

Going Green: Biomimicry

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INTRODUCTION

Imagine the world without the Sun. It would be dark, cold, and lifeless. No living thing would ever exist. However, the Sun is for me the giver of life on the planet Earth. It is one of the brightest stars closest to Earth and the center of our solar system, giving us heat, light, and solar energy. Electromagnetic radiation is the energy that reaches the Earth from the Sun. This energy makes plants grow so that all living things exist, and since sunlight is pure energy, green plants use the Sun's energy to make food. The plant could capture directly its energy. As I look out my kitchen window, I am amazed to see how a lima bean seed has grown into a bean plant. The Sun is the only source of energy in our world that could make this tiny seed grow into a plant. Although I cannot see the valuable process of photosynthesis as it takes place every time the Sun rises, I know that it is indeed happening.

My curriculum unit will emphasize one of nature's principles: Nature runs on sunlight. Janine Benyus is one of the researchers who discovered that biomimics are discovering that nature works in peoples' lives. According to Benyus, biomimicry translates to bio as life and mimesis to imitate. Biomimicry is a new science that studies nature's best ideas and imitates it to solve human problems. It is the study of how nature could be the primary source of solutions to our problems. Its overriding premise suggests the study of nature's best ideas, then an imitation of them to solve human problems. Therefore, Benyus believes that life is based on simple principles.

At Tinsley Elementary School, the core content areas such as reading, math and science are departmentalized. There are six classes of 5th graders. Each class has an average number of 24 students. The students are divided into two groups, namely the boys and the girls. I teach science to the boys that are mostly English as a Second Language Learners (ESL) as well as native speakers of English. Krashen states that when schools provide quality education in their primary language, students learn two things: knowledge and literacy. The knowledge that the children learn through their first language allows the English they hear to become more comprehensible. Literacy developed in their first language transfers to the second language. My school has a traditional ESL program. There are bilingual classes from first to third grades and ESL classes from fourth to fifth grades.

ESL instruction helps the language learners use more contextualized language in math and science. The ESL classes bridge the gap between instruction in the first language and instruction in the second language. The students become proficient in their second language. Aside from the being second language learners, there is high mobility in my school because most of the students live in apartment buildings. So the students are not only challenged to learn English in the academic areas but also have to deal with high mobility. The unit is designed to help second language learners learn science more effectively.

I mentioned earlier that teaching science is also integrating reading/language arts using literature books. I use literature or trade books to teach my unit. I teach comprehension strategies in the content areas – for example, science. It makes learning the science concepts easier, allowing ESL learners to understand science vocabulary words and the different concepts presented. Because of the language skills involved in listening, speaking, reading and writing, learning science words is challenging for ESL learners.

Jim Cummins makes a distinction between the Basic Interpersonal Skills (BICS) and the CALP (Cognitive Academic Language Proficiency) for second language learners. Conversational fluency is often required achieve to a functional level within two years of initial exposure to the second language, whereas at least five years is usually required to catch up to native speakers in initial aspects of the second language. Teachers have to take these two aspects into account; otherwise, ESL students who are mainstreamed in the regular classes will have difficulty in the content areas such as science and math. Second language learners need to be competent not only in their oral communication skills also in their reading and writing skills. Some of these students are also coming from different cultural environments. For these reasons, I am using the literature approach to teach the science concepts. My unit is designed to help the ESL learners understand the science concepts as well as succeed in the yearly state assessment, the Texas Assessment of Knowledge and Skills, which the students take in April in order to be promoted to middle school.

Photosynthesis is one of the favorite science topics of my fifth graders. According to the Horizontal Alignment Curriculum of the Houston Independent School District, there are two objectives in teaching photosynthesis. First, the students should be able to describe and explain some interactions that occur in simple systems, such as with the Sun’s involvement in the water cycle, energy transfers in the food webs, or water particles in the freezing, melting, and boiling point of water. Lastly, they should be able to describe some cycles, structures, and processes that are found in the water cycle and in food webs. One of the objectives in our state curriculum is life science. Some of the topics covered were photosynthesis, food webs, life cycles, and natural resources. I chose the topic of biomimicry to teach in depth the process of photosynthesis which is all about the Sun’s energy giving life to all living things on Earth.

One spring day, when the students had a simple experiment on plant growth, I observed the enthusiasm and the awe when they planted lima beans in plastic cups and observed their growth in four weeks. It is my desire that this unit will give them more knowledge of how the Sun’s energy helps green plants produce their own food and how they will be able to start their own vegetable gardens in the limited space that they have.

RATIONALE

Going Green is an interesting seminar. Rives Taylor explains that going green is being explored in different fields. The merging minds of architects, scientists, biologists, and educators are working together in the Biomimicry Revolution. They are trying to solve problems that involve nature, using the new approach of solving problems by doing them nature’s way and manufacturing the way the plants and animals do, like using the Sun and simple compounds to produce totally biodegradable fibers ceramics, plastics, and chemicals. According to Benyus, American farms are modeled on prairies, and to sustain the produce of these farms, it would be best to use self-fertilizing and natural pest resistance. Biomimicry seeks to find new drugs or crops, so that the biomimics can study animals and insects that have used plants for millions of years to keep themselves healthy and nourished. Now is the time to be conscious of making use of what nature teaches us to sustain the Earth.

I learned from my seminar that there are a lot of changes happening in our environment. For example, global warming is on the rise. The ozone layer has depleted. Pollution ravages our soil, air, and water. I decided to teach this unit on biomimicry, particularly photosynthesis, because I

believe that students will have to understand that they are the future Earth keepers. They must start their awareness now of how to take care of the Earth. This awareness will bring about responsibility and the consciousness of the fact that it is their generation that will sustain life.

Biomimicry creates conditions conducive to life. The three basic needs of man are food, clothing, and shelter. Food provides us energy. All living organisms need energy to survive. Consumers, like the animals, must eat food to get energy. Plants are producers and must make their own food. Sunlight is needed to provide plants with the energy to make their food. Photosynthesis is easy for the students to understand. They may not see the process of plants making their own food with their own eyes; however, when they see a seed grow over time, they will begin to understand photosynthesis. Our seminar discussions have led to the idea of creating a mini vegetable garden in a pot or in a backyard to provide students organic vegetables. Some of the students have limited spaces for gardens or do not have backyards; however, planting seeds even in containers will help provide food for their personal consumption. The students will also learn that nature takes its course for photosynthesis. Everything involved in the process of photosynthesis is natural. Sunlight provides light energy. Chlorophyll provides the green coloring of the plant. When combined with light, plants make sugar. Then the plants give off oxygen. Plants absorb carbon dioxide from the air, and that is this is what makes life sustainable. This curriculum unit is intended for fifth graders in ESL Science and could be modified for students in the mainstreamed classes or for those native English speakers.

I am inspired by Janine Benyus, known as one of the biological science writers who has her heart set on the preservation of nature. She has written six books including the latest one entitled *Biomimicry*. This is a new idea for me, and in the Going Green seminar I learned so much from it. I learned a new way of looking at nature.

Benyus states that biomimicry is a new science that studies models and then imitates or takes inspiration from these designs and processes to solve human problems. It uses ecological standards to judge the “rightness” of our innovations. She mentions that after 3.8 billion years of evolution, nature has learned what works, what is appropriate, and what lasts. Her powerful insight is strategizing a course correction for humans to save humans from humans as we systematically destroy our habitat. She strongly believes that we save what we love, we love what we understand, and we understand what we are taught. I know that 5th graders will be interested to learn more about plants and photosynthesis. It is my desire that as my students move on to the middle school, they will learn to value the importance of plants in their lives. They will in their own little ways love nature. The closest organisms that I think they could relate to is plants.

UNIT BACKGROUND

Author Background – The Remarkable Janine Benyus

I read several articles and watched a video of the nature activist, Janine Benyus. She has put the jargon biomimicry in the English language. She has brought people from different fields of life together to help save nature from being destroyed by humans. Her childhood was spent in the Garden State of New Jersey where she was surrounded by trees, a meadow filled with wild flowers, and a wooded ravine with a creek. When she was ten years old, progress set in. Her beautiful natural environment was plowed to make way for a new subdivision. The sight of huge pieces of equipment and orange flags changed her life forever. She wrote the book *Biomimicry: Innovation Inspired by Nature*. It is a book that inspires readers to read about the mysteries of the natural world.

Benyus describes biomimics working at the edges of their discipline where ecology meets agriculture, medicine, materials science, energy, computing, and commerce who are learning

there is more to discover than to invent. Photosynthesis is a miraculous process by which the Sun turns light into life. According to Benyus this is a phenomenal process whereby sunlight, carbon dioxide, and water are combined within us to produce waste products that plants then use to make sugar and water. This provides humans and animals with oxygen – thus, the circle of life. Benyus gives the nine basic laws of the circle of life, which is the basis of her work.

Benyus states that light is life. It is gathering energy like a leaf. She describes the duckweed plant with a single round leaf, as thin as paper and no wider than a pencil eraser. The duckweed survives in the winter because it is at the bottom of the frozen pond feeding at its own starch. In May the duckweed multiplies very quickly and covers the pond. People driving by are amazed by its perfect green coloring. Most of them think that the pond is a wet green paint.

She also mentions the experiment done in the 18th century by Joseph Priestley, an English amateur scientist, who put a mouse on a sealed jar with a candle and observed that it died. However, he made another experiment using the same materials but adding a mint plant to the mix. The result he observed was that the mouse survived because vegetation somehow repaired the air.

The nine laws of the circle of life are as follows: nature runs on sunlight, nature uses only the energy it needs, nature fits form to function, nature recycles everything, nature rewards cooperation, nature banks on diversity, nature demands local expertise, nature curbs excesses from within, and nature taps the power of limits. I will focus on the first law of the circle of life, which is that nature runs on sunlight. Plants are the main topic. In my curriculum unit I will use children's literature books to teach the science concept. I mentioned earlier that the unit is designed for fifth graders who are second language speakers as well as for the students in the mainstreamed class. It will take about 10-15 days to teach this unit. The students will demonstrate an understanding that plants need the Sun, soil, water, and the seed of life. The process of photosynthesis makes Earth livable for millions of living organisms and provides the materials and energy that Earth's creatures need to live and grow.

As I create this curriculum unit, I try to make connections and reminisce on the good old days at my grandmother's orchard. She owned a mango and coconut plantation. In my youth my dad made sure that my sisters and I spent the summer at my grandmother's place. I remember how he, a businessman, spent time at her plantations quarterly and took care of those trees. Dad explained to me how the process of photosynthesis helped those mangoes and coconuts grow. At that time all I cared about was harvesting them, putting them in baskets, and seeing that the farmers picked them up and sold them at the market place. At times I remember seeing my grandmother's house full of mangoes in the bedrooms with mangoes under our beds. I took notes as my grandmother told me how important it is to till the land and plant fruit trees.

It is only after attending this seminar that the new information on biomimicry encouraged me to think back on land that is taken care of by the tenants and not by the owners. My ancestors were land owners and lived only on the produce of the land. However, during my generation, I have completely ignored it. The seminar leads me back to my awareness of land that was naturally fertilized which produced mangoes, coconuts, and rice abundantly. No chemicals and pesticides were used to fertilize the land. My interest in the land was rekindled.

Also, I realized how my dad and grandmother took care of the land they had inherited from their great grandparents. I understand and appreciate how my sister retired from teaching and decided to take care of what my dad left behind. It is my hope that this unit will impact my students' appreciation for trees and their awareness that planting trees or just simply planting vegetables will help them with growing their own food and sustaining them in small quantities. I would like my unit to at least make my students aware of how important nature is. For instance,

the Sun is the major source of energy for the plants. Photosynthesis is nature's system of allowing producers to grow their food so that animals and humans will have something to eat.

Author: Rachel Carson

Another environmentalist, Rachel Carson, was a marine biologist and a nature writer. Her career as a writer started when she worked for the US Department of Fisheries. Carson wrote three books, namely *The Sea around Us*, *The Edge of the Sea*, and *Under the Sea*. These books were bestsellers because Carson wrote about ocean life, from the shores to the deep waters. In the 1950s Rachel Carson became involved with environmental research. She was concerned about pesticides and their effect on humans and animals. In her research Carson found evidence of the pesticide cancer connection. In addition she did research on many individuals' illnesses due to the use of the pesticide. For this reason, Carson wrote another bestseller, *Silent Spring*, in 1962. It was a very powerful book. The title suggested her concern for the deteriorating natural world and the negative effects of pesticides on humans and animals. The level of environmental consciousness of pesticides greatly increased. Carson explains that the pesticides have a detrimental effect on the environment. This book was one of the reasons that DDT was banned in the United States. In spite of her bouts with cancer, Carson continued her vocal admonishments that in the future the use of pesticides would not simply target the pests but weaken the ecosystem. She maintained that the targeted pests would not be eradicated. Carson appeared in public to explain her environmental concerns. Finally in April 1964 she passed after fighting with breast cancer for her life. She bequeathed her writings, papers, and manuscript to Yale University and has inspired many people to nurture and protect our natural environment. One of them is Janine Benyus.

Plants

Plants come in all different shapes and sizes, but they all have the same parts – namely, roots, leaves, and stems. Plants can also have flowers, seeds, and fruits or nuts. Plants are important to all people and animals because we need food to stay alive. Plants are producers because they can make their own food through the process of photosynthesis. People and animals are the consumers. They need to get energy from the plants. Plants are important to humans because they provide aesthetic value, medicine, food, goods, recreation, air quality, water control, and erosion control, as well as having an impact on our climate, fish and wildlife habitats, and the ecosystem. Plants make our surroundings beautiful. Imagine the beautiful bluebonnets, flowers native to Texas that grow abundantly during spring. We see them growing wild on the sides of the streets, parks, and vacant land. They need to be exposed to the Sun directly for eight to ten hours to thrive well. These beautiful blue bonnets are the pride of Texas.

Medicinal plants such as chinaberry or china tree, cypress, juniper, live oak, mistletoe, Osage, pecan, vitex, and yaupon are native to Texas. The chinaberries have yellow flowers and yellow poisonous fruit. Their toxicity depends on tree varieties. Native Americans used the plant externally to treat ringworms and tetterworms. The Cherokees used the leaves to repel insects from shelters and homes. The chinaberry fruit was dried and made into ceremonial beads. Native Americans believed that the fruits brought them good fortune. The bark was used as poison to fish. When eaten, the fish were stunned and easily captured (“Chinaberry”).

The bald cypress trees are also found in Texas. Their bark is used to make cordage. Native Americans also used the bark as fire starters. The bald cypress trees grow in wetlands and are known as disease free trees. Florida cranes eat the seeds of the bald cypress. Other animals like deer and rabbits eat the young sapling. The bark is eaten by nutria (a large rodent with webbed feet) and other rodents. The root trees are made into furniture like table tops and house décor (“Cypress”).

Juniper is an edible and medicinal plant. Juniper berries are used as spice. One must be careful not to eat too many berries because they can be toxic. The fruit is a spice for cooking stew, meat and barbecue sauce (that's why there are many barbecue places in Texas which people can go to for delicious barbecue and barbecue sauce) ("Juniper.").

The white oak has two edible varieties, acorns and Burk oak acorns. These varieties are usually at their best when blended with water and then strained. Oak trees with rounded leaves are used for making acorn bread. The leaves are blended with water and then strained to get the juice out. As a result the juice leaches away tannins, making nut meal sweeter. The pin oak bark is used for medicinal purposes. The juice is extracted from the bark of the tree for dysentery, edema of joints, and intestinal pain, and is used as an analgesic ("White Oak").

There are many other trees native to Texas; however, the last one that I will describe is the most common tree found in the area where I live. It is the pecan tree. The fruit of this tree is edible. Pecans are used in salads, waffles, pancakes, desserts, candies, ham and vegetables. On a good day one can see people harvesting the nuts. Indeed, the nuts are a good food sources for humans, squirrels, turkey, fox and deer. Pecan wood is used for making brooms, mops and garden tools. All the trees that I mentioned have green leaves, which are necessary for the process of photosynthesis.

Photosynthesis

Photosynthesis is the process of converting light energy to chemical energy and storing it in the bonds of sugar. This process occurs in plants and some algae. Plants need only light energy, carbon dioxide, and water to make sugar. The process of photosynthesis takes place in the chloroplasts, specially using chlorophyll, the green pigment involved in photosynthesis. Photosynthesis takes place only on the leaves. These parts are called the lower and upper epidermis, the mesophyll, the veins (vascular bundles), and the stomata. The epidermis protects the leaf. The stomata are microscopic holes that absorb carbon dioxide and release oxygen. The vein or the vascular bundle transports water and other nutrients to the plant parts. Photosynthesis takes place in the mesophyll that contains the chlorophyll. The chlorophyll appears green because it absorbs the Sun's red and blue light whereas the green light is not absorbed. Therefore, when that light reaches our eyes, it appears green (Carter).

Algae are ocean plants. They are found in the ocean water. Algae are not considered plants but they make their own food the same way green plants achieve photosynthesis. Sunlight is needed to make their food. As a result of photosynthesis they give off oxygen in the ocean water. The Earth is mostly covered with oceans, so our oceans are the best source of oxygen. According to Kalman, the algae are the "rain forests" of the oceans.

The Sun's Energy

The Sun existed billions of years ago and has produced energy for the Earth. It is the star closest to Earth and the center of our solar system. Most of the Earth's energy comes from the Sun. Plants get their energy from the Sun. Seasons are caused by the Sun and the Sun gives off heat to keep the Earth warm. Life exists because of the Sun. All living things need the Sun to live and grow. Energy is invisible but our existence depends on it. Since the Sun is the source of energy everything begins with it. Green plants make their own food through the process of photosynthesis. They turn the Sun's energy into food. The Sun provides us with remarkable energy. We do not see what is happening in the Sun itself, those solar explosions, but it is a fact that the Sun's energy supplies us all the energy we need. As a result of its energy, the green plants affect our lives and our lifestyles. Think about the food that we eat, from our salad to the hamburger. It is the product of green plants that turns sunlight into chemical energy. Consider the automobiles and the electronics that we use daily, our decorative lights. All get the Sun's energy

because of the green plants that turned into fossil fuels which were the remains of the plants and animals whose bodies grew with sunlight.

In addition, we know that the Sun is a huge ball of hot gases held together by gravity. Helium and hydrogen gases make up the Sun. The hydrogen gases move very quickly and collide with one another. When this happens they combine in order to make helium atoms. This process of combining atoms is called fusion. During this process there is a small amount of mass lost. The ratio of the hydrogen atom to a helium atom is almost two to one. The mass is transformed into an enormous amount of energy consisting of infrared and visible light. This is the reason why the light radiates in space, finally reaching the Earth. Although there is only a fraction of solar radiation that reaches us, the Sun is the source of almost all the energy on Earth.

There is a television advertisement that shows the Sun as the giver of life. The Sun's rays touch the flowers and plants and the environment changes into beautiful color scenery. Sunlight keeps on shining and turns the world into a beautiful, remarkable place! This is what environmentalists, scientists, architects, educators, and people like Janine Benyus and Rachel Carlson envision.

This curriculum unit will be literature-based, and the second language learners will use books that will introduce the importance of the Sun and the concept of photosynthesis. Children's literature will be taught to integrate reading and science. Research states that many leaders in the content areas of science, math, social studies, and reading agree that thematic learning is an effective tool to help children make connections in the content area. The children will be able to comprehend, expand their vocabulary skills, improve their language structure, and at the same time learn science concepts the fun way.

The first children's literature book that I will use for my fifth graders is *The Environment*, written by Michael Allaby. It is a book that explores science topics that the students will find interesting. It provides the readers information about the environment, climates and currents, plant life, the food web, and much more. Photosynthesis is explained clearly. It also shows a colorful, vivid image of a leaf and its photosynthesis.

The famous *Magic School Bus in the Rainforest*, written by Joanna Cole and illustrated by Bruce Degen, will be the next book. This book relates the story of Ms. Frizzle and her science class taking a trip to the Rainforest in the magic school bus. She explains to them what a tropical forest is. There are different kinds of trees that make good homes for many animals as well as the gifts from the rainforest. These gifts make many of our favorite foods, such as chocolates and fruits. She tells the children that the rain forest plants are used to make natural products like skin lotion, herbal tea, and life-saving drugs. At the end of the story Ms. Frizzle and her class return to school. They discuss how the students can save the rain forest and find ways to stop its destruction before it is too late.

After reading the *Magic School Bus*, students will compare and contrast plants that mimic medicine naturally in our forests. Some examples of these plants are Aspidistra and Paradise Flower. The Aspidistra is a bushy plant that self-medicates. Scientists have observed chimpanzees using these plants to medicate themselves. The effect is like natural antibiotics. The Paradise Flower tree is a plant that is used to prevent malaria. Desert Plants are plants that seek moisture from the soil. They contain water. The Balanites tree is used to cure infections and stop pains like stomach cramps. The Bog Dwarf plants are shrubs that can survive and pollinate our peat lands.

I would like to mention that plants mimic nature as medicine. In the state of Texas there are plants that thrive for medicinal purpose. One of these herbs is the American licorice. It is a perennial member of the pea family which can grow to 3 feet tall. This plant is use to treat

various ailments. The camphor weed is a biennial plant found in the roadside, in pastures, in prairies and overgrown fields. It's found all over the place in spring and summer time. When picked or stepped on this plant smells like camphor oil (Cross). Is this the same flower that my grandmother crushed to treat my tummy aches?

The third children's literature book will be *The Tree in the Ancient Forest*, written by Carol Reed-Jones and illustrated by Christopher Canyon. The book begins with Aristotle's famous quotation, "in all of nature there is something of the wonderful." This book is all about how every animal and plant is important in nature. Both plants and animals depend on one another to survive. This is called interdependence. In the ancient forest is a tree. The story gives the details of how the tree gets its food from the soil and the animals that depend on it. The characters described in the ancient forest are described scientifically. The author explains, too, why ancient forests are important.

The Forests, written by Joshua Rutten, is an interesting book that students will enjoy. The book describes what the forests look like, where they are located, and why forests are important to us. The pictures are beautiful. The interdependence of plants and animals is shown in this book. Also, it emphasizes how important the forests are to us. I will design a lesson plan for each story integrating science and reading. They will include listening, speaking, reading, and writing skills for the second language learners.

For the science content area I will start with vocabulary words found in photosynthesis – namely, sunlight, hydrogen, carbon dioxide, chlorophyll, sugar, and oxygen. I will explain the importance of sunlight to plants, that living organisms need energy to survive, and the process of photosynthesis. I will also mention the origin of the word photosynthesis. In Greek, the word means "putting together by light." Lastly, students will learn that after the Sun's energy is trapped in the sugar and breaks apart, sugar gives out energy that the plant uses. This process is known as respiration.

CONCLUSION

This curriculum unit is designed for second language learners and could be modified for students in the mainstreamed classes in the fourth or fifth grade. Biomimicry is using the Earth's resources wisely to sustain our only living planet. The students will learn that the Sun is the source of life on Earth. The energy is transferred to us when plants go through the process of photosynthesis. When green plants make their own food, they store the food and give us not only our food but also oxygen. People in turn give off carbon dioxide to the plants. The cycle continues and so does life. The unit leads to other science topics like the plant cycle, the carbon-oxygen cycle, food webs, food chains, animal life cycles, habitats, global warming, ecosystems, and many more life science topics. The use of literature to teach this unit is important for second language learners because they will learn the science content and vocabulary words that will enable them to understand scientific concepts. This unit is part of the state curriculum. At the end of the fifth grade students are expected to understand the objectives and take the science state test to meet the promotion standards.

LESSON PLANS

Lesson Plan One: The Environment

Objectives

The student will describe how living organisms modify their physical environment to meet their needs; student will identify patterns of change, such as in weather, metamorphosis, and objects in the sky.

Material and Resources

Create a PowerPoint presentation of the environment presenting the important topics for discussion. Provide students materials to create their own project showing an environment of their choice. Provide a copy of Michael Allaby's *The Environment*. Provide computer access for the students. Prepare the vocabulary words and matching pictures to go with it.

Procedures and Activities

Divide the class into five groups. There are four students (second language learners with advance high students) in each group. Show the PowerPoint and engage the students in a discussion among themselves. Assign a speaker for each group to share their discussion. Teacher records students' responses on chart paper. Introduce the key vocabulary words, such as environment, living organisms, Earth, core, atmosphere, and ozone layer. Ask volunteers to match the pictures with the key words. Brainstorm with the students on what they know about the Environment. Write their responses on a K-W-L (what do you Know; what do you Want to know; what did you Learn?) chart. Begin the lesson asking the students what they think the book is all about. Describe the cover page. Each group will give their response. Read with the class the environment, climates, and currents, plant life, etc. Provide teacher information and check for understanding (comprehension questions). Explain the reading and science connection to the students. The second reading will focus on the science concepts, such as environment; how the Sun, air, and water affect climate; weather and the different vegetation that grows in an environment; and how plants make their own food (photosynthesis) and its byproduct (oxygen).

After the whole class session, assign a particular topic to a group and ask them to write a group summary of the science concept learned after reading the story. Students will write their responses in Science Journals. The next activity is role-playing. Ask each student to choose an object or a living organism. One student could role-play as Sun. He/she will explain to the class how Sun affects weather/ climate. Another student could be Leaf. He/she will explain how Leaf makes food (photosynthesis). Teachers provide "hats" for the students to use during role playing.

For homework, assign students the task of creating a postcard of their environment and write good sentences to describe it. The postcard will be mailed to a friend or relative who lives in another place.

Puzzle activity: Teachers will explain, for example, the nitrogen cycle. Give each group a puzzle of the different stages of the nitrogen cycle and let the students put the puzzle correctly. After that the students in groups of four will create a poster of the carbon-nitrogen cycle using the different stages. Allow three minutes for group presentation.

Assessment

Each student will create an environment of his or her choice in a foldable project. Create a rubric with the students. Then, choose two or three Texas Assessment of Knowledge and Skills (TAKS) related questions for the students to answer. Create a vocabulary foldable (teacher model) of the vocabulary words. Students will write the word, definition, give examples, draw the picture, and use the vocabulary word in a sentence. Create a teacher-made worksheet to test science concepts; for example, explain in your own words how plants make their own food; compare and contrast a food web from a food chain; illustrate and describe the lifecycle of a plant, lake, or animal.

Lesson Plan Two: The Magic School Bus in the Rain Forest

Objectives

The students will be able to describe how living organisms modify their physical environment to meet their needs; identify patterns of change such as weather; and compare the adaptive characteristics of species that improve their ability to survive and reproduce in all ecosystems.

Material and Resources

Provide *The Magic School Bus in the Rainforest* by Joanna Cole for each group (5-6 copies) and a video. Use chart paper to record students' responses for the KWL Chart. Each group is provided with art supplies, such as construction paper, markers, crayons, colored pencils, pencils, and sticky notes.

Procedures and Activities

Students work in groups of four. Brainstorm for background knowledge. Teachers ask students what comes to students' minds when they see the words "Rain Forest." Allow the group to *Think Pair and Share*. Tell the students to write the group's response on the sticky notes. Display their responses on the KWL chart on the K column. Next, tell the students to think what they would like to learn about the rain forest. Students will *Think Pair and Share*. Remind the students to write their responses on the sticky notes and display them on the KWL chart on the L column. The last column, L, will be filled out at the end of the lesson. Teachers will have vocabulary words with pictures prepared for each group. Discuss the vocabulary words: tropical rain forest, cocoa trees, bromeliad; leaf litter, canopy, pods, pollinate, peccaries, *et cetera*. Pretend you are one of Ms. Frizzle's students as teachers read the book aloud. Engage the students with guided questions: Do you know that chocolate comes from plants? Why is the rain forest important to plants and animals? What are the different products that come from plants? Teachers read aloud the story and explain the vocabulary words as she/he reads along. Students will continue to work in groups and answer comprehension questions posted on the board or written on worksheets (group work). The next reading of the story will be focused on the science concepts. Students will describe the environment in the rainforest, the plants' and animals' adaptation, and think of why people need to protect/save the rain forest.

For homework students will reread the story at home. Explain to them that they will be reading the story as a junior scientist. They will write make a list of plants and animals in the story. The next day use students' lists to research on a plant or animal of their choice using the websites for students' use.

Another suggested activity for a compare and contrast activity is to ask each student to think and write about a plant from the rainforest and a plant from their backyard or at home. Remember to use research paper for this activity.

Show *The Magic School Bus in the Rain Forest* video to the students. Students will work in groups of four. Allow them to *Think-Pair-Share*. Each group will write ten science facts from the video on construction paper. Display student work on classroom walls or the board. Each group will walk and view the different responses. Discuss with the whole class and have teachers clarify or explain the science concepts.

Assessment

Teachers will be able to assess the students as they participate in the whole class or group discussions. Students will create a poster of their favorite plant or animal in a rainforest habitat. Each group will present excerpts from the *Rain Forest* book. Students will create a rubric to grade their presentation (with teacher guidance). Create a class bulletin board that shows different pictures explaining the importance of the rain forest. Create a foldable (teacher model) that shows how people need plants for food and medicine. Students will include a description of each picture (allow the students to use the computer to research on this topic).

Lesson Plan Three: The Tree in the Ancient Forest

Objectives

The students will be able to understand interdependence of plants and animals in the forest and describe the nitrogen cycle.

Material and Resources

Provide *The Tree in the Ancient Forest* resource book to each student or each pair of students. Use a Chart paper to display student's work and the KWL chart. Prepare art supplies such as construction paper, colored paper, scissors, colored markers, pencils, and sticky notes. Distribute for each group a copy of nitrogen cycle pictures with sentence strips describing each stage. Display a nitrogen cycle poster for the class with arrows to use for the activity. Allow students to use the computers for Internet-appropriate research. Science journals will be used to write students' thoughts/insights of what they learned after each lesson. Display a teacher-made farm model. Provide a yellow marker to highlight important information.

Procedures and Activities

Brainstorm students' prior knowledge of an ancient forest. Write all responses on the KWL chart. Discuss briefly with the class their responses. Tell the students that the teacher will read aloud the selection. Teachers set the purpose of reading: if you were the ancient tree in the forest what information in the story would be important to you? Tell the students to use a yellow marker to highlight important information. Post the comprehension purpose on the classroom walls/overhead transparency/board. Teachers read the story aloud and pause for a vocabulary words that students do not understand and continue reading. After the read-aloud ask these questions: What did you highlight and why? Students will *Think-Turn-Share* what he/she thought was most important in the text. After a comprehension check make connections with the science content focus. Science vocabulary words will be taught using the vocabulary cards teacher tool. Provide a meaning of the science word and use student friendly explanations and visuals. Teach the nitrogen cycle and the carbon cycle. Teachers integrate the process in how the ancient tree has to get nutrients through the soil. Introduce the concept of nitrogen from the atmosphere that is converted into compounds that plants utilize as nutrients. To check for understanding teachers plan in advance for the comprehension purpose questions focusing on the science content area.

Assessment

Provide students with a large tree to model an ancient tree in the forest using the vocabulary words. Ask students to *Think Pair and Share* with their partners. Ask a volunteer from each group to write the names of the different parts of the tree; find the truffles; put the voles and mice that tunnel; put the owl that flies at night, that hunts the voles and mice; *et cetera*. Create a bulletin board that shows the importance of ancient forests. Teacher made handout of the nitrogen cycle on printed paper. Show the picture of the nitrogen cycle with the arrows on different stages and ask students to fill out the correct stage. The nitrogen cycle sentences are written on the top of the page for students to copy. Teachers model a farm. Explain how the farmers grow vegetables and take care of cows or sheep. (Show that plants provide food for the cows. Explain how the farmer gets oxygen from the air that plants give off. Provide the information that cows' waste is broken down by bacteria/fungi and emit nitrogen). Students will write an information sheet that explains the nitrogen cycle. Teachers create a paper and pencil quiz to build up stamina.

Lesson Plan Four: Forest

Objectives

The students will be able to observe and describe the habitats of organisms within an ecosystem, especially those located in northern parts of America; understand the variety of flora and fauna brought about by climate and environment; and observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, and space.

Material and Resources

Be sure to provide adequate copies of *The Forest* written by Joshua Rutten to students or each group of students. Use chart paper to make the KWL chart. Also, prepare a “parking lot” chart paper for those with questions written on sticky notes. Prepare art supplies such as construction paper, colored pencils, colored markers, and pencils.

Science Journals to write student’s response/ thoughts about the topic. Video clips of different kinds of forests or a PowerPoint presentation of different kinds of forests; provide a world map to show different places of the forest in the United States or Canada (North America) and the other continents. Access to computers so that students can research using the websites provided by the school district for science. Library books for students to use as a research tool.

Procedures and Activities

Brainstorm for prior knowledge by asking them their thoughts about Forest. Students work in groups of four. Explain to them that they will *Think Pair and Share* with their partners. Each group will write their sentences on a sticky note and teachers will post their notes on the KWL chart displayed on the board. Then, tell the students to write down their thoughts on what would they like to know about the topic: forests. After working with their partners, they will write their responses on sticky notes to be displayed on the W part of the KWL chart. Teachers post the comprehension purpose questions on the overhead or classroom walls from the beginning to the end of the lesson. Teachers prepare in advance comprehension purpose questions (CPQ) for the first, second, and third reading. Read the CPQ questions to the students and remind them the purpose of their reading. Explain to students that they will be taking the role of junior forest rangers as they read along or read with the teacher. Introduce the text. Read the selection aloud to students; explain vocabulary words as teachers read along. Check for students’ understanding as teachers read for them. After the third reading integrate science concepts to the lesson. Teach the following vocabulary words: tree tops, giant green blanket, Sequoia, bristlecone pine, canopy, species, coniferous forest, rainforest, temperate forest, and nocturnal. Teachers will explain why trees lose their leaves, different animals that live in the forest, the importance of forests, forest locations, and why forests are in imminent danger.

Whole class activity: Create a vocabulary foldable (Dinah Zikes) using construction paper. Students will write the word, give the definition, an example, use the word in a sentence and draw a picture to illustrate the word.

Group activity: Locate a forest of your choice on the map. Use the computer to research information or facts. Create a poster to illustrate the forest. Be able to describe your forest. Students will come up with a Rubric. They will decide what are the criteria to get an A (4 points), a B (3 points), a C (2 points) and a D (1 point). Each group will present students poster and explain their forest, what and how they came about their project. While group A presents, the other groups will make their evaluation.

At the end of every lesson that I have prepared for the four lesson plans, teachers give time to recap what went well and what did not.

Assessment

Each student will create a diorama of their own forest. Use the students' rubric and explain to the students that will be the grading system. Create a diorama. A diorama is a mini forest in a shoe box. Students will use their own art ideas like making tree models out of dried stems/branches, *et cetera*. Another form of assessment is the pyramid foldable. Students will compare and contrast different forests. The diorama or the foldable must have an explanation or an informational sheet written or typed up. Challenge the students to role-play trees in the forest telling others like humans and animals to save the trees because people and animals have destroyed their ecosystem and trees need help to sustain the Earth's forests.

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ADDENDUM

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