Welcome to AP Environmental Science! The major topics of the class are as follows:

Energy Systems and Resources – atmosphere, soil, groundwater, and geology
The Living World – ecosystems and cycles
Populations – demographics, dynamics and growth
Land and Water Use – agriculture, forestry, mining, fishing and global economics
Energy Resources and Consumption – fossil fuels, nuclear energy, conservation and consumption
Pollution – types of pollution and its impact, waste disposal
Global Change – ozone, global warming, loss of biodiversity

This course is designed to be the equivalent of a one-semester, introductory college course in environmental science. The goal of the course is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving or preventing them.

Students are expected to assume responsibility for their learning. There may be some independent assignments and readings that will be covered on the test, but not in class. Students should be prepared and motivated to treat this course as they would a college level course.

The course will include a laboratory and field investigation component. We will be leaving the classroom for field trips on campus. The goal of this component is to complement the classroom portion of the course by allowing students to learn about the environment through firsthand observation.

On the following pages you will find two (2) assignments that should be completed over the summer. Pay attention to the due dates, as they are different for each assignment. You may contact us by email kesterson.christopher@mail.fcboe.org or killingsworth.staci@mail.fcboe.org with any questions. We may be in and out of town so allow a few days to respond.

I. FRQ and Classwork Task Verbs

As a student in this course you will be expected to answer all questions in class and on the AP exam in great detail and in complete sentences. You will consistently see several action verbs and question types over the course of the year. You should review the following page as you will need to be able to answer all questions in labs, discussion, tests, and the AP exam completely, clearly, and concisely.

FRQ Task Verbs

Identify	Indicate or provide information about a specified topic, without elaboration or explanation.	Identify a property of soil. *Texture is a property of soil.*
Describe:	Provide relevant characteristics of a specified topic. ***Identify + (which/because/such as/thus, etc.)***	Describe a property of soil. *A property of soil is texture **which** is determined by the amount of sand, silt, and clay.*
Explain:	Provide information about how or why a relationship, process, pattern, position, situation, or outcome occurs, using evidence and/or reasoning to support or qualify a claim.	Explain how a specific property of soil determines the health of soil. *A property of soil is texture. The more sand in the soil, the more permeable the soil is. If the soil is too permeable, it cannot hold enough water to support plant growth.*
Propose a solution:	Provide a proposed solution to a problem based on evidence or knowledge.	Propose a solution to increase the fertility of soil. *The use of compost as organic fertilizer would add more nutrients to soil.*
Make a claim:	Make an assertion that is based on evidence or knowledge.	Make a claim for how the addition of compost would affect the fertility of soil. *The addition of compost would increase the fertility of soil.*
Justify:	Provide evidence to support, qualify, or defend a claim and/or provide reasoning to explain how evidence supports or qualifies the claim.	Justify your claim for how the addition of compost would affect the fertility of soil. *Compost contains decomposing biomass which would add plant nutrients such as nitrogen and phosphorus into the soil. The addition of these plant nutrients would increase soil fertility and allow for more plant growth.*

Analyzing Data

Identify a value: do NOT give a range. Choose a point. If the value is between 70 - 75, choose a number. Ex: 73.	**Describe trend:** Directional (↑, ↓, ↑ then ↓). As ____ (↑ or ↓), then _____ (↑ or ↓).

Experimental Design

Identify the independent variable.	the factor that the scientist changes
Identify the dependent variable.	what you are measuring/observing
Describe the control.	Group that is NOT exposed to the experimental treatment to act as a comparison for results (ex: room temperature water, neutral pH, etc.)
State a scientific question/ State a hypothesis.	**Question**: How will IV affect DV? **Hypothesis**: IV (↑ or ↓) will cause DV to (↑ or ↓).

Don't Use These Phrases!!!

Too vague..be more specific!!!

Natural ● Healthier for the environment ● Eco friendly ● Good for the environment ●
It will balance everything ● It will throw off the balance ● Hurt the environment ● Harm the environment ● Bad for the environment ●
Causes pollution ● Harm human health ● Make it illegal ● Change/affect (how? Increase? decrease?)

Other Words to Know:

Environmental/ecological: animals, plants, soil, air, ***NOT PEOPLE***

Economic: money, jobs

Societal/social: people, cities, crops

Assignment One

- Review the FRQ and classwork task verbs on the previous page, then use the examples to respond to the following questions via email to BOTH Staci Killingsworth and Chris Kesterson
- killingsworth.staci@mail.fcboe.org and kesterson.christopher@mail.fcboe.org
- Due July 9th
- Questions:
    - **Identify** one of your strengths as a student and one of your weaknesses as a student.
    - **Describe** why you believe your strength, identified in the above question, is a good quality in a successful student.
    - **Explain** how your strength, identified in the above question, helps you to be successful in school.
    - **Propose a solution** to help improve on your weakness identified in the first question.
    - **Make a claim** as to why the solution you proposed in the above question would remediate your weakness.
    - **Justify** your claim for why you feel your solution proposed would help remediate your weakness.

Assignment Two

- The following pages include problems and questions that represent math and science skills you should be familiar with to be successful in AP Environmental Science.
- Review the sections on the following pages and complete the tasks in each section.
- The sections will cover basic math skills necessary for the course, the scientific method, graphing, and data analysis.
- **Please work the problems 1 - 18 on pages 5-6 on another sheet of paper, showing all your work and units.**
- For the activities on pages 9-11 , you may complete them within this packet to be turned in on the first day of class.
- All of the work, including calculations, must be turned in on the first day of school.
- There will be no credit given if you do not show your setup and units throughout.
- Please also remember to bring all of the lab supplies listed on p. 13 within the first three (3) days of school.

II. Prerequisite Basic Mathematical Skills

Throughout the year, you will be expected to do some math, especially when we begin to study renewable and nonrenewable energy sources. Below you will find some math reviews to make sure you are prepared. Things to Remember:

- SHOW ALL OF YOUR WORK, even if you think it is really simple. This is REQUIRED on the APES exam, so it will be required on all of your assignments, labs, quizzes and tests.
- INCLUDE UNITS in each step. Your answers ALWAYS need units!
- Check your work! Go back through each step to make sure you didn't make any mistakes in your calculations.
- Make sure your answer makes sense. If the question asks, "How many pizza slices did you eat in 20 minutes?" your answer will probably not be "13 billon." If you get an answer that seems unlikely, it probably is!

Directions: Reach each section below for review. Look over the examples and use them to help you work through the practice problems. SHOW ALL WORK and be sure to include units. Check your work when you are finished.

Percentage

- Percentage is a measure of part of the whole. Or part divided by whole.
- Remember that "percent" literally means divided by 100.
    - 15 million is what percentage of the US population (300million)?
        - $\frac{15\ million}{300\ million} \times 100 = 5\%$
    - A score of 46 of 83 possible points on a quiz is what percentage?
        - $\frac{46}{83} \times 100 = 55.42\%$

1. You are going out to eat with some friends on a Friday evening, what is 20% of your $35 bill so that you can give a good tip?

2. The waiter/waitress then has to pay 25% of her tip in tip share for the hosts/hostesses. How much money does she owe them?

Rates

$$\frac{Rise}{Run} \text{ ——— } \frac{Y_2 - Y_1}{X_2 - X_1} \text{ ——— } \frac{Slope}{Time} \text{ -} \qquad Percent\ Change = \frac{New - Old}{Old} \times 100$$

All of the above are ways to look at rates. The second equation is the easiest way to calculate a rate, especially from looking at a graph. Rates will often be written using the word "per" followed by a unit of time, such as cases per year, grams per minute or mile per hour. The word per means to divide, so miles per gallon is actually the number miles driven divided by one gallon. Rates are calculating by how much an amount changes in a given amount of time. The last formula is used to find percent change or rate of percent change (increase or decrease).

3. For history class, Joe spent 2 hours writing a 4-page report on ancient Egypt. This weekend, he needs to write a 12-page report on the Roman Empire. If he writes at the same rate, how long will it take Joe to write his report?

4. Half-life is the time required for a quantity to reduce to half of its initial value. The half-life of plutonium-239 is 24,300 years. If a nuclear bomb released 8 kg of this isotope, how many years would pass before the amount is reduced to 1 kg?

Scientific Notation

- Thousand = 10^3 =1,000
- Million = 10^6 =1,000,000
- Billion = 10^9 =1,000,000,000
- Trillion = 10^{12} =1,000,000,000,000

- When using very large numbers, scientific notation is often easiest to manipulate. For example, the US population is 300 million people or $300x10^6$ or $3x10^8$
- When adding or subtracting, exponents must be the same. Add the numbers in front of the ten and keep the exponent the same.
- When multiplying or dividing, multiply or divide the number in front of the ten and add the exponents if multiplying or subtract the exponents if dividing
  Ex. $9x10^6 / 3x10^2 = (9/3) \times 10^{(6-2)} = 3 \times 10^4$

Write the following in scientific notation

5	145,000,000,000 =	8	$(3 \times 10^3) + (4 \times 10^3) =$
6	.002 =	9	$(9.85 \times 10^4) - (6.35 \times 10^4) =$
7	13 million =	10	$(1.32 \times 10^8) \times (2.34 \times 10^4)$

Prefixes

m (milli)	=1/1000	$=10^{-3}$
c (cent)	=1/100	$=10^{-2}$
da(deka)	=1/10	$=10^{1}$
k (kilo)	=1000	$=10^{3}$
M (mega)	=1,000,000	$=10^{6}$
G (giga)	=1,000,000,000	$=10^{9}$
T (tera)	=1,000,000,000,000	$=10^{12}$Metrie Unit Practice

11	1300 kilograms	_____ milligrams
12	12000 micrometers	_____ meters

Dimensional Analysis

Dimensional Analysis is a way to convert a quantity given in one unit to an equal quantity of another unit by lining up all the known values and multiplying. In a dimensional analysis problem, start with your given value and unit, and then work toward your desired unit by writing equal values side by side. Remember, you want to cancel out each of the intermediate units. To cancel a unit on the top part of the problem, you have to get the unit on the bottom. Likewise, to cancel a unit that appears on the bottom part of the problem, you have to write it on the top. You must know how to set up a problem using dimensional analysis. There are plenty of online tutorials available, click the links below for a few.

- http://www.chem.tamu.edu/class/fyp/mathrev/mr-da.html
- https://youtu.be/hIAdCTNi1S8
- https://youtu.be/DsTg1CeWchc

Conversions
(this does not include all the necessary conversions. Use your resources for any that you need)

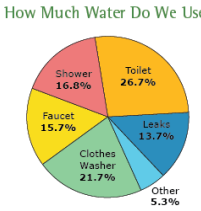
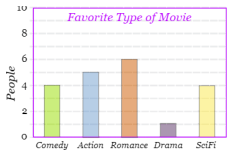
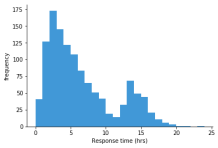
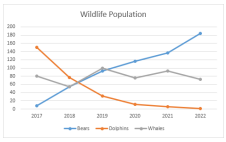
• 1 square mile = 640 acres • 1 hectare (Ha) = 2.47 acres • 1 kw-hr = 3,413 BTUs	• 1 barrel of oil = 159 Liters • 1 metric ton = 1000 kg • 1 MW (megawatt) = 1,000 kW (kilowatts)

Be sure to SHOW ALL your work!

13. 134 miles = _____ inches.
14. 1.35 kilometers per second = _____ miles per hour
15. 8.9 x 105 tons = _____ ounces
16. A city that uses 10 billion BTUs of energy each month is using how many kilowatt-hours of energy?
17. 1,000 homes are in a city. Each home uses 200 kilowatt hours a month. How many kilowatt hours does the entire city use in a month?
18. Your car gets 15 miles to the gallon and your friend's car gets 25 miles to the gallon. You decide to go on a road trip to Virginia Tech, which is 300 miles away. If gas costs $4 per gallon and you decide to split the gas money, how much money will you save in gas by driving your friend's car?

Data & Graph Analysis: Create Effective Visuals; Choosing an appropriate graph

There are several types of graphs that scientists often use to display data. They include:

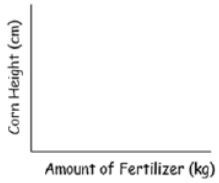
Pie Graphs	Bar Graphs	Histograms	Line Graphs	Scatter Plots
				
• Dependent variable is NOT continuous. • Usually presents data as a "part of a whole" or as percentages.	• Dependent variable is NOT continuous. • There is no order to the categories on the X-axis. • Bars typically don't touch. • Y-axis is usually a percentage or frequency (count)	• A specific type of bar graph. • Dependent variable must have a natural order that can be grouped into defined "chunks".	• Dependent variable IS continuous. • Points are plotted using x and y components. • The points are connected because the observations are NOT independent.	• Dependent variable IS continuous. • Points are plotted using x and y components. • The points are NOT connected because the observations are independent. • Uses a best-fit line or curve to show relationship.

Data & Graph Analysis: Create Effective Visuals; Labeling Axes

When labeling your axes, keep 3 things in mind:

- The independent (manipulated) variable is written along the horizontal axis (X axis)
- Dependent (responding) variable is written along the vertical axis (Y axis)
- Units on any variables should be included in parentheses ( ) following the axis title

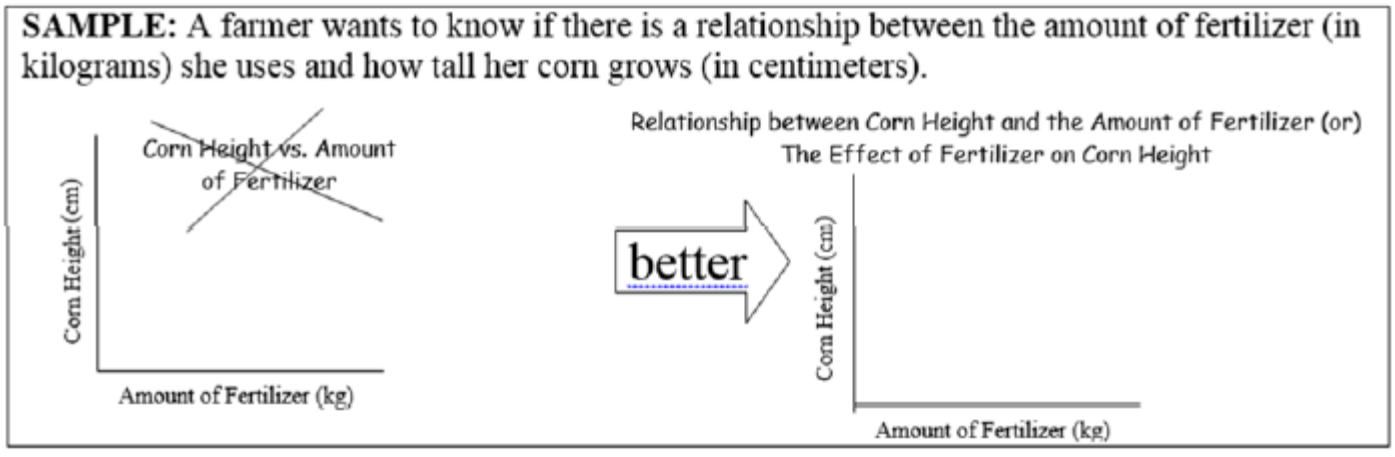
SAMPLE: A farmer wants to know if there is a relationship between the amount of fertilizer (in kilograms) she uses and how tall her corn grows (in centimeters).



Data & Graph Analysis: Create Effective Visuals; Forming Proper Titles

When writing a title for you graph, please remember

- The title must communicate the dependent and independent variables
- The title cannot be presented in the form "Y versus X"
- Some graphs need more explanation than others. Make sure your reader would be able to understand what your data represent.



Data & Graph Analysis: Create Effective Visuals; Scaling Axes

There are a few important steps involved in correctly scaling an axis:

- STEP 1: Find the range for the variable. Range = Largest Value - Smallest Value
- STEP 2: Divide the range by the number of intervals you want (not too many or too few). We don't want all of the data smooshed in only part of the graph; spread it out. After dividing, we may need to round up to get a number that is easy to count by. (It is easier to count by 2s instead of 1.9s)
- STEP 3: Use the rounded number to mark off intervals along the axis. The interval must be the same amount each time (count up by the same number).
- Determine the range for the following data sets:

EX.

Mass (g)
5
11
14
19
26
30
40

Largest #: 40

Smallest #: 5

Range: 40-5 = 35

A)

Students
100
99
88
70
72
64
55

Largest #: _____

Smallest #: _____

Range: _____

B)

Distance (cm)
3
5
6
7
9
10
12

Largest #: _____

Smallest #: _____

Range: _____

C)

Time (s)
0.22
0.51
0.78
1.01
1.23
1.60
1.74

Largest #: _____

Smallest #: _____

Range: _____

EX.

Range = 35

# of intervals = 10

$$\frac{\text{Range}}{\text{Intervals}} = \frac{35}{10} = 3.5$$

Round to Count = 4

A)

Range = _____

# of intervals = _____

B)

Range = _____

# of intervals = _____

C)

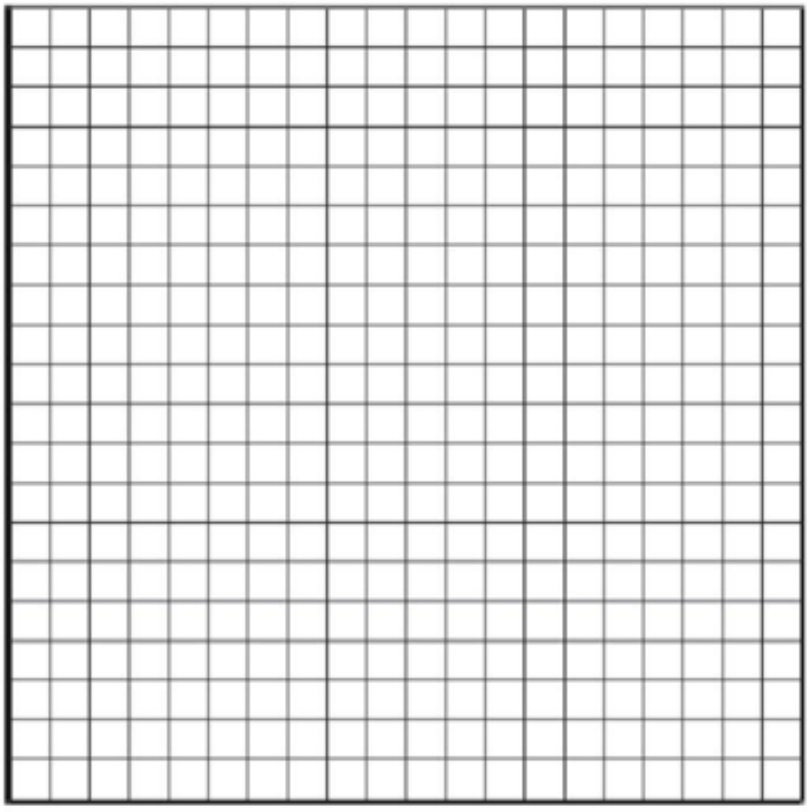
Range = _____

# of intervals = _____

Put it all together - Graph the following data set and include appropriate scale, title, and axis labels.

Plants lose water from their aboveground surfaces in the process of transpiration. Most of this water is lost from stomata, microscopic openings in the leaves. Excess water loss can have a negative effect on the growth, development, and reproduction of a plant. Severe water loss can be fatal. Environmental factors have a major impact on the rate of plant

Temperature (°C)	20	23	27	28
Transpiration Rate ($mmol/m^2.sec$)	1.5	3	5	4.5



Scientific Method Review (You may wish to refer to the FRQ & Classwork Task Verbs on page 2)

A. Below is an experiment that was designed to investigate the effect of sulfur dioxide on soybean reproduction. Answer the following question on the effective components of this experimental design.

Agricultural scientists were concerned about the effect of air pollution, sulfur dioxide in particular, on soybean production in fields adjacent to coal-power plants. Based on initial investigations, they proposed that sulfur dioxide in high concentrations would reduce reproduction in soybeans. They designed an experiment to test this hypothesis. In this experiment, 48 soybean plants, just beginning to produce flowers, were divided into two groups, treatment and no treatment. The 24 treated plants were divided into four groups of 6. One group of 6 treated plants was placed in a fumigation chamber and exposed to 0.6ppm (parts per million) of sulfur dioxide for 4 hours to simulate sulfur dioxide emissions from a power plant. The experiment was repeated on the remaining three treated groups. The no-treatment plants were divided similarly into four groups of 6. Each group in turn was placed in a second fumigation chamber and exposed to filtered air for 4 hours. Following the experiment, all plants were returned to the greenhouse. When the beans matured, the number of bean pods, the number of seeds per pod, and the weight of the pods were determined for each plant.

1. An independent variable is changed or manipulated by the scientist. Identify the independent variable?

2. A dependent variable is measured or observed. Identify the dependent variable(s)?

3. Controlled or constant variables are the same in all groups. Identify as many controls as you can.

4. Explain why replication and sample size are important considerations when designing an experiment. Describe how these scientists incorporate replication and sample size in their investigation.

5. Identify the treatment given to the control group?

6. Identify the level of treatment given to the experimental group? (This is a concentration and/or time.)

7. Describe result(s) that would support the scientists' hypothesis.

8. Describe result(s) that would force the scientists to reject the hypothesis?

B. Create an experiment to investigate a scientific question

The active ingredients in many pesticides are chemical compounds that kill organisms such as insects, molds, and weeds. Opponents of pesticides use claims that pesticides degrade water and soil quality. Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish.

9. Create a hypothesis for this scenario. (Do not use if…then statements. Include a prediction of result and propose a scientific explanation for these results. Multiple sentences are often needed.)

10. Describe the method you would use to test your hypothesis. Identify the control.

11. Identify the dependent variable(s).Describe experimental results that would lead you to reject your hypothesis. (Be specific)

III. Laboratory Materials

Each student should bring 2 ***colorless,*** 2-liter plastic bottles with labels removed completely. Do not lose the bottle caps. Each student should also bring a fist-sized insoluble rock. You may want to soak it in water to make sure it is insoluble. You may bring these items the first three days of school.

IV. Shopping

It is highly recommended that each student should order the paperback version of "The Princeton Review: AP Environmental Science Prep" (2021 or most recent Edition). You may purchase this from your preferred retailer, but you can find a link to the book on Amazon below:
https://www.amazon.com/Princeton-Review-Environmental-Science-Prep/dp/0525569545

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ISBN-10: 0525569545

We are looking forward to seeing you in the fall. Have a wonderful summer.

Chris Kesterson and Staci Killingsworth