

## North Carolina Earth/ Environmental Science Curriculum Guide

Unit	Suggested Pacing
Astronomy	7 days
Earthquakes & Plate Tectonics	11 days
Rocks, Weathering, Erosion, & Soil	8 days
Water	12 days
Oceans & Atmosphere	7 days
Meteorology	8 days
Climate & Energy	9 days
Sustainability & Ecology	7 days

### **Astronomy**

#### **Essential Standard:**

**EEn.1.1** Explain the Earth's role as a body in space.

#### **Clarifying objective:**

EEn.1.1.1 Explain the Earth's motion through space, including precession, nutation, the barycenter, and its path about the galaxy.

EEn.1.1.2 Explain how the Earth's rotation and revolution about the Sun affect its shape and is related to seasons and tides.

EEn.1.1.3 Explain how the sun produces energy which is transferred to the Earth by radiation.

EEn.1.1.4 Explain how incoming solar energy makes life possible on Earth.

#### **Unpacking:**

##### **EEn.1.1.1**

- Explain the origin of the Earth's motion based on the origin of the galaxy and its solar system.
  - Recall Earth's role in the hierarchy of organization within the universe and in the developmental continuum. (Universe is made of galaxies which are made of many stars. Some stars have planetary systems similar to our solar system. Earth is a satellite planet of one particular star.)
  - Explain planetary orbits, especially that of the Earth, using Kepler's laws.
  - Explain relative motion of the Earth in the solar system, the solar system in the galaxy, and the galaxy in the universe—including the expanding nature of the universe; Orbital motion (Earth around the Sun- once/year, seasons depend upon an approximate 23.5 degree tilt); Rotation around our axis (day/night,)
  - Explain Precession—change in direction of the axis, but without any change in tilt—this changes the stars near (or not near) the Pole, but does not affect the seasons (as long as the angle of 23.5 degrees stays the same)
  - Explain nutation—wobbling around the precessional axis (This is a change in the angle— $\frac{1}{2}$  degree one way or the other. This occurs over an 18 year period and is due to the Moon exclusively. This would very slightly increase or decrease the amount of seasonal effects.)
  - Explain barycenter—the point between two objects where they balance each other (For example, it is the center of mass where two or more celestial bodies orbit each other. When a moon orbits a planet, or a planet orbits a star, both bodies are actually orbiting around a point that lies outside the center of the primary (the larger body). For example, the moon does not orbit the exact center of the Earth, but a point on a line between the Earth and the Moon approximately 1,710 km below the surface of the Earth, where their respective masses balance. This is the point about which the Earth and Moon orbit as they travel around the Sun.
  - Summarize that the Sun is not stationary in our solar system. It actually moves as the planets tug on it, causing it to orbit the solar system's barycenter. The Sun never strays too far from the solar system barycenter.
- ##### **EEn.1.1.2**
- Describe daily changes due to rotation, seasonal changes due to the tilt and revolution of the Earth, and tidal impact due to the gravitational interaction between the Earth and moon.
  - Develop a cause and effect model for the shape of the Earth explaining why the circumference around the equator is

larger than that around the poles.

**EEn.1.1.3**

- Compare combustion and nuclear reactions (fusion and fission) on a conceptual level. Identify fusion as the process that produces radiant energy of stars.
- Identify the forms of energy (electromagnetic waves) produced by the sun and how some are filtered by the atmosphere (X-rays, cosmic rays, etc.).
- Summarize how energy flows from the sun to the Earth through space.

**EEn.1.1.4**

- Explain how the tilt of the Earth’s axis results in seasons due to the amount of solar energy impacting the Earth’s surface.
- Explain how solar energy is transformed into chemical energy through photosynthesis.
- Explain how the earth’s magnetic field protects the planet from the harmful effects of radiation.

**Essential Vocabulary:**

Nebular Hypothesis, accretion  
 Big Bang Theory (supported by Hubble’s Law)  
 Kepler’s Laws (qualitative understanding, not quantitative)  
 Rotation, revolution  
 Nutation, precession  
 Causes of seasons  
 Barycenter (qualitative understanding, quantitative would be an extension)  
 Equatorial bulge  
 Fission, fusion  
 Electromagnetic spectrum: all wave types, frequency, wavelength  
 Spectrum  
 Doppler effect, redshift, blueshift  
 Solar wind, sunspots, Earth’s magnetic field (extension: solar flares)  
 Universe, galaxy, solar system, planets, moons (extension: meteor, asteroids, comets)  
 Extension: stellar evolution

<b><i>Key Questions</i></b>	<b><i>Criteria for Success: “I will”</i></b>	<b><i>Suggested Resources/Activities</i></b>
What is the difference between precession and nutation?	Demonstrate the difference between precession and nutation.	Skits demonstrating Earth motions
Does the sun move? How?	Model the sun’s motion within the solar system and the galaxy.	Model barycenter with pencil/clay
Why is the Earth larger around the equator than the poles?	Model equatorial spreading.	Pencil/paper strip activity
What is the difference between a planet and a star? A galaxy and a solar system? A galaxy and the universe?	Put the following objects in order from largest to smallest: universe, galaxy, solar system, planets, moons.	Peppercorn Earth model Cosmic Survey
How did the solar system form?	Construct a flow chart that explains the formation of the solar system.	Model accretion using play-doh.
How does the Earth move?	Describe Kepler’s Law qualitatively. Demonstrate the difference between rotation and revolution.	<a href="#">NASA Kepler’s Laws Activities</a>
What causes the seasons?	Use observations about seasons to evaluate competing hypotheses.	Using flashlights to show change in light intensity at different angles. <a href="#">MyNASAData Seasons</a>
Why does the sun shine?	Compare and contrast fusion and	<a href="#">Fusion vs. Fission explanation</a>

	fission.	<a href="#">Fusion vs. Fission chart</a>
How can we learn about places that are farther away than humans have ever travelled?	Link types of electromagnetic radiation to their significance to humans and astronomers. Use a spectrum to determine if a galaxy is moving towards or away from Earth.	<a href="#">Honors: Evidence for the Expanding Universe (p. 47)</a> Spectrum Lab
What is the “Big Bang?”	Model the expanding universe, and associate the beginning of expansion with the “big bang”	<a href="#">Modeling the Expanding Universe (p. 39)</a>

Helpful Websites:

[Educator’s Guide to Cosmic Questions, by the Harvard-Smithsonian Center for Astrophysics](#)

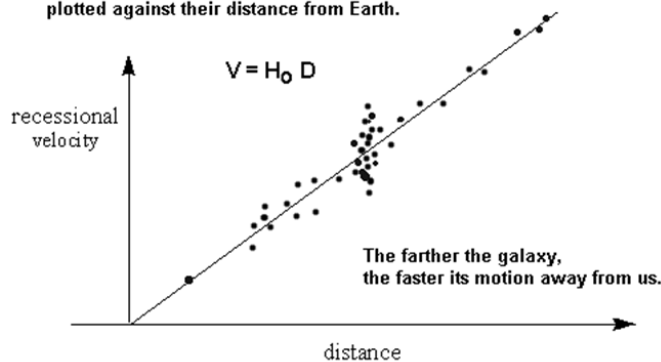
[Barycenter Video](#)

[Scale of Universe](#)

Writing Prompts

- Research the effect of sunspots on climate by using articles on Sciencedaily.com, reading chapter 24.5, finding information from nasa.gov, and using your own sources. Write a short essay that discusses the impact sunspots have on climate. Analyze whether or not changes in solar activity are an important cause of climate change. Be sure to support your position with evidence from your research and differentiate between long and short term climate change.

The recessional velocity of a few galaxies, plotted against their distance from Earth.



On this graph, the slope of the line is equal to Hubble's Constant ( $H_0$ )

Using the data from the graph above, defend the claim that the universe is expanding.

## Earthquakes & Plate Tectonics

**Essential Standard:**

**EEn.2.1 Explain how processes and forces affect the lithosphere.**

**Clarifying objective:**

EEn.2.1.1 Explain how the rock cycle, plate tectonics, volcanoes, and earthquakes impact the lithosphere.

EEn.2.1.2 Predict the locations of volcanoes, earthquakes, and faults based on information contained in a variety of maps.

EEn.2.1.4 Explain the probability of and preparation for geohazards such as landslides, avalanches, earthquakes and volcanoes in a particular area based on available data

**Unpacking:**

**EEn.2.1.1**

- Explain how various mechanisms (mantle convection, ridge push, gravity pull) drive movement of the lithospheric plates.
- Infer the relationship between the type of plate boundary and the locations of various features such as ocean trenches, mountain ranges and mid-ocean ridges. (Relate to the development of the theory of plate tectonics and geologic time.)
- Compare magma and lava. Locate volcanoes and relate back to plate boundaries. Explain volcanic effects on the lithosphere and relate back to plate boundaries (convergent, divergent, transform) including lahar (mud) flows and ash in the atmosphere.
- Describe the anatomy of an earthquake. Locate earthquakes – epicenter and focal point – and relate to different types of

plate boundaries. Explain how the release of energy of various types of earthquakes relates to magnitude, and P and S waves.

**EEn.2.1.2**

- Infer the locations of volcanoes, earthquakes and faults (strike-slip, reverse and normal) from soil, geologic and topographic map studies. (Relate fault locations/types to plate boundaries.)

- Make predictions based on data gathered over time in conjunction with various maps.

**EEn.2.1.4**

- Conclude the best location for various types of development to reduce impacts by geohazards and protect property.

- Explain precautions that can be made to protect life from various geohazards and include meteorological hazards. Some examples include landslides, earthquakes, tsunamis, ~~sinkholes, groundwater pollution, and flooding~~

**Essential Vocabulary:**

Mantle convection, ridge push, slab pull

Magma, lava

Richter magnitude, moment magnitude

Seismic waves: Primary, secondary, surface (extension: love, Rayleigh)

Oceanic crust, continental crust

Ocean trench, ocean ridge, volcanic chain, rift valley, mountain range, hot spot

Convergent, divergent, transform plate boundaries

Subduction

Geohazards: lahar, landslide, tsunami

Epicenter, focus, fault (reverse, strike-slip, normal)

Landforms: Appalachian Mountains, fall zone, shorelines, barrier islands, valleys

Extension: types of volcanoes, p-wave shadow zone, s-wave shadow zone

<b><u>Key Questions</u></b>	<b><u>Criteria for Success: "I will"</u></b>	<b><u>Suggested Resources/Activities</u></b>
What causes plate tectonics?	Label slab-pull, ridge-push, and convection on a plate diagram, and match them to the corresponding forces.	<a href="#">Windows to the Universe Diagram &amp; Explanation</a>
Where do mountains, volcanoes, and other topographic features come from?	Draw plate boundaries and label the landforms associated with each (continental convergence/mountains; oceanic convergence/volcanoes, trenches; continental divergence/rift valleys; oceanic divergence/ocean ridges)	<a href="#">Plate Boundary Draw-along</a> Plate Boundary Pictionary
What is it like inside the Earth? How do we know?	Design an experiment to determine the speed of sound in materials of different density; relate this to how seismic waves move differently through different materials.	<a href="#">Demonstrating density's impact on sound waves with a coat hanger and string</a> <a href="#">Differences between P and S waves within the Earth</a>
How do I stay safe during an earthquake? A tsunami? A landslide? A volcanic eruption?	Design a public safety announcement (radio spot, visual, video, etc.) that helps the public understand what to do in the event of an emergency.	<a href="#">FEMA disaster safety tips</a>
How can I locate the epicenter of an earthquake?	Locate an earthquake's epicenter using seismograms and P-S travel time graph.	<a href="#">Earthquake triangulation lab</a>
How can scientists detect if an earthquake is coming?	Compare and contrast primary, secondary, and surface waves.	<a href="#">Japan's earthquake warning system</a>

	Use the properties of seismic waves to explain how primary waves are used to create earthquake warning systems.	
How do we use topographic maps to interpret landforms?	Describe changes in the shape and slope of Mount St. Helens by reading topographic maps.	<a href="#">Using topographic maps to understand Mount St. Helen's eruption</a>

Helpful Websites:  
[Plate Tectonic Map Analysis: Northeastern Illinois University](#)  
[Discovering Plate Boundaries](#)

**Writing Prompts**

- Describe how Earth would be different if it were not tectonically active.

**Earthquake Comparison Chart**

Location	Port-au-Prince, Haiti	Tohoku, Japan
Magnitude	7.0	9.0
Date of Earthquake	January 12, 2010	March 11, 2011
Casualties	92,000	16,000
Number of people left homeless	895,000	434,000
Population Density	907/sq mi	350/sq mi
Average household income	\$670	\$68,000
Cost of Damage	\$14 billion	\$20 billion

1. Defend each claim with two supporting reasons using data from the chart above.
  - a. Haiti sustained more damage from their earthquake.
  - b. Japan sustained more damage from their earthquake.
2. Suggest two strategies Haiti could use to reduce earthquake damage in the future.

**Rocks, Weathering, Erosion, & Soil**

**Essential Standard:**

**EEn.2.1 Explain how processes and forces affect the lithosphere.**

**EEn.2.2 Understand how human influences impact the lithosphere.**

**Clarifying objective:**

EEn.2.1.1 Explain how the rock cycle, ~~plate tectonics, volcanoes, and earthquakes~~ impact the lithosphere.

EEn.2.1.3 Explain how natural actions such as weathering, erosion (wind, water and gravity), and soil formation affect Earth's surface.

**Unpacking:**

**EEn.2.1.1**

• Explain the rock cycle in enough detail to relate the cycling of materials - formation and destruction of the three major rock types to the forces responsible: physical and chemical weathering, heat and pressure, deposition, foliation and bedding. The forms of energy that drive the rock cycle include heat and mechanical (gravitational potential) energy.

• Summarize the major events in the geologic history of North Carolina and the southeastern United States. Explain how current geologic landforms developed such as Appalachian Mountains, fall zone, shorelines, barrier islands, valleys, river basins, etc. using the geologic time scale.

• Explain how processes change sea-level over time—long- and short-term. Infer the effects on landforms such as shorelines and barrier islands.

**EEn.2.1.3**

• Recall that soil is the result of weathering of rocks and includes weathered particles: sand, silt and clay.

• Explain differences in chemical and physical weathering and how weathering rates are affected by a variety of factors including climate, topography and rock composition.

• Compare erosion by water, wind, ice, and gravity and the effect on various landforms.

**EEn.2.2.1**

- Explain the effects of human activity on shorelines, especially in development and artificial stabilization efforts.
- Explain the effects of human activity on mountainsides, especially in development and artificial stabilization efforts.

**Essential Vocabulary:**

Erosion, including problems (Dust Bowl, landslides) and mitigation (contour plowing, terracing, mountainside netting)  
 Abrasion  
 Features from wind erosion (examples: dunes, Monument Valley)  
 Features from water erosion (examples: canyons, v-shaped valleys, flood plains)  
 Features from ice erosion (examples: u-shaped valleys, glacial lakes)  
 Weathering: mechanical (including frost wedging), chemical, biological  
 Mitigation strategies for beach erosion: artificial stabilization (groins, seawalls, breakwaters), beach nourishment, planting vegetation/beach grass

<b>Key Questions</b>	<b>Criteria for Success: "I will"</b>	<b>Suggested Resources/Activities</b>
What tectonic and geologic events formed North Carolina?	Create a timeline of North Carolina's geologic history.	<a href="#">NC Geography &amp; Geologic History</a>
Why does it become more difficult to reconstruct Earth's history as we go back in time?	Diagram the rock cycle and explain how the changes relate to weathering, erosion, and plate tectonics.	<a href="#">Rock Cycle Diagram</a>
How do barrier islands form?	Describe how barrier islands form and move, and how they change during severe storms. Use this information to argue what types of development should be permitted on barrier islands.	<a href="#">Changing Sands</a>
What factors influence the rate of weathering? What types of locations have the fastest weathering?	Collect and graph weathering data to determine the relationship between temperature, moisture, surface area, mineral composition, and weathering rate.	<a href="#">Weathering Lab</a>
What types of erosion move the largest sediments?	Determine the sediment sizes moved by wind, river, and glacier, by modeling erosion with mixed sediments.	Using a mixture of many sediment sizes, students blow sediments with a straw to simulate wind, pour water to simulate a river, and push through a block of ice to simulate a glacier. Each time, they should measure and record the size sediment moved.
Why should we care about erosion? What can we do to mitigate erosion?	Identify causes and effects of erosion events (Dust Bowl, coastal erosion, deforestation)	<a href="#">PBS "Breaks Down" Erosion</a>
How can we tell if soil is well-suited for growing crops?	Use a soil texture diagram to identify soil types. Identify the four components of healthy soil.	<a href="#">Soil Lab</a>

Helpful Websites:

- [NASA Images of Land Use Change](#)
- [Satellite Image of Dust Storm over China](#)

Writing Prompts

- Should developers in the US be able to build on sensitive areas like barrier islands? Read the article "[Barrier Island Case Study](#)" and participate in a class discussion regarding barrier island development, then write a paragraph that addresses the question and supports your position with evidence from the text. Give examples from past or current events or issues to illustrate and clarify your position.

North Carolina cut over \$10 million from the state budget in 2013 that had previously been spent on beach nourishment.

- Defend the decision to remove the funding for beach nourishment from the state budget.

- Refute the decision to remove the funding for beach nourishment from the state budget.

## Water

### Essential Standard:

**EEn.2.3 Explain the structure and processes within the hydrosphere.**

**EEn.2.4 Evaluate how humans use water.**

### Clarifying objective:

**EEn.2.3.2 Explain how ground water and surface water interact.**

**EEn.2.4.1 Evaluate human influences on freshwater availability.**

**EEn.2.4.2 Evaluate human influences on water quality in North Carolina's river basins, wetlands and tidal environments.**

### Unpacking:

#### EEn.2.3.2

- Illustrate the water cycle to explain the connection between groundwater and surface water, detailing how groundwater moves through the lithosphere. (Emphasize the processes of evaporation and infiltration in the conceptual diagram of the hydrologic cycle.)

- Explain river systems including NC river basins, aquifers, and watersheds.

- Explain how flood events might be affected by groundwater levels.

#### EEn.2.4.1

- Explain various water uses by humans and evaluate for benefits and consequences of use (ex. wells, aquifer depletion, dams and dam removal, agriculture, recreation).

- Explain consequences of aquifer depletion including subsidence and salt-water intrusion on the coast.

- Evaluate the effects of population growth on potable water resources. Infer future effects

- Explain how pollutants might flow through a watershed and affect inhabitants that share the same watershed.

#### EEn.2.4.2

- Evaluate issues of ground and surface water pollution, wetland and estuary degradation, and salt water intrusion.

- Analyze how drinking water and wastewater treatment systems impact quantity and quality of potable water.

- Evaluate water quality of NC streams (chemical, physical properties, biotic index).

- Analyze non-point source pollution and effects on water quality (sedimentation, storm water runoff, naturally and human induced occurrences of arsenic in groundwater).

- Evaluate conservation measures to maximize quality and quantity of available freshwater resources.

#### EEn.2.1.4

- Conclude the best location for various types of development to reduce impacts by geohazards and protect property.

- Explain precautions that can be made to protect life from various geohazards and include meteorological hazards. Some examples include landslides, earthquakes, tsunamis, sinkholes, groundwater pollution, and flooding

### Essential Vocabulary:

Water cycle: evaporation, condensation, transpiration, infiltration, runoff

Aquifers: confined aquifer, unconfined aquifer, cone of depression, ground subsidence, water table

Groundwater contaminants: salt-water intrusion, arsenic, landfill leachate

River basin/drainage basin/watershed, divide, continental divide

Wetland, estuary

Water quality: Wastewater, storm water, sedimentation, eutrophication, dissolved oxygen, biotic index, macroinvertebrates, pH, salinity/conductivity



<b><i>Key Questions</i></b>	<b><i>Criteria for Success: “I will”</i></b>	<b><i>Suggested Resources/Activities</i></b>
Where does our drinking water come from?	Compare and contrast coastal plain and piedmont sources of drinking water.	<a href="#">NC Drinking Water</a>
Where does water go when I flush it down the toilet?	Compare and contrast primary and secondary water treatment, and identify ways private citizens can help keep water clean.	<a href="#">Wastewater Past, Present, and Future</a> <a href="#">Wastewater Treatment Virtual Tour</a>
Where does water go when it flows down a storm drain? What factors increase the risk of flooding?	Assess how land use impacts permeability, run-off, and the potential for flooding.	<a href="#">Color Me a Watershed</a>
What are the causes and consequences of groundwater depletion?	Discuss severe cases of groundwater depletion, such as the Ogallala Aquifer, San Joachin Valley, Houston, and others— why did they over pump? What happened as a result?	<a href="#">USGS Groundwater Depletion</a>
How do we know if our water is safe?	Use water quality data and table of “ideal” ranges to assess local water quality.	<a href="#">Water quality lessons</a>
Why is water conservation important? What can we do to conserve water?	Calculate water footprint, and suggest ways to make it smaller.	<a href="#">Water Footprint</a>
Why are wetlands important?	Describe three important ecosystem services wetlands provide.	<a href="#">Bill Nye Wetlands Video</a>
Helpful Websites: <a href="#">USGS: Ground Subsidence from Overpumping Article</a> <a href="#">Real Time Charlotte Mecklenburg Stream Data</a>		
<p>Writing Prompts</p> <ul style="list-style-type: none"> <li>• Compare and contrast the differences of water runoff and infiltration in urban areas and rural areas. Be sure to include examples of types of runoff, amount runoff, water quality of the runoff (types of pollution). Describe one action that cities, farmers, or residents could make to reduce water pollution, and use evidence from a variety of sources to support why your action should be chosen over other options.</li> <li>• After reading the river basin and groundwater information in class and the current event articles on water shortages in the world, write a <u>proposal</u> that identifies a problem <u>faced by communities in arid regions</u> and argues for a solution. Support your position with evidence from your reading and research. Examine competing views. Give examples from past or current events or issues to illustrate and clarify your position. In addition, include your observations from the soil, gravel, and clay lab in your answer taking in consideration the type of soil found in the arid region you are discussing in your paper.</li> </ul>		

<b>Oceans &amp; Atmosphere</b>
<b>Essential Standard:</b> <b>EEn.2.3 Explain the structure and processes within the hydrosphere.</b>
<b>Clarifying objective:</b> <b>EEn.2.3.1 Explain how water is an energy agent (currents and heat transfer).</b> <b>EEn.2.5.1 Summarize the structure and composition of our atmosphere.</b>
<b>Unpacking:</b> <b>EEn.1.1.2</b> • Describe <del>daily changes due to rotation, seasonal changes due to the tilt and revolution of the Earth, and</del> tidal impact due to the gravitational interaction between the Earth and moon.
<b>EEn.1.1.4</b> • Explain differential heating of the earth’s surface (water temperature vs. land temperature)
<b>EEn.2.3.1</b> • Explain how the density of ocean water is affected by temperature and how this results in major ocean currents



distributing heat away from the equator toward the poles.

- Explain how coastal climates are moderated by water (due to its high specific heat capacity) in comparison to inland climates.

**EEn.2.5.1**

- Summarize information from charts and graphs regarding layers of the atmosphere, temperature, chemical composition, and interaction with radiant energy.

**Essential Vocabulary:**

Neap tide, spring tide (extension: diurnal vs. mixed tides)  
 Surface currents, deep/thermohaline currents  
 Coriolis effect  
 Waves  
 Specific heat capacity  
 Layers of the atmosphere: troposphere, stratosphere, mesosphere, thermosphere  
 Ozone, chlorofluorocarbons (CFCs)  
 Windward coast, leeward coast  
 Land breeze, sea breeze  
 Heat transfer: conduction, convection, radiation  
 Electromagnetic radiation: ultraviolet light, visible light, thermal infrared radiation  
 Emission, transmission, scattering, absorption

<b><i>Key Questions</i></b>	<b><i>Criteria for Success: "I will"</i></b>	<b><i>Suggested Resources/Activities</i></b>
What is the difference between waves, currents, and tides?	Compare and contrast waves, currents, and tides.	Pretend the class is the ocean, and each student is a droplet of water; have them show a wave moving through, a current, an ocean gyre, and a tidal cycle.
What causes deep currents?	Model how differences in density cause convection currents.	Ocean convection lab
What causes surface currents?	Determine which way the Coriolis Force deflects currents in the Northern and Southern hemispheres.	Coriolis activity
How do currents affect climate?	Use an ocean current map to identify places that have climates that are affected by currents.	<a href="#">MyNASAData Gulf Stream</a> <a href="#">MyNASADataOcean Currents</a>
How do large bodies of water affect climate?	Determine the relative heating rates of land and water.	Heating of Land and Water Lab <a href="#">MyNASADataComparision of Land &amp; Water Temperatures</a>
What determines the layers of the atmosphere?	Use atmospheric temperature data to locate the boundaries between atmospheric layers.	<a href="#">Layers of the Atmosphere</a>
Why do we need the ozone layer? How can we protect the ozone layer?	Distinguish between tropospheric and stratospheric ozone.	<a href="#">Ozone Activity</a>
Helpful Websites: <a href="#">NASA's Ocean Motion</a> <a href="#">Earth, the Biography: Atmosphere</a> <a href="#">NOAA Education Resources</a>		
Writing Prompts <ul style="list-style-type: none"> <li>• How do ocean currents affect climate?</li> <li>• How does climate affect ocean currents?</li> </ul>		

**Meteorology**

**Essential Standard:**

**EEn.2.5 Understand the structure of and processes within our atmosphere.**

**Clarifying objective:**

**EEn.2.5.2 Explain the formation of typical air masses and the weather systems that result from air mass**

**interactions.**

**EEn.2.5.3 Explain how cyclonic storms form based on the interaction of air masses.**

**EEn.2.5.4 Predict the weather using available weather maps and data (including surface, upper atmospheric winds, and satellite imagery).**

**EEn.2.5.5 Explain how human activities affect air quality.**

**Unpacking:**

**EEn.2.5.2**

• Explain how air masses move (pressure differentials).

• Explain how interactions of air masses form frontal boundaries, clouds, and affect wind patterns.

Note: Also address precautions for severe cyclonic storms to preserve life and property.

**EEn.2.5.3**

• Explain factors that affect air density and understand their influence on winds, air masses, fronts and storm systems.

• Use data to substantiate explanations and provide evidence of various air mass interactions.

Note: Also address precautions for severe cyclonic storms to preserve life and property.

**EEn.2.5.4**

• Observe, analyze and predict weather using technological resources.

• Interpret and analyze weather maps and relative humidity charts.

• Explain the importance of water vapor and its influence on weather (clouds, relative humidity, dew point, precipitation).

Note: Use predictions to develop plans for safety precautions related to severe weather events.

**Essential Vocabulary:**

Air pressure, relative humidity, cloud condensation nuclei, dew point, barometer, psychrometer, thermometer, isotherm, isobar,

High pressure system/air mass, low pressure system/fronts

Fronts: cold, warm, occluded, stationary

Clouds: cumulus, stratus, cirrus

Storms: Thunderstorm (cumulus, mature, and dissipating stages), tornado, hurricane, updraft, down draft, wind shear, eye of hurricane, storm cell

<b><i>Key Questions</i></b>	<b><i>Criteria for Success: "I will"</i></b>	<b><i>Suggested Resources/Activities</i></b>
Why does Forks, Washington have the ideal weather conditions for vampires?/What conditions cause clouds to form?	Identify the conditions necessary for cloud formation (falling temperature and pressure), and explain how they are linked to rising air.	<a href="#">Cloud Lab</a>
What causes wind?	Explain how pressure moves objects as high and low pressure systems are applied to them.	Air pressure demonstrations <a href="#">Isobar Activity</a>
How do meteorologists identify cold fronts and warm fronts?	Use a weather map to identify cold fronts and warm fronts.	<a href="#">Warm / Cold Front comparison</a> <a href="#">Station Model Lab (standard)</a> & <a href="#">Station Model Lab (advanced)</a>
What causes severe storms?	Design a visual (drawing, comic, flip book, animation, video, etc.) that depicts the steps of storm formation.	<a href="#">Formation of a Thunderstorm</a>
How can I stay safe in a thunderstorm? Tornado? Hurricane?	Design a public safety announcement (radio spot, visual, video, etc.) that helps the public understand what to do in the event of an emergency.	<a href="#">FEMA disaster safety tips</a>
Helpful Websites: <a href="#">Real-time United States Wind Map</a>		

Writing Prompts

- After completing your forecast table and studying pressure systems, predict the weather for tomorrow. Support your prediction with several pieces of evidence.

**Climate & Energy**

**Essential Standard:**

**EEn.2.6 Analyze patterns of global climate change over time.**

**EEn.2.8 Evaluate human behaviors in terms of how likely they are to ensure the ability to live sustainably on Earth.**

**Clarifying objective:**

**EEn.2.6.1 Differentiate between weather and climate.**

**EEn.2.6.2 Explain changes in global climate due to natural processes.**

**EEn.2.6.3 Analyze the impacts that human activities have on global climate change (such as burning hydrocarbons, greenhouse effect, and deforestation).**

**EEn.2.6.4 Attribute changes to Earth's systems to global climate change (temperature change, changes in pH of ocean, sea level changes, etc.).**

**EEn.2.8.1 Evaluate alternative energy technologies for use in North Carolina.**

**EEn.2.8.2 Critique conventional and sustainable agriculture and aquaculture practices in terms of their environmental impacts.**

**EEn.2.8.3 Explain the effects of uncontrolled population growth on the Earth's resources.**

**EEn.2.8.4 Evaluate the concept of "reduce, reuse, recycle" in terms of impact on natural resources**

**Unpacking:**

**EEn.2.6.1**

- Explain major climate categories (Köppen climate classification system – temperate, tropical, and polar).
- Compare weather and climate.

**EEn.2.6.2**

• Summarize natural processes that can and have affected global climate (particularly El Niño/La Niña, volcanic eruptions, sunspots, shifts in Earth's orbit, and carbon dioxide fluctuations).

• Explain the concept of the greenhouse effect including a list of specific greenhouse gases and why CO<sub>2</sub> is most often the focus of public discussion.

**EEn.2.6.3**

• Outline how deforestation and the burning of fossil fuels (linked to increased industrialization) contribute to global climate change.

• Explain how large-scale development contributes to regional changes in climate (i.e. heat islands in large cities like NY, Chicago, Beijing, etc.).

• Analyze actions that can be taken by humans on a local level, as well as on a larger scale, to mitigate global climate change.

**EEn.2.6.4**

• Analyze how changes in global temperatures affect the biosphere (ex. agriculture, species diversity, ecosystem balance).

• Explain how changes in atmospheric composition contribute to ocean acidification. Analyze its effect on ocean life and its connection to global climate change.

• Explain how changes in global temperature have and will impact sea level.

• Analyze how sea level has been affected by other earth processes such as glaciations and tectonic movements. Consider long- and short-term changes.

**EEn.2.8.1**

• Critique the benefits, costs and environmental impact of various alternative sources of energy for North Carolina (solar, wind, biofuels, nuclear fusion, fuel cells, wave power, geothermal).

- Evaluate which sources of alternative energy may work best in different parts of the state and why.

- Extension: Examine for region, country, continent, hemisphere, and world.

**EEn.2.5.5**

- Explain how acid rain is formed and how human activities can alter the pH of rain.

- Infer other human activities that impact the quality of atmospheric composition. (e.g. aerosols, chlorofluorocarbons, burning, industrial byproducts, over farming, etc.)

- Exemplify methods to mitigate human impacts on the atmosphere.

**EEn.2.2.2**

- Compare the methods for obtaining energy resources: harvesting (peat and wood), mining (coal and plutonium), drilling (oil and natural gas), and the effect of these activities on the environment.

**Essential Vocabulary:**

Weather, climate

Köppen climate classification (temperate, tropical, polar), latitude, altitude

El Niño/La Niña, volcanic eruptions, sunspots, Milankovitch cycles (precession, nutation, and eccentricity—students need not know the name “Milankovitch”)

Greenhouse effect/greenhouse gases: water vapor, carbon dioxide, methane

Carbon cycle: photosynthesis, respiration, deforestation, plankton, ocean acidification, coral reefs

Albedo, heat island, green roof

Anthropogenic, mitigate

Thermal expansion (of sea water)/sea level rise

Fossil fuels: coal, petroleum, natural gas

Acid rain

Alternative energy, solar, wind, biofuel, photovoltaic, hydroelectric, hydrogen fuel, turbine, generator, nuclear fission, nuclear fusion, radioactive, radioactive decay, wave power, geothermal,

<b>Key Questions</b>	<b>Criteria for Success: “I will”</b>	<b>Suggested Resources/Activities</b>
What factors are most important in determining biomes?	Create a climatogram and analyze how temperature and precipitation vary regionally.	<a href="#">MyNASAData Climate Zone/Biome Activity</a>
How does El Nino affect local weather patterns?	Infer weather conditions associated with El Nino by analyzing satellite data.	<a href="#">MyNASAData El Nino Activity</a>
What is climate change? What are some ways it can be mitigated?	Research climate issues, evaluate arguments, and support favored solutions with textual evidence.	<a href="#">Carbon Dioxide Cap-and-trade Debate</a>
How do my actions contribute to climate change?	Identify ways to decrease my personal greenhouse gas emissions.	<a href="#">Carbon Footprint Calculator</a>
What evidence is there of climate change?	Describe observed effects of climate change.	<a href="#">Climate Change Evidence</a>
How do volcanic eruptions and changes in solar intensity affect climate?	Evaluate evidence to determine if the “year without a summer” was caused by volcanic eruption or solar activity.	<a href="#">Year Without a Summer Inquiry</a>
What are our alternatives to fossil fuels?	Compare and contrast the advantages and disadvantages of solar, wind, biofuels, nuclear fusion, fuel cells, wave power, and geothermal power.	<a href="#">Renewable Energy Sources</a>

Helpful Websites:

[National Center for Science Education: Climate Change Education](#)

[Global Issues: Climate Change and Global Warming Introduction](#)

## [El Nino & La Nina Animation](#)

### Writing Prompts

- How do humans impact climate change? After viewing one or more of the videos and taking part in class discussion on climate changes, write a persuasive essay that argues the causes of climate change and explains the effects on the planet. What implications can you draw? Support your discussion with evidence from the text resources from this unit. Be sure to use quantitative and graphical data in your analysis.
- After researching data tables, graphs and articles on Discovery Education and National Geographic related to climate change, write an editorial to the Charlotte Observer that addresses whether the American public is adequately informed about climate change. Support your position with evidence from your research on the causes and effects of climate change.

## **Sustainability & Ecology**

### **Essential Standard:**

**EEn.2.7 Explain how the lithosphere, hydrosphere, and atmosphere individually and collectively affect the biosphere.**

**EEn.2.8 Evaluate human behaviors in terms of how likely they are to ensure the ability to live sustainably on Earth.**

### **Clarifying objective:**

**EEn.2.7.1 Explain how abiotic and biotic factors interact to create the various biomes in North Carolina.**

**EEn.2.7.2 Explain why biodiversity is important to the biosphere.**

**EEn.2.7.3 Explain how human activities impact the biosphere.**

### **Unpacking:**

#### **EEn.2.7.1**

- Explain how biotic and abiotic factors determine biome classification (temperature, rainfall, altitude, type of plant, latitude, type of animals).
- Compare impacts of biotic and abiotic factors on biodiversity.
- Match landforms and soils (and their change over time) to biomes

#### **EEn.2.7.2**

- Define the biosphere as all life on Earth.
- Explain biodiversity as including genetic variation within populations and variation of populations within ecosystems that makeup the biosphere.
- Infer the relationship between environmental conditions and plants and animals that makeup live within various biomes that comprise the biosphere.
- Explain the global impact of loss of biodiversity.

#### **EEn.2.7.3**

- Explain effects of human population growth, habitat alteration, introduction of invasive species, pollution and overharvesting on various plant and animal species in NC.
- Explain effects of invasive nonnative species (plant or animal) on an NC ecosystem.
- Summarize ways to mitigate human impact on the biosphere.

#### **EEn.2.8.2**

- Critique the advantages and disadvantages of traditional agriculture/aquaculture techniques and compare with sustainable agriculture/aquaculture techniques. Include the economics and environmental impacts in this comparison.
- Judge potential impact of sustainable techniques on environmental quality (include magnitude, duration, frequency).

#### **EEn.2.8.3**

- Explain carrying capacity.
- Infer limiting factors to human population growth.

- Summarize the impacts of a growing population on the natural resources in North Carolina

#### **EEn.2.8.4**

- Explain how ecological footprints exist at the personal level and extend to larger scales.
- Evaluate personal choices in terms of impacts on availability of natural resources and environmental quality; relate this to ecological footprints on various scales.
- Evaluate the impact of implementing change that adheres to the “reduce, reuse, recycle” philosophy (e.g. through case studies, data collection/analysis, model development, etc.).

Note: Link to EEn.2.8.1 regarding alternative energy technologies.

#### **Essential Vocabulary:**

Agriculture, aquiculture, pesticide, fertilizer, sustainable, fish hatchery, till, plow, crop rotation, strip cropping, genetically modified crop, organic, inorganic, harvest, carrying capacity, limiting factor, population, community, ecosystem, biosphere, urbanization, urban sprawl, biotic factor, abiotic factor, biodiversity, habitat alteration, biome, invasive species, genetic variation, over-harvesting, non-native, ecological footprint, reduce, re-use, recycle

<u><b>Key Questions</b></u>	<u><b>Criteria for Success: “I will”</b></u>	<u><b>Suggested Resources/Activities</b></u>
How many people can the world sustain?	Draw a concept map showing the connections between growing population, limiting factors, and related environmental impacts.	<a href="#">Everything is Connected</a>
How can we reduce the amount of waste we produce?	Compare and contrast strategies for reducing solid waste.	<a href="#">Recycle City</a>
Should population growth be addressed? If so, how?	Debate arguments for and against population control.	<a href="#">Where do you Stand?</a>
What ecosystem services does biodiversity provide?	Identify benefits that come from preserving biodiversity.	<a href="#">Biodiversity Jeopardy</a>
How do humans affect biodiversity?	Rank anthropogenic threats to biodiversity.	<a href="#">Biodiversity Questions</a>
What is an invasive species, and how does it affect biodiversity?	Design a public service announcement that helps people identify a local invasive species, and help them to understand why and how it should be removed.	<a href="#">Invasives in Southern Appalachia</a>
How do the foods we eat impact the environment?	Compare and contrast industrial and sustainable farming. Identify ways to reduce your ecologic footprint when choosing what to eat.	<a href="#">Sustainable Agriculture</a>

Helpful Websites:

[World Population Balance](#)

[World of 7 Billion](#)

[Population Connection](#)

Writing Prompts

- Describe your favorite meal. Discuss two changes you could make to that meal that would decrease the environmental impact of its production.
- Take one of the following positions and develop an argument based off of your research and class work; defend your position to your classmates using evidence from what was learned in class.  
**Position A:** Biodiversity is more important than the resources we gain through mining and deforestation.  
**Position B:** The resources gained through mining and deforestation are more important than the possible impacts to biodiversity.