

## EARTH/ENVIRONMENTAL SCIENCE REVIEW GUIDE – ANSWERS!!!

### Astronomy: EEn1.1

1. Explain the origin of Earth's motion based on the origin of the galaxy and its solar system.

***The Nebular Hypothesis (or Nebular Theory) states that our Solar System originated as a swirling cloud of gas and dust in space (a nebula). The swirling (a remnant motion of the Big Bang) is what caused matter to gather in the center, eventually becoming hot enough to begin the process of nuclear fusion and become the Sun. Through the process of accretion (particles gathering together due to gravity) the Earth and other planets formed; they remained in orbit around the Sun because of the initial swirling motion of the original nebula. Earth's rotation is also a remnant of this original motion.***

2. What is Earth's role in the hierarchy of organization within the universe.

***The Earth is part of the Solar System, which is part of an arm of the Milky Way Galaxy. The Milky Way is part of a cluster of galaxies called the Local Group. The Local Group is still just a small part of the vast Universe.***

3. Describe the planetary orbits, especially that of Earth.

***Planetary orbits, as described by Kepler, are elliptical. They revolve around two foci (plural of focus), the Sun being one. However, the orbit of Earth (and many other planets) is very close to circular because the foci are very close together.***

4. What are the relative motions of Earth in the solar system, the solar system in the galaxy, and the galaxy in the universe?

***The Earth is rotating on its axis (tilted at a 23.5 degree angle) while orbiting the Sun on an elliptical path. The Solar System is revolving around a centerpoint in the Milky Way Galaxy. The Milky Way is, along with all other galaxies, always expanding away from everything else due to the initial outward expansion of the Big Bang.***

5. Define the following:
  - a. ***Precession: The slow movement of the axis of a spinning body around another axis due to a torque (such as gravitational influence) acting to change the direction of the first axis.***
  - b. ***Nutation: A periodic oscillation of the earth's axis that causes the precession of the poles to follow a wavy rather than a circular path.***
  - c. ***Barycenter: The point between two objects where they balance each other; the center of mass where two or more celestial bodies orbit each other.***

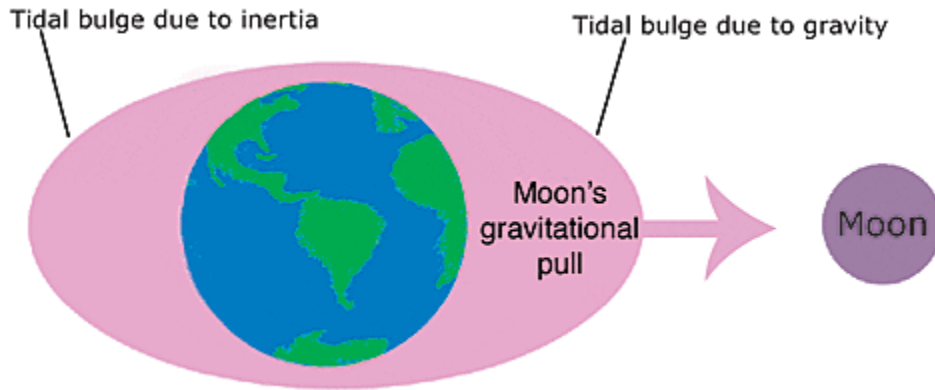
6. What is the position of the Sun within our solar system? Is it stationary?

***The Sun is the central point of our Solar System. Although it is often convenient to think of it as a stationary object, the Sun is moving within our galaxy and, like everything in the Universe, is always moving due to the expansion of the Universe.***

7. 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 Earth and moon.

***Rotation: This is what causes day and night. Revolution of the Earth around the Sun: Because of the tilt of the Earth on its axis, different parts of the Earth receive different amounts of solar radiation through the year. This causes the seasons. E.g. When the Northern Hemisphere is experiencing summer, the Earth is tilted "toward" the Sun on its axis. Tidal Impact: The Moon's gravity, because it is relatively close to Earth, has a strong influence on***

*the planet's oceans. The water of the oceans that is nearest the Moon is drawn into a bulge (also exhibited on the opposite side of the Earth) causing high tide. The sides experience low tide.*



8. Explain the difference between nuclear fusion and nuclear fission reactions. Which is done on the stars?

*Nuclear fusion occurs when enough energy (heat) is present to cause two relatively light atoms (like hydrogen) to join together (fuse) to form a heavier element (like helium). This releases a massive amount of energy. Nuclear Fission can be considered the opposite; A heavy element (like uranium) is split by the bombardment of neutrons into two lighter elements. Nuclear Fusion takes place in stars.*

9. Describe the shape of Earth.

*The Earth is an oblate spheroid; it is slightly fatter at the equator. This is because, as the Earth spins, more of its mass is concentrated at the equator due to the forces of the spinning.*

10. Identify the forms of energy (electromagnetic waves) produced by the sun and tell how some are filtered by the atmosphere (X-rays, cosmic rays, etc.).

*The Sun's energy reaches Earth in the form of electromagnetic waves such as ultraviolet (UV) and visible light (what we see). Some of these rays are filtered by various components of our atmosphere; for example, some UV light is filtered by the ozone layer. The magnetosphere also blocks some of the Sun's energy, including the charged particles that leave the Sun known as Solar Wind.*

11. How does energy flow from the sun to Earth through space?

*Energy from the Sun flows through space (a vacuum) in the form of electromagnetic radiation (waves).*

12. Explain how the tilt of Earth's axis results in seasons.

*The tilt of Earth's axis causes seasons by moderating the amount of sunlight that hits the northern and southern hemispheres at different times of the year. For example, in northern hemisphere summer, the northern hemisphere is tilted toward the Sun.*

13. Explain the differential heating of Earth's surface (land vs water & different latitudes)

*Higher latitudes (the poles) receive much less solar radiation than the equator, resulting in lower average temperatures. Water has a high specific heat capacity, and will therefore heat up and cool down at much slower rates. This causes water to be warmer in the winter and cooler in the summer, moderating coastal areas. Land, on the other hand, heats up and cools down much more quickly. This will cause temperatures to be much more variable.*

14. What process transforms solar energy into chemical energy?

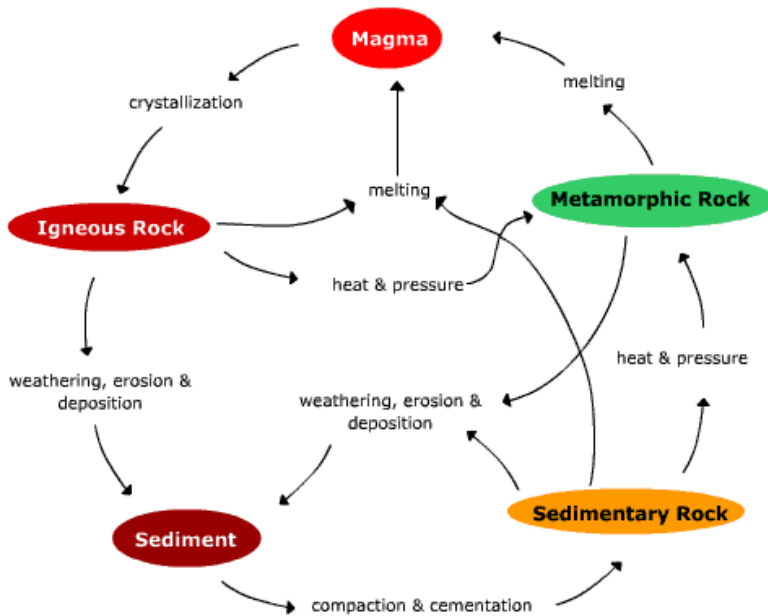
*Photosynthesis transforms solar energy into chemical energy that can then be used by plants (and herbivores) as a food source.*

15. Explain how Earth's magnetic field protects the planet from the harmful effects of radiation.

**Earth's magnetic field protects the planet from the harmful effects of radiation by blocking much of the solar wind that streams from the Sun. Without this protection, the Solar Wind (charged particles, or ions) would cause damage to living tissue.**

### The Lithosphere: EEn2.1

1. Draw the rock cycle in enough detail to relate the cycling of materials – formation & destruction of the three major rock types to the forces responsible: physical & chemical weathering, heat & pressure, deposition, & foliation. The forms of energy that drive the rock cycle include heat & mechanical energy.



2. Define the following mechanisms (mantle convection, ridge push, gravity pull) and explain how each drives movement of the lithospheric plates.

**The driving force of the movement of lithospheric plates is convection of mantle material. As plates move, they will eventually subduct beneath another plate. The weight of the plate pulls the rest of the plate down with it, which is called gravity pull. The opposite, ridge push, happens when the upwelling of new lithosphere pushes the plate along at a mid-ocean ridge.**

3. Infer the relationship between the type of plate boundary and the locations of various features such as ocean trenches, mountains ranges and mid-ocean ridges. (Relate to the development of the theory of plate tectonics & geologic time) **For each boundary (transform, divergent, and EACH of 3 variations of convergent):**

**a. Define the action at each plate**

**Convergent: Plates are moving toward each other**

**Divergent: Plates are moving away from each other.**

**Transform: Plates are moving past each other.**

**b. Give the features formed**

**Convergent: Folded mountains or ocean trenches.**

**Divergent: Mid-ocean ridge or continental rift valley**

**Transform: No defining features; many earthquakes**

c. Name a specific location on Earth where this can be seen

**Convergent: Himalaya Mountains**

**Divergent: Mid-Atlantic Ridge**

**Transform: San Andreas Fault**

4. Compare magma & 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.

**Magma is molten rock beneath the crust; lava is molten rock that has moved to be above the crust. Other answers below.**

- a. Which plate boundaries produce volcanoes?

**All three types of plate boundaries can produce volcanoes. However, volcanoes are most common at convergent and divergent boundaries.**

- b. Where do volcanoes produce new crust?

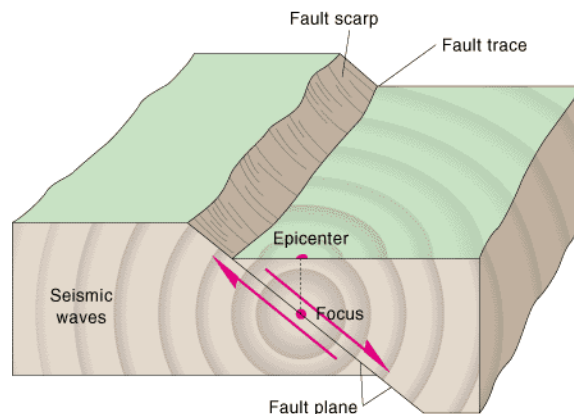
**Volcanoes form new crust at divergent plate boundaries.**

- c. Define lahar and tell which type of volcano create lahar.

**A lahar is a mudflow caused by volcanic activity. Lava is often mixed in with the mud, causing very hazardous conditions. They are generally formed at composite or cinder cone volcanoes.**

5. Describe the anatomy of an earthquake. Locate earthquakes – epicenter & 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.

- a. Create a sketch of an EQ that shows epicenter, focus & EQ waves



- b. In terms of plate tectonics, where do most EQs occur?

**Most earthquakes occur at plate boundaries; Transform plate boundaries are the most common.**

6. Summarize the major events in the geologic history of NC 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.

**The Appalachian Mountains formed due to plates converging at the end of the Paleozoic Era. The shorelines, barrier islands, and river basins all formed about 10,000 years ago as glaciers retreated and sea level rose. The fall zone formed at the same time as the Appalachian Mountains because of various tectonic activities.**

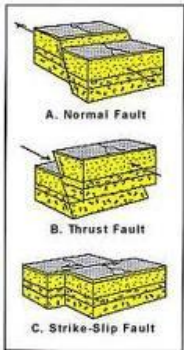
7. Explain how processes change sea-level over time – long & short term. Infer the effects on landforms such as shorelines and barrier islands.

**Global warming processes can cause sea-level to rise over time. Ice caps and ice sheets can melt, causing large amounts of fresh water to be added to the oceans. This has an impact on shorelines and barrier islands because these areas will become flooded at more water is added to the oceans. In a short-term sense, sea level can rise during storms as the storm surge approaches the shoreline.**

8. 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)

- a. Create a sketch for each type fault. Label the hanging wall & foot wall for each.

Volcanoes & earthquakes occur most often at plate boundaries. Earthquakes as a result of movement along a fault and there are three major types of faults.



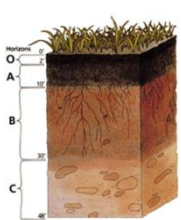
- I. Strike-slip fault – movement results from a shear stress (most often at a transform boundary) where two blocks of rock move horizontally against each other – most often in opposite directions, but can also be in the same direction at different rates

- II. Reverse fault – movement results from a compression stress (most often at a convergent boundary) where two blocks of rock are pushed together and the hanging wall rises above the foot wall. There is a special type of reverse fault called a thrust fault, where the hanging wall moves up and over the foot wall. This special circumstance requires a shallow angle and strong force so that one piece of land moves over the other.

- III. Normal fault – movement results from a tension stress (most often at a divergent boundary) where two blocks of rock are pulled apart and the hanging wall drops below the foot wall.

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

- a. How is soil created from rocks? (think of the horizons within the soil profile)



A solid block of rock is slowly weathered over time (both physical & chemical weathering) until eventually small bits of weathered rock appear above the solid mass. This is considered the C horizon (partially weathered rock). Over time this partially weathered rock continues to break down into smaller pieces of rock and it is combined with decayed plant matter as the very early plants die and decompose to form the beginning of nutrient-rich matter. This creates the subsoil or B horizon. As this material continues to break down and more & more decaying plant matter accumulates, the final layer in the soil profile (the A horizon or topsoil) is formed. This completes the soil profile. Dead organic material accumulates on top (O horizon).

9. Explain differences in chemical and physical weathering . List and describe the factors that affect the RATE of weathering.

Chemical weathering is the breakdown of rock due to chemical processes (hydrolysis, oxidation, carbonation, plant acids, acid precipitation). Physical weathering is the breakdown of rock due to physical/mechanical processes (abrasion, ice wedging, exfoliation, & organic activity – animals or plant roots)

The rate at which weathering occurs depends on four major factors: rock composition, amount of exposure, climate, and topography.

10. Name the four agents of erosion and describe the landforms that can be caused as a result of each.

Wind, Water, Gravity & Glaciers are the 4 agents of erosion.

- I. Wind erosion can create dunes and the large sandstone structures of the SW United States.
- II. Water erosion can create gullies, meanders in river systems, canyons, etc
- III. Gravity can change the mountain landscapes through landslides.
- IV. Glaciers can create lakes and “grooves” along the path of forward motion or the path of retreat.

11. 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.

The best methods would be to avoid living in areas prone to landslides, earthquakes, tsunamis, sinkholes or flooding. If you choose to live in an area at risk for these hazards, then you should be aware of times when the risk is the greatest. Avoid living in regions where groundwater contamination is more likely – such as near a chemical waste site, areas with old septic systems, or areas prone to saltwater intrusion.

## Human Influences on the Lithosphere: EEn.2.2

- 1. Explain the need for and consequences of various types of land use – such as urbanization, deforestation and agriculture.**

With our growing human population, urban areas are needed for housing, employment, & living space and lands must be set aside for agriculture to feed everyone. Lands must be cleared (deforestation) for both of these to occur. Cutting down trees to create both urban areas and agricultural lands decreases biodiversity in the area, as well as destroying a carbon-absorbing part of the ecosystem. Downsides to urbanization include a concentration of waste in one area (solid waste, water contamination, and air quality contamination), and a need to continuously import goods to the urban area. Downsides to increased agriculture include a contamination risk to the surrounding area from excess fertilizers/pesticides needed to grow an ever-increasing amount of food. There is also a higher risk of erosion associated with agricultural lands.

- 2. Explain ways to *mitigate* (means to minimize the effect) detrimental human impacts on the lithosphere and maximize sustainable use of natural resources.**

Regulations are in place (but need to be more stringent) that force the mining industry to clean up their area. Wetland degradation has diminished due to mitigation rules that mandate preserving one wetland area before another area can be developed. Mitigation standards are going to need to be a large part of our future as we are to use our remaining natural resources at a more sustainable rate.

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

As humans continue to develop our shorelines, there is more and more erosion occurring. In an effort to protect their investments, humans are very interested in doing whatever is possible to delay or prevent erosion in this area. These methods include the creation of jetties, breakwaters, and groins. These will often prevent erosion in one location, but can create increased erosion in adjacent areas.

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

The biggest human threat to mountains is from mining. We are destroying the landscape to harvest coal in a process known as mountain-top mining, where the top of the mountain is completely blown off.

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

Harvesting peat & wood: peat is harvested from moss-rich bogs. The peat is not able to replenish itself as fast as it is being harvested, making it a nonrenewable resource. Wood is harvested by cutting down forests. While it is possible to log sustainably, most of the logging across the globe is done in a method known as clearcutting in which all trees in an area are cut down.

Mining for coal & uranium is extremely damaging to the surrounding environment. Habitats are damaged as roads are created and excavation begins. The extra traffic & machinery produce increased amounts of pollutants that enter our atmosphere, leading to acidic precipitation. The waste produced from mining operations creates hazardous runoff that enters our surface water systems and can also contaminate rainwater as it makes its way to the groundwater below.

## The 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.**

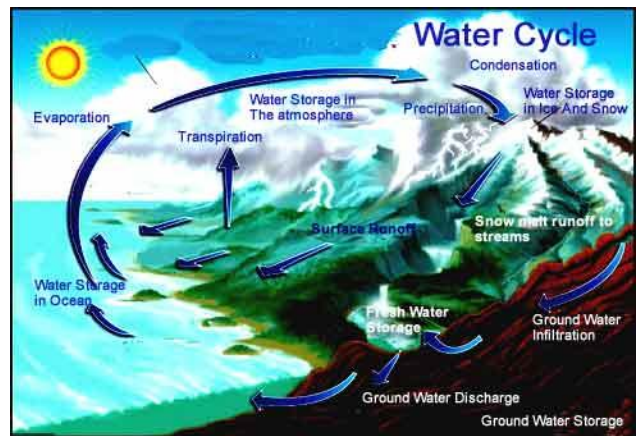
Cold water is more dense than warm water, therefore the colder water at the bottom of the ocean tends to remain at the bottom due to density differences. The area where temperature changes quickly from warm to cold water is known as the thermocline. The analogous area between the high & low densities is known as the pycnocline.

Ocean currents are constantly moving warm water away from the equatorial region and toward the poles. Similarly, currents move cold water from the poles toward the equator.

- 2. Explain how the coastal climates are moderated by water in comparison to inland climates.**

Water temperature does not change as rapidly as the temperature over land. As a result, the climates of coastal areas do not have the extreme highs and lows that occur further inland.

3. Create a diagram of the hydrologic cycle to explain the connection between groundwater and surface water, detailing how groundwater moves through the lithosphere. (emphasize the processes of evaporation, runoff and infiltration in the conceptual diagram of the water cycle)



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

- a. What is the difference between a river basin and a watershed?

Both river basins and watersheds are areas of land that drain to a particular water body, such as a lake, stream, river or estuary. In a river basin, all the water drains to a large river. The term watershed is used to describe a smaller area of land that drains to a smaller stream, lake or wetland. There are many smaller watersheds within a river basin.

- b. How could a river basin also be related to an aquifer?

The water contained in the river basin can also find its way down through the soil and become part of the groundwater. The area can also be referred to as a recharge area for the aquifer.

- c. Provide a general description of the river basins in NC.

There are 17 separate river basins within the state of NC.

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

If groundwater levels are too high, the process of infiltration is hindered and water will pond at the surface rather than soak into the earth.

#### Human Influences on the Hydrosphere: EEn2.4

1. Describe the use by humans of EACH of the following AND give the benefits/consequences for each (ex. wells, aquifer depletion, dams & dam removal, agriculture, recreation)

Wells benefit humans by providing access to drinking water. However, humans are removing water faster than it is being replenished, contributing to a state of drought.

Aquifer depletion describes a current state of many global aquifers where humans are removing water from wells faster than nature can replenish it.

Dams can be used to prevent flooding, as well as generate electricity. However, the process of building dams destroys habitats and can disrupt fish migration. However, once the dams are well established (and nature has recovered) the removal of dams can once again disrupt the natural areas. In spite of this, if water flow downstream is being severely disrupted a strong case can be made for removing the dam and restoring the flow of water.

Agricultural uses are one of the main causes of aquifer depletion.

Recreational uses put our surface water at risk. Oil and gas leaking from boats degrade the quality of rivers & lakes.

2. Explain consequences of aquifer depletion (be sure to also include subsidence and salt-water intrusion on the coast).

In addition to running out of drinking water, other consequences of aquifer depletion include subsidence (pore spaces previously filled with water are now filled with air and can collapse which causes the land above to subside or sink) and salt-water intrusion (as the freshwater is removed from aquifers faster than it can be naturally refilled, IF this area is near an ocean, the salt-water can sometimes backfill into the aquifer in a process known as salt-water intrusion).

**3. Evaluate the effects of population growth on drinking water resources. What are the implications for the future?**

As the human population continues to grow at alarming rates, we will continue to drain our aquifers at a rate faster than they are able to recharge. Humans are also contaminating both the surface waters and groundwater, so that the water that remains is increasingly unfit for human consumption.

**4. Describe how pollutants might flow through a watershed and affect inhabitants that share the same watershed.**

There are many sources of pollution that affect our water systems. These contaminants can be flushed through a river systems and moved on downstream, but will remain longer in ponds and lakes. Any organisms that come in contact with the contaminated water are harmed by it. The level to which they are harmed depends on the type of contaminant.

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

**a. How could each occur?**

Water can be contaminated by chemical spills which can get into surface waters or seep into the ground contaminating the aquifer. If the contaminant makes its way into coastal areas, then estuaries are also at risk. Saltwater intrusion can occur when too much water is removed from wells and the groundwater is not able to recover. Saltwater from nearby oceans will make its way into the aquifer.

**b. Who is most likely to be affected by each?**

Anyone living near rivers, lakes and streams can be affected by surface water pollution. Anyone using well water is affected by groundwater contamination. Only those in coastal areas are affected by saltwater intrusion.

**c. List possible prevention methods.**

Legislation that regulates wastewater from businesses can help prevent contamination of both surface water systems that can ultimately flow downstream toward estuaries or make its way into the groundwater. Saltwater intrusion can best be prevented by monitoring the amount of water removed from wells in an area, as well as conducting periodic tests to determine the salinity levels of groundwater.

**6. Analyze how drinking water and wastewater treatment systems impact quantity and quality of potable (drinking) water.**

**a. What is the difference between these two operations?**

*Wastewater treatment systems take wastewater from homes & businesses and moves that water through a series of treatment steps so that it can be released back into the surface water systems.*

*Drinking water treatment plants remove water from surface water systems and runs it through a series of treatment steps so that it is fit for human consumption.*

**7. Evaluate water quality of NC streams (chemical, physical properties, biotic index). How could this be done?**

*Water quality is evaluated based on several criteria. It can be tested for its level of contaminants/chemicals (such as nitrates, phosphates, pH, or dissolved oxygen), the physical properties (such as temperature, clarity/turbidity, level of flow, or color), and the biotic index (number of organisms living within the aquatic system).*

**8. Give several examples of non-point source pollution and describe the effects on water quality for each.**

*Point source pollution is pollution that can be traced back to one specific source. Non-point solution is pollution that cannot be traced back to a single source. This type of pollution could come from many sources such as acidic precipitation, runoff of excess pesticides & fertilizers from agricultural fields, oil & gasoline contamination as runoff passes over roads and parking lots, or more recently a contamination of pharmaceutical waste in our water systems. Each of these would have different effects on water quality. Acidic precipitation lowers the pH of the waterways, which can degrade water quality and harm the organisms that live in the water system. Excess pesticides & fertilizers can cause an overgrowth of algae which ultimately leads to fish kills due to low dissolved oxygen levels. Contaminations due to petroleum*



*products causes residue to float on top of the water and in extreme cases can coat the organisms that live there. We are just beginning to see the effects of pharmaceutical contamination in our water systems. This is first seen in deformities in fish and amphibians.*

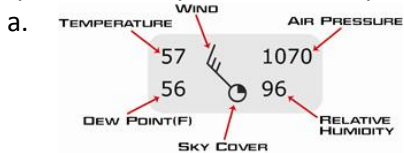
9. List and describe several conservation measures to maximize quality and quantity of available freshwater resources.

*In order to avoid the increasing threat of a water shortage, we need to conserve & protect the water resources that currently exist. Regulations currently exist that protect our water systems and limit the amount of contaminants that can be discharged. These need to be followed and strengthened to ensure the future quality of our water resources. Conservation methods include using low-flow devices in homes & businesses, NOT washing cars in driveways or fund-raising carwashes, taking shorter showers, turning off water while brushing teeth or shaving, watering yards as little as possible and only at night.*

## The Atmosphere: EEn2.5

- Summarize information about the layers of the atmosphere, temperature, chemical composition & interaction with radiant energy.
  - Name each layer and give the corresponding trend in temperature.  
**Troposphere – temperature decreases as you rise through this layer; stratosphere – temperature increases as you rise through this layer; mesosphere – temperature decreases as you rise through this layer; thermosphere – temperature increases as you rise through this layer.**
  - List two important facts about each layer.  
**Troposphere – this is where all our weather occurs/ozone here is bad; stratosphere – contains the ozone layer/commercial jets fly in this layer to avoid turbulence; mesosphere – coldest layer of the atmosphere/not much is known about this layer because weather balloons cannot fly this high in the atmosphere; thermosphere – the space shuttle and international space station orbit the earth in this layer/the auroras occur in this layer.**
- Describe the main types of air masses and explain what makes them move.  
 The four major types of air masses are: **maritime polar (cold/moist), maritime tropical (hot/moist), continental polar (cold/dry) and continental tropical (hot/dry). Pressure differences in the atmosphere and jet streams cause air masses to move.**
- Explain how interactions of air masses form frontal boundaries (types), clouds (types) and affect wind patterns.
  - List and explain each of the four types of fronts. **Warm: Warm air moves into an area formerly covered by cooler air. Cold: Cold, dense air moves into a region occupied by warmer air. Stationary: The flow of air on either side of a front is neither toward the cold or warm air mass, which results in neither air mass moving. Occluded: An active cold front overtakes a warm front and forces it upward.**
  - List and explain the major cloud types: **Cirrus: Wispy fibers, feathery appearance. Cumulus: Rounded single masses, flat bases with rising domes or towers. Stratus: Sheets or layers that cover most of the sky.**
- What are the precautions needed for severe cyclonic storms in order to preserve life and property? **Board up windows, secure outdoor furniture, turn off gas, stock up on batteries, water and non perishable food, etc.**
- Explain factors that affect air density and understand their influence on winds, air masses, fronts, and storm systems. Increases or decreases in air pressure can impact the density of air. **The two major reasons for changes in air pressure are altitude and weather systems. Of these, altitude is the most significant.**

- Interpret and analyze weather maps and relative humidity charts.



b. dry bulb = 20°C  
 wet bulb = 24°C  
 relative humidity=66%

Relative Humidity (%)		Difference Between Wet-Bulb and Dry-Bulb Temperatures (°C)															
Dry-Bulb Temperature (°C)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
-20	100	28															
-18	100	49															
-16	100	48															
-14	100	86	11														
-12	100	61	23														
-10	100	66	33														
-8	100	71	41	13													
-6	100	73	48	20													
-4	100	77	54	32	11												
-2	100	79	58	37	20	1											
0	100	81	63	45	28	11											
2	100	83	67	51	36	20	6										
4	100	85	70	58	42	27	14										
6	100	86	72	59	46	35	22	10									
8	100	87	74	60	51	39	28	17	6								
10	100	88	76	65	54	43	33	24	13	4							
12	100	88	78	67	57	46	38	28	19	10	2						
14	100	89	79	69	60	50	41	33	25	16	8	1					
16	100	90	80	71	62	54	45	37	29	21	14	7	1				
18	100	91	81	72	64	56	48	40	33	26	19	12	6				
20	100	91	82	74	66	58	51	44	36	30	23	17	11	5			
22	100	92	83	75	68	60	53	46	40	33	27	21	16	10	4		
24	100	92	84	76	69	62	55	49	42	36	30	26	20	14	9	4	
26	100	92	85	77	70	64	57	51	45	39	34	28	23	18	13	7	
28	100	93	86	78	71	65	59	53	47	42	38	31	28	21	17	12	
30	100	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16	

- Define each of the following and specify the role water vapor plays on each
- How is acid rain formed? **Burning of fossil fuels releases sulfates and nitrates into the air. Sulfates and nitrates mix with water vapor to form sulfuric acid and nitric acid.**
- List and describe several human activities that can alter the pH of rain. **Driving a car (release of exhaust/burning gasoline), burning coal, mowing your grass (burning gasoline from the lawn mower), industrial plants burning fossil fuels to make various products, etc.**
- How do each of the following human activities impact the quality of atmospheric composition? (aerosols - **Aerosol particles are emitted from Earth's surface both naturally (e.g., dust, sea-salt, biogenic emissions), and as a result of human activities. They also are created and modified by chemical processes in the atmosphere and they are constantly cycled among the Earth's oceans, atmosphere, and biosphere. They have an effect on the energy balance of the atmosphere either by directly scattering and absorbing radiation, by serving as condensation nuclei during cloud formation, and by influencing precipitation. Their presence also affects photosynthesis and agricultural production. These same particles that affect climate also impact the quality of the air that we breathe and the health of all living organisms. Chlorofluorocarbons - From aerosol cans Leak**

*into the atmosphere and causes holes in the ozone layer. Burning industrial byproducts – can contribute to acid rain, cloud condensation nuclei, global warming and climate change, producing holes in the ozone layer, etc. Overfarming – contributes to the increase of carbon in the atmosphere which directly influences global warming.)*

11. Give examples of methods to mitigate (minimize the effects) human impacts on the atmosphere. *Organic farming, use of alternative energy sources (solar panels, hydroelectric power, etc.), limiting development, decreasing the burning of fossil fuels, etc.*

### Global Climate Change: EEn2.6

1. Explain how major climate categories are determined. (Koppen climate classification system) What climate is NC?  
*Major climate categories are classified by average temperature and precipitation amounts. The climate in NC is temperate deciduous forest.*
2. Explain the difference between weather and climate.  
*Weather is constantly changing and it refers to the atmosphere at any given time and place. Climate is based on observations of weather that have been collected over many years.*
3. Explain how each of these natural processes can affect global climate (particularly El Nino - *Affect the eastern tropical Pacific Ocean. Occur every 3-7 years. Countercurrents that replace normally cold offshore waters with warm equatorial waters. Often results in cooler than normal temperatures for the southern US, La Nina - Affect the same area. Used to be considered merely the period between el Nino events, but is now considered its own phenomenon. Surface temperatures are cooler than normal. Results in cooler than normal Pacific Northwest temperatures and warmer than normal temperatures for most of the rest of the southern portions of the United States, volcanic eruptions – Emit ash into the atmosphere which reflects much of the sun's radiation back into space. This can cause much cooler temperatures, sunspots – The sun spots cycle has been suggested to correlate with increases in global temperature as sun spots are often followed by hotter and brighter patches of the sun called faculae, shifts in Earth's orbit - For Earth, the tilt of the axis varies between 22.1 and 24.5 degrees. When the tilt is at a higher degree, the seasons can likewise be more severe. and carbon dioxide fluctuations – increases in carbon dioxide emissions have a direct correlation to increases in global temperatures).*
4. Explain the concept of the greenhouse effect. *The greenhouse effect is defined as when the Earth's atmosphere becomes thick with gases and substances which trap the sun's radiation, making the Earth warmer. Name at least 4 specific greenhouse gases water vapor, carbon dioxide, methane ozone and nitrous oxide and tell why CO<sub>2</sub> is most often the focus of public discussion Burning fossil fuels releases carbon dioxide into the atmosphere and accounts for rising carbon dioxide concentrations.*
5. How does deforestation contribute to global climate change? *Loss of oxygen producers and carbon dioxide eliminators*
6. AND How does the burning of fossil fuels (industrialization) contribute to global climate change? *The main human activity that emits CO<sub>2</sub> is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation. Many industrial processes emit CO<sub>2</sub> through fossil fuel combustion. Several processes also produce CO<sub>2</sub> emissions through chemical reactions that do not involve combustion, for example, the production and consumption of mineral products such as cement, the production of metals such as iron and steel, and the production of chemicals. Fossil fuel combustion from various industrial processes accounted for about 14% of total U.S. CO<sub>2</sub> emissions and 12% of total U.S.greenhouse gas emissions in 2012.*
7. How does large-scale development contribute to regional changes in climate? (for ex. heat islands in large cities) *An urban heat island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in cities (urban areas) compared to their (nonurbanized) surroundings. The heat island is an example of unintentional climate modification when urbanization changes the characteristics of the Earth's surface and atmosphere. This heat flux can be caused by lowered vegetation cover, increased impervious cover and complex surfaces, and possibly from heat trapping by elevated levels of locally produced CO<sub>2</sub>.*
8. What actions that can be taken by humans on a local level, as well as on a larger scale, to mitigate global climate change? *Examples of mitigation include switching to low-carbon energy sources, such as renewable and nuclear energy, and expanding forests and other "sinks" to remove greater amounts*

*of carbon dioxide from the atmosphere. Energy efficiency may also play a role for example, through improving the insulation of buildings., Another approach to climate change mitigation is climate engineering.*

9. How do changes in global temperatures affect the biosphere? Address EACH of the following: agriculture - *Warmer temperatures may make many crops grow more quickly, but warmer temperatures could also reduce yields. Crops tend to grow faster in warmer conditions. However, for some crops (such as grains), faster growth reduces the amount of time that seeds have to grow and mature. This can reduce yields (i.e., the amount of crop produced from a given amount of land),, species diversity - global warming can cause decreases in species diversity, ecosystem balance - Unchecked global warming could affect most terrestrial ecoregions. Increasing global temperature means that ecosystems will change; some species are being forced out of their habitats (possibly to extinction) because of changing conditions, while others are flourishing. Secondary effects of global warming, such as lessened snow cover, rising sea levels, and weather changes, may influence not only human activities but also the ecosystem.*
10. How do changes in atmospheric composition contribute to ocean acidification? *Increasing atmospheric CO<sub>2</sub> concentrations lower oceanic pH.* Analyze its effect on ocean life and its connection to global climate change – *Many aquatic organisms are very sensitive to changes in ph – this can cause a reduction in biodiversity. Additionally, the decrease in ocean water ph due to increases in atmospheric CO<sub>2</sub> is linked to global climate change in that the increase in CO<sub>2</sub> emissions is directly responsible for increases in global temperature.*
11. How do changes in global temperature impact sea level? *More solar radiation being absorbed will accelerate warming, thus increasing the melting back of snow and ice on land. In addition, ongoing break-up of the floating ice shelves will allow a faster flow of ice on land into the oceans, thereby providing an additional contribution to sea level rise.*
12. What Earth processes (other than global temperature) can affect sea level? *isostatic (generally tectonic) causes: these mainly have regional effects. The ice sheets formed during the ice ages are one example. Due to their great weight, they cause the Earth's crust in certain regions to sink, so sea level rises relative to the land. If the ice melts, the land mass rises once more.*

#### **How the Biosphere is Affected by the Lithosphere, Hydrosphere, & Atmosphere: EEn2.7**

1. List several biotic and abiotic factors that determine biome classification (**temperature - abiotic, rainfall - abiotic, altitude- abiotic, type of plant - biotic, latitude - abiotic, type of animals - biotic**). Designate each as biotic/abiotic.
2. List several biotic/abiotic factors that impact biodiversity AND describe the effect of each. ***Biotic factors – living things, such as plants, animals, fungi and bacteria. Abiotic factors: nonliving things such as moisture, temperature, wind, sunlight, and soil. The balance of these factors determines which living things can survive in a particular environment.***
3. Describe the major landforms and soil quality of each major biome. ***Tropical forests have high mountains, rapid decomposition and thin soil. Deserts have dry sandy soil and can contain mountain regions or planes. Sand dunes are present in these biomes. Temperate forests have thicker soil profiles and sustain many species of trees. The tundra is characterized by permafrost. Grasslands are typically characterized by prairies or plains with dry soil. Rolling hills can also be found in grasslands. The taiga biome has thin, poor quality dry soil. Coniferous and needle leaf trees do well in this biome due to their tightly constructed leaves.***
4. Define the biosphere. ***the regions of the surface, atmosphere, and hydrosphere of the earth (or analogous parts of other planets) occupied by living organisms.***
5. Explain biodiversity in a way that discusses genetic variation within populations, as well as variation of populations. ***Biodiversity is the degree of variation of life. This can refer to genetic variation, species variation, or ecosystem variation within an area, biome, or planet. The level of biodiversity, refers to the total number of genetic characteristics in the genetic makeup of a species. It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary.***
6. What is the relationship between environmental conditions and the plants/animals that live within the various biomes? ***Biomes are characterized by the flora and fauna that live within them as well as the major climate***

*trends. Flora and fauna within each biome have adapted specific adaptations to survive and reproduce successfully in each distinctive biome.*

7. Explain the global impact of biodiversity loss. *People depend on biodiversity in their daily lives, in ways that are not always apparent or appreciated. Human health ultimately depends upon ecosystem products and services (such as availability of fresh water, food and fuel sources) which are requisite for good human health and productive livelihoods. Biodiversity loss can have significant direct human health impacts if ecosystem services are no longer adequate to meet social needs. Indirectly, changes in ecosystem services affect livelihoods, income, local migration and, on occasion, may even cause political conflict.*
8. Explain the effects of human population growth – *imposes threats to non-renewable resources, CO<sub>2</sub> production, global warming, etc., habitat alteration – deforestation, acid rain production, use of herbicides/pesticides, etc., introduction of invasive species – increased cases of disease carrying animals, over-competition for food between native and introduced species, etc., pollution – global climate change, increased amounts of acid rain, decreased landfill space, destruction of underground aquifers, depletion of ground water sources, plastic soup, destruction of natural habitats, etc., and overharvesting on various plant/animal species in NC – decrease in species variation, destruction of soil, decrease in biodiversity, etc.*
9. Explain effect of invasive nonnative species (plant/animal) on a NC ecosystem. *Invasive alien species are plants, animals, or other organisms that are introduced to a given area outside their original range and cause harm in their new home. Because they have no natural enemies to limit their reproduction, they usually spread rampantly. Invasive alien species are recognized as one of the leading threats to biodiversity and impose enormous costs to agriculture, forestry, fisheries, and other human enterprises, as well as to human health.*  
List and describe several ways to mitigate (minimize the effect) human impact on the biosphere. *Decrease rates of deforestation (habitat destruction), acid rain production (through burning of fossil fuels and carbon dioxide production/release, decrease use of fossil fuels (rely more heavily on renewable resources, etc. Protect wetland environments, native species and natural habitats.*

### Can Humans Live Sustainably on Earth? EEn2.8

1. For EACH alternate energy source (solar, wind, biofuels, nuclear fission, fuel cells, wave power, geothermal) describe the benefits, costs and environmental impact.

*Renewable energy — wind (inexpensive to construct but harmful to some birds, noisy but can store lots of energy in short period of time – constraints with available elevated land to harness wind),*

*solar (expensive and difficult to store, , geothermal, hydroelectric, and biomass — provides substantial benefits for our climate, our health, and our economy:*

- *Little to No Global Warming Emissions*
- *Improved Public Health and Environmental Quality*
- *A Vast and Inexhaustible Energy Supply*
- *Jobs and Other Economic Benefits*
- *Stable Energy Prices*
- *A More Reliable and Resilient Energy System*

#### ***A Vast and Inexhaustible Energy Supply***

*Throughout the United States, strong winds, sunny skies, plant residues, heat from the earth, and fast-moving water can each provide a vast and constantly replenished energy resource supply. These diverse sources of renewable energy have the technical potential to provide all the electricity the nation needs many times over.*

2. Which of the above sources of alternative energy may work best in different parts of the state AND why?
  - *Wind and sun would work best along the coast and in the Piedmont regions because the land is flat and the coast has winds coming off the ocean with force. The Piedmont has higher and flatter plateau regions good for collecting wind and both are good for capturing the sun because of NC's latitude of 35° which allows for a maximum amount of sunlight throughout the year. Hydroelectric would be best in the mountains because of the streams and rivers and the steep slope allowing water to move fast – there may be locations on mountain tops that are good for harvesting wind!*

3. Describe sustainable methods of agriculture/aquaculture. How do these compare with traditional farming methods?
  - *Sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare.*
  - *The primary benefits of sustainable agriculture are: Environmental Preservation Sustainable farms produce crops and raise animals without relying on toxic chemical pesticides, synthetic fertilizers, genetically modified seeds unlike traditional agriculture practices which may degrade soil, water, or other natural resources. By growing a variety of plants and using techniques such as crop rotation, conservation tillage, and pasture-based livestock, sustainable farms protect biodiversity and foster the development and maintenance of healthy ecosystems.*
4. Define carrying capacity. Give an example of this is an animal species. How does this term relate to humans?

***Carrying capacity is the number of people, other living organisms, or crops that a region can support without environmental degradation. Living within the limits of an ecosystem depends on three factors:***

- *the amount of resources available in the ecosystem,*
- *the size of the population, and*
- *the amount of resources each individual is consuming.*

***An example of carrying capacity***

***The barrel represents the marsh habitat - the amount of food, water, and cover for a fixed number of muskrats. The water in the barrel is the number of muskrats the habitat can support. The pipe pouring water into the barrel represents the new muskrats that are born in the marsh or wander in from other places. The water spilling out is the number of muskrats that die each year due to starvation, predators, disease, or other factors. The barrel can only hold so much water. That is, there is a limit to the number of muskrats that can survive here from year to year unless the habitat (the size of the barrel) is changed in some way. Every parcel of land has a different carrying capacity for every different kind of wildlife that lives there. A pristine cattail marsh would be a deep barrel for muskrats, while a dune forest would hold few, if any.***

***Knowledge of carrying capacity is essential for the conservation and management of wildlife populations. For example, the wolverine requires huge tracts of wilderness to survive - the equivalent of a swimming pool in this illustration. The muskrat, on the other hand, finds everything it needs in a small marsh - a rain barrel by comparison. Biologists use the concept of carrying capacity to determine how much habitat must be conserved to maintain healthy wildlife populations.***



5. What could be considered limiting factors to human population growth?
  - ***Space, clean water, food availability, clean air, resources***

6. How does a growing population affect North Carolina's natural resources?
  - ***Growth in population will cause more resources to be used and exploited to "feed" the masses and will therefore drive the need for more and newer ways to supply the things we need to our ever growing population. As we continue to grow and deplete our natural resources, we will have to find new and alternative forms of energy, food production and reduction in waste to ensure that all residents are afforded the quality of life they have come to expect from North Carolina.***
7. What is a personal ecological footprint? How could this term apply to a larger scale (for a country)
  - ***Ecological footprint is a measure of how much land and water is needed to support man's need for resources. It can be applied to countries by expanding the needs of the country to the amount of available space and resources in that country. It would have to take into account the current available resources, water and land availability and the affect of population growth in that country.***
8. How do YOUR personal choices impact the availability of natural resources and environmental quality?
  - ***Your choices to waste water by letting it run while brushing your teeth, flushing excessively, over consumption of food, driving large gas guzzlers. Littering, and wasting with excessive garbage will all contribute to the overuse of natural resources and ultimately contribute to the decline of environmental quality.***
9. What is meant by each of the parts of "reduce, reuse, recycle"? What role do EACH of these play in sustainability?

***Reduce - means using fewer resources and is the most effective of the three R's. It is also the hardest because it requires letting go of some American notions, including: the bigger the better, new trumps old and convenience is next to godliness. Reduction assists sustainability because you don't use any more new resources and limit the use of consumption.***

***Reuse. Before you recycle or dispose of anything, consider whether it has life left in it. Reusing keeps new resources from being used for a while longer, and old resources from entering the waste stream. It's as important as it is unglamorous. Think about how you can do it more.***

***Recycle. Recycling is the "R" that has caught on the best and this is where towns and municipalities collect and separate things that can be re-made into a new form of that material. For example, paper, plastic, aluminum and glass cans and bottles can all be recycled and made into future products of the same material.***

- ***Sustainability means providing for the needs of the present without compromising the ability of the environment to provide for our future generations. Current consumption rates of our planet's resources are causing an increase in the widespread extinction of varied species. Ultimately the price is that our planet that cannot sustain human life. This means that the way we use our resources today can eventually cause our extinction. Recycling reduces the amount of new materials being extracted and manufactured which keeps ecosystems and environments in check.***