Summer Assignment for AP Environmental Science

1. Reading Writing Critically about Environmental Science Issues

Read *The Ghost Map* and write a paper in which you focus on:

- How the water supply and delivery system in London in 1854 compares to that of Flint, Michigan in 2014, and what specific scientific solutions are indicated in each case.
- One aspect of the infrastructure of London in 1854 that you think most contrasts with the infrastructure of a modern U.S. city such as Washington, D.C.

Your paper must be written in APA format. Submit one hard copy on the first day of class; share the file as a Google Doc on or before the first day of class.

2. Math for AP Environmental Science Laboratory and Field Work

Do all math problems in a composition notebook or lab notebook, as if you were keeping records of environmental notes and data in your field notebook. Your notebook should show how you would keep records so that other scientists could follow your steps and methods, to repeat your results. Your work should therefore be neatly written and shown in an organized format. Be prepared to turn in your notebook on the first day of class.

Review Chapter 3 Exponential and Logarithmic Functions in the Larson *Pre-Calculus* Text. Borrow a text or make copies of the pages as necessary.

- Section 3.1 Exponential Functions and Their Graphs
- Section 3.2 Logarithmic Functions and Their Graphs
- Section 3.4 Solving Exponential and Logarithmic Equations
- Section 3.5 Exponential and Logarithmic Models
- Section 3.6 Nonlinear Models

Do the following problems (Larson Pre-Calculus, 7th Edition)

[Data must be plotted using Excel or other spreadsheet/graphing software]

1. Pages 190-191 problems #78, 79
2. Page 201 problem #110
3. Pages 219-220 problems #150, 151
4. Pages 229-232 problems #35-37; #45-47; #53-55
5. Page 241 problem #38
3. **Math Review for the AP Environmental Science Exam** (Complete these 35 review problems in your notebook, in a second section titled *Math Review*)

The APES Examination requires a wide variety of mathematical calculations. It is mandatory to show all the steps of your work for all calculations on the free-response section of the APES exam, even if you can do some of the problems in your head. These problems that follow are intended help to prepare you for the type of calculations you may be given on this year’s APES exam.

**No Calculators are allowed on the APES exam; therefore do not use a calculator to work these problems.**

*Scientific Notation*—Successful APES student must be able to work comfortably with numbers in scientific notation.

*Express the following numbers in scientific notation. No Calculators!*

1. one billion
2. twenty three thousand
3. 70 trillion
4. three hundred
5. 0.00025
6. 7,310,000

*Perform the following calculations in scientific notation. No Calculators!*

7. five hundred billion times thirty five thousand
8. six thousand divided by 300 billion
9. \( \frac{3.4 \times 10^{-2}}{1.7 \times 10^{-5}} \)
10. \( 1.0 \times 10^5 \)
    \( 2.0 \times 10^3 \)
11. \( (3.5 \times 10^{-2})(2.0 \times 10^{-5}) \)
12. \( (1.11 \times 10^{-5})(6.0 \times 10^9) \)

*Metric Conversions*—Successful APES student must be comfortable converting between common metric prefixes.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = nano</td>
<td>( 10^{-9} )</td>
<td></td>
</tr>
<tr>
<td>( \mu ) = micro</td>
<td>( 10^{-6} )</td>
<td></td>
</tr>
<tr>
<td>m = milli</td>
<td>( 10^{-3} )</td>
<td></td>
</tr>
<tr>
<td>k = kilo</td>
<td>( 10^3 )</td>
<td></td>
</tr>
<tr>
<td>M = mega</td>
<td>( 10^6 )</td>
<td></td>
</tr>
<tr>
<td>T = Tera</td>
<td>( 10^9 )</td>
<td></td>
</tr>
<tr>
<td>G = Giga</td>
<td>( 10^{12} )</td>
<td></td>
</tr>
</tbody>
</table>

13. \( 2.8 \text{ mm} = \_\_\_ \text{ m} \)
14. \( 1.3 \text{ nm} = \_\_\_ \text{ \( \mu \)m} \)
15. \( 300 \text{ mg} = \_\_\_ \text{ g} \)
16. \( 12 \text{ \( \mu \)g} = \_\_\_ \text{ ng} \)
17. \( 250 \text{ mL} = \_\_\_ \text{ L} \)
18. \( 400 \text{ GW} = \_\_\_ \text{ W} \)
19. \( 5 \times 10^4 \text{ kg} = \_\_\_ \text{ Mg} \)
Unit conversions—Successful APES students must be able to convert from one system of units to another.

Use the information in the table below to complete the following questions. Show all of your work including the canceling of all units. **No Calculators!**

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>1 mi$^2$ = 640 acres</td>
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<tr>
<td>1 acre = 0.405 hectares</td>
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<tr>
<td>1 barrel oil = 42 gallons</td>
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<tr>
<td>1 L = 0.264 gallons</td>
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<tr>
<td>1 kilowatt-hour = 3.4 x $10^4$ BTU= 8.6 x $10^5$ calories</td>
<td></td>
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<tr>
<td>1 metric ton (tonne) = 1 x $10^3$ kg</td>
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</tbody>
</table>

20. A 100-square mile area of Shenandoah National Forest comprises how many acres, in both standard and in scientific notation? How many hectares is this, in both standard and in scientific notation?

21. How many kilowatt-hours of energy does Norfolk, VA consume monthly, if it uses 68 billion BTUs of energy each month?

22. If a swine lagoon accidentally releases fifty-eight thousand kilograms of solid waste into the Tar River in North Carolina, what amount of solid waste is this equivalent to in metric tons, in both standard and in scientific notation?

23. One barrel of crude oil provides six million BTUs of energy. How many BTUs of energy will one liter of crude oil provide, in standard notation? How many calories of energy will one gallon of crude oil provide, in both standard and in scientific notation?

24. For crude oil, if 150 pounds of CO$_2$ is released per million BTUs of energy, how much CO$_2$ is produced by each barrel of crude oil, in both standard and in scientific notation? (use information from the previous problem)

Percentages—Successful APES students must work comfortably with percentages.

\[
\% \text{ Change} = \frac{\text{Final} - \text{Initial}}{\text{Initial}} \times 100
\]

25. Calculate the percentage growth rate for a country with a population of 6 million in a year in which it had 100,000 births, 70,000 deaths, 30,000 immigrants, and 50,000 emigrants.

26. If the concentration of mercury in a water supply changes from 65 parts per million (ppm) to 7 ppm in a ten-year period, what is the percentage change of the mercury concentration? How much per year?
27. A natural gas power plant is 60% efficient. If one cubic meter of natural gas provides 1000 BTUs of electricity, how many BTUs of waste heat were produced?

28. If 35% of a natural area is to be developed, leaving 500 acres untouched, how many acres are to be developed?

29. How many gallons are in 15 L of gasoline? What would that cost in 1987, when gas was $0.89/gal? In 2012, when gas was $3.60/gal?

30. What is the percent change in gasoline prices from 1987 to 2012?

**Data Presentation**—Successful APES students must be comfortable constructing tables, graphs and charts.

**Tables**
Tables should be used to present results that have relatively few data points. Tables are also useful to display several dependent variables at the same time. There is a title on top that describes the contents of the table, including experimental conditions. Column or Row headers include units of measure.

**Graphs**
Numerical results of an experiment are often presented in a graph rather than a table. A graph is literally a picture of the results, and trends in the data can be more easily interpreted. Generally, the independent variable is on the x-axis (horizontally) and the dependent variable is graphed on the y-axis (vertically). The effect of the independent variable on the dependent variable can then be determined.

When drawing a graph use a straight-edge or ruler, and preferably graph paper to plot points accurately. Label each axis with the name of the variable and the units it is measured. The title is descriptive of the experiment or the data shown. The intervals labeled on each axis should be appropriate for the range of the data, and must be evenly spaced.

- **Line graphs** are used to represent continuous data, those that have an unlimited number of values between data points. Data are plotted as separate points on the axes, and the points are connected together. Examples include growth over time, amounts of chemical used or changes in concentrations.

- **Bar graphs** are used to represent discrete variables, those that have a limited number of possible values. These can include things like specific locations, species of plant or animal, or types of growing conditions.

- **Pie Charts** are used when all of the parts are percentages of the whole, equaling 100%. Examples include all the types of fuels used globally, or the uses for land in the US.
Use the temperature and precipitation data provided in Table 1 to complete the questions that follow.

Table 1: Average Monthly High Temperature and Precipitation in Four Cities

(T = Temperature in °C; P = Precipitation in cm)

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairbanks, Alaska</td>
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<td></td>
<td></td>
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<tr>
<td>T</td>
<td>-19</td>
<td>-12</td>
<td>-5</td>
<td>6</td>
<td>15</td>
<td>22</td>
<td>22</td>
<td>19</td>
<td>12</td>
<td>2</td>
<td>-11</td>
<td>-17</td>
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<tr>
<td>P</td>
<td>2.3</td>
<td>1.3</td>
<td>1.8</td>
<td>0.8</td>
<td>1.5</td>
<td>3.3</td>
<td>4.5</td>
<td>5.3</td>
<td>3.3</td>
<td>2.0</td>
<td>1.8</td>
<td>1.5</td>
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<td>San Francisco,</td>
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<td>California</td>
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<tr>
<td>T</td>
<td>13</td>
<td>15</td>
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<td>18</td>
<td>18</td>
<td>21</td>
<td>20</td>
<td>17</td>
<td>14</td>
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<tr>
<td>P</td>
<td>11.9</td>
<td>9.7</td>
<td>7.9</td>
<td>3.8</td>
<td>1.8</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0.8</td>
<td>2.5</td>
<td>6.4</td>
<td>11.2</td>
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<td>San Salvador,</td>
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<td>El Salvador</td>
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<tr>
<td>T</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>34</td>
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<td>31</td>
<td>32</td>
<td>32</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>32</td>
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<tr>
<td>P</td>
<td>0.8</td>
<td>0.5</td>
<td>1.0</td>
<td>4.3</td>
<td>19.6</td>
<td>32.8</td>
<td>29.2</td>
<td>29.7</td>
<td>30.7</td>
<td>24.1</td>
<td>4.1</td>
<td>1.0</td>
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<td>Indianapolis,</td>
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<td>2</td>
<td>4</td>
<td>9</td>
<td>16</td>
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<td>30</td>
<td>29</td>
<td>25</td>
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<td>10</td>
<td>4</td>
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<tr>
<td>P</td>
<td>7.6</td>
<td>6.9</td>
<td>10.2</td>
<td>9.1</td>
<td>9.9</td>
<td>10.2</td>
<td>9.9</td>
<td>84</td>
<td>8.1</td>
<td>7.1</td>
<td>8.4</td>
<td>7.6</td>
</tr>
</tbody>
</table>

31. Compare monthly temperatures in Fairbanks with temperatures in San Salvador.
   a. Can data for both cities be plotted on the same graph?
   b. What will go on the x-axis?
   c. How should the x-axis be labeled?
   d. What should go on the y-axis?
   e. What is the range of values for the y-axis?
   f. How should the y-axis be labeled?
   g. What type of graph should be used?

32. Compare the average September temperature for the four cities in the table.
   a. Can data for all four cities be plotted on the same graph?
   b. What will go on the x-axis?
   c. How should the x-axis be labeled?
   d. What should go on the y-axis?
   e. What is the range of values on the y-axis?
   f. How should the y-axis be labeled?
   g. What type of graph should be used?

33. Using graph paper, graph the temperature and precipitation data for San Francisco.
   a. Can both sets of data be plotted on the same graph?
   b. What will go on the x-axis?
   c. How should the x-axis be labeled?
   d. What should go on the y-axis?
   e. What is the range of values on the temperature axis?
   f. How should this axis be labeled?
   g. What is the range of values on the precipitation axis?
   h. How should this axis be labeled?
   i. What type of graph should be used?
Interpreting Data—Successful APES students must be able to read and interpret the information presented in a variety of ways, including graphs and tables.

Once you understand how graphs are constructed, it is easier to get information from the graphs in the textbook or other resources, as well as to interpret the results you obtain from experiments. Use the information presented in the graphs to answer the questions that follow them.

34) a. Describe what the graph shows. (Describing means to look at the overall picture presented, or the trend in the data. What is happening? Interpret the graph; do not just repeat the title.)
   b. What was the world’s population in 1900? What was the world’s population in 2010?
   c. Assuming that the population trend continues, predict the world population in 2025. Do you think this is likely to occur? Defend your answer.
35) a. Describe what the graph shows.

   b. At what latitude does the least variation occur?
   c. Miami is at approximately 26° N latitude. From the information on the graph, what is the range in mean monthly temperature there?
   d. Moorestown is at approximately 40° N latitude. From the information on the graph, what is the range in mean monthly temperature there?
   e. Sydney, Australia is at approximately 33° S latitude (-33° on the graph). From the information on the graph, what is the range in mean monthly temperature there?
   f. Which hemisphere, the northern or the southern, has the greatest range in monthly temperatures? Why does this occur?