Weather and Climate

Shelly Lavoyce Brown
Codwell Elementary

INTRODUCTION

No one can escape the vagaries of our *weather*. Weather changes by the second and represents the daily state of our atmosphere. Because of its perpetual fluidity and its domination of our living planet (the *biosphere)*, weather must be taken seriously. One of the first comments humans make when they casually converse with one another usually refers to the weather. For example, "What do you think of today's weather?" or "How's the weather today?"

In contrast, the sum total, or average, of the day-to-day changes in the weather over longer periods of time (ordinarily up to thirty years) represents the concept of climate (Battan 101). After 300 years or more of gathering information about the weather from global meteorological stations, ships at sea, and other sources, scientists have been able to discern at least a dozen types of climate on the Planet Earth (Cosgrove 12, 13). In turn, climate affects the animals and plants that grow, the soil that exists, and the manner in which humans use them all.

The study of weather and climate should be mandated in every science curriculum in our public schools because of their inherent importance to human life in general and the lives of our children in particular. Weather affects our daily activities; the clothes we choose to wear; whether or not we go to school, to work, or to the grocery store; the crops we grow, and so on. We become accustomed to certain kinds of weather: hot, humid summers; cooler, cloudier winters; temperate springs and falls. Even though we recognize the possibilities of unseasonable weather conditions (droughts when it should be rainy; hard freezes when it should be warm; murderous blizzards and heat waves) and terrible storms (massive hurricanes and killer tornadoes), we still are surprised when such things happen. Witness our lingering shock in the aftermath of Hurricane Katrina, even though a city below sea level, New Orleans, was a proverbial "disaster waiting to happen."

The ordinarily predictable weather expectations are manifestations of what we call climate. Climates also change, but compared to the weather, they customarily evolve slowly over centuries and millennia. Although Earth scientists tell us that occasional quick shifts may be detected in tree rings, swamps or deltaic layers, and glacial ice deposits, in nature rapid climate change is the exception rather than the rule (UCAR 6).

Thus, between 300 million and 265 million years ago, the Earth was plagued with harsh cold, so much so that massive glaciers dominated the southern hemisphere. From 265 million to 65 million years ago, however, the Earth's climate was universally tropical, facilitating the prosperity of the largest organisms ever to inhabit the planet: the dinosaurs. Having to survive on earth for 200 million years, dinosaurs rank among the most successful organisms ever to have inhabited our planet. Ironically, scientists now inform us that the dinosaurs did not perish because of a long-term climatic change, but because of the Earth's collision with an asteroid of up to six miles in diameter on the Yucatan Peninsula in the Gulf of Mexico. They even give the asteroid a name: Chixulub. The Chicxulub catastrophe sent so much particulate into the stratosphere that the radiant energy from the sun was reflected into outer space, leaving Earth in the darkness of the equivalent of a "nuclear winter." The lack of sunlight altered the tropical climate for possibly a

decade or more, destroying perhaps as much as 70 percent of all living organisms, including the vast majority of the dinosaurs (Flannery 200, 201).

After enduring a period of hot, dry climate between 40 million and 3 million years ago, during which the continents were blanketed in dusty grasslands and deserts, the Earth plummeted into its most recent Ice Age (the Pleistocene), in which it witnessed numerous hundred-thousand-year cycles of glacial advance interspersed with shorter episodes of global warming. In fact, the last Ice Age advance ended somewhat more than 10,000 years ago when one-third of the earth was covered in glaciers of several miles thick. The ice sheets of Greenland and Antarctica (both more than two miles thick) represent remnants of these great glaciers. Since the retreat of the last continental ice sheets, the climate of the Earth has experienced at least ten millennia of global warming interlarded with short cooling cycles ordinarily associated with inconsistent solar activity (for example, "the Little Ice Age," AD 1300-1850), (*Global Warming*).

Until 1850, all of these climatic cycles were attributable to natural causes. At the time of the American Civil War (1860-65), approximately 1.3 billion human beings lived on the Earth, the vast proportion in Eurasia; however, our earthly forefathers were on the threshold of a serious worldwide Industrial Revolution that had begun in Great Britain a century earlier. By spring of 2007, 6.7 billion humans resided on the planet and up to half of them had gone through, or were undergoing, an Industrial Revolution, requiring the combustion of climate-altering carbon fuels (coal, oil, and gas). Accordingly, unless human beings reorganize their technology, sometime during the 21st century they may witness a peak of global warming that has not been observed for hundreds of thousands, if not millions, of years (Gore).

Clearly, it is essential that the modern schoolchildren be aware of the contingences of more severe weather events and their implications for longer-term global climatic change; moreover, as they represent the future of our species, our pupils need to be inspired and challenged to find solutions that will be necessary to reduce the volume of greenhouse gases that are now recklessly emitted into the Earth's atmosphere.

As an introduction to my unit, I will focus primarily on the understanding of our weather and climate and how they affect our lives. With the help of books related to the subject, the local newspaper, the media, the Internet, and numerous hands-on activities, I will be able to accomplish my ultimate goal. Venn diagrams and maps will also be used to compare weather conditions in different regions of the United States.

This unit will target third and fourth graders, but can be adapted for the lower and upper grade students. Within a given school year, the students will have an acute awareness of the weather conditions in their own environment and the surrounding areas of their peers.

Four lesson plans will encompass this unit.

HOUSTON I.S.D. SCIENCE OBJECTIVES

TEKS 4.2- The student uses scientific inquiry methods during field and laboratory investigations.

4.2B - Collect information by observing and measuring.

4.2E - Construct simple graphs, tables, maps and charts to organize, examine and evaluate information.

TEKS 4.4- The student knows how to use a variety of tools and methods to conduct science inquiry.

4.4B- Demonstrate that repeated investigations may increase the reliability of results.

TEKS 4.6- The student knows that change can create recognizable patterns.

4.6A- Identify patterns of change such as weather, metamorphosis and objects in the sky.

TEKS 4.11 - The student knows that the natural world includes Earth materials objects in the sky.

4.11B - Summarize the effects of the oceans.

4.11C - Identify the Sun as the major source of energy for the Earth and understand its role in the creation of winds.

RATIONALE

The initial instrument that will be used to enhance my instruction will be a book entitled, *Eyewitness Books-Weather*. This book points out very interesting analyses of the different types of weather patterns, such as natural signs, the science of weather, forecasting, clouds of all kinds, and our changing weather. Because most young elementary students are visual learners, the introduction to many of my sections will be a video on the many aspects of the weather. To provide a daily perception of the weather, copies of the weather report will be utilized to show comparisons of the weather conditions in Texas and other regions of the United States. Part of the unit will include an investigation related to weather inquiries. Another category will include measuring and charting the weather. Since the possibility of changes in the weather is so prevalent, daily notation is needed to better understand how it works. Throughout the unit, I will emphasize the importance of using hands-on activities. By having an availability of a variety of genres, the students will be able to formulate their creative ideas collectively, thus producing mastery.

UNIT BACKGROUND

Weather and Climate

First, I must clarify the difference between weather and climate. Weather is the state of the atmosphere in conjunction with heat or cold, wetness or dryness, clearness or cloudiness, and calm or storm (*School Dictionary* 1045).Climate is the overall average of the weather conditions of a place or region over a long period of time (*School Dictionary* 162). The reason why our weather changes from day to day in different places is the constant movement of the air. Introspective, our climate can depend on three variables, which are: the oceans, the mountains, and latitude. Think about it: mountains have blocked air at high elevation. Oceans are open to the air at low elevation. Latitude defines conditions north and south of the equator (Riehl 246, 247).

Skill- The students can relate to these terms by charting their own weather and climate in the particular area in which they reside. This can be accomplished by using the daily newspaper weather reports. H.I.S.D. Objective 4.2E

Atmosphere

Let’s begin with our atmosphere. As we go about our daily lives, certain things must occur and stay in balance. One piece of evidence that is a certainty is our atmosphere. Put in dramatic terms: without the atmosphere, we would burn or freeze to death. The layers of the atmosphere are (vertically, starting from sea level): the troposphere, the stratosphere, the mesosphere, and the thermosphere. In between these spheres are “pauses.” The troposphere is the layer nearest to us. It provides the weather that we experience (Cosgrove 6).

Skill- The students can demonstrate a model of the spheres by making a diagram. A sheet of paper will be given to fold into fourths, indicating each sphere with information provided. When the students finish, at the bottom of their diagram, they may draw a picture of their home. H.I.S.D. Objective 4.1E

Natural Signs

Does the groundhog really see his shadow? Is this a fact or a myth? You don't have to venture far looking for a groundhog on February the second because it will not happen. Forecasters have proven time and again that this is a myth. There are some real natural signs that indicate oncoming weather. For example, the pinecone is a very reliable natural indicator of inclement weather. When the weather is dry the scales open up. When the scales are closed, there is a strong possibility that rain is nigh (Cosgrove 9).

Skill- The students can collect pinecones during the Christmas season; place them by the window and watch and observe when the scales will open. They can use a timer to indicate how long the scales will remain open. H.I.S.D. Objective 4.11

The Sun

Because the Earth is so far from the sun, it intercepts only a tiny percentage of the sun's rays. When the sun is at its highest peak (noontime), an area of given size on the ground will intercept the sun's maximum solar energy. During the equinoxes (when the sun is overhead at the equator), all latitudes experience twelve hours of daylight and twelve hours of night. "Equinox" means "equal night" (Riehl 34).

It has been hypothesized that the incoming solar radiation from the sun is constant and climatic changes are caused by modification in the properties of the Earth's surface or of the atmosphere. Radiant energy from the sun is what keeps the atmosphere in constant motion, thus determining all types of weather occurrences. Radiant energy from the sun that is absorbed by the Earth's surface is converted to thermal (heat) energy. The highest temperatures are experienced in tropical deserts where cloudless conditions prevail, and solar radiation is near its zenith much of the year (Riehl 35).

Skill- On a hot sunny day, the students can record the temperature in the morning, at noontime, and in the mid-afternoon with the use of a thermometer. Afterward, the students can make a comparison chart to see if there is a difference in the temperature, and why? H.I.S.D. Objective 4.6

The Wind

You can feel me, but can't see me. Who am I? The wind, of course. Wind is moving air. It can be as calm as a breeze, or as fierce as a hurricane. There is no escaping it. It can demolish a tall building with a single blow or carry a light feather all around the world. We know that it exists and we cannot live without it.

Since most students are familiar with kites, a bit of history should be noted. The first kites were flown by the ancient Chinese as long ago as 600 B.C. Back then kites were made to scare their enemies away (Cosgrove 43). Today they are used mostly for pleasure.

Skill- The student can construct kites to test wind velocity. Would a kite made of light material flow in the wind faster than one made out of heavy material? The students may use a compare and contrast chart. H.I.S.D. Objective 4.11

Landforms vs. Water forms

Depending on the latitude, the temperature of the surface of the oceans remains relatively constant within a given day compared to a much greater range over land. Even the average temperature range between summer and winter amounts to just a few degrees over water. In contrast to land, fluid water heats and cools by convection, which is facilitated by the mobility of water. Land surfaces are rigid and heat is transferred mainly by conduction; thus land is hotter in

summer and colder in winter than is water. Near the Earth's surface, air becomes warmer or colder mainly through contact (Battan 106).

Because mountains represent higher elevations, they serve as obstacles to wind and clouds, forcing the air to rise or descend along their slopes. High up in the mountains, an intense wind increases the wind chill effect, even on sunny days. Because wind strength increases with elevation, winds can be much stronger at 3300 feet than at sea level (Cosgrove 53).

Kinds of Clouds

A cloud is a mass of condensed vapor suspended in the air at some height from the Earth. Here are some of the types of clouds, and how you would recognize them:

1. Cirrus- detached clouds, delicate looking, feathery with a whitish color
2. Cirro-stratus- thin whitish sheet in the formation of a tangled web
3. Cirro-cumulus- white flakes, arranged in group formation
4. Alto–cumulus-large globular mass, partially shaded with ragged edges
5. Alto–stratus- thick sheet grey or bluish color occasionally showing brilliant patches of the sun or the moon
6. Strate-cumulus- rolls of dark clouds covering the entire sky giving a wavy appearance
7. Nimbuo- stratus and Cumulo- nimbus- Rain Clouds- a massive layer of dark clouds, without shape or form with undefined edges (Battan 68-73).

Skill- Cotton balls pasted on a sheet of blue construction paper can be used to demonstrate different kinds of clouds. For rainy clouds, dark crayons, such as gray or black should be used to enhance their picture. At the bottom of the picture, the students can exercise their writing skills. Additional research can be done via the Internet. H.I.S.D. Objective 4.4B

Weather Forecasting

Powerful sophisticated instruments are now being used to provide large scale forecasting to daily radio and television stations. At every second and minute of any given day weather observations are taken by satellites, radar ships, and weather stations all over the world. This information is retrieved by a special Global Communications System or GTS. These statistics are continually fed into supercomputers that are able to carry out millions and millions of calculations per second. Meteorologists can use this information to make short-range weather forecasts for the next 24 hours. A synoptic chart is used to indicate wind, cloud cover, air pressure, humidity, and temperature (Cosgrove 14).

Skill- Students can use a copy of the U.S. map indicating lines linking points of equal pressure. These long curvy lines are called isobars. They are measured in millibars. After the points and lines are on the map, the students will be able to recognize what kind of weather is likely to occur in any particular region of the United States. H.I.S.D. Objective 4.6

The Water Cycle

When water is transferred from the ground or from the oceans into the air it transcends into evaporation (water vapor). After the water evaporates into the air it condenses to form clouds. In the last stage of the cycle; water falls back to the earth from the clouds, which in turn produces precipitation (EPG, *Science* 388). It is important for young students to know how the water cycle works because rainfall is so frequent in most areas of the United States.

Skill-Students may draw a replica of the water cycle by using symbols from a weather map. They can make predictions from percentages to determine if there will be heavy, moderate, or no rainfall. H.I.S.D. Objective 4.11

Radiation /Energy

The source of energy for the oceans and the atmosphere comes mainly from solar radiation (insolation). The balance of heat on the earth and atmosphere begins when sunlight touches the outer edge of the atmosphere and is ultimately absorbed by the Earth's surface (Battan 9).

As solar radiation penetrates Earth's atmosphere, it maybe transmitted, reflected, or absorbed. When the insolation is absorbed, it is converted to thermal (or heat) energy. It is this thermal energy that heats the Earth and its atmosphere (Battan 10).

As we confront the issue of "global warming" increasing (see below), we will shift from the combustion of carbon bearing fuels to energy sources like solar cells. Solar cells enable us to receive energy directly from the sun by using light-sensitive crystals to convert sunshine into electricity without generating harmful carbon by-products (Battan 11).

Global Warming

Global warming is the most talked about phenomenon so far in the 21st century. Last year (2006) was considered the warmest weather on record (Kaufman). In fact, the eleven hottest years have occurred in last fifteen years (Gore). Unusual seasonal weather patterns and the long-term effects of the buildup of carbon dioxide in the atmosphere as reported by the government's National Climatic Data have contributed to global warming. The burning of oil and other fossil fuels releases carbon dioxide, which rises, blankets the earth and traps heat. Climate scientists report that there has not been this much carbon dioxide in the atmosphere in the past 650,000 years (Kaufman).

Whether global warming is caused by atmospheric conditions, greenhouse gases, carbon dioxide, or the impact of past climatic conditions, humankind must come to grips with the fact that the physical world is changing at an astronomical rate, and for the sake of future generations a change in attitudes and lifestyle must occur, even if it as simple as changing a light bulb, physically and symbolically.

Weather Disturbances

- Hurricanes -- For many years meteorologists, seamen, and just ordinary people have watched the sea and the ocean with anxiety for signs of an approaching hurricane. Under the momentum of winds that can attain up to 200 mph devastating tidal surges can generate in the ocean. A storm surge can exceed 20 feet when such storms make landfall. Because the possibility of an incoming hurricane can be predicted early, precautions can be taken. Thus, our hurricane warning systems need to be at the highest state of readiness (Riehl 204).
- Tornadoes -- Tornadoes are considered to be the most destructive storm in the atmosphere. They can cause massive damage because of their size and duration. A tornado is a small funnel with winds up to 200 mph circling tightly around its core. Even though the width of the area sustaining the most damage is no more than a few city blocks, damage can be catastrophic. Unfortunately most information about tornados comes from the survey of the damage. When a tornado is imminent, meteorologists suggest that you open your doors and windows, and then proceed to the nearest low-profile shelter (Reihl 133).
- Hail -- The cumulonimbus cloud is the cloud that causes hail. The formation of hail appears when both water and ice are present. This is not necessary the case every time a cumulonimbus cloud appears. Evidence has warranted that when a cumulonimbus cloud is required to hold a growing ice pellet for an unusual amount of time, it wrestles against

the law of gravity. This causes the ice pellet the opportunity to increase in size. Hail storms are most frequent in spring and early summer (*Cloud*).

- Lightning -- Lightning develops when collisions between ice crystals within clouds create friction. Recently, scientists have improved their predictions of which thunderstorms will produce lightning by studying the meteorological seeds within clouds that lead to ground strikes. Because of the endless supply of warm humid coastal air that breeds thunderstorms, the city of Houston has attracted more lightning than any other part of Texas. Twelve sensors have been installed throughout the Houston area to detect electromagnetic energy within storm clouds. Each sensor can detect up to 10,000 bits of data per second, and with multiple sensors tracking each discharge, the system can pinpoint the exact location and intensity of each instance of cloud lightning. Identifying the types of thunderstorms that are expected to produce lightning would be a welcome relief for those engaging in outdoor activities (Berger).

Weather Inquiries

- ***How does the weather affect animals?***

  When the weather is too humid and hot, the production of domestic animals decreases. They consume less and produce fewer eggs or less milk. The weight of cattle and hogs slowly increases. In order to have a successful farming season, farmers must consider the dates when temperatures are likely to fall below the freezing point. An accumulation of ice may cause extensive damage to vegetation.

  Some young children have pets. While it is true that wild animals can survive harsh weather conditions, pets for the most part cannot, because they are domesticated. They do not have the survival mechanism that feral animals have because their bodies do not have sufficient fur or fat. Dogs with very short, thin coats and very little body fat may actually need sweaters and coats in the wintertime. Many older dogs have trouble keeping warm. It is illegal to abuse animals, and this includes neglecting to protect your pets against the cold of winter. Owners can be fined a maximum of $750.00 in some states (post-gazette.com). So, if you see an animal shivering, don't feel sorry for the owner, feel sorry for the animal, and call your local Humane Society.

- ***How do our bodies respond to the weather?***

  During very cold weather outdoor exposure to the cold outdoors can lower body temperature to a dangerous level. This is a condition known as hypothermia.

  Hypothermia develops when the body loses heat faster than it produces it, and the body temperature drops below 95 degrees. Older persons and babies are more susceptible to this condition. Warning signs include trouble breathing, confusion, stiff muscles, drowsiness, slurred speech, poor coordination, and confusion. Precautionary measures can be taken, such as: wearing protective clothing, turning the thermostat below 70 degrees at night, and eating a well balanced meal (*NCBuy Home*).

  Just like a covering protects an item, so does our skin. It protects us from the elements of our changing weather. When we do not dress properly, the body reacts in negative way; thus causing various illnesses. Most young students have probably have heard their grandparents say, "I know when the weather is about to change, because I can feel it in my bones."

- ***What are* some of the terms used to describe the weather?**
  1. Stationary Front -- When a cold and warm air mass meet and remain over an area while moving at speeds of 5 mph or less.
  2. Cold Front -- Cold air that moves under a warm air mass. Huge cumulonimbus clouds may build up along with the front, bringing heavy rain and at times severe thunderstorms for up to a few hours.
  3. Warm Front -- Warm air that moves over a cold air mass. Warm fronts often bring a light steady rain or snow for long periods of time.
  4. Moonbow -- When raindrops catch the reflection of the bright moonlight; literally, a rainbow at night.
  5. Ozone -- A bluish gas that protects us from the sun's harmful ultraviolet radiation.
  6. Fog -- When water vapor condenses near the ground. Fog is literally a surface cloud.
  7. Waterspout -- When a tornado develops over the sea.
  8. Blizzard -- When snowfall is accompanied by strong winds.
  9. Hoar Thorns -- When water vapor touches a very cold surface and freezesinstantly, leaving spiky needles on leaves and branches, and even cars.
  10. Currents -- Winds that move across the surface of the oceans. The resultant movement of the ocean is an "ocean current."
  11. Statistical Forecasting -- Weather records based on patterns.
  12. Geostationary Satellites -- Fixed satellites that remain in the same place high above the equator.
  13. Polar-Orbiting Satellite -- Satellites that circle the earth in lines from the North Pole to the South Pole (EPG, Science 112,113).

- ***What are some instruments used to measure the authenticity of the weather?***

  Modern technology and sophisticated equipment are now used to track the weather all over the world. These tracking systems are constantly gathering, evaluating, and recording atmosphere conditions simultaneously. From the far corners of the Earth to weather satellites circling in the Earth's atmosphere, pictures of clouds and temperature patterns are beaming downward to many weather stations. A barometer is used to measure air pressure. It shows a drop in pressure when a storm is approaching and an increase in pressure when a beautiful day is imminent. A wet and dry hygrometer can measure humidity. It has two thermometers. It is the difference between the two temperatures that determines the humidity (Cosgrove 62, 63).

Conclusion

Extreme cold and hot weather is experienced throughout the world more than ever before. This type of weather is making its presence known to politicians, presidents, foreign leaders, and to our most precious possession: our students. With inquisitive minds, the "why" question is asked more frequently, so we must provide an answer. The most accurate and precise answer should be informed by the experts and professionals in this field, not from intelligent persons who just want notoriety. Our weather and climate must be taken seriously, because as it is often said, "The rain falls on everybody, not on a select few." Being in the teaching profession in this day and time is a privilege and an honor, because even though within a school year we may only affect one percent of a child's life, that one percent can make a profound impact on the rest of his or her life.

Lesson Plans

Lesson One: Clouds and Storms

Objective

TEKS 4.6A- Identify patterns of change such as weather, metamorphosis and objects in the sky.

Introduction

Introduce the different types of clouds. How do clouds affect the weather?

Concept Development

The students will be aware of how daily news weather reports can determine what to wear to school and how cloud cover (within an eight hour period) can change those plans.

Student Practice- Graphic Organizer

1. How do clouds develop?
2. What clues do clouds give about the weather?
3. How do thunderstorms form?
4. How can you stay safe during storms?
5. What causes hurricanes?
6. What are tornadoes?
7. What happens to water in clouds?

Assessment

The students will be assessed by writing in detail about the four major types of clouds (Cirrus, Cumulus, Stratus, and Nimbus). They can also use their artistic skills by drawing pictures of these clouds.

Closure

A report of their findings will be presented to the class.

Resources

Classroom science basal, Internet, newspapers

Lesson Two: The Greenhouse Effect

Objective

TEKS 4.2- The student uses scientific inquiry methods during field and laboratory investigations.

Introduction

Explain to the students how the earth is compared, in certain ways, to a greenhouse.

Concept Development

The students will be able to explain how the earth stays warm enough for animal and plant life to survive and thrive.

Student Practice- Create a model greenhouse

1. Design a structure that will act as a greenhouse.
2. Create the structure.
3. Measure and record the changing temperature within the structure over a 24-hour period.

Assessment

Have each student write a summary of his or her data with an explanation of their observations. Research the greenhouse effect in relation to global warming.

Closure

Discuss ways that human activities might be affected by the greenhouse effect.

Resources

Materials for experiment

Research material via internet

Books on the topic

Magazine articles on the greenhouse effect

Lesson Three: Hurricanes

Objective

TEKS 4.6 The student knows that change can create recognizable patterns.

Introduction

Describe the mechanics of the development of a hurricane.

Concept Development

The students will learn about the characteristics of hurricanes. They will also do research to find scientific explanation of wind speed and water depth in relation to hurricanes.

Student Practice **-- Cause and Effect Diagram**

The student will list in sequential order the cause and effect of potential hurricanes.

Assessment

The students will do research on the Internet on how hurricanes are predicted and how their paths are tracked.

Resources

Internet, classroom science basal

Lesson Four: Weather Map

Objective

TEKS 4.2E- Construct simple graphs, tables, maps, and charts to organize, examine and evaluate information.

Introduction

The students will brainstorm the elements that make up weather.

Concept Development

The students will be able to create and present national weather maps showing different weather conditions in the United States.

Student Practice

An opportunity will be given for each student to choose from different types of weather maps. These maps are: satellite, radar, precipitation, temperature, wind speed, and front.

Assessment

A rubric will be used to evaluate how well the students researched, and created their own weather map.

Closure

Discuss how different variations of a weather map and how they affect people lives.

Resources

Books about the weather from the school's library are excellent resources.

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