Welcome to AP Environmental Science!

AP Environmental Science is the equivalent of a one semester introductory college or university course in environmental science where you will learn to identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems and examine alternative solutions for resolving or preventing them. Environmental Science is an interdisciplinary science with topics ranging from geology, biology, and chemistry to environmental studies, environmental science and geography.

Topic areas will include Earth systems and resources, the living world, population, land and water use, energy resources and consumption, pollution and global change. In this class, you will develop an awareness of the environment, and the human impact on it. You will learn to critically observe environmental systems, develop and conduct well designed experiments, utilize appropriate techniques and instrumentation, analyze and interpret data, including appropriate statistical and graphical presentations, think analytically and apply concepts to the solution of environmental problems, make conclusions and evaluate their quality and validity, propose further questions for study, and communicate accurately and meaningfully about observations and conclusions.

To get the most out of class and laboratory time when school begins in the fall, all students must complete the five part summer assignment described below. **The assignment is due on August 22, 2017 (even if we do not have Environmental Science on that day) and must be submitted to turnitin.com.** The class name on turnitin.com is AP Environmental Science 2017-2018, the class ID is 15312961, and the class enrollment password is Eisen-APES. There is a separate assignment on turnitin.com for Parts 1, 3, 4 and 5 below.

The textbook for the class is Environmental Science for AP, 2nd edition, by Friedland and Relyea, published by BFW. The ISBN is 978-1-4641-0868-6. You may purchase either the hard copy edition or the e-text. If you license the e-text version of the textbook, please ensure that you have access through May 30, 2018. Please note that the e-text version requires Internet access at all times – the material cannot be downloaded.

Please read and follow all directions in this assignment in order to receive full credit. During the summer, I will be available to answer questions by email at eisen@sdfa.com. However I will be out of the country from June 23 through July 15 and will only have occasional access to email during that time.
Part 1: Tragedy of the Commons

Read the essay “Tragedy of the Commons” by Garrett Hardin.

http://www.garretthardinsociety.org/articles/art_tragedy_of_the_commons.html

Write a short essay (maximum of 250 words) that answers all of the following questions. Do not include the questions in your essay. Spelling, grammar and word choice all count.

- What is Garrett Hardin’s central idea in this essay?
- Do you personally agree with Hardin’s central idea?
- Is the “Tragedy of the Commons” unavoidable?
- Identify one “commons” in your own life (at school, home, work) and explain how it is (or is not) being managed wisely to avoid the situation described in the essay.

Part 2: Math Assignment

Complete the following problems, showing all work and units. A table of conversion units is attached. Do not use a calculator (you can’t use one on the AP Exam, so you might as well start practicing your math skills now). This portion of the summer assignment must be turned in on Day 1 of class.

1. How many square centimeters are there in a square meter?
2. How many square inches are there in a square meter?
3. You may someday purchase a house that has 2500 square feet of living space. How many square meters of living space is this?
4. If a calorie is equivalent to 4.184 joules, how many joules are contained in that 200 kilocalorie slice of pizza?
5. If a city of 10,000 experiences 100 births, 30 deaths, 10 immigrants, and 20 emigrants in the course of a year, what is its net annual percentage growth rate?

Part 3: Reading Graphs and Maps

1. Read the material in the attached Supplement (S2 - S5).
2. Answer all 12 questions

Part 4: Chapter 1, Environmental Science, Studying the State of Our Earth

1. Read Chapter 1 (pages 1-26) in the text. Consider the learning objectives at the beginning of each module as you read.
2. Create an outline of the chapter that includes all bold terms along with their definitions. If there are any other words in the text that you don’t understand, look them up and make sure that you add the definitions to your outline. Your outline should cover the learning objectives in sufficient detail that you will be able to use it to study for a test, without having to re-read the text.
3. Answer AP Review Questions on pages 6, 18, and 25. For each question, indicate your letter choice and provide a one sentence explanation for why you believe that is the correct answer.

4. Complete the “Do the Math” Your Turn problems on pages 11 and 14 - bring these to class on the first day - do not post to turnitin.com

Part 5: Chemistry for APES
A basic understanding of the fundamentals of chemistry is considered background information for AP Environmental Science and will not be covered in class.

1. Read pages 31-42 (Module 4)
2. Copy the questions in the Module 4 Active Reading Guide: https://goo.gl/RhD5Zv into a google or word doc, answer the questions on that document and then save it as a pdf for posting on turnitin.com

If you have not yet taken and are not currently taking chemistry, or if you just need a refresher, I will do a crash course on this material during Pod in the first week or two of the semester.
**Supplement 1: Measurement Units**

### Length

**Metric**
- 1 kilometer (km) = 1,000 meters (m)
- 1 meter (m) = 1,000 millimeters (mm)
- 1 centimeter (cm) = 0.01 meter (m)
- 1 millimeter (mm) = 0.001 meter (m)

**English**
- 1 foot (ft) = 12 inches (in)
- 1 yard (yd) = 3 feet (ft)
- 1 mile (mi) = 5,280 feet (ft)
- 1 nautical mile = 1.15 miles

**Metric-English**
- 1 kilometer (km) = 0.621 mile (mi)
- 1 meter (m) = 39.4 inches (in) or 3.28 feet (ft)
- 1 inch (in) = 2.54 centimeters (cm)
- 1 foot (ft) = 0.305 meter (m)
- 1 yard (yd) = 0.914 meter (m)
- 1 nautical mile = 1.85 kilometers (km)

### Area

**Metric**
- 1 square kilometer (km²) = 1,000,000 square meters (m²)
- 1 square meter (m²) = 1,000,000 square millimeters (mm²)
- 1 square centimeter (cm²) = 10,000 square millimeters (mm²)
- 1 hectare (ha) = 10,000 square meters (m²)
- 1 hectare (ha) = 0.01 square kilometer (km²)

**English**
- 1 square foot (ft²) = 144 square inches (in²)
- 1 square yard (yd²) = 9 square feet (ft²)
- 1 square mile (mi²) = 27,880,000 square feet (ft²)
- 1 acre (ac) = 43,560 square feet (ft²)

**Metric-English**
- 1 hectare (ha) = 2.471 acres (ac)
- 1 square kilometer (km²) = 0.386 square mile (mi²)
- 1 square meter (m²) = 1.196 square yards (yd²)
- 1 square foot (ft²) = 0.093 square meters (m²)
- 1 square centimeter (cm²) = 0.155 square inch (in²)

### Volume

**Metric**
- 1 cubic kilometer (km³) = 1,000,000,000 cubic meters (m³)
- 1 cubic meter (m³) = 1,000,000 cubic centimeters (cm³)
- 1 cubic centimeter (cm³) = 1,000 milliliters (mL)
- 1 liter (L) = 1,000 milliliters (mL) = 1,000 cubic centimeters (cm³)
- 1 cubic meter (m³) = 1,000 liters (L)
- 1 milliliter (mL) = 0.001 liter (L)

### Energy and Power

**Metric**
- 1 kilojoule (kJ) = 1,000 joules (J)
- 1 kilocalorie (kcal) = 1,000 calories (cal)
- 1 calorie (cal) = 4.184 joules (J)

**Metric-English**
- 1 kilojoule (kJ) = 0.949 British thermal unit (Btu)
- 1 kilocalorie (kcal) = 0.000278 kilowatt-hour (kW-h)
- 1 kilocalorie (kcal) = 3.97 British thermal units (Btu)
- 1 kilocalorie (kcal) = 0.00116 kilowatt-hour (kW-h)
- 1 kilowatt-hour (kW-h) = 860 kilocalories (kcal)
- 1 kilowatt-hour (kW-h) = 3,412 British thermal units (Btu)
- 1 quad (Q) = 1,050,000,000,000,000 kilojoules (kJ)
- 1 quad (Q) = 293,000,000,000 kilowatt-hours (kW-h)

### Temperature Conversions

Fahrenheit (°F) to Celsius (°C): °C = (°F - 32.0) × 1.80

Celsius (°C) to Fahrenheit (°F): °F = (°C × 1.80) + 32.0
Graphs and Maps Are Important Visual Tools

A graph is a tool for conveying information that we can summarize numerically by illustrating that information in a visual format. This information, called data, is collected in experiments, surveys, and other information-gathering activities. Graphing can be a powerful tool for summarizing and conveying complex information.

In this textbook, we use three major types of graphs: line graphs, bar graphs, and pie graphs. Here, you will explore each of these types of graphs and learn how to read them.

An important visual tool used to summarize data that vary over small or large areas is a map. We discuss some aspects of reading maps relating to environmental science at the end of this supplement.

Line Graphs

Line graphs usually represent data that fall in some sort of sequence such as a series of measurements over time or distance. In most such cases, units of time or distance lie on the horizontal x-axis. The possible measurements of some variable or variable such as temperature that changes over time or distance usually lie on the vertical y-axis.

In Figure 1, the x-axis shows the years between 1950 and 2009, and the y-axis displays the possible values for the annual amounts of oil consumed worldwide during that time in millions of tons, ranging from 0 to 4,000 million (or 4 billion) tons. Usually, the y-axis appears on the left end of the x-axis, although y-axes can appear on the right end, in the middle, or on both ends of the x-axis.

The curving line on a line graph represents the measurements taken at certain time or distance intervals. In Figure 1, the curve represents changes in oil consumption between 1950 and 2009. To find the oil consumption for any year, find that year on the x-axis (a point called the abscissa) and run a vertical line from the axis to the curve. At the point where your line intersects the curve, run a horizontal line to the y-axis. The value at that point on the y-axis, called the ordinate, is the amount you are seeking. You can go through the same process in reverse to find a year in which oil consumption was at a certain point.

Questions

1. What was the total amount of oil consumed in the world in 1990? In about what year between 1950 and 2000 did oil consumption first start declining?
2. About how much oil was consumed in 2009? Roughly how many times more oil was consumed in 2009 than in 1970? How many times more oil was consumed in 2009 than in 1950?

Line graphs have several important uses. One of the most common applications is to compare two or more variables. Figure 2 compares two variables: monthly temperature and precipitation (rain and snowfall) during a typical year in a temperate deciduous forest. However, in this case, the variables are measured on two different scales, so there are two y-axes. The y-axis on the left end of the graph shows a Centigrade temperature scale, and the y-axis on the right shows the range of precipitation measurements in millimeters. The x-axis displays the first letters of each of the 12 months' names.

Questions

1. In which month does most precipitation fall? Which is the driest month of the year? Which is the hottest month?

Figure 1: World oil consumption, 1950–2009.

Figure 2: Climate graph showing typical variations in annual temperature (red) and precipitation (blue) in a temperate deciduous forest.
2. If the temperature curve were almost flat, running throughout the year at roughly its highest point of about 30°C, how do you think this forest would change from what it is now (see Figure 7-13, center, p. 136)? If the annual precipitation suddenly dropped and remained under 25 centimeters all year, what do you think would eventually happen to this forest?

It is also important to consider what aspect of a set of data is being displayed on a graph. The creator of a graph can take two different aspects of one data set and create two very different-looking graphs that would give two different interpretations of the same phenomenon. For example, when talking about any type of growth we must be careful to distinguish the question of whether something is growing from the question of how fast it is growing. While a quantity can keep growing continuously, its rate of growth can go up and down.

One of many important examples of growth used in this book is human population growth. For example, the graph in Figure 1-16 (p. 17) gives you the impression that human population growth has, for the most part, been continuous and uninterrupted. However, consider Figure 3, which plots the rate of growth of the human population since 1950. Note that all of the numbers on the y-axis, even the smallest ones, represent growth. The lower end of the scale represents slower growth and the higher end faster growth. Thus, while one graph tracks population growth in terms of numbers of people, the other tracks the rate of growth.

Questions
1. If this graph were presented to you as a picture of human population growth, what would be your first impression?
2. Do you think that reaching a growth rate of 0.5% would relieve those who are concerned about overpopulation? Why or why not?

Bar Graphs
The bar graph is used to compare measurements for one or more variables across categories. Unlike the line graph, a bar graph typically does not involve a sequence of measurements over time or distance. The measurements compared on a bar graph usually represent data collected at some point in time or during a well-defined period. For instance, we can compare the net primary productivity (NPP), a measure of chemical energy produced by plants in an ecosystem, for different ecosystems, as represented in Figure 4.

In most bar graphs, the categories to be compared are laid out on the x-axis, and the range of measurements for the variable under consideration lies along the y-axis. In our example in Figure 4, the categories (ecosystems) are on the y-axis, and the variable range (NPP) lies on the x-axis. In either case, reading the graph is straightforward. Simply run a line perpendicular to the bar you are reading from the top of that bar (or the right or left end, if it lies horizontally) to the variable value axis. In Figure 4, you can see that the NPP for continental shelf, for example, is close to 1,600 kcal/m²/yr.

Questions
1. What are the two terrestrial ecosystems that are closest in NPP value of all pairs of such ecosystems? About how many times greater is the NPP in a tropical rain forest than the NPP in a savanna?
2. What is the most productive of aquatic ecosystems shown here? What is the least productive?

An important application of the bar graph used in this book is the age-structure diagram (see Figure 6-11, p. 131), which describes a population by showing the numbers of males and females in certain age groups (see Chapter 6, pp. 131-132).

Pie Graphs
Like bar graphs, pie graphs, or pie charts, illustrate numerical values for two or more categories. But in addition to that, they can also show each category’s proportion of the total of all measurements. The categories are usually ordered on the graph from largest to smallest, for ease of comparison, although this is not always the case. Also, as with bar graphs, pie graphs are generally snapshots of a
Figure 4  Estimated annual average net primary productivity (NPP) in major life zones and ecosystems, expressed as kilocalories of energy produced per square meter per year (kcal/m²/yr).

(Compiled by the authors using data from H. H. Whittaker, Communities and Ecosystems, 3rd ed., New York: Macmillan, 1957.)

Figure 5  Pie graph showing world energy use by source in 2010.

data set at a point in time or during a defined time period. Unlike line graphs, one pie graph cannot show changes over time.

For example, Figure 5 shows how much each major energy source contributed to the world's total amount of energy used in 2010. This graph includes the numerical data used to construct it: the percentages of the total taken up by each part of the pie. But we can use pie graphs without including the numerical data and we can roughly estimate such percentages. The pie graph thereby provides a generalized picture of the composition of a data set.

Questions
1. Can you tell from this graph whether the use of renewable energy sources is growing or shrinking? Explain.
2. About how many times bigger is oil use than biomass use?

Reading Maps
We can use maps for considerably more than showing where places are relative to one another. For example, in environmental science, maps can be very helpful in comparing how people in different areas are affected by envi-
ronmental problems such as air pollution and acid deposition (a form of air pollution). Figure 6 is a map of the United States showing the relative numbers of premature deaths due to air pollution in the various regions of the country.

Questions

1. Which part of the country generally has the lowest level of premature deaths due to air pollution?
2. Which part of the country has the highest level? What is the level in the area where you live or go to school?

In some of the data analysis exercises that appear at the ends of the chapters in this book, you will have opportunities to apply much of the information from this supplement.

Figure 6 Map showing comparative numbers of premature deaths from air pollution in the United States.

(Compiled by the authors using data from U.S. Environmental Protection Agency)