AP Environmental Science
Summer Assignment
2018-2019 School Year

Welcome, AP Science Scholars, to AP Environmental Science! I am very excited to get to know you all over the coming year. I have very high expectations for each and every one of you, so please be ready to put in the work over the course of the next school year. APES is a course that has a lot of content for us to cover, and I expect you to take the initiative to understand all of the content I ask you to work with. Please make sure to read this document in its entirely to best prepare your summer work – it may be very different from a traditional summer assignment. Please let me know if you have any questions!

Sincerely,
Mr. Branden Anglin
banglin@pasco.k12.fl.us

Task 1: Environmental Research Project (ERP) Topic

DUE: Three ERP topic ideas, turned in digitally on Monday, August 13th by 11:59pm

As one of the premier AP Science Scholars at Wiregrass Ranch High School, you are expected to engage in collegiate-level scientific research. Because this course is specifically focused on the environment, your scientific research must attempt to positively impact our environment. You are free to choose your topic, but it must be something original to you. Please do not attempt to complete a research project that has been found online. I have included three redacted abstracts from previous environmental research projects to give you inspiration in regards to the quality of research I expect from each of you. You will be asked to submit three potential ERP topics on the first day of school, so be please be prepared.

Task 2: Global Map

Assessed on Summer Assignment Test during first week of school.
Tentative Date: Wednesday, 8/15

Because we will be discussing environmental issues throughout the world, a working knowledge of world geography is essential. All AP Environmental Science students must know the names and locations of the following on a map of the world: all continents, all oceans, major seas and lakes (Caribbean Sea, Gulf of Mexico, Mediterranean Sea, Arabian Sea, Black Sea, all 5 Great Lakes, Caspian Sea, Aral Sea), major rivers and river systems (Amazon, Nile, Mississippi (also Missouri and Ohio Rivers), Yangtze, Ganges, Yellow), major mountain chains (Rockies, Andes, Appalachians, Alps, Urals, Himalayas), and approximate locations of some major world cities (New York, Los Angeles, Mexico City, London, Tokyo, Shanghai).

Task 3: Environmental Legislation

Assessed on Summer Assignment Test during first week of school.
Tentative Date: Wednesday, 8/15

Please be familiar with the impacts of each of the following pieces of legislation:

1. Clean Air Act
2. National Environmental Policy Act
3. Clean Water Act
4. Endangered Species Act
5. Convention on International Trade in Endangered Species of Wild Flora and Fauna
6. Safe Drinking Water Act
7. Resource Conservation and Recovery Act
8. Comprehensive Environmental Response, Compensation, and Reliability Act
9. Montreal Protocol
10. Kyoto Protocol

Task 4: Important Background Vocabulary

Assessed on Summer Assignment Test during first week of school.
Tentative Date: Wednesday, 8/15

Please be familiar with the definition of each of the following vocabulary terms:

environment
environmental science
ecology
ecosystem
environmentalism
sustainability
natural capital
natural resources
nutrient cycling
per capita
resource conservation
sustainable yield
environmental degradation
tragedy of the commons
pollution
point source
nonpoint source
output pollution control
input pollution control
poverty
environmental ethics
inductive reasoning
deductive reasoning
paradigm shift
pH
organic compounds
acidity
inorganic compounds
nuclear fission
law of conservation of matter
first law of thermodynamics
second law of thermodynamics
positive feedback loop
negative feedback loop
tipping point
synergy
ecology
species
population
community
genetic diversity
habitat ecosystem
biosphere
geosphere
biome
natural greenhouse effect
abiotic
biotic
range of tolerance
limiting factor
trophic level
formula for photosynthesis
formula for respiration
anaerobic respiration
detritivore
omnivore
decomposer
food web
food chain
biomass
ecological efficiency
net primary productivity
transpiration
aquifer

Task 5: APES Mathematics

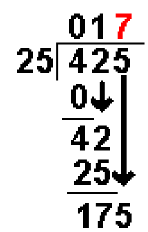
Assessed on Summer Assignment Test during first week of school.
Tentative Date: Wednesday, 8/15

AP Environmental Science is currently the only AP Science class that **DOES NOT** allow calculators on the AP Exam. Subsequently, we will not be using calculators in our course. Please refer to the "APES MATH TIPS for the AP Exam" for 21 important tips for the AP Exam. These tips will be a consistent theme in our course. I expect you to be familiar with all of these tips for your Summer Assignment test. Any of the 21 tips could show up on our first exam, and all subsequent exams.

APES MATH TIPS for the AP Exam

APES students are asked to demonstrate their sense of math by calculating their answers by hand and showing work instead of using a calculator. Numbers lose their meaning too often when students become completely calculator-dependent. Practice!

1) **Show all *work*.** No work, no credit.
2) **Show all *units*.** Units provide valuable information.
3) **Be proficient at *unit manipulation***, also called ***dimensional analysis*** or ***factor label***. This is one of the most important math skills, because you will have to fit numbers with units together through multiplication and division to get the desired results.
4) **Know *simple conversion factors*** such as the number of days in a year or hours in a day.
5) Populations to know (approximate): World, U.S., China, India, Indonesia, Brazil
6) ***Add, subtract, multiply,* and *divide* numbers without a calculator.** Multiplication and division are usually seen more than addition and subtraction. The math is able to be done without a calculator, but because students use calculators so much, even advanced students can be awkward when doing long division by hand. Watch the proper placement of the numbers. For 425/25, see the setup from www.mathisfun.com →



   Dividend (long division) is analogous to numerator (fractions)
   Divisor (long division) is analogous to denominator (fractions)

   When dividing by a decimal, move the decimal point to the right in the divisor to create a whole number. Then move the decimal point the same number of places in the dividend.
7) **Develop good *"math sense"* or *"math literacy."*** The answers should make sense. If you calculate a cost of $50 billion per gallon of water, does this seem right?

8) **Know and convert *metric prefixes*.**

T	tera-	10^{12}	(trillion 1,000,000,000,000)
G	giga-	10^{9}	(billion 1,000,000,000)
M	mega-	10^{6}	(million 1,000,000)
k	kilo-	10^{3}	(1000)
h	hecto-	10^{2}	(100)
da	deka-	10^{1}	(10)
d	deci-	10^{-1}	(0.1)
c	centi-	10^{-2}	(0.01)
m	milli-	10^{-3}	(0.001)
µ	micro-	10^{-6}	(one-millionth 0.000001)
n	nano-	10^{-9}	(one-billionth 0.000000001)
p	pico-	10^{-12}	(one-trillionth 0.000000000001)

9) Understand common statistical terms. The **mean** is the mathematical average. The **median** is the 50^{th} percentile, which is the middle value in the distribution of numbers when ranked in increasing order. The **mode** is the number that occurs most frequently in the distribution.

10) **Be comfortable working with *negative numbers*.** Going from -8 ºC to +2 ºC is a 10º change.

11) **Recognize units of *area* and *volume*, and be able to *convert volumes*.**

1 m = ____ mm… answer → 1000

1 m^3 = ____ mm^3 answer → 1^3 m^3 = 1000^3 mm^3 $(10^3)^3 = 10^9$ mm^3

For area conversions, square the number, square the unit. For volume conversions, cube the number, cube the unit.

12) **Calculate *percentages.*** Example: 80/200 = 40/100 = 0.4 = 40%

13) **Work *scientific notation problems* without a calculator.** M x 10^n

Scientific notation does not have to follow the strict format of M being between 1-9.9.
300 million can be written 300 x 10^6.

a) **Put very large or very small numbers into scientific notation.**
Writing out many zeroes increases the chance of errors.
310,000,000 = 310 million = 310 x 10^6 = 3.1 x 10^8
0.000 000 000 000 097 = 9.7 x 10^{-14}

b) **Watch decimal places and zeroes in your answer.**
200 x 600 = 120,000 (2 x 10^2) x (6 x 10^2) = 12 x 10^4 which is still 120,000

c) **Multiplication and division** will be common. Multiplying numbers in scientific notation requires the exponents to be added. Dividing numbers in scientific notation requires exponents to be subtracted.

d) **Addition and subtraction** – the exponents must be the same value.

(3.6 x 10^5) + (4.9 x 10^7) = [(0.036 x 10^2) x 10^5] + (4.9 x 10^7) = 4.936 x 10^7 OR
(3.6 x 10^5) + (4.9 x 10^7) = (3.6 x 10^5) + [(490 x 10^{-2}) x 10^7 = 493.6 x 10^5

14) **Know growth rate calculations.** (see 2003 FRQ #2)

Growth rate = [CRUDE BIRTH RATE + immigration)] – [(CRUDE DEATH RATE + emigration)]

CBR = crude birth rate = # births per 1000, per year
CDR = crude death rate = # deaths per 1000, per year
(CBR – CDR) / 10 = percent change

15) **Calculate percent change:**

a) The rate of change (**percent change**, growth rate) from one period to another =

$[(V_{present} - V_{past}) / V_{past}] * 100$ (where V = value)

b) **Annual rate of change:** take answer from step a) and divide by the number of years between past and present values

Example: A particular city has a population of 800,000 in 1990 and a population of 1,500,000 in 2008. Find the growth rate of the population in this city.

Growth Rate = [(1,500,000 - 800,000) / 800,000] * 100 = 700,000/800,000 * 100 = 87.5% OR

$\frac{(1,5~~00,000~~ - 8~~00,000~~)}{8~~00,000~~}$ x 100 = $\frac{15-8}{8}$ x 100 = 7/8 x 100 = 87.5%

Average Annual Growth Rate = 87.5% / 18 years = 4.86 %

16) **Calculate percent difference.**

$$\textbf{Percentage Difference} = \left| \frac{\textbf{First Value - Second Value}}{\textbf{(First Value + Second Value) / 2}} \right| \times \textbf{100\%}$$

17) **Know the *Rule of 70* to predict doubling time.**

Doubling time = 70 / annual growth rate (in %, not decimal!) Example: If a population is growing at a rate of 4%, the population will double in 17.5 years. (70 / 4 = 17.5)

18) **Determine *half-life* without a calculator.**

AMOUNT REMAINING = (ORIGINAL AMOUNT)(0.5^x) where x = number of half-lives

Example: A sample of radwaste with a half-life of 10 years has an activity level of 2 Ci (curies). How many years will it take for the sample to have an activity level of 0.25 Ci?

Answer: 2 Ci → 1 Ci (one half-life = 10 yrs.)
1 Ci → 0.5 Ci (another half-life = 10 additional yrs.)
0.5 Ci → 0.25 Ci (another half-life = 10 additional yrs.) = 30 years

19) **Calculate pH using –log [H^+].** $\log_{10} x = y$ and $10^y = x$.

Any pH problems are easily solved without a calculator. Remember that for every one-increment change in pH, the ions change by a factor of 10.

Example: If [H^+] is 10^{-6} M, the pH is 6 and the solution is a weak acid.

20) **Know that "*per capita*" means per person; per unit of population.**

21) **Graphing tips:** include a title and key; set consistent increments for both axes; connect dots for a smooth curve; show dots clearly; know how to use a scatterplot; interpolate and extrapolate; be comfortable with graphing by hand. Almost all APES exam graphs are line graphs.

ERP Model Abstracts

Each of these abstracts was generated by a high school student who attended the INTEL International Science and Engineering Fair, and who was recognized for their work. This is the premiere scientific research competition. I fully expect that the quality of your ERPs be similar to these. Use these as inspiration! I strongly encourage you to take full ownership of this and extend what you think you are capable of.

Abstract 1:
An Innovative Crowdsourcing Approach to Monitoring Freshwater Bodies

Freshwater pollution is a major environmental threat across the globe, exacerbated by the lack of ongoing scientific data about health of freshwater bodies. One way to address this problem is to crowdsource monitoring of freshwater bodies to interested citizens. To enable this I developed an integrated mobile phone app and a highly cost-effective monitoring kit consisting of an electronic sensing device and chemical test strips. The Arduino microcontroller based electronic device measures total dissolved solids, electrical conductivity, salinity, dissolved oxygen, and temperature of a water sample, and transmits this data to a mobile app via Bluetooth. The app also measures levels of pH, Hardness, Alkalinity, total Chlorine, total Bromine, free Chlorine, Iron, Copper, Phosphates, Nitrates, and Nitrites using a novel mobile camera based color detection and contaminant mapping method that avoids human subjectivity in detecting color changes in chemical test strips. The mobile app geo-tags and uploads all collected data to a global cloud platform that enables interactive monitoring, selection, and visualization of fresh water bodies using maps, time periods of interest, or contamination levels. The platform also classifies the overall health of a water body, determines usability of water for various purposes, compares detected contaminant levels against permissible limits, generates recommended actions for a polluted water body based on monitored parameters, and tracks water conditions before and after specific actions. Crowdsourced data from school children who monitored ten lakes over several months, along with accuracy tests, showed that this end-to-end monitoring system indeed provides reliable data and valuable insights on changing conditions of freshwater bodies.

Awards Won: U.S. Agency for International Development: USAID Global Development Innovation First Place Award of $3000 ASU Rob and Melani Walton Sustainability Solutions Initiatives: Award of $2,500 King Abdul-Aziz & his Companions Foundation for Giftedness and Creativity: Award of $1,000 for Water Technology

Abstract 2:
Estimating CO2 and CH4 Emissions from Washington DC Using Low Cost Sensors and Small Drone Technology

Anthropogenic emissions of methane (CH_4) and carbon dioxide (CO_2) especially from large cities have resulted in the build-up of greenhouse gas concentrations responsible for climate change. Existing greenhouse gas sensor technology is both too heavy and expensive for large-scale use in urban areas, and current platforms for measurement are limited in height and stability. In this project, I present the construction and calibration of an inexpensive methane and carbon dioxide sensor. A small lowpowered drone was designed and built to serve as a stable platform for accurate measurements. An atmospheric transport/inversion model to estimate emission inventories for large cities using data collected by drones and tower networks was developed. Low-cost sensor data compared favorably with state-of-the-art instruments (correlation factor = 0.99), and exhibited expected diurnal cycles and traffic patterns. Successful flight demonstrates the potential for sensor-mounted drones to make continuous atmospheric measurements. The predicted CO_2 emission inventory for Washington DC showed a large contribution from the transportation sector. Overall, I demonstrate a methodology to measure and monitor city-wide CO_2 and CH_4 emissions by combining low-cost lightweight sensors, small drone technology and mathematical models, and taking the first step to targeting specific greenhouse gas sources and reducing overall emissions.

Awards Won: American Meteorological Society: First Award of $2,00

Abstract 3:
The Effect of EDTA Chelation as a Desorption Mechanism

Due to the constant lead poisoning of civilians around the world, the field of biosorption as a purification method is quickly growing and developing. This process is done using common baker's yeast, Saccharomyces cerevisiae, to absorb lead nitrate ions from a sample of water and purify it. However, in many areas where this mechanism is needed, such as in third-world countries, a plethora of yeast is not available for this use-conservation of the materials possessed is key. Ethylenediaminetetraacetic acid (EDTA) is an antioxidant, commonly used in treating heavy metal poisoning in the body. The goal of this experiment is to determine the effectiveness of EDTA chelation by testing samples of yeast with different concentrations of EDTA (low- 1 gram/liter, medium (1.5 grams/liter, and high (2 grams/liter). Procedurally, samples of yeast that have already absorbed lead ions will be treated with EDTA and tested to estimate the efficiency of the EDTA chelation mechanism as a desorbing agent. The hypothesis states that the highest concentration of EDTA will produce the highest ppm desorbed. After the desorption process finishes, the samples of water will be tested, using a lead indicator solution and a colorimetry scale, for the concentration of lead. The results of the experiment did show that the EDTA chelation was extremely effective at removing the metal ions from the yeast cells, and the high concentration was the most effective and can be employed in the water crises of many third world countries, possible improving the biosorption process for the future.

Awards Won:
Drexel University: Full tuition scholarship $194,00