AP Biology Summer Tasks #1-7

All notes, vocabulary terms, response questions …. must be handwritten. **(*NO COMPUTER FONT*)**

Dear Students and Parents,

Our AP Biology summer work is an essential assignment, which is longer than it is difficult. Due to the nature of the course, many students will need to adjust their study habits. The more consistent effort you put into this course the better you will be prepared if you decide to take the AP Biology Exam in May. Students who have performed the most successfully on the AP exam are those students who are willing to work steadily throughout the summer / school year and who are willing to work independently reviewing previous material over the course of the school year. **If you decide to only study at the last minute prior to the exam, you will not perform as well.**

Because of the various interruptions to the school calendar: (school activities, snow days, hurricanes, midterms, and other assessments & activities) we may not have as much time as we may need. **During the summer you should purchase an AP Biology prep book**: Cliff, Princeton Review, **ACT Biology (more like the AP Exam)** and Barron's are some example of respected review books, but research before purchasing. **If the review guide was published before 2018 and some even newer they are out dated**. Many students will use their review books as a resource through the school year. The more recent the better and closer to the new style…

You will be required to hand write & complete the tasks before we start the school year. When we return to school in September, you will be tested on the readings (You can use your original handwritten notes, but no copies or text (be prepared).

The Four Big Ideas discussed in class are:
Big Idea 1: The process of evolution drives the diversity and unity of life.
Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties

During the summer if you have any questions, please feel free to email me at **amitybiology@gmail.com** , but **during the school year** please only email me at **Derek.Wilson@amityschools.org.** I will not look at the amitybiology@gmail.com after the school year starts._ Your assignments are due when we get back. To complete these assignments, you may use any resources that you wish, but the textbook will be the most helpful. I urge you to collaborate with your peers but **do not copy each other's work**! ***All work must be hand written and in complete sentences.*** Drawings can be beneficial. Feel free to contact me over the summer but if you don't hear back from me immediately it is because I am also on vacation. Please extend your research and look outside your text for additional information……look forward to seeing you next year….

Mr. Wilson

You have to be an independent learner and be prepared for class.

You may need to change your study habits……

Do not study for hours at a time….

Instead, try….

20 minutes working …. 20 minutes relaxing…. Then back on for 20 minutes…
Or
30 minutes studying…. 10 minutes relaxing… Then back on for 30 minutes…

Less is more…. It is about working hard, but working smarter…….

Tasks

Task #1 Bozeman's Science Practices Video Worksheets (Please print out and complete)

Task #2: Vocabulary (<u>Only</u> define the terms you are not familiar with) **Do not stress out yourself over details. These are some of the terms you will need to become familiar with over the course of the year.**

Task #3 MATH REVIEW: Please REVIEW the following formulas **(pages 07-19).** We use these and other math formulas during the course of the year and for the AP Exam. (Rate, mean, mode, median, standard deviation, variance, probability, logistic growth, exponential growth…). I have attached the AP Biology Math Formula sheet for your convenience **(page 20).** The math sheet is also given to you when taking the AP Biology exam. During the school year and AP Biology Exam, you can use a four-function (with square root), scientific, or graphing calculator. (There is math in biology but not as much as you may think. Many problems often only require a four function) ……

TASK #4 Graphing pages 21-28 (Complete graphs and questions)

TASK #5 PREFIX AND SUFFIX: Pages 29-34 USE AS REFERENCE FOR THE SCHOOL YEAR. It will come in handy. At times we will have quizzes on PREFIX AND SUFFIXES, but you will know what terms to review.

TASK #6 READ, DEFINE & TAKE NOTES: Page 35 **<u>Define any terms you do not know, read and take excellent hand written notes.</u>** **(Drawings can be very useful. Please do not overlook any caption below an image or graph).** *<u>All notes, vocabulary terms, response questions …. must be handwritten.</u>* **(*<u>NO COMPUTER FONT</u>*)**

Chapter 1: Introduction: Themes in the Study of Life	**(1.1-1.4)**	**Pages 1-25**	**24 pages**
Chapter 2: The Chemical Context of Life	**(2.1-2.4)**	**Pages 30-43**	**13 pages**
Chapter 3: Water & Life	**(3.1-3.3)**	**Pages 46-56**	**10 pages**
Chapter 4: Carbon and the Molecular Diversity of Life	**(4.1-4.2)**	**Pages 58-63**	**05 pages**

Task #7 RESPONSES: Answer the following 3 FRQ. **(Pages #36-48)** ***<u>handwritten</u>***. **(*<u>NO COMPUTER FONT</u>*)**

TASK I) The first task in your summer assignment are to familiarize yourself with these seven practices by watching 7 Bozeman Science videos and completing the corresponding video worksheets. Please print and handwrite these worksheets and be ready to turn them in on the first day of class. It will take you about an hour to watch all seven videos. (CB has shortened the science practices from 7 to 6, but no videos are currently offered as of yet….)

Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
Video: https://www.youtube.com/watch?v=v5Nemz_cVew **Worksheet: https://tinyurl.com/y95q5ajp**

Science Practice 2: The student can use mathematics appropriately.
Video: https://www.youtube.com/watch?v=jgqYlSKoXak **Worksheet: https://tinyurl.com/yaqqtqqk**

Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
Video: https://www.youtube.com/watch?v=2zB272Ak63A **Worksheet: https://tinyurl.com/yc2g4qrc**

Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question.
Video: https://www.youtube.com/watch?v=AzTXnne40wU **Worksheet: https://tinyurl.com/ybolylz3**

Science Practice 5: The student can perform data analysis and evaluation of evidence.
Video: https://www.youtube.com/watch?v=0JqukouOtZA **Worksheet: https://tinyurl.com/ybskztts**

Science Practice 6: The student can work with scientific explanations and theories.
Video: https://www.youtube.com/watch?v=3gK1xWNM7kk **Worksheet: https://tinyurl.com/yaosxsgp**

Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.
Video: https://www.youtube.com/watch?v=7l4bcs49JP8 **Worksheet: https://tinyurl.com/y8q8bxqk**

While the emphasis of this course will be on developing the seven skills above, a solid foundation of content knowledge is still necessary in order to be successful. AP Biology is designed to be the equivalent of a two semester introductory college-level course. As such, the responsibility for mastering the content falls largely on YOU as independent learners.

Part II) It is expected that you already have a working knowledge of basic biology from your previous classes. We do not have the time to reteach these basic concepts during the school year. Therefore, your second assignment is review any terms on the list below that you may have forgotten from last year or perhaps never learned. You may use your textbook, notes from previous classes, or the Internet to teach yourself. It is up to you to determine how you will review and how much time you will spend on this assignment. However, it is recommended that you spread your studying out over the summer and review a little bit every couple of days rather than cramming the night before school starts. It is proven that you will retain information better this way. You should be prepared to take a quiz within the first week of school on this content (not the first day). NOTE: You should have a general understanding of each term. Do not stress out yourself over details. These are some of the terms you will need to become familiar with over the course of the year. Please start to complete your vocabulary list earlier than later.

ONLY DEFINE THE TERMS YOU DO NOT KNOW					
1. abiotic	26. cloning	51. eukaryote	76. homologous structure	101. organ	126. punctuated equilibrium
2. active transport	27. co-dominance	52. evolution	77. impermeable	102. organ system	127. recessive inheritance
3. adenosine triphosphate (ATP)	28. cohesion	53. exocytosis	78. incomplete dominance	103. organelle	128. ribosome
4. adhesion	29. commensalism	54. extinction	79. inheritance	104. organic molecule	129. selective breeding
5. allele	30. community (ecological)	55. extracellular	80. interphase	105. organism	130. semiconservative replication
6. analogous structure	31. competition	56. facilitated diffusion	81. intracellular	106. osmosis	131. sex-linked trait
7. aquatic	32. concentration gradient	57. food chain	82. isolating mechanisms	107. parasitism	132. sexual reproduction
8. artificial selection	33. consumer (ecological)	58. food web	83. limiting factor	108. passive transport	133. speciation
9. asexual reproduction	34. crossing-over	59. fossils	84. lipids	109. pH	134. species
10. biology	35. cytokinesis	60. founder effect	85. macromolecule	110. phenotype	135. succession
11. biome	36. decomposer	61. frame-shift mutation	86. meiosis	111. photosynthesis	136. symbiotic relationship
12. biosphere	37. deoxyribonucleic acid (DNA)	62. gamete	87. migration	112. plasma membrane	137. terrestrial
13. biotechnology	38. diffusion	63. gene	88. mitochondrion	113. point mutation	138. tissue
14. biotic	39. DNA mutation	64. gene recombination	89. mitosis	114. polygenic	139. transcription
15. carbohydrate	40. DNA replication	65. gene splicing	90. monomer	115. polymer	140. translation
16. carnivore	41. dominant inheritance	66. gene therapy	91. multicellular	116. population	141. translocation
17. carrier (transport) proteins	42. ecology	67. genetic drift	92. multiple alleles	117. population dynamics	142. trophic level
18. catalyst	43. ecosystem	68. genetic engineering	93. mutualism	118. predation	143. unicellular
19. cell	44. embryology	69. genetically modified organism (GMO)	94. natural selection	119. predator	144. vestigial structure
20. cell cycle	45. endemic species	70. genotype	95. niche	120. prey	
21. cellular respiration	46. endocytosis	71. Golgi apparatus	96. nondisjunction	121. producer (ecological)	
22. chlorophyll	47. endoplasmic reticulum (ER)	72. gradualism	97. nonnative species	122. prokaryote	
23. chloroplast	48. endosymbiosis	73. habitat	98. nucleic acid	123. protein	
24. chromosomal mutation	49. energy pyramid	74. herbivore	99. nucleus	124. protein synthesis	
25. chromosomes	50. enzyme	75. homeostasis	100. omnivore	125. pumps (ion or molecule)	

TASK #3 MATH REVIEW: **Review the following formulas (pages 07-19). We use these and other math formulas during the course of the year and for the AP Exam. (Rate, mean, mode, median, standard deviation, variance, probability, logistic growth, exponential growth…) I have attached the AP Biology Math Formula sheet for your convenience (page 20). The math sheet is also given to you when taking the AP Biology exam. We can use a four function, scientific or a graphing calculator.**

Bozeman's Biology Math Review (Watch the refresher videos if needed)

Standard Error: https://www.youtube.com/watch?v=BwYj69LAQOI

Standard Deviation: https://www.youtube.com/watch?v=09kiX3p5Vek

Student's T-Test https://www.youtube.com/watch?v=pTmLQvMM-1M

Probability: https://www.youtube.com/watch?v=y4Ne9DXk_Jc

Exponential Growth: https://www.youtube.com/watch?v=c6pcRR5Uy6w

Logistic Growth: https://www.youtube.com/watch?v=rXlyYFXyfIM

Chi-Squared Test: https://www.youtube.com/watch?v=WXPBoFDqNVk

Khan Academy

Finding mean, median, and mode: https://www.youtube.com/watch?v=k3aKKasOmIw

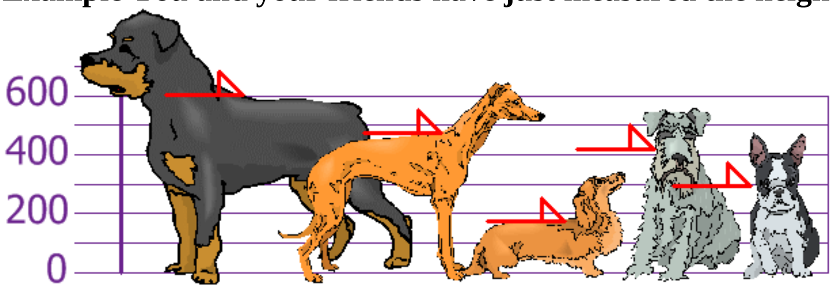
Standard Deviation is a measure of how spreads out numbers are. Its symbol is σ (the Greek letter sigma).
(SEE Bozeman's Biology: Standard Deviation Video)

It is the square root **of the** Variance. **Variance = is defined the average of the** squared **differences from the Mean.**

To calculate the variance follows these steps:

- Work out the Mean (the simple average of the numbers)
- Then for each number: subtract the Mean and square the result (the *squared difference*).
- Then work out the average of those squared differences. (Why Square?)

Example You and your friends have just measured the heights of your dogs (in millimeters):

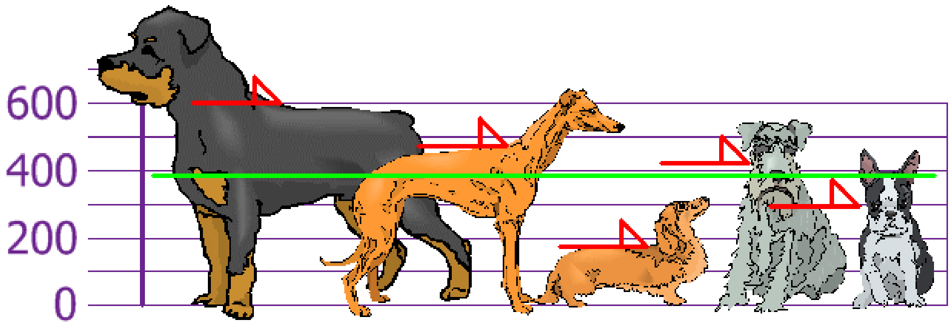


The heights (at the shoulders) are: 600mm, 470mm, 170mm, 430mm and 300mm.

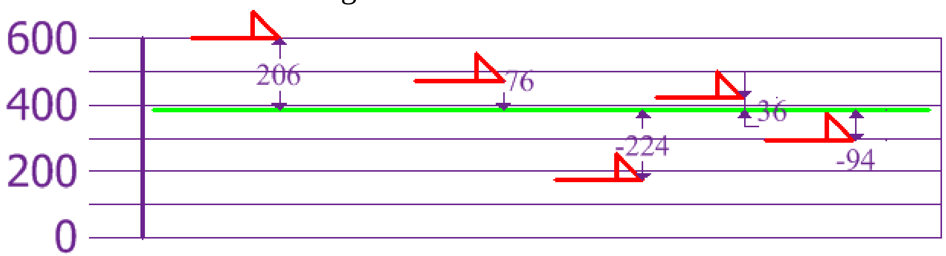
Find out the Mean, the Variance, and the Standard Deviation.

Your first step is to find the Mean: Answer: $\text{Mean} = \dfrac{600 + 470 + 170 + 430 + 300}{5} = \dfrac{1970}{5} = 394$

so the mean (average) height is 394 mm. Let's plot this on the chart:



Now we calculate each dog's difference from the Mean:



To calculate the Variance, take each difference, square it, and then average the result:

$$\text{Variance: } \sigma^2 = \frac{206^2 + 76^2 + (-224)^2 + 36^2 + (-94)^2}{5}$$

$$= \frac{42,436 + 5,776 + 50,176 + 1,296 + 8,836}{5}$$

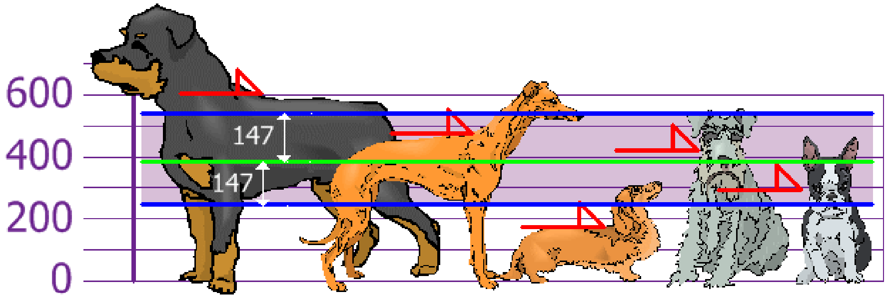
$$= \frac{108,520}{5} = 21,704$$

So, the Variance is **21,704**.

And the Standard Deviation is just the square root of Variance, so:

Standard Deviation: **σ = √21,704 = 147.32...** = **147** (to the nearest mm)

And the good thing about the Standard Deviation is that it is useful. Now we can show which heights are within one Standard Deviation (147mm) of the Mean:



So, using the Standard Deviation we have a "standard" way of knowing what is normal, and what is extra-large or extra small.

Rottweilers **are** tall dogs. And Dachshunds **are** a bit short ... but don't tell them!

Now try the [Standard Deviation Calculator].

But ... there is a small change with Sample Data

Our example was for a **Population** (the 5 dogs were the only dogs we were interested in).

But if the data is a **Sample** (a selection taken from a bigger Population), then the calculation changes!

When you have "N" data values that are:

- **The Population**: divide by **N** when calculating Variance (like we did)
- **A Sample**: divide by **N-1** when calculating Variance

All other calculations stay the same, including how we calculated the mean.

Example: if our 5 dogs were just a **sample** of a bigger population of dogs, we would divide by **4 instead of 5** like this:

Sample Variance = 108,520 / 4 = **27,130**

Sample Standard Deviation = √27,130 = **164** (to the nearest mm)

Think of it as a "correction" when your data is only a sample.

Sample Standard Deviation Example:
Sam has 20 rose bushes, but what if Sam only counted the flowers on 6 of them?

The "population" is all 20 rose bushes, and the "sample" is the 6 he counted. Let us say they are:

9, 2, 5, 4, 12, 7

How to calculate the Sample Standard Deviation: Using sampled values 9, 2, 5, 4, 12, 7

The mean is (9+2+5+4+12+7) / 6 = 39/6 = 6.5

So: $x = 6.5$

How to Find the Mean: The mean is the average of the numbers.

Step 1: **add up** all the numbers, then **divide by how many** numbers there are.
(In other words it is the **sum** divided by the **count**).

Mean Example: 9, 2, 5, 4, 12, 7, 8, 11, 9, 3, 7, 4, 12, 5, 4, 10, 9, 6, 9, 4

The mean is: $$\frac{9+2+5+4+12+7+8+11+9+3+7+4+12+5+4+10+9+6+9+4}{20} = \frac{140}{20} = 7$$

So: $\mu = 7$

How to Find the Mode or Modal Value: The number which appears most often.

Finding the Mode:

To find the mode, or modal value, first put the numbers **in order**, then count how many of each number. A number that appears **most often** is the **mode**.

Example: 3, 7, 5, 13, 20, 23, 39, 23, 40, 23, 14, 12, 56, 23, 29

In order these numbers are:

3, 5, 7, 12, 13, 14, 20, **23, 23, 23, 23**, 29, 39, 40, 56

This makes it easy to see which numbers appear **most often**.

In this case the mode is **23**.

Another Example: {19, 8, 29, 35, 19, 28, 15}

Arrange them in order: {8, 15, 19, 19, 28, 29, 35}

19 appears twice, all the rest appear only once, so **19 is the mode**.

More Than One Mode: We can have more than one mode.

Example: {1, 3, 3, 3, 4, 4, 6, 6, 6, 9}

3 appears three times, as does 6.

So there are two modes: at **3** and **6**

Median Value: The Median is the *"middle number"* **(in a sorted list of numbers).**

Example: find the Median of 12, 3 and 5

Put them in order: 3, 5, 12

The middle number is **5**, so the median is **5**.

Example: 3, 13, 7, 5, 21, 23, 39, 23, 40, 23, 14, 12, 56, 23, 29

When we put those numbers in order we have: 3, 5, 7, 12, 13, 14, 21, 23, 23, 23, 23, 29, 39, 40, 56

There are **fifteen** numbers. Our middle number will be the **eighth** number:

3, 5, 7, 12, 13, 14, 21, 23, 23, 23, 23, 29, 39, 40, 56

The median value of this set of numbers is **23**.

Two Numbers in the Middle: BUT, when there are an even amount of numbers **things are slightly different.**

In that case we need to find the middle pair **of numbers, and then find the value that would be half way between them. This is easily done by adding them together and dividing by two.**

Example: 3, 13, 7, 5, 21, 23, 23, 40, 23, 14, 12, 56, 23, 29

When we put those numbers in order we have: 3, 5, 7, 12, 13, 14, 21, 23, 23, 23, 23, 29, 40, 56

There are now **fourteen** numbers and so we don't have just one middle number, we have a **pair of middle numbers**: 3, 5, 7, 12, 13, 14, 21, 23, 23, 23, 23, 29, 40, 56

In this example the middle numbers are **21 and 23**.

To find the value half-way between them, add them together and divide by 2:

21 + 23 = 44

44 ÷ 2 = 22

So the **Median** in this example is **22**. (Note that 22 was not in the list of numbers ... but that is OK because half the numbers in the list are less, and half the numbers are greater.)

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

STANDARD ERROR CALCULATION (*See Bozeman's Biology Video: Standard Error*)

Procedure:

Step 1: Calculate the mean (Total of all samples divided by the number of samples).

Step 2: Calculate each measurement's deviation from the mean (Mean minus the individual measurement).

Step 3: Square each deviation from mean. Squared negatives become positive.

Step 4: Sum the squared deviations (Add up the numbers from step 3).

Step 5: Divide that sum from step 4 by one less than the sample size (n-1, that is, the number of measurements minus one)

Step 6: Take the square root of the number in step 5. That gives you the "standard deviation (S.D.)."

Step 7: Divide the standard deviation by the square root of the sample size (n). That gives you the "standard error".

Step 8: Subtract the standard error from the mean and record that number. Then add the standard error to the mean and record that number. You have plotted mean ±1 standard error (S.E.), the distance from 1 standard error below the mean to 1 standard error above the mean

Example:

Name	Height to nearest 0.5 cm	**2** Deviations (m-i)	**3** Squared deviations $(m\text{-}i)^2$
1. Waldo	150.5	11.9	141.61
2. Finn	170.0	-7.6	57.76
3. Henry	160.0	2.4	5.76
4. Alfie	161.0	1.4	1.96
5. Shane	170.5	-8.1	65.61
n= 5	**1 Mean m** = 162.4 cm		**4** Sum of squared deviations $\sum(m\text{-}i)^2 = 272.70$

5 Divide by number of measurements-1. $\sum (m\text{-}i)^2 / (n-1) = 272.70 / 4 = 68.175$

6 Standard deviation = square root of $\sum (m\text{-}i)^2/n-1 = \sqrt{68.175} = 8.257$

7 Standard error = Standard deviation/$\sqrt{n}$ = 8.257/2.236 = 3.69

8 m ± 1SE = 162 ± 3.7 or 159cm to 166cm for the men (162.4 - 3.7 to 162.4 + 3.7).

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

Where

$SE_{\bar{x}}$ = Standard Error of the Mean

s = Standard Deviation of the Mean

n = Number of Observations of the Sample

Standard Error Example

X = 10, 20,30,40,50

Total Inputs (N) = (10, 20, 30, 40, 50)

Total Inputs (N) =5

To find Mean:
Mean (x_m) = (x_1+x_2+x_3...x_n)/N
Mean (x_m) = 150/5
Mean (x_m) = 30

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

From the above formula **Standard deviation σ=Standard Error x √n**.

Variance = σ^2
The below example will show you how to calculate Standard deviation from standard error.

Example to Calculate Standard Deviation and Variance from Standard Error

For the set of 9 inputs standard error is 20.31 then what is the value standard deviation.
Standard deviation σ=Standard Error x √n
Standard deviation σ = 20.31 x √9
σ = 20.31 x 3
σ = 60.93

variance = σ^2
variance = 60.93^2
variance = 3712.4649

PROBABILITY AND GENETICS

Probability is the study of the likelihood of the occurrence of a particular event or offspring. The chance or probability that an event will take place can be expressed as a fraction (1/4), ratio (1:4) or % (25%).

Probability = <u># of chances for an event</u>

# of possible combinations

THE RULE OF INDEPENDENT EVENTS: previous events have no impact on future events. The chance of having a girl is 1/2. If you already have one girl the chance that your next baby will be a girl is still 1/2. Each event is regarded as an individual event.

THE PRODUCT RULE: the chance that independent events will occur together is the product of their individual probabilities. Thus the chance of having 3 girls in a row is: 1/2 x 1/2 x 1/2 = 1/8 or 12.5%.

These principles only predict theoretical possibilities and there is no certainty that the event will occur.

EXAMPLE:

Rr x Rr (heterozygous monohybrid cross)

Probability of RR is 1/2 from mom 1/2 from dad thus 1/2 x 1/2 = 1/4

Probability of rr is 1/2 from mom 1/2 from dad thus 1/2 x 1/2 = 1/4

Probability of Rr is R: 1/2 from mom and 1/2 from dad 1/2 x 1/2 = 1/4

r: 1/2 from mom and 1/2 from dad 1/2 x 1/2 = 1/4

Thus 1/4 + 1/4 = 2/4 or 1/2

Our phenotypic ratio of 3:1 is met, 3 dominant to 1 recessive.

Rate = dY/dt

dY= amount of change
t= time
B = birth rate
D = death rate
N= population size
K= carrying capacity

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

A **rate** is a ratio that compares two different kinds of numbers, such as *miles per hour*, or *inches per minute*. A unit rate compares a quantity to its unit of measure. A rate expresses how long it takes to do something.

To drive 50 inches in one minute is to drive at the rate of 50 in./min.

$$\boxed{\frac{50\text{ inches}}{1\text{ minute}} = 50\text{ inches per minute}}$$

The fraction expressing a rate has units of distance in the numerator and units of time in the denominator.

Example: How long, in minutes, did it take the bug to cover 350 inches at a rate of 50 inches per minute?

$$\frac{50\text{ inches}}{1\text{ minute}} = \frac{350\text{ inches}}{x\text{ minutes}}$$

Use "cross multiply" (in a proportion, the product of the means equals the product of the extremes) to solve.

Answer: 7 minutes

Example of how to calculate a growth rate:

2003 population was about : 300 people
2004 population was about : 312
2005 population was about : 330
2006 population was about : 340

Then you can calculate the yearly growth rates by:

*2003 to 2004 growth rate = (312-300)÷300 = **0.040** = 4.0%*
*2004 to 2005 growth rate = (330-312)÷312 = **0.058** = 5.8%*
*2005 to 2006 growth rate = (340-330)÷330= **0.030** = 3.0%*

The overall growth rate you need would the average rate, or: (4.0% + 5.8% +3.0%) ÷ 3 = 4.3%

$$dN/dt = (b - d)N$$

In your research on population dynamics of June beetles, you estimate that the population size is 3,000. Over the course of a month, you record 400 births and 150 deaths in the population. Estimate r and calculate what the population size is predicted to be in 6 months.

We know that there are 400 births in the population over the month, in our population of 3,000 individuals; we can express this as a rate by doing the following:

Birth rate = 400/3000 = 0.1333 births/(indiv. x month)
Using the same logic...
Death rate = 150/3000 = 0.0500 deaths/(indiv. x month)
r = birth rate - death rate = 0.1333 - 0.0500 = 0.0833

$Nt = N_o e^{rt}$

We know that t = 6 months (given in the question)
Therefore, $N_t = 3000\ e^{(0{,}0833)(6)}$
$\ln N_t - \ln 3000 = 0.4998$
N_t = 4945 beetles
Exponential growth is continuous population growth in an environment where resources are unlimited; it is density-independent growth. $dN/dt = rN$ where,

dN/dt = change in population size; r = intrinsic rate of increase (= per capita rate of increase and equals birth rate minus death rate); N = population size.

$N_t = N_o e^{rt}$ where,

N_t = population size at time t; N_o = original population size, r = intrinsic rate of increase and t = time

Logistic growth is continuous population growth in an environment where resources are limited; it is density-dependent growth. Logistic growth is characterized by a sigmoidal, or S-shaped growth curve.
$dN/dt = rN\ [K - N/K]$ where,

dN/dt = change in population size; r = intrinsic rate of increase; N = population size; K = carrying capacity (upper asymptote).

AP BIOLOGY EQUATIONS AND FORMULAS

STATISTICAL ANALYSIS AND PROBABILITY

Standard Error	Mean
$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$	$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$
Standard Deviation	**Chi-Square**
$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$	$\chi^2 = \sum \frac{(o-e)^2}{e}$

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

$\bar{x}$ = mean

n = size of the sample

o = observed individuals with observed genotype

e = expected individuals with observed genotype

Degrees of freedom equals the number of distinct possible outcomes minus one.

CHI-SQUARE TABLE

	Degrees of Freedom							
p	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	9.32	11.34	13.28	15.09	16.81	18.48	20.09

LAWS OF PROBABILITY

If A and B are mutually exclusive, then P (A or B) = P(A) + P(B)

If A and B are independent, then P (A and B) = P(A) x P(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)

RATE AND GROWTH

Rate

dY/dt

Population Growth

dN/dt=B-D

Exponential Growth

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

Logistic Growth

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

dY= amount of change

t = time

B = birth rate

D = death rate

N = population size

K = carrying capacity

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

Temperature Coefficient Q_{10}

$Q_{10} = \left(\frac{k_2}{k_1}\right)^{\frac{10}{t_2 - t_1}}$

Primary Productivity Calculation

mg O_2/L x 0.698 = mL O_2/L

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

t_2 = higher temperature

t_1 = lower temperature

k_2 = metabolic rate at t_2

k_1 = metabolic 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)

Ψ = Ψp + Ψs

Ψp = pressure potential

Ψs = solute potential

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

The Solute Potential of the Solution

Ψs = – iCRT

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

C = molar concentration

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

T = temperature in Kelvin (273 + °C)

SURFACE AREA AND VOLUME

Volume of a Sphere

V = 4/3 π r³

Volume of a Cube (or Square Column)

V = l w h

Volume of a Column

V = π r² h

Surface Area of a Sphere

A = 4 π r²

Surface Area of a Cube

A = 6 a

Surface Area of a Rectangular Solid

A = Σ (surface area of each side)

r = radius

l = length

h = height

w = width

A = surface area

V = volume

Σ = Sum of all

a = surface area of one side of the cube

Dilution – used to create a dilute solution from a concentrated stock solution

$C_iV_i = C_fV_f$

i = initial (starting)

C = concentration of solute

f = final (desired)

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 [H+]

TASK #4: GRAPHING (Pages 21-28)

Problem A: Using the following data, answer the questions below and then construct a line graph.

Depth in meters	Number of Bubbles / minute Plant A	Number of Bubbles / minute Plant B
2	29	21
5	36	27
10	45	40
16	32	50
25	20	34
30	10	20

1. What is the dependent variable and why?

2. What is the independent variable and why?

3. What title would you give the graph?

4. What are the mean, median, and mode of all 3 columns of data?

a). Depth : Mean_____________ Median___________ Mode_________

b). Bubble Plant A.: Mean _____________ Median__________ Mode_________

c). Bubbles Plant B: Mean _____________ Median__________ Mode_________

Problem B: Diabetes is a disease affecting the insulin producing glands of the pancreas. If there is not enough insulin being produced by these cells, the amount of glucose in the blood will remain high. A blood glucose level above 140 for an extended period of time is not considered normal. This disease, if not brought under control, can lead to severe complications and even death. Answer the following questions concerning the data below and then graph it.

Time After Eating hours	Glucose ml / Liter of Blood Person A	Glucose ml / Liter of Blood Person B
0.5	170	180
1	155	195
1.5	140	230
2	135	245
2.5	140	235
3	135	225
4	130	200

1. What is the dependent variable and why?

2. What is the independent variable and why?

3. What title would you give the graph?

4. Which, if any, of the above individuals (A or B) has diabetes?

5. What data do you have to support your hypothesis?

6. If the time period were extended to 6 hours, what would the expected blood glucose level for Person B?

Problem C: Temperatures were obtained in November in a fairly arid area of Nevada. At two different sites, temperature readings were taken at a number of heights above and below the soil surface. One site was shaded by a juniper (a plant) whereas the other was not.

Table 1

Condition	Height in cm from soil surface	Temp. in Co - Beneath Forest Cover	Temp in Co - Unshaded Field
Air	150	18	20
Air	90	18	21
Air	60	18	20
Air	30	18	21
Soil surface	0	16	33
Humus	-6	12	19
Mineral	-15	9	15
Mineral	-30	7	12

Problem D: A researcher interested in the disappearance of fallen leaves in a deciduous forest carried out a field experiment that lasted nearly a year. She collected all the leaves from 100 plots scattered throughout the forest. She measured the amount of leaves present in November, May and August. The percentages reflect the number of leaves found, using the November values as 100 percent. **Complete the table by calculating the missing percentages and Construct a line graph for the ash and elm leaves**

Table 2

Collection Date	Ash	Beech	Elm	Hazel	Oak	Willow
November	4271g 100%	3220g 100%	3481g 100%	1723g 100%	5317g 100%	3430g 100%
May	2431g 57%	3190g 91%	1739g %	501g %	4401g 83%	1201g 35%
August	1376g 32%	2285g 71%	35g %	62g %	1759g 33%	4g 0.1%

Problem E: A species of insect has been accidentally introduced from Asia into the US. The success of this organism depends on its ability to find a suitable habitat. The larval stage is very sensitive to changes in temperature, humidity and light intensity. Expose to situations outside the tolerance limits results in a high mortality (death) rate. Study the data table below.

Table 3

Temp. (oC)	Mortality (%)	Relative Humidity(%)	Mortality (%)	Light intensity (fc)	Mortality (%)
15	100	100	80	300	0
16	80	90	10	400	0
17	30	80	0	600	10
18	10	70	0	800	15
19	0	60	0	1000	20
20	0	50	50	1200	20
21	0	40	70	1400	90
22	0	30	90	1600	95
23	20	20	100	1800	100
24	80	10	100	2000	100
25	100	0	100		

On the graphs, plot line graphs for the effects of temperature and humidity of mortality rates.

TASK #5 PREFIX AND SUFFIX: Scientific Root Words, Prefixes, And Suffixes (USE AS REFERENCE)

a-, an- not, without, lacking, deficient	**anti- against, opposite**	**brady- slow**
ab- away from, out from	**antrhopo- man, human**	**branchi- fin**
-able capable of	**-ap-, -aph- touch**	**brev- short**
ac- to, toward	**apo-, ap- away from**	**bronch- windpipe**
-aceous of or pertaining to	**aqu- water**	**cac-. bad**
acou-, acous- hear	**archaeo- primitive, ancient**	**calor- heat**
ad- to, toward	**-ary, -arium denotes a place for something**	**capill- hair**
aden- gland	**arteri- artery**	**capit- head**
adip- fat	**arthr- joint, articulation**	**carcin- cancer**
aero- air	**-ase forms names of enzymes**	**cardi- heart**
agri- field, soil	**aster-, astr- star**	**carn- meat, flesh**
-al having the character of	**-ate verb form – the act of**	**carp- fruit**
alb- white	**anther- fatty deposit**	**carpal- wrist**
alg-, -algia pain	**-ation noun form – the act of**	**cata- breakdown, downward**
alto- high	**atmo- vapor**	**caud- tail**
ambi- both	**audi- hear**	**-cell- chamber, small room**
ameb- change, alternation	**aur- ear**	**cen-, cene- now, recent**
amni- fetal membrane	**auto- self**	**cente- pierce**
amphi-, ampho- both	**bacter-, bactr- bacterium, stick, club**	**centi- hudredth**
amyl- starch	**barb- beard**	**centr- center**
ana- up, back, again	**baro- weight**	**cephal- head**
andro- man, masculine	**bath- depth, height**	**cerat- horn**
anemo- wind	**bene- well, good**	**cerebr- brain**
ang- choke, feel pain	**bi- (Latin) two twice**	**cervic- neck**
angi- blood, vessel, duct	**bi-, bio- (Greek) life, living**	**chel- claw**
ante- before, ahead of time	**-blast- sprout, germ, bud**	**chem- dealing with chemicals**
anter- front	**brachi- arm**	**chir- hand**
antho- flower	**brachy- short**	**chlor- green**

chondr- cartilage	dactyl- finger	-en made of
chrom-, -chrome color	de- away from, down	encephal- brain
chron- time	deca- ten	enter- intestine, gut
-chym- juice	deci- tenth	entom- insects
-cid-, -cis- cut, kill, fall	deliquesc- become fluid	-eous nature of, like
circa-, circum- around, about	demi- half	epi- upon, above, over
cirru- hairlike curls	dendr- tree	-err- wander, go astray
co- with, together	dent- tooth	erythro- red
cocc- seed, berry	derm- skin	-escent becoming
coel- hollow	di-, dipl- (Latin) two, double	eso- inward, within, inner
coll- glue	di-, dia- (Greek) through, across, apart	eu- well, good, true, normal
coni- cone	dia- (Latin) day	eury- widen
contra- against	digit- finger, toe	ex- out of, away from
corp- body	din- terrible	extra- beyond, outside
cort-, cortic- outer layer	dis- apart, out	-fer- bear, carry, produce
cosmo- world, order, form	dorm- sleep	ferro- iron
cotyl- cup	dors- back	fibr- fiber, thread
counter- against	du-, duo- two	-fid, fiss- split, divided into
crani- skull	-duct lead	-flect, -flex bend
cresc-, cret- begin to grow	dynam- power	flor- flower
crypt- hidden, covered	dys- bad, abnormal, difficult	flu-,fluct-,flux flow
-cul-, -cule small, diminutive	ec- out of, away from	foli- leaf
cumul- heaped	echin- spiny, prickly	fract- break
cuti- skin	eco- house	-gam- marriage
cyan- blue	ecto- outside of	gastr- stomach
cycle, cycl- ring, circle	-elle small	geo- land, earth
-cyst- sac, pouch, bladder	-emia blood	-gen, -gine producer, former
cyt-, -cyte cell, hollow container	en-, endo-, ent- in, into, within	-gene- origin, birth

-gest- carry, produce, bear	**hipp- horse**	**-it is inflammation, disease**
-glen- eyeball	**hist- tissue**	**-ium refers to a part of the body**
-glob- ball, round	**holo- entire, whole**	**-kary- cell nucleus**
gloss- tongue	**homo- (Latin) man, human**	**kel- tumor, swelling**
gluc-, glyc- sweet, sugar	**homo- (Greek) same, alike**	**kerat- horn**
glut- buttock	**hort- garden**	**kilo- thousand**
gnath- jaw	**hydr- water**	**kine- move**
-gon angle, corner	**hygr- moist, wet**	**lachry- tear**
-grad- step	**hyper- above, beyond over**	**lact- milk**
-gram, graph record, writing	**hyph- weaving, web**	**lat- side**
grav- heavy	**hyphno- sleep**	**leio- smooth**
-gross- thick	**hypo- below, under, less**	**-less without**
gymno- naked, bare	**hyster- womb, uterus**	**leuc-, leuk- white, bright, light**
gyn- female	**-iae person afflicted with disease**	**lign- wood**
gyr- ring, circle, spiral	**-iasis disease, abnormal condition**	**lin- line**
-hal-, -hale breathe, breath	**-ic (adjective former)**	**lingu- tongue**
halo- salt	**-chthy- fish**	**lip- fat**
hapl- simple	**ign- fire**	**lith-, -lite stone, petrifying**
hector- hundred	**in-, il-, im-, ir- not**	**loc- place**
-helminth- worm	**in-, il-, im-, ir- to, toward, into**	**-log- word, speech**
hem- blood	**in- very, thoroughly**	**-logist one who studies**
hemi- half	**-ine of or pertaining to**	**-logy study of**
hepar-, hepat- liver	**infra- below, beneath**	**lumin- light**
herb- grass, plants	**inter- within, inside**	**-lys, -lyt, -lyst decompose, split, dissolve**
hetero- different, other	**intra- between**	**macr- large**
hex- six	**-ism a state or condition**	**malac- soft**
hibern- winter	**iso- equal, same**	**malle- hammer**
hidr- sweat	**-ist person who deals with**	**mamm- breast**

marg- border, edge	**neo- new, recent**	**-osis abnormal condition**
mast- breast	**neprho- kidney**	**oste- bone**
med- middle	**-ner- moist, liquid**	**oto- ear**
meg- million, great	**neur- nerve**	**-ous full of**
mela-, melan- black, dark	**noct-, nov- night**	**ov- egg**
-mer part	**-node knot**	**oxy- sharp, acid, oxygen**
mes- middle, half, intermediate	**-nom-, -nomy ordered knowledge, law**	**pachy- thick**
met-, meta- between, along, after	**non- not**	**paleo- old, ancient**
-meter, -metry measurement	**not- back**	**palm- broad, flat**
micro- small, millionth	**nuc- center**	**pan- all**
milli- thousandth	**ob- against**	**par-, para- beside, near, equal**
mis- wrong, incorrect	**ocul- eye**	**path-, -pathy disease, suffering**
mito- thread	**oct- eight**	**-ped- foot**
mole- mass	**odont- tooth**	**-ped- child**
mono- one, single	**-ond form, appearance**	**pent- five**
mort- death	**olf- smell**	**per- through**
mot- move	**oligo- few, little**	**peri- around**
morph- shape, form	**-oma abnormal condition, tumor**	**permea- pas, go**
multi- many	**omni- all**	**phag- eat**
mut- change	**onc- mass, tumor**	**pheno- show**
my- muscle	**oo- egg**	**-phil- loving, fond of**
myc- fungus	**opthalm- eye**	**phon-, -phone sound**
mycel- threadlike	**opt- eye**	**-phore,, pher- bear, carry**
myriad- many	**orb- circle, round, ring**	**photo- light**
moll- soft	**-orium, -ory place for something**	**phren- mind, diaphragm**
nas- nose	**ornith- bird**	**phyc- seaweed, algae**
necr- corpse, dead	**orth- straight, correct, right**	**phyl- related group**
nemat- thread	**oscu- mouth**	**-phyll leaf**

physic- nature, natural qualities	re- again, back	som-, somat-, -some body
phyt-, phyte platn	rect- right, correct	somn- sleep
pino- drink	ren- kidney	son- sound
pinni- feather	ret- net, made like a net	spec-, spic- look at
plan- roaming, wandering	rhag-, -rrhage burst forth	-sperm- seed
plasm-, -plast- form, formed into	rhe-, rrhea flow	-spher- ball, round
platy- flat	rhin- nose	spir-, -spire breathe
pleur- lung, rib, side	rhiz- root	-spor- seed
pneumo- lungs, air	rhodo- rose	stat-, -stasis standing, placed, staying
-pod foot	roto- wheel	stell- stars
ply- many, several	rubr- red	sten- narrow
por- opening	sacchar- sugar	stern- chest, breast
port- carry	sapr- rotten	stom-, -stome mouth
post- after, behind	sarc- flesh	strat- strat
pom fruit	saur- lizard	stereo- solid, 3-dimensional
pre- before, ahead of time	schis-, schiz- split, divide	strict- drawn tight
prim- first	sci- know	styl- pillar
pro- forward, favoring, before	scler- hard	sub- under, below
p[roto- first, primary	-scop- look, device for seeing	super-, sur- over, above, on top
pseudo- false, deceptive	-scribe, -script write	sym-, syn- together
psych mind	semi- half, partly	tachy- quick, swift
pter- having wings or fins	sept- partition, seven	tarso- ankle
pulmo- lung	-septic infection, putrefaction	tax- arrange, put in order
puls- drive, push	sess- sit	tele- far off, distant
pyr- heat, fire	sex- six	telo- end
quadr- four	-sis condition, state	terr- earth, land
quin- five	sol- sun	tetr- four
radi- ray	solv- loosen, free	thall- young shoot

-the-, -thes- put	**xero- dry**	
-thel- cover a surface	**xyl- wood**	
therm- heat	**zo-, -zoa animal**	
-tom- cut, slice	**zyg- joined together**	
toxico- poison	**zym- yeast**	
top- place		
trache- windpipe		
trans- across		
tri- three		
trich- hair		
-trop- turn, change		
-troph- nourishment, one who feels		
turb- whirl		
-ul-, -ule diminutive, small		
ultra- beyond		
uni- one		
ur- urine		
-ura tail		
vas- vessel		
vect- carry		
ven-, vent- come		
ventr- belly, underside		
-verge turn, slant		
vig- strong		
vit-, viv- life		
volv- roll, wander		
-vor- devour, eat		
xanth- yellow		

TASK #6: READ, DEFINE & TAKE NOTES: **<u>Define any terms you do not know, read and take excellent hand written notes.</u>** **(Drawings can be very useful. Please do not overlook any caption below an image or graph).**

Chapter 1: Introduction: Themes in the Study of Life	**(1.1-1.4)**	**Pages 1-25**	**24 pages**
Chapter 2: The Chemical Context of Life	**(2.1-2.4)**	**Pages 30-43**	**13 pages**
Chapter 3: Water & Life	**(3.1-3.3)**	**Pages 46-56**	**10 pages**
Chapter 4: Carbon and the Molecular Diversity of Life	**(4.1-4.2)**	**Pages 58-63**	**05 pages**

<u>All notes, vocabulary terms, response questions .... must be handwritten.</u>

(*<u>NO COMPUTER FONT)</u>*

TASK #7 RESPONSES: (Please time yourself on each frq) (Pages 36-48)

Answer the following 3 response questions

- **Question 1 = 10 points (Longer FRQ)**
- **Question 2 = 4 points (Shorter FRQ)**
- **Question 3 = 10 points. (Longer FRQ)**

Please write each of your three frq in provided space or a separate sheet of paper. Please leave ample space between each section for corrections.

PLEASE WRITE IN PEN

(If you take more than the allotted time, please use another color pen)

FRQ #1 (LONG QUESTION 10 Points) (this is a 20 minute FRQ) **Start Time ___________ End Time __________**

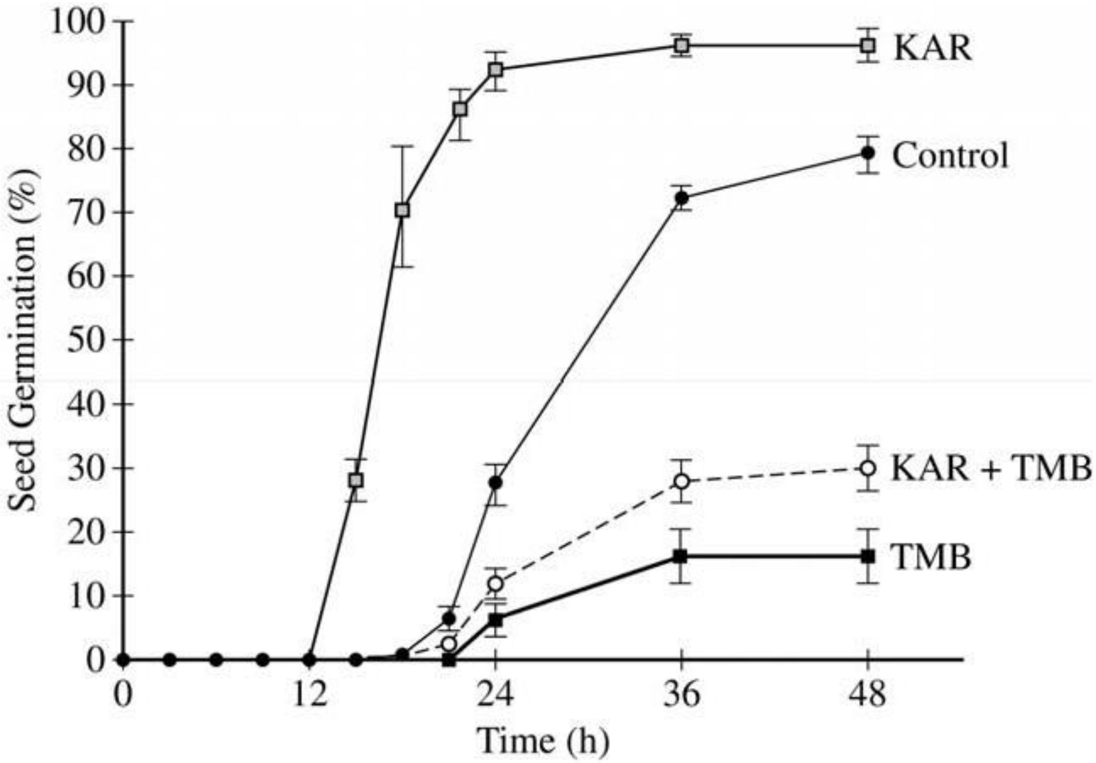


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in Lactuca plants. Error bars represent ±2 SE x.

1.Fires frequently occur in some ecosystems and can destroy all above-ground vegetation. Many species of plants in these ecosystems respond to compounds in smoke that regulate seed germination after a major fire. Karrikins (KAR) and trimethylbutenolides (TMB) are water-soluble compounds found in smoke that are deposited in the soil as a result of a fire. KAR and TMB bind to receptor proteins in a seed. In a study on the effects of smoke on seeds, researchers recorded the timing and percent of seed germination in the presence of various combinations of KAR and TMB. The results are shown in Figure 1.

In a second investigation into the effect of available water on seed germination after a fire, researchers treated seeds with KAR or TMB. The treated seeds were then divided into two treatment groups. One group received a water rinse and the other group received no water rinse. The seeds were then incubated along with a group of control seeds that were not treated. The results are shown in the table.

EFFECT OF CHEMICAL TREATMENT AND WATER RINSE ON GERMINATION

Treatment Group	Chemical Treatment		Water	Germination Result
	KAR	TMB		
1 (control)	−	−	−	Control result
2	+	−	−	Different from control
3	−	+	−	Different from control
4 (control)	−	−	+	Control result
5	+	−	+	Different from control
6	−	+	+	Same as control

(a) The researchers made the following claims about the effect of KAR and the effect of TMB on seed germination relative to the control treatment.

- KAR alone affects the timing of seed germination.
- KAR alone affects the percentage of seeds that germinate.
- TMB alone affects the timing of seed germination.
- TMB alone affects the percentage of seeds that germinate.

Provide support using data from Figure 1 for each of the researchers’ claims.

(b) **Make a claim** about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

(c) There is intense competition by plants to successfully colonize areas that have been recently cleared by a fire. **Describe** ONE advantage of KAR regulation and ONE advantage of TMB regulation to plants that live in an ecosystem with regular fires.

FRQ #2 (SHORT QUESTION 4 Points)

Start Time ___________ End Time __________

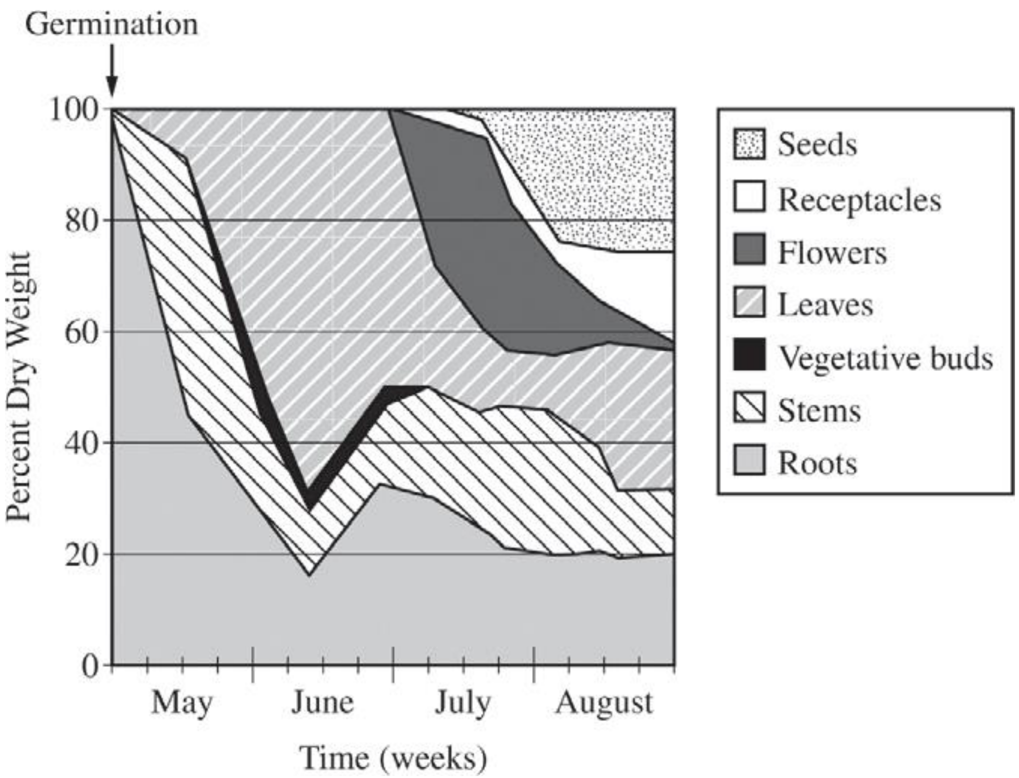


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

2. The graph above illustrates the percent dry weight of different parts of a particular annual plant (plants that live less than one year) from early May to late August. The percent dry weight can be used to estimate the amount of energy a plant uses to produce its leaves, vegetative buds, stems, roots, and reproductive parts (seeds, receptacles, and flowers).

   (a) **Identify** the direct source of the energy used for plant growth during the first week of May, and **identify** the part of the plant that grew the most during the same period.

   (b) Based on the data on the graph, **estimate** the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July.

   (c) Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. **Propose** ONE evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants.

FRQ #3 (LONG QUESTION 10 Points) (this is a 20 minute FRQ)   Start Time __________ End Time __________

3: Trichomes are hairlike outgrowths of the epidermis of plants that are thought to provide protection against being eaten by herbivores (herbivory). In a certain plant species, stem trichome density is genetically determined.

To investigate variation in stem trichome density within the plant species, a student counted the number of trichomes on the stems of six plants in each of three different populations. The student used the data to calculate the mean trichome density (numbers of hairs per square centimeter) for each population. The results are provided in the table below.

TRICHOME DENSITY IN THREE PLANT POPULATIONS (number of trichrome/cm^2)

Population	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Mean	Standard Error of the Mean (SEM)
I	8	11	9	10	8	6	9	1
II	12	6	15	9	13	8	11	1
III	13	17	9	14	12	16	14	1

(a) On the axes provided, **create** an appropriately labeled graph to illustrate the sample means of the three populations to within 95% confidence (i.e., sample mean ± 2 SEM).

(b) Based on the sample means and standard errors of the means, **identify** the two populations that are most likely to have statistically significant differences in the mean stem trichome densities. **Justify** your response.

(c) **Describe** the independent and dependent variables and a control treatment for an experiment to test the hypothesis that higher trichome density in plants is selected for in the presence of herbivores. **Identify** an appropriate duration of the experiment to ensure that natural selection is measured, and **predict** the experimental results that would support the hypothesis.