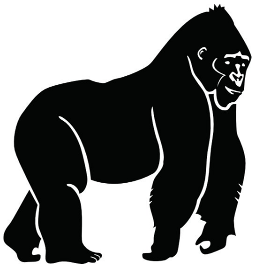
Welcome to AP Environmental Science!!

We are so excited that you've decided to take APES in the 2023-2024 school year. Yes, from now on we will often refer to it as APES, because there has never been a better acronym for something ever.



Environmental science is an engaging, relevant, hands-on subject, but also a very broad topic. In order to cover all of the topics and skills necessary for the AP test, before you leave for summer break, I wanted to let you know about a few things that you might want to practice over the summer. Here are skills you should come into class with in August in order to have a successful year in APES:

- Dimensional Analysis/Stoichiometry
- Interpreting results from data tables and graphs
- Application of scientific thinking to unfamiliar situations
- Presentation skills to discuss current events & controversial topics
- Timed Multiple Choice Assessments
- Timed Free Response Questions
- Taking notes independently
- You will be required to keep an organized scientific notebook/binder

The math required for APES is based on skills you should already have from prior math and science classes. I have included some practice problems for you to self-assess your prerequisite math skills for APES, math skills will not be directly taught in class, you are expected to have these skills and come to tutorials if you need to improve them.

There will be resources available to help you review and practice these concepts once school starts. It would be a good idea to complete the attached assignments if you can.

<u>Materials you will need for next year</u>: Binder or Folder, composition notebook (you will be required to keep your notes organized in a notebook), pencil and multiple colors of pens or colored pencils, scientific calculator. You will also need a laptop or chromebook every day.

APES is now taught using College Board approved Project Based Learning Curriculum, here is an idea of the projects we will complete in APES:

- Course Introduction: What does sustainability mean?
- Ecological Footprint: How can my family reduce our ecological footprint?
- My Community Ecology: How can our community develop more sustainably?
- Food Systems: How can we meet the needs of our growing human population while sustaining ecosystems and the quality of our soil and our water?
- Oceans in Action: How can we balance the needs of humans with the needs of the oceans?

If you have questions or need help with anything, please email either one of us. See you in August!

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1) *The first assignment* is to review some of the basic concepts that we will be using throughout the year. You should have already been introduced to these concepts in previous science and math classes, but you will need to have a strong grasp of them and be ready to apply them at the start of the school year. You are expected to understand the definitions of each of these terms and how to do the basic calculations. You can write out all the definitions, make graphic organizers to help you understand groups of the terms, etc.

Common SI Units of Measurement

What is being measured	Unit Name	Unit Symbol	What is being measured	Unit Name	Unit Symbol
Length		m	Amount of substance		mol
Mass		g	Volume		l
Time		s	Energy/Work		J
Temperature		℃			
	Kelvin	K **note there is NO degree symbol!			

SI prefixes

Factor	Name	Symbol	Factor	Name	Symbol
giga-	10^{9}		nano-	10^{-9}	
mega-	10^{6}		micro-	10^{-6}	
kilo-	10^{3}		milli-	10^{-3}	
hector-	10^{2}		centi-	10^{-2}	
deka-	10^{1}		Deci-	10^{-1}	

Prerequisite Math Skills

Dimensional Analysis is the analysis of the relationships between different physical quantities by identifying their base quantities (such as length, mass, time, and electric charge) and units of measure (such as miles vs. kilometers, or pounds vs. kilograms) and tracking these dimensions as calculations or comparisons are performed. The conversion of units from one dimensional unit to another is often easier within the metric or SI system than in others, due to the regular 10-base in all units. Dimensional analysis, or more specifically the factor-label method, also known as the unit-factor method, is a widely used technique for such conversions using the rules of algebra.

Example: In Raiders of the Lost Ark, Indiana Jones tried to remove a gold idol from a booby-trapped pedestal. He replaces the idol with a bag of sand. If the idol has a mass of 2.00 kg, how many liters of sand must he place on the pedestal to keep the mass sensitive booby-trap from activating? (Density of sand is 3.00 g/cm3)

1. $\frac{1 \text{ Liter}}{1000 \text{ mL}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{1 \text{ cm}^3}{3.00 \text{ g}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{2.00 \text{ kg}}{\text{idol}}$

2. $\frac{1 \times 1 \times 1 \times 1000 \times 2}{1000 \times 1 \times 3 \times 1}$

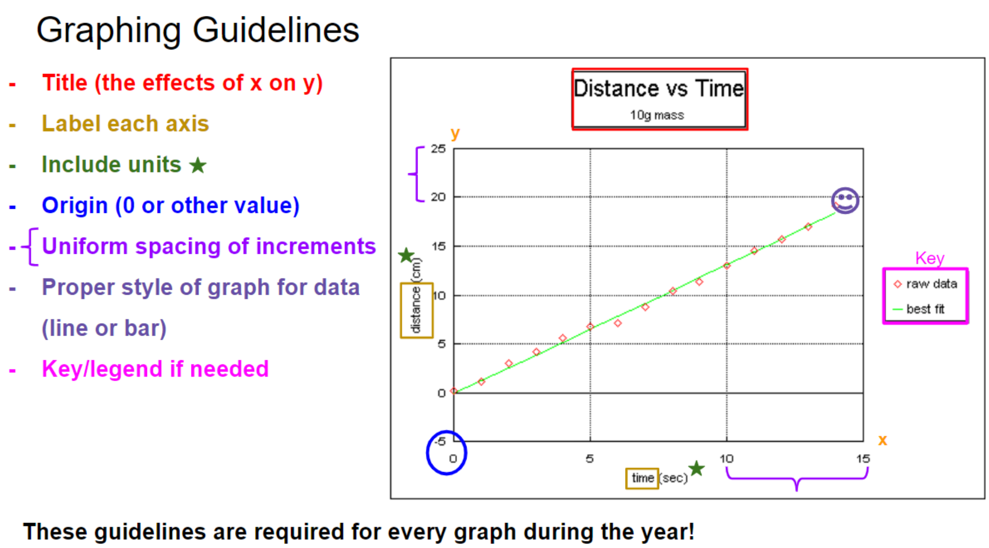
3. $\frac{2000}{3000}$ = 0.667 Liters of sand = weight of the idol

Graphing is a large part of science where you will display results in a visual way. The basic types of graphs are:

1. Line: show changes that take place over time or for representing trends in data (positive or negative correlations). Line graphs are used when data is continuous, like your growth throughout a lifetime.
2. Bar: used for comparisons and representations of data. The length of the bar is represented by the numeric scale on the axis.
3. Pie: represent percentages

To have a correct graph you must have few things:

1. Title (descriptive title of what your graph is showing)
2. X & Y axis properly labeled (x=dependent variable or time, y=independent variable) with corresponding units of measurements
3. Legend or key if applicable
4. Equal scaling



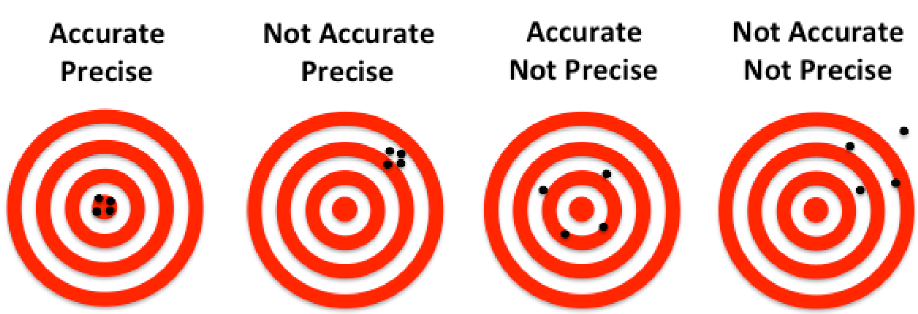
Accuracy and Precision

Two important aspects of scientific measurements are **accuracy** and **precision**. These terms are sometimes used interchangeably, but in fact have very different meanings:

Accuracy is how close a measured value is to the actual value

Precision is how close multiple measurements are to each other

To illustrate the differences between these two concepts, observe the dartboard examples below:



In words, if your measurements are *inaccurate*, it means that they are not close to what the actual value is. For example, a piece of wood that is actually 1.3 meters long is measured as being 1.74 meters long. If your measurements are *imprecise*, it means that when you perform the same measurement multiple times, you get different answers. For example, if three people measured the length of the same piece of wood and got 1.74 m, 1.24 m, and 1.14 m. In science, it is important to use laboratory practices that ensure both accuracy and precision, and to be able to identify when your data are inaccurate and/or imprecise. Accuracy means your measurements are close to the real value, and precision is showing that your measurements are consistent.

Scientific Notation

Scientists often express figures in scientific notation in order to easily work with numbers of small and large magnitude, and easily express the number of significant digits. The anatomy of a number in scientific notation is as follows:

$$4.6 \times 10^5$$

Coefficient Base Exponent

To convert a number written in standard form to scientific notation, place the decimal immediately after the first digit of the number, and drop all non-significant zeros (review significant figures if needed…). This becomes the coefficient.

Example 1: 85,000 □ 8.5 Example 2: 0.000004021 □ 4.021

Next, count the number of places the decimal has been moved, remembering that for a number that does not have a decimal you assume it to be at the very end (on the right). This number will become the exponent. (The base will ALWAYS remain a 10.) If you moved the decimal to the left then the exponent will be positive; if you moved the decimal to the right then the exponent will be negative.

Example 1: Decimal moved 4 places to the left, so exponent is 4. 85,000 □ 8.5×10^4

Example 2: Decimal moved 6 places to the right, so exponent is -6. 0.000004021 □ 4.021×10^{-6}

A number in scientific notation will enable you to write a very large or very small number in a much more concise form. Compare 34,000,000,000,000,000 to 3.4×10^{16}! One of the first math skills we will practice next year will be doing basic math in scientific notation as well.

To convert a number in scientific notation back to standard form, write the coefficient without the decimal. If the exponent is a positive number, move the decimal that many places to the right, adding zeroes as needed. If the exponent is a negative number, move the decimal to the left that many places, adding zeroes as needed. **Please note that you are moving the decimal a certain number of places, not just adding that number of zeroes!**

Example 1: 7.21×10^5 □ 721,000 Example 2: 9.205×10^{-3} □ 0.009205

Percentage

Percent means "for every 100" or "out of 100." The (%) symbol as a quick way to write a fraction with a denominator of 100. As an example, instead of saying "it rained 14 days out of every 100," we say "it rained 14% of the time." Since percentages are often thought of as parts of a larger whole thing, there can be a tendency to divide instead of multiply when faced with a problem such as "find 35% of 80." An important tip is to remember that the word "of" always means "multiply". An understanding of percent also allows you to estimate to check whether your answer is reasonable. In this example, knowing that 35% is between one-quarter and one-half would mean the answer should be somewhere between 20 and 40.

As a percent is a fraction of a whole (the whole is always 100%) it can be written as a decimal. To write a percentage as a decimal simply divide it by 100 (or move the decimal two places to the left). 50% becomes 0.5; 20% becomes 0.2; 1% becomes 0.01 and so on. We can calculate percentages using this knowledge: 50% is the same as a half, so 50% of 10 is 5 - as five is half of 10 (10 ÷ 2). The decimal of 50% is 0.5. So another way of finding 50% of 10 is to say 0.5 x 10. Another example: 17.5% of 380 = 380 × 0.175 = 66.5.

You need to be comfortable with the following types of problems:

1) Finding a given percent of a number. Ex: What is 45% of 2,500?

To solve this kind of problem, remember that the word "of" means multiply, and that the % symbol means "divide by 100". So, 45% of 2,500 is 45/100 x 2,500 or 0.45 x 2,500 = 1,125. Remember to check your answer for reasonableness. You know that 45% is a little under ½. 2,500 / 2 = 1,250. So 1,125 is a reasonable answer.

2) Determine what percent of a whole that a number is. Ex: 54 is what percent of 75?

For this problem, think of it as an algebra problem and remember, "of" means multiply. So, 54 = ? x 75. To solve for the unknown, we need to divide 54/75 = 0.72 which converts to 72%. Again, think about whether this is reasonable. You know that 50 would be 2/3 or 67% of 75, so it is reasonable that 54 would be 72%.

3) Solving for the whole when given a percent and the part. Ex: You have 15 pencils remaining, which is only 30% of the amount you originally had. How many were there originally?

Again, set this up as an algebra problem, remembering how to convert a percent into a decimal. So, 15 = 0.30 x ? This means we need to divide 15/0.30 = 50. Does this answer make sense? First of all, our answer should be larger than the amount remaining, and it is. Another way to check that it makes sense is to think about how 50 x 2 = 100 and 15 x 2 = 30.

4) Finding the Percent Change is another important math skill required for the APES Exam:

$$\text{Percent Change} = \frac{|\text{New Value - Old Value}|}{\text{Old Value}} \times 100$$

Example 1: Ann works in a supermarket for $10.00 per hour. If her pay is increased to $12.00, then what is her percent increase in pay?

Analysis: When finding the percent increase, we take the absolute value of the difference and divide it by the original value. The resulting decimal is then converted to a percent.

Solution: $\frac{12 - 10}{10} = \frac{2}{10} = 0.20 = 20\%$

Answer: The percent increase in Ann's pay is 20%.

APES Math Practice:

The total wind power capacity in the United States in 2000 was about 2540 MW. By 2015, the total wind power capacity in the United States was about 72,500 MW. Calculate the percent change in the total wind power capacity in the United States from 2000 to 2015. Show your work.	A wind turbine has a capacity of 3MW. Assuming the turbine operates at 50 percent of its capacity all day and every day for a week, calculate how many kWh of electricity the wind turbine will produce by the end of the week. Show your work.

If a typical house uses 10,900 kWh per year, calculate how many houses could have their full energy needs provided for one year by the turbine above if it continued to operate as described for one year. Show your work.	In many parts of the United States, homeowners use a significant portion of their energy budget to heat their home in the winter. It has been determined that lowering a thermostat by 3°F in the winter can reduce the energy costs by about 10 percent in many homes. An individual homeowner lowers their thermostat by 3 degrees exactly halfway through the billing period. For the month that the thermostat was lowered, the heating bill was $95. How much money did the family save in the month in which they lowered the thermostat setting halfway through the billing period?
A family of four lives in a three-bedroom house and uses an average of 900kWh of electricity per month. The family cools their house for three months during the summer with two window-unit air conditioners that each use 350kWh of electricity per month. What is the percentage of the family's total annual electricity that is used to run the two air conditioners for the three summer months?	Crude oil released from the well washed up on approximately 1,313 miles of coastline around the Gulf of Mexico. The total length of the coastline of the Gulf of Mexico is approximately 3,540 miles. Calculate the percentage of the coastline along the Gulf of Mexico that was directly affected by the *Deepwater Horizon* oil spill.
Crude oil escaped from the well at an average rate of 60,000 barrels per day. Calculate how many barrels of crude oil flowed from the well from May 1 to May 31, 2010.	An oil refinery can refine about 20 gallons of gasoline from one barrel of crude oil. If an automobile has a fuel economy of 25 miles per gallon, calculate the maximum number of miles an automobile could theoretically travel using the quantity of gasoline that could have been refined from the crude oil that escaped from the well in May of 2010.

2) ***Understanding vocabulary terms*** is a key skill in science. These are some terms you should already be familiar with.

Prerequisite Vocabulary

Adaptation
Aerobic
Anaerobic
Autotroph
Biodiversity
Biomass
Biome
Biosphere
Carrying capacity
Cellular respiration
Climate
Community
Conservation
Consumer
Decomposer
Ecosystem
Food web
Fossil fuel
Gene
Gene pool
Habitat
Heterotroph
Kinetic energy
Latitude
Law of Conservation of Matter
Mutation
Natural selection
Niche
Organism
Photosynthesis
Plate tectonics
Pollution
Population
Potential energy
Producer
Toxic
Trait
Trophic level
Weather

3) ***Common chemical elements, ions, and compounds*** should be recognized quickly. For each of the following, determine its name, identify what type of substance it is, and how it is important to environmental science (e.g. common pollutant, source of energy, etc.)

Chemical Formula	Name	Element, Compound, or Ion?	Importance to Environmental Science
C			
$C_6H_{12}O_6$			
CH_4			
CO			
CO_2			
H_2O			
K			
N			
N_2			
NaCl			
NH_3			
NO_3^-			
O			
O_2			
O_3			

P			
Pb			
S			
SO_2			

4) Understanding the Scientific Method is a very large part of any science class. The scientific method is a process for experimentation that is used to explore observations and answer questions. Does this mean all scientists follow exactly this process? No. Some areas of science can be more easily tested than others. For example, scientists studying how stars change as they age or how dinosaurs digested their food cannot fast-forward a star's life by a million years or run medical exams on feeding dinosaurs to test their hypotheses. When direct experimentation is not possible, scientists modify the scientific method. In fact, there are probably as many versions of the scientific method as there are scientists! But even when modified, the goal remains the same: to discover cause and effect relationships by asking questions, carefully gathering and examining the evidence, and seeing if all the available information can be combined into a logical answer. The steps for the scientific method are as follows:

1. Make an observation
    a. The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where?
2. Background research/ask a question
    a. Rather than starting from scratch in putting together a plan for answering your question, you want to be a savvy scientist using library and Internet research to help you find the best way to do things and ensure that you don't repeat mistakes from the past.
3. Form a hypothesis
    a. Remember a hypothesis is a statement, not a question. It is an educated guess about how things work. it is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction: "If _____[I do this] _____, then _____[this]_____ will happen."
4. Design an experiment
    a. Your experiment tests whether your prediction is accurate and thus your hypothesis is supported or not. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all other conditions the same.
5. Gather data
6. Analyze data & draw conclusions
    a. Once your experiment is complete, you collect your measurements and analyze them to see if they support your hypothesis or not.
    b. Scientists often find that their predictions were not accurate and their hypothesis was not supported, and in such cases they will communicate the results of their experiment and then go back and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again. Even if they find that their hypothesis was supported, they may want to test it again in a new way.
7. Submit for peer review

It will be important to recognize variables as well

- Independent variable: variable that is manipulated or changed by the scientist
- Dependant variable: variable that is observed or measured in the experiment
- Control group: setup that is exposed to normal conditions
- Constant variables: variables that remain the same