A Cold Earth

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INTRODUCTION

Is another Ice Age approaching? The climate of Earth has fluctuated quite a bit over the 4.6 billion years of its history, and it can be expected that the climate will continue to change. Since 1860, average global temperatures have risen a modest 1.5^{o} F (0.8^{o} C); yet, they increased very little between 1940 and the 1970s (Flannery 160). Since then, as the polar ice cap and one glacier after another thaw, short-term evidence seems to point toward a continued warming well into the twenty-second century, while Earth-Sun relationships (see **precession** below) tend to contradict those observations. I find one of the most intriguing questions in Earth science to be whether the ice ages are really over, or if we living in an "interglacial" (a warm period between ice ages).

The geologic time period in which we now live is known as the Holocene. This epoch began about 11,000 years ago, which marked the end of the last glacial advance and the end of the Pleistocene epoch. The Pleistocene was an epoch of frigid glacial and warmer interglacial cycles, which began about 1.8 million years ago. Today about ten percent of the earth's surface is covered by ice, and 96% of this is located in Antarctica and Greenland. Conspicuous areas of glacial ice are also present in such diverse places as Alaska, Canada, New Zealand, Asia, and California. Ninety percent or more of the remaining glaciers and ice sheets are melting, when theoretically they should be expanding.

Have you ever heard of Milankovitch Cycles and their long term effects on climate? A Milankovitch (mil-ANK-o-vich) Cycle perpetually occurs and reoccurs. We are in the middle of three now. We just don't notice them because they take many thousands of years to complete.

OBJECTIVES

This unit will be aligned with the Houston Independent School District's Texas Essential Knowledge and Skills (TEKS). The use of HISD's CLEAR objectives will be utilized to maximize the success of the students taking the (TAKS) Texas Assessment of Knowledge and Skills test. This unit can be taught in conjunction with a section of the fifth grade science textbook entitled *Weather Patterns and Climate*.

TEKS Math: 5.1.13 - Collect and analyze information using tools including calculators, and computers.

TEKS Math 5.1.01 - Use place value to read, write, compare, and order whole numbers through the 999,999,999.

TEKS Math 5.6.01 - Identify the mathematics in everyday situations.

TEKS Math 5.6.02 - Solve problems that incorporate understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness.

TEKS Math 5.6.04 - Use tools such as real objects and manipulatives, and technology to solve problems.

TEKS Math 5.6.08 - Justify why an answer is reasonable and explain the solution process.

TEKS ELA (English Language Arts) 5.2.11 - Use strategies before reading (skim, scan text, question purpose, and expected outcome, activate prior knowledge) and during reading (text coding/margin notes, use of pictures and graphics, visualization, prediction, cycle, self questioning) to enhance comprehension.

TEKS Science 2.2.01 - Manipulate, predict, and identify parts of a plant and its functions that, when separated from the whole, may result in the part of the whole not working properly.

TEKS Science 5.1.12 - Connect Grade 5 science concepts with the history of science and contributions of scientists.

TEKS Science 5. 1.13 - Collect and analyze information using tools including calculators and computers.

TEKS Social Studies 5.1.21 - Cite examples and describe the impact of increased industrialization on 20th century American Life.

RATIONALE

This unit will be written for a fifth grade science class. The student audience is a regular science class that can be adapted for English Language Learners. The objective of this unit is to identify events and describe changes that occur on a regular basis, such as in daily, weekly, lunar, and seasonal cycles. This curriculum unit will help students understand the effects of the Milankovitch Cycles and their impact on climate change. Presently, Earth is experiencing warmer average temperatures whereby household energy consumption, especially in summer, is extremely high. Having experienced Houston's hot, humid weather during the majority of the year, my students are very interested in learning about climatic change. It is difficult for them to imagine that the Earth may ultimately be headed for a "cool down." I will teach this unit by using many visual aids such as pictures of Earth during the cycles, temperature graphics, the Cosmic Calendar and various timelines.

This unit will help students identify and describe events that occur in the Milankovitch Cycles that directly affect our climate. The focus of the curriculum unit will be to get students to understand what life on earth was like over a vast period of time and to think critically as to whether we are living in an "interglacial" or period of time between ice ages.

UNIT BACKGROUND

Ice Ages are the result of subtle changes in Earth's orbit and rotation known as the Milankovitch Cycles. Robert Ehrlich of George Mason University in Fairfax, Virginia, has developed a model that hypothesizes a dimmer switch inside the sun that causes its brightness to rise and fall on timescales of around 100,000 years. An ice age is a period of long-term downturn in the temperature of Earth's climate, resulting in an expansion of the continental ice sheets, polar ice sheets and mountain glaciers ("glaciation"). During an ice age, such temperature declines are marked by glaciations (Murck and Skinner, 1999). This is important, because even while global temperatures decline during an ice age, and glaciations push ice into larger areas, there are also periods of relief in the form of warmer interglacials and receding ice. Geologically, an ice age is often used to mean a period of advance and retreat of massive ice sheets in either or both hemispheres; in fact, according to this definition we are still in an ice age, because the Greenland and Antarctic ice sheets still exist.

The cold, dry air above the Arctic and Antarctic carries little moisture and drops little snow on the regions. Be reminded, an increase in global temperature could expand the amount of moisture in the air and increase the amount of snowfall. After years of more snowfall than melting, the Polar Regions could accumulate more ice. An accumulation of ice would lead to a lowering of the level of the oceans, and there would be further, unanticipated changes in the global climate system as well.

Effects relating to climate change, sea level changes, and sedimentation due to temperature change and surface runoff are related to the Milankovitch Cycles. Milankovitch Cycles are the collective effect of changes in the Earth's movements upon its climate. Variations in the Earth's **eccentricity, axial tilt,** and **precession** comprise the three dominant cycles, collectively known as the Milankovitch Cycles. Milankovitch, a Serbian astronomer who lived between 1879 and 1958, is generally credited with calculating their magnitude. Variation in the three cycles creates alterations in the seasonality of solar radiation reaching the Earth's surface. The three Milankovitch Cycles impact the seasonality and incidence of solar energy around the Earth, thus influencing seasonal contrasts. Some scientists believe that an increase in global temperature, such as we are now experiencing, could be a sign of an impending ice age and could actually increase the amount of ice on the Earth's surface.

Eccentricity

The first of the three Milankovitch Cycles is the Earth's **eccentricity**. It is simply the shape of the Earth's orbit around the Sun. This orbital shape ranges between more and less elliptical (0 to5% ellipticity) on a cycle of about 100,000 years. These oscillations from more elliptic are of prime importance to glaciation in that they alter the distance from the Earth to the Sun, thus changing the distance the Sun's shortwave radiation must travel to reach Earth. In different seasons, these oscillations can reduce or increase the amount of radiation received at the Earth's surface. When the Earth's orbit is most elliptical the amount of solar energy received at the perihelion (when the sun is closer to the Earth) is in the range of 20 to 30 percent more than at aphelion. Most certainly, these continually changing amounts of received solar energy around the globe result in conspicuous alterations in the Earth's climate and glacial regimes. Currently, the orbital eccentricity is nearly at the minimum of its cycle. The current orbital eccentricity is almost a perfect circle.

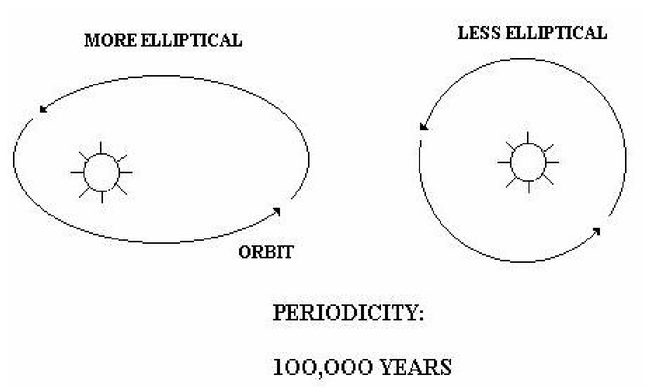

Fig. 1 Eccentricity (From Milankovitch Cycles and Glaciation)

Axial Tilt

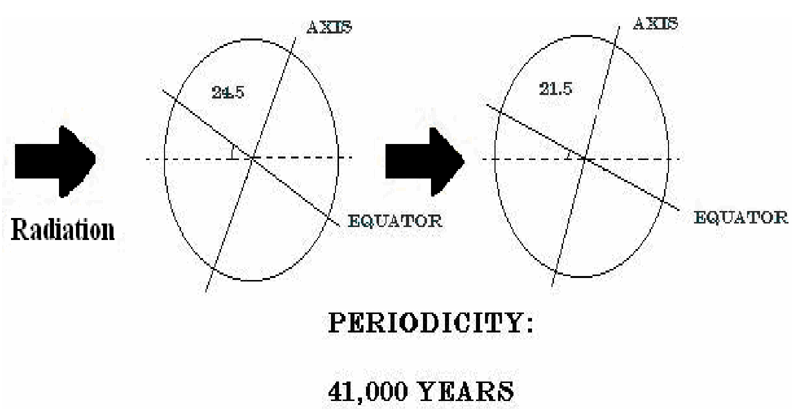

Fig. 2 Periodicity (From Milankovitch Cycles and Glaciation)

The second of the three Milankovitch Cycles is **axial tilt**. This is the inclination of the Earth's axis in relation to its plane of orbit around the Sun. Oscillations in the degree of Earth's axial tilt occur on a periodicity of 41,000 years from 21.5 to 24.5 degrees.

Today the Earth's axial tilt is about 23.5 degrees and is returning to a more vertical position (21.5 degrees). Axial tilt largely accounts for our seasons. The severity of the Earth's seasons changes because of the periodic variations of this cycle. With less axial tilt, the Sun's solar radiation is more evenly distributed between winter and summer.

One hypothesis for Earth's reaction to a smaller degree of axial tilt is that it would promote the growth of ice sheets. This response would be due to a warmer winter in which warmer air would be able to hold more moisture, and subsequently produce a greater amount of snowfall. In addition, summer temperatures would be cooler, resulting in less melting of the winter's accumulation, thus adding layer after layer of new, compacting snow. The general rule of thumb for the creation of glacial ice (*névé*) from a permanent snow field (firn) is 100 years.

Precession

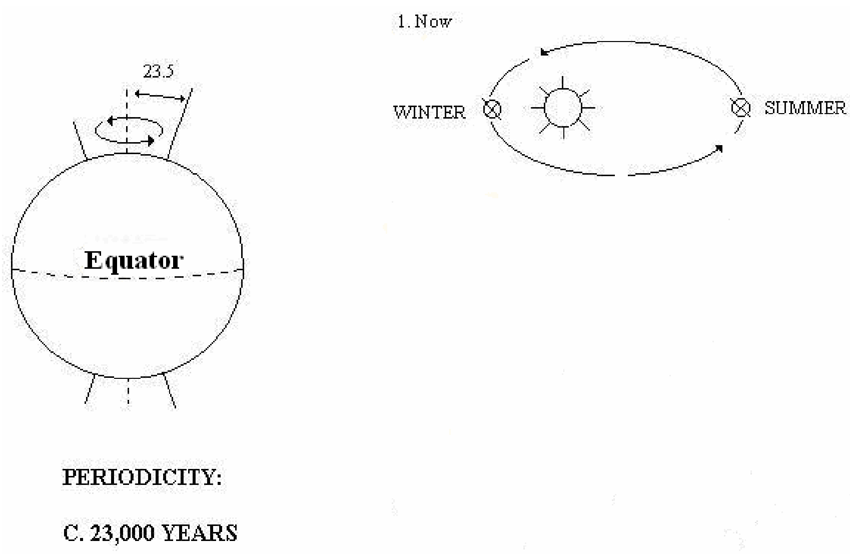

Fig. 3 Precession (From Milankovitch Cycles and Glaciation)

The third and last of the Milakovitch Cycles is Earth's precession. Precession is the Earth's slow wobble as it spins on its axis. This wobbling of the Earth on its axis is like a top slowing down and beginning to rock back and forth on its axis. This top-like wobble, or precession, has a periodicity of 23,000 years. The precession of Earth wobbles from pointing at Polaris (North Star) to pointing at the Vega. When this shift to the axis pointing at Vega occurs, Vega becomes "the North Star." A climatically significant alteration will take place due to this wobble. This significant alteration means the Northern Hemisphere will experience winter when the Earth is farthest from the Sun and summer when it is closest to the Sun. This coincidence will result in a greater range of temperature. Earth experiences harsh winters and harsh summers. The precession cycle could also usher in glacial periods. Currently, Earth experiences its perihelion on January 3rd, twelve days after the northern hemisphere's winter solstice.

Approximately 12,000 years from now the Northern Hemisphere will experience summer in December and winter in June because the axis of the earth will be pointing at the star Vega instead of its present alignment with the North Star or Polaris. Now, this seasonal reversal won't happen suddenly, but the seasons will gradually shift over thousands of years.

According to the National Geophysical Data Center, at times when the Northern Hemisphere summers are coolest (farthest from the Sun due to **precession** and greatest orbital **eccentricity**) and winters are warmest (minimum **tilt),** snow can accumulate on and cover broad areas of northern America and Europe. Currently, only precession is in the glacial mode, with tilt and eccentricity not favorable to glaciation.

Geologic Time Scale

One of the most difficult ideas in geology for students to grasp is the immense span of time since the formation of Earth. Human experiences deal in terms of seconds, hours, days, weeks and months. A year is a long time for most, especially children. A few decades comprise a lifetime. According to de Blij, students should be as familiar with the geologic time scale as they are with the months of the year and the days of the week. Just knowing the geologic time scale is a great way to keep things geographic in temporal perspective.

	Geological Time Scale			
Notable Events	MYA	Epoch	Period	Era
	0.01	Holocene	Quaternary	Cenozoic
Appearance of hominds	1.8	Pleistocene	Quaternary	Cenozoic
	5.3	Pilocene	Tertiary	Cenozoic
Start of Late Cenozoic Ice Age	24	Miocene	Tertiary	Cenozoic
	37	Oligocene	Tertiary	Cenozoic
Age of Mammals	58	Eocene	Tertiary	Cenozoic
Comet Impact	65	Paleocene	Tertiary	Cenozoic
Break-up of Pangaea	144		Cretaceous	Mesozoic
Age of Dinosaurs	208		Jurassic	Mesozoic
Major Extinction	248		Triassic	Mesozoic
Dwyka Ice Age	290		Permian	Paleozoic
	328		Pennsylvanian Carboniferous	Paleozoic
Amphibians Appear	360		Mississippian Carboniferous	Paleozoic
	410		Devonian	Paleozoic
Land Plants Appear	443		Silurian	Paleozoic
Ice Age	505		Ordovician	Paleozoic
Explosion of Marine Life	570		Cambrian	Paleozoic

Fig. 4 Geologic Time Scale

Geologists refer to the first 800 million years as the Hadean Eon, when the Earth was as hot as Hades. This era began some 4.6 billion years ago with the formation of Earth from dust and gas orbiting the Sun. During this era the surface of Earth was like popular visions of Hades: oceans of liquid rock, boiling sulfur, and impact craters everywhere! Volcanoes blasting off all over the place, and the rain of rocks and asteroids from space never ended. According to Richard S. Williams, it would have been hard to take a step without falling into a pool of lava or getting hit by a meteor! The air was hot, thick, steamy, and full of dust and crud. You couldn't breathe it because it was made of nothing but carbon dioxide and water vapor, with traces of nitrogen. If any life formed on Earth during this era, it was probably destroyed.

The next 1,300 million years after the formation of Earth is known as the Archean Era. By then things had really changed. Everything had cooled down! Most water vapor in the air had cooled and condensed to form a global ocean. Even most of the carbon dioxide had gone, having been chemically changed into limestone and deposited at the bottom of the ocean. The air was now mostly nitrogen, and the sky was sated with normal clouds and rain. During the Archean era, islands were the only land surface. The continents had not yet formed. The islands were carried over the surface of the Earth by the movement of rock deep in the Earth's interior. According to Eugene Linden, the small islands occasionally collided with each other to form larger islands and eventually the larger islands collided to form cores of continents as we know them today.

The only life during the Archean era was the blue-green algae (actually simple bacteria) floating in the ocean. That's all there was: just single-celled bacteria in the ocean. The oldest known fossils, the remains of different types of bacteria are in Archean rocks about 3.5 billion years old. Geologists define the beginning of the Archean era as the age of the oldest rocks on Earth that we can still find today.

The Proterozoic Eon followed, lasting from 2,500 million years until 570 million years ago. During this period of time, there was a lot more land and there were two super continents. These huge masses of land were formed by the collisions of the islands during the Archaean and most of the Proterozoic eras. The Earth's interior was still cooling and there were fewer volcanoes than in the Archean era. Life during the Proterozoic Eon had not changed much, but the few changes were significant. Single-celled creatures appeared that had a real nucleus. Multi-celled creatures had no hard parts like skeletons, shells, or teeth in their bodies.

The atmosphere was mostly nitrogen, with a little water vapor and carbon dioxide. There was little free oxygen released by the algae floating in the oceans collecting in the air. These single-celled plants had been producing oxygen for about two billion years, but until this time, the oxygen had been combining chemically with iron and other elements to form great mineral deposits. This oxygen which we now must have to survive was poisonous to most of the life forms living on Earth during the Proterozoic era; however, a great change in the types of life loomed on the horizon. The Earth plunged into a deep freeze.

Earth scientists call the 400 million years that followed, the "Snowball Earth." It was a time when all landmasses were buried under ice and snow and the ocean surface was frozen solid. One might ask, "What caused this to happen? The answer may be that there is a dimmer switch inside the sun that causes its brightness to rise and fall on time scales of around 100,000 years, which is exactly the same frequency as the glacial and inter-glacial cycle. A temporary but significant decline in the Sun's radiactive output could have caused significant cooling. Whatever the cause, the planet and its early life forms experienced a crisis.

A general reduction in the amount of carbon dioxide (CO_2) in the atmosphere may have contributed to the development of the Proterozoic ice age. Carbon Dioxide is an important greenhouse gas. Decreases in the amount of CO_2 in the atmosphere commonly lead to global cooling, but variations in the Milankovitch cycles are even more important because they alter the distribution and intensity of solar radiation. Although the Proterozoic Eon witnessed the longest glaciations (400 million years and 220 million years in duration), three other ice ages have ensued, including the most recent one that is in progress at present.

Paleozoic Era

When the Proterozoic finally ended, Earth was set for its Cambrian Explosion, the rise of marine organisms and subsequent life forms in unprecedented diversity. After more then 4,000 million years of the planet's existence, began the drama that would ultimately lead to the emergence of humanity, 570 million years later, again during an ice age.

Although the Paleozoic Era, which existed 570 million to 248 million years before the present, experienced two ice ages, one was more important than the other. When the Permian Ice Age (known as the Dwyka) struck, forests were widespread, amphibians thrived, small reptiles had made their appearance, and insects had proliferated. When it was over, one of the greatest mass extinctions, precipitated by fallout from the collision with a huge meteorite that fell on Antarctica, had decimated life on Earth. Large areas fell dry, forests withered and countless species of plants and animals became extinct (de Blij 61).

Mesozoic Era

When the ice age ended, and the Mesozoic Era opened, there was little left of Permian life. The Mesozoic era ushered in rampaging dinosaurs, dive-bombing pterodactyls, endless forests of giant ferns and erupting volcanoes. It lasted about 180 million years. The Mesozoic is divided into three time periods: the Triassic, the Jurassic, and the Cretaceous.

In the middle of the Jurassic period, Earth began to change once again. The single super continent called Pangaea (Whole Earth) began to break up into the continents we know today. North America broke away from the northwest coast of Africa and the Atlantic Ocean and the Gulf of Mexico began to form. The Appalachian mountains of the eastern United States were a high, rugged mountain range, something like the Rocky Mountains of today. Over the next fifty million years, South America, India and Antarctica broke from Africa and moved toward their present positions.

The dominant animals on both land and sea were reptiles, the most famous of which were the dinosaurs. Dinosaurs became conspicuous in the Triassic after having evolved slowly from lesser forms in the Paleozoic. They dispersed widely during the Jurassic, and dominated the earth in the Cretaceous. They were so prominent that the Mesozoic was also called the "Age of Reptiles." Dinosaurs were not the only life form around during this diversifying period. Birds and mammals appeared, as well as deciduous trees and flowering plants during the Mesozoic.

The climate during the Mesozoic era was so warm that there were no ice caps at all. Not even at the poles! Plants grew like crazy in the warmth and moisture. There was food everywhere for the average gluttonous 50-ton Ultrasaurus! It was a tropical paradise.

The dinosaur paradise was heavily populated with wildlife until a mass extinction like that in the Paleozoic ended the idyllic Mesozoic era. Seventy percent of all life forms disappeared, including virtually all the dinosaurs. Why? There are many hypotheses, including disease, volcanic eruptions and giant impacts, but one hypothesis stands out more than the others: a comet or asteroid, six-miles in diameter struck the Earth at a an estimated speed of 55,000 miles per hour (90,000 kph) at a low angle in the vicinity of the Yucatan Peninsula, creating a crater, 40 miles (65 km) deep and 110 miles (180 km) wide in the Bay of Campeche near the small port of Progreso. Geologists call the asteroid *Chicxulub* (a Mayan name for a nearby village). One of a swarm of meteors that impacted the Earth elsewhere, Chicxulub was surely one of the largest "extraterrestrials" to ever hit Earth. In its wake, the atmosphere was darkened with aerosols for a decade or more, reducing sunlight and transforming the "tropical paradise" into a much colder climate (deBlij 62).

Cenozoic Era

The Cenozoic period began 65 million years ago with the extinction of the dinosaurs and continues to the present. This is the last of three geologic eras squeezed into the Phanerozoic eon. The Cenozoic era is the "Age of Mammals" in which whales took over the oceans, saber-tooth cats shared the land with elephant-like mammoths, giant sloths lazily slumbered in the tropical forests, and primates, including humans, finally appeared. The Cenozoic era is divided into two time periods: Tertiary and the Quaternary.

Earth continued to change. The Atlantic Ocean opened from a narrow valley to a vast ocean. India moved across the Indian Ocean and collided with Asia to make the Himalayan Mountains. North and South America moved westward over part of the Pacific Ocean. The pressure crumpled the western coasts of both continents to form the Rocky and Andes mountains. Part of the Pacific sea floor has been forced into the warm interior under the American continents, causing melting and the formation of the Cascade and Andes volcanic mountain chains.

During the Cenozoic era, the Earth's average temperature has turned colder. The last few million years have seen the return of giant glaciers and ice caps to North America, Eurasia and Antarctica.

After the disappearance of the dinosaurs, there were many empty places on Earth where animals could live. The tropical forests gradually shrank and grasslands and deserts began to accrue in their place. At the beginning of the Cenozoic, small mammals quickly spread out into the grasslands and savannas and diversified and grew in size. Soon giant rhinos, mammoths, lions, saber-tooth cats, horses and deer were occupying the plains and forests of Earth. In the now-shrinking rainforests, primates cavorted in the trees. Meanwhile, the skies filled with bats and birds, and the seas teemed with whales and porpoises, as well as with fish and octopus. Finally humanity appeared during the last two million years.

The Pleistocene and the Holocene were the two major epochs that constituted the Quaternary Period of the Earth's history. The Pleistocene began about 1,600,000 years ago and ended roughly 10,000 years ago. This was a time period during which a succession of glacial and interglacial climatic cycles occurred. The growth of large ice sheets, ice caps, and long valley glaciers was among the most significant events of the Pleistocene.

The Holocene, better known as the time of modern humans, began about 10,000 years ago and refers to the present geological time period. In this epoch, humanity has spread across the lands and seas of Earth, altering the face of our planet with farms and cities. Humans have destroyed some plants and animals and have domesticated others. During Holocene, humans have become the most influential terrestrial life form, more numerous than any other large animal, and more fearsome than the most terrible of dinosaurs. The proliferation and dispersal of these "naked apes" (human beings) is one of Earth history's most fascinating tales. The fact of the matter is that their evolution has come primarily during the last 11,000 to 14,000 years, a time noted for global warming and retreating glaciers.

LESSON PLANS

Lesson One: What is a Million?

Math Science Integration

Time allotment: 4-5 Days; 45- 60 minutes a day

Objectives

TEKS: 5.1.13 - Collect and analyze information using tools including calculators and computers.

Math 5.1.01 - Use place value to read, write, compare, and order whole numbers through the 999,999,999.

Math 5.6.01 - Identify the mathematics in everyday situations.

Math 5.6.04 - Use tools such as real objects and manipulatives, and technology to solve problems.

Materials Needed

Computer, calculator, paper (11 ½ X 14)

Procedures and Activities

<u>Introduction</u>

To understand the concept of a million, ask students to engage themselves in watching and the following television shows: *Who Wants to Be a Millionaire?* and *Are You Smarter Than A Fifth Grader?* The prizes on each show range from $1000 through $1,000,000. Students will record the various dollar amounts that the participants earned while striving for the one million dollar prize.

<u>Note</u>: This is a project best done with a whole classroom of students.

1. Students can actually see a million.
   - Ask students to use a word processor on a computer, type out one page filled with nothing but asterisks.
     Print the page and count the number of asterisks there are on the page.

- Divide that number into one million to see how many pages it will take to print one million asterisks.
- Print out the right number of pages and put them all up on one wall.

2. Once students have seen a million asterisks, have them calculate how many classroom walls, like the one used above will it take to put up one billion asterisks.
3. Ask students to predict how long it would take to count to a million. Counting once per second, eight hours per day, seven days a week (no weekends off).
Answer: It would take a little over a month to count to one million!
4. Teach place values from the hundred thousand to one million.

Assessment

1. Using a place value chart, ask students to identify hundreds, thousands, ten thousands, millions, and billions.
2. Ask students to compare geologic time to the length of a football field. Give each student a printed copy of a 100 yard football field. Tell students to start at the left (4.6 billion years ago) and move forward in time, labeling the ten yard lines in years. Ask students to use colored markers to draw horizontal lines to show the beginning and the end of the various eras.

Lesson Two: *How Much Is a Million?* Written by David M. Schwartz and Illustrated by Steven Kellogg

Language Arts and Math Integration

Objectives

Math 5.1.01 - Use place value to read, write, compare, and order whole numbers throughout 999,999,999.

ELA 5.2.11 - Use strategies before reading (skim, scan text, question purpose, and expected outcome, activate prior knowledge) and during reading (text coding/margin notes, use of pictures and graphics, visualization, prediction, cycle, self questioning) to enhance comprehension.

Materials Needed

A jar filled with marbles or M&M chocolates, paper clips, beans or other things to count. *How Much is a Million?* by David Schwartz.

Procedures and Activities

Introduction

Display the jar one day before the lesson. Beside the jar leave sticky notes and pencils for the students to guess how many objects are there in the jar.

1. Brainstorm with the students the number of millions that the students can count and measure. Write students' responses on a chart.
2. Read aloud the story *How Much Is a Million?*
3. Ask comprehension questions.
4. Remind the students to conceptualize the immensity of the numbers. How long does it take to count a million? Probably 23 days for the lower elementary and 14 days for the upper elementary students.
5. Discuss the illustrations in the book that amounts to millions and trillions.
6. Check for understanding.

7. Students work in pairs. Ask them to measure as many things or in as many ways possible to measure/count on million.
8. Bring out the jar again and ask the students to guess how many objects are there inside the jar. Their estimates should be accurate this time. Reveal the students the actual number of objects in the jar.

Assessment

Teacher Made Test

1. Write 10 different number combinations that will equal to one million.
2. Estimate the following numbers to the nearest million.
3. Think and write the answer to the question: What was the author's purpose in writing the book?

Lesson Three: Calculating How Old Is Mother Earth?

Science and Math Integration

Objectives

TEKS Science 2.2.01 - Manipulate, predict, and identify parts of a plant and their functions that, when separated from the whole, may result in the part of the whole not working properly.

TEKS Math 5.6.02 - Solve problems that incorporate understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness.

TEKS Math 5.6.08 - Justify why an answer is reasonable and explain the solution process.

Materials Needed

Pencil and paper, 5 tree rings

Procedures and Activities

Introduction

Ask students to calculate the age of their grandparents and compare it to their age. Ask students to find the difference.

Prerequisite

To help students better understand the enormity of the numbers involved when we talk about time and the Earth's history; it is recommended that students are introduced to the concept of a "billion." Students will better understand the reference to the long time that Earth has existed.

1. Compare and Contrast. Ask students to compare and contrast old and new buildings. Show visual aids of old/new building structures. Ask the students to identify the different clues from the past.
2. Provide students different samples of tree rings to examine the age of each tree. Record the various ages and compare to Earth's Age.
3. Mother Earth's Birthday Cake. Ask students to predict how many candles you can put on a birthday cake and then try and figure out how large a birthday cake you would need to celebrate Mother Earth's birthday!
4. Teach the Earth's History.

Assessment

Teacher Made Test

Students solve mathematical/scientific problems relating to ages and time.

Students work in groups (3-4 students in one group). Give the students a time period within the geological time scale and ask students to pick an event card that represents the first evidence of an organism in the fossil record or the occurrence of a particular event during the Earth's history.

Lesson Four: History of Life's Events

Objectives

Science 5.1.12 - Connect Grade 5 science concepts with the history of science and contributions of scientists.

Science 5. 1.13 - Collect and analyze information using tools including calculators and computers.

Social Studies 5.1.21 - Cite examples and describe the impact of increased industrialization on 20^{th} century American Life.

Materials Needed

Cut out visuals of events and history; Cut out visuals of historical events, sentence strips, scissors and glue, construction paper.

Procedures and Activities

Introduction

Ask students to draw a timeline of their life's span (birth to present). Allow the students to work in pairs. Ask the students to share their timeline orally.

1. Distribute teacher made worksheet of "Events in Your Life." Ask the students to arrange the events in alphabetical order.

My Life's Events

__________________ when I learned to ride my training bike

__________________ when I read my first book

__________________ when I learned to walk

__________________ when I lost my first tooth

__________________ when I had my first haircut

__________________ when I ate my first solid food

__________________ when I celebrated my first Christmas/Holiday

__________________ when I learned to tie my shoes

__________________ when I went to my first day care.

__________________ write today's date

2. Explain to the students that a geologist might refer to a time line or life's events to describe a geologic time scale.

3. Teach the students the geologic time scale namely: era, period, epoch, millions of years ago and the major biological events.

Assessment

Allow the students to work in groups (3-4 students in a group). Distribute the Geologic Time Scale Strips such as the Cenozoic Era, Mesozoic Era and Paleozoic Era. Students will arrange the major biological events in correct sequence.

CONCLUSION

This curriculum unit has emphasized the long history of the Earth (4.5 billion years) and the myriad physical and organic changes that have occurred during that time. One of the most difficult concepts that modern children confront is understanding how old the Earth is and how long it has taken for the biosphere to arrive at its present state. To our pupils, the definition of "old" is the age of their grandparents (60-100 years) or a venerable European basilica (1,000 years). These abbreviated durations are infinitesimal by standards of the Proterozoic Eon (almost 2 billion years), the heyday of the dinosaurs (200 million years), the length of time that true humans have been on Earth (2 million years), or Milankovitch's Eccentricity Cycle (100,000 years). The geologic ages are so long in fact that once that concept is mastered, students can easily comprehend why climatic and geologic changes cycle and recycle, and why the most truly dramatic earthly phenomena take place over millennia, and not with brevity. In fact, as my unit has stressed, the current bout of "global warming" is very probably the quintessence of the most recent interglacial, which, given time, will revert to a new glacial advance: such is the rhythm of Ice Ages on Earth. Previous Ice Ages (the early Silurian and the Dwyka) endured an average of 60 million years, and there is no reason at all to surmise that the Pleistocene/Holocene Ice Age will not match or exceed that time span.

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