I am a Kindergarten Vulcanologist

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INTRODUCTION

It was November 14th, 1985. I woke up at 5:00 A.M. and started getting ready for school. I had a routine that I used to do everyday, but that routine was interrupted when I noticed that everything had changed. At home, everything seemed different for me, a nine year-old fourth grader. I still remember my parents' faces reflecting worry, sadness, nervousness, and distress. That morning, my father started watching news earlier than usual. My mom could not continue with her household activities as usual either. Colombian television was broadcasting a tragedy. The beautiful, tranquil city of Armero no longer existed (Bruce 68).

It was still difficult to comprehend what happened while I was pleasantly sleeping. During my trip to the school, I tried to obtain some answers from my school friends. But, as young as we were, we could only conclude that something very sad had happened. As soon as we got to school, teachers announced that a tragedy occurred in a town located a few hours from Bogotá, the city where I used to live. Although teachers made a good effort to explain the tragedy in an age-appropriate way, we were not able to accurately understand the issue. During the afternoon, when I came back home, there still was a surrounding sensation of sadness. Then, I decided to watch the incessant live news with my parents.

It was impossible to get near Armero. Mud covered all of the roads, and the bridges were destroyed. The rescue workers could, however, see hundreds of people who were still alive. It was immediately obvious why the pilot hadn't seen them from the air; the victims were camouflaged by the thick mud that covered their bodies.

The media from Ibague (a small town close to Armero) followed on the heels of the rescue workers, and news of the devastation was soon on Colombian television. Hours later, news had spread around the world. The images were surreal; graphic scenes of Civil Defense workers stacking bodies like cordwood. A helicopter view showed hundreds of casualties stuck in the mud and screaming for help. The church steeple seemed to float above the mire. At the local cemetery, perched on a small hill in the northern part of town, neatly tended plots and carved headstones stood completely intact (Bruce 72).

My parents did not stop getting information about the tragedy for the following two weeks. By then, I had become more familiar with the tragedy, but I still did not understand why a volcano erupted, and it was still an abstract number of 22.000 people dead. One thing I learned was that a natural catastrophe not only creates own victims, it also moves people around the world and creates new relationships. I remember helping my mom to pack some clothes and food to support the few survivors of the Nevado del Ruiz's tragedy. I had a neighbor who shared updated information with my mom about her survivor family members in Armero. I remember the agonizing case of a five-year old girl, Omayra. Her legs were trapped in the mud, which was rapidly turning into a kind of thick cement around her. In spite of all the efforts, she was not a survivor. I, along with much of Columbia, witnessed her last words broadcasted on television.

After many years, the tragedy seemed like a memory. I ceased asking questions about Nevado del Ruiz's disaster. It became history. But, twenty years later, I had the opportunity of becoming a fellow in a seminar entitled "Living with Geologic Hazards." I thought it was going to be a great opportunity to apply some of my kinesthetic and visual learner's abilities. But I did not know it was going to be the occasion of clarifying questions I put away twenty years ago.

At the beginning, I felt intimidated because I did not have enough theory, statistics, and/or academic background to share and explain anything about the volcanic eruption I witnessed. I felt that I should have better understood the eruption that occurred in my country. But I could not explain something I had never understood.

Later on, my interest in the topic became a challenge. I wanted to find accurate answers to my many questions. When the seminar's leader mentioned the Nevado del Ruiz's case, I learned that a tragedy I considered was known only to Colombians and, unknown for the rest of the world, was, in fact, a very important case study. I learned that the tragedy of Nevado del Ruiz, November 13, 1985, was considered the second worst volcanic disaster of the 20th century.

Today, after clarifying most of my questions from the past, I have created this unit to provide kindergarteners with a very challenging topic full of high expectations and meaningful and fun engagement activities. I will take advantage of the power that volcanoes have to amaze children and adults. This theme is an excellent motivational source because children love science intrinsically. It is also a perfect theme to develop academic language skills. Additionally, students can connect the content of this unit directly with real life cases. Finally, it is never too early or too late to learn about volcanoes.

UNIT BACKGROUND

This month-long unit will be taught in Spanish and will be an inductive learning process. First, students will learn about the solar system in order to identify the Earth as the planet where we live. Then, students will get involved in different cooperative and independent practices to explore and learn about Earth's layers, plate tectonics, formation of volcanoes, and types of volcanoes. Finally, students will have the opportunity of making a real life connection about hazards, warnings, and risks by comparing a volcanic eruption with traffic lights and fire drills at school.

During the course of the unit, we will become amateur volcanologists. Each stage of the unit will provide students with information about volcanoes to record in a book named "I am a Volcanologist" (see appendix 1.) This book will not only be colorful, but it will be a portfolio of some meaningful activities in which students will be get involved during the unit's learning process. Although most of students are not going to have the opportunity to ever visit a volcano, I expect that the record book can be used as a small resource that students keep, check, and review later on. The book will be the gift students are going to receive as proudly scientific authors at the end of the unit.

The Earth and Tectonic Plates

Earth is the name of the planet on which we live. Earth moves around the sun along with eight other planets. Earth is the third planet of our solar system. Scientists divide the earth into three basic zones: the core, the mantle, and the crust. The core is the earth's center. The mantle is the earth's thick middle zone. The crust is the earth's outermost zone. People live on the surface of the crust. The layers inside Earth are thicker and much hotter than the crust. In the mantle, temperatures are hot enough to soften a rock. The rock is soft enough to squeeze - like toothpaste inside a tube. When completely melted, this soft rock becomes magma. When magna reaches the surface during volcanic eruptions, it becomes lava, the basic building block of volcanoes.

The rocks of the crust are rather like rafts, floating on top of the mantle layer. Continental crust is about 35 km (22 miles) thick on average, but it is up to 70 km (43 miles) thick beneath mountain ranges. Oceanic crust forms a much more uniform layer, averaging 6 km (3 1/2 miles) thick. The deep sea bed is covered with fine muddy sediments made mainly of the shells of tiny drifting sea animals (Bramwell 5).

The crust and the upper mantle make up the layer of the earth called the lithosphere. Rock in the lithosphere is brittle and solid and it seems unmoving to us as we stand upon it. However, the lithosphere is actually like a jigsaw puzzle made of 12 large pieces, called tectonic plates (Bunce 10). Plates float on top of a weaker portion of the Earth's mantle (the asthenosphere), like rafts on the sea. Some plates underlie oceans on top, some form continents or land masses, while others include both parts of continents and oceans.

The plates move slowly, colliding or pulling away from each other at rates similar to the growth of fingernails (a few cm's a year). This model of the earth's structure is called the Theory of Plate Tectonics. Spectacular mountain ranges like the Himalayas can form when continental plates collide and grind together. Oceans form where plates pull apart. Of particular importance in this unit is the fact that the movement of the tectonic plates determines where most volcanoes occur, what types of volcanoes will form, and the resulting types of volcanic eruptions.

Volcanoes

A volcano is a land form created when molten material and gases escape from the earth's interior at a vent, or opening, on a planet's surface. Most vents are found inside craters, bowl-shaped depressions often located at the top of a volcano. Additional vents and craters may be found on the side (Walker 8).

The heat necessary to generate the magma that feeds a volcano is typically formed either where plates collide (convergent plate boundaries) or where they are pulled apart (divergent plate boundaries). For this reason, most of the volcanoes on Planet Earth are bound along these two types of plate boundaries.

Some volcanoes are fueled by upwelling plumes of magma (not unlike a "lava lamp") that originate at the base of the mantle. They form "hot spots" where they heat up and melt the overlying crust. Because plates are always on the move, hot spots usually create chains of volcanoes. As the first volcano grows, it is carried away from the hot spot, and another volcano grows in its place. This process may continue for tens or even hundreds of millions of years, creating lines of volcanoes linked like the posts in a fence. Eventually, the plate may carry the hot-spot volcanoes to a subduction zone, where they are pulled back into the mantle and destroyed. Sometimes a hot spot beneath an ocean ridge can create a volcanic island being slowly pulled apart by sea-floor spreading. That was how Iceland was formed in the North Atlantic.

Hot spots can occur almost anywhere. They can create undersea mountain ranges, oceanic islands, or continental volcanoes, and the resulting volcanic chains may cross sea or land. In addition to Iceland, hot spots formed the Hawaiian and Galápagos islands in the Pacific Ocean, Reunion Island in the Indian Ocean, and the Yellowstone plateau in the United States (Sutherland 18).

There are three main types of volcanoes: shield volcanoes, composite volcanoes, and cinder cones. Shield volcanoes are wider than they are high and form the largest volcanoes in the world. Due to the lava's low viscosity, the lava flows far away from the vent, giving shield volcanoes their large size and gentle slope. The five volcanoes on the island of Hawaii - Mauna Loa, Kilauea, Mauna Kea, Hualalai, and Kohala, are all shield volcanoes. Sheild volcanoes most commonly occur at divergent plate boundaries and where hot spots underlie oceanic crust. A

composite volcano looks like a tall mountain with steep sides. This type of volcano produces effusive and explosive eruptions, and contains layers of both lava and pyroclastics. These are the most deadly of all volcanoes! Mount Pinatubo, in the Philippines, and Mount Saint Helens, in Washington, are composite volcanoes. Composite volcanoes only occur at convergent plate boundaries. A cinder cone is a cone-shaped hill. It is much smaller than a shield or a composite volcano, and they seldom erupt more than once, because they are fed by only a small amount of magma. Sometimes cinder cones form on the side of a bigger volcano (Walker 42).

Although every volcano has a unique eruptive history, most can be grouped into three main types based largely on their eruptive patterns and their general forms. A volcano's original shape can change greatly because of the one large eruption. A giant hole, called a caldera is left behind when an eruption creates a force strong enough to blow apart a volcano's summit. Crater Lake, for example, in Oregon, today fills the huge caldera, erroneously referred to as a "crater," formed when the upper part of the original volcano collapsed into the magma chamber below.

Scientists classify volcanoes in three different kinds: active, dormant, and extinct, according to the recurrence of a volcano's activity. An active volcano is one that has erupted in the historic past and is expected to erupt again. Dormant volcanoes are like hibernating bears -- they are only resting. They have erupted during the last 10,000 years and may erupt again in the future. Extinct volcanoes have completely finished erupting.

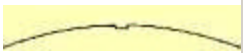
VOLCANO TYPE	VOLCANO SHAPE	COMPOSITION	ERUPTION TYPE
SCORIA CONE	 Straight sides with steep slopes; large summit crater	Basalt tephra; occasionally andesitic	Strombolian
SHIELD VOLCANO	 Very gentle slopes; convex upward	Basalt lava flows	Hawaiian
STRATOVOLCANO (Composite volcano)	 Gentle lower slopes, but steep upper slopes; concave upward; small summit crater	Highly variable; alternating basaltic to rhyolitic lavas and tephra with an overall andesite composition	Plinian

Table 1. Form and Composition of Volcanoes (Camp)

The eruption of a volcano can produce many interesting features, including lava (magma erupted at the surface), pyroclastic material, and gas. Just as bubbles escaping from boiling oatmeal spatter and throw bits of cereal out of a pan, the exploding gas bubbles in the magma toss volcanic material and pieces of surface rock out of the vent. One type of lava flow is called pahoehoe, which forms smooth "ropy-looking" rock when it cools. Another lava flow is called aa, which has a rough, jagged shape. When lava flows into the ocean, it quickly cools into a series of balloon-like features called pillow lava. All materials blasted into the air are called pyroclastic. This word comes from two Greek words: pyro, meaning fire and klastos, meaning

broken. Volcanologists classify pyroclastics by size. Very small pieces are called ash. Ash consists of very fine particles of rock and minerals measuring up to about 1/4 inch (6.25 mm) across. Pyroclastic fragments up to about 2-1/2 inches (62.5 mm) across are called cinders. Larger pyroclastic fragments are called bombs and blocks. Because of their size, bombs take longer to solidify than smaller pyroclastics.

The amount of pyroclastics material thrown out during an eruption depends on the amount of magma beneath the vent area, the size of the vent, and the amount of gas dissolved in the magma. After an explosive eruption occurs and the pressure of gases has been released, effusive eruptions may follow.

One of the most deadly products of volcanic eruptions is pyroclastic flows. Largely restricted to eruptions of composite volcanoes, they are deadly mixtures of pyroclastic material and hot, poisonous gases. They can move downslope at speeds in excess of 100 km/hr, devastating all that lies in their path.

Throughout recorded history, volcanic eruptions have transformed landscapes and affected the lives of millions of people all around the world. But some countries have more volcanic activities than others. Most of those countries are located in geologically active zones -- regions where one tectonic plate collides with another.

Approximately 14,000 volcanoes have erupted in the last 10,000 years (Sutherland, 2000). A major eruption is one that explodes with immense power, spews out vast amounts of lava, or causes catastrophic damage. Large explosive eruptions produce an enormous umbrella-shaped cloud of ash and pumice. By measuring the size of these clouds, scientists can estimate the power of different eruptions. They have also used this information to create the Volcanic Explosivity Index (V. E. I.), which measures the strength of eruptions on a scale of 0 to 8.

But the size of an eruption does not determine the amount of damage it causes, and even small eruptions can be deadly. In 1985, for example, a small eruption of lava under an icecap on Nevado del Ruiz in Colombia produced a mudflow that killed 22,000 people and destroyed an entire village. Some of the major volcanic eruptions are:

Location	**Date**	**Consequences**
Yellowstone, Wyoming	700,000 yrs. ago	590 $mi.^3$ (2,500 km^3) ash produced
Santoruni, Greece	1550 B.C.	Island destroyed
Vesuvius, Italy	A.D. 79	Approx. 20,000 dead Pompeii buried under ash
Etna, Italy	1669	20,000 dead
Tambora, Indonesia	1815	92,000 dead
Krakatoa, Indonesia	1883	36,000 dead
Mont Pelée, Martinique	1902	26,000 dead
Novarupta, Alaska	1912	4.7. $mi.^3$ material erupted
Mount St. Helens	1980	66 dead
Nevado del Ruiz, Colombia	1985	22,000 dead
Mount Pinatubo, Philippines	1991	420 dead

Table 2. Volcanic Eruptions (Bunce 29)

Volcanic Hazards

The direct hazards of volcanic activity are pyroclastic material (e.g. volcanic ash, dust), lava flows, pyroclastic flows, and poisonous gases. Volcanic eruptions can lead to less direct hazards, sometimes known as secondary hazards. These include lahars (mudflows), avalanches, and tsunamis (sometimes erroneously refers to as "tidal waves"). Apart from the effects on the immediate area around a volcano, an eruption can have other consequences, far away from the volcano itself. The effects of volcanoes on our climate are poorly understood.

If volcanic dust clouds are blasted high enough into the atmosphere by the power of an eruption, winds blow them great distances around the globe. Evidence of this comes from satellites. Weather around the world was affected when Mount Tambora erupted in 1815. Volcanic dust in the air made it dark as night for three days in places as far away as 300 miles (480 km). In 1991, dust clouds thrown 25 mi. (40 km) into the atmosphere from Mount Pinatubo in the Philippines traveled around the world in under four weeks. Scientists calculated that 2 percent of the incoming sunlight was deflected by this dust cloud, causing slightly lower temperatures worldwide. In the longer term, volcanic dust is believed to remain in the atmosphere for several years (Bunce 23).

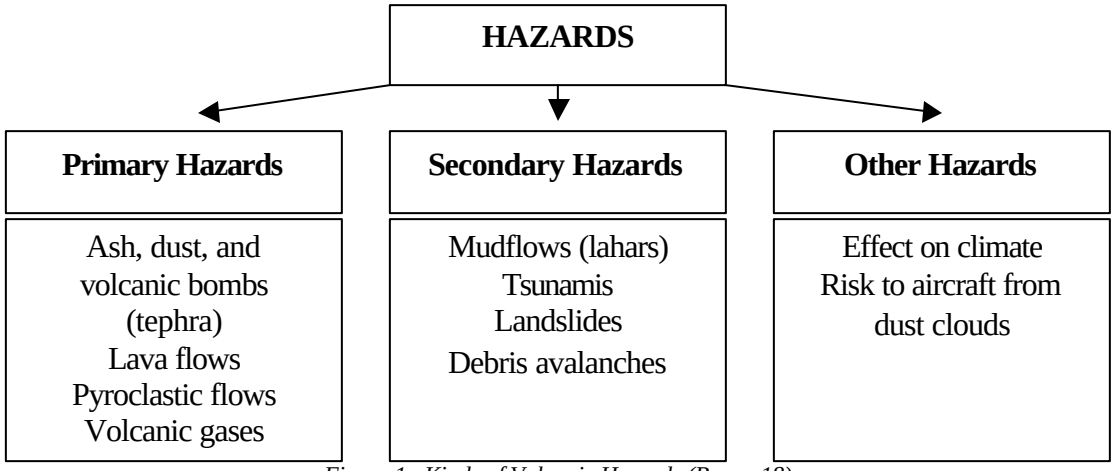


Figure 1. Kinds of Volcanic Hazards (Bunce 18)

Living near a volcano means living with the threat of an eruption. If an eruption occurs, there is the chance for great loss of life and property. Scientists now understand why volcanoes occur where they do, and have learned a great deal about how they erupt. They can also explain how a volcanic eruption fits into the theory of plate tectonics, which tries to explain patterns of continental movement, mountain building, and volcanic and earthquake activity. However, researchers continue to work on developing methods of accurately predicting volcanic eruptions before they occur.

Benefits of Volcanoes

Despite our fear of volcanoes' power, some effects of an eruption are beneficial. Air and rain act chemically on pyroclastic material and lava to turn them into very rich soil. This can happen in as little time as one year. In Hawaii, Central America, and South America, pineapples and coffee beans thrive in the rich volcanic soil.

There is also mineral wealth formed within volcanic rocks. The high temperatures, high pressures, melting, and mixing that accompany volcanic activity concentrate valuable minerals in veins and cavities, and high-grade ores. Cooper, sulfur, nickel and bauxite (the source of aluminum) are among the important raw materials mined from volcanic rocks (Bramwell 21).

Near plate boundaries, where magma is being produced, magma's heat turns groundwater into water vapor. This steam can be used to produce geothermal energy. New Zealand, Mexico, and the United States are some of the countries that use geothermal power. Even though there is no current technology to drill into magma, if it would exist, we would have access to a tremendous source of energy.

Whether we think of volcanoes as powerful and beneficial, amazing and beautiful or dangerous and frightening or perhaps a mixture off all these things -- volcanoes and their eruptions will continue to shape our planet for millions of years to come. Some important ways that demonstrate volcanoes as builders and shapers of land and life on our planet are:

- They add gases to the atmosphere.
- They add water to the oceans.
- They build chunks of continents, mountain ranges, and islands.
- Volcanic materials break down to make rich soil.
- Lava cools to form new land. (Blobaum 59)

IMPLEMENTANTION STRATEGIES

This unit will be presented through three correlated stages.

Our Planet: The Earth

This week-long stage will provide students with academic knowledge related to our planet. First, students are going to recognize the earth as a planet and as part of a solar system. I will present a picture of the solar system, the students are going to represent the solar system in cooperative groups, and finally they are going to record a picture of the solar system where they highlight the earth as the planet where they live. During this stage, I will present different pictures of the earth that are going to build the background for the next stage. The pictures will help students to recognize the characteristics of mountains, volcanoes, valleys, rivers, forests, lakes, oceans, etc.

Once students recognize the Earth as the place where they live, I will present a peach, a hard-boiled egg, and a coconut as three models to represent the Earth and its layers. I will show students what it would look like if we could cut the earth and could see inside of it. This session will be supported by an Internet link to show children the earth's layers in a colorful way. In order to enhance comprehension, students are going to create a Mini-Earth Model. Once students identify the compositional layers of the earth, they will decorate a picture to record the names of the layers in their record book.

Plate Tectonics

It may be difficult and very abstract for any kindergartener to understand a concept such as plate tectonics. However, I consider plate tectonics is one of the most important concepts children must understand to recognize earth's landforms as consequences of plate movement. For this reason, I will create a pictorial story about the formation of continents and plate tectonics. Then, students are going to participate in four different correlated workstations as such as: reading, creating art, building the plate tectonics puzzle, and doing hands-on activities. I will be a facilitator in the hands-on workstation in order to model different movements of the plates and generally explain to children how plates work and what they cause. For example, it will very important to work with clay to show students how mountains are formed. One of the consequences of plates is going to be the formation of volcanoes.

During the following lesson, I will present to students different images of valleys, islands, mountains, rivers, lakes, oceans, and volcanoes. In cooperative groups, students are going to create a small clay model about shapes around the earth. The CLEAR curriculum for the

kindergarten grade requires that the student identify lakes, rivers, and oceans as important and useful resources.

Additionally, students are going to record the information received by creating a web map about earth. This web map will be part of the Volcanologist book, too. Students will draw and label each picture according to everything that they have seen and learned. The CLEAR curriculum requires that student develops vocabulary through meaningful/concrete experiences.

Volcanoes

I will read the story "Nacimiento del Paricutín." This study will focus on sequence and students are going to understand the formation of a volcano through literature. There is not an age-appropriate version of the story. It will be necessary to adapt the vocabulary of the story and illustrate it colorfully to make it attractive for students. After reading the story aloud, students will record the sequence of the story in their book. The CLEAR requires that a kindergarten uses own words to retell a story and exhibits understanding of 2-3 events in sequence. This part will be the beginning of the next stage of the unit.

In order to increase motivation, I will model an eruption of a volcano. After this, it will be the time to introduce what is a volcano. I am going to explain why a volcano is different from other mountains. I will draw a volcano and label its parts. Then I will present three different models to the students that represent the three kinds of volcanoes. The Project CLEAR curriculum requires kindergarteners to understand and explain the meaning of words. They must use age-appropriate vocabulary in academic discourse. I will design four workstations where students can enhance comprehension, practice, and record information.

Hazards

I will try to explain to students volcanoes as geologic hazards using a real eruptions' video. I will take advantage of my experience in Colombia and will share with them the Nevado del Ruiz's case. It is important for students to understand what is meant by a warning. I will talk to them about different daily-life examples, such as traffic lights, their colors and meaning of each one. I will use those colors to simulate an emergency.

Additionally, I will compare a warning of a possible volcanic eruption with the fire drills we have at school. We will read a book about fire evacuations. Students are going to brainstorm about fire. They are going to think about what could happen if there is fire at the school. They are going to conclude with why we practice fire drills and what to evacuate means. At this stage, students are going to understand safety and why tragedies can be prevented with proper preparation. Project CLEAR requires kindergarteners to explain a problem in his/her own words and propose a solution. Additionally, it requires students to recognize danger and identify safe procedures.

LESSON PLANS

Lesson One: The Solar System

Purpose

This lesson will provide students with an experience in observing and recognizing the Solar System and in developing vocabulary as such as: star, sun, planets, orbits, translation, rotation, Earth, and moon.

Description

Most primary grade classrooms have an intrinsically curiosity for the Solar System. Students begin by making a brainstorm about everything they know or imagine about the Solar System.

Students will look at different pictures and images about the Solar System, participate in a simulation of the Solar System's movement, and create a complete record of it.

Standards

SCI.K.022.D.	Construct reasonable explanations using information.
SLA.L.K.01.a.	Listen actively, attentively, and purposefully.
SLA.L.K.02.c.	Develop specific vocabulary to suit different purposes.
SLA.L.K.03.b.	Provide information acquired from a variety of sources (print and non-print.)
SLA.R.K.08.c.	Draw conclusions from information gathered.

Preparation and Materials

- Create a space in your classroom library for books related to the solar systems. Stop by your closest public library and enrich your classroom library with some amazing books. You may try to find colorful books with pictures of the Solar System, planets, etc.
- Download coloring pages from the Internet. Make 4 sets of coloring pages including the 9 planets and the sun. You can download the coloring pages from the following web address: <http://www.windows.ucar.edu/coloring_book/SS_Beg_new2.pdf>
- Have sentence strips ready for students to create their hats.
- Plan a walk outside the classroom, and find the right place to simulate the Solar System movement. You can draw the orbits with chalk while students get ready for the simulation.
- Make 21 copies of the Appendix 1 and 2.

Procedure

1. Students brainstorm about everything they know, they have heard or they imagine about the Solar System. Teacher records everything in writing, with pictures, or both, on the board.
2. Teacher will present a picture of the solar system to students where students recognize the sun as the center of the solar system and identify nine planets around it. Teacher will model a solar system vocabulary web map using the solar system's picture.
3. The students will form two groups of ten each, and one student from each group will represent the sun and the other nine students will represent the planets. Students are going to represent the solar system cooperatively. Each student will color and decorate a hat of a planet and one student a hat of the sun.
4. Teacher and students take a walk outside the classroom and teacher draws nine orbits on the floor. Teacher guides the students to scale distances among planets, to review the names of the planets, and to simulate the translation movement walking around the sun.
5. Students will work independently to record the content learned during this lesson. Teacher will provide students with the first page of their record book where they can color, cut and paste the Sun and planets. (Appendix 2)

Enrichment

Make connections to other curriculum areas, including math, ESL, reading, writing, and art. Enrich each center in your classroom with materials that students can explore and use to reinforce the knowledge they have acquired during this lesson. For example, the hats of the planets and the sun that the students made will be available for students in the Science Center, the classroom library will offer books with pictures of the solar system. The art center can have clay to let students represent the solar system making spheres, etc. It would be great to connect this lesson with a math lesson related to geometric figures and solids in the solar system.

Assessment

Observe students working in groups or individually to explain what the solar system looks like and have short one-to-one discussions about the topic. Keep anecdotal notes on how students are able to connect the vocabulary learned to other classroom experiences.

Students should be able to use the scientific vocabulary appropriate to the grade level in describing the solar system.

Students should be able to describe some of the characteristics of the solar system, making conclusions about its movements and components.

Lesson Two: The Earth

Purpose

This set of learning activities provides students with a hands-on experience in observing and creating a unique and fun mini earth model. While studying the earth's layers, students are going to increase their vocabulary and critical thinking skills. Students will focus on the Earth as the planet where we live and its specific characteristics.

Description

Most children are enthralled with the Earth and its layers. This is a great topic to enhance motivation and positive interaction with students. During this lesson, students are going to feel powerful and are going to be the owners of their learning process. The activities presented in this lesson will be fun and a strong resource of lifelong learning.

Standards

SCI.K.01.A.	Demonstrate safe practices during classroom and field investigations.
SCI.K.02.B.	Plan and conduct simple descriptive investigations.
SCI.K.04.B.	Make observations using tools including hand lenses, balances, cups and computers.
SCI.K.05.A.	Describe properties of objects and characteristics of organisms.
SCI.K.09.C.	Identify ways that the Earth can provide resources for life.
SLA.L.K.01.c.	Interact in conversations and discussions with peers, parents, and teachers.
SLA.R.K.01.c.	Demonstrate print awareness.
SLA.R.K.03.b.	Understand and explain the meaning of words.

Preparation and materials

- Bring a globe to your classroom and place it in your science or social studies center.
- Connect your computer to a TV and present a real picture of the Earth to students. You can use real pictures of the planet from <http://visibleearth.nasa.gov/images/2429/globe_west_540.jpg>, and use pictures of how it would look the Earth inside, from <http://visibleearth.nasa.gov/images/2429/globe_west_540.jpg>.
- Use a peach, a hard-boiled egg, and a coconut, to use them as models of the Earth inside.
- Create a Mini-Earth Model with students using large marshmallows, peppermint candy, toothpicks, a saucepan, 1/4 cup (50 g) of chocolate chips, and waxed paper.
- Make arrangements to have a secure area where you can set a pot and boil some chocolate.
- Review the safety procedures with your students before starting the activity of creating a Mini-Earth Model.
- Make 21 copies of the Appendix 3.

Procedure

1. Teacher presents a globe to students and real pictures of the Earth downloaded from a web page.
2. Teacher explains that although no one has ever been able to drill a hole to the middle of the earth, geologists have made some educated guesses about what is deep inside. To enhance understanding about the Earth's layers, students are going to be exposed to three models made with a peach, a hard-boiled egg, and a coconut. Using these models, teacher will explain to students that the Earth is a sphere and has three main compositional layers: the crust, the mantle, and the core. The crust is made up of solid rock. The mantle is a thick layer of more mobile rock of different composition from the overlying crust (called magma), and the core is made up of an outer molten (liquid) layer and a solid center.
3. Teacher presents the procedures and activities students are going to work in each workstation, as it follows:
    - Reading: Students will use books about the Earth and they are going to be able to see pictures and diagrams about the solar system and the Earth's parts.
    - Art: Students are going to have an independent work to record the content learned during this lesson. Teacher will provide them with the second page of their record book (Appendix 3). They have to color the parts of the Earth and name them.
    - Mini-Earth model: Teacher is going to be in this workstation all the time. Students are going to create a Mini-Earth Model. They will need: large marshmallow, a peppermint candy, toothpick, saucepan, 1/4 cup (50 g) of chocolate chips, and waxed paper. The outer layer (chocolate) is the earth's crust of rock, covered in most places with soil. Just as with the real earth, it was formed from hot, melted material that cooled down and hardened. This thin crust is home for all life that we know. The soft, gooey middle layer (marshmallow) is the earth's mantle. It's about 1,800 miles (3,000 km) thick, or about the distance you'd go if you drove halfway across the United States. When striking the candy in the middle, it will represent the core. Scientists believe that the earth's core is a solid kernel of metal surrounded by a layer of liquid metal. The core is just a little bit thicker than the mantle and about 9,000 F (5,000 C) -- almost as hot as the surface of the sun (Blobaum 47).
    - Exploration and technology: Students are going to explore the three models of Earth's layers that teacher presented at the beginning of the lesson. Additionally, students are going to see different Earth pictures found on the Internet.

Enrichment

Students can bring to the class a peach or an apple and create a new Earth model naming the layers on it. Teacher can provide students with materials that they can use to create their own Earth model (clay, marbles, tissue paper, glue, finger paints, etc.).

Assessment

Observe students working individually and create a closer interaction with each student to make sure they understand and can name the compositional layers of the Earth. Keep anecdotal notes on how students are able to connect the vocabulary learned to other classroom experiences.

Students should be able to use the scientific vocabulary appropriate to the grade level in describing the Earth and its layers.

Students should be able to describe some of the characteristics of the Earth, making conclusions about its layers.

Lesson Three: Plate Tectonics

Purpose

This lesson is designed to guide students in exploring continents and predicting something about them. Students are going to be exposed to a big concept such as plate tectonics in order to develop vocabulary and enhance understanding about the forms around the earth.

Description

Although plate tectonics may look as a very difficult topic for kindergarteners, it is an amazing topic to enhance motivation and to create a student-centered environment in your classroom. The success of this lesson depends on the classroom management routine teacher uses in the classroom. This is a very rich unit that composes more than guided practice. It composes whole group instruction, cooperative group work, independent practice, creativity and hands-on activities.

Standards

SCI.K.09.C.	Identify ways that the Earth can provide resources for life.
SCI.K.04.B.	Make observations using tools including hand lenses, balances, cups and computers.
SLA.L.K.01.c.	Interact in conversations and discussions with peers, parents, and teachers.
SLA.R.K.03.b.	Understand and explain the meaning of words.

Preparation and Materials

- Create 4 spread out sets of continents for students to explore.
- Create a PowerPoint presentation to recreate the story about Pangaea Puzzle. You can use pictures and information from USGS web page. <http://pubs.usgs.gov/publications//text/historical.html>
- Enrich your classroom library with colorful books where students can see pictures of the continents.
- Arrange an art workstation with scissors, glue and pencils.
- Prepare 4 plate tectonic puzzles (Appendix 4) to use in the concentration workstation.
- Make 21 copies of the Appendix 4.
- Provide the "push those plates" workstation with graham crackers, waxed paper spread and peanut butter.

Procedure

1. Teacher will mention that the crust and the outer mantle of the Earth make up the layer of the earth called the lithosphere.
2. Groups of 4-students are going to receive a set of continents spread out in pieces. Students are going to explore continents and are going to predict something about them.
3. After 10 minutes of observing students' comments and interactions, teacher is going to use a PowerPoint presentation to talk about the story about Pangaea Puzzle. About 240 million years ago, the seven continents were one giant continent (Blobaum 49). It was named Pangaea, which means "all lands." How did continents break apart? The earth's lithosphere, rather than being one solid layer of rock is actually made up of huge sections called plates. There are six major plates and seven smaller ones. These plates are always moving around, riding on top of the atmosphere. Usually they move a few centimeters/year (about as much as your fingernails grow in one year), so we don't notice how slowly they creep. But over millions of years, they have moved apart enough to create seven continents, and the oceans that separate them. The six major Earth plates are: Pacific Plate, American Plate, African Plate, Antarctic Plate, Eurasian Plate, Indian Plate, and Pacific Plate.

4. Teacher reviews the rules for workstations and classroom management routines.
5. Teacher presents the procedures and activities students are going to work in each workstation, as it follows:
    - Reading: Students will use books about the Earth and they are going to be able to see pictures and diagrams about the Earth parts, continents and plate tectonics.
    - Art: Students are going to paste their own pate tectonics puzzle in their record book. (Appendix 4)
    - Concentration: Students are going to work with puzzles of the plates and review their names.
    - Push Those Plates: Students are going to observe, explore, discuss and conclude about plate tectonics working graham crackers put on a waxed paper spread with a thick layer of peanut butter. If students push crackers apart, they will simulate a crack on the ocean floor. If they push two crackers toward each other, making one slide under the other, I can explain that the bottom plate starts to melt from the intense heat and pressure. It becomes a new magma that floats up between the two plates, building up and up over many years until it finally causes a volcano blast! If students put two graham crackers side by side on the waxed paper, wet the edge of one cracker first and slowly push them together, they will see how many mountains have been formed (Blobaum 51).

Enrichment

The teacher can display a bulletin board in the science center representing the plate tectonics. The word wall can be enriched with words learned during this unit and the ones before. Students can use crackers and peanut butter in the kitchen center and repeat the experiment over and over again. There are a lot of web pages where there are available games related to plate tectonics and students can use.

Assessment

Observe students working individually and create a closer interaction with each student to make sure they understand and can name the different plates. Keep anecdotal notes on how students are able to connect the vocabulary learned to other classroom experiences.

Students should be able to use the scientific vocabulary appropriate to the grade level in describing plate tectonics.

Students should be able to name the plate tectonics, and make conclusions about them.

Lesson Four: Earth Resources

Purpose

This lesson will help students understand nature and Earth's resources. Students are going to work in cooperative groups creating models of land forms seen around the earth. Additionally, students will be able to recognize forms around the earth using the vocabulary words learned during the lesson.

Description

This lesson will enhance motivation while students work in cooperative groups building a model of parts of the Earth. When the model is finished, teacher can take pictures of the cooperative groups with the model and display them in the science bulletin board. Students enjoy working with modeling clay and it helps students in improving their fine motor skills.

Standards

SCI.K.02.B.	Plan and conduct simple descriptive investigations.
SCI.K.04.B.	Make observations using tools including hand lenses, balances, cups and computers.
SCI.K.05.A.	Describe properties of objects and characteristics of organisms.
SCI.K.09.C.	Identify ways that the Earth can provide resources for life.
SCI.K.10.B.	Give examples of ways that rocks, soil, and water are useful.
SLA.L.K.01.c.	Interact in conversations and discussions with peers, parents, and teachers.
SLA.R.K.03.b.	Understand and explain the meaning of words.

Preparation and Materials

- Download pictures of different places of the world and create a PowerPoint presentation. Some of the most beautiful pictures can be found at <http://www.edu.pe.ca/southernkings/landforms.htm>.
- Organize four cooperative groups and provide students with glue, modeling clay (green, blue, yellow, red), cardboard, wood sticks, plastic cups and cotton.
- Have a digital camera available to create a bulletin board with pictures of the cooperative groups while students are working.

Procedure

1. The teacher shows pictures (printed, on the computer or on the television) of different places around Earth. Pictures can be displayed as a PowerPoint presentation or can be printed if they are downloaded from Internet.
2. Students brainstorm about everything they see on each picture. While students participate, the teacher models a web vocabulary map drawing and writing names such as lake, river, mountain, waterfall, tree, forest, and volcano.
3. The teacher gives the instruction to work in cooperative groups explaining the importance of each member of the group. Each student will have a responsibility. The teacher is going to assign one leader and one materials' manager per group. The leader is going to supervise the discipline of the group and make sure each member is working and following instructions. The materials' manager is going to be aware of the materials needed and will contact the teacher if the group needs more supplies.
4. Each student will choose a part of the model to work (e.g., to make a mountain, a volcano, a forest, a river, a lake, or the sun and the clouds). The teacher can give instructions and can model one of the following ways to create each part of the model.
    - Mountain: Student will cover a plastic cup with pieces of green or brown modeling clay.
    - Volcano: First, create a mountain and then make modeling clay lines to cover the top of the mountain.
    - Forest: Student can draw three medium trees and can paste green and brown modeling clay on the paper to decorate each. Then, staple wood sticks on the back of each three and put them on a stack of modeling clay.
    - River and lake: Student can draw a river and a lake and can fill them with pieces of blue modeling clay.
    - Clouds and sun: Student can draw the sun and some clouds. The sun will be filled with orange (red + yellow) modeling clay and the clouds with pieces of cotton.
5. Students start working in the part they choose. Teacher is a facilitator and supervises the work of the students while answering and making some questions.
6. Once each group has finished the model, each group is going to present its model to the class, describing what they included and how each landform looks different from another.

7. Models are going to be displayed in the science center and teacher can decorate the bulletin board with pictures of the students working in their project.
8. Finally, each student is going to complete a web map with vocabulary related to the Earth and its resources. This page will be the fourth page of their record book. (Appendix 5)

Enrichment

During reading and writing class, let students write about everything they learned about Earth's different landforms. In math, it is possible to create the class' favorite landform graph. In art, let students work with modeling clay to create new models of landforms and to apply what they have learned.

Assessment

Observe students working in cooperative groups and create a closer interaction with each group asking some questions about the topic to check understanding. Students will be able to name different landforms and see the differences. Keep anecdotal notes on how students are able to connect the vocabulary learned to other classroom experiences.

Students should be able to use the scientific vocabulary appropriate to the grade level in describing the Earth landforms.

Teacher can use Appendix 5 to assess the vocabulary learned during this lesson.

Lesson Five: Volcanoes

Purpose

The main purpose of this lesson is to provide students with information they will use in future grades levels. The information will be presented with age-appropriate vocabulary for better understanding. Students will be able to discover new things about volcanoes, parts and types.

Description

Students will master volcanoes' concepts after few repetitions. With this idea, this unit is designed to create an environment full of motivation and fun learning. The workstations designed can be used during reading, writing and language arts classes. The most important thing is to give the opportunity for students to explore, interact and improve their science knowledge and vocabulary.

Standards

SCI.K.01.A.	Demonstrate safe practices during classroom and field investigations.
SCI.K.02.A.	Ask questions about organisms, objects and events.
SCI.K.02.C.	Gather information using simple equipment and tools to extend the senses.
SCI.K.04.A.	Identify and use senses as tools of observation.
SLA.R.K.03.b.	Understand and explain the meaning of words.
SLA.R.K.05.b.	Listen actively to text being read aloud.
SLA.R.K.05.c.	Demonstrate comprehension after a section is read.
SLA.R.K.08.c.	Draw conclusions from information gathered.
SLA.L.K.01.a.	Listen actively, attentively, and purposefully.

Preparation and Material

1. Create 21 sets of the volcano's parts labels.
2. Create a big book with construction paper re-writing with age-appropriate vocabulary the story of "Nacimiento de Paricutín."
3. Make 21 copies of the Appendix 6 and Appendix 7.
4. Build a volcano to simulate an eruption.

5. Have baking soda and vinegar.
6. Learn and understand more about volcanoes. Teacher can use this Spanish web site to navigate <http://centros3.pntic.mec.es/cp.valvanera/volcanes/partes/partes.html>
7. Create a poster of the types of volcanoes and its parts, to be displayed in the science center.
8. Provide red toothpaste, soil, clear plastic cups and scissors for the hands-on workstation.
9. Choose colorful and big volcanoes books for the reading workstation.

Procedure

1. Teacher simulates a volcanic eruption with baking soda and vinegar.
2. Teacher explains what a volcano is and introduces the topic reading a sequencing story about the Paricutín. The Paricutín volcano formed in the middle of a cornfield, and although it wasn't as cataclysmic as the fall of Pompeii, it nonetheless represent a dramatic period in the lives of the inhabitants of Paricutín, Mexico, who lost crops, livestock, and suffered substantial property damage during this natural disaster.
3. Teacher makes some questions to enhance comprehension. Students retell the story of Paricutín focusing on the sequence of this volcano formation.
4. Teacher presents a poster with the three types of volcanoes and presents the parts of a volcano drawing in chart paper while explaining to students.
5. Students are going to work in the following workstations:
    - Reading comprehension: Students will record the sequence of the story "Nacimiento de Paricutín." This work will be the fifth page of students' record book.
    - Art: Students are going to color and name the parts of a volcano and the three types of volcanoes. This work will be the sixth page of students' record book.
    - Hands-On: Students will use toothpaste, soil, plastic cups and scissors. The teacher will review and model the parts of a volcano to students and they can explore the model creating their own volcano model. The teacher opens a whole at the bottom of the clear plastic cup. Then, the teacher fills the cup with soil. The teacher introduces the toothpaste tube in the hole opened and squeezes the tube. The volcano is the cup, the magma us the toothpaste and the magma camera is the toothpaste tube. Students will be able to simulate an eruption in this workstation too.
    - Free Reading: The teacher will provide students with different books that they can use to explore pictures of volcanoes, its parts and types.

Enrichment

Review safety rules students have to remember before every science experience.

Assessment

Observe students working during workstations and create a closer interaction with each student to check for understanding. Students will be able to name the parts of a volcano. Keep anecdotal notes on how students are able to connect the vocabulary learned to other classroom experiences.

Students should be able to use the scientific vocabulary appropriate to the grade level in describing a volcano, its parts and types.

The teacher can use Appendix 6 and 7 to assess the vocabulary learned during this lesson.

Lesson Six: Hazards

Purpose

This lesson is designed to help students understand danger, risk and warnings. Students are going to understand the importance of following instructions and paying attention to warnings. Students are going to identify daily-life warnings and will understand that although natural disasters cannot be prevented, their consequences can be fewer.

Description

The teacher is going to share a personal experience related to Nevado del Ruiz disaster. With this activity students are going to be exposed to new information about volcanic hazards. The teacher will compare hazards with traffic lights and fire drills. Students are going to be involved in simulations about traffic accidents and how to evacuate in a fire drill.

Standards

SCI.K.01.A.	Demonstrate safe practices during classroom and field investigations.
SCI.K.03.B.	Discuss and justify the merits of decisions.
SCI.K.03.C.	Explain a problem in his/her own words and propose a solution.
SLA.R.K.05.b.	Listen actively to text being read aloud.
SLA.R.K.05.c.	Demonstrate comprehension after a section is read.
SLA.L.K.01.c.	Interact in conversations and discussions with peers, parents, and teachers.
SLA.L.K.01.d.	Give and follow instructions and directions.
SLA.L.K.03.a.	Choose and adapt spoken and non-verbal language appropriate to the audience and purpose.
SLAL.K.04.a.	Monitor and modify his/her own communication.

Preparation and Materials

1. Have the video *All about Volcanoes*.
2. Visit the web page <http://vulcan.wr.usgs.gov/Hazards/Safety/what_to_do.htm> to download information about how to act before, during and after a volcano eruption.
3. Bring a traffic light and traffic signs poster to the classroom.
4. Print the fire drill's evacuation route used in your school.
5. Pull out the books *Clifford the Firehouse Dog* and *Clifford al Rescate*.
6. Bring police and fireman hats to the classroom.

Procedure

1. Teacher presents the video *All about Volcanoes* to students.
2. Teacher explains that nature disasters cannot be prevented but there are warnings and signals that people can follow to avoid severe consequences.
3. Teacher presents the different types of volcanic hazards to students while sharing the story of Nevado del Ruiz, focusing on its consequences. Teacher reinforces the importance of following instructions, listening and paying attention to signals. Some of the consequences of Nevado del Ruiz 's tragedy could have been prevented if people had followed instructions and believed in warnings.
4. The teacher presents a chart to students about instructions people must follow before, during, and after a volcanic eruption.

5. The teacher explains what a warning system is and connects this concept to real life situations. The teacher compares warning systems with traffic lights. In a traffic light each color has a meaning. It is important to know, understand, and follow the meaning of each color in order to avoid traffic accidents.
6. The teacher calls two students and gives instructions to simulate a traffic accident. Students conclude why the accident was caused.
7. The teacher reads the book *Clifford in a Fire*. The teacher asks the students what they would do if there is fire at school.
8. The teacher explains what a fire drill is and presents a copy of the school's evacuation route to the students. The teacher is going to explain the warnings and bells they will hear if there is fire at school.
9. The teacher then simulates a fire in the classroom, and students are going to evacuate according to the evacuation route.
10. When returning to the classroom, the teacher gives a map of the school to students. They are going to draw the evacuation route in the blank school map and put it inside their record book.

Enrichment

This lesson is a great opportunity to reinforce classroom management strategies and social skills with students (listen, pay attention, follow instructions, etc.).

The teacher can provide students with some costumes of community helpers to enhance the importance of their work in the community. It will be a great idea to review with students some of the most common traffic signals and their meanings.

Assessment

This lesson will be assessed by keeping anecdotal notes on how students are able to understand the importance of social skills in every situation in their lives. Additionally, students will retell the different situations presented in the classroom and what can be some consequences of not following the warnings instructions or of not understanding the meaning of warnings.

CONCLUSION

Often teachers forget about the importance of social skills in our classroom. We work on developing social skills in our children, and we create an environment where students can be powerful leaders and good community members and maybe save lives in the future. We know that natural disasters cannot be prevented, but their devastating consequences can be prevented if we know how to react.

Soy un vulcanólogo de Kinder

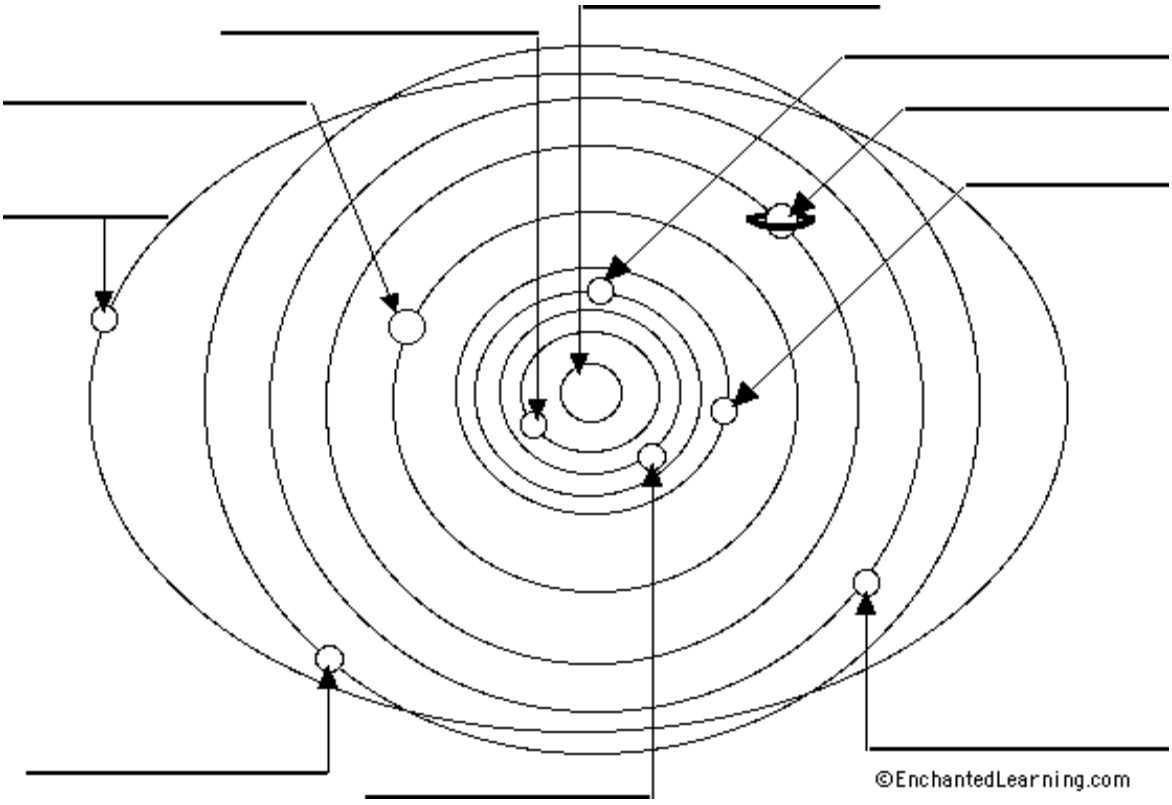
STUDENT'S
PICTURE HERE

Autor

2005 - 2006

Appendix 1

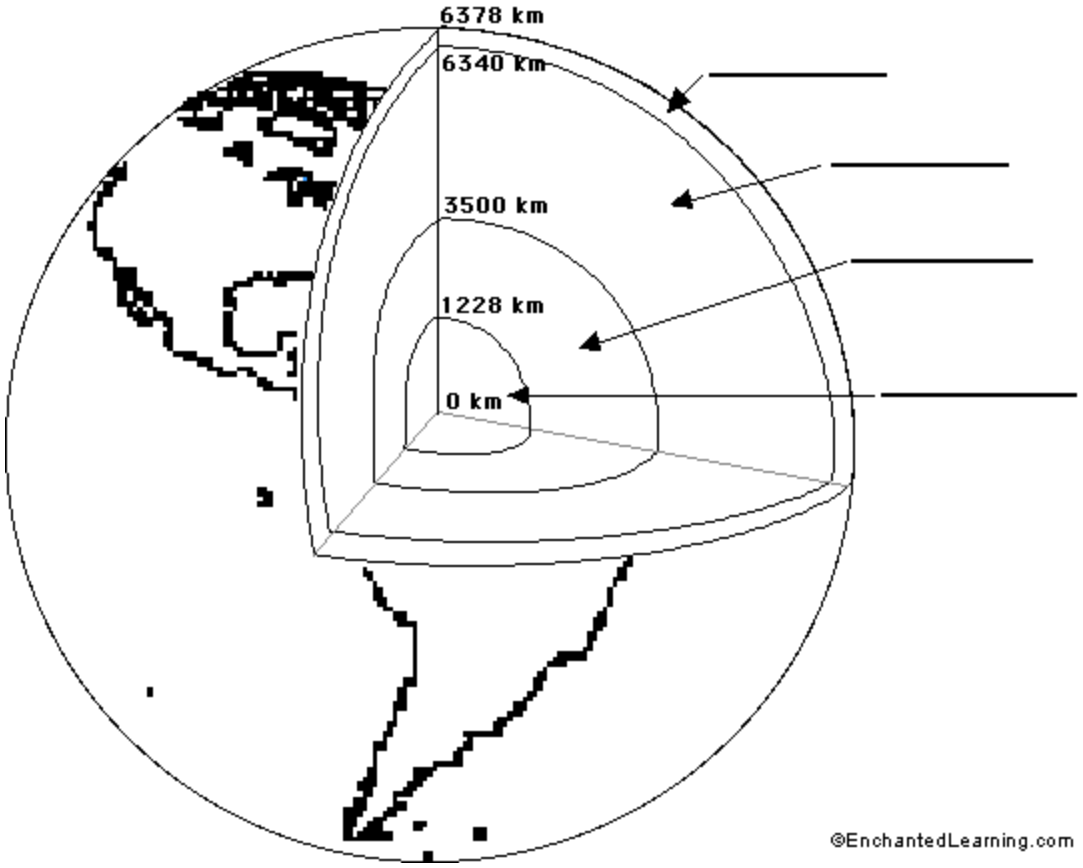
El Sistema Solar



Mercurio	Venus	Tierra	Marte	Jupiter
Saturno	Urano	Neptuno	Plutón	Sol

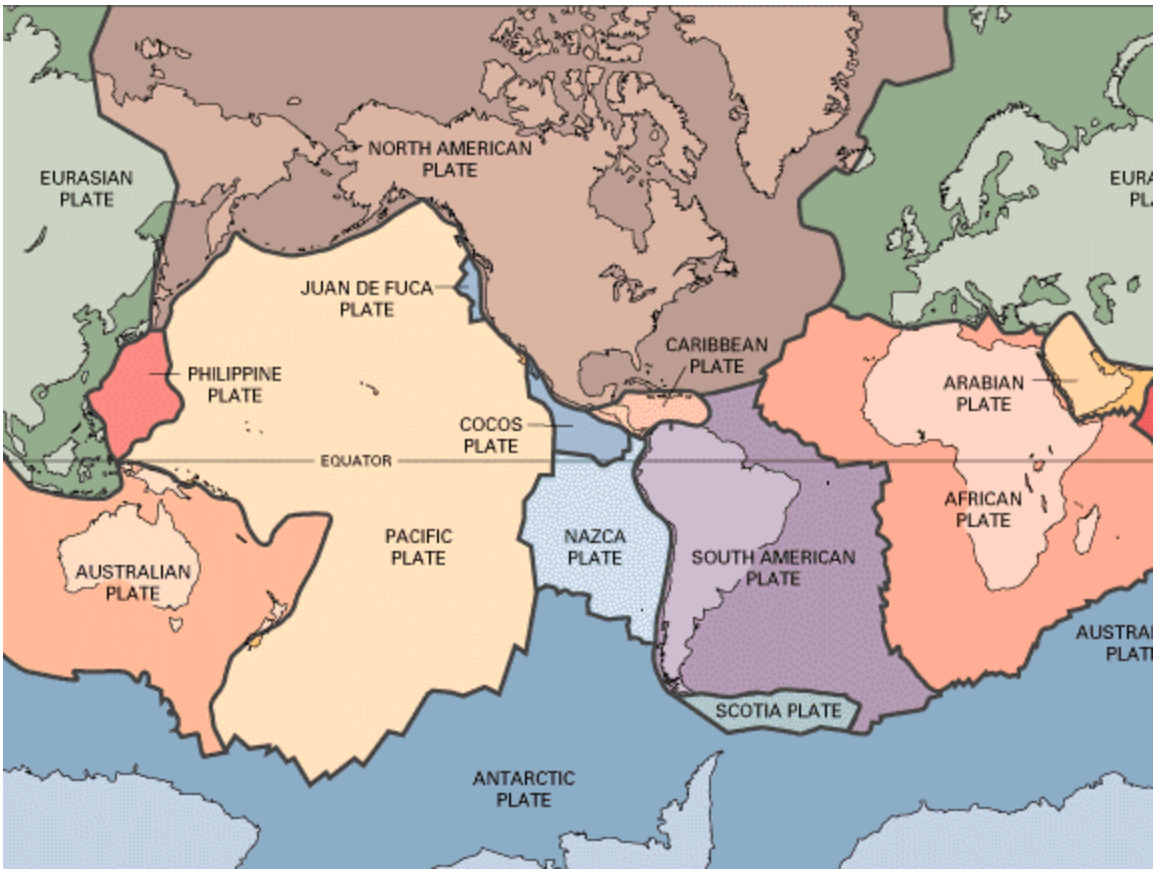
Appendix 2

La Tierra



Appendix 3

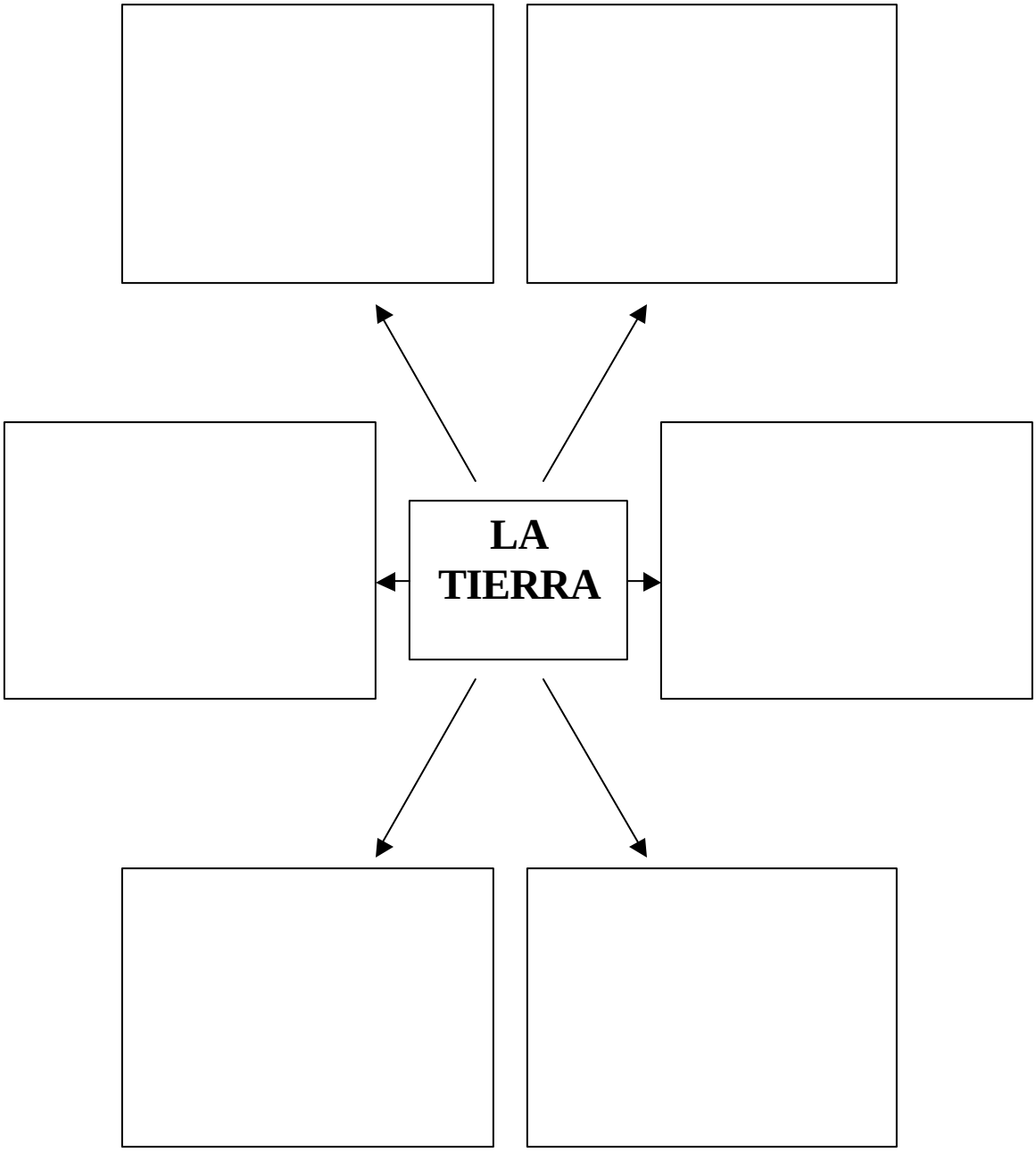
Placas Tectónicas



http://geology.er.usgs.gov/eastern/plates.html

Appendix 4

Formas en la Tierra



Appendix 5

Nacimiento del Volcán Paricutín

Primero_____

_____

_____

Luego_____

_____

_____

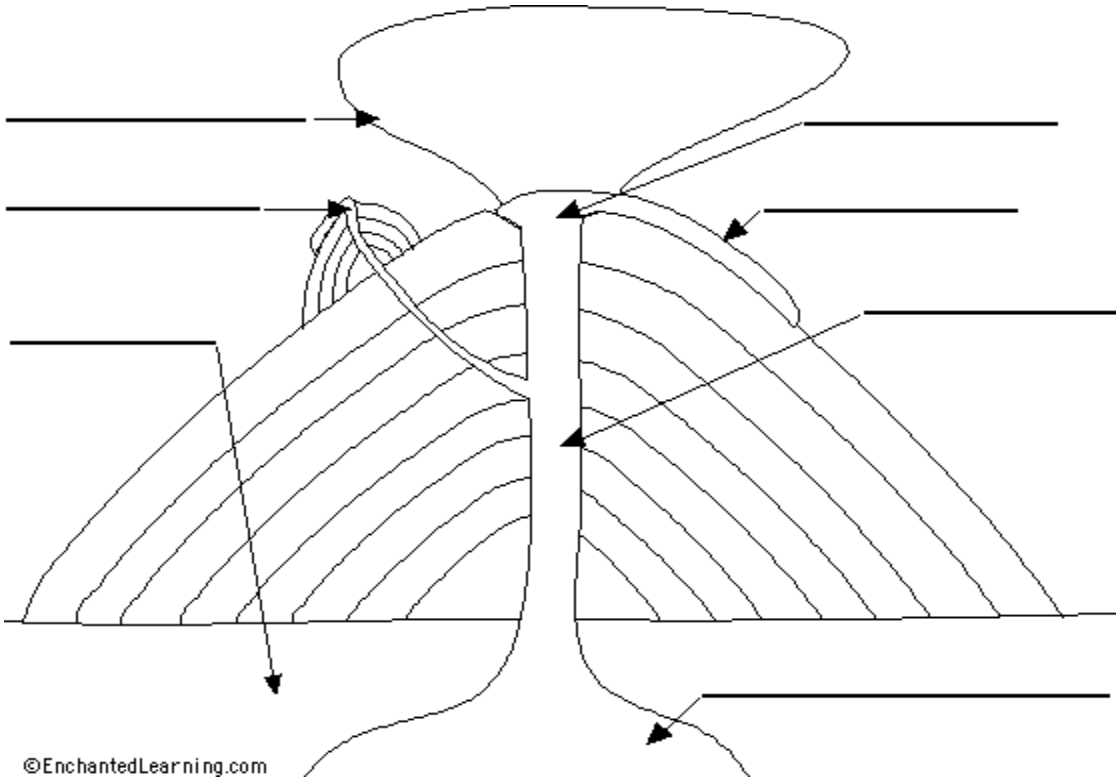
Al final_____

_____

_____

Appendix 6

Los volcanes



CLASES DE VOLCANES SEGUN SU FORMA

Cono de Ceniza	**Volcán en escudo**	**Volcán estratificado**

Partes de un volcán

Gas y ceniza volcánica	Cámara de magma	Chimenea	Grieta lateral
Cráter	Manto	Rio de Lava	

Appendix 7

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