AP Environmental Science Summer Assignment 2022

Welcome to AP Environmental Science (aka APES)! I am excited that you've signed up to take this course, and I look forward to meeting you all in August.

The summer assignment is comprehensive, designed to give you a jumping off point for this course. This is an advanced science course that combines the disciplines of biology, chemistry, geology, history, global studies, and sociology to investigate global environmental problems and mitigation strategies. We will discover how the Earth's systems function together and how humans have affected our planet. Because this is a college level course, you will be responsible for learning a large amount of material this year. I will help you as we go, but it will be your responsibility to take notes, read the textbook, study, and learn.

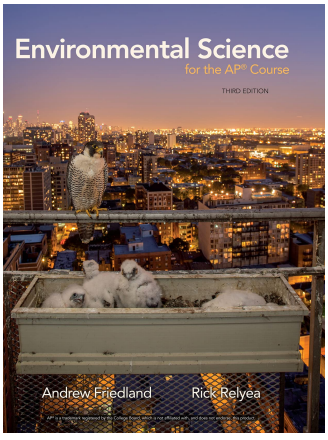
We begin the year with an assumption that you have a well-rounded academic foundation that includes biology, chemistry, geography, research & writing, and algebra. The purpose of this summer assignment is to help you prepare for the APES content by getting organized, reviewing background information, and becoming familiar with introductory concepts in environmental science. Solidifying foundational understanding and integrating it into your new understandings of environmental science background knowledge will be key to your success in this course.

You will receive a syllabus and course schedule for the year on the first day of class. For now, here is the important information you need to get started!

General Course Information

Required Course Materials

1. Textbook
   Environmental Science for the AP® Course 3rd Edition, by Andrew Friedland and Rick Relyea. Please purchase a physical copy (not an ebook).
2. 2'' binder
3. Spiral-bound notebook



2023 AP Exam Date = Tuesday, May 2, 2023

Summer Assignment Directions

The summer assignment has 2 parts: 1) Review and 2) Introduction to Environmental Science. Read the **Review Guide**, including indication sections in your textbook. Take notes as you read and study. Then, complete the Review **Problem Set**. Next, complete the **Introduction to Environmental Science Readings** and **Problem Set**. This assignment is due the first day of class. You will have a test on the content from the summer assignment on our third day of class. Please email me if you have questions.

~Ms. Glassco

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Summer Assignment Checklist

Readings

- ☐ Review Guide A - Biology
  - ☐ Friedland & Relyea (F & R) pgs. 197-198 *Nature exists at severals level of complexity*
  - ☐ F & R pgs. 75-76 *Photosynthesis captures energy and respiration releases energy*
  - ☐ F & R pgs. 76-78 *Energy Captured by producers moves through many trophic levels*
- ☐ Review Guide B - Science Vocabulary
- ☐ Review Guide C - Scientific Method
  - ☐ F & R pgs. 18-26 Module 3: *Scientific Method*
- ☐ Review Guide D - Chemistry
  - ☐ F & R pgs. 35-44 *Module 4: Systems and Matter*
  - ☐ F & R pgs 33-34 *Case Study: A Lake of Salt Water, Dust Storms, and Endangered Species* and pgs. 65-66 *Science Applied 1: Where is the missing salt of Mono Lake?*
- ☐ Review Guide E - Math
  - ☐ F & R Math Review *Final page of textbook + back cover*
- ☐ Review Guide F - Geography
- ☐ Friedland and Relyea Module 1 *Environmental Science: Studying the State of Our Earth*
- ☐ Friedland and Relyea Module 2: *Environmental Indicators and Sustainability*

Assignments

- ☐ Review Problem Set - due first day of class
- ☐ Introduction to Environmental Science Problem Set - due first day of class
- ☐ Study for Exam Unit 0

Summer Review Guide

A. Biology Review

Learning Objectives

1. Identify and give examples of the ecological levels of organization
2. Understand how ecological levels of organization relate to higher and lower levels of complexity in the natural world.
3. Describe how photosynthesis captures energy and cellular respiration releases energy. Understand the chemical reaction formulas for photosynthesis and cellular respiration.
4. Define and give examples of producers, herbivores, and carnivores in an ecosystem.
5. In a food web or given scenario, identify the producers and primary, secondary, and tertiary consumers.

Levels of Organization

When you studied biology, you learned about cellular organization in plants, animals, fungi, protists, and bacteria. Environmental science focuses on interactions within ecosystems, including how an individual organism is part of its environment. The system scientists use to organize the natural world is called the levels of organization. Your textbook refers to this system as the "levels of complexity;" both terms mean the same thing.

Read pages 197-198 in F & R for an explanation of the ecological levels of organization:individual → population → community → ecosystem → biome → biosphere.

In this class, we'll focus on the ecological levels of organization. However, it is important to understand how the study of ecosystems fits into the larger picture of scientific organization. In order from smallest (an atom) to largest (the universe), each level of organization builds upon the one which follows.

The levels of organization for the known universe are:

atom → molecule → cell → tissue → organ → organ system → organism → population → community → ecosystem → biome → biosphere → solar system → galaxy → universe

Atom - the smallest unit of matter (matter = anything that has mass and takes up space)
- ★ Atoms are nonliving, but can combine to make cells which are living.

Molecule - 2 or more atoms joined together
Cell - the smallest unit of a living thing
- ★ Cells are living
- ★ Cells are made of molecules

Tissue - a group of similar cells that work together
Organ - a group of tissues in the organism that work together (heart, lungs, brain)
Organ system - a group of organs that work together (circulatory system, respiratory system)
Organism/Individual - a living thing / something that is alive
Population - a group of the same species living in the same area
Community - the living organisms (animal, plant, fungus, bacteria, protist) in the same area
Ecosystem - the living and nonliving things in the same area / environment
Biome - a large geographic area with a specific climate and plant life (a group of ecosystems)

Biosphere - the Earth (a planet)
Solar system - a group of planets that orbit a sun
Galaxy - a systems of billions or stars, dust, and gas held together by gravity
Universe - Everything. All existing matter and space.

We can use the levels of organization to describe how a human being is organized and how she fits into the systems of the natural world. A human is made of 7,000,000,000,000,000,000,000,000,000 (7 octillion) atoms. Let's say that one of those atoms is oxygen (the most common element in our bodies). That oxygen atom could be part of a glycerol molecule that makes up the lipid bilayer of a nervous cell. The nervous cell (called a neuron) is one of millions of cells that make up your brain tissue. These tissues together make up your brain, which is an organ. The brain is part of an organ system, your nervous system. The nervous system joins together with your other systems (circulatory, endocrine, respiratory, skeletal, digestive, etc.) to make a human body (AKA an organism or individual).

As an organism, the human being is part of a population of other organisms of the same species. Together with other living things like plants, other animals, fungi, bacteria, and protists, humans are in a community. When we add in the abiotic (nonliving) components of the surrounding environment, like air, water, sunlight, minerals, and temperature an ecosystem forms. Ecosystems are part of larger geographic areas called biomes that each have a specific climate and plant life adapted to that climate. All the biomes on Earth together make up the biosphere, which is the planet Earth. Earth is part of a planetary system which we call the Solar System. There are countless other solar systems in the universe, including an estimated 5,000 in our Milky Way Galaxy alone. Solar systems make up galaxies, and the over 200 billion galaxies together comprise the known universe.

Read F&R pgs. 75-76 "Photosynthesis captures energy and respiration releases energy"
Read F&R pgs. 76-78 "Energy captured by producers moves through many trophic levels"

B. Science Vocabulary

Learning Objectives

1. Know the meanings of common science root words, prefixes, and suffixes.
2. Be able to look at a novel word and determine its approximate meaning based on the root words, prefixes, and suffixes.

Many science words have their origins in Greek and Latin roots. Knowing the meanings of parts of words (prefixes, roots, and suffixes) can help you to break down words to better understand and learn important terms and definitions. Study the prefixes, roots, and suffixes below, then answer the Science Vocabulary questions in the Review Problem Set.

Prefixes

a-/an-	without
aero-	air
anti-	against/opposite
auto-	self
bi-	two
co-/con-/comm-	with, together
de-	remove, reverse

di-/dis-	apart
en-/endo-	into, within
epi-	upon
equi-	equal
eu-	good
hyper-	more than
hypo-	less than
ex-	out, without
exo-	outer
im-/in-	not
inter-	between
macro-	large
micro-	small
mono-	one
multi-	many
non-	not
per-	through
pre-	before
pro-	for
re-	again
sub-	below, under
un-	not

Roots

-agri-	field, soil
-anthrop-	human
-aqui-	water
-bio-	life
-carcin-	cancer
-carn-	meat
-centr-	center
-chem-	dealing with chemicals
-cult-	grow
-dem-	people
-detri-	to wear away
-div-	separate
-eco-	home
-electro-	electricity
-enviro-	to surround
-ethos-	moral character
-fert-	to carry
-fract-	break
-gene-	origin, birth
-geo-	earth
-graph-	write, draw
-herb-	plant, grass
-hetero-	different, other
-homeo-	same, similar
-hydro-	water

-ignis-	fire
-iso-	equal, same
-litho-	stone, rock
-magni-	large, great, increase
-mal-	bad
-man-	hand
-meso-	middle, mid
-meta-	above, beyond
-meter-	measure
-mort-	death
-mut-	change
-nat-	birth
-neuro-	relating to nervous or the brain
-nitro-	pertaining to nitrogen
-nuc-	center
-oxi-	pertaining to oxygen
-pan-	all
-para-	beside
-path-	disease
-petro-	oil
-photo-	light
-phys-	nature, natural order
-pol-	city
-poly-	many
-pop-	people
-sal-	salt
-seismo-	earthquake
-sol-	sun
-spect-	look, see
-sym-, -syn-	together
-terra-	land, earth
-therm-	heat
-toxi-	poison
-trop-	turn, change
-troph-	nourishment
-trans-	across
-vor-	eat
-zoo-	animal

Suffixes

-able	capable of
-aceous	of or pertaining to
-ation/-cation/-ition	the process of
-icide	to kill
-ism	state or condition of
-ist	person who deals with
-ology	the study of

C. Scientific Method Review

Learning Objectives

1. Explain the scientific method and its application to the study of environmental problems.
2. Describe some of the unique challenges and limitations of environmental science research.
3. Define and give examples of a testable hypothesis.

The free-response section of the APES exam always includes a question that asks you to design an experiment. You need to know how to explain each step of the scientific method, how to derive a testable hypothesis, and how to identify independent and dependent variables in an experiment.

Read F&R pgs. 18-26 "Module 3 "Scientific Method"

D. Chemistry Review

Learning Objectives

1. Describe how matter is made of atoms and molecules that move among different systems.
2. Explain why water is a vital component of most environmental systems.
3. Discuss how matter is conserved in chemical and biological systems.
4. Understand pH and the relative acidity of common substances.

In environmental science, we will focus on chemical elements that occur naturally on Earth and how these elements cycle through different systems like the water, carbon, nitrogen, rock and phosphorus cycles.

Below is a table listing chemical elements and molecules that you need to be able to identify for environmental science. These are all essential to our study of how matter cycles, as well as understanding the environmental and human health impacts of common pollutants.

$C_6H_{12}O_6$	CH_4	N_2	NO_2
NH_3	O_2	O_3	P
S	SO_2	NaCl	Pb
Rn	Hg	Cl	CO_2

Read F&R pgs. 35-44 "Module 4: Systems and Matter"

It is important to understand that matter is constantly moving around Earth in these cycles. Chemical reactions in the environment occur when atoms separate from molecules or recombine with other molecules. In a chemical reaction, no atoms are ever destroyed or created, although the bonds between particular atoms may change.

For example when methane (CH_4) is burned in air, it reacts with 2 molecules of oxygen ($2O_2$) and two molecules of water ($2H_2O$).

The formula for this chemical reaction looks like this: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

Notice how the number of atoms of each chemical element is the same on each side of the reaction.

E. Math Review

Learning Objectives

1. **Metric Prefixes**-Know common metric system prefixes.
2. **Scientific Notation**-Understand how to use and write in scientific notation when dealing with very large or very small numbers.
3. **Converting Units**- Convert values into different units.
4. **Calculating Averages**- Calculate the mean of a set of values.
5. **Percent of a Total Value**- Calculate of the percent of a total.
6. **Percent Change**- Calculate percent change.
7. **pH Scale**- Determine the scale factor change for pH values which are on a logarithmic scale.
8. **Celsius and Fahrenheit**- Convert between Celsius and Fahrenheit AND know baseline temperature equivalent WITHOUT using the conversion formula.

This course requires a firm grasp of mathematical concepts through Algebra 2. The math is not super difficult, but you do need to understand how to interpret an environment question or problem and apply the appropriate mathematical formula or process.

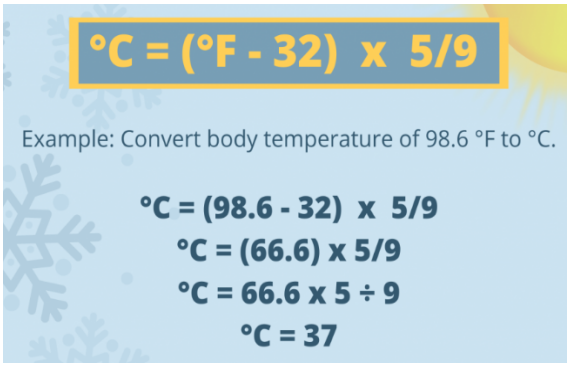
Please refer to the VERY back of your textbook for the Math Review content. It is printed on the final page and back cover of the textbook. We'll learn a few new formulas this year, but to start with you should know the math described in the 8 Learning Objectives above. You have learned this content before, but may need to give yourself a bit of a refresher.

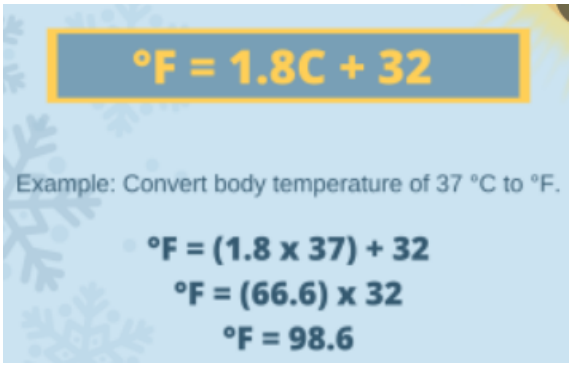
Celsius and Fahrenheit Conversions: We'll be learning about Earth's climate systems and biomes around the world. The average temperatures for biomes are typically presented in °C. The scientific community operates in Celsius, as does much of the world.

Here is what you need to know: In °C, the freezing point of water is 0°C and the boiling point is 100°C. In °F, the freezing point of water is 32°F and the boiling point is 212°F.

To convert from °F → °C, use the following formula: **C = 5/9 x (F - 32)**

To convert from °C → °F, use this formula: **F = C × (9/5) + 32**





In addition to knowing the conversion formulas, you also need to develop a baseline for understanding Celsius without calculating the conversions. For example, if your friend from the UK says that it is 32° outside so she's changing into shorts, you should understand that this is reasonable.

Here are some baseline Celsius values you should learn:

-20°C = -4°F
-10°C = 14°F
0°C = 32°F
10°C = 50°F
20°C = 68 °F (room temperature)
30 °C = 86 °F
37°C = 98.6 °F (human body temperature)
40°C = 104 °F
100°C = 212 °F

F. Geography Review

Learning Objectives

1. Name and locate the 5 world ocean basins and the 7 continents on a map.
2. Locate the following countries on a map: Canada, Mexico, Costa Rica, Brazil, United Kingdom, New Zealand, Japan, Ukraine, Singapore, India, China, South Africa, Spain, Madagascar, Argentina, Saudi Arabia Botswana, Democratic Republic of Congo, the Scandinavian countries (Finland, Norway, Sweden) Russia, Greenland, Iceland, Indonesia, Tanzania
3. Locate the following geographic features on a map: Mid-Atlantic Ridge, Ring of Fire, Andes Mountains, Himalayas, Mississippi River, Appalachian Mountains, Colorado River, Rocky Mountains, Grand Canyon, Mt. Kilimanjaro, the Great Lakes, Lake Victoria, Amazon Rainforest, Mediterranean Sea, Red Sea, Persian Gulf, Hudson Bay, equator, prime meridian, the Bering Sea, Tropic of Cancer, Tropic of Capricorn, Sea of Okhotsk, Bay of Bengal, Gulf of Mexico, Great Barrier Reef

It is important to have a solid understanding of basic geography for environmental science, as we'll be studying where major biomes, plate tectonics, natural disasters, and biodiversity hotspots are located. Please review or become familiar with the locations listed above in the learning objectives.

Review Problem Set

Directions: Please print the Problem Set and handwrite your responses. This problem set is due the first day of class. Write your responses in complete sentences (except for lists, sketches, models, etc.)

Name: _____

Honor Code: *I have neither given, nor received, nor witnessed any unauthorized assistance*

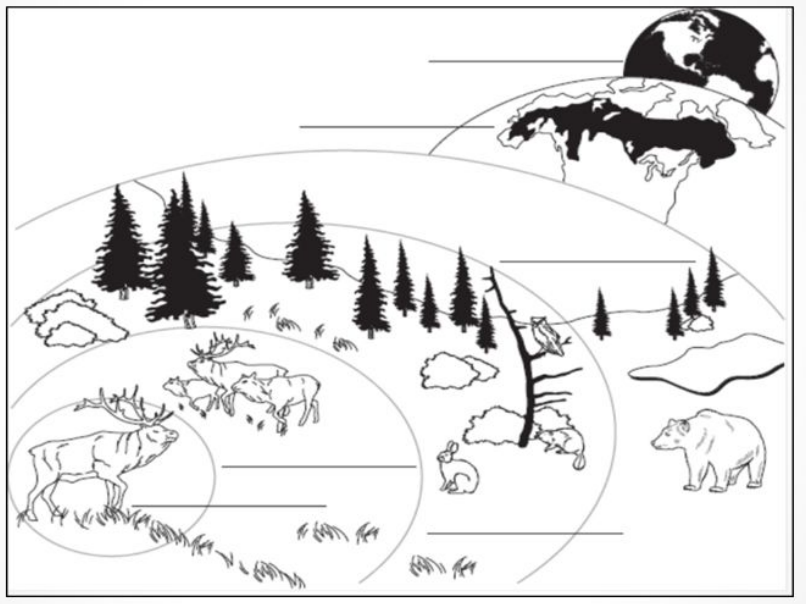
prior to or during this work. _____

A. Biology Review

1. List the 15 levels of organization for the known universe in order from least complex to most complex.

2. In your list above circle or highlight the 6 levels of ecological complexity that we will focus on in this class. Then below, define the ecological levels of organization.

3. Label the levels of ecological organization in the diagram below.



4. Explain where energy in an ecosystem comes from. What is the original source of all energy? How does this energy move throughout the ecosystem?

5. Draw a model to show how photosynthesis captures energy and respiration releases energy.

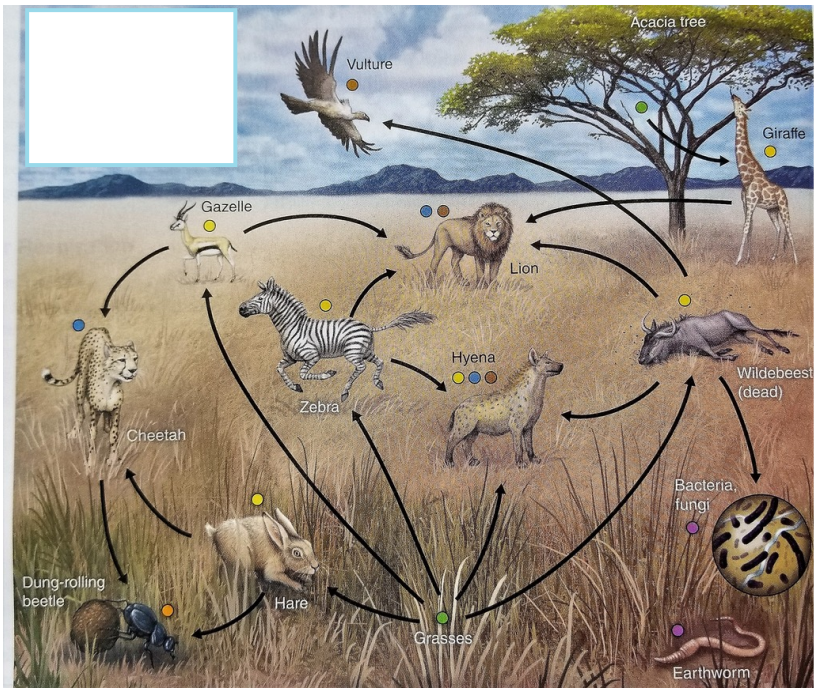
6. Explain how photosynthesis and cellular respiration work, including the inputs and outputs of each process.

7. Describe how anaerobic respiration differs from aerobic respiration. Why do some organisms conduct anaerobic respiration? Which process provides more energy- aerobic or anaerobic respiration?

8. Define each of the following:
    a. producer/autotroph
    b. consumer/heterotroph
    c. herbivore/primary consumer
    d. carnivore
    e. secondary consumer
    f. tertiary consumer
    g. scavenger
    h. detritivore
    i. decomposers

9. What does a food web illustrate?

10. On the food web diagram below, label each organism as a producer, primary consumer, secondary consumer, scavenger, detritivore, or decomposer. Please note that some organisms will fit into multiple categories. Label all appropriate categories.



B. Science Vocabulary

1. The prefix *herb-* means *plant* and the root *-vore* means *to eat*. Therefore, the word *herbivore* means:

2. The suffix *-cide* means *to kill*. Therefore, the word *insecticide* means:

3. The prefix *a-* means *not* and *bio* means *life*. Therefore, the word *abiotic* means:

4. Using the list in the Review Guide (not Google), match each word to its meaning.

ecology	the diversity of life forms in an environment
autotroph	farming
zoology	the study the environment and habitats
biogeochemical cycle	a scientist who studies earthquakes
seismologist	the study of animals
agriculture	a poison the affects nerves and the brain
biomass	an increase of chemicals in living animal tissues
neurotoxin	the study of people and populations
biomagnification	electricity derived from moving water
hydroelectric power	the total mass of living matter in a specific area
demography	an organism that can produce its own food
biodiversity	the movement of matter within ecosystems

5. Using the Science Vocabulary list in the Review Guide, create a monster and give it a name that incorporates at least 7 of the prefixes, roots, and/or suffixes. Write a description for your monster that explains its name.

Example

I introduce to you the **Lithogenic polymanual misanthropic electrochemipathological petrivore.**

This monster is lithogenic, meaning it is born from rocks and stone. It packs a mean polymanual (multi-handed) punch that includes throwing electrochemipathological lightning bolts (disease and chemical laden electricity) at anyone or anything that crosses its path. This misanthropic (human-hating) monster is a pure petrivore, subsisting only on crude oil.

C. Scientific Method Review

1. Describe the steps in the scientific method.

2. Compare controlled and natural experiments.

3. Describe some of the unique challenges and limitations of applying the scientific method to the study of environmental science.

4. One forestry issue we'll learn about this year is deer browsing. You may have noticed that we have an abundance of deer in Maryland. This is because deer no longer have an adequate number of natural predators like wolves, coyotes, and wolverines. More deer means the deer eat more vegetation. This is a problem in forests because sapling trees (baby trees) cannot grow to maturity before they are eaten by deer. One solution is to fence off large areas of forest, so that deer cannot enter. In the photo below, you can see the results of an fencing experiment. Notice that one side of the fence has sapling trees and the other side has very little vegetation.

i. For the fencing experiment described above, **state** the hypothesis.

ii. **Describe** the method researchers used to test this hypothesis.

iii. I**dentify** the control.

iv. **Identify** the dependent variable.

5. The active ingredients in many pesticides are chemical compounds that kill organisms such as insects, molds, and weeds. Proponents claim that the use of pesticides improves crop yields and thus protects land and soil by reducing the conversion of forests and wetlands to cropland. Opponents of pesticide use claim that pesticides degrade water and soil quality and that other modern agricultural techniques and practices are responsible for the improved crop yields in recent years.

   Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish. For the experiment you design, be sure to do all of the following.

   i. **State** the hypothesis.

   ii. **Describe** the method you would use to test your hypothesis.

   iii. **Identify** the control.

   iv. **Identify** the dependent variable.

   v. **Describe** experimental results that would lead you to reject your hypothesis in (i). (Be specific.)

6. The first step in the scientific process is
   a. collecting data.
   b. observations and questions.
   c. forming a hypothesis.
   d. forming a theory.

7. A control group is
   a. a group with the same conditions as the experimental group.
   b. a group with conditions found in nature.
   c. a group with a randomly assigned population.
   d. a group with the same conditions as the experimental group except for the study vairable.

8. Challenges in the study of environmental science include all of the following EXCEPT
   a. dangers of studying natural systems.
   b. lack of baseline data.
   c. subjectivity of environmental impacts.
   d. complexity of natural systems.

9. Researchers conducted an experiment to test the hypothesis that the use of fertilizer near wetlands is associated with increased growth of algae. An appropriate null hypothesis would be:
    a. Growth of algae in wetlands is never associated with increased fertilizer use.
    b. Application of fertilizers near wetlands is always associated with increased growth of algae.
    c. Fertilizer use near wetlands has no association with growth of algae.
    d. Fertilizer use near wetlands leads to increased growth of algae as a result of elevated nutrient concentrations.

10. Which is an example of a null hypothesis?
    a. Plants grow faster when exposed to classical music.
    b. If you smoke several cigarettes a day, you are more likely to get lung cancer.
    c. The ability to sing in tune is unaffected by age.
    d. Egg size is influenced by female body mass.

11. A research team does an experiment to test how watching horror movies might affect heart rate. They attach a heart rate monitor to each of 20 subjects. Each subject's resting heart rate is measured before f watching the movie and again while watching a clip from a horror movie in a dark room. The researchers do the same with another 20 subjects, but in a well-lit room. In this experiment, which is the dependent variable?

D. Chemistry Review

1. Write the chemical name or compound for each chemical symbol below.

$C_6H_{12}O_6$	CH_4	N_2	NO_2
NH_3	O_2	O_3	P
S	SO_2	NaCl	Pb
Rn	Hg	Cl	CO_2

2. What are the average pH ratings for the following common substances in the environment?
i Seawater

    ii. Rainwater

    iii. Pure water

3. If two atoms of an element are isotopes, then they have a different number of _____.

4. Describe how water's surface tension, capillary action, and solvent ability make it vital for life.

5. Which of the following is NOT an organic compound?
   a. CH_4
   b. NH_3
   c. NaCl
   d. CO_2

6. Which is NOT a type of organic biological molecule?
   a. Lipids
   b. carbohydrates
   c. salts
   d. nucleic acids

7. Which does NOT demonstrate the law of conservation of matter?
   a. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.
   b. $NaOH + HCl \rightarrow NaCl + H_2O$.
   c. $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$.
   d. $PbO + C \rightarrow 2Pb + CO_2$.

8. Explain WHY pure water has a pH of 7.

9. Refer to the Case Study reading about Mono Lake on pgs. 33-34 and pgs. 65-66 to answer the following questions.

Photo to right: Tufa tower

   a. How did Los Angeles inadvertently conduct an experiment at Mono Lake?

b. What chemical principle causes terminal lakes to become more salty?

c. What is the reason for the discrepancy between the two calculations of salt content in Mono Lake?

E. Math Review

1. In the metric system, land area is expressed in hectares. A hectare (ha) is 100 meters by 100 meters. In the United States, land area is most commonly expressed in acres. There are 2.47 acres in 1 ha.

   If a nature preserve is 253 ha, what is its size in acres? Show your work, including all labels.

2. A web search of organizations yielded a range of estimates of the amount of forest clearing that is occurring worldwide.
   Estimate 1 = 1 acre per second
   Estimate 2 = 86,400 acres per day
   Estimate 3 = 34,000 ha per day

   a. Convert Estimate 1 into acres per day. Show all calculations and unit conversions

   b. Convert Estimate 3 into acres per day. Show all calculations and unit conversions.

   c. Why might environmental organizations choose to present these estimates in different ways?

3. Five common hybrid-electric vehicles (which are powered by an internal combustion engine and batteries) have mileage ranges as follows: 409 miles, 703 miles, 513 miles, 583 miles, and 492 miles. What is the average mileage range of these five hybrid vehicles? Show your calculations and round to the nearest whole number.

4. On page 29 in your textbook, answer the Practice Math and Graphing Question.

Practice Math

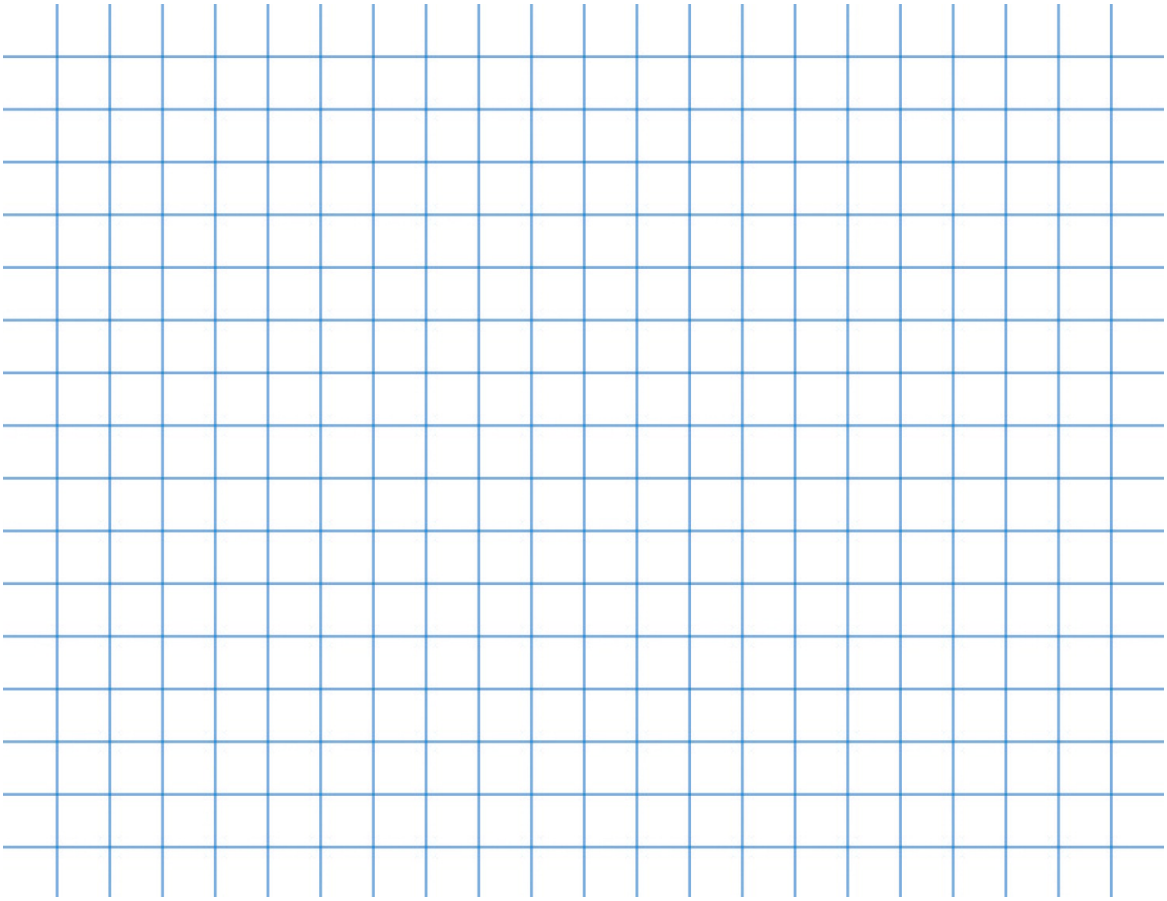
(a) What is the temperature difference from the year 2000 through 2016?

(b) What is the average temperature for the last 5 years of measure (from 2012 to 2016)?

(c) Convert the average temperature from the last 5 years (calculated in b) to degrees Fahrenheit.

Practice Graphing - Using the data from the table, plot the graph of global temperature on the y axis and the time from 2000 through 2016 on the x axis.

Label the axes and graph title.



5. Environmental scientists often convert energy units in order to compare various types of energy. For instance, you might want to compare energy you would save by purchasing an energy-efficient refrigerator with the energy you would save by driving a more fuel-efficient car. Assume that for the amount you would spend on the new refrigerator ($500), you can make repairs to your car engine that would save you 20 gallons (76 liters) of gasoline per month. (Note that I L of gasoline contains the energy equivalent of about 10 KWh.) Using this information and Table 5.1 Common units of energy and their conversion into joules (F&R Textbook page 46), convert the quantities of both gasoline and electricity into joules and compare the energy savings. Which decision would save the most energy? Show all work and unit conversions. (See page 47 for an example.)

6. Which is greater; the energy contained in 4 metric tons of coal or the energy contained in 1,00 liters of diesel oil? Note that 1 metric ton of coal = 29,300 megajoules energy equivalen and 1 liter of diesel fuel = 36 megajoules. Show all work and unit conversions. (See page 49 for an example.)

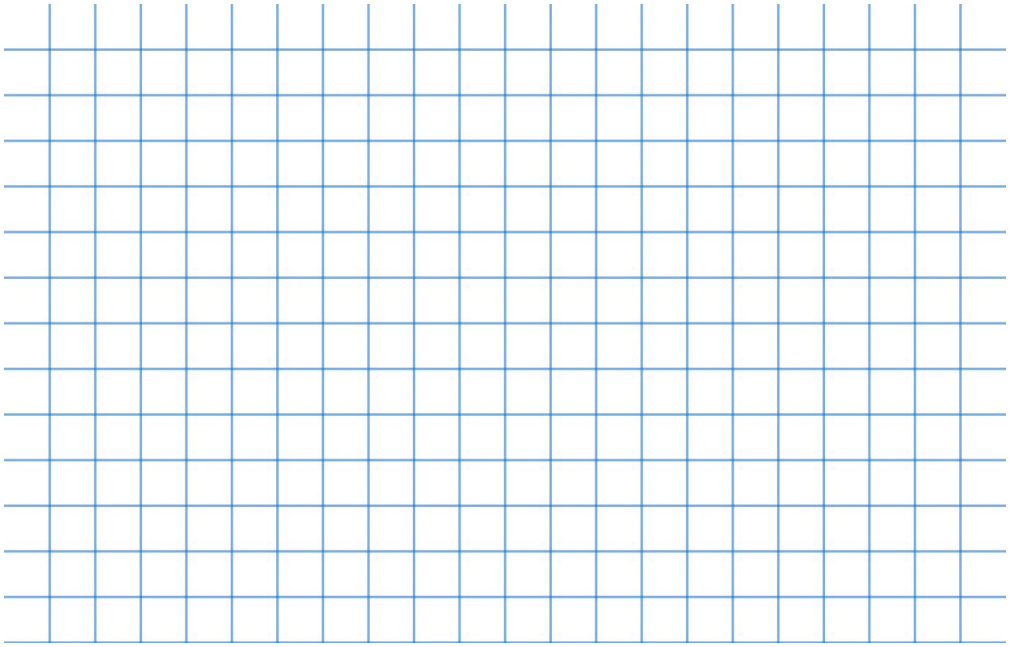
7. If a solar photovoltaic panel produces 1,000 watts of electrical energy and is active for 12 hours each day, how many kWh of electricity will be produced in a week? Show all work and units.

8. Wood pellets are a common heating fuel for small wood pellet stoves used in homes. A typical bag of wood pellets weighs 40 pounds and wood pellets usually contain 7,450 BTUs of energy per pound. A typical 18-year old using a rowing machine can produce 100 watts while rowing. Compare the energy in a 40-pound bag of wood pellets to the energy produced by rowing for 1 hour. Show all work and unit conversions.

9. Answer Question #2 Practice Graphing on page 61 of your F&R textbook.

(a) Calculate the 5-year average pH values. Take the yearly pH values for each 5-year period and average them. Note the 5-year averages below.

(b) Graph the 5-year averages versus time. Describe the trend in pH. State whether or not the data from these research vessels support the ocean acidification hypothesis.



10. Sarah is currently spending $100 per month on electricity. She pays $0.20 per kWh. Her space heater is responsible for 10 percent of the electricity consumption. How many kilowatt-hours does her space heater use in a month? Assume a month is 30 days.

11. Write each value below in scientific notation:

a. 76300 =

b. 2,560,000 =

c. 0.000066 =

d. 0.005 =

12. Write each scientific notation value as a numerical value.

a. 86.788×10^{7} =

b. 3.1×10^{-7} =

c. 2.17×10^{5} =

d. 4×10^{-4} =

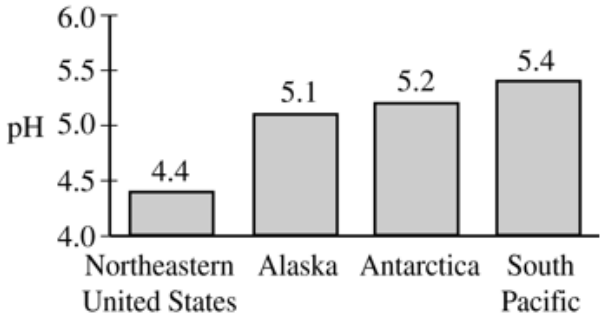
13. In a deer population, researchers counted 17 does, 5 bucks, and 12 fawns. What percentage of the deer population are fawns? Show your work.

14. From 1999 to 2006, meat consumption averaged over 250 pounds per person. From 2015 to 2019, per capita consumption increased each year, reaching 264 pounds per person in 2020. What was the percent change in meat consumption from 2006 to 2020? Show your work.

15. Wind capacity in the United States has undergone rapid increase over the past 2 decades. Total capacity of wind turbines in the US was 4,000 MW in 2000 and 85,000 MW in 2017. What was the percentage increase per year over this 17-year period? Show your work.

16. Geothermal electricity generation in the United States went from 14 MWH in 2000 to 17 MWH in 2016. What was the percentage increase over this 16-year period? Show your work.

17. The graph below shows the average pH of precipitation from several regions of the world.



18. Approximately how many more times acidic, in terms of H+ concentration, is precipitation in the northeastern United States as compared to precipitation in the South Pacific?

19. The concentration of H+ ions in a solution with a pH value of 4 is how many times as great as the concentration of H+ ions in a solution with a pH value of 7 ?

F. Geography Review - On the map on the next page, locate and label the 7 continents, 5 world ocean basins and all countries and geographic features listed in the Review Guide.

Introduction to Environmental Science Problem Set

Directions: Please print the Problem Set and handwrite your responses. This problem set is due the first day of class. Write your responses in complete sentences (except for lists, sketches, models, etc.)

Name: _____

Honor Code: *I have neither given, nor received, nor witnessed any unauthorized assistance*

prior to or during this work. _____

Read Module 1: "Environmental Science" pages 1-6 in F&R and Module 2: "Environmental Indicators and Sustainability" pages 7-18.

Learning Goals:

1. Define the field of environmental science and discuss its importance.
2. Identify ways in which humans have altered and continue to alter our environment.
3. Identify key environmental indicators and their trends over time.
4. Define sustainability and give examples of sustainable actions.

1. Describe in detail the positive and negative ways humans have altered our environment over the last 2.5 million years. Provide four examples.

2. Define fracking. Identify two major consequences of fracking.

3. Describe each of the five global-scale environmental indicators outlined in Module 2:
    a. biodiversity

    b. food production

    c. average global surface temperature & CO_2 concentrations in the atmosphere

    d. human population

    e. resource depletion

4. What is environmental sustainability? Give four examples of sustainable actions that can be taken by individuals and groups.

5. In 2015, 640,000 ha of the Amazon rainforest were cleared. Approximately how many hectares is that each hour? Show your work.

6. Describe the three levels of biodiversity.
    a. genetic diversity

    b. species diversity

    c. ecosystem diversity

7. Use Figure 2.3 on page 11 to calculate the approximate percentage change in world grain production per person between 1950 and 2000.

8. Use Figure 2.4 on page 11 and the reading in Module 2 to explain why the Earth is getting warmer.

9. Look at Figure 2.5 on page 12. What is the relationship between CO_2 and global temperatures?

10. Look at Figure 2.7 on page 13. How does paper consumption in developed and developing countries compare? Explain.

11. Refer to Figure 2.8 on page 15. Based on the graph, what is a reasonable prediction of the world population and 2042?

12. Which of the following events has increased the impact of humans on the environment?
    I. advances in technology
    II. reduced human population
    III. use of tools for hunting
    a. I only
    b. I and II
    c. II and III
    d. I and III

Watch the original animated Lorax movie on youtube. Search for "The Lorax: Original". It is the 1972 version and is about 25 minutes long. Then, complete the assignment below.

Dr. Seuss touches on many environmental issues in the short story *The Lorax.* On the following pages are some environmental topics from the story. For each, topic:

1. Write a brief definition (use your textbook).
2. Describe how this topic or idea is portrayed in *The Lorax*.
3. Give a current, real-world example of this environmental issue or idea. You can rely on your own background knowledge or do research. If you use outside research, cite your sources in APA7 format.

Example- Urbanization

Urbanization is the expansion of city areas in places that were previously rural. This reduces forested land habitats and land available for agricultural production. Oftentimes, urbanization increases pollution and waste as more humans move in to reside in the new city spaces. In *The Lorax*, urbanization occurs after the Oncler begins the thneed factory. With a new factory in the previously forested land, houses and business are needed to support the factory workers. The area begins to look more and more like a city and less like a forest. Major cities, like Wuhan, in China have been rapidly expanding in recent years. According to *The Washington Post*, urbanization played a role in the rapid expansion of the coronavirus. Pandemic level viruses spread quickly in urban centers because large numbers of people reside in close proximity. Additionally, as spaces for wildlife shrink, occurrences of zoonotic virus transmission between humans and animals become more likely.

Smith, N. R. (2021, March 31). *China's rapid urbanization will make another pandemic more likely*. The Washington Post. Retrieved June 4, 2022, from https://www.washingtonpost.com/outlook/2021/03/31/who-report-pandemic-china-cities/

Habitat destruction

Conspicuous Consumption

Deforestation

Industrial Smog

Water pollution

Conservation

Tragedy of the Commons

Loss of Biodiversity

Environmental Advocacy

Unit 0 Exam Study Guide

There will be a test on the third day of class covering the content in this Summer Assignment. The following is a list of topics to study.

REVIEW

1. Identify and give examples of the ecological levels of organization (individual → population → community → ecosystem → biome → biosphere)
2. Understand how ecological levels of organization relate to higher and lower levels of complexity in the natural world.
3. Describe how photosynthesis captures energy and respiration releases energy and relate this understanding to the chemical reaction formulas for photosynthesis and respiration.
4. Define and give examples of producers, herbivores, and carnivores in an ecosystem.
5. In a food web or given scenario, identify the producers and primary, secondary, and tertiary consumers in an ecosystem.
6. Know the meanings of common science root words, prefixes, and suffixes.
7. Be able to look at a novel term and determine its approximate meaning based on the root words, prefixes, and suffixes.
8. Explain the scientific method and its application to the study of environmental problems.
9. Describe some of the unique challenges and limitations of environmental science.
10. Define and give examples of a testable hypothesis.
11. Describe how matter is made of atoms and molecules that move among different systems.
12. Explain why water is a vital component of most environmental systems.
13. Discuss how matter is conserved in chemical and biological systems.
14. Understand pH and the relative acidity of common substances.
15. **Metric Prefixes**-Know common metric system prefixes.
16. **Scientific Notation**-Understand how to use and write in scientific notation when dealing with very large or very small numbers.
17. **Converting Units**- Convert values into different units.
18. **Calculating Averages**- Calculate the mean of a set of values.
19. **Percent of a Total Value**- Calculate of the percent of a total.
20. **Percent Change**- Calculate percent change.
21. **pH Scale**- Determine the scale factor change for pH values which are on a logarithmic scale.
22. **Celsius and Fahrenheit**- Convert between Celsius and Fahrenheit AND know baseline temperature equivalent WITHOUT using the conversion formula.
23. Name and locate the 5 world ocean basins and the 7 continents on a map.
24. Locate the following countries on a map: Canada, Mexico, Costa Rica, Brazil, United Kingdom, New Zealand, Japan, Ukraine, Singapore, India, China, South Africa, Spain, Madagascar, Argentina, Saudi Arabia Botswana, Democratic Republic of Congo, the Scandinavian countries (Finland, Norway, Sweden) Russia, Greenland, Iceland, Indonesia, Tanzania
25. Locate the following geographi features on a map: Mid-Atlantic Ridge, Ring of Fire, Andes Mountains, Himalayas, Mississippi River, Appalachian Mountains, Colorado River, Rocky Mountains, Grand Canyon, Mt. Kilimanjaro, the Great Lakes, Lake Victoria, Amazon Rainforest, Mediterranean Sea, Red Sea, Persian Gulf, Hudson Bay, equator, prime meridian, the Bering Sea, Tropic of Cancer, Tropic of Capricorn, Sea of Okhotsk, Bay of Bengal, Gulf of Mexico, Great Barrier Reef

NEW CONTENT - Introduction to Environmental Science

1. Define the field of environmental science and discuss its importance.
2. Identify ways in which humans have altered and continue to alter our environment.
3. Identify key environmental indicators and their trends over time.
4. Define sustainability and give examples of sustainable actions.

Be able to define and explain the key terms below:

- Fossil fuel
- Fracking
- Environment
- Environmental science
- Ecosystem
- Biotic
- Abiotic
- Environmentalism
- Environmental studies
- Ecosystem services
- Environmental indicator
- Biodiversity
- Genetic diversity
- Species
- Species diversity
- Speciation
- Background extinction rate
- Greenhouse gasses
- Anthropogenic
- Per capita
- Sustainability
- Sustainable development
- Biophilia
- Ecological footprint
- Scientific method
- Hypothesis
- Variable
- Independent variable
- Dependent variable
- Null hypothesis
- Replication
- Sample size (*n)*
- Accuracy
- Precision
- Uncertainty
- Theory
- Control group
- Natural experiment
- Urbanization
- Habitat destruction
- Deforestation
- Industrial smog
- Water pollution
- Tragedy of the Commons
- Conservation
- Conspicuous consumption