WOW-

Watching Our Weather

A Student Inquiry Project

Gwen Foote, Science Dept Chair/Teacher
gfoote@dadeschools.net
Nautilus Middle School –IB World School
4301 N Michigan Ave.
Miami Beach, FL
305-532-3481
School Mail Code 6541

For information concerning IMPACT II opportunities,
Adapter and Disseminator grants, please contact:
The Education Fund
305-892-5099, Ext. 18; E-mail: Lvalle@educationfund.org
Web site: www.educationfund.org

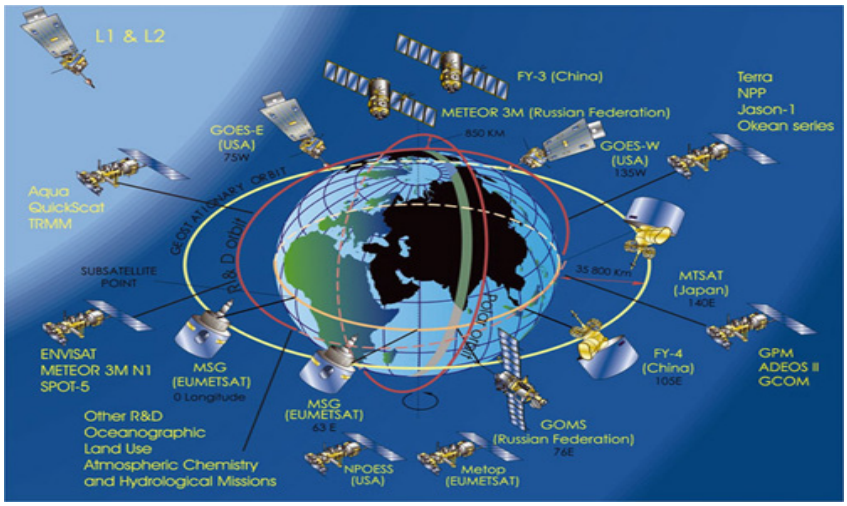
Table of Contents

Page

Goals & Objectives 3
Common Core & New Generation State Standards 5
Pacing Guide Topics: 2012-2013Example 6th Grade 7
Course Outline/ Overview 8
A Student Inquiry Program

Lesson Plans 9
Lesson 1: Hurricane History and Life Cycle 9
Lesson 2: Thermal Energy Movement 12
Lesson 3: Graphing the Atmosphere 13
Lesson 4: Causes of Weather- Relative Humidity 15
Lesson 5: Water Cycle in Earth's Atmosphere & Spheres 18
Lesson 6: How Weathering & Erosion Affect the Earth 21
Lesson 7: Weather & Landforms 24
Lesson 8: Observing & Tracking Weather 25
Lesson 9: Weather & Energy Inquiry-WOW 27

Resource List 29
Appendices
A Student Worksheets #3 30
B Student Worksheets #4 31
C Student Worksheets #5 36
D Student Worksheets #6 39
E Student Worksheets #7 41



LESSON MODULE

WOW- Watching Our Weather

A Student Inquiry Project

OBJECTIVES:

Students will:

- Explain how scientific knowledge about natural disasters has changed as new evidence is discovered
- Identify an instance in history when scientific knowledge has changed as a result of new evidence
- Investigate how a hurricane is formed and the dynamics that can cause it to strengthen and/or weaken
- Compare and analyze the different forecasting models used to predict the path of hurricanes
- Collect information about an historical natural disaster and its effects
- Apply concepts to produce a national disaster preparation brochure or PSA video
- Research and interpret important disaster preparedness information
- Design a hurricane preparedness and protection plan
- Explain how energy provided by the Sun influences global patterns of atmospheric movement and temperature differences among air, water, and land.
- Discuss conduction, convection, and radiation in the context of Earth's atmosphere, hydrosphere, and geosphere.
- Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere through graphs
- Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperatures or states of matter
- Identify, compare, and contrast temperature, heat and thermal energy
- Identify examples of conduction, convection and radiation in the real world
- Identify a problem from energy transfer and design a lab to test your hypothesis
- Explain natural occurring weather patterns as a result of convection and radiation
- Classify the different climate regions of the world and the factors that create them
- Observe and compare the rate of heat loss of different substances (sand, water, soil, rock, cement, etc.) and applying it to the earth system
- Graph the rate of heat loss of different substances
- Investigate and understand the dynamics of the greenhouse effect on the earth
- Identify and research the natural and unnatural causes of climate change in the world
- Evaluate possible solutions to climate change and habitat loss
- Design and build a convection current model, a conduction model and a radiation model to observe and analyze heat transfer
- Design and build a model of the greenhouse effect on the Earth
- Design and build a model to observe convection currents
- Differentiate between weather and climate
- Describe and explain how the cycling of water and global patterns influence local weather.
- Explain causes of wind and wind patterns
- Investigate the factors that affect weather
- Investigate tools that are used to measure weather
- Describe and explain the interactions of water between the different spheres of the earth (water cycle)
- Build a closed model of the water cycle and observe effects of different student synthesized variables
- Apply the water cycle processes to a real world example
- Diagram and label jet stream and ocean currents for different regions of the world
- Record and graph temperature and precipitation over a period of time
- Measure wind speed and direction using an anemometer and weather vane

- Define a problem about a factor of weather and design an experiment to test a hypothesis
- Infer the possible weather from given data and conditions
- Design and build a barometer to understand the effects of air pressure
- Predict the effects of different factors on different ecosystems
- Design and present a student weather device to track weather in the community
- Students will describe the composition and structure of the atmosphere and how the atmosphere protects life and insulates the planet
- Compare and contrast the different layers of the atmosphere and present information in small groups
- Investigate the purpose of the ozone layer in the earth's system & evaluate the effects of the ozone on the earth's environments
- Differentiate between the different layers of the atmosphere/ Model the layers of the atmosphere
- Explain how energy provided by the sun influences global patterns of atmospheric movement and the temperature differences between air, water, and land
- Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate
- Students will explain how energy provided by the Sun influences global patterns of atmospheric movement and/or the temperature differences among air, water, and land.
- Investigate the role weathering plays in shaping/reshaping the earth
- Compare/contrast physical and chemical weathering.
- Identify community features affected by weathering and write a proposal to restore such a structure.
- Design an experiment that will provide proof on the formation of beaches through deposition
- Explain how glacial erosion contributes to the formation of large lakes
- Differentiate between erosion and deposition
- Explain how the agents of erosion shape/reshape earth
- Investigate local landforms that were developed as a result of erosion and deposition
- Collect data/create a report on the fact that beaches, spit, and tombolos are by products of erosion and deposition
- Differentiate between the different types of landforms in Florida
- Diagram all the rivers and other landforms on a map or model of Florida
- Compare and contrast the landforms found in Florida and those found outside of Florida
- Create a travel brochure focusing on the multiple landforms in Florida and relate their importance to human society and the environment
- Model and observe causes and dynamics of dunes and importance to beaches during severe weather
- Create a landform model and identify its features
- Evaluate the issues concerning the different landforms of the earth and how they are being affected by humans (debate)
- Compare and contrast potential and kinetic & Apply concepts of potential and kinetic energy
- Explore kinetic and potential energy through a real life application or model
- Diagram the transfer of kinetic and potential energy in a real world application
- Design an experiment or device to investigate kinetic energy and potential energy
- Compare how different forms of energy are used and measured
- Investigate temperature, heat and thermal energy
- Explain the Law of Conservation of Energy in a real life example
- Differentiate the difference between a theory and a law
- Explain the difference between an experiment and other scientific investigations
- Research scientists, engineers, and/or inventors who have made contributions to the design of machines that demonstrate the Laws of Conservation of Energy

GOALS & OBJECTIVES/ COMMON CORE STATE STANDARDS

- Students will develop their sense of science process, investigation and data analysis and interpretation through personal research and use of data findings through technology.

New Generation State Standards:

Science Standards 6-8:

Big Idea 1: The Practice of Science

SC.6.N.1.1 Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systemic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. ***Assessed as SC.8.N.1.1*** (DOK High)

SC.6.N.1.2 Explain why scientific investigations should be replicable ***Assessed as SC.8.N.1.1*** (DOK High)

SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation. ***Assessed as SC.7.N.1.2*** (DOK High)

Big Idea 2: The Characteristics of Scientific Knowledge

SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but in also creating explanations that fit evidence. ***Not assessed*** (DOK Moderate)

SC.6.N.2.1 Distinguish science from other activities involving thought. (DOK Moderate)

SC.6.N.2.2 Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered. (DOK Moderate)

Big Idea 2: The Characteristics of Scientific Knowledge

SC.6.N.2.3 Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals. ***(D.O.K.: Low)***

Big Idea 3: Role of Theories, Laws, Hypotheses, and Models

SC.6.N.3.2 Recognize and explain that a scientific law is a description of a specific relationship under given conditions in the natural world. Thus, scientific laws are different from societal laws. ***(D.O.K.: Moderate)***

SC.6.N.3.3 Give several examples of scientific laws. ***(D.O.K.: Moderate)***

Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models

SC.6.N.3.1 Recognize and explain that a scientific theory is a well supported and widely accepted explanation of nature and is not simply a claim posed by an individual ***Assessed as SC.7.N.3.1*** (DOK moderate)

SC.6.N.3.4 Identify the role of models in the context of the sixth grade science benchmarks

Big Idea 6: Earth Structures

SC.6.E.6.1 Describe and give examples of ways in which Earth's surface is built up and torn down by physical and chemical weathering, erosion, and deposition. ***Assessed as SC.7.E.6.2 (D.O.K: Moderate)***

SC.6.E.6.2 Recognize that there are a variety of different landforms on Earth's surface such as coastlines, dunes, rivers, mountains, glaciers, deltas, and lakes and relate these landforms as they apply to Florida. ***Assessed as SC.7.E.6.2 (D.O.K.: Moderate)***

Big Idea 7: Earth Systems and Patterns

SC.6.E.7.1 Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through Earth's system. ***Assessed as SC.6.E.7.5*** (DOK Moderate)

SC.6.E.7.2 Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate ***Assessed as SC.6.E.7.4*** (DOK High)

SC.6.E.7.4 Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere. **AA** (DOK High)
SC.6.E.7.3 Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation ***Assessed as SC.6.E.7.4*** (DOK High)
SC.6.E.7.5 Explain how energy provided by the sun influences global patterns of atmospheric movement and the temperature differences between air, water, and land ***AA*** (DOK High)
SC.6.E.7.6 Differentiate between weather and climate. ***Assessed as SC.6.E.7.4*** (DOK Moderate)
SC.6.E.7.9 Describe how the composition and structure of the atmosphere protects life and insulates the planet ***Assessed as SC.6.E.7.9*** (DOK Moderate)
SC.6.E.7.7 Investigate how natural disasters affect human life in Florida. (DOK High)
SC.6.E.7.8 Describe the ways human beings protect themselves from hazardous weather and conditions (DOK Moderate)
SC.6.E.7.8 Describe the ways human beings protect themselves from hazardous weather and conditions. (DOK Moderate)
SC.912.E.7.3 Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, geosphere, and biosphere
SC.912.E.7.5 Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions.
SC.912.E.7.6 Relate the formation of severe weather to the various physical factors.
SC.912.P.10.4 Describe heat as the energy transferred by convection, conduction, and radiation, and explains the connection of heat to change in temperature or states of matter
Big Idea 10: Energy
SC.912.P.10.4 Describe heat as the energy transferred by convection, conduction, and radiation, and explains the connection of heat to change in temperatures or states of matter
Big Idea 11: Energy Transfers and Transformations
SC.6.P.11.1 Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where potential energy is transformed into kinetic energy and vice versa.
Assessed as SC.7.P.11.2 (D.O.K.: Moderate)
Standard 10: Energy
SC.912.P.10.4 Describe heat as the energy transferred by convection, conduction, and radiation, and explains the connection of heat to change in temperatures or states of matter

Common Core State Standards:

Math Standards 6-8:
MA.6.A.3.6 Construct and analyze tables, graphs, and equations to describe linear functions and other simple reactions using both common language and algebraic notation.

Language Arts Standards 6-8:
LA.6.4.2.2 The student will record information (e.g., observations, notes, lists, charts, legends) related to a topic, including visual aids to organize and record information and include a list of sources used

LA.6.2.2.3 The student will organize information to show understanding (e.g., charting, mapping, paraphrasing, summarizing, or comparing/contrasting

Pacing Guide Example: 6th Grade

I. Quarter 1
   1. Natural Disasters & Effects on Floridians
      a. Hurricanes
      b. Other Natural Disasters
      c. Models
      d. Emergency Preparedness
      e. Effects of Sun exposure
   2. Thermal Energy Transfer
      a. Heat Transfer in Earth's Systems
      b. Temperature vs. Thermal Energy
      c. Water Cycle
   3. Climate & Global Patterns
      a. Global Patterns that affect weather
      b. Influences on Local Weather
   4. Causes of Weather
      a. Weather
      b. Air Mass Form
      c. Atmospheric Conditions
      d. Predicting the Weather
   5. Atmosphere & Spheres of Earth
      a. Earth's Spheres
      b. Composition structure and function of the atmosphere
      c. Weather vs. Climate
      d. Human activities and Climate Change
      e. Quarterly Assessment

II. Quarter 2
   6. How Weathering & Erosion Affect the Earth
      a. Weathering
      b. Erosion
      c. Deposition
   7. Landforms of Geosphere
      a. Types of formation
      b. Florida Landforms
   8. Potential & Kinetic Energy
      a. Potential Energy
      b. Kinetic energy
      c. Forms of energy
   9. Energy Transfers and Law of Conservation
      a. Law of Conservation of Energy
      b. Energy Transformations
      c. Scientific Investigations- Nature of Science
      d. Quarterly Assessment

Course Outline/ Overview
WOW: Watching Our Weather - A Student Inquiry Program

NAWAS- Nautilus Awareness of Weather Alert Station:

Natural Weather Disasters and severe conditions occur worldwide and are in news daily. Students in South Florida live in a living lab of hurricane events. This is a chance to implement S.T.E.M. activities and promote common core standards for College and Career fields. Students have fun learning with technology and topics that are applicable to their daily lives and families. The lessons included in this packet fit the schedule of MDCPS Curriculum and include various technological virtual and inquiry engaged labs for weather, communication and environmental concerns. It promotes communication with local /national weather with a wireless tablet.

Students monitor data from a portable weather station to practice the scientific process, gathering information and application of lessons about weather, and how it applies to their daily lives. Students practice regular collection of data for graphing and analysis to compare it with weather patterns of recognized meteorologists. Students become proficient in Microsoft Excel to analyze their graphed data. They engage in labs and activities so they can present weather, data, and forecasts to student groups and classes. These may be posted on school websites.

Students engage in inquiry lab activities to use weather statistics, including how humidity, temperature, barometric pressure, wind speed and heat index relate to weather forecasts and trends during hurricane season. Weather patterns and predictions in forecasts are explored in engaged lab activities and problem solving scenarios of real life events. Technology presentations are prepared by collaborative learning student groups for other classes and students. Visuals and weather patterns are presented in class discussions for cross curriculum application and predictions of environmental concerns for hurricanes and other severe weather preparedness.

The lab activities are ongoing throughout the year, in accordance to scheduled Pacing Guides of the curriculum. There are other labs in pacing guide topics that can integrate environmental and weather awareness concerns. As seasons and weather patterns change throughout the year, students mentor younger students in the practical work ethic of scientific observations in nature, with classification and analysis of qualitative and quantitative data.

The practice of inquiry that uses technology and the application of data monitoring improves understanding of the scientific process. Integrating communication improves critical thinking and problem solving in real life events of changing weather patterns, seasons, and weather events in changing atmospheres. Students gain an understanding of alternate energy sources of solar, wind, and hydropower energy through solar powered energy of a weather station and lessons in alternative energy about renewable resources.

Students observe national weather and local weather reports to compare it with their own data collected from the NAWAS (Nautilus Awareness Weather Alert Station). They observe information in their daily lives and apply current weather patterns and predictions to forecast weather through lab activities and problem solving in coordinated activities. The Samsung Galaxy Tab 2- 7.0 Tablet is used for its ability to go WI-FI to watch the latest weather reports, maintain tracking maps, and submit weather reports to local stations and school website from the Nautilus Weather Station. The tablet is also used to communicate and download information with local and national weather stations, NOAA, NHS, and national weather reports. Students compiled data from a variety of sources to submit current weather reports.

Lesson Plans

LESSON 1: Natural Disasters and their Effects on Floridians Hurricanes through multimedia

Purpose: Students design a hurricane preparedness and protection plan

Vocabulary: hurricane, cyclone, typhoon, tornado, weather, disaster, atmosphere, pressure, precipitation, model, evidence, latitude, longitude, troposphere, convection

Procedure

Teacher can access videos, photos, interactive glossaries to insert into Power Point Presentations for classes from MDCS Pacing Guides. They can also use www.discoveryeducation.com or other educational Internet resources (www.noaa.gov, www.nhc.gov, local weather/ news stations, www.nationalgeographic.com, www.discoverychannel.com, etc.). Power Point presentations can be reused and shared with teachers that can increase time efficiency for teachers.

In this way, teachers can show lessons about hurricanes, fires, and storm surge problems that are typical of the South Florida region. Contrasts can be shown about other parts of the country and other global ecosystems. Students enjoy learning through technology and teaching topics that they identify with and can apply to their daily lives is effective in teaching critical thinking, reasoning, and problem solving. Assignments about hurricane preparedness can involve them in creating presentations to each other to share in class so they are involved in their learning and taking important information home to share with families.

Background Information: How are Hurricanes formed?
Tracking Hurricanes.

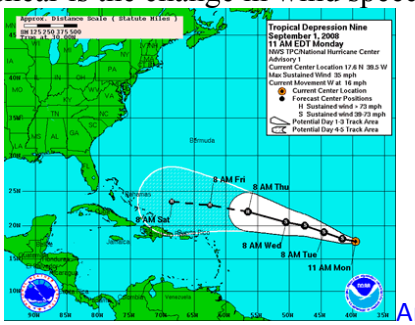
Weather and storm alerts are no longer a small segment of current events. Weather plays a part in daily news on a global level. Natural disasters occur due to weather everywhere. In South Florida there is a valuable chance to study hurricanes in their native region. Experiencing firsthand how to deal with hurricanes promotes engaged learning, critical thinking with reasoning and problem solving and lessons that students can take home to share with families and communities. Awareness in how to maintain homeostasis is integral in the survival of people and improve living conditions for a large population of the world.

In this lesson students will explore, research, and prepare engaging presentations about Hurricanes, their history, how they are caused, their effects, how to track them, and present visual models of storms and their patterns. Other natural disasters are investigated to show comparisons with tornadoes, floods, fires, and droughts. Emergency Preparedness plans and presentations will be shared for increased awareness of improved safety precautions and impact weather has on human populations.

The term “hurricane” has its origin in the religions of past civilizations. The Mayan storm god was named Hunraken. A god by the Taino people of the Caribbean was called Huracan. Hurricanes are one of nature’s most powerful storms. Their potential for loss of life and destruction of property is tremendous. Hurricanes are only one type of tropical cyclone. Tropical cyclones are warm-core, low pressure systems without any "front" attached, with organized circulation that develop over the tropical or subtropical waters. Depending upon location,

tropical cyclones have different names around the world. In the Atlantic & Eastern Pacific Oceans they are called Hurricanes. In Western Pacific they are called Typhoons. In the Indian Ocean they are called Cyclones.

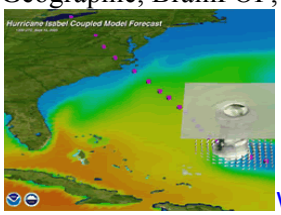
Regardless of what they are called, tropical cyclones are powered by heat from the sea. They are products of a warm tropical ocean and a warm, moist atmosphere. Hurricanes are typically steered by easterly winds, generally south of 25° north latitude and by high-level westerly winds north of 25° north latitude. There are several favorable environmental conditions that must be in place before a tropical cyclone can form. These situations are warm ocean waters (at least 80°F / 27°C) throughout a depth of about 150 ft. (46 m). An atmosphere which cools fast enough with height such that it is potentially unstable to moist convection. There is relatively moist air near the mid-level of the troposphere (16,000 ft. / 4,900 m).Hurricanes begin generally a minimum distance of at least 300 miles (480 km) from the equator in a pre-existing near-surface disturbance. Winds are significant factors with low values (less than about 23 mph / 37 kph) of vertical wind shear between the surface and the upper troposphere. The vertical wind shear is the change in wind speed with height



. Animation showing path of Hurricane Ike -National Hurricane Center

Although hurricanes are well known for their strong and destructive winds, a hurricane's storm surge is by far the greatest threat to life and property along the immediate coast. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. In addition, wind driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides. Because much of the United States' densely populated Atlantic and Gulf Coast coastlines lie less than 10 feet above mean sea level, the danger from storm tides is tremendous.

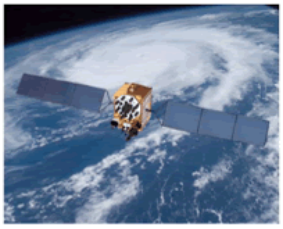
Hurricane lessons and presentations are done with Power Point Presentations. Photos and videos are available from online educational sources, including Discovery Education, History Channel, National Geographic, BrainPOP, and Scholastic. These are accessible through the curriculum pacing guide links.



What's New in Hurricane Research September 2010 (NOAA)

Where and how strong? When it comes to a hurricane, those are two key questions that coastal residents need answered. And those answers come much faster today thanks to decades of studies by NOAA's Office of Oceanic and Atmospheric Research. Over recent decades, the Hurricane Research Division of the NOAA Atlantic Oceanographic and Meteorological Laboratory has led many of the scientific advances behind better forecasting....

http://www.education.noaa.gov/Weather_and_Atmosphere/Hurricanes.html

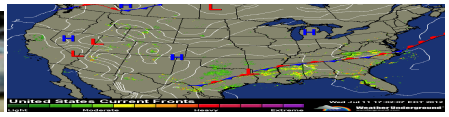


GPS For Hurricanes May 2010 (Boeing)

To get ready for this year's hurricane season, NOAA scientists spent the last few months working to place Frisbee sized satellite antennas high atop stationary platforms in the Gulf of Mexico. The instruments are based on Global Positioning System technology - commonly known for making precise location measurements.

Inland Flooding - Hidden Danger of Hurricanes June 2010 (NOAA)

Coastal residents understand the dangers associated with hurricanes -- heavy rainfall, high wind and storm surge can cause a host of problems. But did you know that the majority of hurricane-related deaths in the United States do not occur along the coast?



http://www.wunderground.com/

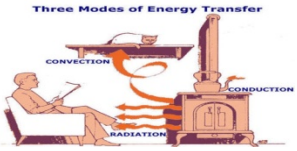
Technology:

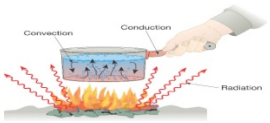
Pearson My science online, www.discoveryeducation.org, www.CPalms.org, www.dadeschools.net (Village Learning)

1. NOAA Educational Programs
2. Weather Underground
3. WeatherBug
4. National Hurricane Center
5. State of Florida Emergency Division
6. GIZMOS: Hurricane Motion
7. StormZone

http://www.floridastandards.org/RESOURCES/URLresourcebar.aspx?ResourceID=0bzi69XNO7Q=D

LESSON 2: Thermal Energy Movement





Heat Energy & Particle Movement

Purpose:

- Discuss conduction, convection, and radiation in the context of the Earth's atmosphere, hydrosphere, and geosphere.
- Identify, compare, and contrast temperature, heat and thermal energy
- Design experiment to investigate molecular motion of molecules in three states of matter
- To demonstrate the motion of particles due to heat

Vocabulary: Temperature vs. Thermal Energy, Temperature, Thermal Energy, Heat, Changes in state of matter, Heat Transfer in Earth's Systems, Conduction, Convection, Radiation, Protecting from radiation, UV light and radiation, Greenhouse effect (use www.wordle.net:)

Materials:

3 small beakers Ice water Dark food coloring
Room temperature water Hot water

Procedure: Part 1

1. Fill a small beaker about 2/3 full of room temperature water.
2. Place one drop of dark food coloring on the surface of the water. DO NOT STIR.
3. Observe & record your observations.
4. Fill a second beaker about 2/3 full of ice water.
5. Fill a third beaker 2/3 full of hot water.
6. Place the beakers with the hot and cold water side by side.
7. Wait a minute for water to stop moving. Add one drop of food coloring to each beaker at the same time.
8. Observe and record.

Procedure: Part 2

1. In a clear tank or small aquarium fill at least 20-30 cm of room temperature (tepid) water
2. Place 2 small (25-50ml) beakers of water at the bottom of the container of water
   a. Cold water with blue food coloring
   b. Hot water with red food coloring

Data: Movement of Water Particles in Different Temperatures
Observations Water Temperature, Room (Tepid), Cold, Hot Temperature

Conclusion: In your own words, explain your observations.

Technology: Pearson: My Science online

1. EPA: SunWise Kids
2. Related movies-free download
3. GIZMOS- Heat Transfer by Conduction / Greenhouse Effect

LABS

1. What is the Source of Earth's Energy? (TX: LabZone Quick lab)
2. Measuring Temperature (TX: LabZone Quick lab)
3. Temperature and Height (TX: LabZone Quick lab)
4. Showing Off Heat (EL)
5. Melting Ice (EL)

LESSON 3: *Graphing the Atmosphere*

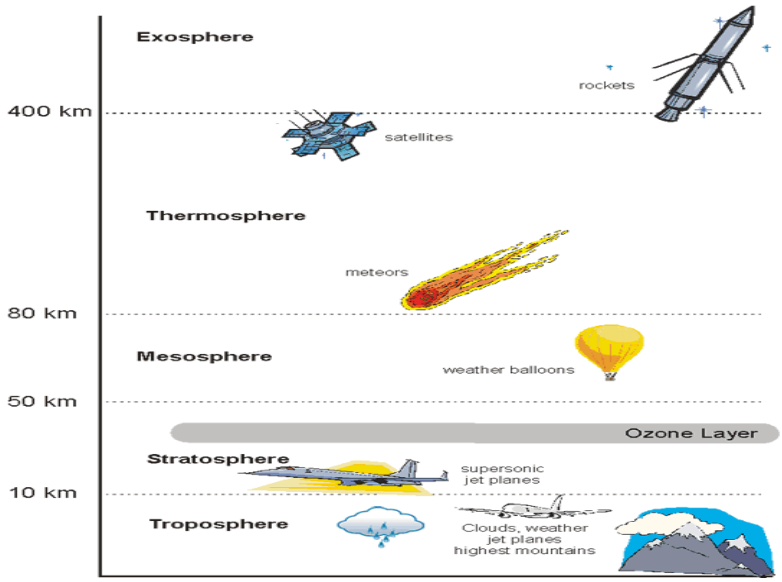
(Topic 3-Climate and Global Patterns &5 -Atmospheres and Spheres of the Earth)

Purpose: To visualize how the atmosphere can be divided into layers based on temperature changes at different heights by making a graph.

Vocabulary: weather, climate, radiation, convection, conduction, elevation, latitude, altitude, greenhouse effect, heat transfer, global warming, ozone, atmosphere, climate change, troposphere, stratosphere, mesosphere, thermosphere, exosphere, geosphere, hydrosphere, cryosphere, atmosphere, biosphere, condensation, evaporation, precipitation

Background Information: The atmosphere can be divided into layers based on temperature differences. The layer closest to the Earth is called the **troposphere**.
Above this layer is **stratosphere**, followed by **mesosphere**, and **thermosphere**. The upper boundaries between these layers are known as the **tropopause**, **stratopause**, and **menopause**, in that order. The final layer is called the **exosphere**.

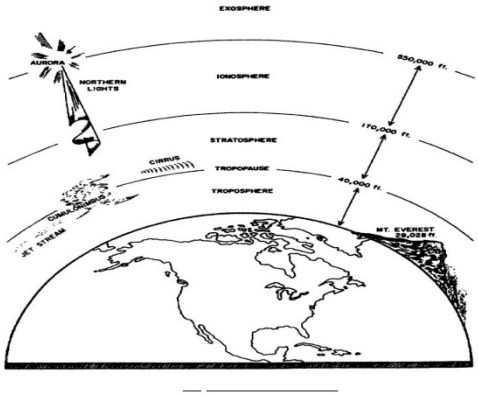
Temperature differences in the layers are caused by solar energy (energy from the Sun), absorbed by the atmosphere as it moves downward. The Earth's surface absorbs most of the Sun's energy. Some of this energy is returned back from the Earth as heat, which warms the troposphere.

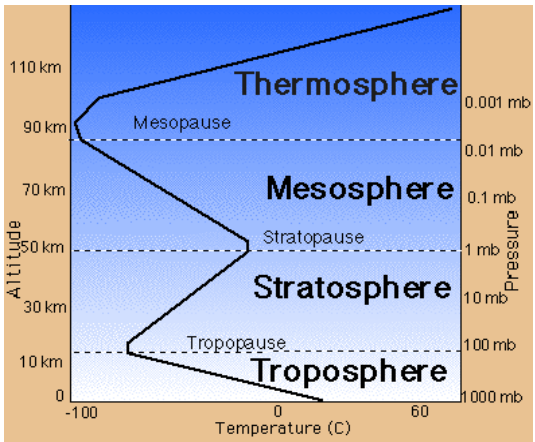


At the mesosphere, the temperature begins to increase with altitude, and this trend continues in the thermosphere. Solar energy hits the Earth's atmosphere and heats it
The mesosphere does not absorb solar heat, so the temperature decreases altitude.

The temperature begins to increase with altitude in the stratosphere. Warming is caused by a form of oxygen called ozone, absorbing ultraviolet radiation from the sun.

The average temperature in the troposphere rapidly decreases with altitude –the higher the elevation, the colder it gets.





Procedure:

1. Given this data:

Average Temperature Readings at Various Altitudes Y= Temperature

Altitude (km)	Temperature (C)																						
0	15																						
10	-49																						
20	-56																						
30	-46																						
40	-22																						
50	-2																						
60	-17																						
70	-54																						
80	-79																						
90	-86																						
100	-72																						
200	100																						

X = Altitude

2. Graph this data using a line graph. Why? _____

Be careful to plot the negative temperature numbers correctly.

4. Label the different layers of the atmosphere and the separating boundaries between each layer. (troposphere, stratosphere, mesosphere, thermosphere)

5. Describe function and general location of the ozone layer.

6. What is the outer layer of the atmosphere?

LESSON 4: Causes of Weather

Purpose: Students will

- Understand that evaporation causes objects to cool down and more evaporation occurs in dry air than humid air.
- Explain temperature differences between a dry and wet bulb thermometer.
- Use a psychrometer and a psychrometer table to determine relative humidity.
- Understand the effect of temperature on the amount of water vapor that can exist in air.
- Determine the dew point.
- Describe the relationship between air temperature, dew point, and relative humidity.

Vocabulary: Percolation, Temperature, Jet stream, Ocean currents, Air pressure, Wind speed and direction, Humidity, Precipitation, Water Cycle, Evaporation, Condensation, Transpiration, Precipitation, Gulfstream, dew point, psychrometer, relative humidity, saturated, water vapor, wet bulb depression

Technology: www,
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=425

Related Gizmos:
Water Cycle: http://www.explorelearning.com/gizmo/id?435
Phases of Water: http://www.explorelearning.com/gizmo/id?661
Weather Maps: http://www.explorelearning.com/gizmo/id?430

Assessment: Formal/Authentic; Graph accuracy, Venn diagram comparing weather and climate, project based assessment, formal assessment, design presentation
Presentations using media from www.noaa.gov or www.nbcmiami.com/weather

Lesson Overview

On hot, muggy days, you've probably heard people complain, "It's not the heat; it's the humidity!" Sweat does not evaporate very quickly on a humid day, leaving you feeling hot and sticky. In contrast, on dry days sweat evaporates easily and cools you off.

In the Relative Humidity Gizmo™, students can use an instrument called a psychrometer to determine relative humidity. Students can also observe condensation on a water bucket in order to determine the dew point.

The Student Exploration sheet contains two activities:

- Activity A – Students measure the relative humidity at various times of the day.
- Activity B – Students measure the dew point at various times of the day.

Suggested Lesson Sequence

1. **Pre-Gizmo activity: Pulling water out of thin air** (10 – 15 minutes)
   Give small groups of students drinking glasses filled with room temperature water. Have students take the temperature of the water and observe the outside of their glass. Next, add several ice cubes to the glasses. Ask students to closely watch the thermometer and the outside of their glass and describe what happens.

   Students should note when condensation forms on the outside of the glass and the temperature of the water when this occurs. Ask students to identify what type of liquid condensed on the glass (water) and discuss where the water came from. Have students hypothesize why condensation only formed after ice was added to the water.
2. **Prior to using the Gizmo** (10 – 15 minutes)
   Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations.
3. **Gizmo activities** (15 – 20 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.
4. **Discussion questions** (15 – 30 minutes)
   As students are working or just after they are done, discuss the following questions:
   - What is the difference between humidity and relative humidity?
   - What would happen to the relative humidity of an air mass if the amount of water vapor in the air stayed the same, but the temperature increased? Decreased?
   - Suppose a psychrometer's dry bulb and wet bulb thermometers were the same temperature. What can you assume?
   - How does humidity relate to the temperature difference between the wet and dry bulb thermometers? Why is this true?

5. **Follow-up activity: Determining relative humidity** (30 – 45 minutes)
   Have students use a psychrometer or a set of dry bulb and wet bulb thermometers to take temperature readings at various locations. For example, students could take a reading in the classroom, at an outside location, in the inside of a refrigerator, near the opening of a clothes dryer's vent, and so on. For each location, students should use a psychrometer table, such as the one in the Gizmo, to determine the relative humidity. (More information can be found in the **Selected Web Resources** on the next page.)

Scientific Background

When water evaporates from Earth's surface, the resulting water vapor enters the atmosphere. The greater the mass of water vapor in the air, the higher the *humidity* of the air will be. Air is said to be *saturated* when the amount of water vapor in the air is at a maximum.

Most of the gases in Earth's atmosphere, including oxygen, nitrogen, and carbon dioxide, have very low boiling points. As a result, these substances act as gases at any air temperature found near Earth's surface. Water, on the other hand, boils at a relatively high temperature. At most temperatures found near Earth's surface, water molecules are constantly moving from the liquid phase to the gas phase, and vice versa. When air is saturated, the rate of liquid water evaporating into water vapor is equal to the rate of water vapor condensing to liquid water. Adding more water into the system will not increase the amount of water vapor in the air.

As the temperature of water vapor decreases, condensation occurs more quickly and evaporation slows. Hence, if air that is already saturated cools, condensation will exceed evaporation and water can condense on nearby surfaces (e.g., grass, glass, dust particles, metal car bodies). For wet surfaces this occurs when the temperature reaches the *dew point*.

The *relative humidity* of air, usually expressed as a percentage, is equal to the ratio of the partial pressure of water vapor in air to the partial pressure of water vapor in an equal volume of saturated air. For example, if the partial pressure of water vapor in a volume of air is half the partial pressure of water vapor in an equal volume of saturated air, the relative humidity is 50%.

When liquid water evaporates from a surface, heat energy is drawn away from the surface and the surface is cooled, a process called *evaporative cooling*. The greater the rate of evaporation, the greater the cooling the surface will experience. Because the rate of evaporation is greater in dry air than humid air, the amount of evaporative cooling can be used to measure humidity.

Humidity is measured with a psychrometer, an instrument that consists of two thermometers mounted together. The first thermometer is called the "dry bulb thermometer" and is used to measure the air temperature. The bulb of the second thermometer—called the "wet bulb thermometer"—is wrapped in a wet cloth. The psychrometer also contains a handle that allows the thermometers to be whirled around. The temperature of the wet bulb thermometer decreases as water evaporates from the cloth. The relative humidity can then be determined by looking up the air temperature and the temperature difference on a psychrometer table.

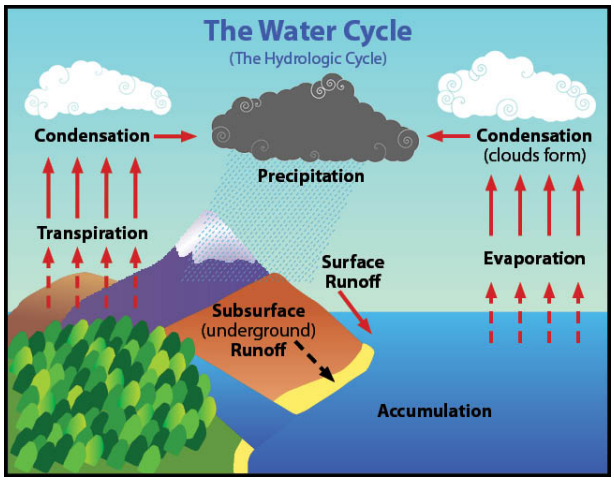
LESSON 5: WATER CYCLE in the Earth's Atmosphere & Spheres

Purpose: Students will

- Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate
- explain how energy provided by the Sun influences global patterns of atmospheric movement and/or the temperature differences among air, water, and land.

VOCABULARY:

- Layers of the atmosphere, troposphere, stratosphere, mesosphere, thermosphere, exosphere
- Ozone Layer, Importance, Depletion-causes and effects, Effect on global warming
- Spheres of the Earth- Geosphere, Hydrosphere, Cryosphere, Atmosphere, Biosphere



http://www.floridastandards.org/RESOURCES/URLresourcebar.aspx?ResourceID=BYjDTuXw3rk=D

Technology:

1. **Favorite weather**
2. CPALMS– Weather Factors, surface weather data
3. Gizmos-Water Cycle
4. GIZMOS-Global Warming
5. EcoHealth Ozone Depletion Science and Response
6. CPALMS – Water Science for Schools

http://www.floridastandards.org/RESOURCES/URLresourcebar.aspx?ResourceID=BYjDTuXw3rk=D

Assessment: **Formal/Authentic:** Climate brochure, formal assessments, graphing, Power Writing; Formative

Acid Base Reactions Lab

GOAL: SC.6.E.7.2 Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate
SC.6.E.7.3 Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation

Purpose: The students identifies various ways in which substances differ (e.g. Mass. volume, shape, density. texture and reactions to temperature and light)

- Describe and explain how the cycling of water and global patterns influence local weather.
- Investigate the factors that affect weather & water cycle between hydrosphere /atmosphere.
- Describe and explain the interactions of water between the different spheres of the earth (water cycle)
- Build a closed model of the water cycle and observe effects of different student synthesized variables
- Apply the water cycle processes to a real world example
- Test substance to see if they are acid, base or neutral
- Neutralize the pH of the substances

Vocabulary: Percolation, Temperature**,** Jet stream, Ocean currents, Air pressure, Wind speed and direction, Humidity, Precipitation, Water Cycle, Evaporation, Condensation, Transpiration, Precipitation, Gulfstream

pH lab for Acidity/ Alkaline of Solutions

Background information:

- Acids release hydrogen ions (-) in water
- Bases release hydroxide ions (+)
- Hydroxide ions (+) react with hydrogen ions (-) to produced water thus "neutralizing " each other
- Substances can be classify as acid base or neutral
- Some substances do not dissolve in water but will dissolve in acid
-

Materials

- pH indicators (litmus paper and cabbage juice)
- Acidic solutions (vinegar, lemon juice, hydrochloric acid,)
- Basic or alkaline solutions (baking soda, ammonia, soap)
- Test tubes
- Test tubes rackets
- Paper towels
- Pipettes

Procedures: ***(please read instructions Carefully)***

1. Using the cabbage juice determine if the solution in each test tube is an acid or a base. Write your observation in the data table #1

Solution	Acid or Base?
#1	
# 2	
# 3	
#4	
#5	
#6	

2. In a test tube mix solution 1 and solution 5. Test the solution you just create with the cabbage juice. It is an acid or a base? What do you think happened?

_____

_____

_____

_____

_____

_____

_____

3. Using the litmus paper, measure the pH value of each solution.
   Write your results in data table #2.

Solution	pH value (acid or base?)	Name of the solution
#1		
#2		
#3		
#4		
#5		
#6		

4. In a test tube, mix solution 1 and solution 5. Measure the pH value of the new solution. Why do you think the pH value is different from the two original solutions?

_____

_____

_____

_____

_____

5. Can an acid solution be changed to a base? How?

LESSON 6: How Weathering and Erosion Affect the Earth
A Hands-on Activity – Learning through Inquiry

Purpose:

- Describe and explain how Earth's surface is built up and torn down through the processes of physical and chemical weathering, erosion, and deposition
- Investigate the role weathering plays in shaping/reshaping the earth
- Compare/contrast physical and chemical weathering
- Investigate local landforms that were developed as a result of erosion and deposition
- Collect data/create a report on the fact that beaches, spit, and tombolos are by products of erosion and deposition
- Provide an explanation of how weathering and erosion helps in the formation of soil
- Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryospere, geosphere, geosphere, and biosphere

Vocabulary: mechanical weathering, ice wedging, abrasion, chemical weathering, oxidation, carbonation, organic acids, acid precipitation, erosion, sheet erosion, glacier, glacial erosion, mass movement, deposition, spit, tombolo, acid rain, sediment, limestone, permeable, sand dune, sand bar.

Weather & Landforms:
Viewing a snowcapped mountain, exploring a cave, or tubing/ kayaking on a river in a valley, various landforms are evident as they exhibit natural physical features of the earth's surface. Various landforms exist as a result of weather and climate. The greatest agent of weathering on landforms is wind, next water. Both are factors in weather exposure and severe weather events. Movements of the earth's crust, tectonic activity, earthquakes, tsunamis, volcanoes, blizzards, weather from seasons, regional weather trends, and the impact of severe weather from wind, water, sun, and ice cause landforms.

Erosion from Weather in Coastal Areas & Sand Dunes

Sand particles and sand dunes are formed and moved by wind and water through erosion. In nature, the process of erosion can be quite devastating. Beaches can appear or disappear over a season of harsh weather. This activity demonstrates the concept of erosion and interrelationships of weather and landforms.

ACTIVITY: This inquiry activity through models demonstrates how water and wind through weather events shape landforms resulting in erosion and land movement. Creating 3-D working models, students will experiment on the impact of erosion activities to shape earth's structures and evaluate their findings with presentations to other small collaborative working groups. Students make a 3-D version of a landform to interact with simulated events and understand weather impact on landforms and geologic processes that shape earth's surface.

Sand and shells for Coastline for sand dune erosion simulation
Storm surge vs. storm wind and water on sand and coastal communities
Topographical 3-D map models showing landforms

Materials: Sugar cubes for limestone simulation
A wind source (fan, blow dryer, air mattress inflator)
Blue food coloring Red food coloring
Sand and shells Soil and gravel Cardboard
Flats for container to put soil, sand, etc in

A Portable unit for demonstrating stream erosion and deposition of soils can be created with a plastic flat box, plastic tray, drain trough, tray support for inclined angling, and siphon tube.

I. Topographical 3-D map models: Food choices, Candy, cake dough, Playdo, Modeling clay, recycling Styrofoam with paper towels and glue or papier-mâché.

Instructions

1. Identify an ecosystem and weather influence in creating landforms. Print and enlarge a U.S. Geological topographic map of desired landform in an easy to read size, making as many copies as index contour lines. *Use a light setting to enhance visibility of dark contour lines.* An aerial map with topographical contour lines could also be used. (www.usgs.com)

2. Cut around the outermost contour line, lowest elevation, on one map copy, and label #1. For each succeeding map copy, move in one contour line, cut around the contour line and number it.

3. Glue each contour line piece to cardboard or Styrofoam flat pieces, using a glue or glue stick.

4. Cut each piece of material around the contour line.

5. Place the pieces on a flat cardboard base, starting with #1 labeled piece on the bottom, building up by numbers and elevation, as they are glued on the spacers (cardboard / Styrofoam).

6. Glue the layers with glue sticks. The scale of the landform model should be consistent.

7. Fill in the area inside the spacers with modeling clay or paper towels and glue. Glue the second layer to the top and repeat the process with the remaining layers.

8. Add modeling clay or papier-mâché to the model to make the landform look realistic with steep or gradual elevation incline.

9. Place optional pieces on or around the landform. If you used papier-mâché for the model, then allow it to dry before painting it and placing optional pieces.

II. Interactive activity models:

Sand and shells for Coastline for sand dune erosion simulation
Storm surge vs. storm wind and water on sand and coastal communities

Preparation

1. Divide your class into small collaborative learning groups (3–4 students).
2. For each group of students, color 250 ml of sand with 7 drops of the red food coloring and color another 250 ml of sand with 7 drops of the blue food coloring.
3. Allow the sand to dry completely before using it.
4. Provide each group with 250 ml of red sand, 250 ml of blue sand, 500 ml of uncolored sand, a box top, and a wind source (which can be shared between groups if necessary).

Procedure

1. Place the plastic flat on a flat surface.
2. Create a "dune" by pouring red sand in a straight line across one end of the box top. (about 8 cm wide and 2 cm deep)
3. With blue sand, create another dune of the same size behind and adjacent to the red one.
4. With uncolored natural sand, create 2 more dunes, each the same size as the previous ones, behind and adjacent to the blue one.
5. Predict how sand will be affected by a horizontal wind blowing directly into the dunes.
6. Use the wind source to create a horizontal wind blowing directly into the dunes. Start with a fairly low wind speed and then increase it. Continue until about half the red sand has been eroded. Note changes in the behavior of the dunes and the particles of sand at different wind speeds.
7. Observe the distribution of the colored sand particles. Are there any differences in the distributions of the red and blue particles? Are there any differences in the distributions of particles of different sizes?
8. Pour water in one corner or end of the flat with a slight incline. Observe how sand is affected when water is poured in gradually. Lift one end slightly and create “turbulence” and wave action on the model shore. Observe how sand is impacted by the tides and wave action of stronger wind action.

Extension activities and questions

How does the shape of the dunes affect their erosion? Investigate by building semicircular or serpentine model dunes and applying wind to them.

How do changing wind directions affect dune erosion? Find out by blowing wind across the dunes from different directions.

How does water influence wind erosion of the dunes? Spray the dunes with varying amounts of water before applying wind to them. Note: The food dyes are water-soluble and may separate from the colored sands.

How do plants influence dune erosion? Use model shrubs on your dunes. Apply wind to the dunes and see what effect the shrubs have on erosion.

How do plants act as barriers at the surface? Do roots affect dune erosion?

Apply wind to the dunes with and without modeled vegetation.

Compare the erosion of the 2 sand dune models.

LESSON 7: Weather & Landforms of the Geosphere

Purpose:

- Recognize and label different landforms found on Earth through research and identify those formed through t he processes of weathering, erosion and/or deposition
- Differentiate between the different types of landforms in Florida. Diagram all the rivers and other landforms on a map or model of Florida
- Compare and contrast the landforms found in Florida and those found outside of Florida
- Create a travel brochure focusing on the multiple landforms in Florida and relate their importance to human society and the environment
- Model and observe the causes and dynamics of dunes and their importance to beaches during severe weather
- Evaluate the issues concerning the different landforms of the earth and how they are being affected by humans (debate)

Vocabulary: coastlines, dunes, rivers, mountains, volcanoes, glaciers, deltas, lakes, landform, limestone, sinkholes, caves, groundwater, sandbar, barrier islands, sand dunes, estuaries, wetlands, weather, climate, radiation, convection, conduction, elevation, latitude, altitude, greenhouse effect, heat transfer, global warming, climate, convection currents, elevation, latitude

Using an Interactive Journal, students will research landforms and discuss how the issues of weather impact and alter various landforms. These landforms are influenced by weather, erosion, Earth's structure, and global positioning. Students will identify and label different landforms found on Earth through research and identify those formed through the processes of weathering, erosion and/or deposition. Each student will complete the following tables with information, observations, and brainstorming discussions while differentiating the different types of landforms. They will include this in their journal with their personal observations of weather impacting the local community in South Florida. Students diagram all rivers and other landforms on a map or model of Florida to model and observe the causes and dynamics of dunes and their importance to beaches during severe weather. Students will discuss and evaluate the issues concerning the different landforms of the earth and how they are being affected by humans (debate)

Students will construct a Venn Diagram about landforms as a collaborative learning group to compare and contrast the landforms found in Florida and those found outside of Florida. They will create a travel brochure focusing on the multiple landforms in Florida and relate their importance to human society and the environment. They will also distinguish weather from climate and identify this through biomes and ecosystems with global positioning latitude and longitudinal identification.

LESSON 8: Observing &Tracking Weather for Energy Transfer

Energy Transfers and the Law of Conservation of Energy due to Causes of Weather
Students will work with Weather forecasters and meteorologists working with the impact of energy on human population and other regions and ecosystems.

Technology: Communication, Presentations, Causes of Weather

Purpose:

❖ Energy Transfers and the Law of Conservation of Energy

- Describe the time in history in which the law of conservation was discovered
- Explain the Law of Conservation of Energy in a real life example
- Differentiate the difference between a theory and a law
- Explain the energy transformation
- Diagram the transfer of kinetic and potential energy in a real world application
- Define a problem using the law of conservation
- Cite evidence of the generation of heat during the transfer of energy through conduction, convection, and radiation

❖ Causes of Weather

- Describe and explain how the cycling of water and global patterns influence local weather.
- Explain causes of wind and wind patterns
- Cite evidence of the cycling of water between the hydrosphere and atmosphere
- Investigate the factors that affect weather
- Investigate tools that are used to measure weather
- Apply the water cycle processes to a real world example
- Differentiate between weather and climate
- Diagram and label jet stream and ocean currents for different regions of the world
- Record and graph temperature and precipitation over a period of time
- Infer the possible weather from given data and conditions
- Predict the effects of different factors on different ecosystems

Vocabulary: Energy, Kinetic Energy, Potential Energy, Joule, Mass, Velocity, Temperature, Friction, radiant energy, nuclear energy, thermal energy, electrical energy, chemical energy, mechanical energy, Law of Conservation of Energy, convection, conduction, radiation, Percolation, Temperature, Jet stream, Ocean currents, Air pressure, Wind speed and direction, Humidity, Precipitation, Water Cycle, Evaporation, Condensation, Transpiration, Precipitation, Gulfstream, weather, disaster, atmosphere, pressure, precipitation, model, evidence, latitude and longitude, Instruments/tools used to measure weather , Anemometer, rain gage, barometer, hygrometer, weather vane, thermometer, Forms of Energy- Mechanical, Chemical, Radiant, Nuclear, Thermal, Electrical

Hurricane Tracking including research and reporting on natural disasters like tornados, floods, fires, drought, Weather patterns, Ocean currents, and Emergency Preparedness

Influences on Local Weather: Wind speed and direction, Humidity, Precipitation, Clouds,

Student Assignment:

1. Students will use technology, computer, mobile device dedicated by classroom teacher that is incorporated in this project to monitor and make notes of data on weather / news reports, records visualizations and satellite photos to compile information for reports.
2. Monitoring weather forecasts and meteorologists who are reporting on current weather conditions, energy movements through fronts and storms. News/Weather reports include how they impact human population and other regions as ecosystems.
3. Researching factors of weather through news/weather reports, tracking real time weather conditions and learning to collect data for analysis.
4. Data collection and news/weather reports organized in weekly presentations by collaborative learning groups to the rest of the class. Groups will rotate on a weekly basis.

Technology:

1. www.noaa.gov
2. www.nbcmiami.com/weather
3. www.local10news.com
4. www.justweather.com
5. www.abcnews.com/weather
6. www.msn.com/weather
8. www.today.com
9. www.stormzone.us
10. Samsung Galaxy Tablet 2 - 7.0
11. Davis Instruments 6152 Wireless Vantage Pro2

Additional Labs Located on MDCPS Pacing Guides and Curriculum

1. Pearson: My science online
2. Virtual Lab-How is energy is converted from one form to another?
3. The Law of the Conservation of Energy
4. Cycles and Energy Flows
5. Reading a Weather Map (TX LabZone Lab)
6. How Clouds Form (TX LabZone Quick Lab)
7. Types of Precipitation (TX LabZone Quick Lab)
8. Tracking Air Masses (TX LabZone Quick Lab)
9. Weather Fronts (TX LabZone Quick Lab)
10. Modeling Weather Satellites (TX LabZone Quick Lab)

StormZone *provides science teachers with a unique multidisciplinary FCAT-compliant curriculum that covers the science of hurricanes and the role of emergency management during a weather crisis.* www.stormzone.us

LESSON 9:

Causes of Weather with the transfer of energy (from one system to another)
Energy Transfers and the Law of Conservation of Energy

Technology, Communication, Presentations, References on multimedia for Causes of Weather

Purpose:

- **Energy Transfers and the Law of Conservation of Energy**
- **Causes of Weather**
- Investigate tools that are used to measure weather
- Build a closed model of the water cycle and observe effects of different student synthesized variables
- Record and graph temperature and precipitation over a period of time
- Measure wind speed and direction using an anemometer and weather vane
- Define a problem about a factor of weather and design an experiment to test a hypothesis
- Infer the possible weather from given data and conditions
- Design and build a barometer to understand the effects of air pressure
- Predict the effects of different factors on different ecosystems
- **Design and present a student weather device to track weather in the community**

Vocabulary: Weather, Temperature, Jet stream, Ocean currents, Air pressure, Wind, Humidity, Precipitation, Water Cycle, Evaporation, Condensation, Transpiration, Precipitation, Gulfstream, atmosphere, pressure, Percolation, model, evidence, latitude and longitude, Hurricanes Tracking, natural disasters, Tornadoes, Floods, Fires, Drought, Emergency Preparedness

Davis Instruments 6152
Wireless Vantage Pro2 with Passive Solar Radiation Shield

Technology: Pearson My Science Online

1. www.noaa.gov
2. www.nbcmiami.com/weather
3. www.local10news.com
4. www.justweather.com
5. www.abcnews.com/weather
6. www.msn.com/weather
7. Samsung Galaxy Tablet 2 - 7.0
8. Davis Instruments 6152 Wireless Vantage Pro2

NAWAS- Nautilus Awareness / Weather Alert Station:

Students monitor data from a portable weather station to practice scientific process, gather information, and apply lessons learned about weather in their daily lives. Students practice the regular collection of data for graphing and analysis with peer evaluation, by comparing the recognition of weather patterns with recognized meteorologists. Students will learn to use Microsoft Excel to collect data that is gathered from weather station readings and lab activities so they can present weather data, and forecasts.

Students learn through engaged lab activities about weather statistics, how humidity, temperature, barometric pressure, wind speed and heat index relate to weather forecasts, and trends during hurricane season. Weather patterns and predictions in forecasts are explored with engaged lab activities and problem solving scenarios of real life events. Technology presentations are prepared by student collaborative groups for other classes and students. Visuals and weather patterns are presented in class discussions for cross curriculum application and the prediction of environmental concerns for hurricanes and severe weather preparedness.

The lab activities are ongoing throughout the year in accordance to the scheduled pacing guide topics in the curriculum. As seasons and weather patterns change throughout the year, students mentor younger students in the practical work ethic of scientific observations in nature with classification and analysis of qualitative and quantitative data.

Students working on this project came to a consensus that because we got the weather station at such a good price, we could afford a wireless tablet to compare with weather stations and Internet information.

Our project could use the Samsung Galaxy Tab 2 7.0 to communicate and download information with local and national weather stations, NOAA, NHS, and national weather reports. Students compiled data from a variety of sources while submitting current weather reports to local broadcasting stations and websites.

The Davis Vantage Pro2 series of wireless weather stations:

The Davis Vantage Pro2 uses frequency hopping spread spectrum radio technology. The VP2 can transmit and receive data up to 1000' (300 m) line of sight. Add wireless repeaters for distances up to 2 miles (3.2 km). The full-featured Davis Instruments Vantage Pro2 (Davis Weather 6152) with Standard Radiation Shield not only wirelessly transmits weather data from its sensors to a console that sits on your desk (or wherever) every 2.5 seconds, it collects historical data and even does forecasting. The Davis Weather 6152 tracks a huge number of weather variables: temperature (indoor and outdoor), barometric pressure, humidity, rainfall, wind, wind chill, dew point, and many others.

Students can graph the last 24 hours, days, or months of readings or highs and lows, and view over 80 graphs including additional analysis of temperature, rain, rain rate, wind, and barometric pressure without a computer. The weather station can be linked to PC via Vantage Pro2 WeatherLink software and upload near real-time weather information to your website.

References

Web resources

NOAA Educational Resources http://www.education.noaa.gov/

JetStream – online for school weather http://www.srh.noaa.gov/jetstream/matrix.htm

Lightning Safety http://www.lightningsafety.noaa.gov/teachers.htm

NOAA National Weather Service http://www.nws.noaa.gov/om/reachout/kidspage.shtml

NOAA Primarily for Teachers http://www.education.noaa.gov/teachers1.html

Discovery Education http://www.discoveryeducation.com/teachers/

Weather WIZ Kids http://www.weatherwizkids.com/

Cricket Magazine http://www.cricketmag.com/ProductList.aspx?cat=4

Satellite Insight http://itunes.apple.com/us/app/satellite-insight/id463588902?mt=8

USGS online lectures http://education.usgs.gov/lectures.html

TeachersFirst's Hurricane Resources http://www.teachersfirst.com/spectopics/hurricane.cfm

NASA Kids Space Place http://spaceplace.nasa.gov/en/kids/goes/slyder/

NASA Meteorology- An Inquiry http://www.nasa.gov/centers/langley/science/met-guide.html

NASA Animals on the Move http://spaceplace.nasa.gov/migration/

NASA Ocean Floor Topography http://sealevel.jpl.nasa.gov/science/

NASA Teaching from Space

http://www.nasa.gov/audience/foreducators/teachingfromspace/home/index.html

The National Science Center http://www.nscdiscovery.org/

The Weather Wiz http://theweatherwiz.com/

Global Climate Change Education Resources http://www.challenger.org/gcce/

BURPEE http://www.burpeehomegardens.com/ICanGrow/_ICanGrowCurriculum.aspx

The Weather Channel

http://www.weather.com/weather/videos/news-41/top-stories-169/latest-forecast-for-severe-weather-365

GIZMO

http://www.explorelearning.com/index.cfm?method=cResource.dspResourcesForCourse&CourseID=299

The Davis Vantage Pro2 series of wireless weather stations: available from several scientific supply stores.

APPENDIX
STUDENT HANDOUTS

LESSON 3: **Questions & Conclusions**:

1. Why is the atmosphere separate into layers? What purpose does it serve?

2. Does the temperature increase or decrease with altitude in the:

troposphere? _____ stratosphere? _____
mesosphere? _____ thermosphere? _____

3. What is the approximate height and temperature of the:

troposphere: _____ _____
stratosphere: _____ _____
mesosphere: _____ _____

4. What causes the temperature to increase with altitude through the stratosphere?

5. What causes the temperature to decrease with altitude through the mesosphere?

6. What causes the temperature to decrease with altitude in the troposphere?

7. How do the spheres in Earth's structure mirror the earth's atmosphere layers?

8. Draw a diagram of the Spheres of the Earth, labeling the Geosphere, Hydrosphere, Cryosphere, Atmosphere, and Biosphere.

Assessment: Formal/Authentic: Climate brochure, formal assessments, graphing, Power Writing.

LESSON 4: Student Exploration: Relative Humidity

Vocabulary: condense, dew point, evaporate, humidity, psychrometer, relative humidity, saturated, water vapor, wet bulb depression

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

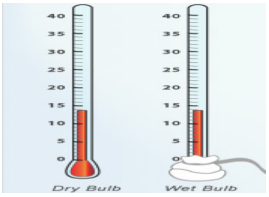
1. When you go outside on a hot summer day, usually your body begins to sweat. Why does your body do this? _____

   _____

2. **Humidity** is the amount of moisture in the air. Do you think sweating cools you down more on a dry day or a humid day? _____

Gizmo Warm-up

When sweat **evaporates**, heat energy is removed from our skin and our bodies cool down. But the amount of **water vapor** air can hold is limited, so sweat can only evaporate if the air still has the capacity to hold more water. If the humidity is high, less water can evaporate from the sweat on your skin.



The amount of water vapor in the air compared to the maximum amount air can hold is known as **relative humidity**. In the *Relative Humidity* Gizmo™, you will use a **psychrometer** to determine relative humidity. A psychrometer has two thermometers. The dry bulb thermometer measures air temperature. The second thermometer has a wet bulb. As water evaporates from the wet bulb, its temperature decreases relative to the air temperature.

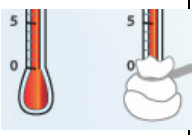
1. Do you think the wet bulb will cool down more on a dry or humid day? _____

2. Click **Play** ( ) and observe the thermometers for about 24 simulated hours. Describe some of the changes in temperature for both thermometers:

   _____

   _____

   _____

Activity A: **Measuring relative humidity**	Get the Gizmo ready: • Click **New**. • Turn on **Show relative humidity**.	

Question: How can you use a psychrometer to measure relative humidity

1. Predict: How will relative humidity relate to the temperature of the wet bulb thermometer?

   _____

   _____

2. Gather data: Click **Play**, and click **Pause** ( ) at several random times. Record the dry bulb temperature, wet bulb temperature, and relative humidity.

Trial	Dry bulb temp. (°C)	Wet bulb temp. (°C)	Relative humidity (%)
1			
2			
3			
4			

3. Analyze: What patterns do you notice? _____

   _____

4. Measure: Select the TABLE tab. This table will help you to determine relative humidity.

   A. Click **Play** and then **Pause**. What is the dry bulb temperature? _____
   B. What is the wet bulb temperature? _____
   C. What is the difference between the dry bulb and wet bulb temperature? _____

      This value is called the **wet bulb depression**.
   D. Find the dry-bulb temperature on the table's left column. Then find the wet bulb depression along the top row. (Use the dropdown menu to see different temperature differences.) The relative humidity is found at the intersection of this row and column.

      What is the relative humidity? _____

      Click on the CONTROLS tab to check your answer. (Your value should be close.)

(Activity A continued on next page)

Activity A (continued from previous page)

5. Practice: Select the TABLE tab again. Click **Play**, and click **Pause** at several random times. Each time, record the dry bulb temperature, wet bulb temperature, wet bulb depression, and the relative humidity.

Trial	Dry bulb temp. (°C)	Wet bulb temp. (°C)	Wet bulb depression (°C)	Relative humidity (%)
1				
2				
3				
4				

6. Interpret: Examine the psychrometer table on the TABLE tab.

   A. As the wet bulb depression increases, what happens to the relative humidity?

   _____

   B. As the dry bulb temperature increases with a constant temperature difference, what happens to the relative humidity? _____

   C. How do you think the amount of water vapor air can hold changes as air temperature increases? _____

7. Think about it: Warm air is able to hold much more water vapor than cold air before it becomes **saturated** (100% relative humidity). How would you expect the relative humidity of air to change as air warms up in the morning? How would you expect it to change as air cools in the evening? Test your ideas using observations from the Gizmo and describe your results below.

   _____

   _____

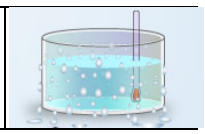
   _____

   _____

   _____

   _____

   _____

Activity B: Measuring dew point	Get the Gizmo ready: • Click **New**. • Turn on **Show water bucket**.	

Introduction: Air is saturated when the relative humidity reaches 100%. If saturated air is cooled down, the amount of water vapor the air can hold will decrease, so water vapor in the air will begin to **condense** into drops of liquid water. The temperature at which condensation begins is called the **dew point**.

Question: How can you measure the dew point?

1. Observe: Set the temperature (***T***) of the water bucket to 50.0 °C.

   A. Look at the sides of the bucket. Is there any condensation there? _____

   B. Slowly decrease the temperature of the water bucket until you see condensation form. What temperature does condensation first form on the bucket? _____

   This temperature is the dew point. Turn on **Show dew point** to check your answer.

2. Measure: Click **Play** and watch the dry bulb temperature, relative humidity, and dew point for several days. Click **Pause** at random times and record your readings in the table below. Take readings at least once for a relative humidity above 70% and below 30%.

Trial	Dry bulb temp. (°C)	Relative humidity (%)	Dew point (°C)
1			
2			
3			
4			

3. Analyze: Compare the dew point to the dry bulb temperature and the relative humidity.

   A. For which relative humidity was the dew point closest to the air temperature? _____

   B. Why do you think this is the case? _____

   _____

   _____

(Activity B continued on next page)

Activity B (continued from previous page)

Gather data: Now, gather data for a whole day. Fill in the table below.

Time	Dry bulb temp. (°C)	Relative humidity (%)	Dew point (°C)
1:00 A.M.			
5:00 A.M.			
9:00 A.M.			
1:00 P.M.			
5:00 P.M.			
9:00 P.M.			

2 . Describe: Look at the data in your table. What patterns do you see? _____

_____

_____

_____

3. Interpret: Based on your data, describe what the weather probably was like that day.

_____

_____

4. Apply: Think about real-life situations when condensation occurs.

A. Why do water droplets form on the outside of a cold can of soda? _____

_____

B. Why does dew form on grass in the early morning? _____

_____

C. Describe another example of condensation, and explain why it occurs. _____

_____

LESSON 5: Reading Assignment-

Acid Rain

Robert L. Burgess*

SUNY College of Environmental Science and Forestry

Acid Rain, the common term for **rain** or other precipitation of higher than normal **acidity**. In extreme cases the **acidity** may reach a pH of 3.2—nearly as **acid** as a carbonated beverage. In some regions, especially parts of northeastern North America and western Europe, **acid rain** has been associated with the decline of forests and with the destruction of fish and other water life. The existence of **acid rain** was first documented in 1852 by Robert A. Smith, a British chemist.

Causes. Manmade increases in the **acidity** of precipitation are traced mainly to the burning of coal, oil, and gas by heavy industry and electrical utilities. Burning these fuels releases sulfur and nitrogen oxides (SO_x and NO_x) to the atmosphere, where they combine with water vapor to produce sulfuric **acid** (H_2SO_4) and nitric **acid** (HNO_3). The **acids** in the atmosphere are carried downwind—sometimes for great distances—and deposited on the earth's surface in **rain**, snow, and other precipitation.

Distribution. The most severe effects of **acid rain** occur in southeastern Canada, the northeastern United States, and western Europe.

Possible Effects. **Acid rain** has been associated with death of fish in ponds and lakes, death of forest trees, and with changes in soil chemistry. It also has been linked with the deterioration of exposed surfaces of buildings, monuments, and statues, with the deterioration of fabrics, and even with human disease.

No precise effects of **acid rain** have been demonstrated for agricultural crops. The sulfur and nitrogen in **acid rain** may act as fertilizers in some soils.

Control. The equipment for removing sulfur and nitrogen from flue gases is so expensive to install and operate that most countries—including the United States—have been reluctant to mandate its use. Less expensive measures may include more reliance on nuclear energy, hydroelectric power, and fossil fuels low in sulfur, such as Western coal in the United States.

Bibliography**Alm, Leslie R.,** *Crossing Borders, Crossing Boundaries: The Role of Scientists in the U.S.* ***Acid Rain*** *Debate* (Praeger 2000).

Kennedy, I. R., ***Acid*** *Soil and* ***Acid Rain****,* 2d ed., vol. 10 of Research Studies in Botany and Related Applied Fields (Wiley 1992).

Questions:

1. The pH value for the acid rain is:
   a) lower than 7
   b) higher than 7
   c) equal than 7
   d) none of above

2. Acid rain have been associated with all of these but:
   a) decline of forests
   b) destruction of fish
   c) deterioration of statues and buildings
   d) damage to agricultural crops

3. The cause (s) of acid rain are:
   a) winter winds, snow and cold temperatures
   b) summer winds, humidity and hot temperatures
   c) use of solar energy
   d) burning coal, oil and gas

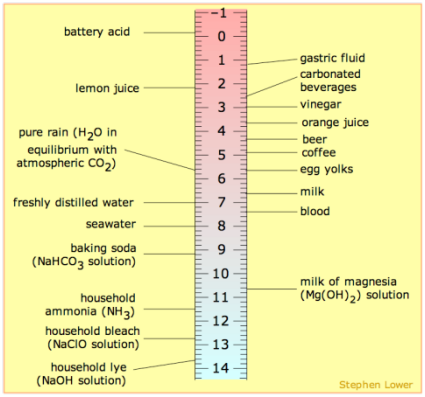
4. Mention some ways in which we humans can control the production of acid rain:

_____
_____
_____
_____
_____

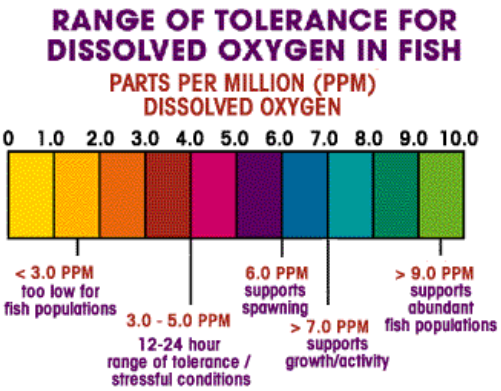
5. What effect would acid rain have on ecosystems, vegetation, water, human populations?

_____
_____
_____
_____
_____
_____

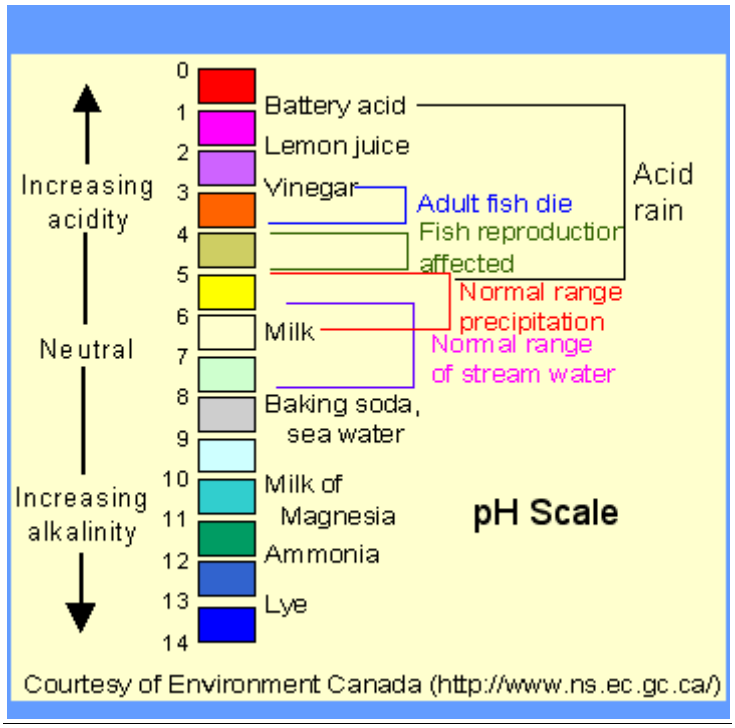
pH Scales and examples of acid/alkaline solutions and water quality

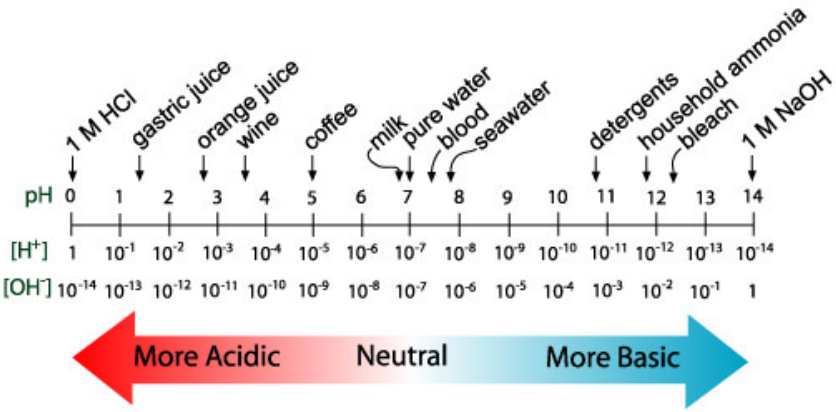


This image was borrowed from wikimedia.org-



This image was borrowed from www-tc.pbs.org





bishopmark@comcast.net

LESSON 6: How Weathering and Erosion Affect the Earth

Reading About Erosion and Landforms

LANDFORMS & EROSION

The landforms that are found on the surface of the Earth can be grouped into 4 categories:

1. **Structural Landforms** - landforms that are created by massive earth movements due to plate tectonics. This includes landforms with geomorphic features like fold mountains, rift valleys, and volcanoes.
2. **Weathering Landforms** - landforms that are created by the physical or chemical decomposition of rock through weathering. Weathering produces landforms where rocks and sediments are decomposed and disintegrated. This includes landforms with some of the following geomorphic features: karst, patterned ground, and soil profiles.
3. **Erosion Landforms** - landforms formed from the removal of weathered and eroded surface materials by wind, water, glaciers, and gravity. This includes landforms with some of the following geomorphic features: river valleys, glacial valleys, and coastal cliffs.
4. **Deposition Landforms** - landforms formed from the deposition of weathered and eroded surface materials. On occasion, these deposits can be compressed, altered by pressure, heat and chemical processes to become sedimentary rocks. This includes landforms with some of the following geomorphic features: beaches, deltas, flood plains, and glacial moraines.

Coasts & Landforms of coastal deposition

Coastal deposition is the laying down of material on the coast by the sea. It occurs when waves lose energy or when large inputs of sediment are made into the coastal system - perhaps due to the arrival of fluvial sediment at a river estuary. Wave refraction in bays also encourages deposition due to the dispersal of wave energy. Lower-frequency constructive waves often contribute to deposition due to their strong swash, moving beach material inland.

In addition to beaches, a range of unique depositional landforms exist, including the bar, spit, tombolo and cuspate foreland. The formation of these landforms additionally depends upon the process of long shore drift. This occurs when waves approach a coast-line at an angle, due to the dominant wind. There is thus a sideways component to the swash which helps move beach material diagonally up the beach (it travels laterally as well as inshore). Backwash under gravity returns water and beach material directly to the sea (perpendicularly to the beach profile). The net result is a zigzag or saw-tooth motion that can carry material past the end of a headland.

Depositional landforms can be highly vulnerable to erosion during extreme storm events unless vegetation colonization has taken place. Plant roots can help anchor sediments, making them more resistant to the action of destructive waves.

How will climate change impact on depositional processes and landforms?

Climate change threatens depositional landforms in two main ways:

1. Rising waters mean that landforms such as beaches and bars will be increasingly at risk of day-to-day erosion and submergence. Beaches in Miami already need to be artificially replenished at regular intervals using deposits dredged from further offshore. Similar actions could soon be needed in many other places, especially where expensive developments have taken place. On developed beaches with higher populations, sandy beaches, which attract many visitors each year, are being eroded every year. Commercial businesses, cafes, toilets, shops, car parking and beach huts on the eroding beaches under threat.

2. Extreme weather events may become more common as a result of climate change and these can wreak sudden havoc on depositional landforms such as spits and bars. As rising sea temperatures provide greater energy for hurricanes and depressions, moist water becomes even more unstable when it is warmed. The combination of wind and low atmospheric pressure forces sea levels upwards by many centimeters or even meters in some cases. This can lead to the breaching of bars and spits. For instance, in 2004, Hurricane Charley was one of a series of hurricanes that devastated the coast of Florida. The North Captiva spit was breached by the high tides and strong winds, leaving a 450m gap between a newly created island and the mainland.

Additional reading resources:
NOAA Coastal Services Center. www.csc.**noaa**.gov

Internet resources
Topographical maps www.MapsGalaxy.com and www.usgs.com
http://geology.com/teacher/erosion.shtml
www.usgs.gov
The International Erosion Control Association
Learn more about erosion and the measures taken to prevent it. Students, be sure to check out the Student Resources section.
The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center
A portal site for NOAA's coastal erosion studies with an extensive survey of the problem and a description of some of the remote sensing techniques used to study it.
United States Geological Survey (USGS) Coastal and Marine Geology Program
This is a collection of the USGS's current research, educational, and publishing efforts concerning coastal erosion.
United States Geological Survey (USGS) Coastal and Nearshore Erosion

Additional LABS-Streams in Action (TX LabZone Lab)
Erosion Cube (TX LabZone Quick lab)
Surging Glaciers (TX LabZone Quick lab)
Shaping a Coastline (TX LabZone Quick lab)

Lesson 7 Weather & Landforms of the Geosphere

Interactive Journal Worksheets

MODEL 1: COASTAL PLAINS		MODEL 2: CANYON	
Drawing	1. List several evidence of erosion on the model.	Drawing	1. Why do you suppose there are no settlements bordering the river?
	2. Look along the edges of the model for breaks in the rock or faults. Would you expect earthquakes to occur in this area?		2. Why doesn't the shale formation (blue) create flat-topped steps like the red and yellow sandstone formations do?
	3. List as many reasons as you can that explain why coastal plains such as this may support a dense population.		3. What kind of rock underlies the main canyon – sandstone, shale, or conglomerate? Does it seem to be easily eroded?
MODEL 3: FAULT BLOCK MOUNTAINS		MODEL 4: FOLDED MOUNTAINS	
Drawing	1. What happens to the water from the mountains when it reaches the desert?	Drawing	1. What type of force caused the folding – extension, compression, or shearing?
	2. Where does the material in the alluvial fan (49) come from?		2. If you cut straight across the top of an anticline (like 67), the oldest beds are exposed in the center. If you cut across a syncline (66) are the older or younger beds in the center?
	3. Would you expect a lot of earthquakes to occur in this area? Why or why not?		3. If you were standing at the bottom of a syncline, would the beds be dipping toward you or away from you?

MODEL 5: COASTLINE		MODEL 6: GLACIER	
Drawing	1. Where did the sand on the beaches come from?	Drawing	1. Examine the model CAREFULLY using your fingertips to feel the landforms. What general conclusion can you make about the effects of glaciers in mountainous regions?
	2. Look at the rock layers on the side of the model. If a rock formation is not deformed, must it be the same thickness everywhere? Why or why not?		2. Would you describe the glacial valley (112) as U-shaped or V-shaped? Explain your answer.
	3. Why is at port located at the drowned river mouth (95) instead of the tidal flat (97)?		3. Why do you think the delta (124) formed where it is compared to the glacier (106)?
MODELS 7 & 8: VOLCANO		3_D Display	
Drawing	1. Is lava igneous, metamorphic, or sedimentary rock?	Landforms:	
	2. Some lava is very fluid and flows like corn syrup, while other lava is very chunky and flows more like thick oatmeal. If this is the case, how does this affect the shape of the volcano?		
	3. How many lava flows (black) can you see in the cross-section of this model?		

Labs:
1. It's All on the Surface (TX LabZone Quick lab)
2. Surface Features (TX LabZone Quick lab)
3. Modeling Landforms (TX LabZone Quick lab)
4. Desert Pavement (TX LabZone Quick lab)
5. Local Landscapes (TX LabZone Quick lab)
6. Student design- investigating different coastlines