AP Biology Summer Tasks 1-5

All work must be hand written and in complete sentences.

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, CAPT, SBAC 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 2012 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…

The Ecology sections are found in the last unit of our textbook, AP Biology, 9th edition by Campbell. **You will be required to hand write / complete the four tasks found on the following page**. When we return to school in September, you will be tested (be prepared).

During the summer if you have any questions, please feel free to email me at **amitybiology@gmail.com** , but **during the school year** please email me at **Derek.Wilson@reg5.k12.ct.us** 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.

The four Big Ideas for 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

Please extend your research and look outside your text for additional information……

I look forward to seeing you next year,

Mr. Wilson

Your assigned packet and reading materials will also be located in the AP Biology Summer Folder. At the back of this packet you can find the areas within the book we will cover. Page 52

You have to be an independent learner and 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

Or

30 minutes studying…. 10 minutes relaxing…

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

Task #1 READ, DEFINE & TAKE NOTES: **Define any terms you do not know, read and take excellent hand written notes.**

(Drawings can be very useful. Please do not overlook any caption below an image or graph).

Ecology Unit and Introduction
51.2, 51.3, 51.4 (1123-1139) 17 pages
52.2 1150-1152) 3 pages
53.1 -53.6 (1170-1190) 21 pages
54.1 -54.5 (1194-1213) 20 pages
55.1-55.5 (1218-1233) 16 pages
56.1 & 56.4 (1239-1241 & 1254-1258) 8 pages
When we get back, look over the introduction (Chapter 1) and chemistry (Chapter 2)

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

Task #2: AP Biology Book Organizers: ***(Pages 4-21)*** Please complete **at least two** of the chapter organizers that has been provided. (**Example Chapter 51 includes sections 51.2 – 51.4**). Answer the multiple choice questions located at the end of the textbook readings that only relate to the assigned reading sections with-in the chapter. (If you like using the organizers keep on using them, but the organizers in the folder are not edited to the designated areas like the summer packet). Organizers can be found in the student drive under AP Biology Wilson. If you do not like them, that is ok too.

Task #3 MATH REVIEW: Review the following formulas (**pages 22-34).** 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 35).** 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.

TASK #4 Graphing pages 36-43 (Complete graphs and questions)

TASK #5 PREFIX AND SUFFIX: Complete the chart (page 44)

TASK #6 RESPONSES & Multiple Choice: Answer the following 3 FRQ and answer all 21 multiple choice. **(Pages #46-62)** ***handwritten***. (*NO COMPUTER FONT*)

TASK #2: AP Biology Book Organizers: ***(Pages 3-21)*** Please complete **at least two** of the chapter organizers that has been provided. (Example Chapter 51 includes sections 51.2 – 51.4). Answer the multiple choice questions located at the end of the textbook readings that only relate to the assigned reading sections with-in the chapter. ***All terms, response questions and notes must be handwritten.*** (NO COMPUTER FONT)

Chapter 51

Concept 51.2 Learning establishes specific links between experience and behavior

1. What is the difference between *innate* and *learned* behavior? Give an example of each.
2. What is meant by *fitness*? How can *habituation* increase fitness?
3. Describe the process of *imprinting*, and explain what is meant by *sensitive* or *critical period*.
4. Describe the classic study of *parental imprinting* done by *Konrad Lorenz*.
5. What special challenges did researchers face in order to return whooping cranes to the wild? What would you have to wear if you worked with hatchlings? Why?
6. There are several types of learning. What occurs in *spatial learning*?
7. What are two types of *associative learning*? Which type did *Ivan Pavlov* use to get a dog to salivate at the sound of a bell?
8. What occurs in *operant conditioning*?
9. What is *cognition*? Give three examples of cognition in animal species; include at least one bird behavior.
10. Many bird songs are learned during a critical period. What will happen if a white-crowned sparrow does not hear the song of its species during this time?

Concept 51.3 Both genetic makeup and environment contribute to the development of behaviors

1 Based on *cross-fostering* and *human twin studies*, what are the two factors that contribute significantly to behavior?

2 This concept looks at some very interesting ways that genetic changes affect behavior. Several important case studies that show a genetic component to behavior are presented. Take time to read and enjoy them. The study of voles and their mating behaviors is often discussed in other science articles. To return to fruit fly mating, a single gene called *fru* controls male mating behavior. If males lack a functional *fru* gene (short for *fruitless*), what happens? And what occurs if females are genetically manipulated to express this gene?

Concept 51.4 Selection for individual survival and reproductive success can explain most behaviors

1. What is *foraging behavior*?
2. What is proposed by the *optimal foraging theory*? Explain it in terms of cost and benefit, and cite two examples from your text.
3. To demonstrate that you understand the principle of optimal foraging, describe a food source that you would not be likely to exploit.
4. Explain each of these mating systems:

   promiscuity **monogamy** **polygamy** **polygyny** **polyandry**

5. Explain two factors that may be important in determining the evolution of these systems, and apply each factor to a particular species.
6. Let's return to an earlier idea. What is *sexual selection*? (Chapter 23)
7. There are two types of sexual selection. Explain each of them. **intersexual selection intrasexual selection**
8. What is *agonistic behavior*? Give one example of this behavior that is not in your book.

Testing Your Knowledge: Self-Quiz Answers (Only answer ones in sections you have read questions are at the end of each chapter

Chapter 52

Concept 52.2 Interactions between organisms and the environment limit the distribution of species

1 What is *biogeography*? What factors determine the distribution of organisms?

2 Read this section carefully to understand different types of experiments and observations that help explain the distribution of species. As you conclude this section, list and describe five examples of *biotic factors*.

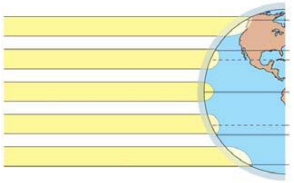
Biotic Factor	**Example and Description**

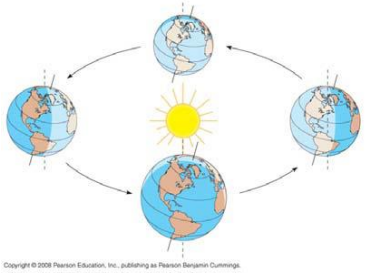
3 List five abiotic factors. Include an example and description of each factor's influence on living organisms.

Abiotic Factor	**Example and Description**

4 What is *climate*? What abiotic factors are its components?

5 Study Figure 52.10, which summarizes Earth's climate patterns and how they are formed. Explain how Earth's curvature and axis of rotation influence the amount of sunlight reaching a given area, and how these factors influence the temperature and precipitation in that area.





6 Let's look at factors that affect climate on a smaller scale. Begin by studying Figure 52.11. Why is the Pacific Northwest so rainy? What causes the Mediterranean climate?

Explain the "rain shadow" effect.

7 What effect does elevation have on climate? Why do we say that hiking from Gatlinburg, Tennessee, at 393 meters of elevation in the Smoky Mountains region, to the top of Mount LeConte, at 2010 meters, is like traveling to Canada?

Chapter 53

Concept 53.1 Dynamic biological processes influence population density, dispersion, and demographics

1 What two pieces of data are needed to mathematically determine *density*?

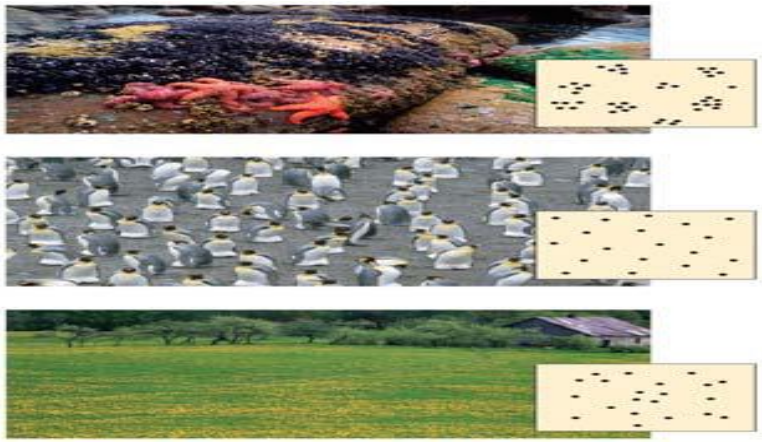
2 What is the difference between density and *dispersion*?

3 Work through Figure 53.2, doing the math to make sure you get the same answer as the text. Note and understand what the letters of the formula mean. Next, try the following problem.

A population ecologist wished to determine the size of a population of white-footed deer mice, *Peromyscus leucopus*, in a 1-hectare field. Her first trapping yielded 80 mice, all of which were marked with a dab of purple hair dye on the back of the neck. Two weeks later, the trapping was repeated. This time 75 mice were trapped, out of which 48 of the mice were marked. Using the formula $N = mn/x$, what is the population of mice in the field? (Answer is at the end of this reading guide.)

4 Explain the impact of *immigration* and *emigration* on population density. (To avoid confusion between these two terms, it might help to use this memory trick: **i**mmigration is the movement **i**nto a population, while **e**migration is the **e**xiting of individuals from a population.)

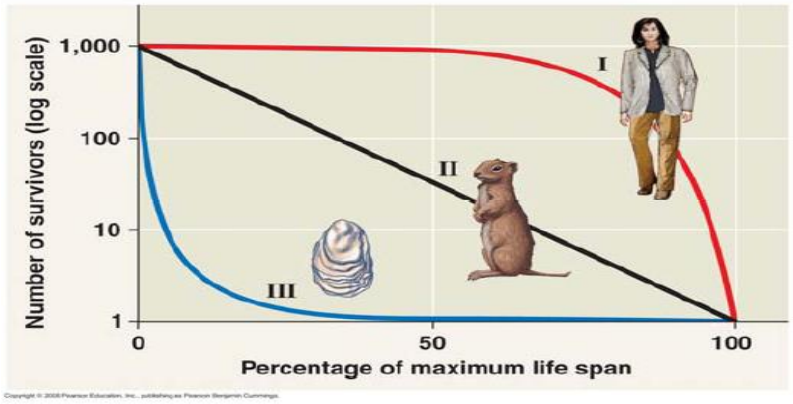
5 Label the dispersion pattern shown by each population in the figure below. Second, and most important, what do the dispersion patterns tell us about the population and its interactions?



6 In what population statistic do *demographers* have a particular interest? How is this data often presented?

Is your biology class a *cohort*? Explain.

7 Survivorship curves show patterns of survival. In general terms, survivorship curves can be classified into three types. Using the figure below, label and explain the three idealized survivorship patterns.



8 In the natural world, many species show survivorship curves that are combinations of the standard curves. How would an open nesting songbird's survivorship curve appear if it was Type III for the first year and then Type II for the rest of its life span? Sketch this curve on the survivorship curve graph in question 8.

What does a *reproductive table* show?

Concept 53.2 Life history traits are products of natural selection

1 On what is the *life history* of an organism based?

2 What three variables form the life history of a species?

3 Explain the difference between *semelparity (big-bang reproduction)* and iteroparity *(repeated reproduction)* as life history strategies.

4 Explain how two critical factors influence whether a species will evolve toward semelparity or iteroparity.

5 Explain the effect of offspring care on parental survival in kestrels.

Concept 53.3 The exponential model describes population growth in an idealized, unlimited environment

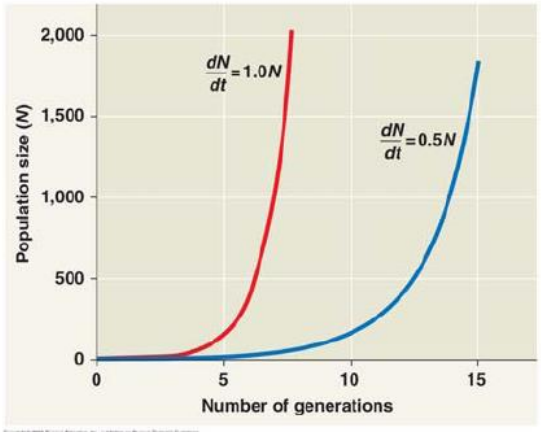
1 Do not let the math in this section be a problem. Instead of trying to understand the calculus involved, concentrate on the idea of exponential growth, how it is graphed, and what this type of growth indicates about a population.

2 What is the advantage to using per capita birth and death rates rather than just the raw numbers of births and deaths?

3 What will the per capita birth and death rates be if a population is demonstrating *zero population growth*?

4 What does it mean for a population to be in *exponential population growth*?

5 In the graph below, explain why the line with the value of 1.0 shows a steeper slope that reaches exponential growth more quickly than does the line with the value of 0.5. On this graph, add a third line that approximates a population with an exponential value of 1.25.



6 What are two examples of conditions that might lead to *exponential population growth* in natural populations?

Concept 53.4 The logistic model describes how a population grows more slowly as it nears its carrying capacity

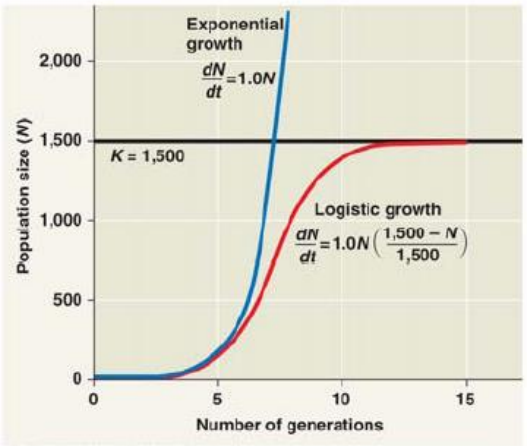
1 What is *carrying capacity*?

2 What are six examples of limiting resources that can influence carrying capacity?

3 In the *logistic population growth* model, the per capita rate of increase approaches zero as the _____ is reached.

4 If the carrying capacity (or K) is 1,000 and N is 10, the term $(K – N)/K$ is large. Explain why a large value for $(K – N)/K$ predicts growth close to the maximum rate of increase for this population.

5 In the graph below, explain why the logistic model predicts a sigmoid (S-shaped) growth curve when the population density is plotted over time. Hint: The critical part of this answer concerns why growth slows as *N* approaches *K*.



6 The end of this concept attempts to bring together the ideas of life histories and growth models. This is done with the introduction of two new terms: *K*-selection and *r*-selection. Explain the ideas behind the creation of these two terms.

Compare and contrast these two terms:
density-independent regulation
density-dependent regulation

7 Explain how negative feedback plays an essential role in the unifying theme of regulation of populations. Does negative feedback play a role in both density-independent and density- dependent regulation?

8 Complete the following chart. **Density-Dependent Population Regulation**

Negative Feedback Mechanism	**Explanation**	**Example**
Competion for resources		
Territoriality		
Disease		
Predation		
Toxic wastes		
Intrinsic factors		

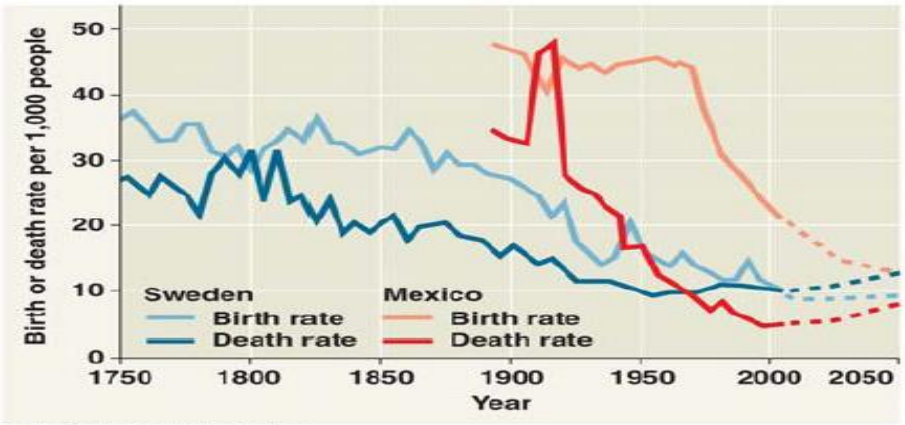
9 Give both biotic and abiotic reasons for population fluctuations over the last 50 years in the moose population on Isle Royale, based on *population dynamics*.

10 Explain the importance of immigration and emigration in *metapopulations.*

Concept 53.5 The human population is no longer growing exponentially but is still increasing rapidly

1 Summarize human population growth since 1650. (Of all the reported statistics, which one surprises you the most?)

2 What is *demographic transition*? Use the figure below to explain the process in Sweden and Mexico.



3 You should be able to look at *age-structure graphs* and make predictions about the future growth of the population. Using Figure 53.25, describe the key features for the three age- structure graphs and predict how the population of each country will grow.

4Why do *infant mortality* and *life expectancy* vary so greatly between certain countries?

5 Can the world's population sustain an *ecological footprint* that is currently the average American footprint?

Country	Key Features	Predicted Future Growth
Afghanistan		
United States		
Italy		

Testing Your Knowledge: Self-Quiz Answers

1._____2._____3._____4._____5._____6._____7._____8._____9._____ 10._____

Chapter 54

Concept 54.1 Community interactions are classified by whether they help, harm, or have no effect on the species involved.

1 What is a *community?* List six organisms that would be found in your schoolyard community.

2 This section will look at *interspecific* interactions. Be clear on the meaning of the prefix! To begin, distinguish between *intraspecific competition* and *interspecific competition.* Give an example of each.

Type of Competition	Explanation	Example
Intraspecific competition		
Interspecific competition		

3 What is G. F. Gause's *competitive exclusion principle*? Give one example

Define *ecological niche*.

4 Several species of *Anolis* lizards live in the same types of trees and have a similar diet. Discuss *resource partitioning* to explain how interspecific competition is reduced. (Study Figure 54.2.)

5 What is the difference between the *fundamental niche* and the *realized niche*?

6 Study Figure 54.5, and then explain what is meant by *character displacement*. (To do this, you will have to learn or review the difference between *sympatric* populations and *allopatric* populations. You will find this information in Chapter 24.)

7 Predation is a term that you probably already know. Can you give examples of some predator-prey combinations as listed below?

Predator	Prey	Example
Animal	Animal	
Animal	Plant	
Fungus	Animal	
Bacteria	Animal	
Fungus	Plant	

8 List three special adaptations that predator species possess for obtaining food.

9 List three ways prey species elude predators.

10 Compare the two types of mimicry

Type of Mimicry	Description	Example
Batesian		
Mullerian		

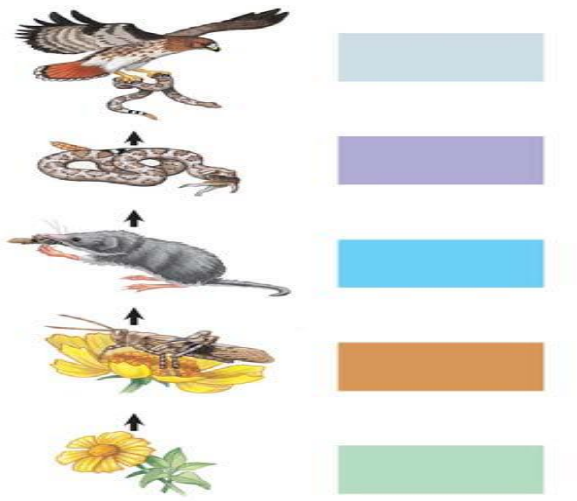
11 What is *herbivory*?

12 What is *species diversity*? What are its two components? Why is it important?

13 What does an ecologist summarize in a *food web*?

14 Know the levels of trophic structure in food chains. Give a food chain here, including four links that might be found in a prairie community, and tell the level for each organism.

15 Name every organism in the pictured food chain, and give the trophic level in the box.



16 According to the *energetic hypothesis*, why are food chains limited in length? How much energy is typically transferred to each higher level?

17 What is a *dominant species*? For the area where you live, what would be considered a dominant tree species?

18 How is a *keystone species* different from a dominant species?

19 Name one keystone species, and explain the effect its removal has on the ecosystem.

20 Explain *facilitator* or *foundation species* and give an example. You may omit bottom-up and top-down controls.

Concept 54.2 Disturbance influences species diversity and composition

1 What is the *intermediate disturbance hypothesis*? Give an example of a disturbance event, and explain the effect it has on the community.

2 Ecological succession is the changes in species that occupy an area after a disturbance. What is the difference between *primary succession* and *secondary succession*?

Concept 54.3 Biogeographic factors affect community biodiversity

1 Explain *latitudinal gradients* in terms of species richness. Where is species richness greatest?

2 There are probably two key factors in latitudinal gradients. List and explain both here, and put a star next to the one that is probably the primary cause of the latitudinal difference in biodiversity.

3 Explain what is demonstrated by a *species-area* curve.

4 Renowned American ecologists Robert MacArthur and E. O. Wilson developed a model of *island biogeography*. While the model can be demonstrated with islands, any isolated habitat represents an island. What are the two factors that determine the number of species on the island?

5 What two physical features of the island affect immigration and extinction rates?

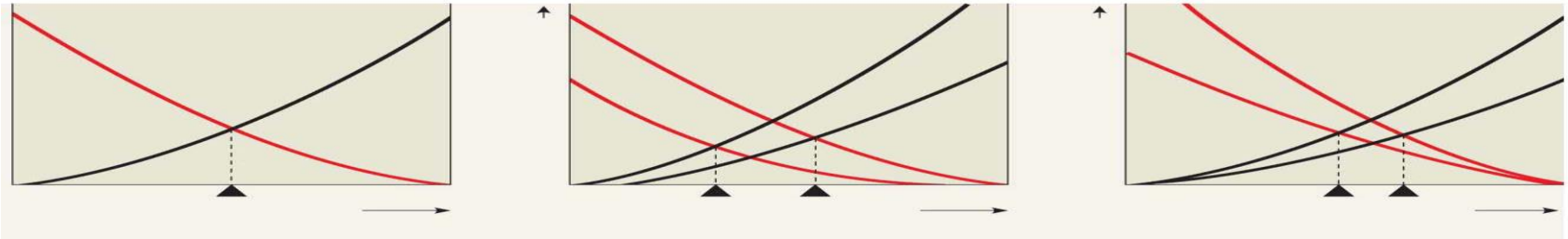
6 Why do small islands have lower immigration rates? Higher extinction rates?

Closer islands have _____ extinction rates and _____ immigration rates.

7 What is the *island equilibrium mode*l?

8 Use this model to describe how an island's size and distance from the mainland affect the island's species richness.

9 Label this figure to show immigration, extinction, island size, and equilibrium. Then explain what each figure shows.



Concept 54.4 Community ecology is useful for understanding pathogen life cycles and controlling human disease

1 Let's pull a couple of ideas from this section: What is a *pathogen*?

2 What is a *zoonotic pathogen*? List three examples.

3 What is a *vector*? List three examples.

Testing Your Knowledge: Self-Quiz Answers
1._____2._____3._____4._____5._____6._____7._____8._____9._____

Chapter 55

Chapter 55: Ecosystems

1 What is an *ecosystem*?

2 Where does energy enter most ecosystems? How is it converted to chemical energy and then passed through the ecosystem? How is it lost? Remember this: *energy cannot be recycled*.

3 Besides the energy flow that you described in question 2, chemicals such as carbon and nitrogen *cycle* through ecosystems. So energy _____ through an ecosystem and matter _____.

Concept 55.1 Physical laws govern energy flow and chemical cycling in ecosystems

1 Both energy and matter can be neither _____ nor _____.

2 We can measure the efficiency of energy conversion in an ecosystem, as well as whether a given nutrient is being gained or lost from an ecosystem. Let us take a second look at *trophic levels*. What trophic level supports all others?

3 List three groups of organisms that are *photosynthetic autotrophs*

4 What are the *primary producers* of the deep-sea vents?

5 This concept reviews trophic relationships. Know all terms in your textbook that are bolded.

6 What are *trophic levels*? What is always at the first trophic level?

7 What are *detritivores*? What is their importance in chemical cycling? Give some examples of detritivores.

8 State the trophic level of each of the following:
cow _____ grass _____ man _____ mushroom _____

Concept 55.2 Energy and other limiting factors control primary production in ecosystems

1 What is *primary production*? Distinguish between *gross primary production* and *net primary production*.

2 Write an equation here that shows the relationship between gross and net primary production.

3 You may recall from Chapter 54 that *biomass* is the total mass of all individuals in a trophic level. Another way of defining net primary production is as the amount of *new* biomass added in a given period of time. Why is net primary production, or the amount of new biomass/unit of time, the key measurement to ecologists?

4 Which ecosystem would tend to have a greater biomass/unit area, a prairie or a tropical rain forest? Explain.

5 Describe a technique for measuring net primary production in an aquatic environment.

6 What are some factors that limit primary productivity in aquatic ecosystems?

7 What is a *limiting nutrient*? What is the limiting nutrient off the shore of Long Island, New York? In the Sargasso Sea?

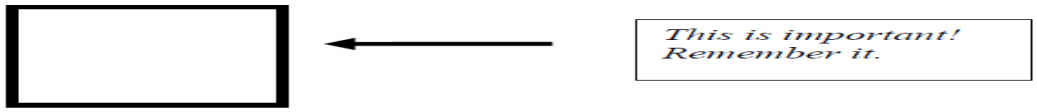
8 Phytoplankton growth can be increased by additional nitrates and phosphates. What are common sources of each of these?

9 What is *eutrophication*? What are factors that contribute to eutrophication?

Concept 55.3 Energy transfer between trophic levels is typically only 10% efficient

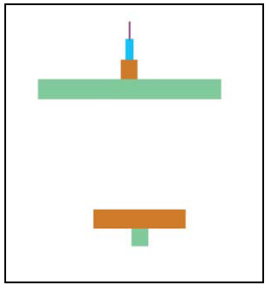
1 What is *trophic efficiency*?

2 Generally, what percentage of energy available at one trophic level is available at the next?



3 Consider a food chain with 1,000 *joules* (an energy unit) available at the producer level. If this food chain is grass grasshopper lizard crow, how much energy is found at the level of the crow? (See answer at the end of this Reading Guide.) Show your work here.

4 Notice that most biomass pyramids have greatest biomass on the bottom of the pyramid. Label the trophic levels on the figure. Explain why the second pyramid of biomass is inverted.



5 Why do people who have limited diets in overpopulated parts of the world eat low on the food chain?

Concept 55.4 Biological and geochemical processes cycle nutrients between organic and inorganic parts of an ecosystem

1 Pay particular attention to the nutrient cycles in Figure 55.14. Note the key processes in each cycle.

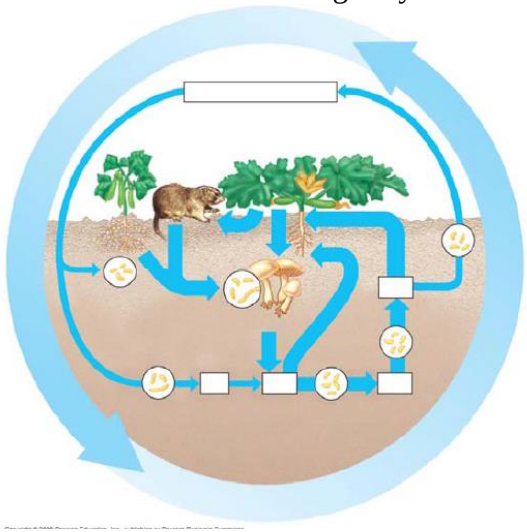
2 Use the figure below to describe the water cycle. Specify the roles of *evaporation*, *transpiration*, and *rainfall*.

3 Use the second figure on the following page to describe the carbon cycle. In doing so, explain how carbon enters the living system and how it leaves, indicate the role of microorganisms in the cycle, and identify the reservoir for carbon.

4 Write the equation for photosynthesis here: _____

5 Write the equation for cellular respiration here: _____

6 Use the diagram below to describe the nitrogen cycle. In doing so, indicate the role of microorganisms in *nitrogen fixation*, *nitrification*, and



denitrification.

6 Review the *Case Study*: *Nutrient Cycling in the Hubbard Brook Experimental Forest*. What effect has deforestation been shown to have on chemical cycling?

Concept 55.5 Human activities now dominate most chemical cycles on Earth : This section looks at human impact on ecosystems.

1 How has agriculture affected nitrogen cycling? What are some negative consequences of nutrient enrichment?

2 In what ways have human activities contributed to acid precipitation? What are some negative consequences of acid precipitation?

3 Explain the process of biological magnification. Discuss at least one example.

4 What is meant by the *greenhouse effect*? What would life on Earth be like without this effect?

5 What is contributing to the great increase in atmospheric carbon dioxide? What are potential effects of this increase?

6 How is atmospheric ozone depleted? What are projected effects of this depletion?

Testing Your Knowledge: Self-Quiz Answers
1._____2._____3._____4._____5._____6._____7._____
Solution to Question 22: Grass (1,000 J) grasshopper (100 J) lizard (10 J) crow (1 J)

Chapter 56

Chapter 56: Conservation Biology and Restoration Ecology: In the overview at the beginning of the chapter, the author sets the stage for this final chapter of the book. This chapter will deal with both *conservation biology* and *restoration ecology*. Let's begin by

1 comparing and contrasting these two terms. **conservation biology & restoration ecology**

Concept 56.1 Human activities threaten Earth's biodiversity

1 Ecologists organize biodiversity on three levels. In the table below, explain the impact of decreasing diversity in each division. Begin reading on page 1248, where the topic changes to threats to biodiversity before answering this question.

Level of Biodiversity	Impact
Genetic Diversity	
Species Diversity	
Ecosystem Diversity	

2 Explain the difference between *endangered species* and *threatened species*.

3 Use this table to organize your thoughts on how the following three threats affect biodiversity

Threat to biodiversity	How it reduces biodiversity
Habitat loss	
Introduced species	
Overexploitation	

4 List five *introduced species* that present a serious threat to their new communities. Explain the damage done by each introduced species. ***Include two introduced species that are a threat in your own region of the country. Indicate these with an asterisk.

Introduced Species	Damage

Concept 56.4 Restoration ecology attempts to restore degraded ecosystems to a more natural state

1 What is the goal of restoration ecology?

2 Restoration ecology uses two key strategies. Explain how each strategy works:

bioremediation

biological augmentation

TASK #3 MATH REVIEW: **Review the following formulas (pages 29-41). 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 42). The math sheet is also given to you when taking the AP Biology exam. You can only use a four function calculator during the AP Biology Exam. This means No graphing calculators are allowed during the AP Biology Exam. We can use graphing calculators during the school year, but know how to use a simple 4 function calculator too.**

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

Khan Academy

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

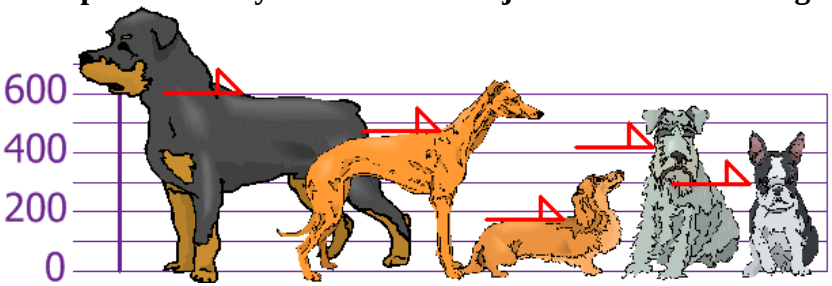
Standard Deviation is a measure of how spreads out numbers are. Its symbol is σ (the Greek letter sigma).
(SEE Bozeman's Biology: Standard Deviation Video)

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):

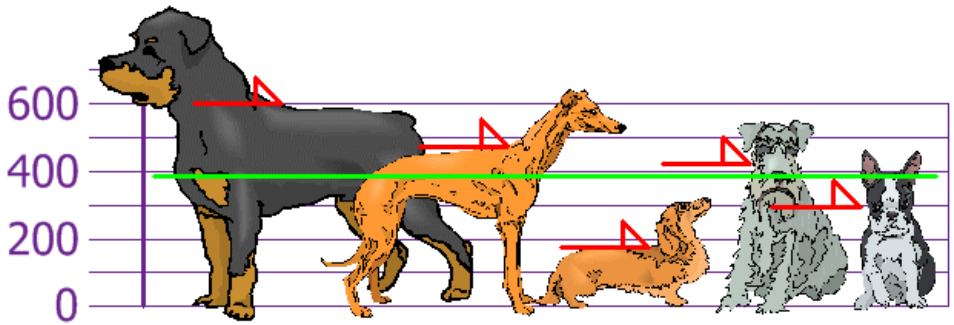


The heights (at the shoulders) are: 600mm, 470mm, 170mm, 430mm and 300mm.

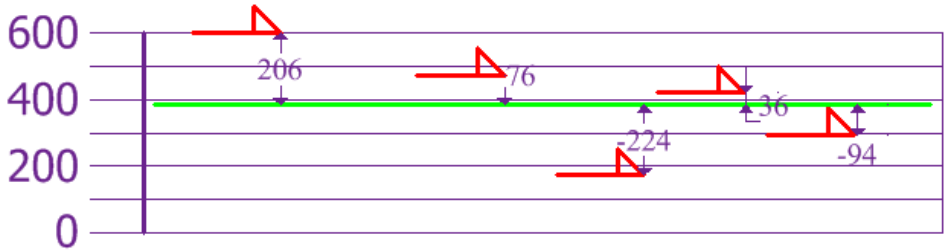
Find out the Mean, the Variance, and the Standard Deviation.

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:

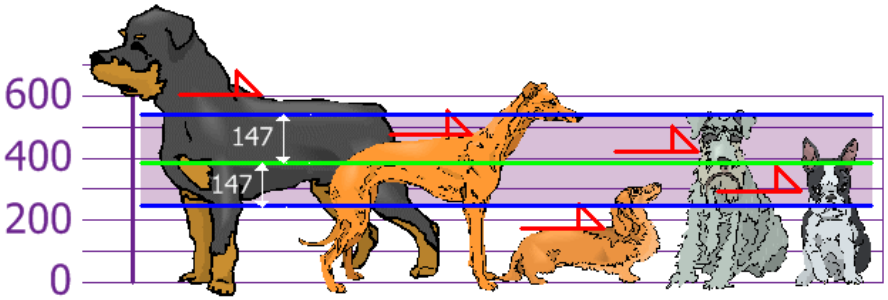
$$\begin{aligned}\text{Variance: } \sigma^2 &= \frac{206^2 + 76^2 + (-224)^2 + 36^2 + (-94)^2}{5} \\ &= \frac{42,436 + 5,776 + 50,176 + 1,296 + 8,836}{5} \\ &= \frac{108,520}{5} = 21,704\end{aligned}$$

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: μ = 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 **<u>most often</u>**.

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 $(m-i)^2$
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 $\sum(m-i)^2 = 272.70$

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

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

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 = # of chances for an event

# 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.

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

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 = frequency of the dominant allele in a population

$p + q = 1$ — 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}

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

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

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

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

$V = 4/3\ \pi r^3$

Volume of a Cube (or Square Column)

$V = l\ w\ h$

Volume of a Column

$V = \pi r^2 h$

Surface Area of a Sphere

$A = 4\ \pi r^2$

Surface Area of a Cube

$A = 6\ a$

Surface Area of a Rectangular Solid

$A = \Sigma$ (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

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:

LEARN THESE ROOT WORDS--- YOU WILL SEE THEM OFTEN NEXT YEAR.—THINK QUIZZES!!!

Word	Meaning
a / an	
meso	
leuco	
aero	
anti	
amphi	
aqua / hydro	
arthro	
auto	
bi / di	
bio	
cephal	
chloro	
chromo	
cide	
cyto	
derm	
haplo	
ecto (exo)	
endo	
epi	
gastro	
genesis	
herba	
hetero	
homo	
ov	
kary	
neuro	
soma	
saccharo	
primi / archea	
phyll	
hemo	

Word	Meaning
hyper	
hypo	
intra	
-itis	
lateral	
-logy	
-lysis	
-meter	
mono	
morph	
micro	
macro	
multi / poly	
pod	
-phobia	
-philia	
proto	
photo	
pseudo	
synthesis	
sub	
troph	
therm	
tri	
zoo, zoa	
-tropism	
-taxis	
-stasis	
zyg / zygous	
phago	
path / pathy	
sym / syn	

AP BIOLOGY AREAS TO FOCUS ON (51-56, 22-26, 3-49)

Animal Behavior 51.2, 51.3, 51.4	**An Introduction to Ecology and the Biosphere 52.2**	**Population Ecology 53.1 -53.6**	**Community Ecology 54.1 -54.5**	**Ecosystems and Restoration Ecology 55.1-55.5**	**Conservation Biology and Global Change 56.1 & 56.4**
Descent with Modification: A Darwinian View of Life 22.2-22.3 (455-467)	**The Evolution of Populations 23.1-23.4 (469-485)**	**The Origin of Species 24.1-24.4 (488-504)**	**The History of Life on Earth 25.1-25.5 (507-529)**	**Phylogeny and the Tree of Life 2 6.1-26.3 &26.6 (537-548 & 551-553)**	**Water and Life 3.1-3.3 (46-56)**
Carbon and the Molecular Diversity of Life 4.1-4.2 (58-63)	**The Structure and Function of Large Biological Molecules 5.1-5.5 (68-89)**	**A Tour of the Cell 6.2-6.5 (98-112)**	**Membrane Structure and Function 7.1-7.5 (125-138)**	**An Introduction to Metabolism 8.1-8.5 (142-160)**	**Cellular Respiration and Fermentation 9.1-9.5 (164-179)**
Photosynthesis 10.1-10.3 (186-199)	**Cell Communication 11.1-11.4 (206-223)**	**The Cell Cycle 12.1-12.3 (229-243)**	**Meiosis and Sexual Life Cycles 13.1-13.4 (248-260)**	**Mendel and the Gene Idea 14.1-14.4 (262-281)**	**The Chromosomal Basis of Inheritance 15.1-15.5 (286-302)**
The Molecular Basis of Inheritance 16.1-16.2 (305-319)	**From Gene to Protein 17.1-17.6 (325-347)**	**Regulation of Gene Expression 18.1-18.4 (351-373)**	**Viruses 19.1- 19.2 (381-390)**	**Biotechnology 20.1-20.2 (396-412)**	**Genomes and Their Evolution 21.2 & 21.5 (429-432 & 438-442)**
Bacteria and Archaea 27.1-27.2 (556-564)	**28-37 omit**	**Angiosperm Reproduction and Biotechnology 38.1 (801-811)**	**Plant Responses to Internal and External Signals 39.1-39.3 &39.5 (821-841 & 845-847)**	**Basic Principles of Animal Form and Function 40.1-40.4 (852-872)**	**41-42 omit**
The Immune System 43.1-43.4 (930-950)	**44 omit**	**Hormones and the Endocrine System 45.1-45.2 (975-984)**	**46 omit**	**Animal Development 47.3 (1035-1042)**	**Neurons, Synapses, and Signaling 48.1-48.4 (1045-1060)**
Nervous Systems 49.2 (1067-1072)	**50 omit**	***Chapter 1 and 2 are introductory you should already know but you do not remember…. Please look over it….***			

TASK #6 RESPONSES & Multiple Choice: <u>After</u> going through your reading and note taking, answer the following.

(Please time yourself on each frq and mc)

Answer the following 3 response questions

- **Question 1 = 10 points (Longer FRQ) (Pages 47-51)**
- **Question 2 = 4 points (Shorter FRQ) (Pages 52-54)**
- **Question 3 = points. (Longer FRQ) (Pages 55-58)**
- **All 21 multiple-choice. (Pages #59-62)**

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.

<u>PLEASE WRITE IN PEN</u>

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

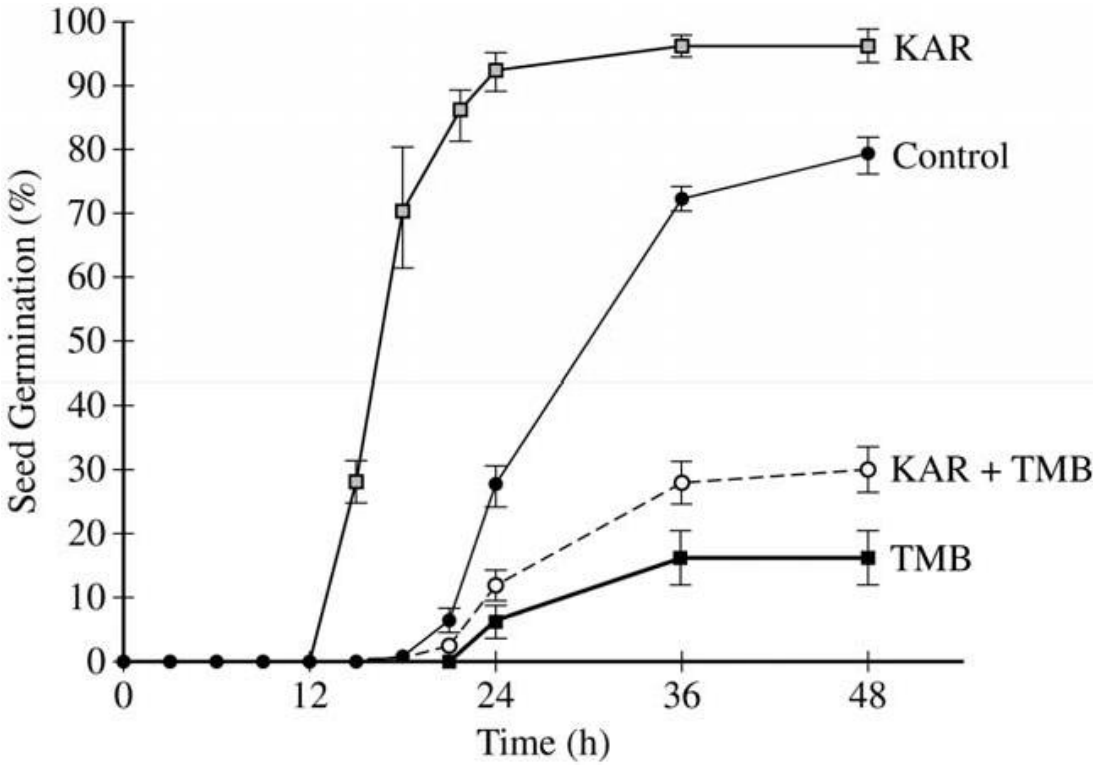


Figure 1. The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in Lactuca plants. Error bars represent ±2 SE $_{\bar{x}}$.

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 _____**

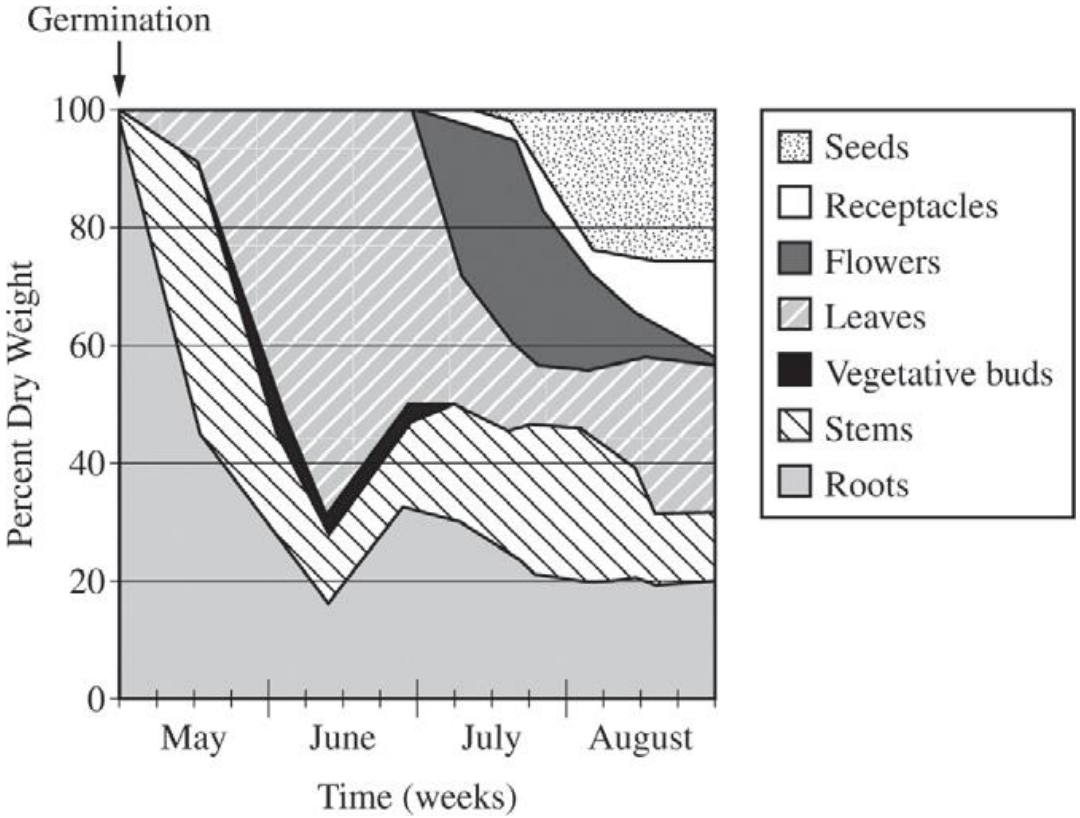


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

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.

TASK #6 RESPONSES & Multiple Choice (PAGES 59-62) Start Time _____ End Time _____

21 Multiple Choice:

1. All of the following are density-dependent factors that limit animal populations EXCEPT
A. weather B. predation C. birthrate D. food competition E. mortality

2. During the carbon cycle, which of the following carbon compounds would be utilized as an energy source by heterotrophs?
A. calcium carbonate B. carbonic acid C. organic molecules D. carbon dioxide E. carbon monoxide

3. All of the following statements concerning characteristics of predator-prey relationships are correct EXCEPT:
A. A rise in the population of prey is often followed by a rise in the population of predators.
B. A rise in the population of predators is followed by a decrease in the population of prey.
C. Camouflage is an adaptation that protects prey.
D. The production of large numbers of offspring within very short periods of time ensures the survival of some prey populations.
E. The population of predators most often eliminates the population of prey.

4. Which of the following is true about secondary consumers in an ecosystem?
A. They eat only plants.
B. They are eaten by primary consumers.
C. They are smaller and weaker than are primary consumers.
D. They are fewer in number than are primary consumers.
E. They contain the greatest total biomass in the system.

5 In the nitrogen cycle, the transformation of gaseous nitrogen into nitrogen-containing compounds is performed primarily by
A. fungi B. bacteria C. green plants D. herbivores E. carnivores

6-10 use these options) A. tropical rain forest B. taiga C. arctic tundra D. temperate grassland E. desert

6. Permafrost; temperatures range from approximately -50°C to +25°C; a growing season of 60 days or less

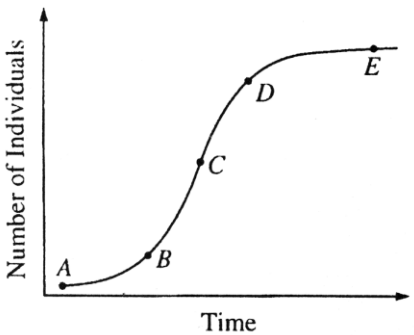
7. Over 10 inches of precipitation per year; long, cold winters and short summers; dominant vegetation is gymnosperm

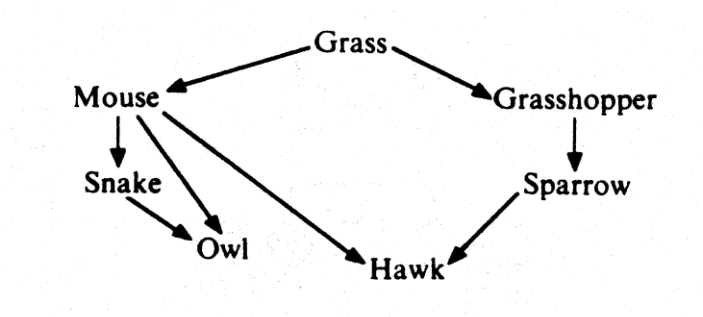
8. Lack of water common in summer; seasonal temperature variations; maintained by periodic fires

9. Less than 10 inches of precipitation per year; extremes of hot and cold throughout the year; large daily temperature variations

10. This biome has the greatest diversity of species.

Which point on the curve in the diagram above best represents the carrying capacity of the environment for the population shown.
A. A B. B C. C D. D E. E





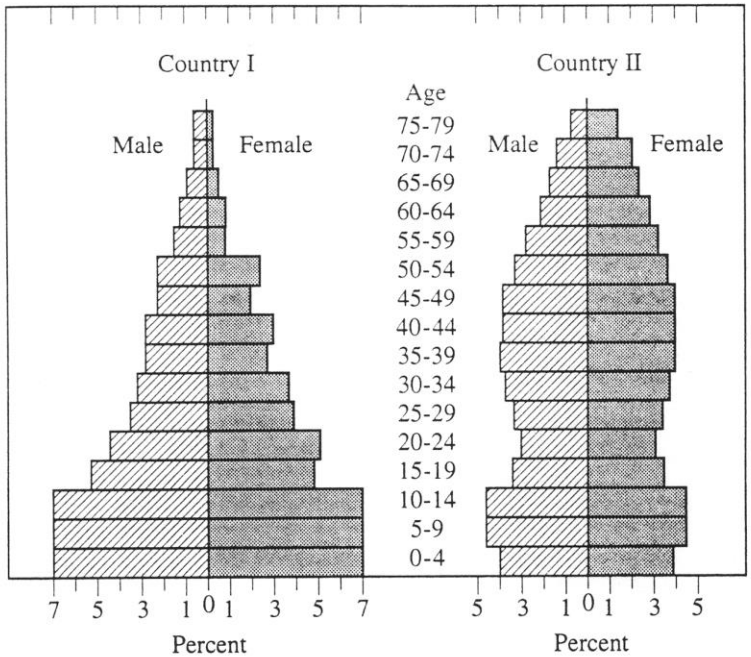
12. Which of the following organisms is most likely to be located at the apex of the pyramid of biomass?
A. grass B. grasshopper C. snake D. mouse E. hawk

13. All of the following statements about the diagram are correct EXCEPT:
A. The grasshopper is an herbivore. B. Only two trophic levels are depicted. C. The mouse and grasshopper are at the same trophic level.
D. The grass is a producer. E. All of the organisms except grass are consumers, regardless of position.

14. The organic and inorganic materials in all the organisms in the diagram will eventually return to the environment by the action of
A. decomposers B. producers C. primary consumers D. secondary consumers E. top carnivores

15. Which of the following best explains why there are seldom more than five trophic levels in a food chain?
A. Most carnivores function at more than one trophic level. B. Trophic levels above this number contain too many individuals.
C. Top carnivores are too few in number to prey effectively. D. The ecosystem contains too much biomass.
E. Energy is lost from each trophic level.

Questions 16-19. The illustrations below show the age and sex of the human populations in Country 1 and Country 2. The ages are grouped by 5-year classes, and the sexes are represented separately. The percentages in the different age classes are shown by the relative widths of successive horizontal bars.



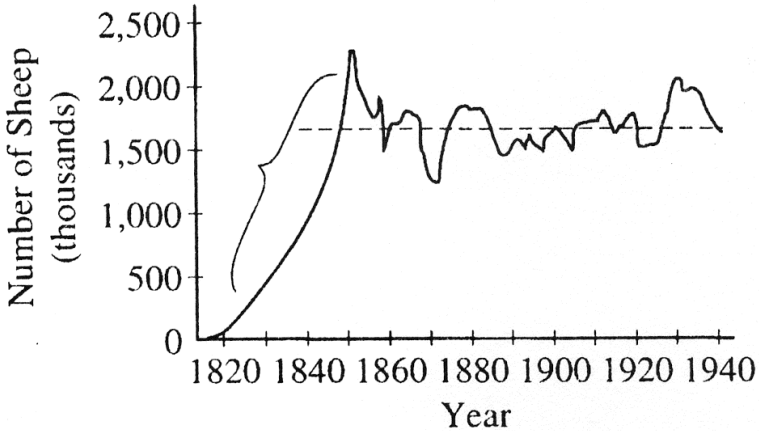
16. In Country 1, approximately what percentage of the individuals were younger than fifteen years of age?
A. 10%
B. 21%
C. 42%
D. 52%
E. It cannot be estimated from the graph.

17. Which of the following best approximates the ratio of males to females among individuals below fifteen years of age?

	Country 1	Country 2
A.	1 : 1	1 : 1
B.	0.75 : 1	0.75 : 1
C	. 0.5 : 1	0.5 : 1
D	. 1 : 1	0.5 : 1
E.	0.75 : 1	1 : 1

18. If, in Country 1, infant mortality declined and the birth rate remained the same, then initially the population would be expected to
A. be more evenly distributed among the age classes
B. be even more concentrated in the young age classes
C. stabilize at the illustrated level for all age classes
D. increase in the oldest age classes
E. increase in the median age classes

19. Over the next 10-15 years, the stabilization of Country 1's population at its current size would require that
A. infant mortality be reduced to about half the present level
B. the death rate be reduced drastically
C. each couple produce fewer children than the number required to replace themselves
D. about 15 years be added to the life expectancy of each person
E. couples have an average of only 3 children



20. The type of population growth represented by that portion of the graph line enclosed in the bracket is most accurately termed
A. stable
B. exponential
C. density-dependent
D. arithmetic
E. decelerating

21. The graph indicates that the sheep population most likely is
A. growing in excess of its carrying capacity, since fluctuations in population size occurred after 1850
B. headed for extinction because of the population explosion about 1930
C. regulated by density-independent factors, because there appears to be about a 10-year cycle of sharp declines in size
D. shifting from K-selected strategy to an r-selected strategy
E. stable after 1850 under the effects of density-dependent regulating factors