Earth/Environmental Science Pacing Guide 2015-2016

1. Earth in the Universe ***4-5 days***	**Introduction to Earth/Environmental Science** • Classroom policies/procedures and lab safety • Overview of the branches of Earth Science and Earth's spheres • Introduction to environmental Science, environmental issues, and sustainability
2. Astronomy (NCFE- Multiple Choice = **EEn.1.1** 11% to 16%) ***10-11 days***	**EEn.1.1 Explain the Earth's role as a body in space.** **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. **UNPACKED STANDARDS- Astronomy** **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 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—½ 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 differential heating of the earth's surface (water temperature vs. land temperature) • 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.
3.Meteorology ***10-12 days*** (NCFE- Multiple Choice **EEn.2.5** 4% to 10%)	**EEn.2.5 Understand the structure of and processes within our atmosphere.** **EEn.2.5.1** Summarize the structure and composition of our atmosphere. **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. **UNPACKED STANDARDS -Atmosphere** **EEn.2.5.1** Summarize information from charts and graphs regarding layers of the atmosphere, temperature, chemical composition, and interaction with radiant energy. **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. **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.
4. Climate ***10-12 days*** (NCFE- Multiple Choice= **EEn.2.6** 7% to 10%)	**<u>EEn.2.6 Analyze patterns of global climate change over time.</u>** **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.). **<u>UNPACKED STANDARDS- Climate</u>** **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 Nino/La Nina, 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 CO2 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.
4 days	**MIDTERM REVIEW & EXAMS**

5. Geology (NCFE- Multiple Choice **EEn.2.1** 11% to 17% **EEn.2.2** 11% to 17% ***8-9 days***	**<u>EEn.2.1 Explain how processes and forces affect the lithosphere.</u>** **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.2.1.3** Explain how natural actions such as weathering, erosion (wind, water and gravity), and soil formation affect Earth's surface. **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 **UNPACKED STANDARDS-Lithosphere** **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. • 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. • Summarize the major events in the geologic history of North Carolina and the southeastern United States. Explain how current geologic and forms 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.2.1.2** • 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.2.1.3** • 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.2.1.4** • 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

5-6 days	include landslides, earthquakes, tsunamis, sinkholes, groundwater pollution, and flooding. **EEn.2.2 Understand how human influences impact the lithosphere.** **EEn.2.2.1** Explain the consequences of human activities on the lithosphere (such as mining, deforestation, agriculture, overgrazing, urbanization, and land use) past and present. **EEn.2.2.2** Compare the various methods humans use to acquire traditional energy sources (such as peat, coal, oil, natural gas, nuclear fission, and wood). **UNPACKED STANDARDS continued-Lithosphere** **EEn.2.2.1** • Explain the need for and consequences of various types of land use such as urbanization, deforestation and agriculture. • Explain ways to mitigate detrimental human impacts on the lithosphere and maximize sustainable use of natural resources. • 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. **EEn.2.2.2** Compare the methods of obtaining energy resources: harvesting (peat and wood), mining (coal and uranium/plutonium), drilling (oil and natural gas) and the effect of these activities on the environment. **Note**: Link to EEn.2.8.1 and explore alternative energy technologies to get a more complete picture of possible sources of energy for human use.
6. Hydrology (NCFE- Multiple Choice= **EEn.2.3** 4% to 10% **EEn.2.4** 7% to 12%) **5-6 days**	**EEn.2.3 Explain the structure and processes within the hydrosphere.** **EEn.2.3.1** Explain how water is an energy agent (currents and heat transfer). EEn.2.3.2 Explain how ground Water and surface water interact. **UNPACKED STANDARDS-Hydrosphere** **EEn.2.3.1** • 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.2.3.2** • 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 Evaluate how humans use water.** **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.

5-6 days	**UNPACKED STANDARDS continued-Hydrosphere** **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, stormwater runoff, naturally and human induced occurrences of arsenic in groundwater). • Evaluate conservation measures to maximize quality and quantity of available freshwater resources.
7. Biosphere (NCFE-EEn.2.7 14%-19% EEn.2.8 9%-14%) **6-7 days**	**EEn.2.7 Explain how the lithosphere, hydrosphere, and atmosphere individually and collectively affect the biosphere. (ECOLOGY)** **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. **UNPACKED STANDARDS- Biosphere** **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.

8-9 days	**EEn.2.8 Evaluate human behaviors in terms of how likely they are to ensure the ability to live sustainably on Earth.** **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. **UNPACKED STANDARDS continued- Biosphere** **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.2.8.2** • 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.).
8 days	**NCFE Review & Testing**