Common Core 4th Grade Environmental Science Lesson Plans for California Teachers

A Senior Project

presented to

the Faculty of the Natural Resources Management Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science

by

Gillian Schoenfeld

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Abstract

This project and its analyses were conducted to assist California fourth grade elementary school teachers in adjusting to teaching Common Core standards and science curriculum in their classrooms. The project included the creation of lesson plans, which could be utilized throughout the state of California.

As the Common Core standards, California's Next Generation Science Standards for K-12, were just proposed in June of 2013, these lesson plans would help teachers update their lessons and provide them materials and concepts of how to do so. These lessons provide higher-order thinking for students, which is the whole concept of the new Common Core standards.

Acknowledgements

I would like to thank the faculty and staff in the Natural Resources Management Department as well as the faculty and staff in the School of Education of California Polytechnic State University. This project was made especially possible with help from Dr. Priya Verma, Dr. Robert Flores, Dr. Tanya Flushman and Julee Bauer. I appreciate the time and motivation they provided into helping me complete this project, utilizing the most effective teaching techniques, recommendations, tools and resources.

My hope with this project has been to guide students pursuing teaching, of or relating to environmental science, to complete a well-written and formatted professional document, which they might be proud to show peers and prospective employers in the future.

Sincerely,

Gillian Schoenfeld

Senior Project Editor

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SECTION I: INTRODUCTION

This project created five introductory environmental science lesson plans for California 4th grade elementary school teachers. With the introduction of California's Next Generation Science Standards in June 2013, teachers throughout California need to adapt to new Common Core standards as well as curriculum such as that mentioned above. Elementary school teachers commit most of their classroom time to Reading, Writing and Mathematics, as a specific amount of time is dedicated to this daily. Teachers in the past have found difficulty in implementing science instruction into their daily, weekly and monthly lesson plans.

Although the reasons for limited amounts of teaching science vary, in the article *What Are Science and Math Test Scores Really Telling U.S.?*, Brown discusses what the new Common Core standards focus on as well, the idea of deeply looking at 4 or 5 science concepts as opposed to skimming the surface of 30 science concepts (Brown and Brown, 2007). This is my reasoning for developing five hour-long, or more, lessons that can be adapted and added to based on the science background of the class and the teacher. These lessons are meant to be the first lesson getting into the subject as other lessons and more in-depth education should be continued with these topics.

Each lesson will provide background information for the teacher, useful tools for teaching environmental science as well as activities that are low in materials and can therefore be implemented in schools in various socio-economic neighborhoods. Many teachers will be in need of some extra assistance in developing new science lesson plans for the next year as Common Core is increasing higher-order thinking of curriculum and more inter-related subject teaching techniques.

Each lesson plan will begin with background information for the California teacher. This may include important vocabulary, subject history and other important information related to the lesson directly. It will also include a few fun facts, which may be used in the lesson to relay a deeper meaning to the topic. Then the lesson will be provided with a specific introduction, materials, content standards, academic language instruction, procedures and timeline and assessment evidence.

Each lesson plan will actually consist of two lessons. One lesson will have more focus on outdoor or hands-on exploration while the other will make use of more in-class and technology based information.

Objectives

The objectives of this project are to:

1. Create adaptive lesson plans that can be taught throughout California and in all school districts.
2. Give teachers a background on different environmental disciplines.
3. Educate children on their surrounding environment and world around them.
4. Create ten lessons plans that should last an hour to an hour and a half each.
5. Encourage outdoor exploration while learning.

SECTION II: PROCEDURES AND METHODOLOGY

Participants for this study included two classrooms in San Luis Obispo County. Both classrooms consisted of fourth grade students who began as of Fall 2013. The two teachers were contacted in advance asking if their classrooms would be interested in participating in this experiment.

Data collection took place in and around classrooms during the actual lessons, as well as with feedback from the two teachers via phone conversations. Both lessons occurred in a one day time frame and the classes were both told in advance of the activity they would be participating in during the day. Due to all the participants being under the age of 18, the teacher withheld certain information, such as name and age, in order to maintain privacy guidelines of the district and school.

Participants engaged in one academic science lesson, which was limited to one hour, that consisted of a series of focus questions, group activities, science papers and presentations. The majority of these lessons were created with the inclusion of individual work, group work, and whole class learning. Lessons were conducted by one person and assisted by the teacher who was mindful of behavior more than anything else.

There was no extrinsic reward for participating in this experiment other than the opportunity to learn from a different individual. Since the hands-on lessons were more time intensive due to strategies, the teachers advised to leave the experiment to be done another time and focus on the actual lesson. Therefore, the entire activity was academically focused.

First Lesson Topic: Internal and External Features of Plant and Animal Structures

(Background Information for Teacher)

Vocabulary

1. Roots: A plant organ that functions in anchorage and absorption; most roots are produced below ground.
    a. Root cap: A thimble-shaped mass of cells at the tip of a growing root, functions primarily in protection.
    b. Root hairs: A delicate protuberance that is part of an epidermal cell of a root; root hairs occur in a zone behind the growing tip.
    c.
2. Stem: A plant axis with leaves or enations.
    a. Runner: A stem that grows horizontally along the surface of the ground; typically has long internodes.
    b. Stolon: A stem that grows vertically below the surface of the found; it typically has relatively long internodes.
3. Leaves: Flattened usually photosynthetic structures arranged in various ways on the stem.
4. Seed: A mature ovule containing an embryo and bound by a protective seed coat.
5. Seed Coat: The outer boundary layer of a seed; it is developed from the integuments.
    a. Integuments: The outermost layer of an ovule; usually develops into a seed coat; a gymnosperm ovule usually has a single integument, and an angiosperm ovule usually has two integuments.
6. Cotyledon: An embryo leaf that usually either stores or absorbs food.
7. Embryo: Immature sporophyte that develops from a zygote within an ovule or archegonium after fertilization.

Background Information

- **Process of Growth for a Seed**
    - The seed is classified to be dormant, not actively growing, until it has been exposed to water and sunlight. After these two needs are met, the seed's embryo within the seed coat will begin to grow and eventually emerge. The embryo's main source of food is the cotyledon, where food is stored in the seed. Then, the root will emerge from the seed coat and will attempt to secure itself within the ground.
    - After the seed has secured itself, it will need adequate amounts of sun, water and air in order to further grow. At this point the plumule, the terminal bud of the embryo, will begin to grow and separate between the cotyledon and the epicotyl.
    - The plant will continue to develop, if still being provided with its basic needs, and will then grow new leaves and more extensive root systems.

- **Continual Survival**
    - There are three universal parts needed for a plant to survive and those include the roots, stem and leaves.
        - The roots allow for absorption of water and nutrients from the soil.
        - The stem allows the transport of nutrients to all parts of the plant.
        - The leaves make food for the plant by using a combination of air, sunlight and water.
    - If all these parts are intact the plant should function properly. Although each part of the plant is an external feature, the processes that are happening internally are keeping the plant alive.
        - For example, if there is no sunlight where a plant is trying to grow, it will rely more on its water source and oxygen content which will not provide it with the needs to survive. It may adapt to its environment and last a few days but usually, it will not survive.
    - Some plants have protective features to survive such as thorns and spines. Plants can also have chemical reactions that can be painful to poisonous.
        - Thorns are modified branches that protect plants from grazing vertebrates. Spines are thorn-like structures that are actually modified leaves or parts of leaves.
- **Extra Information**
    - Plants need to maintain four key minerals in order to survive.
        - Nitrates – essential for every cell of the plant.
            - Deficiencies can cause poor growth and yellow leaves
        - Phosphates – needed to make the DNA of new cells.
            - Deficiencies can cause poor root growth and discolored leaves.
        - Potassium – used for photosynthesis and respiration
            - Deficiencies can cause poor flower and fruit growth as well as discolored leaves.
        - Magnesium – essential for building chlorophyll and keeping leaves green.
            - Deficiencies can cause yellow leaves.

Lesson Plan One: Internal and External Features of Plant and Animal Structures

(Hands-On Emphasis)

Lesson Time – 70 minutes

Introduction to Class

Focusing Question:

- What are some important parts of a human body?

Skin is the main protection for humans externally. Internally, we survive by having functioning organs and systems such as a working nervous system.

- Do we know how plants survive? What parts of their body help them to survive?

The roots of a plant can absorb water and nutrients. The stem can transport nutrients to all parts of the plant. The leaves make food from the combination of air, sunlight and water. The leaves also allow the plant to breathe by taking in carbon dioxide and putting out oxygen.

- What about animals? Are their survival structures more similar to plants or to humans?

Animals are similar to humans in that they usually have skin or fur to protect themselves externally as well as having systems and processes internally which help them to survive.

- What do we think would happen if one part of a plant, animal or human stopped working?

They would not survive long because in order for all these different kinds of living creatures to survive they need well functioning systems. If one part of their system is out of balance, the other systems may try to "catch up" and can overwork themselves. This can lead to further destruction of the body.

    - Think about a cake. If a person adds too much or too little of an ingredient, it can mess up the whole cake. This is similar to living organisms. If one process of its functioning is compromised, it will not work to the best of its abilities and will eventually not function at all.

Teacher: Today we are going to focus on the ways in which plants can survive due to their internal and external structures.

Materials

- White Boards and Markers for each student
- Science Journals
- Pencils
- 10 cups of milk, apple juice, white vinegar, coffee and water.
- Cup measure
- Scissors
- Plastic Bag
- Plastic Wrap
- Tape
- 15 plants (small and preferably potted)

Content Standards

4-LS1 From Molecules to Organisms: Structures and Processes
Students who demonstrate understanding can:
4-LS1-1. **Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. **Each structure has specific functions within its associated system.**] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
4-LS1-2. **Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

Academic Language Instruction

1. Roots
2. Stems
3. Leaves
4. Seed Coat
5. Cotyledon
6. Embryo

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. The remaining questions the teacher can call on students and explain if students do not know the answer.
    b. Further engagement
        i. Fun Fact #1: Bamboo can be a fast growing plant. Some types can grow almost a meter (3.28 feet) in just one day.
        ii. Fun Fact #2: There are over 200,000 identified plant species and the list is growing all the time.
        iii. Fun Fact #3: Bristlecone pines can be as old as 4,500 years old. They grow in California, Nevada and Utah.

2. Procedure (**45 minutes)**
    a. Step #1: Pass out white boards with markers to each student. Debrief the students on the three essential needs of a plant – water, air, and sunlight. Explain that if the plants do not receive enough of one needs, they won't survive. **(15 minutes)**
        i. Begin by talking about what the seed needs in order to survive and the external and internal factors. Draw out the seed and its survival structures.
            1. External Survival Factors
                a. Seed Coat – protects the seed
            2. Internal Survival Factors
                a. Cotyledon – stored food
                b. Embryo – will sprout if it received enough water and warmth
            3. Both
                a. The root begins as an internal factor since it emerges from within the seed coat but then becomes a main external factor as it becomes the main source of absorption of water and nutrients for the plant.
    b. Step #2: Have the students discuss the different parts of the seeds survival with a partner. Have the students record their images from their whiteboards into their Science Journals. **(10 minutes)**
    c. Step #3: Break the students into three different groups. Each group will be in charge of one specific science experiment. All of the experiments will show students the importance of enough sunlight, water or air. (The initial experiment will be set up on day one but they should continue for one month.) **(15-20 minutes)**
        i. First Experiment: Can plants grow if they are soaked in a liquid other than water?
            1. This group will be given 5 plants. Each plant will be given 1 cup of each liquid. The five liquids will be milk, apple juice, white vinegar, coffee and water. All plants will be placed on a windowsill inside the classroom.
                a. After they pour each in, they should be looking at what happens to the plant immediately and writing down any notes. They should also hypothesize what may happen to the plant in comparison to the water as well as whether the plant will survive or not.
                b. Each week they will add more of the designated liquid to the plant one day, and two days later the students will observe what is happening to it. They need to take notes in their Science Journal.

ii. Second Experiment: How much sun do plants need in order for them to grow and survive properly?
    1. This group will also receive five plants. For this project, the students will choose five different places to put the plants. All that the teacher should tell them is that one should have full exposure to the light and the other should have almost no exposure to the light. The students may interpret this however they want.
        a. After they place each plant, they need to record exactly where it is located. They will need to hypothesize what may happen to the plant. They should address whether or not the plant will survive and why.
        b. Each week they will observe the plant one day and see what is happening to it. They need to take notes in their Science Journal.

iii. Third Experiment: This is going to consist of two different experiments in one but both will be testing how the lack of air can affect a plant.
    1. Half of the group will be given three plants. One plant they will keep all the leaves, one plant they will cut off all the leaves and the third plant they will choose however many leaves to leave on, as they want. All plants will be placed on a windowsill inside the classroom.
        a. They will need to hypothesize what may happen to the plant. They should address whether or not the plant will survive and why.
        b. Each week they will observe the plant one day and see what is happening to it. They need to take notes in their Science Journal.
    2. The other half of the students will be given two plants. One plant will receive all the essential needs. The other plant will need to be sealed from all possible air. (They could use a plastic bag or another source but it needs to be completely sealed from all airways.)
        a. They will need to hypothesize what may happen to the plant. They should address whether or not the plant will survive and why.
        b. Each week they will observe the plant one day and see what is happening to it. They need to take notes in their Science Journal.

Assessment Evidence (15 minutes)

- Gather back together as a class to discuss and review the three essential needs of a plant.

- Have an individual from each group present their experiment and what some of their hypotheses are. Ask other students for their input on what they think can happen to the project.
- Tell the students that next time in science, we will look at how these experiments have changed and discuss as a class whether our hypotheses were correct.

⇒ Formative Assessment
- Collection of Science Journals.
  - Written evidence throughout the science lesson.
    - Notes of whiteboard lesson and experimental procedures.

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
  - Making sure that they have retained the information long-term.
- Science Paper (at Home) – Growing a plant at home and testing some of these experiments (i.e. using bleach in their plant instead of water) and writing a report on what happens.

Lesson Plan One: Internal and External Features of Plant and Animal Structures

(Technology Emphasis)

Lesson Time – 70 minutes

Introduction to Class

Focusing Question:

- What are some important parts of a human body?

Skin is the main protection for humans externally. Internally, we survive by having functioning organs and systems such as a working nervous system.

- Do we know how plants survive? What parts of their body help them to survive?

The roots of a plant can absorb water and nutrients. The stem can transport nutrients to all parts of the plant. The leaves make food from the combination of air, sunlight and water. The leaves also allow the plant to breathe by taking in carbon dioxide and putting out oxygen.

- What about animals? Are their survival structures more similar to plants or to humans?

Animals are similar to humans in that they usually have skin or fur to protect themselves externally as well as having systems and processes internally which help them to survive.

- What do we think would happen if one part of a plant, animal or human stopped working?

They would not survive long because in order for all these different kinds of living creatures to survive they need well functioning systems. If one part of their system is out of balance, the other systems may try to "catch up" and can overwork themselves. This can lead to further destruction of the body.

    - Think about a cake. If a person adds too much or too little of an ingredient, it can mess up the whole cake. This is similar to living organisms. If one process of its functioning is compromised, it will not work to the best of its abilities and will eventually not function at all.

Teacher: Today we are going to focus on the ways in which plants can survive due to their internal and external structures.

Materials

- Paper
- Pencil
- White Board and Marker for each student
- Science Journals
- 1 KWL Chart for each student)

Content Standards

	functions within its associated system.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
4-LS1-2.	**Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

Academic Language Instruction

1. Roots
2. Stems
3. Leaves
4. Seed Coat
5. Cotyledon
6. Embryo

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. For the remaining questions the teacher can call on students and explain if students do not know the answer.
    b. Further engagement
        i. Fun Fact #1: Bamboo can be a fast growing plant. Some types can grow almost a meter (3.28 feet) in just one day.
        ii. Fun Fact #2: There are over 200,000 identified plant species and the list is growing all the time.
        iii. Fun Fact #3: Bristlecone pines can be as old as 4,500 years old. They grow in California, Nevada and Utah.
2. Procedure (**45 minutes)**
    a. Step #1: Pass out white boards with markers to each student. Debrief the students on the three essential needs of a plant – water, air, and sunlight. Explain that if the plants do not receive enough of one needs, they won't survive. **(15 minutes)**
        i. Begin by talking about what the seed needs in order to survive and the external and internal factors. Draw out the seed and its survival structures.
            1. External Survival Factors
                a. Seed Coat – protects the seed

2. Internal Survival Factors
    a. Cotyledon – stored food
    b. Embryo – will sprout if it received enough water and warmth
3. Both
    a. The root begins as an internal factor since it emerges from within the seed coat but then becomes a main external factor as it becomes the main source of absorption of water and nutrients for the plant.

b. Step #2: Have the students discuss the different parts of the seeds survival with a partner. Have the students record their images from their whiteboards into their Science Journals. **(10 minutes)**
c. Step #3: Hand out a KWL chart to your students. Have them fill out what they know already about plants and their ability to survive. Have them also write down what they want to learn more about. After watching these videos with your students, have them fill out anything and everything that they learned. **(15 minutes)**
    i. http://www.youtube.com/watch?v=AfTp1ObzNHM - It is about 3 minutes and gives a good understanding of why certain parts of the plant help it to survive.
    ii. http://www.youtube.com/watch?v=_KKw3UavsPA&list=PLBF99D28EB6124F6B - It is about 4 minutes and it has a lot of extras about reproduction so a teacher may save this for a future lesson but it is catchy and fun.

Assessment Evidence (15 minutes)

- Gather back together as a class to discuss and review the three essential needs of a plant.
- Review the Focusing Questions and break them apart so that more students have the opportunity to answer.
- Discuss the science videos and what they learned. (Have multiple students answer this so that different learning opportunities are discussed.)
- Have them write a paragraph in their science journals. **(5-10 minutes)**

⇒ Formative Assessment
- Collection of Science Journals.
    - Written evidence throughout the science lesson.
        - Notes of whiteboard lesson and science videos.

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
    - Making sure that they have retained the information long-term.
- Science Paper (at Home) – Growing a plant at home and testing to see what happens to plants it they eliminate one of the plant's needs and writing a report on what happens.

Second Lesson Topic: Patterns of Change in Earth's Surface Relating to Fossils and Rocks

(Background Information for Teacher)

Vocabulary

a. Igneous Rock: Rock formed by the solidification of molten magma.
b. Sedimentary Rock: Rock formed from consolidated clay sediments.
c. Metamorphic Rock: rock altered by pressure and heat.
d. Fossils: The remains or impression of a prehistoric organism preserved in petrified form or as a mold or cast in rock.
e. Rock Layers: A stratum is a layer of sedimentary rock or soils with internally consistent characteristics that distinguish it form other layers.

Background Information

- Igneous Rock
    - Igneous rocks are formed from the solidification of molten rock that can cause two basic types of igneous rock including intrusive and extrusive.
        - Intrusive rocks solidify below Earth's surface and these include diorite, gabbro, granite and pegmatite.
        - Extrusive rocks solidify on or above the Earth's surface and consist of andesite, basalt, obsidian, pumice, rhyolite and scoria.
- Sedimentary Rock
    - Sedimentary rocks are formed by the accumulation of sediments and the three basic types are clastic, chemical and organic sedimentary rocks.
        - Clastic rocks are formed from mechanical weathering debris and include breccia, conglomerate, sandstone and shale.
        - Chemical rocks are formed when dissolved materials precipitate from solution and form rocks including rock slat and limestone.
        - Organic rocks form from the accumulation of plant or animal debris and form coal and some other limestone.
    - Rock layers are noticeable in the Earth's surface as each layer is defined and separated from the one prior.
        - One place where you can see extensive rock layers is the Grand Canyon.
- Metamorphic Rock
    - Metamorphic rocks are usually altered by heat and pressure and buried deep in the Earth's surface. There are two types of metamorphic rocks including foliated and non-foliated rocks.
        - Foliated rocks have a layered or banded appearance because of direct heat and pressure exposure. Some of these rocks can include gneiss, phyllite, schist and slate.

        - Non-foliated rocks are not layered or banded and consist of marble and quartzite.
- Fossils
    - Fossils usually only form in sedimentary rock because it builds on the fossil over time due to accumulation so it maintains its form as opposed to crushing it.
    - Fossils can be found in casts, molds or permineralization.
        - Casts or molds are created when an organism is buried and rots away.
        - Permineralization is when an organism is buried and minerals from the ground seep into the organism and slowly replace the tissue.

Lesson Plan Two: Patterns of Change in Earth's Surface Relating to Fossils and Rocks

(Hands-On Emphasis)

Lesson Time – 70 minutes

Introduction to Class

Focusing Questions:

- What do we know about rocks?

Rocks are constantly being formed, broken down and then formed again. This is shown in the Rock Cycle. We know that there are three types including Igneous, Sedimentary and Metamorphic. Rocks have the ability to form and can therefore maintain fossils in their formations.

- Can anyone state the three types of rocks? What is unique about each?

New igneous rock is created when volcanoes erupt and the liquid rock comes up to the earth's surface and becomes solidified. Sedimentary rock is created from broken down bits of rock and sand, which is then compressed on top of each other creating layers. Metamorphic rocks are those rocks that change over time, due to pressure and heat, and originally were either igneous or sedimentary.

- All right, now lets think about this. What do we know about fossils?

Fossils are remains or impressions of a prehistoric organism preserved in petrified form or as a mold or cast in rock.

- What kinds of fossils can we find?

Fossils of animals, plants, people, almost anything.

Teacher: Today we are going to do an experiment so that we can better understand rock layers and fossils.

Materials

- Posters of the Rock Cycle
- Science Journals
- Pencils
- Newspaper (for covering tables)
- For each student:
    - Plastic water bottle
    - 5 tablespoons of Gravel
    - 5 tablespoons of Sand
    - 5 tablespoons of Chalk Powder or Plaster of Paris
    - Water
    - 1-2 coffee filters
    - Scissors
    - 6 tablespoons (if not more)
- Paper Towels

Content Standards

4-ESS1 Earth's Place in the Universe
Students who demonstrate understanding can: **4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

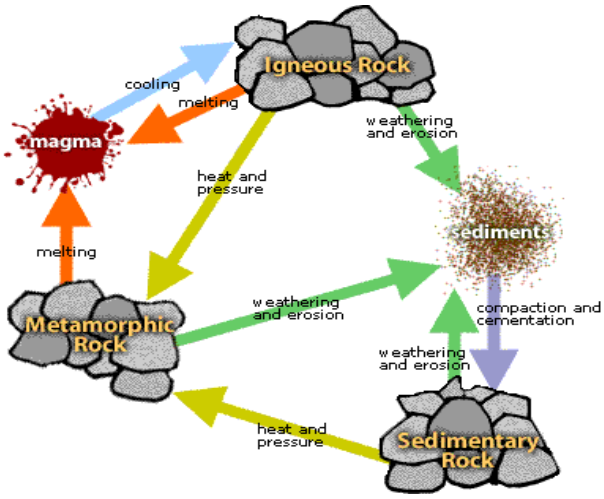
Academic Language Instruction

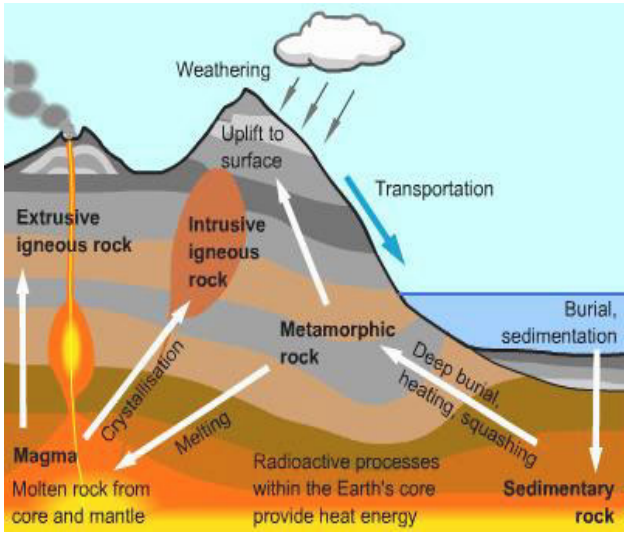
1. Igneous Rock
2. Sedimentary Rock
3. Metamorphic Rock
4. Fossils
5. Rock Layers

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    1. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. For the remaining questions the teacher can call on students and explain if students do not know the answer.
    2. Further engagement
        i. Fun Fact #1: Humans have used rocks for millions of years, from early tools and weapons to various construction materials.
        ii. Fun Fact #2: In Death Valley National Park, rocks can be found on the floor of the playa (dry lake bed) with long trails behind them. These rocks, which can weigh several hundred pounds somehow slide across the playa.
            1. Part of Death Valley National Park is in California.
        iii. Fun Fact #3: All rocks are made up of two or more minerals but minerals are not made of rocks.
2. Procedure (**50 minutes)**

1. Step #1: Restate to the class that rocks are constantly being formed, worn down and then formed again. Sometime the wearing down of rocks can be chemical and other times it can be natural. **(5-10 minutes)**
    i. Show them a few different rock cycle images for them to observe and see the differences in how the rocks will break down and change over time.
        1. Make sure to emphasize the transportation of rocks as well as the burial or layering of rocks over time. (See images below.)





2. Step #2: Have all the students take out their Science Journals. Based on the Rock Cycle images, have the students draw how each rock type is formed in their Journals. **(10 minutes)**
3. Step #3: Have the students clear their desks completely. The only things that should be on their desks are their Science Journals and a pencil. Explain that they will each create their own rock layer formation, which will help them to better understand the processes of change over time and more specifically where fossils can be located. **(20 minutes)**
    i. Each student will need to bring in a plastic water bottle.
    ii. The student will take scissors and cut a small hole in the middle of a coffee filter. The hole should be big enough to allow gravel to travel through.
    iii. The student will then shape the coffee filter into a funnel and place it in the opening spout of the bottle.
    iv. Then the student will measure 5 tablespoons of sand and pour it into the bottle. Next, 5 tablespoons of gravel. Then 5 tablespoons of chalk powder or Plaster of Paris.
    v. Then have the student pour water into the bottle until it is half way full.

vi. Have the student put the water bottle cap back on, make sure it is tight, and then shake the bottle for 20-30 seconds to mix everything up really well.
vii. Wait 3 minutes for the contents to sit and then have the students observe their bottles.
viii. Have each student write down what happens, to each ingredient added, in about a paragraph.

4. Step #4: Have the class partner share what they saw happen with their bottle. Then ask the class what happened and call on 3-5 students. Explain to the students that the materials mixed together just as materials would mix in rivers, lakes and oceans. The heavier materials sank to the bottom. **(10 minutes)**
    i. Ask what kind of rocks they think would form through this process. Have each student provide evidence for why they think one way or another.
        1. The answer should be sedimentary. → Explain to the students that most fossils are actually found in sedimentary rocks.
    ii. Ask if they think something can get stuck in those layers? As the layers built up, do they change how the area appears?
        1. If yes, what would that be called? Do we think that other fossils could get stuck in other rock formations?

Assessment Evidence (10 minutes)

- Gather back together as a class to discuss and review the three types of rocks, how they form and what can be found in them.
- Tell the students that next time in science, we will look at how these rocks move and how fossils from different places can show up in other countries.
- Discuss the Science Experiment and what they learned as well as what was most interesting about it. (Have multiple students answer this so that different learning opportunities are discussed.)

⇒ Formative Assessment
- Collection of Science Journals and Experiments to see if everyone got it to work.
    - Written evidence throughout the science lesson.
        - Notes of rock cycle and observations.

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
    - Making sure that they have retained the information long-term.
- Science Paper (at Home) - Researching the rocks in the neighborhood you live in. Are they all one type or are they mixed?

Lesson Plan Two: Patterns of Change in Earth's Surface Relating to Fossils and Rocks

(Technology Emphasis)

Lesson Time – 60 minutes

Introduction to Class

Focusing Questions:

- What do we know about rocks?

Rocks are constantly being formed, broken down and then formed again. This is shown in the Rock Cycle. We know that there are three types including Igneous, Sedimentary and Metamorphic. Rocks have the ability to form and can therefore maintain fossils in their formations.

- Can anyone state the three types of rocks? What is unique about each?

New igneous rock is created when volcanoes erupt and the liquid rock comes up to the earth's surface and becomes solidified. Sedimentary rock is created from broken down bits of rock and sand, which is then squished on top of each other in layers. Metamorphic rocks are those rocks that change over time, due to pressure and heat, and originally were either igneous or sedimentary.

- All right, now lets think about this. What do we know about fossils?

Fossils are remains or impressions of a prehistoric organism preserved in petrified form or as a mold or cast in rock.

- What kinds of fossils can we find?

Fossils of animals, plants, people, almost anything.

Teacher: Today we are going to do an experiment so that we can better understand rock layers and fossils.

Materials

- Science Journals
- Pencils and Markers
- Paper
- Video Camera or computer to film students
- Computer (to show videos)

Content Standards

4-ESS1 Earth's Place in the Universe
Students who demonstrate understanding can: **4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the

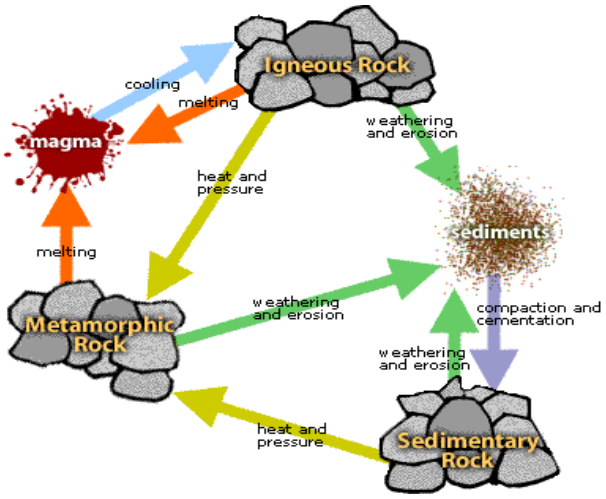
Academic Language Instruction

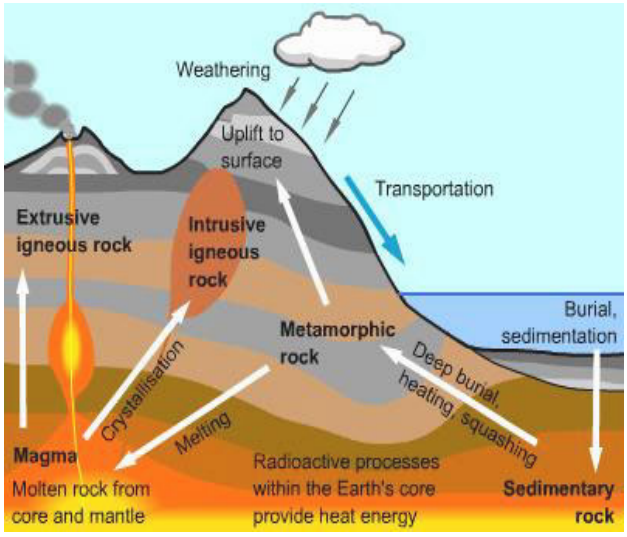
1. Igneous Rock
2. Sedimentary Rock
3. Metamorphic Rock
4. Fossils
5. Rock Layers

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. For the remaining questions the teacher can call on students and explain if students do not know the answer.
    b. Further engagement
        i. Fun Fact #1: Humans have used rocks for millions of years, from early tools and weapons to various construction materials.
        ii. Fun Fact #2: In Death Valley National Park, rocks can be found on the floor of the playa (dry lake bed) with long trails behind them. These rocks, which can weigh several hundred pounds somehow slide across the playa.
            1. Part of Death Valley National Park is in California.
        iii. Fun Fact #3: All rocks are made up of two or more minerals but minerals are not made of rocks.
2. Procedure (**40 minutes)**
    a. Step #1: Restate to the class that rocks are constantly being formed, worn down and then formed again. Sometime the wearing down of rocks can be chemical and other times it can be natural. **(5-10 minutes)**
        i. Show them a few different rock cycle images for them to observe and see the differences in how the rocks will break down and change over time. (at the bottom of the steps) Have students take notes in their Science Journals.
    b. Step #2: Show them the videos on the Rock Cycle. Have students take notes in their Science Journals. **(10 minutes)**
        i. This video http://www.youtube.com/watch?v=53lMdHzvGCQ is about 5 minutes. It is the Rock Cycle Song and catchy but a review is needed before an after because it is a little hard to understand at times.
        ii. This video https://www.youtube.com/watch?v=lE3jR_RhxO4 is about 3 minutes long and is catchy. It is the Types of Rocks Song.

5. Step #3: Have the students work with their table members to create their own song to remember about the rock types and their formation. **(20 minutes)**
    i. You can have the students be completely creative or you can guide their process by having them use certain words or certain songs.
        1. This will help the students develop their own understanding of the process.
    ii. After, the students should try to create a short video either singing their song or talking about their song and why they chose it and the words they thought were important from it.





<u>Assessment Evidence (10 minutes)</u>

- Gather back together as a class to discuss and review the three types of rocks, how they form and what can be found in them.
- Tell the students that next time in science, we will look at how these rocks move and how fossils from different places can show up in other countries.
- Discuss the Science videos and what they learned.
- Have the students write on a piece of paper why their group chose the song it did and whether or not they felt it helped them learn the material. Ask the student to draw one rock type being formed.

⇒ Formative Assessment
- Collection of paper on the group song.
    - Written evidence throughout the science lesson.
- Collection and presentation of the group song.

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
    - Making sure that they have retained the information long-term.
- Science Paper (at Home) - Researching the rocks in the neighborhood you live in. Are they all one type or are they mixed?

Third Lesson Topic: Erosion and Weathering due to Water and Vegetation

(Background Information for Teacher)

Vocabulary

1. Erosion: The wearing away of land surface by running water, wind, ice or other geologic agents, including processes such as gravitational creep.
    a. A group of processes that, acting together, slowly decompose, disintegrate, remove and transport materials on the surface of the Earth.
2. Weathering: The first step of erosion attacks solid rock, produces loose sediment, and makes the sediment available for transport.
    a. The two main processes include mechanical and chemical weathering.

Background Information

- Vegetation
    - Plants tend to secure and stabilize sediment but may also help in weathering bedrock by prying open cracks during root growth.
- Water
    - Wearing away of the soil surface by water from rain, runoff, snowmelt and irrigation. Rainwater in the form of runoff is the main cause of water erosion.
    - Complex three-step natural phenomenon which consists of detachment, transport and deposition of soil particles.
        - Detachment – breaking down aggregates
        - Transport – selective removal and movement
        - Deposition – moved material is deposited
    - There are four specific kinds of water erosion including rain splash, sheet erosion, rill erosion and gully erosion.
        - Rain splash erosion is the impact of water hitting the surface which can cause soil to loosen.
        - Sheet erosion is the unconfined flow of water running across the surface.
        - Rill erosion is the process of water flowing and cutting out small channels.
            - If not treated and checked, they can form gullies.
        - Gully erosion is the creation of steep trenches formed by a collection of rills.
- Weathering
    - Chemical: The formation and retention of minerals in equilibrium with environmental conditions at the Earth's surface.
        - Usually will lead to an increase bulk creating stress within the rock, lower density minerals, decreased particles size with increase surface area, more mobile materials and more stable materials.

        - This can also include oxidation, hydrolysis and carbonic acid action.
    - Mechanical: The disintegration of rock materials or break down of larger materials into smaller ones.
- Other
    - Steeper slopes are more susceptible to erosion.
    - Warm and moist climates increase the rate of weathering and therefore speed up the process of erosion.

Lesson Plan Three: Erosion and Weathering due to Water and Vegetation

(Hands-On Emphasis)

Lesson Time – 60 minutes

Introduction to Class

Focusing Questions:

- Has anyone ever heard of erosion? What do we think it means?

Erosion is the wearing away of land surface by running water, wind, ice or other geologic agents. It is a group of processes that, acting together, slowly decompose, disintegrate, remove and transport materials on the surface of the Earth.

- Has anyone heard of weathering? What can we guess it means?

Weathering is the first step of erosion. It attacks solid rock, produces loose sediment, and makes the sediment available for transport. The two main processes of weathering are mechanical and chemical.

- Have you ever looked at a hill and noticed it seemed barren? Do you think that erosion can occur there?

Erosion is more likely to occur on hillsides as well as areas that are not covered with vegetation.

- Do you think erosion can occur on a mountainside that isn't very steep and has lots of vegetation?

Erosion can still occur because elements such as water, wind and ice can erode through vegetation to the soil and pry it apart.

Teacher: Today we are going to focus on weathering, erosion and deposition. We are going to do an experiment to understand the ways in which water can impact soil.

Materials

- Science Journals
- Pencils
- Each group will need:
    - Two aluminum pans
    - Natural soil
    - Scissors
    - Three textbooks
    - Cup measure
    - Water

Content Standards

Students who demonstrate understanding can:

4-ESS2-1. **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of

water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

Academic Language Instruction

1. Erosion
2. Weathering

Procedures and Timeline

1. Introduction and Hook (**5-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. Since most of these questions are yes and no, as well as opinion pieces, you should give the students some "think time" before answering. (This could be one to two minutes per question.)
    b. Further engagement
        i. Fun Fact #1: Glacial movement, a form of erosion, is what created Yosemite Valley over thousands of years.
            1. Yosemite Valley is a National Park in California.
        ii. Fun Fact #2: River Erosion created the Grand Canyon as rocks were taken away.
        iii. Fun Fact #3: Deforestation and overgrazing can expedite erosion and strip the land of soils needed for food to grow.
2. Procedure (**40 minutes)**
    a. Step #1: Present the Erosion and Weathering Slideshow from http://www.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.erosion/erosion-and-weathering/. It gives a great quick overview of water erosion and wind erosion. **(15 minutes)**
        i. You can add to this with previous knowledge and also refer to the teacher background knowledge if students have questions or want to know more information.
        ii. Have the students take notes as you are talking about the important facts – not word for word. You will need to model what is important and what is information that isn't necessary to write down. Demonstrate this on the first slide.
    b. Step #2: Have the students break up into four groups in order to participate in the science experiment. Explain that the experiment is going to look specifically at the impact of water on soil. **(15-20 minutes)**
        i. Pass out all necessary supplies and then have the students follow you outside to a designated area to test the experiment. (Try to go to a grassy area so that the soil can be spilled without too much clean-up.) The students will need to follow your directions very carefully in order for this to work so you will need to model the entire process step by step.

1. Tell the students to pour dirt into one of the aluminum pans about 2-3 inches deep. If they stick their finger in it should cover about 2/3 of their finger. Have the students smooth the soil out so it is even across the entire pan.
2. Tell the students to look at and touch the soil. What is in the soil? Does it feel the same?
    a. Have the students write their answers in their Science Journals.
3. Tell the students to carefully use a needle or scissors to punch 6 small holes in one end of the pan.
    a. They should be evenly dispersed.
4. Place the second aluminum pan under the end of the dirt filled pan where the holes are located.
    a. The second pan will catch the water as it leaves the top of the pan.
5. Slip two or three books under the other end of the dirt-filled pan so that it is propped up about 2 inches higher than the end with the holes punched in it.
    a. Have the students predict what will happen when they pour one cup of water? Two cups of water? Four cups of water?
6. Have the students pour one cup of water into the dirt-filled pan at a time. After each cup, the students should write what happens in their Science Journals.
    a. The max amount of cups of water should be ten.

c. Step #3: Have the students come back into the classroom and sit down with their group members. Put the further understanding questions on the board for the students to discuss with one another and write their answers in their Science Journals. **(5 minutes)**
    i. Do you think it matters if the soil starts as wet or dry?
    ii. Does the water equally push all the soil particles?
    iii. What would happen if you added more books to make the slope steeper?

<u>Assessment Evidence (10 minutes)</u>

- Gather as a class to discuss the topics for the day.
- Review the Focusing Questions.
- Have each group share their experiences with their experiment and how it turned out.

⇒ Formative Assessment

- Collection of Science Journals.
    - Written evidence throughout the science lesson and experiment.
- Asking Assessment Evidence Questions at the end.

- Walking around during experiment to see if students understand what they are looking for and testing.

⇒ Summative Assessment

- Science Exam in 2 weeks or longer
  - Making sure that they have retained the information long-term.
- Science Paper (at Home) – Choose one area in the world that has been affected by erosion. Write one page about what kinds of weathering and erosion has occurred.
- Science Project (at Home) – Go to a site in the area and take pictures of erosion and weathering. Write up a short paragraph on where it is, what kind of erosion is occurring and predict what may happen to the area.

Lesson Plan Three: Erosion and Weathering due to Water and Vegetation

(Technology Emphasis)

Lesson Time – 60 minutes

Introduction to Class

Focusing Questions:

- Has anyone ever heard of erosion? What do we think it means?

Erosion is the wearing away of land surface by running water, wind, ice or other geologic agents. It is a group of processes that, acting together, slowly decompose, disintegrate, remove and transport materials on the surface of the Earth.

- Has anyone heard of weathering? What can we guess it means?

Weathering is the first step of erosion. It attacks solid rock, produces loose sediment, and makes the sediment available for transport. The two main processes of weathering are mechanical and chemical.

- Have you ever looked at a hill and noticed it seemed barren? Do you think that erosion can occur there?

Erosion is more likely to occur on hillsides as well as areas that are not covered with vegetation.

- Do you think erosion can occur on a mountainside that isn't very steep and has lots of vegetation?

Erosion can still occur because elements such as water, wind and ice can erode through vegetation to the soil and pry it apart.

Teacher: Today we are going to focus on weathering, erosion and deposition. We are going to look at some facts to understand their differences.

Materials

- Science Journals
- Pencils
- One set of worksheets per table (probably 6 groups)
- Scissors
- Glue
- Computer (for showing videos)

Content Standards

4-ESS2 Earth's Systems	
Students who demonstrate understanding can:	
4-ESS2-1.	**Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of

Academic Language Instruction

1. Erosion
2. Weathering
3. Deposition

Procedures and Timeline

1. Introduction and Hook (**5-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. Since most of these questions are yes and no, as well as opinion pieces, you should give the students some "think time" before answering. (This could be one to two minutes per question.)
    b. Further engagement
        i. Fun Fact #1: Glacial movement, a form of erosion, is what created Yosemite Valley over thousands of years.
            1. Yosemite Valley is a National Park in California.
        ii. Fun Fact #2: River Erosion created the Grand Canyon as rocks were taken away.
        iii. Fun Fact #3: Deforestation and overgrazing can expedite erosion and strip the land of soils needed for food to grow.
2. Procedure (**40 minutes)**
    a. Step #1: Step #1: Show your class one of the Weathering and Erosion Videos. Tell students to take notes in their Science Journals on both videos. (**10 minutes)**
        i. http://makemegenius.com/video_play.php?id=141
            1. Whole video – kid friendly and about 5 minutes
        ii. http://www.youtube.com/watch?v=XteN4hRrbJM
            2. Whole video – kid friendly and about 3 minutes
    b. Step #2: Have table groups discuss what the videos talked about. Make sure the students understand the difference between weathering and erosion as well as the different kinds of weathering that can occur. (**10 minutes)**
        i. While the students discuss in their groups, write the words mechanical and chemical on the board. Have one student from each group come up and write their groups definition of the word on the board. Have all the students write these definitions in their Science Journal.
    c. Step #3: Pass out the worksheets on weathering, erosion and deposition. **(20 minutes)**
        i. The students will have one worksheet explaining again the definition of all three words. The second page will have the three words in boxes that need to be cut out. The next two pages have lots of different facts that the students will need to place in the correct boxes.
            1. Each student can help cut and one set can be given to each table group.

2. Here is the website where the worksheets can be found: http://www.lauracandler.com/filecabinet/science/WeatheringErosionandDeposition.pdf

ii. The students should work together to place the answers in the correct boxes. After they have finished, have the students write down one or two important facts for each box in their Science Journal.

Assessment Evidence (5-10) minutes

- Go back to the classroom and then gather as a class to discuss the topics for the day.
- Review the Focusing Questions and break them apart so that more students have the opportunity to answer. Have the students pair-share some questions to hear different people talk.

⇒ Formative Assessment
- Collection of Group Worksheets and Science Journals.
  - Written evidence throughout the science lesson, videos and worksheet.
- Asking Assessment Evidence Questions at the end.

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
  - Making sure that they have retained the information long-term.
- Science Paper (at Home) – Choose one area in the world that has been affected by erosion. Write one page about what kinds of weathering and erosion has occurred.
- Science Project (at Home) – Go to a site in the area and take pictures of erosion and weathering. Write up a short paragraph on where it is, what kind of erosion is occurring and predict what may happen to the area.

Fourth Lesson Topic: Renewable and Non-Renewable Energy

(Background Information for Teacher)

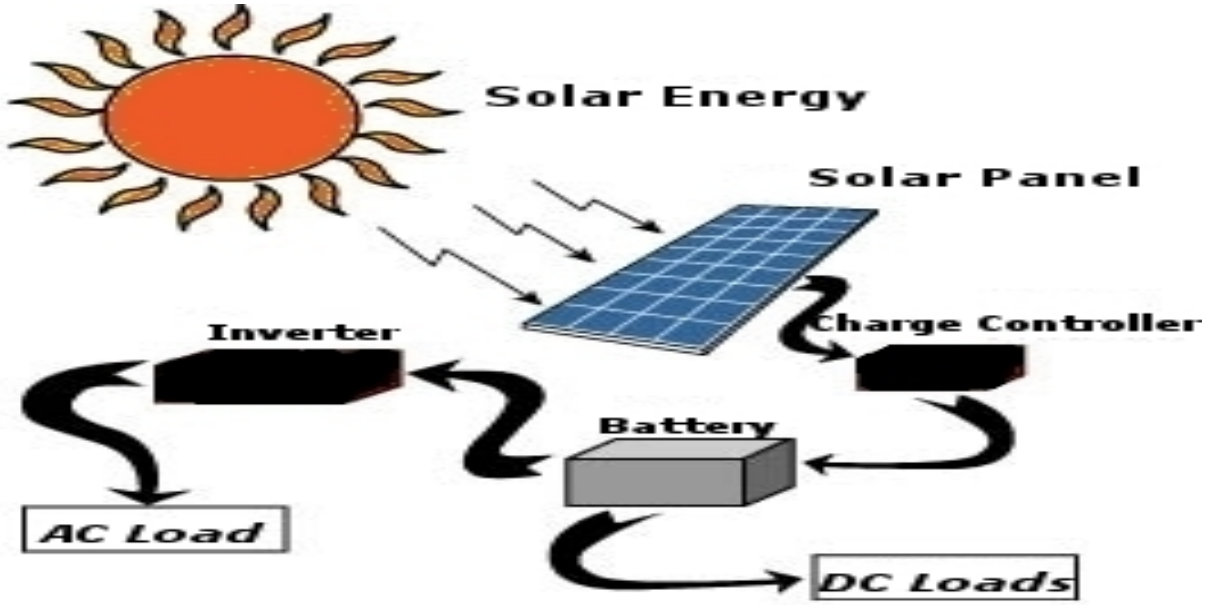
Vocabulary

1. Renewable Energy: Any naturally occurring, theoretically inexhaustible, source of energy such as biomass, solar, wind, tidal, wave and hydroelectric power, that is not derived from fossil or nuclear fuel.
    a. Solar: Radiant energy emitted by the sun.
    b. Wind: Electrical energy obtained from harnessing the wind by utilizing windmills or wind turbines.
    c. Tidal: A form of hydropower that converts energy of the tides into useful forms or power – mainly electricity.
    d. Bio-energy: Renewable energy produced by living organisms.
2. Non-renewable Energy: A resource that cannot be replaced after it has been used.
3. Fossil Fuels: A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
    a. Carbon: A chemical element, which is the main component of fossil fuels.

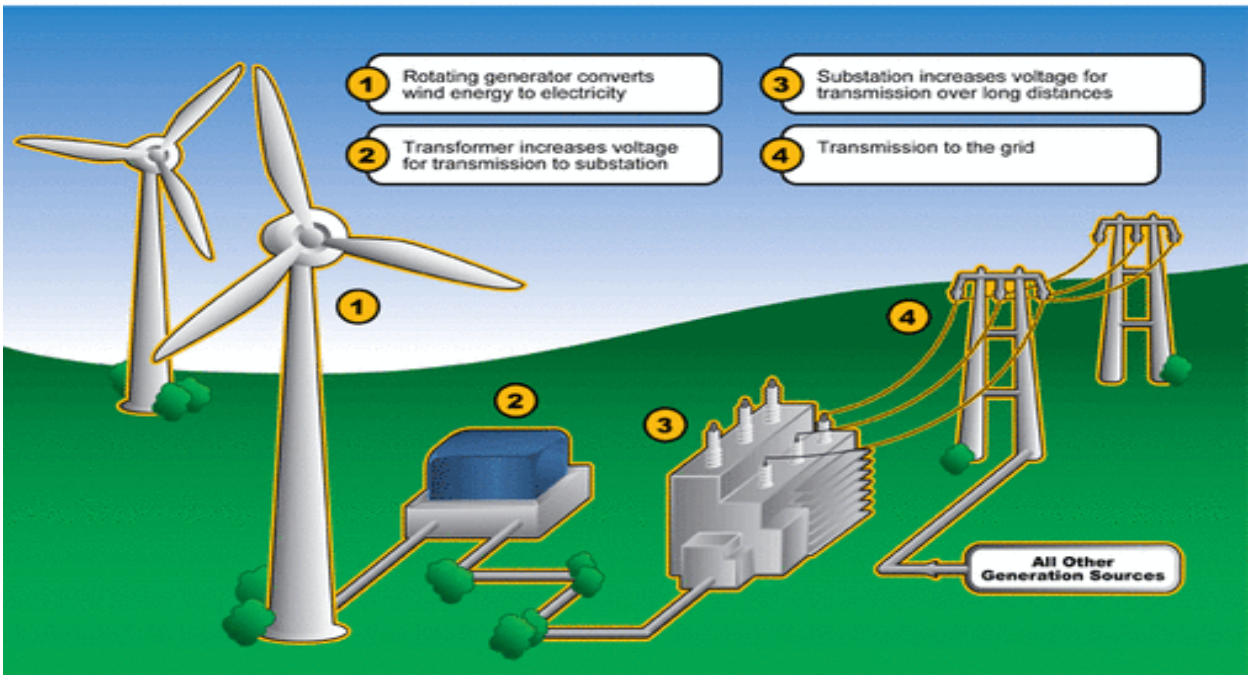
Background Information

- **Renewable Energy**
    - The United States is lagging in the development of future renewable energy resources when compared to European countries.
    - Becoming more important as our society is realizing the negative effects of non-renewable energy such as coal, oil and nuclear.
- **Solar Energy**
    - **One of the largest energy resources. → Could potentially supply enough energy for the whole world if obtained and harnessed properly.**
    - A push for solar energy development didn't take flight until after World War II around the 1950's. At this point in time, the focus was on Nuclear energy and the potential that would bring. The Paley Report, created by William Paley who was the chair of the President's Materials Policy Commission during the Truman period, discussed the 'possibility for solar energy' and advised a push to create solar fields. In the last 60 years, solar energy has gained more attention but is not nearly as utilized as it could be.
    - Considerably smaller environmental footprint in comparison to fossil fuels. Solar panels can be placed on homes for low/medium heat systems as well as can be large-scale projects such as in the Mojave Desert.
    - Photovoltaic (PV) Panels, more commonly referred to as solar panels, obtain solar Energy from the sun. The electric current running through goes into a Charge

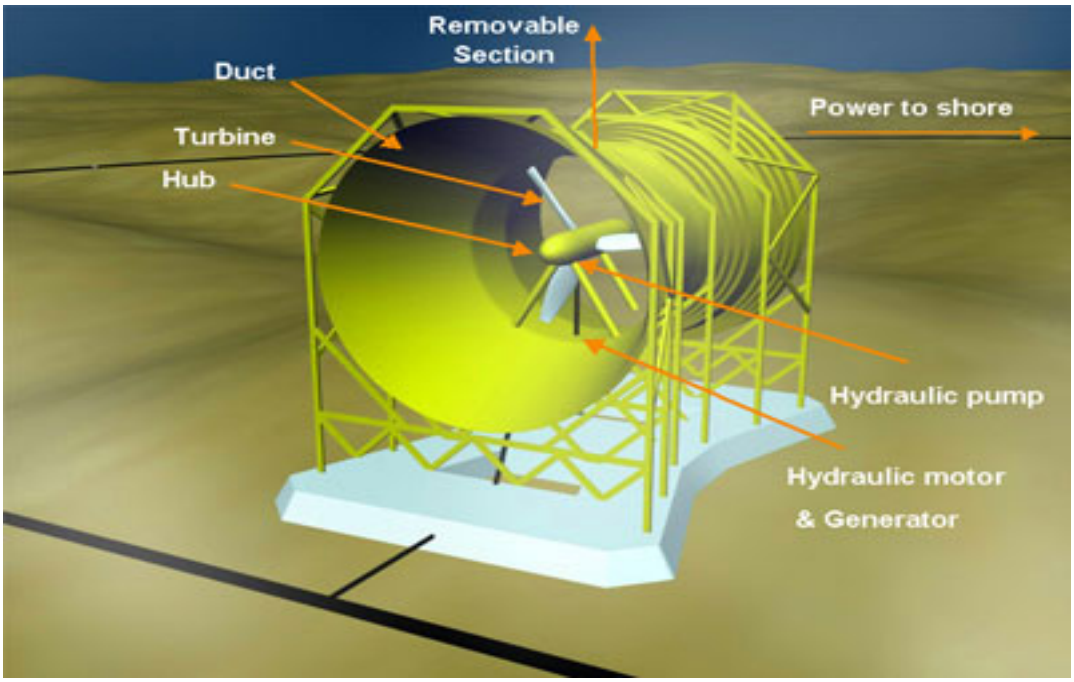
Controller, which is able to process the high amounts of energy and then send them to a battery system. The battery will disperse the energy to a Direct Current (DC) Power, an Inverter, or both. From the Inverter, the energy then proceeds to the Alternating Current (AC) Power. This then goes into the Home Electrical Panel that is measured by the Utility Meter and placed on the Utility Grid.



- **Wind Energy**
  - Windmills have been in existence since 200 BC. They were evolved and perfected in the United States during the 19th century. The first wind mechanism that could create electricity was installed in Cleveland, Ohio in 1888. After the oil crisis of 1973, wind energy gained momentum as turbines and windmills were popping up all over the United States.
    - Between 1981-1990, 16,000 wind machines were installed in California.
    - Europe has exceeded the United States in building and installing wind machines. (It has double the distribution of global wind power capacity as the United States.)
  - Can be built onshore and offshore. Need to be in places with high volumes of wind in order for them to be efficient and effective. The second most desirable renewable energy to the public and fastest-growing energy source in the world.
  - When the blades begin to move, they spin a shaft that leads to a generator. The generator consists of a conductor, such as a coiled wire, that is surrounded by magnets. The rotating shaft turns the magnets around the conductors and generates an electrical current. Sensors cause the top of the turbine to rotate to face into the wind and the blades change their angle to catch the wind.



- **Tidal Energy**
  - Extremely predictable energy source – focuses on the earth-moon system. Technology is still being created to learn the best techniques to fully harness the potential energy from tides. Clean and renewable source of energy.
  - The tidal phenomenon occurs twice every 24 hours, 50 minutes and 28 seconds.
  - Main tidal power facilities include tidal barrages and tidal current turbines.
    - Tidal barrage – more commonly known as a dam.
      - It is built across a bay or estuary. Similar to hydroelectric energy but the water flows in both directions.
      - 4 Barrages → La Rance, France; Bay of Fundy, Canada; Kislaya Guba power facility, Russia; Jangxia Creek, east China Sea
      - Projects are very costly but resource is already available and reliable.
    - Tidal Turbines
      - Horizontal axis tidal current turbines: The turbine blades rotate about a horizontal axis, which is parallel to the direction of the flow of water.
      - Vertical axis tidal current turbines: The turbine blades rotate about a vertical axis, which is perpendicular to the direction of the flow of water.
      - Many unique kinds of turbines
      - Issues include installation challenges, maintenance, electricity transmission, loading conditions and environmental impacts.



- **Non-renewable Energy**
  - Energy resources that are exhaustible and will therefore be completely depleted in the upcoming decades.
- **Fossil Fuels**
  - Primary provider of global energy. Dead organic matter must lie in either stagnant, oxygen-free waters at the bottom of the sea until buried or be buried quickly after death.
  - Oil
    - Dead organic matter must lie in either stagnant, oxygen-free waters at the bottom of the sea until buried or be buried quickly after death. It can be found in oil pits, sands, seeps, springs and tar pits. Early uses included street paving, medicine, waterproofing and lighting.
    - Utilized for over 1,500 years and originally began in China in 347 A.D.
    - 1858 – First oil well in North America
    - 1859 – First oil well in the U.S. (Titusville, Pennsylvania)
      - Only produced about 10 barrels/day
    - 1861 – First oil well in CA is drilled in Humboldt County
    - 1901 – largest oil gusher. Spindletop Hill → 100,000 barrels/day (Beaumont, Texas)
      - When people began to realize the true potential of oil
    - **<u>Limited resource – will cause continuous wars as it is further depleted</u>**
  - Coal
    - Becoming more important as a primary source of energy. This is probably because it is the cheapest source of energy.

- The history of coal began originally as a substitute for wood for producing glass and smelting metals after the forests were cut down. Many issues came from coal because it was a dangerous occupation. Miners would work in the caves and risk the caves falling in on them and trapping them as well as being exposed to poisonous gases such as methane.
- Controversial resource since the beginning
    - Severe air pollution in various parts of Europe
    - Switched to wood because of deforestation
- Four types of coal
    - Lignite – Lowest quality but largest portion. Geologically young, soft, brownish-black and has the lowest carbon content.
    - Sub-bituminous – Dull black with slightly higher carbon content. Used for generating electricity.
    - Bituminous – More carbon content and most plentiful In the U.S. It is used to generate electricity.
    - Anthracite – Highest carbon content and closely associated to home heating because it burned nearly smokeless. Very scarce and largely exhausted resource.

o Nuclear
- Clean energy because it doesn't generate emissions to global warming but dirty energy because the spent fuel needs to be disposed of somehow.
- Expensive and extremely harmful to the environment if leaks or spills occur. (i.e. Three Mile Island, Chernobyl, Fukushima)
- Most common in the United States, Japan and France. The U.S. began investing in nuclear energy in the 1950's and 1960's after the creation and explosion of the atomic bomb.

Lesson Plan Four: Renewable and Non-Renewable Energy

(Hands-On Emphasis)

Lesson Time – 85 minutes → may be broken up if needed

Introduction to Class

Focusing Questions:

- What is energy? Does anyone know the difference between renewable and non-renewable energy?

Energy can come from many different kinds of sources such as oil, water, wind and even the sun. The two types of energy are renewable and non-renewable. Renewable energy can be used again and again whereas non-renewable energy is a one-time use.

- Can anyone name some energy sources?

Some examples of non-renewable energy are fossil fuels such as oil and coal, which the United States relies on in order to function regularly. Some renewable energy resources are solar panels, wind turbines and dams or wave power.

- Where can we find these energy sources in the world?

Many of the non-renewable sources are shipped in from countries in the Middle East. Coal mines are still in operation in the United States but are not as common because of their dangerous conditions and unsustainable methods for extracting the coal.

- How do we use energy?

We use energy daily because energy powers our cars, heats our homes and allows us to participate in activities such as watching television.

- How can we conserve energy?

There are many ways we can conserve energy including fluorescent light bulbs, low-flow toilets and something simple like bicycling.

Teacher: Today we are going to focus on renewable energy and non-renewable energy and how they impact the environment.

Materials

- White boards and markers **or** Paper and Pencils
- 5 images of energy sources (per table)
- Science Journals
- 5 process graphics for each energy source
- Anemometers (each student will need)
    - 2 straws
    - Staples (10)
    - Tape
    - 1 sheet of paper (4 cone patterns on paper to cut out)
    - Red marker
    - Push pin
    - Pencil
    - Water Bottle with a narrow neck

- Scissors
- Watch

Content Standards

4-ESS3 Earth and Human Activity
Students who demonstrate understanding can: **4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

Academic Language Instruction

1. Renewable Energy: Sources of energy that are infinite and will never run out. These include wind, water and the sun.
2. Non-renewable Energy: Sources of energy that are finite and will one day run out.
3. Fossil Fuels: Fuel consisting of the remains of organisms preserved in rocks in the earth's crust.
4. Solar Energy
5. Wind Energy
6. Tidal Energy

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. For the remaining questions the teacher can call on students and explain if students do not know the answer.
    b. Further engagement
        i. Fun Fact #1: The sun's light hitting the Earth for one hour has enough energy to power the world for one year.
        ii. Fun Fact #2: The Mojave Desert, in the United States, is home to the world's largest solar power plant.
            1. Part of the Mojave Desert is in California.

iii. Fun Fact #3: Most types of energy are either a form of kinetic energy or potential energy.

2. Procedure (**60 minutes)**
    c. Step #1: Pass out five images to each table. The five images will be a solar panel, a wind turbine, a dam, an oil barrel and a mineral. (**5 minutes)**
        i. The words renewable and non-renewable will be spelled out on the board along with the five words (solar panel, winder turbine, etc.).
        ii. Explain to the students that they will need to identify whether they think the energy resource is renewable or non-renewable and why. They will work with their group members and will write the answers down in their science journals. They will also write which kind of energy source they think it is (i.e. solar panel).
    d. Step #2: Have the students individually hypothesize in their science journals how they believe the energy is obtained and stored. (**10 minutes)**
        i. The teacher will walk around as the students are working and encourage them to look for contextual clues in the images.
    e. Step #3: Bring the class back together and give a short presentation on the different kinds of energy sources. (**15 minutes)**
        i. Re-state that renewable energy sources can be used over and over again and that non-renewable energy sources are used once and are finite.
        ii. Have one student from each group come up one at a time and place a different image on the front board under either the renewable energy or non-renewable energy.
        iii. After each student brings up the image – discuss it utilizing the Teacher Background Information. Talk about how it works and what it can do to the environment.
    f. Step #4: Science Project (**30 minutes total**)
        i. The students will build their own anemometer, which is a way of measuring wind energy. (**15 minutes)**
        ii. The teacher will demonstrate and model the project to the class prior to receiving the materials. (**2-3 minutes)**
            2. The students will each need to bring in one, or more, plastic water bottle.
            3. The students will staple the two straws to each other so that they make an X.
            4. The student will then cut out the cones, which will be pre-printed on the piece of paper. One of the cones should be colored red.
            5. After cutting and coloring, the student will staple one cone pattern to each straw so that they all face the same way.
            6. The students will curve each cone pattern to form a cone and then tape it.

7. They will then pin the center of the X (straws) to the pencil eraser.
8. Lastly, the student will insert the pencil in the narrow necked bottle, so that the anemometer can spin freely.

iii. Take the students outside, away from other classrooms, and have them try to measure how many times their cones rotate as you time a minute. (**5 minutes)**

9. Explain to the students that they will be counting one spin every time the red cone makes a full circle.

iv. Go back inside the classroom and have the students write down their observations. (**5 minutes)**

v. Discuss them as a class and see if they grasped the material (i.e. is this renewable and why). (**2-3 minutes)**

<u>Assessment Evidence (15 minutes)</u>

- Gather back together as a class to discuss the topics for the day.
- Review the Focusing Questions and break them apart so that more students have the opportunity to answer. (i.e. What is non-renewable energy? What is renewable energy?)
- Discuss the Science Project and what they learned. (Have multiple students answer this so that different learning opportunities are discussed.)
- Have them write a paragraph in their science journals. (**5-10 minutes)** They should answer the following questions:
    - What is the difference between renewable and non-renewable energy? Name some examples of each.
    - Choose an energy source and discuss its process of being collected and stored. (Can be written, drawn or both.)
    - Do you think one energy source is better than the others discussed?
    - What energy resource did you enjoy learning about the most?
    - Name one fact that you didn't know before.

⇒ Formative Assessment

- Collection of Science Journals
    - Written evidence throughout the science lesson.
- Asking Assessment Evidence Questions.

⇒ Summative Assessment

- Science Exam in 2 weeks or longer
    - Making sure that they have retained the information long-term.
- Science Paper (at Home) - Researching a kind of energy source either discussed in class or a different energy source (i.e. Geothermal energy)
- Science Project (at Home) - Researching a kind of energy source either discussed in class or a different energy source (i.e. Geothermal energy) and creating a hand-drawn image or built example to bring into class.

Lesson Plan Four: Renewable and Non-Renewable Energy

(Technology Emphasis)

Lesson Time – 80 minutes → can be broken up if necessary

Introduction to Class

Focusing Questions:

- What is energy? Does anyone know the difference between renewable and non-renewable energy?

Energy can come from many different kinds of sources such as oil, water, wind and even the sun. The two types of energy are renewable and non-renewable. Renewable energy can be used again and again whereas non-renewable energy is a one-time use.

- Can anyone name some energy sources?

Some examples of non-renewable energy are fossil fuels such as oil and coal, which the United States relies on in order to function regularly. Some renewable energy resources are solar panels, wind turbines and dams or wave power.

- Where can we find these energy sources in the world?

Many of the non-renewable sources are shipped in from countries in the Middle East. Coal mines are still in operation in the United States but are not as common because of their dangerous conditions and unsustainable methods for extracting the coal.

- How do we use energy?

We use energy daily because energy powers our cars, heats our homes and allows us to participate in activities such as watching television.

- How can we conserve energy?

There are many ways we can conserve energy including fluorescent light bulbs, low-flow toilets and something simple like bicycling.

Teacher: Today we are going to focus on renewable energy and non-renewable energy and how they impact the environment.

Materials

- Science Journals
- Computer (to show students videos in classroom)
- Computer Lab for students (two students per computer if not enough for one to one)
- Worksheet on Energy Resource (one per student)
- Pencils

Content Standards

Students who demonstrate understanding can:

4-ESS3-1. **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

Academic Language Instruction

1. Renewable Energy: Sources of energy that are infinite and will never run out. These include wind, water and the sun.
2. Non-renewable Energy: Sources of energy that are finite and will one day run out.
3. Fossil Fuels: Fuel consisting of the remains of organisms preserved in rocks in the earth's crust.
4. Solar Energy
5. Wind Energy
6. Tidal Energy

Procedures and Timeline

3. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should write down on either a piece of paper or a white board. Allow the students one minute to think of their answer. Call on 3-4 students to answer what they think energy is.
        ii. Have the students pair-share with a partner to discuss what the difference is between renewable and non-renewable resources for two minutes. Call on 2-3 groups.
        iii. For the remaining questions the teacher can call on students and explain if students do not know the answer.
    b. Further engagement
        i. Fun Fact #1: The sun's light hitting the Earth for one hour has enough energy to power the world for one year.
        ii. Fun Fact #2: The Mojave Desert, in the United States, is home to the world's largest solar power plant.
            1. Part of the Mojave Desert is in California.
        iii. Fun Fact #3: Most types of energy are either a form of kinetic energy or potential energy.
4. Procedure (**55 minutes)**
    a. Step #1: Show your class one of the Non-renewable and Renewable Energy Sources Video. (**5-10 minutes)**
        i. http://www.youtube.com/watch?v=q5JEiqy6WLs
            1. Whole video – kid friendly and about 3 minutes
        ii. http://www.youtube.com/watch?v=-1EIhowgtgA
            1. Watch to about 2:20 unless you would like to discuss geothermal at this time – more factual
        iii. http://www.youtube.com/watch?v=6O2A2x1Wyhk
            1. Whole video – kid friendly and about 3 minutes
    b. Step #2: Have table groups discuss what the videos talked about. (**5 minutes)**

i. While the students discuss in their groups, write the words renewable and non-renewable on the board along with the words describing specific energy sources. Have the students write this down in their science journal.

c. Step #3: Pass out the worksheet that the students will answer questions about while they work in the computer lab doing individual and partner research on renewable and non-renewable energy. **(20 minutes)**
    i. The worksheet will ask the following questions:
        - What is the difference between renewable and non-renewable energy? Name three examples of each.
        - Choose an energy source and discuss how its process of being collected and stored. (Can be written, drawn or both.)
            a. The teacher will assign the energy sources to the table and the students will each pick one to research and come back to inform their table about.
        - Why is this energy source the best or worst? Explain.
    ii. Tell the students to go to the website http://energyclassroom.com/. Allow them to explore other websites if they would like as they are related. Walk around and assist students. Make sure students are staying on topic so that they finish their papers on time.

d. Step #4: Have the students gather in their table groups, in the computer lab, and have each student present the energy resource they looked up. (**5-10 minutes)**
    i. Tell the other students in the groups to take notes in their science journal so that they have the information for later.

e. Step #5: On the http://energyclassroom.com/ tell them to explore the Power Sources tab of the website and practice using the interactive Power Puzzle to test their understanding of how the energy sources are created and used. (**10 minutes)**
    i. Model and demonstrate that there are videos to watch as well as interactive games to play.

<u>Assessment Evidence (15 minutes)</u>

- Go back to the classroom and then gather as a class to discuss the topics for the day.
- Review the Focusing Questions and break them apart so that more students have the opportunity to answer. (i.e. What is non-renewable energy? What is renewable energy?)
- Have one student who looked up each energy resource topic give a summary to the class.
- Have them write a paragraph in their science journals. (**5-10 minutes)** They should answer the following questions:
    - Do you think one energy source is better than the others discussed?
    - What energy resource did you enjoy learning about the most?
    - Name one fact that you didn't know before.

⇒ Formative Assessment
- Collection of Worksheets and Science Journals.
    - Written evidence throughout the science lesson.

- Asking Assessment Evidence Questions.

⇒ Summative Assessment

- Science Exam in 2 weeks or longer
  - Making sure that they have retained the information long-term.
- Science Paper (at Home) - Researching a kind of energy source either discussed in class or a different energy source (i.e. Geothermal energy)
- Science Project (at Home) - Researching a kind of energy source either discussed in class or a different energy source (i.e. Geothermal energy) and creating a hand-drawn image or built example to bring into class.

Fifth Lesson Topic: Natural Hazards and Preparation for Environmental Effects

(Background Information for Teacher)

Vocabulary

- Natural Hazard: The potential, experience, and aftermath of environmental extremes such as earthquakes, volcanic activity, drought, storms and other weather extremes.
- Earthquake: A sudden slipping or movement of a portion of the earth's crust, accompanied and followed by a series of vibrations.
- Epicenter: The place on the earth's surface directly above the point on the fault where the earthquakes rupture began.
- Aftershock: An earthquake of similar or less intensity that follows the main earthquake.
- Fault: The fracture across which displacement has occurred during an earthquake.
- Magnitude: The amount of energy released during an earthquake, which is computed from the amplitude of the seismic waves. Each whole number on the scale represents an increase of about 30 times more energy released than the previous whole number.
- Seismic Waves: Vibrations that travel outward from the earthquake fault at speeds of several miles per second.

Background Information

- Variables of Environmental Hazards
    - Risk – The probability of particular extreme events occurring in a particular place.
    - Exposure – The number of people and value of property or other social goods physically exposed to a given hazard.
    - Vulnerability – Highlights the uneven effects of a given hazard on differentiated societies. Determine socially differentiated impacts experienced by people otherwise similarly exposed to the same level of hazard intensity and frequency.
    - Response – Identifying strategies to put into place prior to a natural hazard, during a natural hazard and after a natural disaster.
- Hazard Response
    - **Utilize the FEMA website as it has all the possible answers to help your students succeed in their earthquake community plans. http://www.ready.gov**
    - Pre-disaster planning and preparation – Earthquake Needs and Necessities
    - Vulnerability mitigation
        - Disaster Risk Reduction Strategies (DDR) – aimed at addressing the sort of differential vulnerabilities.
    - Disaster relief
    - Long-term reconstruction
    - Resistance and Resilience
- Responding to an Earthquake

- Drop down onto your hands and your knees.
- Cover your head and neck.
- Hold on to your shelter.
- Do not → run outside or to other rooms or stand in doorways

- Earthquake Needs and Necessities
  - Food – Store enough food to last for 72 hours. The food should be what your family will eat as well as taking into account special dietary needs. Some good options are salt-free crackers, cereals, canned foods with high liquid content, dried fruit, nuts, vitamins and comfort/stress foods. You should also make sure to have a can opener and a few eating utensils.
  - Water – one gallon per person/day
  - Battery powered radio with extra batteries
  - Flashlight with extra batteries
  - First Aid Kit
  - Whistle
  - Wrench or pliers to turn off utilities (if possible)
  - Clothing – Each individual should have at least one complete change of warm clothing and shoes. This should include a jacket, pants, long sleeve shirt, sturdy shoes, hat and gloves.
  - Some extras
    - Sleeping bags and tents
    - Cash or traveler's checks
    - Important family documents such as copies of insurance policies, identification and bank accounts records in a waterproof portable container.

Lesson Plan Five: Natural Hazards and Preparation for Environmental Effects

(Hands-On Emphasis)

Lesson Time – 115 minutes → should be broken up into two days due to research gathering

Introduction to Class

Focusing Questions:

- What is a natural hazard? Does anyone know the difference between hazard and a disaster?

A natural hazard, also known as an environmental hazard, refers to the potential, experience, and aftermath of environmental extremes such as earthquakes, volcanic activity, drought, storms and other weather extremes. Hazard is different from disaster because a disaster only refers to the actual extreme event.

- Can anyone name some natural hazards that occur throughout the world?

Some examples include drought, earthquakes, extreme heat, foods, hurricanes, landslides/debris flow, thunderstorms and lightning, tornadoes, tsunamis, volcanoes, wildfires, winter storms and extreme cold.

- Does anyone know the most common hazards for California?

Earthquakes, Tsunamis and Wildfires

- What can these natural hazards do to communities? Can they affect people like you and me?

They can cause injury to property, such as homes, as well as individuals. Sometimes, these disasters can destroy an entire community and need complete rebuilding, if that is deemed possible. They can affect whoever is in, near or around the area where the disaster is occurring.

- Let's focus on earthquakes – what can we do to prepare for these?

There are many ways we can prepare and this is going to be our focus for the day.

Teacher: Today we are going to learn more about earthquakes and what they are caused from, some of their hazards and how to prepare for an earthquake.

Materials

- One worksheet per student
- Pencils
- 6 or more copies of Earthquakes by Deborah Heligman
- 6 or more copies of Earthquakes by Neil Morris
- 6 posters
- Markers
- Computers – for further research and printing images if desired
- Scissors
- Glue sticks

Content Standards

4-ESS3 Earth and Human Activity
Students who demonstrate understanding can: **4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Academic Language Instruction

1. Earthquake: A sudden slipping or movement of a portion of the earth's crust, accompanied and followed by a series of vibrations.
2. Epicenter
3. Aftershock
4. Fault
5. Magnitude
6. Seismic Waves

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should pair-share with the person sitting next to them. Allow the students two minutes to talk about their answer. Call on three students to answer what they think a hazard is and three more students to answer the difference between that and a disaster.
        ii. Ask For the remaining questions and choose multiple students to answer each questions. Allow students to have some "think time" prior to answering. Tell them to try and organize their answers before saying the first thing to come to their heads.
    b. Further engagement
        i. Fun Fact #1: There are about 500,00 earthquakes a year. In Southern California, there are 10,000 earthquakes, but most of these earthquakes aren't felt by people.
        ii. Fun Fact #2: The Pacific Ring of Fire is the most geologically active region of Earth. It circles the Pacific Ocean.
        iii. Fun Fact #3: The largest earthquake ever recorded was a magnitude 9.5 in Chile on May 22, 1960.
            1. Discuss the intensity of this in regards to the 30 times each magnitude level.
2. Procedure (**90 minutes – split into two days and have presentations on different days)**

a. Step #1: Split the class into six groups, not based on reading abilities. Hand out one Earthquake worksheet to each student. Explain that they will only be working on the left column, which will have the student provide previous knowledge about earthquakes. **(15-20 minutes)**
    i. They will need to answer all the questions with their previous knowledge. They may rely on their group members to help answer questions as they go but it should mainly be the individual student's knowledge and hypotheses.
        1. The questions on the handouts will be:
            a. What causes an earthquake to occur?
            b. What is an aftershock, the epicenter, a fault, a magnitude and a seismic wave?
            c. Name two specific damages an earthquake can cause.
            d. After an earthquake what should you do?
            e. Extra credit: Have you ever experienced an earthquake? How did it make you feel and what did you notice going on around you? If you haven't experienced an earthquake, what do you think it would feel like?
    ii. Then have the students read aloud their answers to one another. Demonstrate and model to the students how you would like them to do this. (i.e. Everyone in the group answers number one and then moves to number 2 or someone reads all their answers and then the next person reads theirs.)
b. Step #2: Hand each group one copy, if not more, of the book Earthquakes by Deborah Heligman and Earthquakes by Neil Morris. Tell the students to look through the book together for information that is asked on the worksheet. **(15 minutes)**
    i. Tell the students to take turns reading sections of the text.
        1. If more than one copy for each group, have a smaller group read and find information.
c. Step #3: Explain to the class that one of the goals for the rest of the science time today is to become informed about the possible ways that earthquakes can affect us and how we can be prepared for them. After the group has completed their worksheet, they will work together to create a plan for an earthquake for a particular location as well as safety precautions that can be used. **(15-20 minutes)**
    i. Discuss six locations including a school, a house, a playground, church or temple, the grocery store and in a car.
    ii. Tell the students they should think about what they may need if the magnitude of the earthquake was a 7.0 and they were stuck somewhere for a full day.

1. When walking around, see if the students are thinking of preparing in advance of the earthquake or in the moment. Advise students to think in advance as this can happen anytime, anywhere.

d. Step #4: (Depending on the time given to the students as well as extra resources, this could take place on a separate day.) Have each group create a poster with their location. Each group will give a presentation and each member of the group will need to try to say at least one interesting fact or decision. (**30-35 minutes)**
   i. Allow 5-7 minutes for each group.
   ii. If students do not feel comfortable talking in front of their peers try to have them participate in a different way (i.e. holding the poster or handing out materials to students when giving presentation.)

Assessment Evidence (10-15 minutes)

- After all the presentations have occurred, have the students get back in their groups and talk about the most interesting fact they learned. **(5 minutes)**
- On the back of the worksheets, have each student write a few sentences about the other groups presentations and if they felt they would add or change anything to them or their own based on what they saw each group present. (**5-10 minutes)**

⇒ Formative Assessment
- Collection of Worksheets and Posters from Presentations.
- Asking Assessment Evidence Questions
  - Evaluating their own work and others

⇒ Summative Assessment
- Science Exam in 2 weeks or longer
  - Making sure that they have retained the information long-term.
- Science Report (at Home) - Researching a specific earthquake either discussed in class or a different earthquake.
- Science Project (at Home) – Have the students check their own homes to see if they are prepared for an earthquake. Write about whether they are or not and provide evidence.

Lesson Plan Five: Natural Hazards and Preparation for Environmental Effects

(Technology Emphasis)

Lesson Time – 95 minutes (plus 60 bonus minutes)

Introduction to Class

Focusing Questions:

- What is a natural hazard? Does anyone know the difference between hazard and a disaster?

A natural hazard, also known as an environmental hazard, refers to the potential, experience, and aftermath of environmental extremes such as earthquakes, volcanic activity, drought, storms and other weather extremes. Hazard is different from disaster because a disaster only refers to the actual extreme event.

- Can anyone name some natural hazards that occur throughout the world?

Some examples include drought, earthquakes, extreme heat, foods, hurricanes, landslides/debris flow, thunderstorms and lightning, tornadoes, tsunamis, volcanoes, wildfires, winter storms and extreme cold.

- Does anyone know the most common hazards for California?

Earthquakes, Tsunamis and Wildfires

- What can these natural hazards do to communities? Can they affect people like you and me?

They can cause injury to property, such as homes, as well as individuals. Sometimes, these disasters can destroy an entire community and need complete rebuilding, if that is deemed possible. They can affect whoever is in, near or around the area where the disaster is occurring.

- Let's focus on earthquakes – what can we do to prepare for these?

There are many ways we can prepare and this is going to be our focus for the day.

Teacher: Today we are going to learn more about earthquakes and what they are caused from, some of their hazards and how to prepare for their arrival on our local environment.

Materials

- Science Journals
- Pencils
- Paper
- Computers

Content Standards

4-ESS3 Earth and Human Activity
Students who demonstrate understanding can: **4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Academic Language Instruction

1. Earthquake: A sudden slipping or movement of a portion of the earth's crust, accompanied and followed by a series of vibrations.
2. Epicenter
3. Aftershock
4. Fault
5. Magnitude
6. Seismic Waves

Procedures and Timeline

1. Introduction and Hook (**7-10 minutes**)
    a. The hooks for the lesson are the focus questions.
        i. Ask the students the focusing questions. The first focus questions they should pair-share with the person sitting next to them. Allow the students two minutes to talk about their answer. Call on three students to answer what they think a hazard is and three more students to answer the difference between that and a disaster.
        ii. Ask For the remaining questions and choose multiple students to answer each questions. Allow students to have some "think time" prior to answering. Tell them to try and organize their answers before saying the first thing to come to their heads.
    b. Further engagement
        i. Fun Fact #1: There are about 500,00 earthquakes a year. In Southern California, there are 10,000 earthquakes, but most of these earthquakes aren't felt by people.
        ii. Fun Fact #2: The Pacific Ring of Fire is the most geologically active region of Earth. It circles the Pacific Ocean.
        iii. Fun Fact #3: The largest earthquake ever recorded was a magnitude 9.5 in Chile on May 22, 1960.
            1. Discuss the intensity of this in regards to the 30 times each magnitude level.
2. Procedure **(65 minutes)**
    a. Step #1: Show National Geographic Video and have students take notes on what they think is important in their Science Journals. The website is http://video.nationalgeographic.com/video/environment/environment-natural-disasters/earthquakes/earthquake-101/ and it is about a 3 minute video. **(10 minutes)**
        i. After the video have the students discuss with their group what they found most interesting.
        ii. Have each student write down one question that they want to learn more about in their Science Journal.
    b. Step #2: Explain to the class that we are going to watch one more video on the San Francisco earthquake in 1906. Tell your students to pay particular attention to

the issues the earthquake caused and the lasting effects. This is the https://www.youtube.com/watch?v=x1xRAtTnQ88 and it is about a 7 minute video but the last minute isn't necessary to watch. **(10 minutes)**

i. Have students take notes on what they think is important in their Science Journals.
ii. Allow students a few minutes to read over their notes and add anything else they think is necessary.

c. Step #3: Talk with your students about just how much of an impact this event had on the world. It was the first major incident in the United States but moreover it proved that humans inhabited a world that did not revolve around them. (**30-45 minutes)**

i. Tell the students that they now work for FEMA, the Federal Emergency Management Agency. With their table members, they need to come up with a plan of what they would do if this kind of earthquake happened and how they should prepare.
    1. They should come up with a plan for individuals, schools and communities. What should each of these entities do in order to be prepared?
ii. Each group will take turns switching between the library and the computer lab.

<u>Assessment Evidence (20 minutes + 60 bonus minutes)</u>

- Each group will write a letter to a community telling them the proper materials and tools, which they believe are necessary to be prepared for an earthquake. **(20 minutes)**
    - **Further the project by having a rough draft with editing by peers and then prepare a final draft. (60 minutes extra)**

⇒ Formative Assessment
- Collection of Science Journals and Notes from researching in the library and on the Internet.
- Asking Assessment Evidence Questions
    - Having each group pass around their FEMA Letter of Preparation to allow students to see how others decided what was important.

⇒ Summative Assessment
- Science Write-up in 2 weeks or longer
    - Making sure that they have retained the information long-term about the information they researched.
- Science Report (at Home) - Researching a specific earthquake either discussed in class or a different earthquake.
- Science Project (at Home) – Have the students check their own homes to see if they are prepared for an earthquake. Write about whether they are or not and provide evidence.

SECTION III: ANALYSIS AND RESULTS

In order to examine whether or not the two classes gained and retained the knowledge from the lesson, self-reporting by the teachers were taken and the outcomes were measured. The lesson that was presented was Lesson Four: Renewable and Non-renewable Energy. Both results appeared to show positive feedback in Science Journals and worksheets. Although, more detailed comparisons showed that the students that participated in the hands-on activities lesson proved to retain more of the information.

The class that was given the hands-on lesson was extremely attentive during the introduction of the lesson. The students worked independently when asked but also remained on task when working with their table partners. The presentations to the class about each energy source interested the students as many questioned were fielded. Unfortunately, due to time constraints, the class wasn't able to complete the anemometer project. The teacher said she would be able to have them do this activity another time but hadn't been able to plan it into her curriculum when I spoke with her last. The students wrote correct answers in their Science Journals with help from peers. This group learning allowed students to gain deeper understanding as they could teach one another the concepts showing that their understanding was strong.

The class that was given the technology-based lesson was focused during the introduction of the lesson but the videos did not enthuse them. Although the teacher, and myself, reminded them to take notes during the movie, it was limited in what they were writing. Once they began working with their worksheets they were able to focus again. Talking with their table members also increased their attentiveness. The teacher said that the students did well in their Science Journals when they looked up the information about the energy source and presented it to their peers.

SECTION IV: DISCUSSION

According to the teacher reports, they said that the lessons were helpful but many factors could have contributed to way in which their students learned or behaved. Both teachers explained that some of the limiting factors could have included a different person teaching, the level of experience of teaching and then time in which the experiments were conducted.

Due to the fact that someone else was teaching the subject matter, and not the teacher, the students were going to have mixed emotions and actions towards this event. Some students could be more interested and other students could be less interested. Behavior could play more of a role since the students do not know whether the person can manage a classroom of new students or not.

The way in which the material was presented could have been a factor because of teaching experience. When a teacher has her students for a few months, they will understand what works for their classroom, such as movement. Also, these teachers have had student teaching and a few years of experience that someone younger will not have. Their ability to control situations is easier and faster to attain than a new teacher.

Lastly, the experiments were conducted before Thanksgiving break when children were beginning to become antsy about the holidays and "weren't as focused as normal" both teachers explained. Going in at a different time may have helped to combat this issue but being a new person in the classroom and a new teacher still both contribute to the potential limits of this project.

Some advice given from the technology-based lesson classroom teacher was to have the students move around more or work with more students. The students are technologically savvy but are in need of personal experiences and connections still.

SECTION V: CONCLUSION

Considering that in the future the classroom teacher would teach these lessons, many of these limiting factors wouldn't exist. Overall, the teachers found the experiments very interesting and thought they would be especially helpful for new teachers who are coming in with very little science background. Both teachers expressed interest in knowing when I would be creating more lessons as to help them further with accomplishing the more in depth follow up lessons. Since these are introductory lessons, they provide the essential information needs to begin the topics but more lessons do need to be created.

Although it appeared that the hands-on lesson classroom learned the material better and had more focus throughout the lesson, this did not necessarily mean that they retained and understood all the information they were taught.

Well-trained professional teachers teach both classrooms and the experiences gained from this activity can provide information that will be beneficial for other training teachers and new teachers who wish to receive help in their transition into the teaching world.

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