



YALE NATIONAL INITIATIVE

to strengthen teaching in public schools®

Curriculum Units by Fellows of the National Initiative
2009 Volume V: Green Chemistry

Experiencing Positive Relationships with Managing the Environment

Curriculum Unit 09.05.07, published September 2009

by Stephanie Johnson

Introduction

This unit is about relationships and cycles. The relationships involve green chemistry. This topic can be very interesting due to the fact that it has so many different components that you can research and look at. So, as I walk around on a cool brisk day contemplating my writing, I ask myself what will be beneficial to my students. Should I think green as everyone else does? So I started to ponder images of green places that are scenic and beautiful. A park in my city came to mind. The park is Point State Park. It is full of trees where all of the three rivers meet, the Ohio, Allegheny and the Monongahela. As I walked through this park looking at the leaves in their autumn state, I thought about oxidation in its proudest form. How it shows off in different phases and cycles. About thirty percent of the world is forested, and trees are very popular in urban and rural settings. I know I have at least two trees in my yard. I will be discussing trees in several different ways, but the main point is that, without the infrastructure of an ecosystem, this topic would not exist. For example, a tree interacts a certain way with the soil, an animal that may use it for shelter, the amount of sun available to it, the amount of water available and the climate. A tree has abiotic and biotic features; sunlight is abiotic and the tree is biotic. So, I guess from this you can tell that trees will be important in this unit. Decomposition is often referred to as composting. Composting will also be discussed in this unit.

To begin with, there were two Pennsylvanians who had an interest in what I will be writing about. The first is Joseph Priestley, a British born theologian, philosopher, educator and political scientist. He wrote over 150 works. He discovered oxygen. He tried to explain the oxidation theory by using phlogiston, but this was incorrect. Nonetheless, he took the current theory and tried to make something from it. He focused on the scientific thought on combustion from the 1700's. He tried to understand oxygen through respiration. He experimented with a lit candle by covering and uncovering it with a bell jar. Then after the candle went out, he put a piece of mint plant in the bell jar to see if it would grow. His conclusion was that plants helped cleanse the atmosphere. After many different tests, he determined that only the green parts of plants cleaned the air (http://wikipedia.org/wiki/Joseph_Priestley)¹. (Accessed July 6, 2009.) The second person from my state and very near to my city is Rachel Carson. She was a writer, a scientist and an ecologist. She enjoyed working with natural habitats. She wrote pamphlets on natural resources and edited scientific journals. She wrote a children's book named "Preserving a Sense of Wonder" and a very popular book about pesticides called "Silent Spring". The reason I choose Rachel is because she has a homestead trail. I intend to visit this place with my class and see demonstrations on composting. They also have a Sense of Wonder Hike with examples of

organic gardening using native plants. I will be discussing her in this unit. Both she and Joseph will be discussed in relation to trees and ecological systems.

The most important science of the sciences I believe is biochemistry. I sat listening to Gary W. Brudvig, a Eugene Higgins Professor of Chemistry, Biochemistry and Molecular Biophysics, talk about pollution prevention by way of green chemistry. This discussion went into the molecular structures and the periodic chart and common chemical reactions that affect our daily lives related to polluting and conserving. I enjoyed taking in all of this information and I couldn't wait to get to our next meeting. This is what I want for my students, to feel excited and curious about biochemistry as I do. Oh well! Back to the biochemist; this type of chemist is the chemist of the living world. Plants and other living things use the basic chemical compounds to live their lives. Biochemists look at the molecules in a living thing. They also look at the cycles that create those molecules. When you put these three individuals together, Rachel, Joseph and Gary, you get a clear idea of what science is in its broadest sense.

Why oxidation? I teach half the semester about trees. This content is part of my science class that I teach two periods a week per year. The curriculum that is used is FOSS Full Options Science Systems. So how do I tie in green chemistry with trees? Plants are at the base of all living organisms. So we know all the physical parts of a tree. Let's learn its function. My student's demographics consist of several factors. They are kindergarteners who are very curious. I teach in a relatively brand new school five years old to a predominantly African American population in an urban setting. It is a technology-equipped school environment. This unit will be taught over a three-month period using one of my science periods that is forty five minutes in length. I find that my students are very curious and want to learn. My belief is that all students must be motivated to learn and it's my job as teachers do it, and this includes socioeconomic, gender, race and learning ability. Learning styles are different for every individual and I plan to incorporate activities that will meet the various learning styles in my classroom. The FOSS curriculum that I use fosters integration of science stories, exploration, discussion and language development. I will focus on the same principles while developing this unit. Assessing the students will be in three categories. They are content knowledge, investigation and explanation. I will talk about these more in the strategies section of this paper.

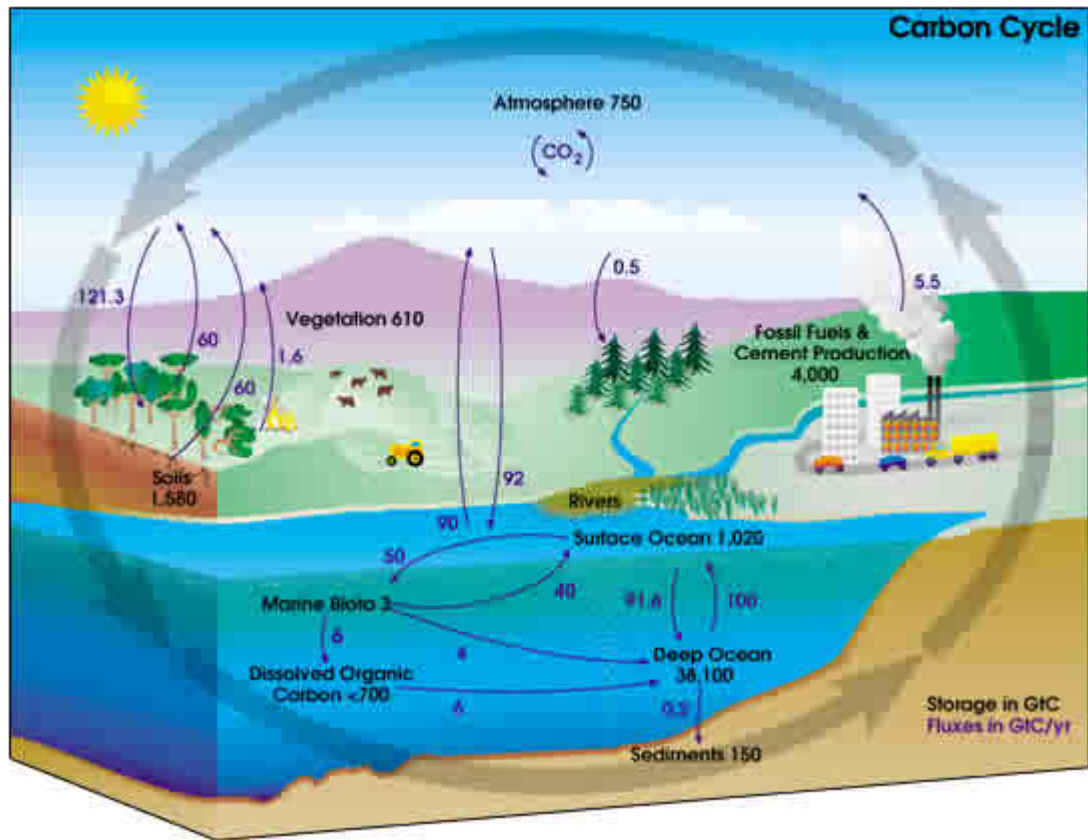
The subject green chemistry has twelve principles. In this unit we will focus on three. The first one is that it is better to prevent waste than to clean up after it is formed. The second one is that chemical products should be designed to preserve efficacy of function while reducing toxicity. The third one is to design chemicals and products to degrade after use: design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment. I will be teaching on these three principles through the use of trees. There will be three specific topics related to trees. The three are the photosynthesis cycle, air pollution and composting. The main motivation will be how we can help with controlling air pollution. The carbon cycle is part of the larger cycle called photosynthesis. In this cycle, a great many things are happening. This is studied under the title of a biochemist. In biochemistry, you are studying the living world. Plants and other living things use basic chemical compounds to live their lives. In this part of chemistry, a chemist looks at the molecules in a living thing. They look at the cycles that create the compounds. The cycles that repeat themselves allow for us to live on this earth. So as a biochemist, we will be looking at photosynthesis.

The carbon cycle as I stated is part of a bigger cycle called photosynthesis. Carbon dioxide is an odorless gas. The cycle just like other cycles of give and take are in perfect balance. An example of this cycle is when people inhale oxygen and then exhale carbon dioxide. This is the carbon/oxygen cycle. How do you relate this to trees? Trees let off oxygen and take in carbon dioxide. All living things need oxygen to live. All living things use carbon dioxide. This is how trees make their own food. Living things are joined by a natural balance. They

are joined by energy and other living material. There is a balance between oxygen and carbon. Also, a good way of saying this is when people inhale O_2 they exhale CO_2 , the plants use that CO_2 as humans use O_2 . This is why trees let off oxygen to balance the CO_2 they have taken in.

First of all green plants are autotrophic and self-nourishing with the help of energy from the sun, and also water, nutrients from the soil and carbon dioxide. From this point on, I will call it by its chemical name CO_2 (carbon dioxide). All life is connected in a very delicate balance called ecosystems. All living things do one of three things: produce, consume or decompose. A tree takes on all of these things in its own special way. They produce oxygen, O_2 . And they consume CO_2 . And they decompose through the weathering process and eventually can be used for composting. Now back to this cycle. I will explain it from the photosynthesis standpoint. In order for trees to survive, they need a supply of CO_2 . Photosynthesis is the process by which plants transform water and carbon dioxide into carbohydrates using the energy of sunlight. Sunlight provides energy to create a reaction. There are two phases of photosynthesis. These are called the light reactions and the dark reactions. The light reactions store light energy in chemical form and the dark reactions use the stored energy to form sugars. A chemical in the leaves make these reactions possible. The chemical is called chlorophyll. The chlorophyll absorbs the light and gives the leaves their green color. The captured energy is used to build carbohydrates known as sugars. Along with the sunlight, plants take water from the soil. The process is $CO_2 + H_2O = \text{chlorophyll/light energy} = (CH_2O) + O_2$. The oxygen produced replenishes the oxygen that was used. This process is the most important biological process on earth. Chlorophyll is a catalyst. This means that it helps chemical reactions take place. (The Columbia Encyclopedia, Sixth Edition/2008.)²

How does this work? Trees are like busy factories. The main production is in their leaves; the transportation of raw material is done through the roots. The soil contains water and minerals. This is where the roots of a tree live. The roots get tiny hairs on them. This is where the absorption of water takes place. The stems transport this water and material to other parts of the tree. There are different types of tubes in the stems; one transports water and minerals and the other transports food from the leaves to other parts of the tree. Leaves are mostly flat; this gives them a wide surface to absorb the sun. The more leaves, the more light a tree absorbs. Did you know that it is estimated that a full-grown maple tree has over 100,000 leaves. I guess this is why it grows so tall. A leaf has many parts. The top layer is like a sunroof to let in the sun. Inside of a leaf, so much goes on. CO_2 passes through tiny holes that you cannot see. They are called stomata. These stomata have other cells that watch out for the stomata holes to make sure that not just anything passes through. When they are open gases can pass in and out; when they are closed nothing can pass through. This is how it is run and then to the chloroplast and so on. Photosynthesis keeps this world alive by providing fuel by which we get energy, providing oxygen to burn the fuel and keeps the world's climate in balance. The balance would be aided by having trees in everyone's backyard.



(Carbon Cycle/Photosynthesis. Wikimedia Common-NASA, Encyclopedia.com) Accessed July 27, 2009.

Air Pollution

The purpose for writing this unit is air pollution. I want my students to help with stopping air pollution by planting trees. Clean air or lack of it can cause many problems. It can affect the balance that I spoke of when discussing ecosystems such as in photosynthesis. Air pollution is the action of the environment contaminated with manmade waste into the air. It includes all contaminants found in the atmosphere. They can be in the form of gas or particles. It can be indoor or outdoor. The ozone formed at breathing altitude is bad and is affected by spraying aerosols. Combustible such as barbecues or propane space heaters are not good for the air. Dust, pollen, fungus and viruses are not helping with eliminating air pollutants. Here are some facts about the air we breathe. The air we breathe is composed of nitrogen and oxygen, CO₂, H₂O vapors and argon. The earth's air has its own contaminants. Some factories release other harmful gases, which are called green house gases. The green house gases cause the earth's heat to be trapped, raising the temperature so high that it causes global warming. They also injure the health and environment. There are four important pollutants. They are carbon dioxide, carbon monoxide, hydrocarbons, and particulates. These gases directly affect the environment. There are also others that may interact with these. Regulating these pollutants is important and that is why the Environmental Protection Agency was developed; this agency oversees the laws that monitor the environment. Some of the laws are listed below www.epa.gov.

(Accessed July 10, 2009.)

Environmental Protection Law	Date Entry	Significance to the Environment
------------------------------	------------	---------------------------------

*National Environment Policy Act NEPA	1969	Basic foundation for environmental laws
*The Clean Air Act CAA	1970	Regulates air emissions from mobile and stationary sources
The Clean Water Act CWA	1977	Regulates discharges of pollutants into water and water quality standards
The Oil Pollution Act OPA	1990	Dictates how the EPA will respond to a major oil spill.
*The Pollution Prevention Act PPA	1990	Reduces pollution through cause effective changes, recycling, and agriculture
The Safe Drinking Water Act SDWA	1974	Protects drinking water sources above and below ground
*The Toxic Substance Control Act TSCA	1976	Allows the EPA to monitor chemicals

The EPA has been in the forefront of keeping the environment under control. Grant you, we should do more, and with green chemistry developing, there will be more done for the environment. The acts with the asterisks are the ones that have impact on this unit. Without these acts, trees would not be so important around the world. The trees help keep pollution down by trapping pollutants that are in the air. Also, having these regulations helps with cutting down on diseases. Common illnesses in developing countries are respiratory diseases. Respiratory diseases are caused by a combination of factors. These factors can be genetic or environmental. Air pollution may trigger some effects of a respiratory disease. I know in my city of Pittsburgh, Pennsylvania, we were known for our steel mills and even named our football team after them. The steel mills made everyone prosper, but they were polluting the city. Now some of the local residents that have been there all their lives are experiencing respiratory illnesses. One of the major combinations of those diseases is COPD - Chronic Obstructive Pulmonary Disease. This is a combination of emphysema and bronchitis. This illness was formerly related to coal miners, but now people who have never worked in the mines are coming up with this disease. In children, one of the major diseases is asthma. This is also affected by the air and can be caused by air pollutants. I know on some very humid days children with these types of diseases cannot come outside.

There are some improvements that have happened to decrease air pollution. We in America have cut back on air pollution through new automotive and fuel regulations. With different manufacturing going on, fewer pollutants are going into the air. Lead that use to be so heavy in the air is greatly decreased. Pollution has declined in major cities. I would hope that this tree unit will also assist in some small way with cleaning the air. Some of the things trees help with are they settle and trap particles and dust and they absorb dangerous gases. They also keep it cool when it's warm.

Composting

Composting is a great way to recycle from a tree. This concept came to mind because it creates a cycle of its own related to trees. There are three processes that occur within composting. They are microbiological, chemical and physical. The carbon bond is broken down in the presence of oxygen and moisture. Composting occurs in a closed bin and the heat makes the process last longer. It is a process that occurs when the leaves (organic waste) are decomposed by soil microorganisms. Compost is usually mixed with other soils to improve the quality of soil. It adds nutrients for plant growth. The major benefit of composting is that the organic content of compost changes the soil structure to hold oxygen, minerals and water. It is also a natural fertilizer. During the composting process, the material oxidizes, breaking down organic matter into proteins and carbohydrates. The proteins break into nitrates that can be used by plants to make chlorophyll. The carbohydrates break down into simple sugars, organic acids and CO₂. The compost then goes through the

roots and provides nutrients for the tree (www.wikipedia.org/wiki/compost/)³. (Accessed July 10, 2009.)

Objectives

The correlation will be with the content in the unit and the Pennsylvania Kindergarten Standards (www.pde.state.pa.us). (Accessed May 10, 2009.) The first of these is to understand how important trees are to the life cycle. We will discuss and look at trees using literature and real specimens. Using trees as a basis for this unit, we will explore the benefits of having trees. Those benefits are giving off oxygen to other living things. This will be illustrated by the photosynthesis cycle. Coming from this basis will allow my students to identify the photosynthesis process as a life cycle. Having the students nurture a plant and trees will assist with the understanding of a life cycle. Also reading books such as the "Very Hungry Caterpillar" can give an example of a life cycle. The language development will be utilized through the development of a vocabulary word wall and identification of vocabulary activities. The vocabulary words will be energy, sugar, carbon dioxide, air, pollution, hydrogen, oxygen, chlorophyll, stomata, breathe, living, nonliving, inhale, exhale, cycle, light, gas and others that are in the unit. These words will be used with this unit consistently. Since there will be discussions throughout the unit, they will get an opportunity to use the words in their proper context. The chemical notation will be written for them as well such as for oxygen that would be O₂. This will expose them to the proper way that chemists write their work. They will explore patterns that regularly occur in nature. These patterns will be as in growth patterns of a plant but a simpler example of this in which they already have learned is day, afternoon, night, or a seasonal cycle.

They will recognize that matter can change from one state to another. This concept is important because comprehending that the tree is actually breathing is a complex goal, but they do know that it is growing and that will drive their curiosity. They will identify air as a source of movement. This objective is based on scientific experimentation with my students and looking at different ways that air is produced such as breathing, fans and natural wind. They will understand that living things are made up of parts with specific functions. This will be the meatiest part of this unit because it will show the photosynthesis process and this will help with understanding life processes of living things. They will be able to identify energy as coming from sunlight to help with growing a tree. Experiments with the trees will help with the understanding of this invisible matter.

They will be able to use tools to complete a task. The tools that I am talking about are planting tools to work in the garden and magnifying glasses to look at the leaves. This will help them to identify products that come from nature. These products are going to come from composting. I want them to be able to describe the effects of air pollution by listening to a story. A great amount of time will be focused on understanding responsibility related to green chemistry as a deterrent to pollution. This will help with respect for the use of products that do not create air pollution as well as assist with spending time on discussing the causes and effects of air pollution. They will be able to understand that all living things need air and water for survival. Activities of needs and wants will help with bringing this to reality by showing that there are some things you need and some you want to have but are not necessary. They will be able to observe and describe a tree growing in different experimental conditions through the use of a book. After looking at my standards one of the activities was to grow plants with sunlight and without sunlight. This will illustrate a visual concept as well as a cause and effect for the students to experience. They will understand that living things depend on

nonliving things for survival. This is another way of teaching the students about the tree being a living thing. The non-living things do not come alive, but provide important nutrients for living things. They will be able to identify human activity that affects the environment.

After a discussion and stories about resources, the students will keep a record of the activities through illustrations in their foot journals. The foot journal is a portfolio of their work. A tool that measures their use of resources in the environment, it will give them better information about their usage. They will be able to categorize living and nonliving things in the journal. We will discuss good environmental practices related to protecting the trees' ecosystem. These practices will be fostered through caring for nature and providing compost to use by the students. I will encourage respect for plants and their habitats. The stories that will be read will generate respect for trees. Then they will be able to form clear explanations based on observations and participation. This objective goes with the strategy of scientific practices. They will learn this practice. They will participate in several scientific investigations that involve experiments that will show processes and cycles. You will notice that it sounds like an overlapping objective, but it is not. To be able to ask relevant questions will be important because asking critical-thinking questions will take a technique that will have to be facilitated by me but will help get better answers from the students. They will be able to make predictions based on observations and experiences. This is back to the scientific thought that needs to be introduced and made a routine as much as possible. They will be participating in a story by listening and responding to an informational text about trees. An informational text is a story that gives information that is factual and in the nonfiction genre category. They will draw relevant illustrations to represent facts. The main idea needs to contain oral descriptions and drawings. I will be looking for the main idea in literature because it will help with understanding the vital points about the process of trees being living things. They will be able to use data with facilitation from the teacher to record facts about experiments on trees.

They will learn and understand some of the principles in green chemistry through a visit to the Carnegie Science Center and the visit to Rachel Carson's Homestead which will focus on these principles. They will learn about resource usage related to matter and the three important cycles that come with the photosynthesis cycle, carbon cycle and oxygen cycle. They will participate in a recycling material program through the use of leaves from the trees that we will be caring for. To know that green chemistry is about improving the environment, I will be talking about the award that is given out for greening the environment. It's called the Presidential Green Chemistry Challenge Award that was introduced by the Clinton administration in 1995. We will simulate this activity by doing a family involvement activity where the students draw a picture of their family practicing one of the green chemistry principles related to this unit.

FOSS

The Foss curriculum has goals that are expected of the students. The word FOSS means Full Options Science Systems. I will incorporate these goals into the unit. Trees are considered to be giants to the kindergartener. They are captivated by the tree. These objectives will bring a better understanding of trees. I would hope to develop a growing curiosity and interest in the student about the living things that make up the world. I will be using pictorial experiences to heighten their awareness of the diversity and variety of trees and leaves. This will also provide a way to show continuity by knowing all plants go through the photosynthesis process. The students will develop a beginning of awareness that all organisms have basic needs. Trees need water, nutrients in the soil, light and air. Also, they will learn that these organisms have different structures that serve different functions in growth and functions that are related to the tree. Trees have a life cycle that involves development from a seed, maturation and the formation of new seeds. This is taught in a separate lesson from this unit so it will help with basic background knowledge. The students will develop the

understanding that all living things, such as people, depend on plants as a way of surviving and living. They will draw, report, and communicate their ideas and understanding. They will develop a social perspective that resources are things we use to meet our needs. So this unit will not only convey a personal message but it will also give a social message. That social message is act green, think green and do green. The website www.fossweb.com will be accessed to follow up on trees and ask the chemist that is available for questions.

Strategies

In this unit, I will be using several ways to teach the skills. The most important skill is scientific investigation. Since this is a science unit, the basic skills of science will be used. Scientific investigation refers to a body of techniques for investigating phenomena, acquiring new knowledge or integrating previous knowledge. For it to be a scientific method of inquiry, it must be based on gathering information that is measurable. This method consists of their activities such as collecting data, observation and experimentation. The student environment will be filled with objects to touch. They will have opportunities to experience and explore the material that is in the unit. They will have an environment where the atmosphere will foster creativity. They need to explore and take part in meaningful experiences. These experiences can be through play, experimenting and inventing. They can also learn through social interaction. The skills that they need to learn are predominantly observing, collecting data and communicating. My scientific strategy will go like this:

- Free exploration - I will provide the material or organism with the opportunity to freely explore. This part involves active engagement of both of us. I will be taking note of what the conversation is about so that I may address it later.
- Discussion- This is where they shares their ideas and observations are shared. They will answer questions that are posed. The teacher should ask the questions that were noted in free exploration.
- Now this is when a question should be posed as in the scientific method. See if the students can answer the question. The questions should be answered well after an experiment. They should also state facts about their observations. Talk about the data they collected

These strategies have been included to involve diverse learners. Students with different learning styles such as multisensory will benefit from this unit. This includes the culturally diverse population. I want to make this unit assessable to all learners. Now I would like to talk about the components individually and how I plan on teaching them.

Components in the Unit

This unit's flow depends on how well it is delivered to the students and I have learned in chemistry, which you teach in steps. There will be a language development and vocabulary lesson with each topic introduced. The language will build communication skills. The new word will be defined, used in context and put on the word wall. The unit will also be accompanied with interactive websites that will assist with teaching the comprehension of the green chemistry principles.

Ecological Foot printing

This is a measuring tool that measures the demand a person places on the ecosystems. It compares your need with the capacity of earth to regenerate it. This is an assessment tool that was developed by Mathis

Wackermackel -Wikipedia. (Accessed August12, 2009). 4 I intend to use this as a tool throughout the unit to motivate my students to take ownership of what they use in the environment. The things that are used are energy, food, homes, water and resources. This tool will be used by giving my students footprint-writing journals. The first thing is to discuss the things we use in the environment. Give examples and show visuals of things people use in the environment. Then show ways to calculate your footprints. For my class, it will be a picture of the things we use. During this exercise the environment and green chemistry should be introduced. It will illustrate why it is important and why we as a classroom or individual should care about what happens in our environment. The story by Rachel Carson - "Preserving a Sense of Wonder," will be read. This book talks about the environment and the harmful effects of pesticides and generally just taking care of the environment. This is time to talk about taking care of the environment and how if you do certain things the environment will be safe for everyone.



+



= **Ecological Foot print**

Talk about the principles of green chemistry that this unit supports.

- *Prevent Waste: design chemical syntheses to prevent waste, leave no waste to treat or clean.
- *Design safer chemicals and products: design chemical products to be fully effective, yet have little or no toxicity.
- *Design chemicals and products to degrade after use: design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.

Trees

The students will have already learned about the basic parts of a tree. This part will discuss a tree as a functioning ecosystem. The story that will be read is "Are Trees Alive". This story tells about trees and the parts and their function. Trees have general functions to provide habitats for animals. Also, those trees provide food for insects and fruit for us to eat. They also bloom flowers that provide pollen for bees and nectar for humming birds. The bark of the tree is like our skin and protects the tree. Also, insects can put their babies inside a tree. This book describes the characteristics that are similar in a tree to a human. This is a comparing book. One example is that roots anchor a tree just as our feet help us to stand. Trees use stomata to breathe and we use our noses. The veins in a leaf are like veins in our hand. This can give you a picture. My strategy is to make my students see what they and the tree have in common. This similarity will make them have compassion for the tree. The basic intro to photosynthesis has been done. They will draw in their foot journals their responses to this informational text. It also introduces a variety of trees to the students: Baobab, Banyan, Weeping Willow, Kapok, Sugar Maple, Ribbon Gum Tree, Sequoia, Paper Birch, Bristlecone Pine, Cherry Tree, Major Oak and a Quaking Aspen. Seeing all of these different trees should get the students on the right path of curiosity. As I said, this unit will have a language development component as a way of building communication skills in the students. The stories are just that. The next strategy is to read the "Giving Tree." This is a fictional story about a boy and a tree. The tree gives the boy fruit and shade and the boy loves the tree. This light-hearted story will take us to the very serious one. The next story that I will introduce will be - "Living Sunlight - How Plants Bring the Earth to Life". This story will introduce the technical terms for and process of photosynthesis. To understand the breathing, we will do two activities; one will be mirror breathing and the

other a Windmill Party. These activities are twofold; one is to show breath the other is to show air. Several vocabulary words have already been introduced and this story will have many of them.

The photosynthesis cycle will be introduced by using posters. I will use the visual aids as well as the experiment with planting two seeds. In this experiment, start by providing moisture for the seeds to grow quickly, and then, after they have grown, deprive one of them of sunlight. One source that I used was: <http://visual.merriam-webster.com/plants-gardening/plants.php>. (Accessed July 10, 2009). ⁵

The next story will be "I Am a Leaf". This story tells what a leaf does and how it functions. It is a level one reader so the students that know how to read can read this in the classroom library. It names the important steps in the process but uses the word chlorophyll. Now I will introduce the chemical names for the words such as O₂ for oxygen. Each compound will be introduced as it goes in the photosynthesis order. Although these reactions are working at one time, I need to teach it as if it is a machine. This would be the perfect time to read the "Very Hungry Caterpillar". It shows the cocoon all the way through to a butterfly. This is a wonderful way of showing a cycle. I will also have an experiment on time of day which also is a cycle. I will provide an energy center so they can explore a hands-on energy manipulative and an interactive web site: www.touchstoneenergykids.com. (Accessed July 10, 2009). ⁶ this center will have pretend energy saving products that can be used for dramatic play. In this section of the lesson, it will be highly expressed about the breathing in of CO₂ and breathing out of O₂ related to the cycle of a tree.

Air Pollution

The strategy for teaching about this will be to explain how it affects us. Our cause for becoming green will reflect on this. Air pollution is a problem for everyone. There are 137.2 million Americans and 29.8 million children that suffer from asthma attacks (American Lung Association (Accessed July 14, 2009). ⁷ Air pollution is known to trigger these attacks. Smog in the inner city is the most familiar to see as air pollution. Although air pollution can be visible or invisible, we will look at both. Introducing pollution, we will do a shared writing activity and make a list of pollutant causing things. Also after this list is done, we will have a discussion on how important it is to have clean air. I will review the photosynthesis and talk about how important it is to have clean air. This is called making a cause and effect visual. "The Lorax" will be read at this time. This is a good time to introduce the game that accompanies this story. The story is basically about saving the trees and also saving an ecosystem. The experiment for this lesson will be called Clean Air. This lesson will take distilled vinegar and a container with a lid. The containers can be decorated. It is called Clean Air because it takes odors out of the air. This is to give them an example of invisible pollution and the vinegar is strong. Often times you can smell a pollutant but cannot see it. Also, there are plants that are natural air fresheners such as aloe vera, English ivy, peace lily, golden pothos, spider plant, and mum. These plants act as filters taking toxins out of the air. These indoor pollutants are benzene, formaldehyde and trichloroethylene. These are also things my students will not see, but will be told about. The names will not be used; they are for the benefit of the teacher.

Composting

Teaching my students to take care of a composting bin will be interesting. First of all, we do have a school garden and a farmer that comes to the school. We will get a school demonstration of composting and also visit Rachel Carson's Homestead and look at a composting activity. The composting chemistry of it all is that decomposition takes place for all living things. A well-managed composting system is nature's way of continuing the cycle. The elements of having a successful composting system are to have a composting team.

This will have to be maintained and monitored at all times. It has to have support material and this is what this unit does. This is a hands-on learning tool. A comparison can be made to plant growth by planting some in compost and planting some in regular soil. I will tell my students that compost is wasted matter. We will be using leaves to do this process. I will discuss some of the benefits of composting. You can compost a great deal of things. The good reason for composting is that it enriches the soil. It cleans up contaminants that may be in the soil. It also prevents pollution and is economical. A big activity will be with the family connection. The students will get a gallon milk container and with their families create compost that they can use to fertilize their home plants soil.

Assessments

Portfolios

My focus will be on portfolios of my students' work rather than discussion. The portfolios will show comprehension skills. My students' portfolios will take many forms, as discussed in the paper, so it is not easy to describe them. A portfolio is not the pile of student work that accumulates over a semester or year. Rather, a portfolio contains a purposefully selected subset of student work. "Purposefully" selecting student work means deciding what type of story you want the portfolio to tell. For example, do you want it to highlight or celebrate the progress a student has made? Then, the portfolio might contain samples of earlier and later work, often with the student commenting upon or assessing the growth. Do you want the portfolio to capture the process of learning and growth? Then, the student and/or teacher might select items that illustrate the development of one or more skills with reflection upon the process that led to that development. I would like for both of these variables to be in place. I want the portfolio to showcase the final products or best work of my students. The portfolio would likely contain samples that best exemplify the student's current ability to apply relevant knowledge and skills. All decisions about a portfolio assignment begin with the type of story or purpose for the portfolio. The particular purpose of this footprint portfolio is to get a collection of the unit.

Conferencing

This part of the assessment is in three parts. The first is conferencing with the teacher. This is in an informal format where I may meet at a table with several students or individually with a student at their desk. The other way to do this, which I would prefer, is to meet during the class time with the student one-on-one. This will let the student ask questions and address that student's particular need. The conference only takes a few minutes but it will help with recapping progress. The second part is a small group conference. This conferencing is important because some students may need more examples of an activity than others. They may have also been absent during a key presentation. This is also a time that a reflection can occur across student conversation. The last part of conferencing can be with peer-to-peer conferencing. This will help with conserving time and will give the students the opportunity to learn how to provide feedback along with receiving it. This can be a structured teacher-directed activity, for example, discussing what you learned from a story that was read. Conferencing was chosen because it provides a personal connection to the unit and an oral method for modeling of the information. A small area can be designated as a conferencing area and to let the students know it is conferencing time.

Rubric

A rubric assesses the knowledge that you want your students to have. I have included a participation rubric. This is to evaluate the scientific inquiry practices.

	Criteria				Points
	4	3	2	1	
Attendance / Promptness	Student is always prompt and regularly attends classes.	Student is late to class once every two weeks and regularly attends classes.	Student is late to class more than once every two weeks and regularly attends classes.	Student is late to class more than once a week and/or has poor attendance of classes.	—
Level Of Engagement In Class	Student proactively contributes to class by offering ideas and asking questions more than once per class.	Student proactively contributes to class by offering ideas and asking questions once per class.	Student rarely contributes to class by offering ideas and asking questions.	Student never contributes to class by offering ideas and asking questions.	—
Listening Skills	Student listens when others talk, both in groups and in class. Student incorporates or builds off of the ideas of others.	Student listens when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class. Student often interrupts when others speak.	—
Behavior	Student almost never displays disruptive behavior during class.	Student rarely displays disruptive behavior during class.	Student occasionally displays disruptive behavior during class.	Student almost always displays disruptive behavior during class.	—
Preparation	Student is almost always prepared for class with assignments and required class materials.	Student is usually prepared for class with assignments and required class materials.	Student is rarely prepared for class with assignments and required class materials.	Student is almost never prepared for class with assignments and required class materials.	—
				Total-->	—

Teacher Comments:

Powered by TeAch-nology.com- The Web Portal For Educators! (www.teach-nology.com)

(Accessed July 12, 2009.)

Classroom Lessons

Activities

The lesson will be paired with a reading exercise. These stories are purposeful and instructive. A list is provided below as they should be introduced.

- Are Trees Alive
- Giving Tree
- Living Sunlight- How Plants Bring the Earth to Life
- I Am A Leaf
- Very Hungry Caterpillar
- The Lorax

An example of the reading lessons is to do a preview of the story by introducing the title, author and front cover. Then read the story. During the reading ask questions that elicit thinking skills, such as having the student paraphrase, summarize, recall, interpret and use basic comprehension skills. These skills can be activated by discussion. The text should provide enough clues for me to facilitate the students. Three of the books will be read for preparation. This preparation will take place prior to the first lesson. The Carnegie Science Center should be scheduled before the first activity. This will be an introduction to chemistry and the chemical process.

Activity I

This lesson is an introduction to the concept of photosynthesis. The basic model of this in a visual will be provided. That should consist of a sun, tree, air and directions of what's going on. A poster will be hung up for reference. The book "Living Sunlight How Plants Bring the Earth to Life" will be placed on an overhead. The page with the explanation of the photosynthesis will then be discussed.

Planting a Plant

1. Provide the students with paper cups (12 oz. size) and lima beans.
2. Plant the seeds in the soil that will be put into the cups.
3. Place each cup on the window sill or where it can get some sunlight.
4. Read the book "Living Sunlight How Plants Bring the Earth to Life".

This lesson will show plant growth. The discussion on photosynthesis and its process will better help the students to have a pictorial understanding.

Activity II

Windmill Party

This activity should be introduced after air pollution is discussed. Organize a brief discussion on air and breathing related to air pollution. Discuss some of the causes of air pollution and how green chemistry is trying to minimize it. Also, discuss the natural way that a tree takes pollutants out of the air using the photosynthesis process. The breathing on the mirror exercise should be done at this time. The directions are as follows for making the windmills. Take an 8"x11" sheet of paper and cut it to 8.5"x8.5" squares. This size can be achieved by cutting 2.5 inches off the bottom. Colored copying paper would be perfect or green for the windmills. This activity will need materials that consist of fasteners, markers, oak tag paper or straws for the handle and scissors. Give each student their squares and let them decorate them with trees. On each corner of the square have the students cut from one corner of the square an inch from the middle. It will be outlined because this will help them with eye and hand coordination. Then the ends need to be folded. To fold the windmills attach the center to the straw or oak tag. Then fold each corner down to the center. Poke a hole with the fastener through each of the folded centers. This will make the sheet of paper look like a windmill. After

the windmills are made, let the students blow on them. This activity should be done in and outdoors. Show the clip art that depicts air coming out of a company and trees helping clean up the air.



Activity III

Composting - Our Product

This activity will start with a field trip to Rachel Carson's Homestead. This will be a field trip that will include a visit to her birthplace a four-room farm house. This is where she grew up as a child as well. We will do the "Sense of Wonder Hike". This hike will include using your senses to explore living and nonliving things. We will look at trees and smell them. We will also make a nature craft. There are many more activities on this hike that will reinforce this unit (www.rachelcarsonhomestead.org). (Accessed July 25, 2009)

This activity will consist of leaves and gallon milk cartoons. First collect falling leaves and other tree remnants that have fallen. Put them in a pile. After accumulating leaves enough for each student, have each student fill their milk cartoon. Then add some dirt to each of the containers or soil. The compost will need air to decompose. The compost will need some air to keep moisture in. The compost has to be moist. Moisture helps with the decomposition of the leaves. Let the students take home with a note to their families how to care for the compost and how to use it. This compost will be our product and will help with promoting green chemistry.

Bibliography

Amsel, Sheri. *The Everything Kids Environmental Book*. Avon: Adam Media, 2007.

This book provides learning about a safe environment and how to get involved with greening the environment.

Anastas, Paul, and John Warner. *Green Chemistry*. New York: Oxford, 2000.

A basic book about green chemistry and the principles and how to help with this effort.

Bang, Molly, and Penny Chisholm. *Living Sunlight - How Plants Bring the Earth to Life*. New York: The Blue Sky Press, 2009.

A colorful book explains the photosynthesis process. Molly has taken the time to have wonderful illustrations.

Bruchac, Joseph. *Rachel Carson Preserving a Sense of Wonder*. Golden: Fulcrum, 2004.

This is a bibliography about Rachel, her life in Pennsylvania and how she became an ecologist.

Carle, Eric. "Very Hungry Caterpillar". Philomel: Penguin Group, 1969.

This book is concerned with cycles from days of the week to butterfly cycles.

Heywood, Victoria. Composting: a Practical Step by Step Guide. Melbourne: Penguin Group, 2005.

A book about conserving and investing in a natural way of conserving through composting. A step-by-step guide on how to compost.

Landau, Elaine. Rachel Carson and the Environmental Movement. New York: Children's Press, 2004.

Rachel, a pioneer for the environmental movement, discusses the reasons to be aware.

Rachel had written several articles and her greatest writing Silent Spring made society aware of the dangers to the environment.

Miller, Debbie. Are Trees Alive? New York: Scholastic, 2002.

This book is about the life of a tree. It is a comparative book. The book compares a tree by its similarity to humans.

Morzollo, Jean. I Am a Leaf. New York: Scholastic, 1998.

What is a leaf really about? Well, if you read this book, the author takes the time to explain what a leaf does for the world.

Rudge, Colin. The Tree. New York: Random House, 2005.

This book tells you the names of trees and how to care for them. Geographically where they can be planted.

Seuss, Dr. The Lorax. New York: Random House, 1999.

A forty year old story that tells about how society in this makes believe village will destroy the trees by too much pollution.

Silverstein, Shel. The Giving Tree. New York: Harper Collins, 1992.

A book about a young boy who had a wonderful caring relationship to a tree.

Van Cleaves, Janice. Ecology for Kids. Canada: John Welesy and Sons Inc., 1976.

How do you learn about all the ecosystems that exist? Get this book. It is a great resource for learning about the way things function.

Van Cleaves, Janice. Chemistry for Every Kid 101 Easy Experiments that really Work.

Canada: Weledy and Son, 1989.

Chemistry its basic form. I found this book helpful for a beginner. It has the periodic chart and activities that could be used in the classroom.

Vanderwood, Jill. What's it Like Living Green? Kids Teaching Kids How to Live Green.

New York: Book Surge, 2009.

This is a wonderful book because it shows other kids how to help with caring for the environment.

Silverstein, Alvin. .Photosynthesis. Minneapolis: Twenty First Century Books, 2008.

A book on the biology of the process and a chemical explanation for the process.

Websites/ Links

www.bibme.org

This is a website that will assist you with constructing a bibliography. (Accessed July7, 2009)

www.Lungusa.org

This is the website for the American Lung Association and discusses respiratory diseases. (Accessed July12, 2009)

www.touchstoneenergykids.com

The character talks about conserving energy and what energy is. (Accessed July 7, 2009)

www.pbs.org/teachers/connect/resources/6984/preview/

This is the Go Green Challenge website there are resources and interactive activities for them.

(Accessed May 10, 2009)

<http://encyclopedia2.thefreedictionary.com>

This site is an information site with the tools to define concepts.

(Accessed May12, 2009)

www.kidsgardening.com

This site is a how to do site and it helps kid create their own garden. (Accessed June 11, 2009)

www.pde.state.pa.us

This site is where you can find the Pennsylvania Kindergarten Standards after typing it into the search area. (Accessed May 12, 2009)

www.thelorax.com

This website is concerned with conservation efforts and raising awareness on forestry efforts. (Accessed June 11,2009)

www.kidsforsavingtheearth.org

This is a club site that has membership for the students and also has information on pollution topics. There is a composting section that has ideas to include in your composting efforts. (Accessed May 12, 2009)

www.fossweb.com

This site is used along with the curriculum I teach. It has an ask the chemist section and a trees section. (Accessed July 8, 2009)

www.wheresciencehappens.org

This is the site for the Carnegie Science Center. They have school visits where they bring the lab to your classroom along with a chemist. (Accessed June 15, 2009)

www.arborday.org

This is a day of celebration for trees. You can purchase a tree and get resources on natural activities. (Accessed July 8, 2009)

www.pages.drexel.edu/~cy34/

An air pollution site. It has information on pollutant causing agents and how it affects the environment. (Accessed July 7, 2009)

www.epa.gov

This web site is about the laws and rules governing the environment. It is the site of the Environment Protection Agency. (Accessed July 10, 2009)

www.rachelcarsoncouncil.org

This web site promotes environmental causes. It informs the public about toxic waste and how to prevent it. It encourages healthier and sustainable living. (Accessed July 7, 2009)

<http://www.realtrees4kids.org/ninetwelve/system.htm>

This site explains what trees are and how they are part of an ecosystem. It explains what a system is. (Accessed July 12, 2009)

Appendices

A - Pennsylvania Kindergarten Standards

3.1 Unifying a Theme

- a. Identify and describe what parts make up a whole.
- k. Examine and Explain change through simple observation and recording.

3.2 Inquiry and Design

- b. Form clear explanations based on observation and participation in common experiments.

3.3 Biological Sciences

- g. Understand that living things are made of parts that have specific functions.
- j. Describe changes over a period of time.
- k. Record changes over a period of time.

3.4 Physical Science, Chemistry and Physics

- e. Develop a working vocabulary that manages concepts of material characteristics.

3.7 Technology Devices

- g. Use a computer in a variety of applications including instructional software.

4.2 Renewable and Nonrenewable Resources

- b. Identify products that come from nature.
- c. Identify ways to conserve.

4.3 Environmental Health

- a. Know that all things need air and water to survive.

4.9 Environmental Laws

- a. Understand how laws and regulations can protect the environment.

Endnotes

1. Wikipedia contributors, "Joseph Priestley". Wikipedia. The Free Encyclopedia, http://en.wikipedia.org/w/index.php?title=Joseph_Priestley&oldid=306393137
2. The Columbia Encyclopedia, "Photosynthesis". Sixth edition. 2008, Columbia University Press
3. Wikipedia contributors, "Compost". Wikipedia. The Free Encyclopedia, 2009, <http://en.wikipedia.org/w/index.php?title=Compost&oldid=306332946>
4. Wikipedia contributors, "Ecological Foot print". Wikipedia. The Free Encyclopedia. <http://en.wikipedia.org/w/index.php?title=Ecological=footprint&oldid=3073433073>
5. Merriam-Webster. Visual Dictionary Online, Plants & Gardening "Plants". 2009 www.merriam-webster.com
6. Touch stone kids "Teacher Zone".2009, www.touchstonekids.com
7. American Lung Association, "Air Quality".2009, www.Lungusa.org

<https://teachers.yale.edu>

©2023 by the Yale-New Haven Teachers Institute, Yale University, All Rights Reserved. Yale National Initiative®, Yale-New Haven Teachers Institute®, On Common Ground®, and League of Teachers Institutes® are registered trademarks of Yale University.

For terms of use visit https://teachers.yale.edu/terms_of_use