15-16 Environmental Earth Science Final Exam Review Guide (L1-L2)

*(these are not the only things you need to know, but they will certainly help)*

1. ***Experimental Design and Density***
	1. **Independent variable** is the one you change, and is graphed on the x axis.
	2. **Dependent variable** changes in response to changes in the independent variable, and is graphed on the y axis.
	3. **Control** is a test performed with exactly the same conditions (constants), except for the variable being tested, but the **constant**s are the items that do not change from test to test.
	4. Metric System uses factors of 10. Meter for length, Gram for mass, Liter for volume
	**Kilo    Hecta    Deka    meter     deci    centi    milli**
	If converting within the metric system all you have to do is move the decimal place over
	5. Matter is defined as anything with mass and volume; therefore it has **density**. The formula for density is **D=m/v**
	6. The same substance always has the same density.
2. ***Energy transfers and transformations***
	1. Energy is the ability to do work
	2. Energy cannot be created or destroyed, only changed from one form to another.
	3. Energy cannot be created or destroyed; however, energy can be converted from one form to another.
	4. Two forms of energy; **kinetic** which is energy of motion, and **potential** which is stored due to gravity, gravity, nuclear, electric, chemical, or elasticity.
	5. **Mechanical KE** is calculated in joules as KE= ½ MV2 where M=mass and V= speed. If you double the mass – you double the kinetic energy; double the speed and quadruple the energy.
	6. **Gravitational PE** is calculated in Joules as GPE=MGH M=mass G=acceleration of gravity, and H equals the height of an object above the ground.
	7. Total **energy** = kinetic energy + potential energy.
	8. Numerous types of Energy: **mechanical** (motion), **thermal** (molecule motion), **chemical** (within bonds), **electrical** (movement of electrons), **nuclear** (from splitting-**fission** or combining nucleus of atom-**fusion**), **sound** (movement of matter), and **electromagnetic** (radiation / light waves).
	9. Sound and light travel as waves. Sound needs matter to travel through - light does not.
	10. Energy enters the Earth system primarily as solar radiation, is captured by materials and photosynthetic processes, and eventually is transformed into heat.
	11. Energy can be transferred by **conduction** (molecule to molecule), **convection** (mass movement of a fluid (liquid or gas) due to differences in density), or **radiation** (waves which can move in a vacuum).
	12. Dark colors such as black are good **absorbers** and **radiators** of energy, whereas light colors such as silver are good **reflectors** of energy.
	13. Energy from the Sun is received as light energy. This energy is the source of the Earth’s energy, and it powers the water cycle, weather, and all living things through a series of **energy transformations**.
3. ***Electricity and Magnetism***
	1. Electricity is the flow of electrons.
	2. **Opposite** charges (+ and -) **attract**, while similar charges (- and -, + and +) repel.
	3. Static electricity is the buildup of electrons (negative charges). Electrons are discharged when they leave the site of the buildup (ex. Jump from your hand to the doorknob).
	4. Electrical energy can produce light, heat, motion and sound.
	5. Current electricity flows through a path (circuit). **Direct current** flows in only one direction. (Ex. Electrons flow from negative end of the battery, through circuit and back into positive end). **Alternating current** changes direction and is generated at a power station. (Ex. Outlets in your home).
	6. A simple circuit has at least 3 parts: a source of electrons (ex. Battery), wires, and a load (or something to use the electricity… ex. Light bulb).
	7. A **series circuit** connects all parts in a **single loop**. A break in the path stops the electron flow to the entire circuit… So, when one light bulb burns out they ALL stop working.
	8. A **parallel circuit** has more than one path for the electricity to flow, so if one device burns out then the rest can still operate. This type of circuit is found in your home.
	9. **Ohm’s law** states that **I=V/R. I = current** (flow of electrons through the wire; measured in amps). **V = voltage** energy available to move the electrons; measured in volts). **R = resistance** (force opposing the flow of electrons; measure in Ohms).
	10. Natural magnets include cobalt, iron and nickel.
	11. Moving a magnet inside a coil of wire will produce an electric current.
	12. Moving an electrical field through a wire wrapped around an iron nail can create a magnetic field.
4. ***Telescopes, Light, and Doppler Effect***
	1. All the energies of the **electromagnetic spectrum** travel at the same speed (**speed of light, C**) in waves, and can travel through the vacuum of space.
	2. We see the **visible light,** which is only a fraction of the electromagnetic spectrum, which includes radio waves, microwaves, infrared waves, visible light, ultraviolet light, x-rays, and gamma rays.
	3. As **wavelength** increases the **frequency** decreases, because **C = wavelength · frequency**.
	4. Radio waves are long wavelength, low frequency; while gamma rays are short wavelength, high frequency.
	5. Higher the frequency the warmer the object, because more frequency means more energy.
	6. A **spectroscope** is used to view visible light from space. It can tell us temperature, distance, and composition. There are 3 types of **visible light spectra**: **continuous, bright line (emission), dark line (absorption)**.
	7. The **red shift** of light is an indication that the star is moving away from us (wavelength increases). **Blue shift** of light indicates that star is moving towards us (wavelength decreases). This is known as the **Doppler Effect**.
	8. **Refracting telescopes** only use lenses, **reflecting telescopes** use at least one mirror in combination with a lens.
	9. Power of a telescope depends upon the radius of the objective mirror or lens. A=π r2
5. ***Moon’s Motion and Earth’s Motion***
	1. **Foucault's pendulum** and the coriolis effect prove the earth rotates
	2. The Earth has seasons because of the **Earth’s axial tilt**, earth orbits the sun, and earth’s axis always points towards the North Star (aka Polaris).
	3. **Summer solstice** is June 21st (when direct sunlight hits the Tropic of Cancer at noon); **Winter solstice** is December 21st (when direct sunlight hits the Tropic of Capricorn at noon).
	4. Earth is closest to the sun in January. (perihelion)
	5. Equator always has 12 hours of daylight.
	6. **Equinoxes:** March 21st and September 23rd (when direct sunlight hits the Equator at noon).
	7. The earth revolves around the Sun counterclockwise (365¼ days).
	8. The earth rotates west to east (24 hours), this is counterclockwise. Which makes sun rise in east and set in west.
	9. The lower the altitude of the sun, the longer shadows it casts. Shortest shadow is at noon, and on summer solstice in the Northern Hemisphere.
	10. Vertical rays (overhead sun) can only occur between 23-1/2oN (Tropic of Cancer) and 23-1/2oS (Tropic of Capricorn)
	11. Earth’s axis is tilted **23-1/2o** to the **ecliptic plane**.
	12. The period from one full moon to the next is 29.5 days (**lunar month**), but the time it takes for the moon to fully revolve around the Earth is 27.3 days (**sidereal month**).
	13. The moon has phases because of the angle at which we view its surface (Remember though: half is always lit by the Sun). OUR VIEW OF THE LIT SURFACE OF THE MOON.
	14. **Waxing** is the increase of the Moon’s lighted surface (right side); **waning** is the decrease of the lighted surface (left side).
	15. **Crescent** moons are less than ½ lighted; **Gibbous** are more than ½ lighted.
	16. Earth can only view the same side of the moon regardless of the phase because the moon rotates at exactly the same speed it revolves around the Earth. This is known as **synchronous rotation**.
	17. Full moon rises at sunset and sets at sunrise. The New moon rises at sunrise and sets at sunset (that is why we don’t see it). The moon rises 50 minutes later each day.
	18. Tides are caused by the gravitational pull of the moon and sun; with 2 high and 2 low tides occurring each 24 hour period.
	19. **Spring tides** only occur during new and full moons, **neap tides** occur at quarter moons.
	20. **Lunar eclipse** only occurs during full moon and is visible to more of the Earth than a solar eclipse. It is when the shadow of the Earth is on the Moon.
	21. **Solar eclipse** only occurs during New moon. It is when the shadow of the moon is on the earth.
6. ***Astronomy – The Planets***
	1. **Rotation**: turning on an axis
	2. **Revolution**: movement of one body around another other = orbit
	3. Some planets APPEAR to go backwards (**retrograde motion**) as the earth passes them in space. However, all planets orbit the sun counterclockwise.
	4. **Geocentric**: Earth centered (proposed by Ptolemy); **Heliocentric**: sun centered (proposed by Copernicus)
	5. Galileo was first to use a telescope to view the sky, and found evidence for the heliocentric model of the solar system – the phases of Venus and 4 moons of Jupiter
	6. The closer a planet is to the sun the higher its velocity (because of Kepler’s 2nd Law –influence of gravity).
	7. The farthest distance of a planet from the sun is the **aphelion**, closest is **perihelion**. *Remember “A” away.*
	8. According to Kepler’s First Law, all orbits of planets are **ellipses**, and the more “oval” the more **eccentric** the orbit (and the eccentricity is closer to 1). An ellipse has two foci (the Sun is at one of them).
	9. Kepler’s 2nd Law is the **Equal Areas Law**, and is used to determine planet **speed.**
	10. Kepler’s 3rd Law is used to determine a planet’s distance to the Sun or its period of revolution.
	11. Newton’s Law of Universal Gravitation states that the gravitation force between 2 objects is directly related to the mass and distance between the 2 objects.
	12. **Astronomical Unit** is the Earth’s average distance from the Sun, approximately 150 million kilometers.
	13. Our solar system contains 8+ planets, their satellites, comets and asteroids.
	14. Inner planets aka **Terrestrial Planets** have a rocky crust, denser mantle layer, very dense core, smaller in size, and fewer moons.
	15. Outer planets aka **Jovian or Gas Planets** are much larger, gaseous, much less dense, colder, and have rings and more moons.
	16. **Comets** have highly eccentric orbits, are composed of ice and rock with tails that point away from the Sun due to solar wind. They originate in the **Oort Cloud**.
	17. **Asteroids** are rock/metal that mostly inhabit the space between the Inner and Outer Planets (**Asteroid Belt**).
	18. **Meteors** occur when **meteoroids** enter the Earth’s atmosphere, and **meteorites** occur only when they strike the Earth’s surface.
	19. There are many minor planets found in the area known as the **Kuiper Belt**. Pluto was demoted and is one of them.
	20. My-Very-Earnest-Mother-Just-Served-Us-Nachos → Mercury-Venus-Earth-Mars-Jupiter-Saturn-Uranus-Neptune
7. ***Astronomy - Stars***
	1. The brightness of a star as we view it from Earth is called **apparent magnitude**. This does not represent their true brightness or energy output.
	2. The true brightness of a star is measured in **absolute magnitude,** as if they were seen from the same distance.
	3. **Hertzsprung-Russell Diagram** (HR diagram) compares star temperature and **luminosity** (or **absolute magnitude**) of stars, and color is directly related to temperature.
	4. Stars spend most of their lives as **main sequence** stars (which is a diagonal band on the HR diagram)
	5. **Red Giants** are cooler stars than **white dwarfs**.
	6. A star’s light is produced by the **nuclear fusion** of 4 hydrogen atoms making one helium. This is true for our Sun too.
	7. Stars have a life cycle which depends upon the stars mass. The more massive, the more likely the star will have a shortened life span, ending in a **Supernova** and then possibly a **Black Hole** or **neutron star**.
	8. All the elements beyond iron are made in the explosion of a supernova.
8. ***Astronomy – The Sun***
	1. The Sun is a **main sequence star**, a stable state; and is expected to become a red giant then a white dwarf.
	2. Sunspots are cooler areas on the Sun’s surface, and go through a cycle every 11 years.
9. ***Cosmology***
10. The universe began with a big explosion -"The Big Bang" about 13-15 billion years ago.
11. The **Big Bang Theory** states that the universe formed from the explosion of a point of infinite temperature and density that expanded outward in all directions creating simple elements as the universe cooled in the first moments, which coalesced to form stars.
12. Evidence supporting the Big Bang Theory are:
	1. The universe has been measured to contain ~75% hydrogen and ~25% helium.
	2. Universe continually expanding as measured by the **Red Shift** of faraway galaxies.
	3. Existence of **Cosmic Microwave Background Radiation** (CMB) showing the leftover light energy of the “bang”.
	4. Small differences in temperature across the universe as measured by **COBE and WMAP** (indicating variations in the concentration of matter)