water is not a solid wall, it will not stop you. But water always goes where it wants to go, and nothing in the end can stand against it. Water is patient. Dripping water wears away stone. Remember that, my child. Remember you are half water. If you can't go through any obstacle, go around it. Water does.

- Margaret Atwood, The Penelopiad

I love my job. Teaching is awesome. I am fortunate to be a third grade teacher and will hopefully get another new class of students who are hard-working and truly love to learn. My children come from many, many diverse backgrounds, but we are able to learn so much from one another. One of the most important units I teach for the future is about water. This unit is to help foster the importance of water conservation.

West Park Place Elementary School is a small suburban school in the Christina School District. We have about 400 students from kindergarten through fifth grade. We are located in close proximity to the University of Delaware in Newark, Delaware. West Park is a diverse school, hosting the English as a Second Language (ESL) program, Delaware Autistic Program, and REACH –Realistic Educational Alternatives for Children with Disabilities. According to the annual report generated by the Christina School District, about a third of our students are English as a Second Language Learners (ESL): representing about 25 different countries. About 45 percent of our population are free/reduced lunch students. Our demographics are 20% African American, 26% Asian, 46% Caucasian and 4% Hispanic. I am a third grade, self-contained teacher and therefore teach all subjects: math, reading, writing, science and social studies. A typical school year provides me with 22 students, a third of which are usually active or recently dismissed ESL. This year I anticipate having a large class size due to the reduction in force that Christina implemented last year. We will be going from three third grade classes to two.

A strength of our students is attendance and a desire to learn. Additionally, West Park is a mile from the University of Delaware, so we have many resources available. At times, we have many college students doing placements, tutoring and student teaching. Based on the data from the Christina School District annual report, the teachers at West Park are predominately Highly Effective and Highly Qualified and have many years of experience with most of the educators having obtained at least a Masters degree. As a staff, we work in Professional Learning Communities to analyze data and provide appropriate instruction for our students.

The areas of struggle for West Park are no different than any other typical school. The most obvious concern is lack of funding. Additionally, a third of our students and their families are ESL: with many parents not able to speak English at all. As a result, we have

low parental involvement. Finally, families are reeling from the current economic situation. Many of our families are of low socio-economic status.

Rationale

My search to understand why students do not see connections between different content studies, why they compartmentalize what they learn, has spurred the creation of this unit. The older I get, the more connections I see from subject to subject. I do not want my students to wait to see all the connections in their learning.

From my own personal observations, I have noted that many of our West Park students are promoted to third grade but have great difficulty taking information that is taught to them in one class, say math class, and transferring it to a science lesson. Or taking elements of writing and identifying them in reading. I feel that if we help students see that all the information they learn in school is connected and useful, they will learn more and be able to apply their knowledge more effectively.

Through teaching this unit I am developing, in conjunction with the FOSS Water unit that the Christina District requires me to teach, I feel that the students will have a greater appreciation for water and its many contributions to our lives. In gaining respect for water, the students will be more likely to conserve and protect this greatest natural resource as they grow up.

Common Core State Standards (CCSS) make this unit important. It is equally important to make students “college and career ready”. The new state test (Smarter Balance) will require skills that may be difficult for young elementary students. The students will have to read multiple non-fiction pieces and synthesize the information from multiple sources to answer questions and write essays. Exposing students to non-fiction material and requiring them to utilize higher order thinking skills will benefit them through their schooling and their life, as well as, make them more successful on the state test.

This unit will be appropriate for any elementary grade but is designed to fit the Christina School District third grade curriculum. The students will participate in three main components of the unit. First, we will learn about biodiversity and how important healthy ecosystems are to the survival of plants and animals, but also how tightly linked the human populations' well-being is tied to ecosystems. A healthy ecosystem provides us with all our basic needs: food, water, air and soil. Additionally, a healthy ecosystem prevents the spread of disease through biological control. We gain medicines and resources needed to prevent or cure disease. Finally, ecosystems contribute to our mental health by providing recreational and creative outlets.¹ Wetlands, which are defined as the habitats that occupy the transitional zones between the terrestrial (dry) areas and fully aquatic (wet) environments are the world's most productive ecosystems. In Habitat Creation and Repair, Gilbert states that thirty percent of all plant species live in the wetlands. More than half of North America's bird species nest or feed in the wetlands. Two-thirds of fish species depend on wetland areas, and the wetlands perform many important mechanical and chemical functions, such as water filtration, erosion control and recycling critical nutrients.²

Secondly, we will discuss and learn about pollution in the world. We will discuss the impact humans have had on the environment. I will introduce the vocabulary of bio

indicators and bio markers. The children will learn about indicator species. We will explore the negative impact humans have had on the ecosystems, especially since the Industrial Revolution. We will discuss the effects of the human population explosion, urban development, agricultural effects and the use of fertilizers and other toxic substances. The students will learn about acidification, eutrophication and all the important concepts and vocabulary at a level where they are able to understand.

The last component of the unit will be about habitat creation and repair. We will discuss animal adaptations. The children will learn about how plants and animals adapt and change to survive in their altering environments. We will conduct research on various animals and their adaptations.

The unit fits perfectly into my curriculum in all subject areas. It addresses almost all the reading and writing standards, and the speaking and listening standards. We will also be tying into history through the Industrial Revolution, economics through the study of resources, biology, ecology and many other subject areas. Within this unit, I will cover many of the Common Core Standards that are essential for student success, but I will focus on three main standards. I will select one standard from Reading, Writing and Listening/Speaking.

- *Reading Literature 3.3:* Describe the relationship between a series of historical events, scientific ideas, or concepts, or steps in a technical procedure in a text using language that pertains to time, sequence and cause/effect.
- *Writing 3.7:* Conduct short research projects that build knowledge about a topic.
- *Speaking and Listening 3.1:* Engage effectively in a range of collaborative discussions (one-on-one, in groups and teacher led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

Background Information/Content

Ecology

Wikipedia defines “ecology” as the branch of biology that studies the relations of organisms to one another and their surroundings. Studies have shown the dramatic changes that are taking place in environments around the globe, affecting both terrestrial and aquatic ecosystems. Humans have viewed nature as an inexhaustible source of resources. Now we see the growing scarcity of critical resources, such as fresh water, and we are becoming more cognizant of the means by which we utilize our natural resources.

In the book Biodiversity by Mounolou, one team of ecologists, economists and geographers has conducted economic evaluations of the natural resources provided each year to humans. They identified seventeen categories of services provided by the land or water. The oceans contribute 63% of the overall resources. Scientists have been trying to gain attention to garner support for their causes. The number of academic papers on issues within ecosystems has grown steadily over the last 40 years. The explosion of scientific papers over the last ten years about ecological restoration has led to new public policies and awareness by all. Recently, attention is being paid to the problems of our ecosystems because economists are being called upon to mediate between scientists and decision makers and stake holders.³

Wetlands

Wetlands are land areas that are saturated with water, either permanently or seasonally so that they take on their own characteristics as distinct ecosystems. Wetlands are those areas with habitats that occupy the transitional zones between true terrestrial (dry) areas and fully aquatic (wet) environments: swamps, marshes, reed-beds, bogs and mires. These areas can be connected within landscapes, forming one continuous water body often referred to as a watershed.⁴

Today, less than 50% of the original wetlands remain in the United States. Some states are worse than others. For example, 90% of wetlands have been lost in both Ohio and California. The rate of loss is greatest in Florida, with 9,400 hectares disappearing annually.⁵

Dunes are another important part of ecosystems. They prevent coastal erosion and are critical to the survival of many "barrier islands." They often serve as a physical barrier between the ocean and a salt marsh. The salt marsh occupies the upper limits of the tidal zone and has vegetation that has a fairly high tolerance for changes in salinity. The intertidal sand and the mudflats are there, too. Rivers and floodplains support a variety of plants and animals. Many species rely on specific hydrological and sedimentological conditions, for others it is the connectivity between the floodplain and the river that is crucial to their survival.⁶

Wetlands are among the world's most productive ecosystems. In Restoration Ecology Greipsson states worldwide resources derived from the wetlands ecosystem are valued at \$4.9 trillion. Wetlands play an important role in groundwater hydrology and recharge of aquifers.⁷ Thirty percent of all plant species live in the wetlands. More than half of North American bird species nest in wetlands. Two thirds of fish species depend on the wetlands. Wetlands act as giant sponges, helping with flood mitigation, erosion control, and helping to stabilize the local climate. They also improve water quality by acting as a filter.⁹

Human Need/Impact

Ecosystems provide humans with some basic needs: food, water, air and soil. The ecosystems also help prevent the spread of disease through biological controls. We obtain many of our medicines and genetic resources to prevent or cure diseases through organisms found in undisturbed ecosystems, such as tropical rain forests. Finally, nature contributes to our mental health through providing recreational and creative outlets for humans.

Humans have drastically impacted the environment throughout the centuries. Fire has transformed the grasslands. Grazing and farming and the use of fertilizers have caused pollution. Excessive hunting has caused some animals to become extinct or endangered. Humans are one of the few species that have built settlements in all biomes on Earth.¹⁰ We have introduced invasive species. Deforestation has had a major impact on river systems, allowing sediments to build up and introducing excessive nutrients. Humans have transformed about 40% of terrestrial lands, typically changing a complex native ecosystem into a monoculture.¹¹ We utilize about 55 % of the potable water, making water become more scarce, especially in dry over-populated areas such as the

southwestern United States. About 500 million people in China use contaminated drinking water. In *Principals of Economics*, N. Gregory Mankiw predicts that in 2050 the world's population will be at 9.4 billion. It will peak in 2150, to 11 billion, and level off thereafter. This will be an additional stress on the availability of fresh water.

Water Quality

Water is the most precious resource needed for sustainable human and ecosystem health, for society and for the economy.¹² Water has four main contaminants: metals and metalloids, metallic compounds, fertilizers, and greenhouse gases.¹³ A great deal of research has been conducted on water quality, while many other studies investigate biodiversity in water. Unfortunately, little research has been conducted to connect the two. Nothing has been done to document the impact of changes in water quality in aquatic biodiversity.¹⁴

The major detrimental pressures on freshwater ecosystems are habitat loss and degradation, species invasion, over harvesting, and pollution. Humans are reducing the complexity of the world's freshwater ecosystems by draining wetlands and introducing physical flood control structures. We are experiencing a loss of variety. We have accidentally or intentionally introduced excessive nutrients, creating eutrophic conditions, and dumped chemicals and other contaminants to create highly polluted waters. We have introduced aggressive species that do not belong there. The amount of biodiversity we see today may have taken a few billion years to evolve, but it may be largely destroyed in only a few human generations.

Pollution

Pollution can be referred as the undesirable alteration in the physical, chemical and biological characteristics of an environment.¹⁵ The development of human society, especially the human population explosion and intense industrial urban developments in the last four decades, has caused surface waters to become heavily enriched by agricultural fertilizers.¹⁶ Freshwater continues to be the most vulnerable of habitats. Aquatic ecosystems play a vital role. Water is the main constituent for forming terrestrial life and acts as a medium for different ecosystems. Water directly provides the life support system for aquatic life forms, and has a huge influence on all life forms, in general. Contamination of water will result in an ecological imbalance through the loss of species that are critical to the maintenance of a healthy ecosystem.¹⁷

Eutrophication is when the aquatic environment becomes enriched with nutrients. These nutrients may cause algal blooms, which in turn can cause a depletion in dissolved oxygen in the water. Eutrophication is caused primarily from fertilizer usage and runoff from farms, causing an increase in the nutrient levels.

Acidification is the ongoing decrease in the pH due to the uptake of carbon dioxide from the atmosphere. Approximately 30-40% of the carbon dioxide from human activity dissolves into the rivers, oceans and lakes. It is second to eutrophication among the widespread changes in lakes, reservoirs and streams. About 50% of all photosynthesis, which removes carbon dioxide, is carried out by photosynthetic aquatic organisms.¹⁸ The burning of coal results in atmospheric pollution which ends as acid rain, which along with direct absorption of carbon dioxide, can adversely affect aquatic ecosystem.

Several studies show that running waters contain large numbers of seeds which demonstrates that they are major dispersal agents in wetlands. Water, unlike wind, is unidirectional in its dispersal. It only sends downstream. Humans and animals are a poor dispersers of seeds.¹⁹ Rivers have been impacted worldwide by humans. Industry and agriculture have polluted the waters through deforestation, overgrazing and sedimentation. Sedimentation is when excess sediments gather as a result of erosion. Sedimentation is one of the greatest degrading factors of rivers. It impedes fish spawning. Dams are a problem as well, impeding the movement of fish and creating artificial accumulations of sediment.

Biodiversity

Biodiversity became an environmental issue in the early 1980's, culminating at the Conference on Sustainable Resources, held in Rio in 1992.²⁰ The relevance of biological diversity as an economic resource was under-appreciated for a long time. We utilize biodiversity in agriculture, pharmacology and recreational activities.²¹ The World Health Organization (WHO) estimates that 85% of the people on the planet depend on plants for their primary health care. Over 50% of Western pharmaceuticals are derived from biodiversity.²² Biodiversity no longer explores only the extinction of isolated species but rather the modification of the entire ecosystem.²³

POP

POPs are persistent organic pollutants. They are organic compounds that do not degrade through chemical or photolytic processes. POPs are highly persistent having a long half-life in the environment and the biota. They may have a half-life of years or decades in soils and sediment and several days in the atmosphere.²⁴ POPs dissolve in liquids and accumulate in the fatty tissues of animals. Hence the chemicals persist in the biota and bio magnify in the food chain.²⁵ Experts typically monitor nine variables: dissolved O₂, pH, BOD biochemical oxygen demand, nitrates, phosphates, temperature, turbidity, total solids, and fecal coliforms.²⁶

Bio indicators

Bio indicators are a means by which the health of an aquatic environment may be monitored. Bio indicators provide an early warning to contamination. They can identify the cause and effect between environmental stresses and biological responses to those stresses.²⁷ Bio indicators also provide insight as to the presence, absence or abundance of certain species indicating information about the environmental quality: they determine whether or not, in a specific environment, organisms are physiologically normal.

For aquatic environments, there are different types of indicators: early warning indicators, compliance indicators, diagnostic indicators, and bio geochemical and socio-economic indicators. The early warning indicators signify impending changes before unacceptable changes in the environment occur. Compliance indicators assess the degree to which the previous environmental issues are maintained or deviate from acceptable limits. Diagnostic indicators determine if conditions are outside the acceptable limits. Finally, bio geochemical and socio-economic indicators are mutually affected by environmental degradation and restoration as well.²⁸ Aquatic plants such as macro algae, mosses and seaweeds can indicate water pollution.

A bio marker is a measurable trait of an organism that responds to a toxin. It shows a disturbance of a normal function of an organism.

Scientists look for certain properties in indicator species: the organism must be sedentary or have limited dispersal; it should be easy to sample. Accumulations of pollutants should occur without killing the organisms. Also, the organism should have a long life, and a narrow tolerance to environmental variables. Sometimes an indicator species is also a keystone species. A keystone species could be identified as a species whose loss would cause a significant change in the general structure and processes of the ecosystem.²⁹

Extinction/Endangered Species

We are losing biological diversity at an unprecedented rate. The disappearance of species is from human activities more than any other factor. Biological resources are renewable but are being exploited at rates that exceed their sustainable yield.³⁰ There are an estimated 20-80 million species on Earth now. Extant species equal 1.5 million species. One scientist, Wilson, estimates that the extinction rate of species is 3 per hour.³¹ Without a doubt the best way to save biodiversity is to value it. Whether we look at it as a resource for direct use or on a sustainable basis, or for its individual function, such as maintaining fresh water supplies or providing a sink for greenhouse gases.

Adaptations

Adaptations are genetic traits that enable a species to deal with conditions that exist in their environment. They are essential to the survival of the organism.³² There are three main types of adaptations: morphological, physiological or behavioral.

Morphological adaptations are physical changes that happen over generations. These are the type of changes that Darwin observed when, for example, the finch's beak changed in order to be able to eat a seed on the Galapagos Islands. Physiologic adaptations are an organism's ability to perform a specific function in order to cope in an environment. Some examples of these are making venom, maintain a body temperature, making slime or changing color. Behavioral adaptations refer to the things animals do to survive. Some of these items are migration, or bird calls.

Habitat Creation

Habitat creation involves creating a dynamic community of interacting plants and animals that should increase in its diversity over time. The goal of ecosystem restoration is to emulate a natural and self-regulating system that is integrated within ecological landscapes.³³ Habitat restoration still has an enormous role to play in areas where the natural environment has already been extensively damaged through deforestation, agriculture, land drainage, mineral extraction, or civil engineering projects.³⁴ Four approaches exist to habitat creation. The first is to do nothing, take no action. The second option is for the replacement of the degraded ecosystem. A third option is for rehabilitation. Finally, the fourth is restoration.³⁵ Most wetland creation is largely in response to environmental damage or habitat loss. The projects tend to be aesthetically

pleasing rather than replacing the habitats that continue to be lost. To explain better, the wetlands are lost at a late stage in their ecological succession and are very biologically diverse. The replacements are at an early stage and are relatively simple in their make-up. A crucial point to be made about habitat creation is that it is never a substitute for the genuine article. It fails to deliver the goods on at least three fronts: naturalness, continuity and complexity.³⁶

Some habitat creation projects have failed because there has not been enough planning and thought before the project begins. Objectives are not set, and if set, are not met. Others are too ambitious, and the resources needed are not available. However, wetland habitat creations are ahead of the rest in their technique and long-term success.³⁷

To be successful in designing a new habitat, some key things must be considered. First objectives must be set. Why is this habitat being created? Site context must be considered: site scenery, topography, hydrology, climate, existing plants, soil, water, and other items studied. Finally, long-term monitoring must happen.³⁸ Habitat restoration and creation have a vital role to play in buffering sites with fragmented or isolated and diminishing habitats and extending nature conservation in the small protected areas to the adjacent, troubled lands and linking them together.³⁹

Riparian Buffers

A riparian buffer is a small strip of land with vegetation planted on it. It serves as a method to shade and protect a stream, or other body of water, from the land to which it is adjacent. It improves water quality of the stream, lakes, river or whatever body of water, acting as a sort of filter of fertilizers and other pollutants from the crops and farms or factories located next to the water shores.

Objectives

The objectives in my unit are cumulative. First, we will set a foundation. We will be learning important vocabulary and science concepts such as ecosystems, biodiversity, bio indicators, and such.

Secondly, the students will learn about the causes of pollution. We will explore some historical information and learn why clean ecosystems are so valuable. We will introduce adaptations and survival. Understanding the importance of biodiversity and the links created between organisms will be crucial to the success of the unit.

Finally, the students will conduct short research projects on animal adaptations, habitat creation or repair, or areas that suffer from water pollution. They will utilize all their vocabulary and information that they have learned over the course of the unit to create and share their reports with the class.

Enduring Understandings

Students will understand:

- The science vocabulary introduced and taught from the unit.
- The value of biodiversity in an ecosystem and how parts are related to one another.
- The causes of pollution in an ecosystem and the costs incurred from pollution.

- The rewards and challenges of habitat creation and repair.
- Adaptations help animals survive.

Essential Questions

What are adaptations?
What is biodiversity and why is it important?
What are the causes and costs of pollution?

Classroom Activities-Books

I am going to teach this unit through a variety of picture books, video clips and activities.

Here are some of the books I plan to utilize. I will use at least the following: *The Magic School Bus At the Waterworks* and *The Magic School Bus on the Ocean Floor* by Joanna Cole and Bruce Defen, *A River Ran Wild* by Lynne Cherry, *Follow the Water from Brook to Ocean* by Arthur Dorros, *The BP Oil Spill* by Peter Benoit, *Earth in Danger* by Kate Waters, *Fire and Floods* by Kate Waters, *Hydrology* by Christine Taylor-Butler, *Saving Our Earth* by Peggy Hock, *Water Cycle* by Monica Hughes, *You Wouldn't Want to Live Without Clean Water* by Roger Canavan, *A Warmer World* by Caroline Arnold, and *Just a Dream* by Chris Val Allsburg,

Hydrology by Christine Taylor-Butler is an excellent overall resource for my water unit. It tells students a ton of information about water: in the air, underground, on the ground- everywhere. It defines the study of water as hydrology. This text discusses runoff, irrigation, levee, dikes, aqueducts, dams, the hydrologic cycle and all of its parts, aquifers, properties of water and much more.

The Water Cycle by Monica Hughes is a simple book that restates all the properties of water that we discover throughout our FOSS water kit. It covers the water cycle allowing us to create our own models of the water cycle on paper plates showing each step of the cycle. We also create a water cycle bracelet from different colored bead showing: collection, evaporation, condensation and precipitation all caused by the energy of the sun.

The Magic School Bus on the Ocean Floor by Cole and Defen offers all types of facts: why the ocean is salty, why we have tides and waves, what continental shelf and sea life are including creatures such as plankton, sharks, whales and coral. It provides clear explanations about the ocean floor and vents. The children will learn about coral reefs and sea mammals. Finally, they will read about ocean currents. This general information will provide a strong foundation for the rest of the unit.

A River Ran Wild is a gorgeous book that starts off by showing beautiful nature scenes untouched by humans and then follows human activity along the river. It first shows the native people settling and building a village from the resources provided by the woods and surrounding areas. They live for generations, respecting the Earth and what she provides. Then the trappers and white settlers begin to move in. They clear some land for their farms and their crops. They build dams to harvest the power of the water. Gristmills and sawmills begin to appear. The start of the new century brings the industrial revolution. Machines are created, and wool, cotton and paper products are made. Waste is being dumped into rivers and things begin to change more rapidly. Now from the birds

eye view in the illustrations, we see farms, houses, factories. Still some nature but not the pristine place as it started. Paper mills begin to pollute and pulp is dumped into the system. Fish die and birds stop migrating. People begin to notice how things have changed and they try to help repair the damage. They sign petitions, protest and write letters. New laws are passed. Factories are no longer able to pollute; things change for the better. It ends up that although it is not the pristine place from the beginning of the book, they can find a way to co-exist. The beauty of the nature is there and thriving among the families and communities that have sprouted up over the decades.

Follow the Water from Brook to Ocean is a book by Arthur Dorros that lays out the path water takes from when it falls from the sky and lands in the street in front of one's house. The students follow the book along the path of water flowing from one part to the next as we are able to learn about each ecosystem. The book introduces the brook to the stream, to the river to a reservoir until we finally reach the ocean.

Cole's *The Magic School Bus at the Waterworks* is a book which describes all the steps that are taken to clean water for human consumption. It provides some background information about the importance of water and why we should conserve it. It briefly reviews the water cycle. The main portion of the book describes the steps taken by the local waterworks company to purify and clean the water. This process starts the students on the outside at the reservoir and shows how plants, fences, inspectors, and other protections start to clean the water. As the children and the water enter, they pass through alum, the mixing basin, to the settling basin. The story explains how gravel and sand filter the water more. It shows how fluoride and chlorine are added. Finally, it demonstrates how water is pumped out from the treatment center and transported throughout the city to our homes. The children should find this book interesting.

After learning about where the water travels and how it is filtered for us to use, I follow up with an additional resource, *You Wouldn't Want to Live Without Clean Water* by Roger Canavan. It is another resource that provides the students with information about the water cycle, where water comes from, how long one is able to survive without water, why clean water is important to humans, plants and animal, and finally the many topics involved with water conservation.

The BP Oil Spill by Peter Benoit is a detailed explanation of the accident that occurred on April 20, 2010 on the Deep Horizon oil rig. Providing pictures and explanations of the entire process of the disaster from the beginning to the clean-up and the costly repercussions that followed, the text details the human costs and the animal tragedies. Many of the various methods used to clean oil spills are discussed in this book. Benoit takes a clear position on the economics of big oil companies and the power they possess.

Kate Waters' *Earth in Danger* is a book that details all the natural resources we have available to us. It goes on to explain how scientists are becoming concerned about specific changes that are happening. It expounds on the issues of climate change, burning fossil fuels, and our ever increasing carbon footprint. This book offers some solutions to the students. It discusses alternative energy solutions, such as wind power. It lists some steps we are able to take to help the earth: recycling, reusing, reducing, conserving energy, planting trees. It is a book that offers hope. It provides information on things the students are able to do to make changes to improve our situation.

Fire and Floods is a book that demonstrates how fire and water may be helpful to us but may also cause damage. It outlines how fire provides heat and the ability to cook. However, it may also cause damage in forest fires. Water is crucial for survival, but it may also cause flash floods, hurricanes, and tsunamis. It also discusses ways in which we attempt to control water, such as levees and dams.

A Warmer World by Caroline Arnold is a book that explains how climate change is affecting wildlife across the globe. The book shows the effects on toads, polar bears, foxes, butterflies, walruses, krill and many other animals. It discusses the disappearing ice and coral reefs. It is a great book demonstrating what humans are doing to the world.

Our Earth Saving Water explains the difference between fresh and salt water. This book discusses a typical families' consumption of water per day, providing many example for the students about how they will be able to conserve water. It teaches the students how to be a water detective and try to save water.

Another book I will use is *Just a Dream* by Chris Van Allsburg at the beginning of my unit and revisit it again at the end. This story is about how actions create consequences. A boy wishes to live in the future where he thinks it will be filled with robots and adventure. Walter is a litterbug and does not appreciate nature. When his neighbor plants a tree that she got as a birthday gift, he thinks she has wasted her gift. Walter falls asleep and goes on a journey where he sees trash piling up, forests being cut down, urban sprawl, and pollution everywhere. When he wakes, he understands that the future is not bright. He begins to make changes and sees a brighter future as a result. I want this story to be the catalyst for the water unit and learning about our environment, and about making changes for our brighter future. It shows two scenarios requiring choices, which is the point of my unit.

Classroom Activities- Vocabulary Development

There is an immense amount of vocabulary that will need to be learned over the course of the unit. Some activities we will do to help learn words and their meanings are: Memory Concentration Game Cards, Bingo Game, crossword puzzles, grouping and organizing, word pictures, vocabulary flip books, "I have who has" game cards, Fly Swatter Relay Game, Frayer Model or other similar worksheet and SMART Board Vocabulary Games. These will all be teacher and student created. I have attached a few at the end of the unit.

Classroom Activities-Videos

Surrounding each of the books we will read and discuss, the children will also watch some videos that correlate with them. After a quick internet search, one may find a video documentary about the BP Oil spill. Two I located are [Deepwater Disaster BP Oil Spill](#) and the [National Geographic Gulf Coast Disaster](#). These documentaries show how difficult it was to clean up the oil spill and the tremendous costs incurred from the spill on animals, water quality, economics, and the people and rescuers trying to help. The images bring the incident to life and make it real. It is much different than just reading about it in a book, even when the books contain great pictures.

Other videos we will watch are [Ocean of Garbage or Plastic Paradise: The Great Pacific Garbage Patch](#) narrated by Angela Sun, or [Where is the Biggest Garbage Dump](#)

on Earth?, or the TED Talk, The Great Pacific Garbage Patch (large vocabulary in this video) which explains the currents and the use of plastics resulting in this massive collection of trash. It states that every piece of plastic that has ever been created is still existing on this planet somewhere. It takes the side that we need to control the amount of plastics utilized to be able to reduce further contributions to this problem. Be careful in selecting videos for one's audience! For example, I need to find videos that are not too scary/graphic with dead animals or sad for my younger students but with vocabulary that they will be able to understand. Some of the documentaries use foul language that would not be appropriate, either. I would definitely suggest watching and editing your clips before showing to students.

Finally, I will use one more video to offer solutions and give the students hope that there are ways to help. I will most likely show part or all of a video by Yann Arthus-Bertrand called Home. It is a 2009 documentary made up of aerial shots of fifty-four countries. It is available free online.

At my school, we have an extensive collection of videos in our library. Having the students as my guide, some I will consider showing are The Eyewitness Series Collections. We have videos about the following: *Ocean Habitats: Shoreline and Reef*, *Ocean Habitats: Light and Dark Zone*, *All About Forest Ecosystems*, *Pond and River*, *Ocean, Fish*, *All About Fish*, *See How They Grow Desert Animals*, *See How They Grow Forest Animals*, *All About Deserts and Grasslands*, *Desert Habitats*, *All About Plant Structures and Growth*, *Tropical Rain Forest Habitats*, *Forest Habitats*, *All About Plant and Animal Interdependence*, *All About Plant Adaptations*, and many more from which to select (based on student interest/need).

Classroom Activities- Trips and Lessons

The activities we are going to do also match up with the books and videos we will be learning from and discussing. We will be taking a district sponsored trip to Dayett Mill in Newark, Delaware. On this trip, the students participate in various center-driven activities. They will be going to the stream to look at water quality and the organisms that live in and around the stream. We will walk through a meadow to look for evidence of living organisms. We will stop at a marsh area to look at the environment for frogs and discuss this area. Inside, the children will tour the mill and learn about the water power generated by the water wheel and the mill race. Finally, they will participate in a filtering activity where they must determine the best way to filter water to make it potable. This will pair with the Magic School Bus at the Waterworks book very well.

We will be doing our FOSS Water kit which allows students to conduct investigations to explore the properties of water: surface tension, water on a slope-water flows down, building a thermometer, sinking and floating, expanding and contracting, observing ice, surface area and evaporation, and the power of water. Additionally, we will discuss the water cycle: collection, evaporation, condensation and precipitation. The unit wraps up with water conservation. I have multiple class sets of books about water that we will read and discuss to build our background knowledge. This is also where I will interject the BP oil spill books and videos. We will have a guest speaker from Delaware Department of Health Services come in to discuss the importance of water. At the end of his visit, he plays a Jeopardy game with the students to review all he has taught them. This kit/unit will take four weeks or more to complete.

Classroom Activities- Additional Articles

After a quick search of Read Works or other sites, additional articles with comprehension questions may be located to supplement the unit. I have located these: "Wow Water!" "What's the Big Idea About Water? Living Things and Ecosystems Need Water," "What's the Big Idea About Water? Water's Impact on Earth," "Weather-Water Cycle," "Water Worries, Water Woes," "How Water Loss Affects Biodiversity," "Pythons Invade the Florida Everglades," "After the Floods," "Life in the Ocean," "The Most Important Question," "What Lives in a Pond?", "Ecosystem of the Forest," "Vanishing Frogs" and many more. Teachers may select what is appropriate for their class and grade.

Classroom Activities- Final Project

For our final water activity, the children will do a report on one of three topics. They may wish to write a report about habitat creation and repair to demonstrate what they have learned about the topic, and hopefully, get a community project started in a local area that may need repair.

Secondly, they may wish to write a research report about an animal and the adaptations that allow that organism to be successful in the environment. This report should detail how these adaptations relate to the environment and how altering the environment makes challenges for the organism's survival. I would also ask for them to create a 3-D model of their organism to display with their report.

Some students may want to write about a local waterway that is experiencing some pollution problems. They must include solutions to help this local ecosystem and why it is important that we act now. If possible, we will send these off to politicians or interest groups for some action.

This culminating activity is designed to show students that they have a voice and that they may be an agent of change, even at this young age. I hope to have a Water Night where the students will be able to display their work or possibly just display their materials and findings in the library from which other students may learn.

Bibliography

Andel, J. Van. *Restoration Ecology*. Malden, MA: Blackwell Pub., 2006. Print.

This book explores ecological restoration and supports the hopes for it to be sustainable.

Clark, Susan G. *Endangered Species Recovery: Finding the Lessons, Improving the Process*. Washington, D.C.: Island, 1994. Print.

Endangered Species Recovery is a book about endangered species conservation. Policy and implementation programs for species recovery are explored with social scientists, as well as biologists.

Gilbert, O. L., and Penny Anderson. *Habitat Creation and Repair*. Oxford: Oxford UP, 1998. Print. This book is a guide to successful habitat creation and repair. It covers all the key requirements to meet with success.

Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011. Print.

Restoration Ecology is a book that addresses concerns of climate change, rainforest destruction and many other interconnected environmental issues.

Kaiser, Jamil. *Bio indicators and Bio markers of Environmental Pollution and Risk Assessment*. Enfield, NH: Science, 2001. Print.

This text explains bio indicators and bio markers in polluted environments, specifically water ecosystems.

Kumar, H. D. *Biodiversity and Sustainable Conservation*. Enfield, N.H.: Science, 1999. Print.

This book helps identify and begin remedial measures to conserve species before they vanish forever.

Mooney, Harold A. *Functional Roles of Biodiversity: A Global Perspective*. Chichester:

Wiley, 1996. Print.

This book explores biodiversity and how species diversity and global change will affect system stability and resistance.

Nielsen, Knut. *Animal Physiology: Adaptation and Environment*. 5th ed. Cambridge [England: Cambridge UP, 1997. Print.

This textbook examines animal physiology in a user-friendly manner.

Nikinmaa, Mikko. *An Introduction to Aquatic Toxicology*. Burlington: Elsevier Science, 2014. Print.

This text provides a foundation for learning about toxicology in aquatic ecosystems. It demonstrates the history overview and modern day solutions.

Sala, Osvaldo E. *Biodiversity Change and Human Health from Ecosystem Services to Spread of Disease*. Washington, DC: Island, 2009. Print.

This book explores the connection of human health to the natural resources, which are diminishing.

Salt, George W. *Ecology and Evolutionary Biology: A round Table on Research*. Chicago: U of Chicago, 1984. Print.

This collection addresses competition and community ecology; the importance of inter specific competition.

Spellerberg, Ian F. *Monitoring Ecological Change*. Cambridge [England: Cambridge UP, 1991. Print.

This book stresses the importance of ecological monitoring programs in order to detect changes that are occurring.

Spicer, John I., and Kevin J. Gaston. *Physiological Diversity and Its Ecological Implications*. Malden, Mass.: Blackwell Science; 1999. Print.

This text book examines the relationship between physiological diversity and ecology.

Tanabe, Shinsuke, and Annamalai Subramanian. *Bio indicators of POPs: Monitoring in Developing Countries*. Kyoto, Japan: Kyoto UP; 2006. Print.

This book explains what POPs are: persistent organic pollutants.

Thomas, William A., and Gerald Goldstein. *Biological Indicators of Environmental Quality; a Bibliography of Abstracts*. Ann Arbor: Ann Arbor Science, 1973. Print.

This book provides information on pollutants in various environments.

Willmer, Pat, and G. Stone. *Environmental Physiology of Animals*. Malden, MA: Blackwell Science, 2000. Print.

This book discusses the physiological functioning and comparative adaptations of animals.

Cs, Margit. *Biological Indicators in Environmental Protection*. New York: Ellis Horwood, 1992. Print.

This book looks at environmental stress and the various levels of the biological hierarchy.

Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England: John Wiley & Sons, 2003. Print.

This book provides the current knowledge of diversity along with information about conservation in a global way.

Works Cited

- 1 Sala, Osvaldo E. *Biodiversity Change and Human Health from Ecosystem Services to Spread of Disease*. Washington, DC: Island, 2009, 2.
- 2 Gilbert, O. L., and Penny Anderson. *Habitat Creation and Repair*. Oxford: Oxford UP, 1998, 234.
- 3 Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England, 213.
- 4 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011, 314.
- 5 Ibid. 316-317.
- 6 Andel, J. Van. *Restoration Ecology*. Malden, MA: Blackwell Pub., 2006, 148.
- 7 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 333.
- 8 Ibid. 315.
- 9 Ibid. 1.
10. Ibid. 2.
- 11 Sala, Osvaldo E. *Biodiversity Change and Human Health from Ecosystem Services to Spread of Disease*. Washington, DC: Island, 2009, 143.
- 12 Nikinmaa, Mikko. *An Introduction to Aquatic Toxicology*. Burlington: Elsevier Science, 2014, 21.
- 13 Sala, Osvaldo E. *Biodiversity Change and Human Health from Ecosystem Services to Spread of Disease*. Washington, DC: Island, 2009, 143.
- 14 Kaiser, Jamil. *Bio indicators and Bio markers of Environmental Pollution and Risk Assessment*. Enfield, NH: Science, 2001, 2.
- 15 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011, 158.
- 16 Kaiser, Jamil. *Bio indicators and Bio markers of Environmental Pollution and Risk Assessment*. Enfield, NH: Science, 2001, 2.
- 17 Nikinmaa, Mikko. *An Introduction to Aquatic Toxicology*. Burlington: Elsevier Science, 2014, 20.
- 18 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011, 38.
- 19 Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England, 210.
- 20 Ibid. 207.
- 21 Sala, Osvaldo E. *Biodiversity Change and Human Health from Ecosystem Services to Spread of Disease*. Washington, DC: Island, 2009, 269.
- 22 Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England: John Wiley & Sons, 2003, 9.
- 23 Tanabe, Shinsuke, and Annamalai Subramanian. *Bio indicators of POPs: Monitoring in Developing Countries*. Kyoto, Japan: Kyoto UP; 2006, 9.
- 24 Ibid. 5.
- 25 Spellerberg, Ian F. *Monitoring Ecological Change*. Cambridge [England: Cambridge UP, 1991, 220.
- 26 Kaiser, Jamil. *Bio indicators and Bio markers of Environmental Pollution and Risk Assessment*. Enfield, NH: Science, 2001, 11.
- 27 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011, 26.

- 28 Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England, 101.
- 29 Kumar, H. D. *Biodiversity and Sustainable Conservation*. Enfield, N.H.: Science, 1999, 6.
- 30 Ibid. 6.
- 31 Que, C., and Jean Mounolou. *Biodiversity*. Chichester, England, 54.
- 32 Greipsson, Sigurdur. *Restoration Ecology*. Sudbury, MA: Jones and Bartlett, 2011, 158.
- 33 Gilbert, O. L., and Penny Anderson. *Habitat Creation and Repair*. Oxford: Oxford UP, 1998, 3.
- 34 Kumar, H. D. *Biodiversity and Sustainable Conservation*. Enfield, N.H.: Science, 1999,270.
- 35 Gilbert, O. L., and Penny Anderson. *Habitat Creation and Repair*. Oxford: Oxford UP, 1998, 2.
- 36 Ibid. 13.
- 37 Ibid. 16.
- 38 Ibid. 7.
- 39 Ibid 14.

Curriculum Unit
Title

Water, Water Everywhere...Nor any drop to drink.
Samuel Taylor Coleridge, The Rime of the Ancient Mariner

Author

Julie V McCann

KEY LEARNING, ENDURING UNDERSTANDING, ETC.

The students will understand: -the science vocabulary introduced and taught in this unit. -the causes of pollution and the costs incurred from that pollution.
-the value of biodiversity in an ecosystem and how they are related. -the rewards and challenges of habitat creation and repair
- adaptations help organisms survive.

ESSENTIAL QUESTION(S) for the UNIT

What are adaptations?
What is biodiversity and why is it important?
What are the causes and costs of pollution?

CONCEPT A

CONCEPT B

CONCEPT C

Biodiversity

Pollution

Adaptations

ESSENTIAL QUESTIONS A

ESSENTIAL QUESTIONS B

ESSENTIAL QUESTIONS C

What is biodiversity?
Why is biodiversity important?

What is pollution?
What does pollution cost us?

What are adaptations?

VOCABULARY A

VOCABULARY B

VOCABULARY C

biodiversity, habitat, aquatic, wetland,
riparian buffer, dunes, ecologists

pollution, aquifer, sediment, erosion,
hydrology, ecology, eutrophication, POP's

adaptations, extinct, endangered,
drought, organism

ADDITIONAL INFORMATION/MATERIAL/TEXT/FILM/RESOURCES

The Magic School Bus At the Waterworks and *The Magic School Bus on the Ocean Floor* by Joanna Cole and Bruce Defen, *A River Ran Wild* by Lynne Cherry, *Follow the Water from Brook to Ocean* by Arthur Dorros, *The BP Oil Spill* by Peter Benoit, *Earth in Danger* by Kate Waters, *Fire and Floods* by Kate Waters, *Hydrology* by Christine Taylor-Butler, *Saving Our Earth* by Peggy Hock, *Water Cycle* by Monica Hughes, *You Wouldn't Want to Live Without Clean Water* by Roger Canavan, *A Warmer World* by Caroline Arnold, and *Just a Dream* by Chris Val Allsburg,

“Water, water everywhere, not any drop to drink,” said the sailor from Coleridge’s poem describing to a friend how awful it was to be without drinking water on a ship in the middle of the ocean. It is strange to think that the water around his ship was probably quite safe to drink. It was salty “ but not polluted. The sea waters today are much more dangerous.