Name_____

AP Biology Summer HW

Dear AP Biology student,

Welcome! I'm looking forward to spending next year with you. In order to prepare you for the rigorous nature of AP Biology, I am asking you to complete four tasks in order to give you some background information that will aid in your success. Everything needs to be completed before the 1st day of class in August.

- ❑ Pick up the summer HW packet (good job, this is done already!). Please read this first page thoroughly and check off each of the following items as you complete them.

- ❑ Visit the class website and save the site as a "bookmark" on your browser. We will access this website everyday! **http://jeffreybuckingham.wixsite.com/bhsscience**. Navigate to the AP biology resources page and click on the summer homework button. There you will find all the resources for this summer homework.

- ❑ Check out the required textbook before summer break from the library. *Biology in Focus* by Urry, et al.

- ❑ Introductory Content: (all required videos are in the summer HW folder on the website)
  - ❑ **Ecology:** (a) read textbook chapters 40-43, (b) complete the ecology packet (attached) to this document, (c) watch and take notes on the videos posted on the website. You should reference the equations page posted to the back of this packet.
  - ❑ **Biology of water and pH**: (a) Read chapters 1 and 2 from the textbook, (b) watch and take notes on the videos posted on the website (c) complete acid and base coloring worksheet in this packet.
  - ❑ **Water lab:** (attached) The lab is designed to help you apply the knowledge you learned from chapters 1 and 2. You may work with a friend if you know they are taking AP biology next year! Please submit different labs. Items for this lab can usually be found in any household. If you are having trouble finding some of the materials, please don't hesitate to contact me.
  - ❑ **Lab safety:** Watch the required video on the website and take notes.

We will have video quizzes on lab safety, water and pH the first day of class. The ecology test will be the second day of class, so make sure you are prepared! Review your notes a night or two before school starts. I will collect this packet from you after the test for a grade. To help you review before coming back to school, try taking the quiz on page 17, 39, 843, 880, and 904 in the textbook. Answers are in the back of the textbook. In the summer HW folder, there is also a "unit plan study guide" for ecology with learning targets, example problems and vocabulary.

- ❑ Optional - extra credit (attached to back): In order to get to know you I've included a fun to do list for your summer. As you complete the items, I will add these points to your ecology test. Have fun completing it - that's the intent! Get out of your house and start exploring your world.

Please get started on this important work rather than making it a last-minute afterthought. In fact, if you start on it now, I am available to help you during the last week of school (room 237). Stop by and introduce yourself!

Here's to a fantastic year together,
Jeff Buckingham
jeffrey_buckingham@beaverton.k12.or.us

Ecology Packet

Chapter 40 – Population Ecology

1. What is ecology?

2. What is the difference between/what kinds of research and studies would be conducted:
   a. Organismal ecology –
   b. Population ecology –
   c. Community ecology –
   d. Ecosystem ecology –
   e. Landscape ecology -

3. What is the biosphere?

4. What is the precautionary principle? (You will need to google search this one!)

5. **Cells, organisms and populations are affected by biotic and abiotic factors. (40.3)**
   a. Describe three examples of how biotic factors might influence distribution/dispersal of a species.

   b. Describe four examples of how abiotic factors might influence distribution/dispersal of a species.

6. The three patterns of dispersion are provided below. Draw a quick picture of each and explain WHY a population might be distributed in such a way. (40.4)

Clumped	Uniform	Random

7. Draw the Idealized Survivorship Curves graph from page 834. Then answer the questions below:

   a. What does a survivorship curve show?

   b. Describe are the three main kinds of survivorship curves?

   c. What kind of curve do humans exhibit and why?

8. **Mathematical models and graphical representations are used to illustrate population growth patterns and interactions.** Pages 835 and 836 describe the formulas for determining population growth & exponential population growth. Read this section *carefully* and then answer the following questions.

   a. Use the formula given below (& in the text & on the AP Biology Equations and Formulas sheet!) to solve the following problem:

   $$\frac{\Delta N}{\Delta t} = B\text{-}D$$

   You are studying a population of vampire squids. Given that there have been 201 births and 198 deaths over the last year, what is the change in population size?

   b. Use the formula given below (& in the text & on the AP Biology Equations and Formulas sheet!) to solve the following problem. All you have to do is plug and chug!

   $$\frac{\Delta N}{\Delta t} = r_{max} N$$

   You are studying a group of Burmese Pythons that were accidentally released in Florida. Because they have few natural predators and access to unlimited food they are experiencing exponential population growth. What is their rate of growth, given that in the past year their population increased by 400 and their current population size is 1800.

What would a graph for a population in exponential growth look like?

c. Use the formula given below (& in the text & on the AP Biology Equations and Formulas sheet!) to solve the following problem. Just plug and chug!

$$\frac{\Delta N}{\Delta t} = r_{max} N \left(\frac{K - N}{K}\right)$$

You are studying a group of Handfish near Australia. If the population's carrying capacity is 150,000 individuals and there are currently 149,000 individuals in the population and there is an intrinsic growth rate of .6, how much will the population grow by over the next year?

9. What is carrying capacity and how does this affect population growth?

10. Explain or show the difference between exponential and logistic growth. Which includes the concept of carrying capacity?

11. **Reproduction and rearing of offspring requires free energy beyond that which used for maintenance and growth. Different organisms use various reproductive strategies in response to energy availability.** What three factors determine an organism's "life history?" What are the costs and benefits (trade-offs) of each?

12. There are two major life-history "strategies" that are termed r-selection and K-selection. (Note: r and K strategies are extremes, many species may have evolved strategies that are in the middle of the spectrum.) Complete the table below. Some of the table has been filled out for you to help get you started.

	r	**K**
Size of organism (generally)	small	
Energy expended to produce each offspring		
How many offspring are produced during each reproductive episode? (clutch size)		Few
How quickly do offspring mature	Quickly	
Is parental care required?		Yes
Life expectancy	Short	
Growth Model (exponential or logistic?)		
Type of survivorship Curve (I, II, or III?)		
Environment	Unstable	
Reproductive Strategy	Often Semelparity (reproduce many offspring and then die)	Often Iteroparity (produce only a few offspring at a time, but may reproduce several times)
Affected by:	Density Independent Factors	Density Dependent Factors
Animal Examples		
Plant Examples		Avocado

13. How will you remember which is which? (*Hint:* I'd try and think of an animal species that is r-selected and starts with the letter "r" and do the same thing for "k.")

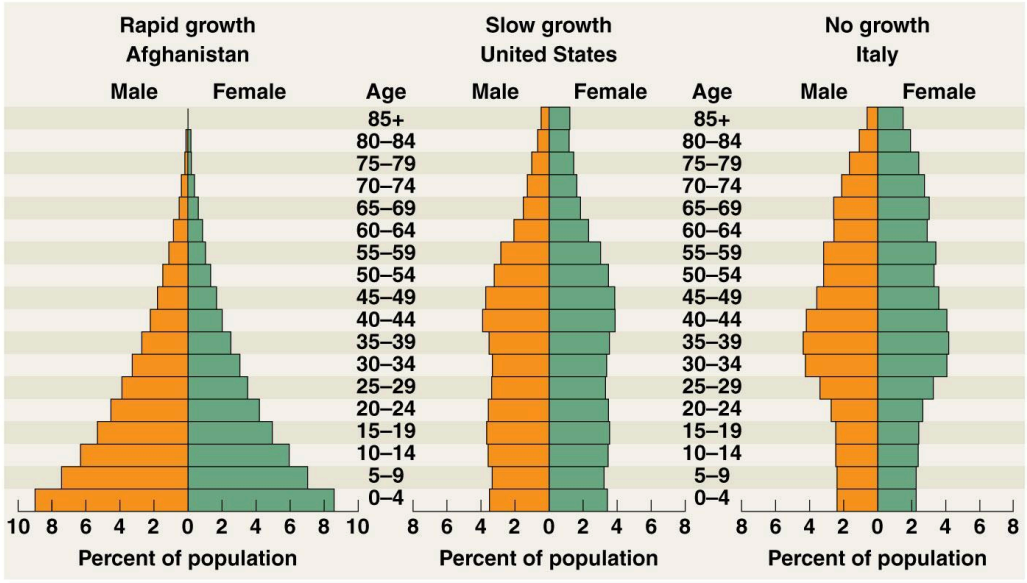
14. You discover a new animal species (nice!) that reproduces late in life and produces a vast number of offspring (semelparity), but provides little parental care, what kind of survivorship curve do you predict?

15. Population dynamics focuses on the complex interactions between biotic and abiotic factors that cause variation in population size. What are some of the reasons that populations undergo fluctuations in size?

16. **Cells, organisms and populations are affected by biotic and abiotic factors**. Describe 6 density dependent factors that limit population growth. (page 840 & 841)

17. What do you think would be a density independent factor?

18. **Mathematical models and graphical representations are used to illustrate population growth patterns and interactions.** Look at the graphs below….explain each FULLY…



Chapter 41 – species interactions

1. What is an ecological community?

competition	
predation	
herbivory	
mutualism	
parasitism	
commensalism	

2. **Communities are composed of populations of organisms that interact in complex ways**. Interspecific interactions occur between different species in a community. Listed below are examples of interspecific interactions. Please briefly describe each type of interaction and provide an example. (Pages 846-850)

3. Describe the difference, using a named example, between an organism's fundamental niche and realized niche?

4. What is the competitive exclusion principle and how does that explain resource partitioning?

5. What is the difference between aposematic coloration, batesian mimicry and mullerian mimicry. Give an example of each. (page 848)

6. How are species diversity, species richness and relative abundance related? Look on page 852. Both communities have four species of trees so why does community 1 have greater species diversity (biodiversity.) See page 851 for more information…

7. Create a marine or terrestrial food chain and label each trophic level. Assume that **1,000,000 J** of sunlight power the producers in your chain. *(Hint: look ahead at page 871 & 872 if you need help)* Indicate how much energy is passed on at each level. (This was the topic of an AP essay in 2007!) How does this explain why food chains are usually 5 links or less?

8. **Change in free energy availability can results to changes in an population size and result in disruptions to an ecosystem.** How would your food chain above be different if the number of producers DRASTICALLY decreased due to increases in pollution?

9. Study the picture on page 854 – how are food webs different than food chains?

10. What is the difference between a dominant species and a keystone species? So, why are sea stars considered a keystone species (see page 854) What would happen if a keystone species went extinct?

11. **Species-specific and environmental catastrophes, geological events, the sudden influx/ depletion of abiotic resources or increased human activities affect species distribution and abundance.** In other words, a disturbance is an event that changes a community, removes organisms from it and alters resource availability. List five examples of natural disturbances. I've given you one to get you started:
    a. **Meteors! Sorry dinosaurs** ☹

12. List five examples of human caused disturbances. (*Hint: if you are having trouble, look ahead to pages 885-887.*)

13. What is succession? Explain the difference between primary and secondary. (This was the topic of an AP essay question in 2010!) What is a climax community? (You may want to do a google search to learn more!)

CHAPTER 42 – Energy & Ecosystems

1. Look at the picture on page 866…Explain what it means to say "nutrients are cycled but energy comes in as light and leaves as heat."

2. What are detritivores and why are they important in an ecosystem?

3. How are gross primary production, net primary production and respiration related (*hint: you did this in the lab simulation!)?*

4. Use the formula below (& on your Equation & Formula sheet) to determine how many mg of carbon were fixed by producers at Triangle Lake, given that 15 mL of oxygen per liter was detected in the water sample.

   mL O_2/L x 0.536 = mg carbon fixed/L

5. What is eutrophication and why is it problematic? (This was a question from the AP exam 2011!)

6. Look at page 874 & 875… In the space below draw a sketch of the water, carbon, nitrogen and phosphorous cycle.

Water Cycle	**Nitrogen Cycle**
Carbon Cycle	**Phosphorous Cycle**

*It's a lot of steps to memorize, so just make sure you know the basic ideas of each!

7. Describe bioremediation.

CHAPTER 43 – global ecology & conservation biology

1. **Disruptions to ecosystems impact the dynamic homeostasis/balance of the ecosystem.** What is an invasive/introduced species and how do they affect an ecosystem? (Read up on invasive species at the National Wildlife Federation site, http://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx

2. Define biological magnification. (See page 896)

3. Just in case it comes up as an essay – read pages 897-899 which review the greenhouse effect/global climate change. In the space below list the key ideas and facts!

4. Read about ocean acidification in your text (pg. 36), then watch "Acid Test Documentary" https://www.youtube.com/watch?v=5cqCvcX7buo This is a great short documentary on the issue (around 21 min.). Then, read the following article: https://www.nrdc.org/experts/lisa-suatoni/acid-test-movie

   Describe the causes, effects and evidence for ocean acidification.

Acids and Bases Coloring

Atoms can gain or lose electrons in order to form ions in a process called ionization (compounds formed in this way are called ionic compounds). When ionic compounds dissolve in water, their ions separate from one another in a process called dissociation. One interesting feature of water and many other covalent compounds is that they too can dissociate into ions. Unlike ionic compounds, such as sodium chloride, they are not ionized before they dissociate; they accomplish ionization and dissociation at the same time.

Dissociation of Water

When water dissociates, one of the hydrogen nuclei leaves its electron behind with the oxygen atom to become a hydrogen ion, while the oxygen and other hydrogen atoms become a hydroxide ion. Since the hydrogen ion has no electron to neutralize the positive charge on its proton, it has a full unit of positive charge and is symbolized as H+. The hydroxide ion retains the electron left behind and thus has a full unit of negative charge, symbolized by OH-. The hydrogen ion (proton) does not wander long by itself before it attaches to the oxygen atom of a second un-ionized water molecule to form a hydronium ion (H_3O^+)
In any sample of water, very few of the molecules are dissociated at any one time: in fact, only about one in 550 million. There is, however, a constant change; as one hydrogen ion reattaches to a hydroxide ion to form a water molecule, another water molecule dissociates to replace the hydrogen ion and the hydroxide ion in solution.

Hydrochloric Acid

Certain molecules, ionic and covalent, dissociate in such a way that they release a hydrogen ion without releasing a hydroxide ion. These substances are called acids. Since a hydrogen ion is really just a single proton in most cases, the chemist's definition of an acid is a "proton donor." If very many protons (hydrogen ions) are "donated" the effect can be very profound, such as burning your skin or dissolving metal. The acid illustrated is hydrochloric acid. Pure hydrochloric acid is a gas, but it dissolves easily in water to produce a solution of hydrogen ion and chloride ion. Since nearly all of it is dissociated in water, it is called a strong acid. Acids that do not dissociate completely are called weak acids.

Sodium Hydroxide

The opposite of an acid is a base, also known as an alkali. A typical strong base is sodium hydroxide, the principal component of lye. Sodium hydroxide dissociates to form a sodium ion and a hydroxide ion. A base is defined as a "proton acceptor." The most common bases produce hydroxide ion when they dissociate, and it is the hydroxide ion that accepts the proton. A strong base can give your skin a much worse burn than an acid.

Neutralization

When a base and an acid are mixed, the hydroxide ion and the base combines with the hydrogen ion from the acid to form water. This process is called neutralization.

Questions:

1. What happens when an atom gains or loses an electron?

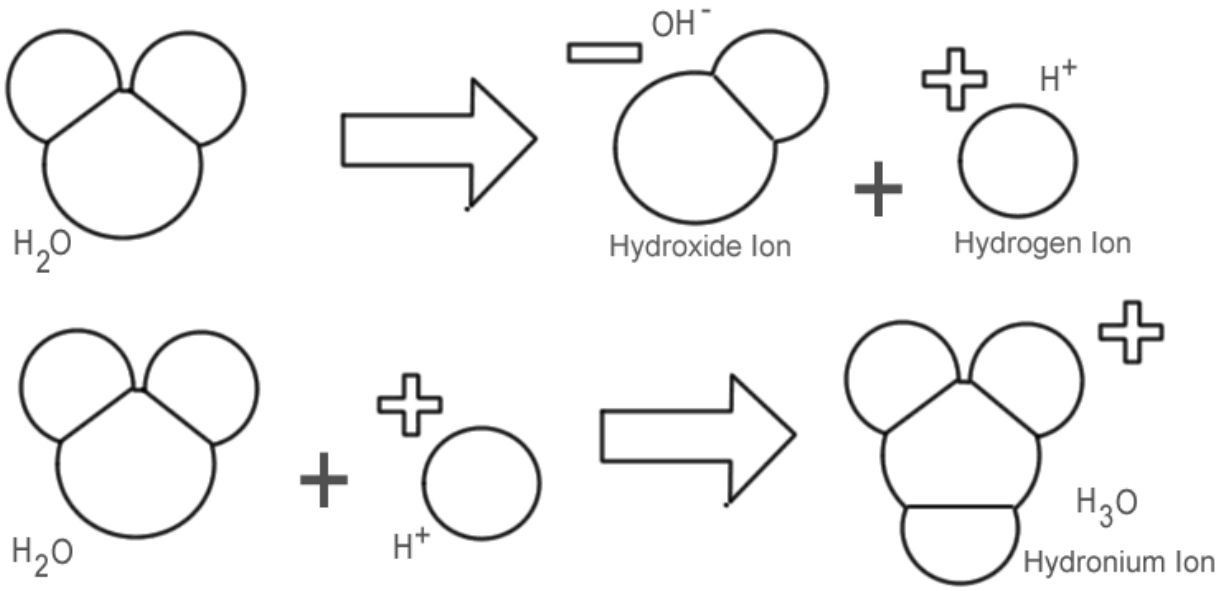
2. In your own words, explain why water generally has a neutral pH, even though water molecules dissociate.

3. Why are acids called proton donors?

4. What happens during neutralization?

DISSOCIATION OF WATER

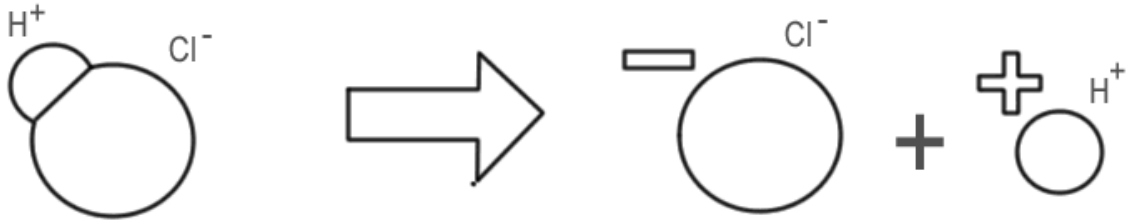
HYDROGEN (yellow)
OXYGEN (red)



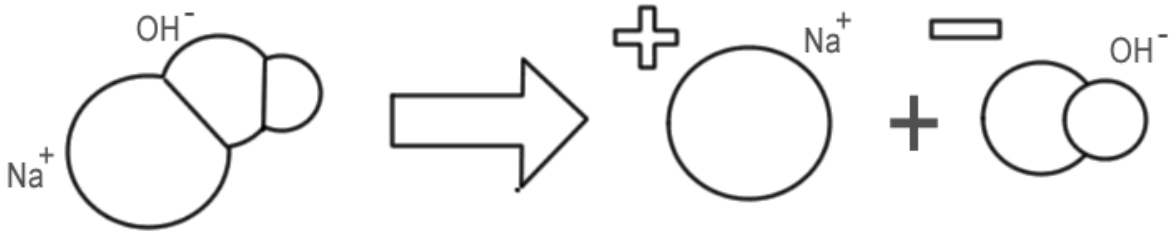
ACIDS & BASES

Chlorine (green)
Sodium (blue)

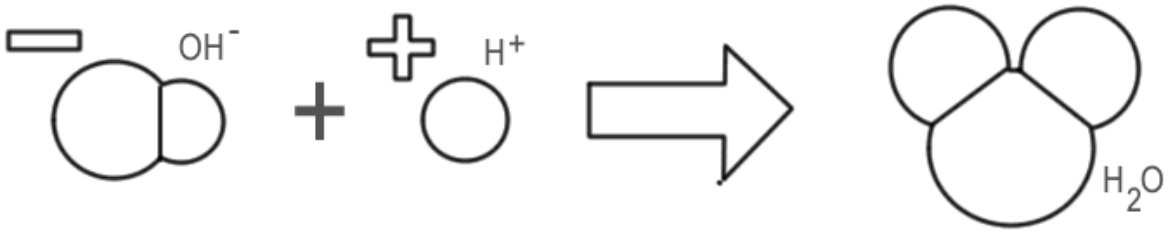
Hydrochloric Acid



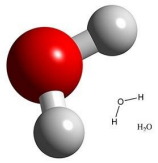
Sodium Hydroxide



NEUTRALIZATION



Significance of Water Lab



It has been said that "the chemistry of life is water chemistry." Because of its chemical properties, water is the medium in which most of life's chemical reactions occur. Life first evolved in water, it resided there exclusively for three billion years, most life is now concentrated in water-rich areas, and the cells of organisms are about 70 to 90 percent water.

Because of its polarity, water molecules attract to each other forming hydrogen bonds. This attraction of like molecules is called cohesion. Because water is cohesive, it remains liquid at normal temperatures over much of the Earth. Cohesion allows water to move up a plants and it results in the tension that allows some organisms to live on the surface of water. Water's polarity results in many important characteristics, such as adhesion, high heat capacity, and versatility as a solvent.

Perform the activities outlined below and complete a lab report. Print out the lab for the first day and submit. Your lab report MUST include:

- **Background**: 200 word MAX paragraph describing the properties of water and its importance (this is background information, so it comes from videos/textbook)
- **Purpose**: What is the goal of this lab.
- **Data Table**: This is of your own design. It needs to be organized and easy to read.
  It should include:
  - ❏ A brief description/sketch of the activity (the descriptions need to be IN YOUR OWN WORDS)
  - ❏ Your results: again it can be a brief description/sketch
  - ❏ Explanation using the words found in the instructions below.

	ACTIVITY	EXPLAIN USING…
1	Make staples float on water. Challenge… make a paper clip float on water!	**Polar, Hydrogen bonding, Cohesion, Surface tension**
2	Count the number of drops of water you can put on top of a penny.	**Hydrogen bonding, Cohesion**
3	Fill a cup with water and sprinkle pepper on the top. Touch a bar of soap to the top of the water.	**Hydrogen bonding, Cohesion, Surface tension, Hydrophobic**
4	Determine if ice sinks or floats when placed in liquid water.	**Polar, Hydrogen bonding, Density**
5	Observe a stalk of celery in a beaker of colored water. (you can simply watch the video instead of actually performing this one)	**Hydrogen bonding, Cohesion, Adhesion**
6	Place a pinch of salt (an ionic compound) in the bottom of a cup. Add 60mL (1/4 cup) of water to the cup. Mix the contents. What happens to the salt crystals?	**Polar, Hydrogen bonds, Solvent, Hydrophilic**
7	What will happen if water comes in contact with a nonpolar molecule? Mix oil and water to find out.	**Polar, Non-Polar, Hydrophobic**
8	Explain why humans don't just die when they are outside in the summer heat.	**Hydrogen bonds, Polar, Heat capacity**

Extra Credit Assignment

Complete the tasks listed and provide the appropriate documentation (indicated in parentheses). For every five tasks you complete and document successfully, I will give you two bonus points on your first ecology test (up to 4 points max, which is huge!).

1. Introduce yourself to Mr. Buckingham (room 237) before summer break. Be prepared to tell him who inspires you and why. (take a selfie with him and attach to this document)
2. Make a video of yourself, describing who you are (likes, dislikes, aspirations, future plans, classes, funny stories about yourself, songs you like etc.). Tell me what to expect about yourself! (minimum 1 minute, send Mr. Buckingham your youtube link - email is on front page)
3. See a movie in a theater. Make sure it's a good one. (attach stub and selfie at theater)
4. Go to two state parks and take a walk/hike. (attach selfie AND map)
5. Go to a museum of natural history. Take a photo of yourself in front of your favorite exhibit and write a brief caption of why it is your favorite. (attach selfie AND stub)
6. Play a board game. (attach selfie of you playing with others)
7. Identify three species of trees in your neighborhood. (attach a list with genus and species AND selfies with trees)
8. Find and watch some wild animals (be careful and don't feed them!). Video tape their movements and upload on youtube. (send link to Mr. Buckingham)
9. Learn a new song and perform it on an instrument. (send link of youtube video of you playing)
10. Knit something with an animal print. (bring product day 1)

AP BIOLOGY EQUATIONS AND FORMULAS

Statistical Analysis and Probability

Mean

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Standard Deviation*

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

Standard Error of the Mean*

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

Chi-Square

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51
0.01	6.64	9.21	11.34	13.28	15.09	16.81	18.48	20.09

$\bar{x}$ = sample mean

n = size of the sample

s = sample standard deviation (i.e., the sample-based estimate of the standard deviation of the population)

o = observed results

e = expected results

Degrees of freedom are equal to the number of distinct possible outcomes minus one.

Laws of Probability

If A and B are mutually exclusive, then:

$$P(\text{A or B}) = P(\text{A}) + P(\text{B})$$

If A and B are independent, then:

$$P(\text{A and B}) = P(\text{A}) \times P(\text{B})$$

Hardy-Weinberg Equations

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

p = frequency of the dominant allele in a population

q = frequency of the recessive allele in a population

Metric Prefixes

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Mode = value that occurs most frequently in a data set

Median = middle value that separates the greater and lesser halves of a data set

Mean = sum of all data points divided by number of data points

Range = value obtained by subtracting the smallest observation (sample minimum) from the greatest (sample maximum)

** For the purposes of the AP Exam, students will not be required to perform calculations using this equation; however, they must understand the underlying concepts and applications.*

Rate and Growth

Rate

$\frac{dY}{dt}$

Population Growth

$\frac{dN}{dt} = B - D$

Exponential Growth

$\frac{dN}{dt} = r_{max}N$

Logistic Growth

$\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$

Temperature Coefficient Q_{10} †

$Q_{10} = \left(\frac{k_2}{k_1}\right)^{\frac{10}{T_2 - T_1}}$

Primary Productivity Calculation

$\frac{\text{mg } O_2}{\text{L}} \times \frac{0.698 \text{ mL}}{\text{mg}} = \frac{\text{mL } O_2}{\text{L}}$

$\frac{\text{mL } O_2}{\text{L}} \times \frac{0.536 \text{ mg C fixed}}{\text{mL } O_2} = \frac{\text{mg C fixed}}{\text{L}}$

(at standard temperature and pressure)

dY = amount of change

dt = change in time

B = birth rate

D = death rate

N = population size

K = carrying capacity

r_{max} = maximum per capita growth rate of population

T_2 = higher temperature

T_1 = lower temperature

k_2 = reaction rate at T_2

k_1 = reaction rate at T_1

Q_{10} = the factor by which the reaction rate increases when the temperature is raised by ten degrees

Water Potential (Ψ)

$\Psi = \Psi_P + \Psi_S$

Ψ_P = pressure potential

Ψ_S = solute potential

The water potential will be equal to the solute potential of a solution in an open container because the pressure potential of the solution in an open container is zero.

The Solute Potential of a Solution

$\Psi_S = -iCRT$

i = ionization constant (this is 1.0 for sucrose because sucrose does not ionize in water)

C = molar concentration

R = pressure constant (R = 0.0831 liter bars/mole K)

T = temperature in Kelvin (°C + 273)

Surface Area and Volume

Volume of a Sphere

$V = \frac{4}{3}\pi r^3$

Volume of a Rectangular Solid

$V = lwh$

Volume of a Right Cylinder

$V = \pi r^2 h$

Surface Area of a Sphere

$A = 4\pi r^2$

Surface Area of a Cube

$A = 6s^2$

Surface Area of a Rectangular Solid

$A = \sum$ surface area of each side

r = radius

l = length

h = height

w = width

s = length of one side of a cube

A = surface area

V = volume

Σ = sum of all

Dilution (used to create a dilute solution from a concentrated stock solution)

$C_iV_i = C_fV_f$

i = initial (starting)
f = final (desired)

C = concentration of solute
V = volume of solution

Gibbs Free Energy

$\Delta G = \Delta H - T\Delta S$

ΔG = change in Gibbs free energy

ΔS = change in entropy

ΔH = change in enthalpy

T = absolute temperature (in Kelvin)

pH* = $-\log_{10}[H^+]$

** For the purposes of the AP Exam, students will not be required to perform calculations using this equation; however, they must understand the underlying concepts and applications.*

† For use with labs only (optional).