AP Biology **bI·YŜΨψψψψψψψψψψψψψψψψψψψψψψψψ**
Summer Assignment
DUE DATEY ² ŜŘyŜăŘI·è {ŜLJűŜY ōŜN nűK
DEADLINE: CNλŘI·è September cűK (10% deduction of score)

INTRODUCTION

This packet has Y dzfűλLJfŜ sections, each with some background information and some resources to get you started. Visit all or some of the resources, but then find your own resources. Then tasks are provided to give you practice thinking and responding like an AP Biologist.
Some tasks require you to learn facts and other tasks require you to apply those facts.
Take your time on both; in AP Biology, it is not enough to know something; instead, you must apply what you know to new situations and connect what you know across a variety of topics. This takes practice so start early, take your time, and learn lots! Your work will be graded for both accuracy and thoroughness.

We encourage you to work together, to compare and to discuss strategies, ideas, and answers. We also expect you to monitor yourselves to ensure that you do not cross the line to copying each others' work. Each of you needs to practice these skills for yourselves. Persevere! Be accountable! Have integrity!

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SECTIONS & SOME RESOURCES
1. Population ecology
http://www.bozemanscience.com/050-populations
https://www.youtube.com/watch?v=RBOsqmBQBQk
http://www.pbs.org/wgbh/nova/nature/population-ecology.html

2. Community ecology
http://www.bozemanscience.com/046-communities
http://www.bozemanscience.com/049-cooperative-interactions
http://www.bozemanscience.com/055-biodiversity
https://www.youtube.com/watch?v=GxE1SSqbSn4
https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-ecology-2/v/crash-course-ecology-04
http://www.globalchange.umich.edu/globalchange1/current/lectures/ecol_com/ecol_com.html

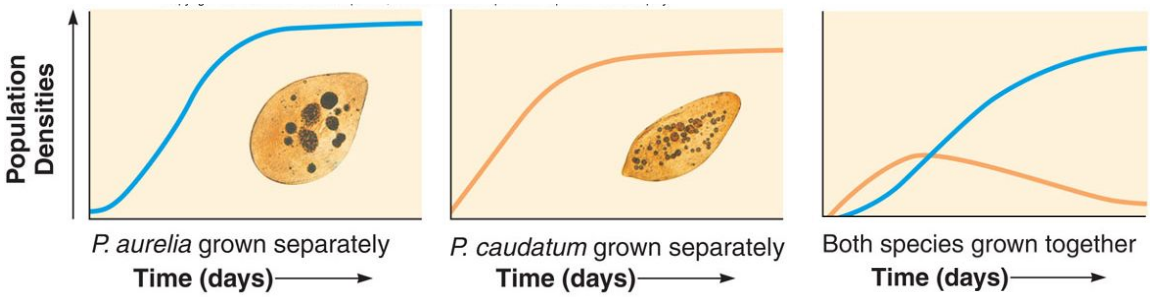
3. Ecosystems
http://www.bozemanscience.com/047-ecosystems
http://www.bozemanscience.com/051-ecosystem-change
http://eschooltoday.com/ecosystems/what-is-an-ecosystem.html
http://www.nhptv.org/natureworks/nwepecosystems.htm
http://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

1. POPULATION ECOLOGY (background information)

A population is a group of individuals of the same species living in an area. Population ecology analyzes factors that affect population size and describes how/ explains why populations change through time.

Where a population can live is determined by both abiotic and biotic factors.

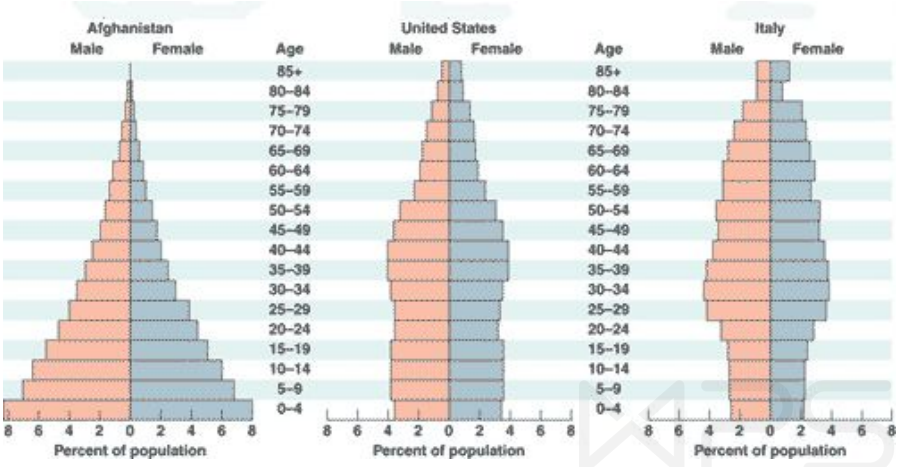
- Abiotic:
  - Temperature, water availability, oxygen availability, salinity, sunlight/shade, soil type and pH all have to be appropriate for a population to live in an area.
- Biotic:
  - A population requires food sources and perhaps also mutualistic species such as pollinators to live in an area.
    - Lichen, for example, is made up of an algal species and a fungus. One cannot live without the other.
  - A population cannot live in the same area as a competing species.
    - The Competitive Exclusion Principle states that a species cannot share its niche with another species; one will outcompete the other, causing it to dies out. See the graphs below.



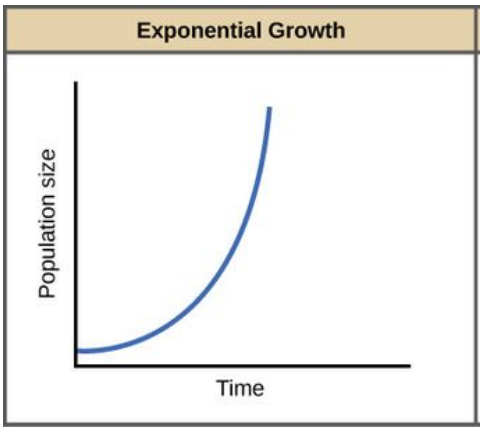
When each species is grown alone, each species does fine, but when they are grown together, *P. Aurelia* outcompetes *P. caudatum*. If two species need the same resources, they can't live in the same area.

  - Interestingly, populations need herbivores/predators to help keep their growth in check. Populations that lack predators grow so much that they soon deplete their resources.

Age structure diagrams, such as the ones shown below, show the distribution of various age groups in a population.



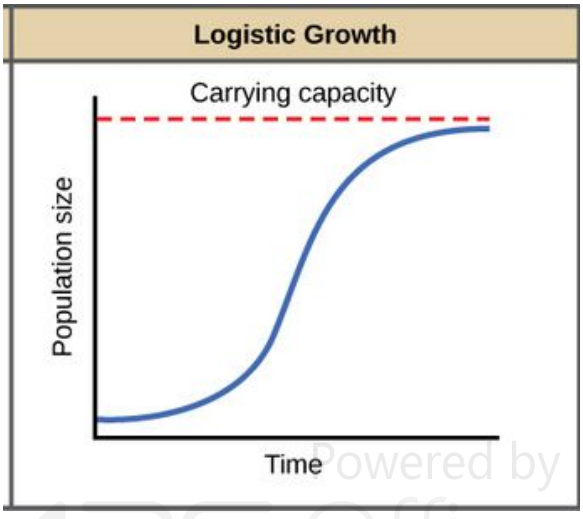
- Afghanistan is an example of a population that is growing. You can see that there are more people in the younger age groups than in the older age groups. This occurs when couples have more than 2 children, on average.
- The United States is an example of a population that is relatively stable. There are approximately the same number of people in each age group. This occurs when couples have 2 children, on average.
- Italy is an example of a population that is declining. There are fewer people in the younger age groups than the older age groups. This occurs when couples have fewer than 2 children, on average.



Populations tend to grow. But they grow according to two different models.

- Exponential growth occurs when members of a population have access to abundant food and are free to reproduce at their physiological capacity. The size of a population that is growing exponentially is best depicted in a J-shaped growth curve.
    - Exponential growth is characteristic of populations that are introduced into new environments or whose numbers were drastically reduced and are re-bounding.
    - The elephant population in Kruger National Park, South Africa grew exponentially for about 60 years after the elephants were protected from hunting. The increasing number of elephants eventually caused enough damage to the vegetation in the park that a collapse in their food supply was likely to occur. To avoid such a crash, park managers began limiting the elephant population by using birth control and exporting elephants to other countries.

- Carrying capacity
    - The exponential growth model assumes that resources are unlimited, which is rarely the case in ecosystems.
    - In most ecosystems, there is a limit to the number of individuals that can be supported. This is known as the carrying capacity (K) and is defined as the maximum population size that a particular ecosystem can sustain.

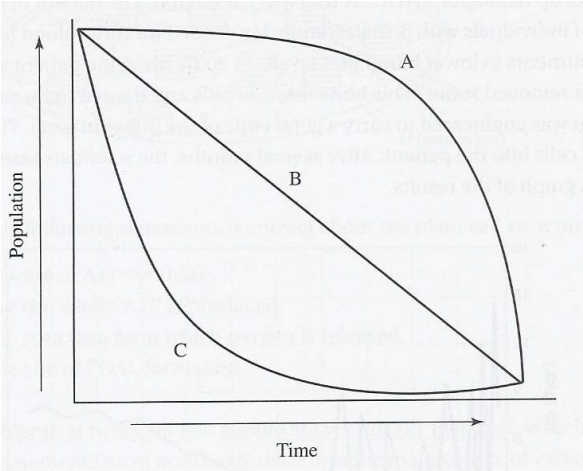


- Logistic growth occurs when crowding and limited resources affect population growth. If members of a population can't obtain sufficient resources to reproduce, the growth rate declines.
    - Logistic growth starts with exponential growth. As the size of the population approaches carrying capacity, the growth rate decreases and levels out.

Different species follow different strategies, which are mainly determined by their physiological abilities to reproduce.

- K-strategists have few young (per birth and over their lifetimes) but ensure that their young survive to adulthood by providing a large amount of parental care.
    - These organisms usually have internal embryonic development. This requires a great deal of energy and time, so few young are produced. However, since they are so well protected and nourished during development, these few young are likely to survive.
    - After birth, these organisms are able to provide a great deal of care to their young because there aren't many of them.
    - Mammals are a good example; especially primates.
- r-strategists have many young (per birth and over their lifetimes) and are therefore unable to provide their young with much care. As a result, very few of these young survive to adulthood.
    - These organisms usually lay eggs, which requires little energy so many can be laid at once.
    - Young that hatch receive little to no parental care.
    - Insects are a good example.

Diagrams such as the one below illustrate these different strategies.



A represents K-strategists.

- Young tend to survive
- Death becomes more likely as the organisms age

C represents r-strategists.

- Organisms are very likely to die when they are young
- If organisms make it to a critical age, they become less likely to die

B is a control for comparison.

- These organisms have an equal chance of dying when they are young and when they are old.

The equations shown below are on the AP Biology Exam Equation sheet.

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

Take a look at the population growth equation: the change in population size over time is equal to the number of births minus the number of deaths.

Now, take a look at the exponential growth equation: the change in population size over time depends on both the maximum rate of increase and the population size. Although the maximum rate of increase is constant, a population grows more quickly when it is large than when it is small.

Finally, take a look at the logistic growth equation: now, the maximum rate of increase approaches zero as the population size nears its carrying capacity.

POPULATION ECOLOGY TASKS

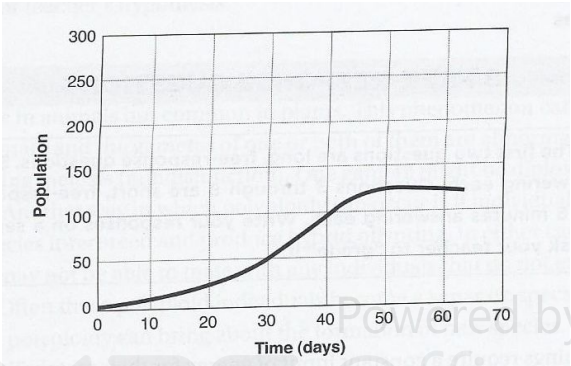
1. Examine the data from 2 populations below.

Population A	Population B
N = 25	N = 1000
r_{max} = 1	r_{max} = 1
K = 1500	K = 1500

Calculate the exponential growth rate AND the logistic growth rate for BOTH populations. **Compare** the exponential growth rate and the logistic growth rate for population A, a small population. **Compare** the exponential growth rate and the logistic growth rate for population B, a larger population. Use your comparisons to **describe** what happens to exponential growth and logistic growth as population size increases.

2. Examine the logistic growth equation and **determine** when logistic growth is 0.

3. To the right is a growth curve for a population of rabbits that were accidentally introduced into a region of New Zealand. **Calculate** the mean growth rate from Day 30 to Day 40. Record your answer to the nearest whole number and include units.



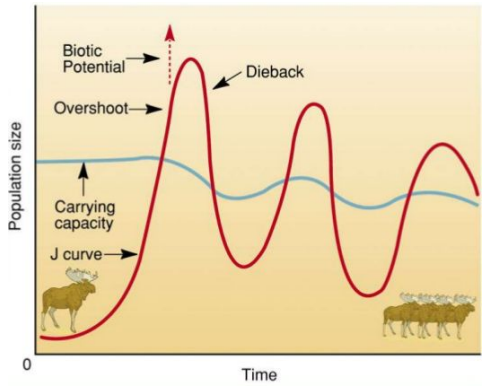
4. Two ecologists have different opinions on how to increase the number of bison on a reservation in the western US. Ecologist A wants to increase the number of producers on the reservation. Ecologist B wants to ban hunting on the reservation. **Identify** the ecologist who is more likely to successfully increase the number of bison AND **explain** why he will be successful.

5. You are an ecologist studying the feeding relationships among sea otters, sea urchins, and kelp. You know that sea otters prey on sea urchins and that sea urchins eat kelp. At four coastal sites, you measure kelp abundance. Then you spend one day at each site and mark whether otters are present or absent every 5 minutes during the day. **Describe** AND **explain** the pattern you observe.

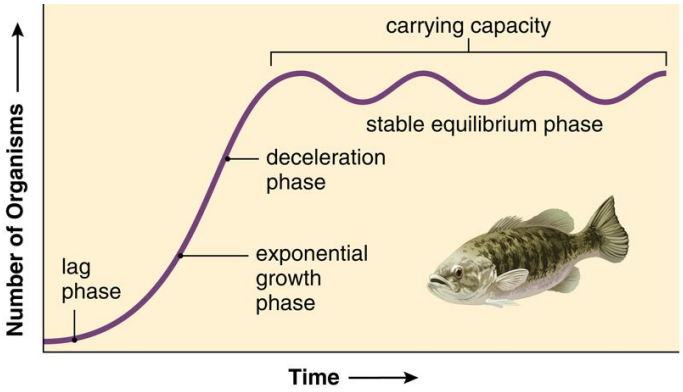
Site	**Kelp abundance (% cover)**	**Otter density (# sightings per day)**
1	75	98
2	15	18
3	60	85
4	25	36

6. **Compare** the patterns of growth shown in the two graphs below.

GRAPH A



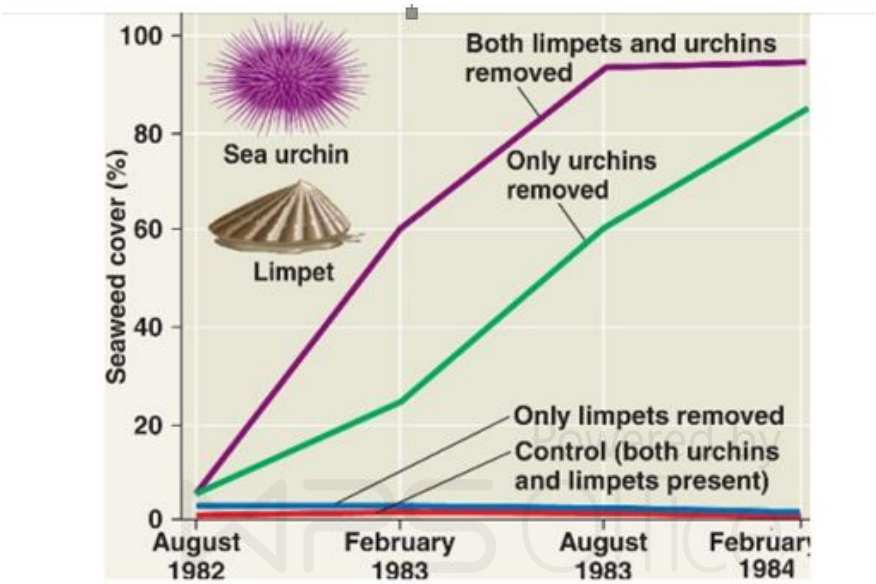
GRAPH B



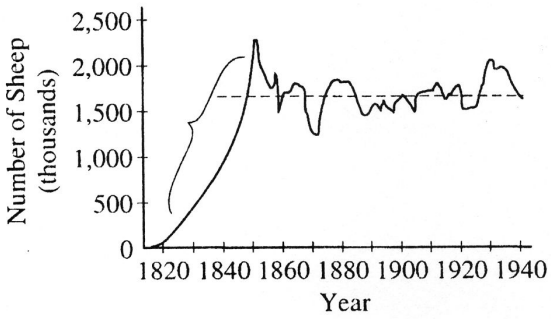
7. Each female of a particular fish species produces millions of eggs per year. **Sketch** the most likely survivorship curve for this species. **Defend** your sketch.

8. Both limpets and sea urchins feed on seaweed. Four different areas were investigated for the percentage of seaweed coverage. In area 1, both limpets and sea urchins were removed, in area 2 only sea urchins were removed, in area 3, only limpets were removed, and in area 4, neither limpets nor sea urchins were removed. The percentage of seaweed coverage was measured every 6 months.

A. **Propose** a question that the scientists wanted to answer.
B. **State** a conclusion that can be made from the data

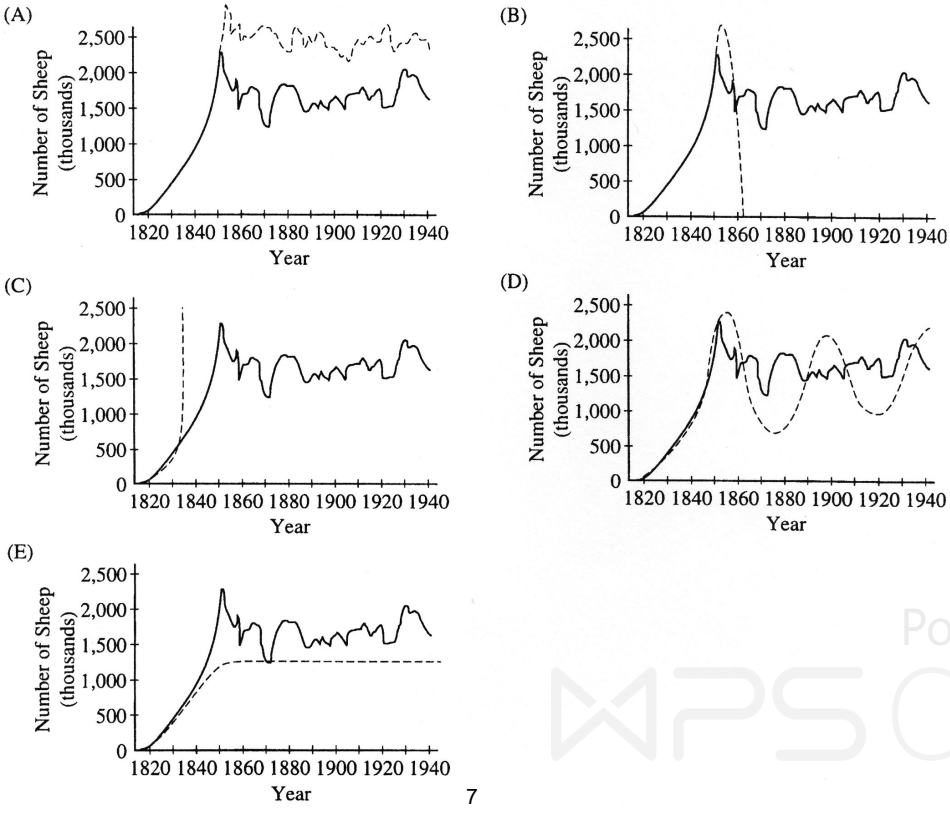


Use the information and the graph below to answer items 9 and 10.
The graph below shows changes in a population of wild sheep that were introduced to the island of Tasmania in the early 1800s.



_____ 9. 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

_____ 10. In the graphs below, the solid line represents the original population. The dotted line on which graph best represents the sheep population that would have resulted from a sustained increase in the primary productivity of the environment?

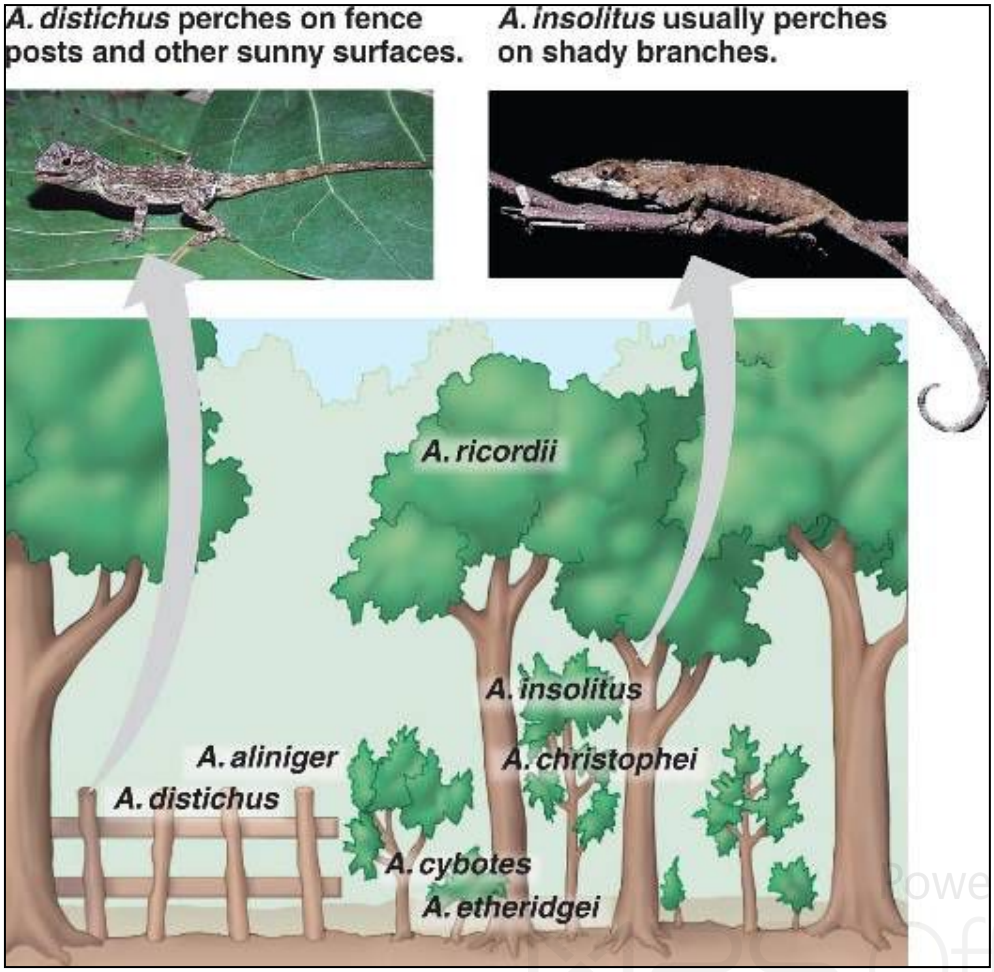


COMMUNITY ECOLOGY (background information)
A community consists of a group of populations of different species living close enough to interact. Community ecology is the study of the interactions between organisms of different species. It does not deal with the interactions between organisms and their environment. In our first unit (ecology and evolution), we will see lots of examples of ecological interactions acting as selective agents in the evolution of species.

1. Competition is perhaps the most influential interaction in a community. Competition occurs when two species need the same resources in the same place at the same time. Like you learned in population ecology, two species can't occupy the same niche. This is the competitive exclusion principle. Species often evolve in response to each other to minimize competition; competition is often a selective agent. Keep in mind that species aren't consciously making decisions to share; instead differential survival results in evolution.

a. Resource partitioning. The seven lizard species shown below live in close proximity and feed on insects and other small arthropods. Competition among them is reduced because each lizard species has a different preferred perch. Thus, each lizard species occupies its own niche.

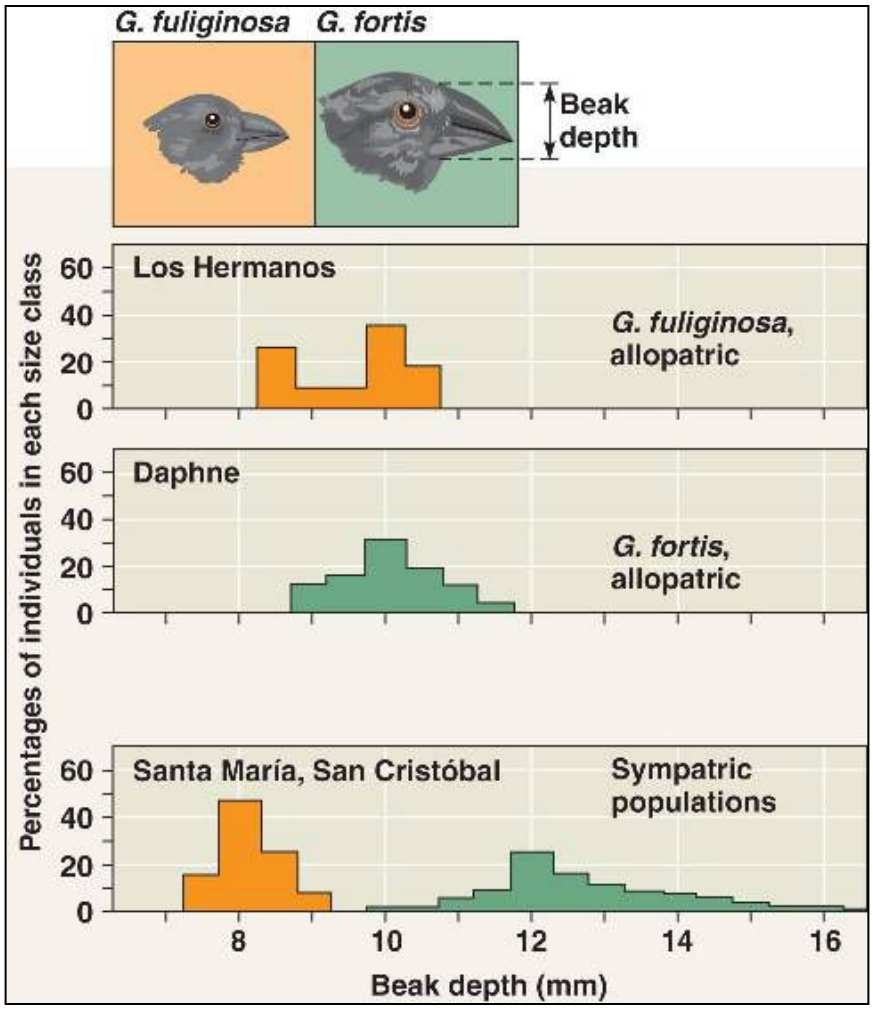
   The lizards did not have a homeowners' association meeting to decide who would live where. What we observe is the ghost of competition past. In their evolutionary histories, lizards who lived in overlapping niches did not survive and reproduce as well as lizards who had unique niches, so over time, each lizard evolved to fill its own niche.



b. Character displacement.

The two finch species shown below have similar beak depths when they live alone. However, when they live together, their beak depths are very different. This minimizes competition.

When *G. fuliginos* and *G. fortis* first inhabit the same niche, birds with the same size beaks experienced competition for seeds. Birds with either much smaller or much larger beaks experienced less competition. These birds survived and reproduced better than the competing birds and the result of many generations of natural selection is that the two finch species show differences in body structure.



2. Predation is also an influential interaction in a community; it drives the evolution of both predators and prey. Many adaptations of predators are obvious and familiar –acute senses, claws, teeth, stingers, poison, speed, agility, and camouflage. Just as predators have adaptations for catching prey, prey have adaptations for avoiding capture – camouflage, hiding, fleeing, forming herds or schools, for example. Prey may also have mechanical or chemical defenses such as porcupine spines or skunk spray. Prey species with effective chemical defenses often exhibit bright aposematic coloration, or warning coloration.

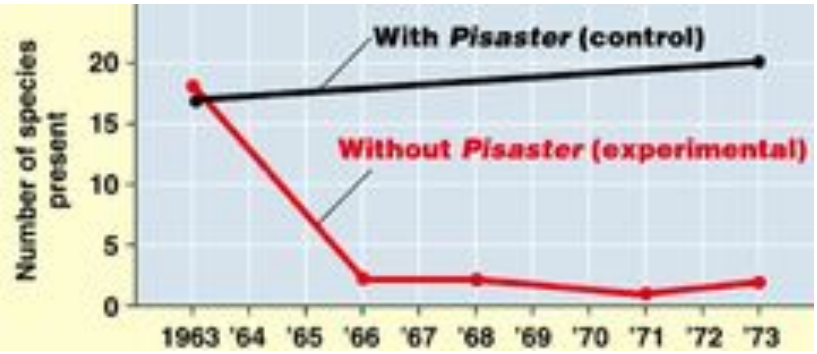
Perhaps the most interesting prey adaptation is mimicry.

a. In Batesian mimicry, a harmless species mimics (looks like) a harmful species. The larva of a hawkmoth puffs up its head and thorax when disturbed so that it looks like a small venomous snake.
b. In Mullerian mimicry, two or more harmful species resemble each other so that predators learn more quickly to avoid that phenotype. The cuckoo bee and yellow jacket both have yellow and black stripes.

3. Symbiosis refers to two or more species living in direct contact with each other.

A. Parasitism – one organism, the parasite, derives nourishment from another organism, its host. Common parasites of mammals include ticks and mosquitoes.
B. Mutualism – both organisms help each other.
    - Legumes are plants (such as peas, alfalfa, soy) that have nitrogen-fixing bacteria in their roots. The bacteria provide the plant with a constant source of nitrogen (fertilizer) and the plant provides the bacteria with glucose and oxygen.
    - Pollinators such as insects and birds go from flower to flower getting food and also spreading pollen.
C. Commensalism – one species benefits, but the other species is neither harmed nor helped.
    - Barnacles often hitchhike on whales or turtles. The barnacles are carried to new habitats, but the whales and turtles are not affected.

4. Communities with a lot of diversity are healthier than communities with very little diversity. Keystone species are important in maintaining the diversity of an ecosystem. Keystone species are not abundant in a community, but they exert strong effects. The graph below shows the importance of *Pisaster*, a genus of sea stars.



Pisaster feeds on mussels which are strong competitors for space.

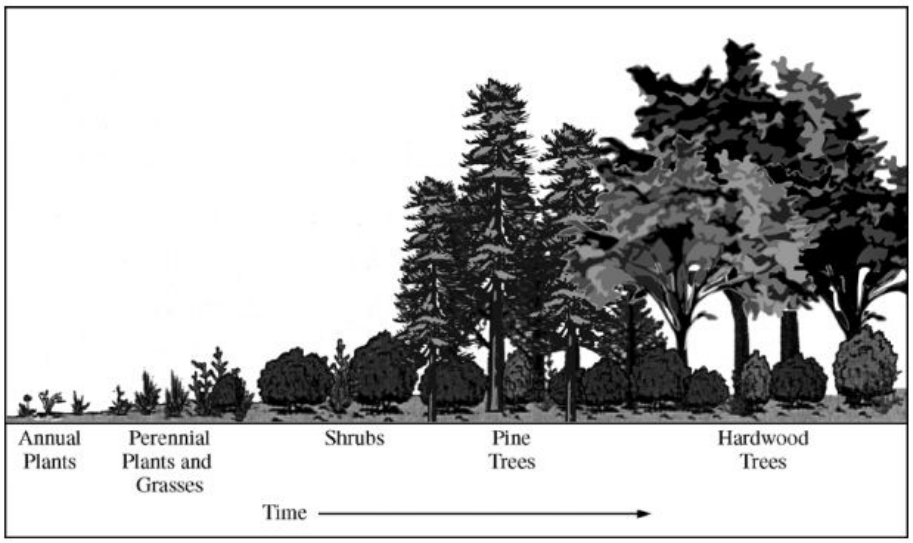
An ecologist removed the *Pisaster* from an area of intertidal zone and examined the effect on species richness.

In the absence of *Pisaster*, species richness declined as mussels monopolized the rock face and outcompeted most other species. In a control area where *Pisaster* was not removed, species richness changed very little over time.

5. Ecological succession refers to the changes in the composition and structure of ecosystems after a disturbance.

- Disturbances include fires, volcanic eruptions, glaciers, clear-cutting by humans, etc.
- Primary succession occurs in lifeless areas where soil has not yet formed, such as a new volcanic island or the rubble left by a retreating glacier.
- Secondary succession occurs when an existing community has been cleared by some disturbance that leaves the soil intact, such as in Yellowstone following fire.

The diagram of ecological succession below appeared on an AP exam.



The first organisms to live in an area can withstand harsh conditions, such as bright sun, little water, and no soil. These pioneer species tend to be r-strategists that produce a lot of offspring very quickly, but have short life spans. As rocks weather and pioneer species die and decay, soil accumulates and more complex plants can survive.

During ecological succession, the following changes occur in an ecosystem:

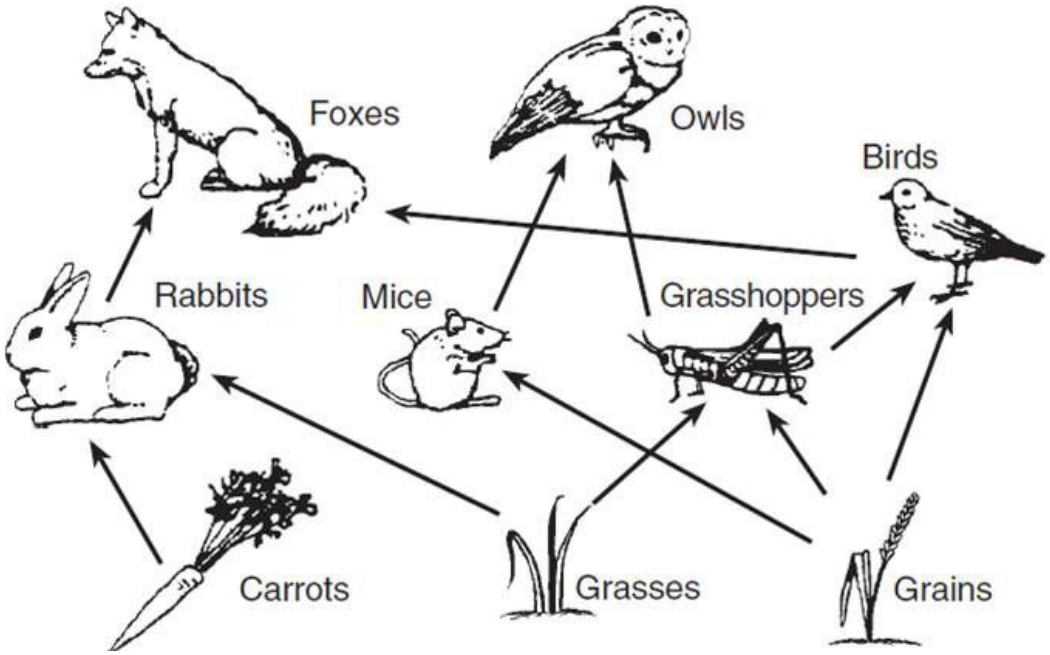
ABIOTIC:

- Increase in soil quantity
- Improvement in soil quality
- Increased nutrients
- Increased water retained in soil
- Decrease in the amount of light reaching the floor
- Decrease in temperature
- Increase in humidity

BIOTIC:

- Increase in niches
- Increase in biodiversity
- Increase in plant stratification (increased layering of plants)
- Increase in produce diversity leads to increase in consumer species
- Shift from species that are r-strategists to species that are K-strategists

6. Interactions among populations are indicated in diagrams called food webs. Arrows indicate the flow of energy and matter from one population to the next.



- Producers are at the base of food webs (carrots, grasses, and grains). They obtain energy from their environments and convert it into a form (such as carbohydrates) that is usable by consumers.
- Herbivores (rabbits, mice, grasshoppers) eat producers and carnivores (foxes, owls) eat consumers.
- Omnivores (birds) eat both producers and consumers.
- Primary consumers (rabbits, mice, grasshoppers, birds) eat producers. Secondary consumers (foxes, owls, birds) eat primary consumers. Tertiary consumers (foxes) eat secondary consumers. Quaternary consumers eat tertiary consumers. If an organism eats more than one thing (which most do), then it may occupy multiple trophic levels.

COMMUNITY ECOLOGY TASKS

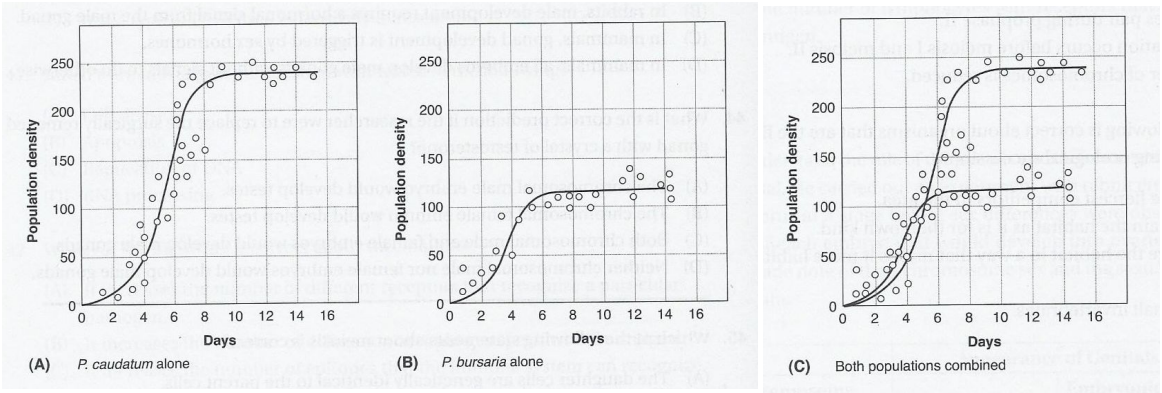
_____ 1. Two species, A and B, occupy adjoining environmental patches that differ in several abiotic factors. When species A is experimentally removed from a portion of its patch, species B colonizes the vacated area and thrives. When species B is experimentally removed from a portion of its patch, species A does not successfully colonize the area. What might you conclude from these results?

A. Both species A and species B are limited to their range by abiotic factors.
B. Species A is limited to its range by competition, and species B is limited by abiotic factors.
C. Both species A and species B are limited to their range by competition.
D. Species A is limited to its range by abiotic factors, and species B is limited to its range because it cannot compete with species A.
E. Species A is a predator of species B.

_____ 2. When one species was removed from a tidepool, the species richness became significantly reduced. The removed species was probably

A. a strong competitor.
B. a potent parasite.
C. a resource partitioner.
D. a keystone species.
E. the species with the highest relative abundance.

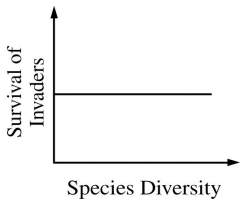
_____ 3. In the microscopic world of a pond, paramecia are ferocious predators that prey on smaller protists. In a classic experiment, two species of paramecia were grown separately in culture. The species in culture A was *P. caudatum*. The species in culture B was *P. bursaria*. Then the two species were combined in one culture dish (culture C).

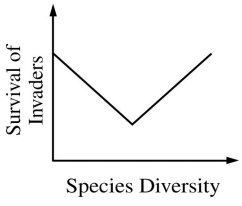


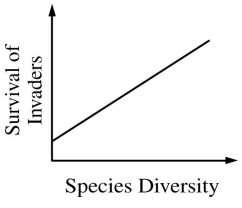
Which of the following is the most likely explanation for the growth pattern of the two populations combined in culture C?

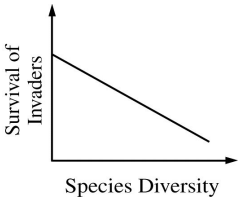
A. *P. caudatum* is driving *P. bursaria* to extinction because *P. caudatum* is the fitter species.
B. *P. caudatum* and *P. bursaria* share a niche.
C. *P. caudatum* and *P. bursaria* occupy different niches.
D. *P. caudatum* is feeding on *P. bursaria* but only to a limited degree.

_____ 4. A researcher is investigating the relationship between the existing species diversity in a community and the ability of an introduced non-native species to destabilize the community. Which of the following graphs is most consistent with the claim that communities with high diversity are more resistant to change than are communities with low diversity?

A.


B.


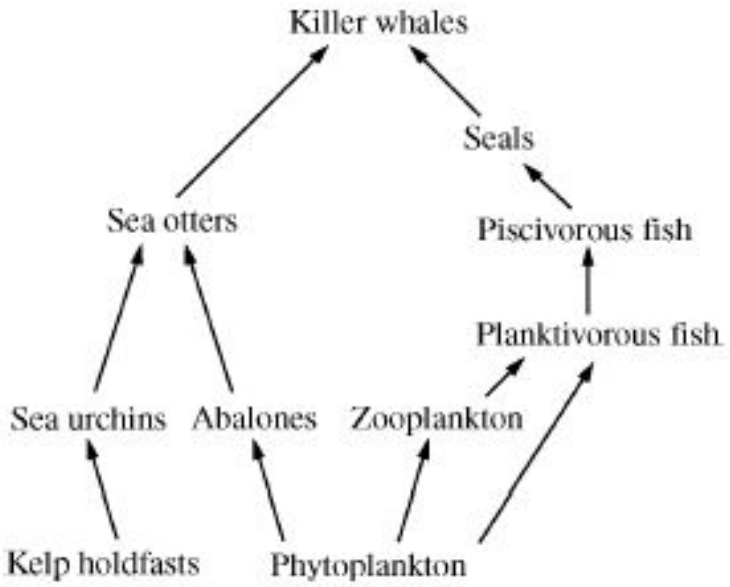
C.


D.


_____ 5. The lionfish is a venomous fish found primarily in the Red Sea and the Indian Ocean. In the 1990s, lionfish were accidentally released into the Atlantic Ocean, where they found abundant resources and favorable environmental conditions. Which of the following scenarios is most likely to result in the lionfish having a major impact on the communities into which they were introduced?

A. With no natural predators, the lionfish population will become very large.
B. Some native species of invertebrates will develop a resistance to lionfish venom.
C. Random mating will allow the lionfish population to reach Hardy-Weinberg equilibrium.
D. A virus that specifically infects lionfish will become more prevalent.

Questions 6-8.



_____ 6. The minimum number of trophic levels in a food chain ending with killer whale is

A. 2
B. 3
C. 4
D. 5
E. 6

_____ 7. Species that feed at only one trophic level include which of the following?

I. Zooplankton
II. Planktivorous fish
III. Killer whales

A. I only
B. II only
C. III only
D. II and III only
E. I, II, and III

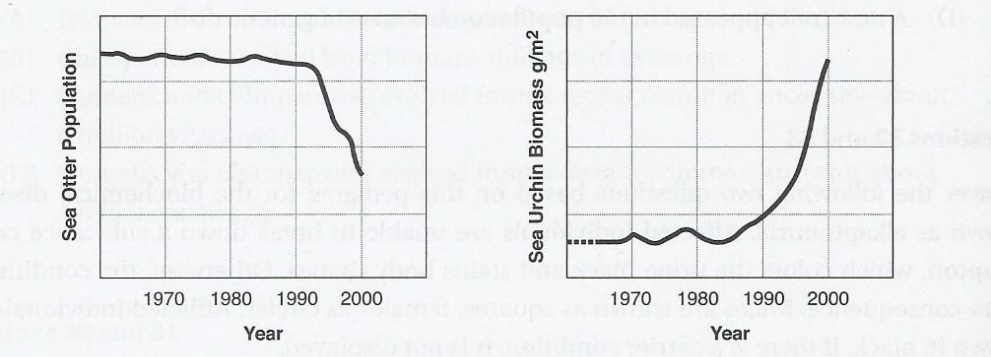
_____ 8. In similar rocky coastal ecosystems where sea otters have disappeared due to human harvesting or killer whale predation, the kelp forests also disappear and the species diversity of the community decreases drastically. In these ecosystems, the sea otter can best be described as

A. A top carnivore
B. A keystone species
C. A primary producer
D. A secondary herbivore
E. A dominant species

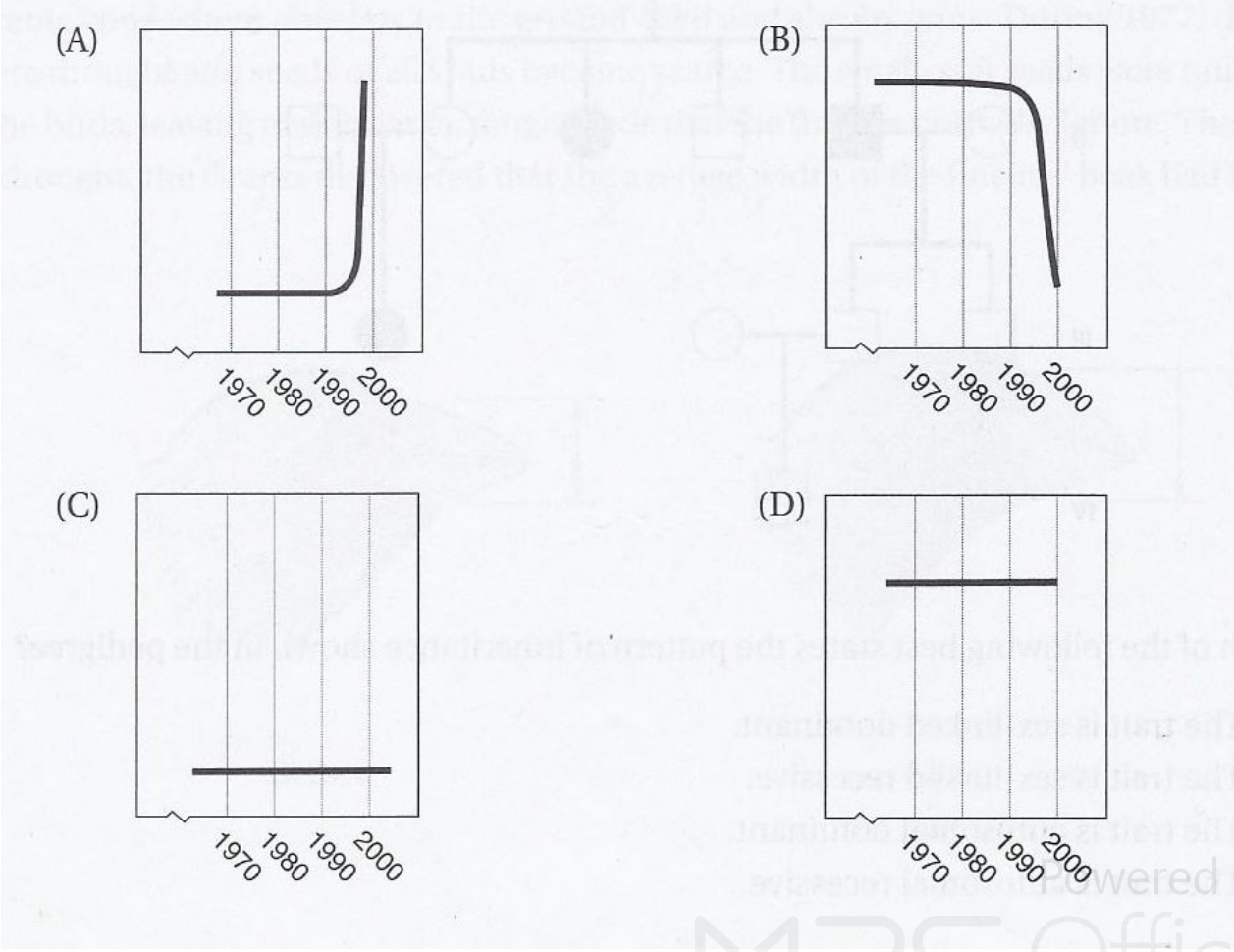
_____ 9. Sea otters in the North Pacific are a keystone species. That means that they are not abundant in a community. However, they do exert major control over other species in the community. Here is a food chain in which the sea otter is a keystone species.

Kelp → Sea urchin → Sea otter → Orca

Here are two graphs showing the populations of sea otters and sea urchins from 1970 to 2000.



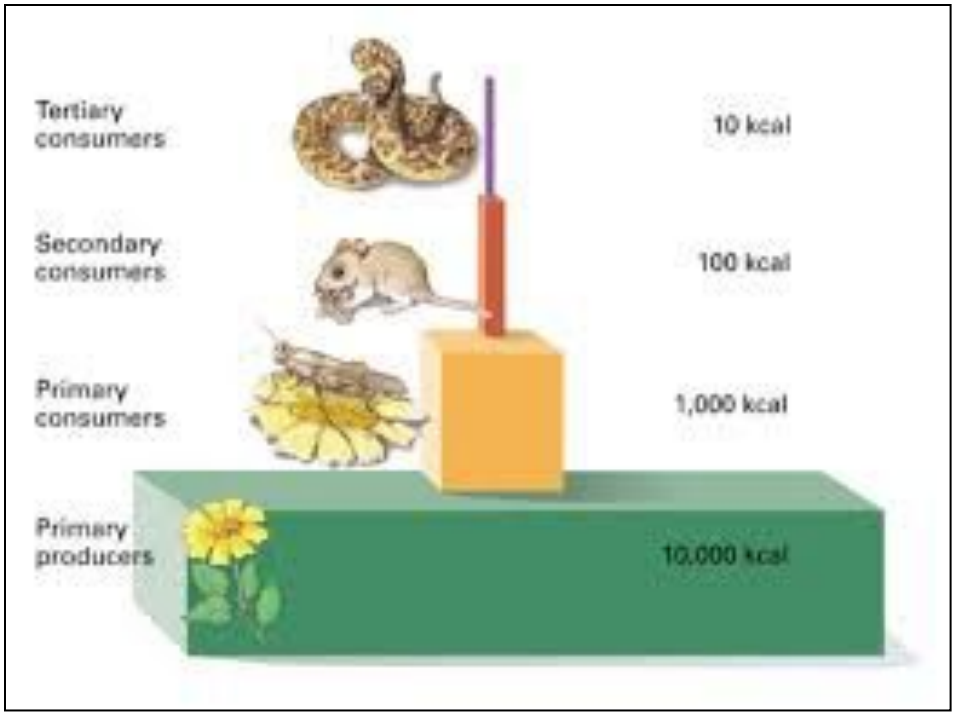
In the late 1990s, orcas, which are active hunters of sea otters, moved into the area. Which of the following graphs correctly shows the kelp population from 1970 to 2000?



ECOSYSTEMS (background information)
An ecosystem contains all of the organisms living in a given area and the abiotic factors with which they interact. An ecosystem can be a vast area, such as a lake or forest, or a microcosm, such as the space under a fallen log. Ecosystems are governed by the movement of carbon and energy through biotic and abiotic factors.

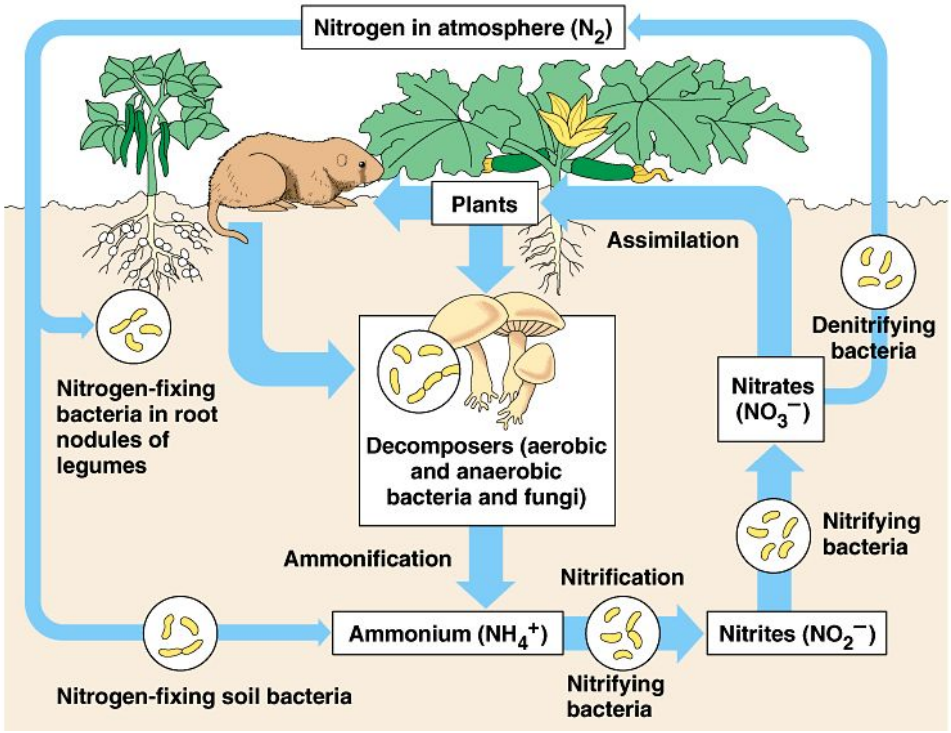
1. Energy travels through a food web in one direction, from producer to consumer. Energy is never returned to the producers from the consumers. In most ecosystems, the sun is the ultimate source of energy and the producers are photosynthetic. In some ecosystems, chemosynthetic producers get their energy from inorganic chemicals such as methane NS hydrogen sulfide. As energy is transferred from one trophic level to the next, some is used by the organisms at that trophic level and converted into body heat, an unusable form of energy. As a result, the amount of usable energy decreases from trophic level to trophic level.

Diagrams like these can be used to illustrate the trophic efficiency of an ecosystem.



For the sake of simplicity, it is sometimes assumed that the trophic efficiency is 10% which means that 10% of the energy available to one trophic level is passed to the next; 90% of the energy fuels the life functions of the organisms at a trophic level and is converted to heat.

2. Nutrients (such as carbon, nitrogen and phosphorous), on the other hand, are recycled in ecosystems. Nutrients pass from producer to consumer and then return to producers thanks to decomposers. Each trophic level passes all of its nutrients to the next trophic level.
In the nitrogen cycle, nitrogen-fixing bacteria are responsible for converting atmospheric nitrogen gas into a form that plants can use.



Plants require bacteria to convert the unusable nitrogen gas in the air to usable nitrogenous compounds in the soil.

Plants take up the nitrogen they need from the soil.

When animals eat plants, they get nitrogen.

When plants and animals die, decomposers return the nitrogen to the environment to re-start the cycle.

ECOSYSTEMS TASKS

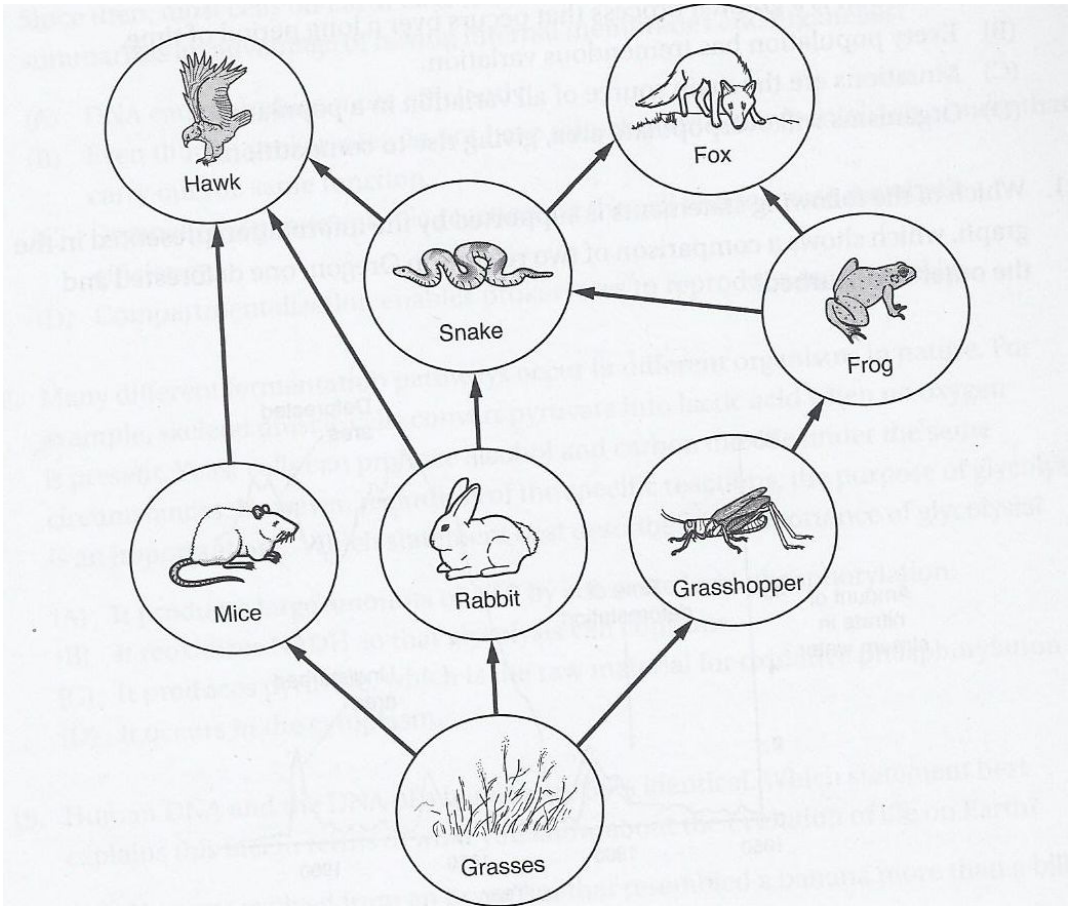
_____ 1. Which of the following best explains why there are typically five or less trophic levels in a food chain?

A. Many carnivores feed at two or more trophic levels.
B. Each trophic level represents a small fraction of the energy of the trophic level below it.
C. The population of tertiary consumers would be too small and would go extinct.
D. Ecosystems with more than five trophic levels contain too much biomass.
E. If there were more than five trophic levels, the carrying capacity of the environment would be exceeded.

_____ 2. Beaked whales feed at various depths, but they defecate at the ocean's surface. Nitrogen-rich whale feces deposited in surface waters supply nutrients for algae that are eaten by surface dwelling fish. Which of the following best predicts what would happen if the whale population decreased?

A. There would be a reduction in surface nitrogen concentration, which would cause an algal bloom.
B. The surface fish populations would decline due to reduced populations of algae.
C. The remaining whales would accumulate mutations at a faster rate.
D. The remaining whales would be forced to forage in the deepest parts of the ocean

_____ 3. Here is a food web for a habitat that is threatened by developers who will remove three-fourths of the grasses in the area on which the mice and rabbits feed.



Which of the following statements describes what will most likely happen to the wildlife in the area?

A. The hawk will begin to eat frogs instead of snakes and mice.
B. Since three trophic levels are shown in the food web, 75% of the organisms in this food web will die.
C. Based on the number of trophic levels, about 25% of the mice and rabbits will die.
D. The hawk population will decrease.

4. **Sketch a model** that shows how a molecule of carbon dioxide moves from the atmosphere, through a food chain, and then back into the air. **Describe** TWO ways in which humans have impacted the carbon cycle.

Section 2- Review of Chapter 1-7

Directions: As you carefully read through chapters 1-7 in your Campbell Biology textbook, thoughtfully respond to each of the following questions. It is important that you *actually read* the chapters for review and understanding. Do not just look for answers to the questions provided. Review *all diagrams* provided. The majority of the material in these beginning chapters should be a review for you. If need be, focus on those areas which may seem less familiar. After reviewing this material independently during the summer, it is expected that you have a solid understanding of these basic concepts for the start of this course. Prepare any *specific questions* that you may have. Again, this is an independent *review* and you will be expected to know these concepts for future use and assessment. This introductory material will not be covered in detail during class time.

Chapter 1: Introduction: Themes in the Study of Life

1. Explain the importance of a biological hierarchy in terms of biological organization.

2. Why must scientists study the interactions of organisms with each other and the environment?

3. Comment on the relationship between structure and function in biology.

4. How specifically is the cell life's basic unit of structure and function?

5. What is the significance of DNA to organisms?

6. Explain the basic concept of a biological feedback system. How does it work?

7. Explain briefly how life's vast organisms are classified. Give the basic ideas. Make sure to include domains in your discussion.

8. Explain Darwin's mechanism of evolutionary adaptation called natural selection.

9. Explain why “editing” is an appropriate metaphor for how natural selection acts on a population’s heritable variations.

10. Why do “science” and “inquiry” fit so naturally together?

11. Explain the role of a hypothesis in scientific inquiry.

12. How was the case study on mimicry in snake populations a good example of scientific inquiry in action?

13. Experimental controls and repeatability are crucial to a well done investigation. Explain why.

14. Explain how a scientific theory is different from how people use the word “theory” colloquially.

15. Why is natural selection called a theory?

16. Why is evolution considered the core theme of biology?

17. How could natural selection have led to the evolution of adaptations such as the thick, water-conserving leaves of the mother-of-pearl plant on the cover of your textbook?

18. Explain why different approaches and diverse backgrounds among scientists are important.

Chapter 2: The Chemical Context of Life

1. Read about and review the following terms in the text of Chapter 2. Make sure that you understand them enough to explain them and relate them or more complex biological processes later. I would not suggest looking up generic definitions in a glossary.

matter	element	compound	trace elements
atom	proton	neutron	electron
atomic nucleus	isotope	radioactive isotope	energy
potential energy	electron shell	valence electron	valence shell
covalent bond	molecule	single bond	double bond
electronegativity	nonpolar	polar	ionic bond
ion	cation	anion	salts
hydrogen bond	chemical reaction	reactant	product
chemical equilibrium			

2. In humans, iron is a trace element required for the proper functioning of hemoglobin, the molecule that carries oxygen in red blood cells. What might be the effects of an iron deficiency?

3. Using Figure 2.13, explain how a water molecule is formed.

4. Write an equation that uses the products of photosynthesis as reactants and the reactants of photosynthesis as products. Add energy as another product. This new equation describes a process that occurs in your cells. Describe this equation in words. How does this equation relate to breathing?

5. The percentages of naturally occurring elements making up the human body (see Table 2.1) are similar to the percentages of these elements found in other organisms. How could you account for this similarity among organisms?

6. Female silkworm moths attract males by emitting chemical signals that spread through the air. A male hundreds of meters away can detect these molecules and fly toward their source. The sensory organs responsible for this behavior are visible comblike antennae. Each filament of an antenna is equipped with thousands of receptor cells that detect the sex attractant. Based on what you learned in this chapter, propose a hypothesis to account for the ability of the male moth to detect a specific molecule in the presence of many other molecules in the air. What predictions does your hypothesis make?

7. In what way does the need for iodine or iron in your diet differ from your need for calcium or phosphorus?

Chapter 3: Water and Life

1. How does electronegativity affect interactions between water molecules?

2. Discuss cohesion, adhesion and surface tension. Give biological examples of each one in nature.

3. Explain and relate the terms solution, solvent, solute and aqueous solution.

4. What does it mean for a substance to be water-soluble?

5. Explain hydrophilic and hydrophobic and give examples of each in nature.

6. A water strider (which can walk on water) has legs that are coated with a hydrophobic substance. What might be the benefit? What would happen if the substance were hydrophilic?

7. Review and know the following terms:

hydrogen ion	hydroxide ion	acid
base	basic pH scale (no equations)	buffer

8. Explain how increasing amounts of CO2 dissolving in the ocean leads to ocean acidification. How does this change in pH affect carbonate ion concentration and the rate of calcification?

9. In agricultural areas, farmers pay close attention to the weather forecast. Right before a predicted overnight freeze, farmers spray water on crops to protect the plants. Use the properties of water to explain how this method works. Be sure to mention why hydrogen bonds are responsible for this phenomenon.

Chapter 4: Carbon and the Molecular Diversity of Life

1. Explain the significance as carbon for the backbone of life. Use Figure 4.5 on page 61 to review carbon skeletons.

2. Using pages 64-65 review these functional groups so that you could identify them.

3. What is the biological importance of these functional groups, in general?

4. Discuss the importance of ATP as an organic phosphate molecule.

5. What does the term amino acid signify about the structure of such a molecule?

6. What chemical change occurs to ATP when it reacts with water and releases energy?

Chapter 5: The Structure and Function of Large Biological Molecules

1. Review and know these terms:
polymer, monomer, enzyme, dehydration reaction, hydrolysis

2. What are the four main classes of large biological molecules? Which class does not consist of polymers?

3. How many molecules of water are needed to completely hydrolyze a polymer that is ten monomers long?

4. Suppose you eat a serving of fish. What reactions must occur for the amino acid monomers in the protein of the fish to be converted to new proteins in your body?

5. What are the roles of carbohydrates in living organisms?

6. Explain the difference between monosaccharides, disaccharides and polysaccharides and give examples of each one.

7. Compare and contract starch, cellulose, glycogen and chitin both structurally and functionally.

8. Why are lipids grouped together? List the types of lipids.

9. Relate fat, fatty acid and triacylglycerol.

10. Contrast saturated, unsaturated and trans fatty acids. How do these impact fats? Give examples of each type.

11. What is the importance of phospholipids?

12. Why is cholesterol crucial for animals?

13. Compare the structure of a fat (triglyceride) with that of a phospholipid.

14. Why are human sex hormones considered lipids?

15. What are the roles of proteins? (Consider using Fig. 5.15 as reference)

16. Compare and contrast polypeptide and protein.

17. Briefly discuss amino acids as building blocks of proteins.

18. Discuss the four levels of protein structure.

19. What does sickle cell disease have to do with protein structure?

20. Why does a denatured protein no longer function normally?

21. What parts of a polypeptide participate in the bonds that hold together secondary structure? Tertiary structure?

22. What is the role of nucleic acids in organisms?

23. Discuss the building blocks of nucleotides. Include the following terms in your discussion → nucleotide, pyrimidine, purine, deoxyribose, ribose, double helix, antiparallel

24. In a DNA double helix, a region along one DNA strand has this sequence of nitrogenous bases: 5'-TAGGCCT-3'. Copy this sequence, and write down its complementary strand, clearly indicating the 3' and 5' ends of the complementary strand.

25. What is the fundamental basis for the differences between carbohydrates, proteins, and nucleic acids?

26. Why are lipids not considered to be marcromolecules or polymers?

27. Proteins are the most structurally and functionally diverse class of biological molecules. Explain the basis for this diversity.

27. What role does complementary base pairing play in the function of nucleic acids?

Chapter 6: A Tour of the Cell

1. How is an electron microscope different from a light microscope? What is the difference between a SEM and TEM?

2. Review and know the STRUCTURE AND FUNCTION of the following cellular organelles and associated terms. Make sure to review the accompanying diagrams in the text.

cytosol	nucleoid	plasma membrane
nucleus	nuclear envelope	chromosomes
chromatin	nucleolus	ribosomes
endomembrane system	vesicles	Rough ER
Smooth ER	glycoproteins	Golgi apparatus
lysosome	phagocytosis	vacuoles (food, contractile, central)
mitochondria (cristae, mitochondrial matrix)	plastids	chloroplasts (thylakoids, grana, stroma)
peroxisome	centrosome	cytoskeleton (microtubules, microfilaments)
centrioles	flagella	cilia
pseudopodia	cell wall	middle lamella
extracellular matrix	plasmodesmata	

3. Explain the endosymbiont theory.

4. After carefully reviewing Figure 6.8, briefly describe the structure and function of the nucleus, the mitochondrion, the chloroplast, and the endoplasmic reticulum.

5. As a cell begins the process of dividing, its chromatin becomes more and more condense. Does the number of chromosomes change during this process? Explain.

6. Describe how transport vesicles integrate the endomembrane system.

7. Imagine a protein that functions in the ER but requires modification in the Golgi apparatus before it can achieve that function. Describe the protein's path through the cell, starting with the mRNA molecule that specifies the protein.

8. Do plant cells have mitochondria? Explain.

9. A classmate proposes that mitochondria and chloroplasts should be classified in the endomembrane system. Argue against the proposal.

10. Males afflicted with Kartagener's syndrome are sterile because of immotile sperm, and they then to suffer from lung infections. This disorder has a genetic basis. Suggest what the underlying defect might be.

11. In what way are the cells of plants and animals structurally different from single-celled eukaryotes?

12. If the plant cell wall or the animal extracellular matrix were impermeable, what effect would this have on cell function?

13. Explain how the compartmental organization of a eukaryotic cell contributes to its biochemical functioning.

14. Which aspects of cell structure best reveal evolutionary unity? What are some examples of specialized modifications?

Chapter 7: Membrane Structure and Function

1. Describe how selective permeability is key for the plasma membrane.

2. Describe how the amphipathic property of phospholipids helps them form membranes.

3. Why is the plasma membrane described as a fluid mosaic model?

4. Why is cholesterol so important to cell membranes?

5. Discuss types of membrane proteins and their functions [integral (transmembrane), peripheral].

6. Glycolipds and glycoproteins – what are they? Why are they important to membranes?

7. The carbohydrates attached to some proteins and lipids of the plasma membrane are added as the membrane is made and refined in the ER and Golgi apparatus. The new membrane then forms transport vesicles that travel to the cell surface. On which side of the visible membrane are the carbohydrates?

8. The soil immediately around hot springs is much warmer than that in neighboring regions. Two closely related species of native grasses are found, one in the warmer region and one in the cooler region. If you analyzed their membrane lipid compositions, what would you expect to find? Explain.

9. Channel proteins are a type of transport protein in the membrane. Why does the membrane need them?

10. What is the role of aquaporins in the membrane?

11. How is selective permeability determined for the plasma membrane?

12. Two molecules that can cross a lipid bilayer without help from membrane proteins are O2 and CO2. What property allows this to occur?

13. Why is transport protein needed to move water molecules rapidly and in large quantities across a membrane?

14. Aquaporins exclude passage of hydronium ions. Recent research on fat metabolism has shown that some aquaporins allow passage of glycerol, a three-carbon alcohol, as well as water. Since a hydronium ion is much closer in size to water than is glycerol, what do you suppose is the basis of this selectivity?

15. Review the following terms and be able to explain them:

diffusion	concentration gradient	passive transport
osmosis	tonicity	isotonic
hypertonic	hypotonic	osmoregulation
turgid	flaccid	Plasmolysis
facilitated diffusion	ion channels	gated channels

16. How do you think a cell performing cellular respiration rids itself of the resulting CO2?

17. In the supermarket, produce is often sprayed with water. Explain why this makes vegetables look crisp.

18. If a *Paramecium caudatum* swims from a hypotonic to an isotonic environment, will its contractile vacuole become more active or less? Why?

19. Explain active transport in detail using the example of the sodium-potassium pump.

20. How do ion pumps maintain membrane potential? Make sure to include electrochemical gradient, electrogenic pump, proton pump.

21. Explain how cells use cotransport.

22. Sodium-potassium pumps help nerve cells establish a voltage across their plasma membranes. Do these pumps use ATP or produce ATP? Explain.

23. Explain why the sodium-potassium pump in Figure 7.18 would not be considered a cotransporter.

24. Thoroughly explain how exocytosis and endocytosis are achieved in cells.

25. As a cell grows, its plasma membrane expands. Does this involved endocytosis or exocytosis? Explain.

26. In what ways are membranes crucial to life?

27. What happens to a cell placed in a hypertonic solution? Describe the free water concentration inside and out.

28. ATP is not directly involved in the functioning of a cotransporter. Why, then, is cotransport considered active transport?

29. *Paramecium* and other protists that live in hypotonic environments have cell membranes that limit water uptake, while those living in isotonic environments have membranes that are more permeable to water. What water regulations adaptations might have evolve din protists in hypertonic habitats such as the Great Salt Lake? In habitats with changing salt concentration?

30. An experiment is designed to study the mechanism of sucrose uptake by plants cells. Cells are immersed in a sucrose solution, and the pH of the solution is monitored. Samples of the cell are taken at intervals, and their sucrose concentration is measured. After a decrease in the pH of the solution to a steady, slightly acidic level, sucrose uptake begins. Propose a hypothesis for these results. What do you think would happen if an inhibitor of ATP regeneration by the cell were added to the beaker once the pH is at a steady level? Explain.

31. Extensive irrigation in arid regions causes salts to accumulate in the soil. (When water evaporates, salts that were dissolved in the water are left behind in the soil.) Based on what you learned about water balance in plant cells, explain why increases soil salinity might be harmful to crops. Suggest way to minimize damage. What costs are attached to your solutions?

Section 3-AP Biology Graphing Practice Packet

Graphing is an important procedure used by scientists to display the data that is collected during a controlled experiment. When a graph is put together incorrectly, it detracts the reader from understanding what you are trying to present. Most graphs have 5 major parts:

1. Title
2. Independent Variable (X-axis)
3. Dependent Variable (Y-axis)
4. Scale for each variable
5. Legend (or Key)

A. **Title:** Depicts what the graph is about. The Title gives the reader an understanding about the graph. A good title is closer to a sentence than a phrase and is usually found at the top of the graph.

B. **Independent Variable:** Variable controlled by the experimenter. The variable that "I" am testing. (I for Independent). Common independent variables include: time, generations, measurements (length, distance), and temperature. This variable goes on the X-axis.

C. **Dependent Variable:** Variable that is affected by the independent variable; what the experimenter measures. Example: How many oxygen bubbles will depend on the depth of the water. This variable goes on the Y-axis.

D. **Scale:** Before you can plot your data points, you must figure out how much each box on your graph paper is worth. Scale doesn't' always have to start at zero, but I must be consistent. If you start off making each box worth 5 cm, each subsequent box must also be 5 cm. Always make sure your scale is labeled with what it is and what the units are.

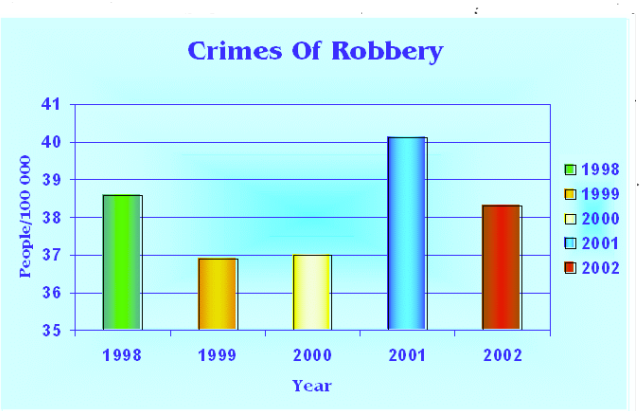
E. **Legend:** A short description about the graph's data. Most often used to show what different patterns or colors stand for on your graph.

Rules and Tips for Graphing:

1. Always use a pencil to draw your graph. It's easier to fix mistakes (Or use Excel!).
2. Always draw lines with a ruler. Do not freehand. Use at least half of your paper for the graph.
3. Make sure Independent Variable is on the X-axis and Dependent Variable is on the Y-axis.
4. Include all parts:
    a. Title
    b. Axis Labels WITH Units
    c. Legend
5. If you are graphing multiple subjects, use different colored or patterned lines and explain what they are in the legend.
6. Choose an appropriate graph to explain your data. Examples:
    a. LINE: Measuring a change in something over time
    b. BAR: Comparing individuals to each other with only one data point.
    c. PIE: Show percentages that add up to 100%.

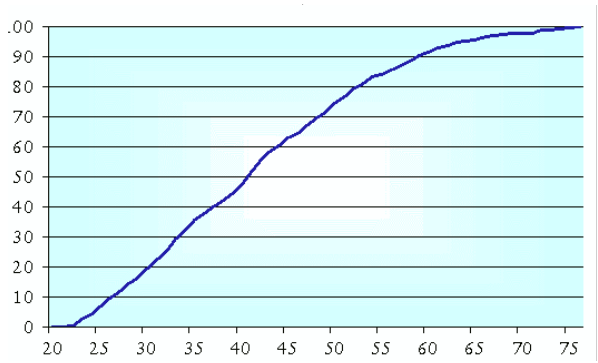
Questions:

1. The following graph is a fair to good example. Fill in the table with what is good about the graph and what could use improvement.



GOOD	IMPROVE

2. The graph below is not a good graph. What parts are missing?



Experiment #1: Use the following data to create an appropriate graph and answer the questions. (graph paper on next page).

Depth (meters)	Bubbles per minute Plant A	Bubbles per minute Plant B
2	29	21
5	36	27
10	45	40
16	32	50
25	20	34
30	10	20

3. What is the dependent variable? Why did you pick that answer?

4. What is the independent variable? Why did you pick that answer?

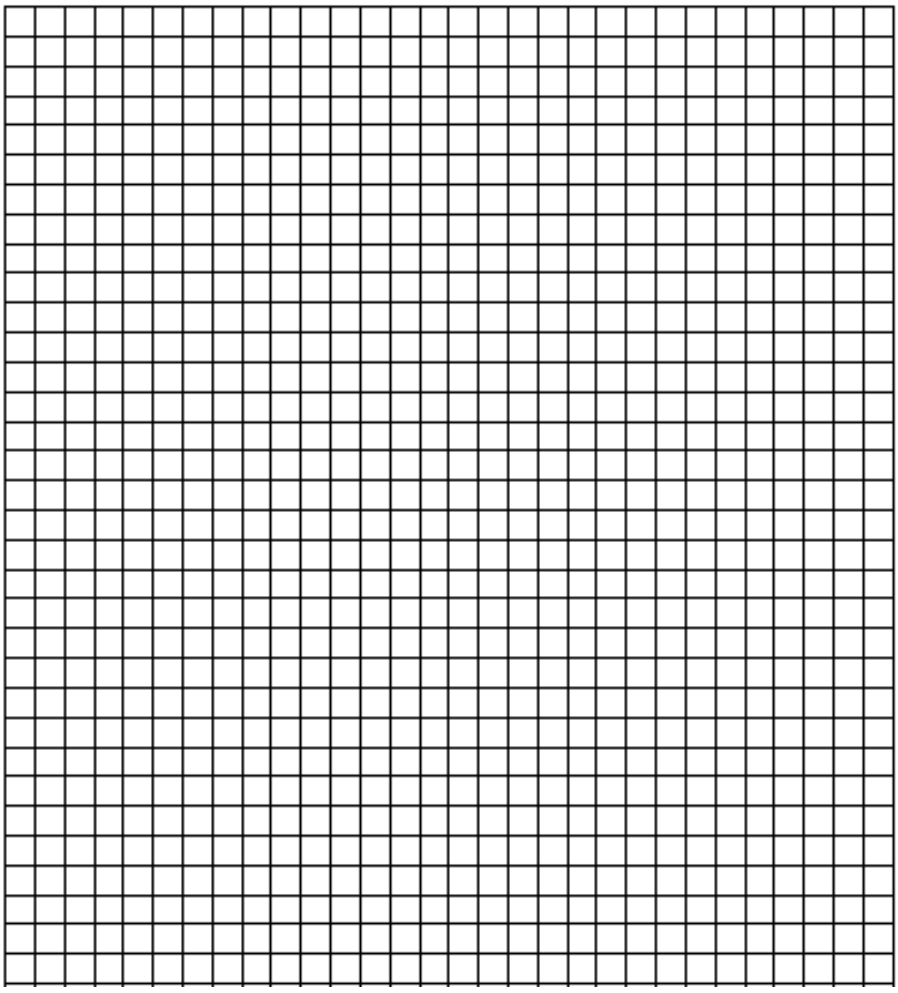
5. What type of graph would be best for this data? Why did you pick that answer?

6. What title would you give this graph?

7. What information would you include in the legend of the graph?

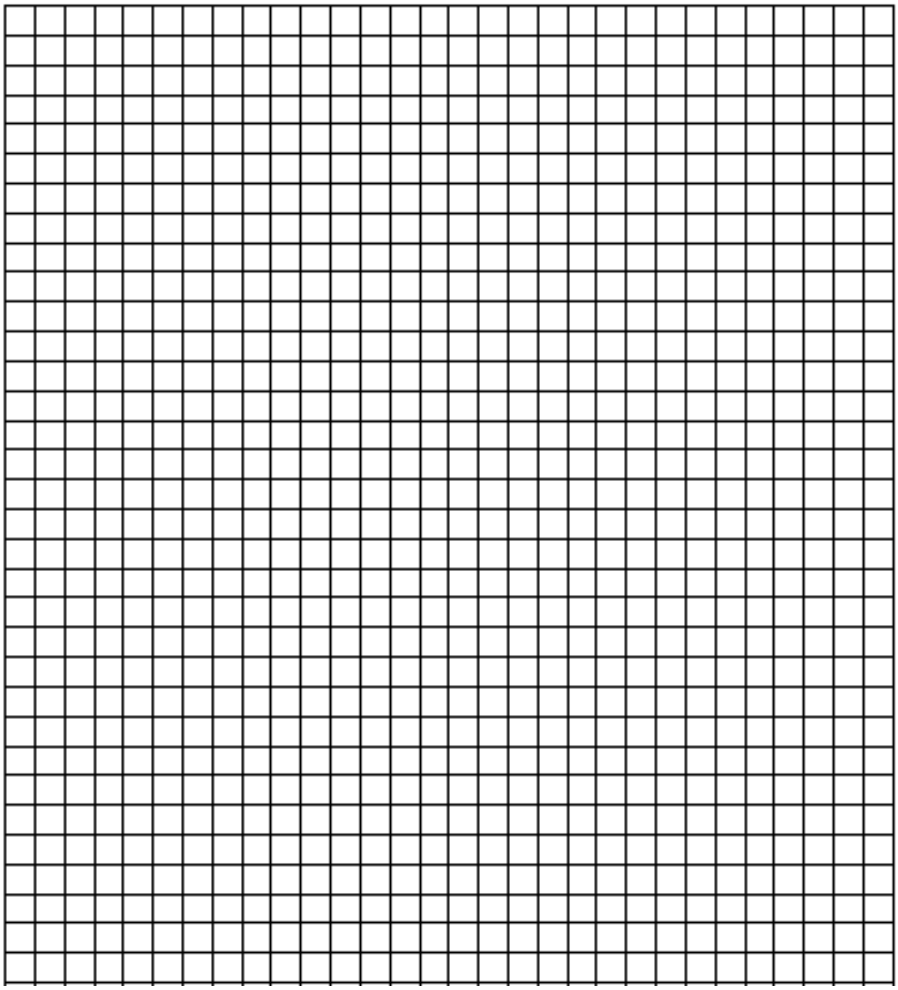
8. What will you label the X-axis with?

9. What will you label the Y-axis with?



Experiment 2: Use the following data to create an appropriate graph and answer the questions.

Time after eating (Hours)	Glucose in mg/dL Person A	Glucose in mg/dL 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



10. Which individual would you potentially diagnose as diabetic?

11. What evidence do you have that supports your answer to #10?

12. IF the time period was extended to 6 hours, what would be the expected blood glucose level for Person A? _____ Person B? _____ (assume they don't eat again).

13. What conclusion can you make about the data and graph for experiment 1?

14. What evidence did you use to support your conclusion?

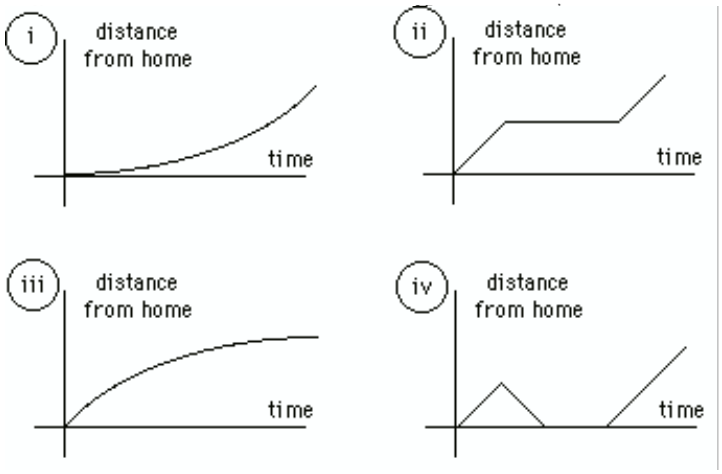
15. What conclusion can you make about the data and graph for experiment 2?

16. What evidence did you use to support your conclusion?

17. What other type of graph could you have created for experiment 1? For experiment 2?

Interpreting Graphs

In addition to being able to draw a graph based on data collected, you will also need to interpret data given to you in graph form. Answer the following questions based on the graphs presented. NOTE: Most of these are NOT examples of great graphs, they are for interpretation practice only.

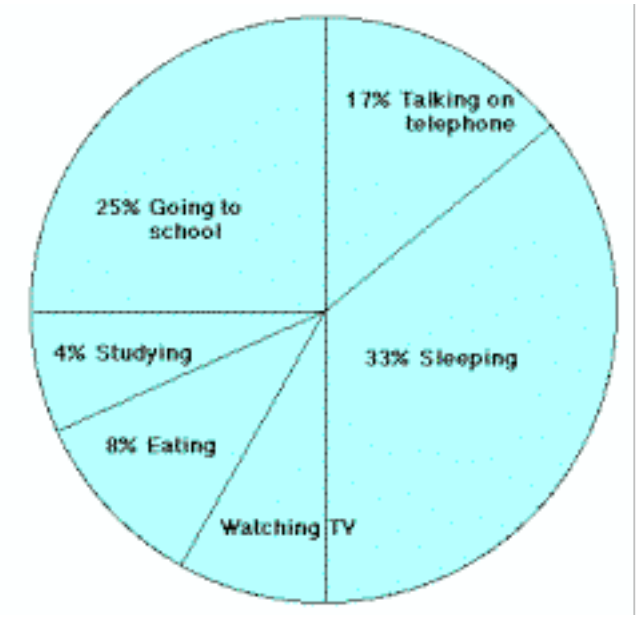


Identify the graph that matches each of the following stories:

18. _____I had just left home when I realized I had forgotten my books so I went back to pick them up.
19. _____Things went fine until I had a flat tire.
20. _____I started out calmly, but sped up when I realized I was going to be late.

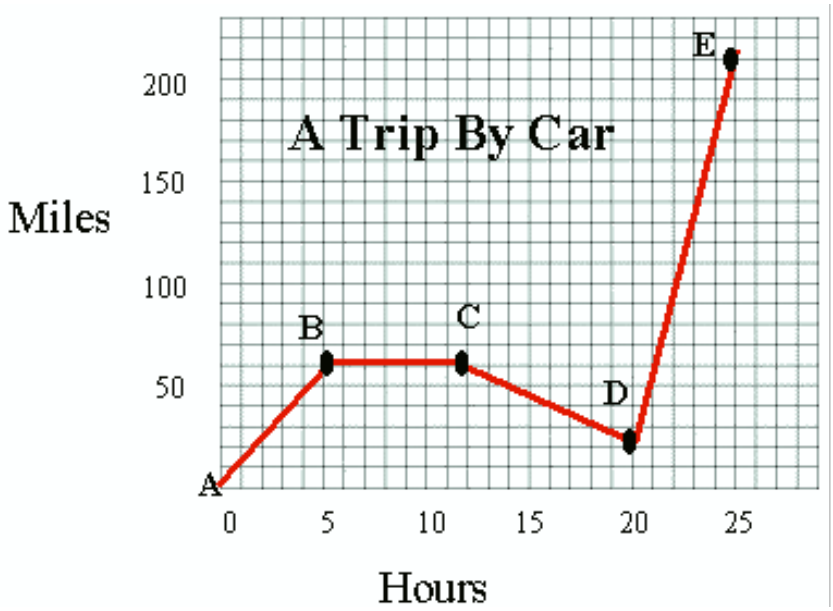
The graph to the right represents the typical day of a teenager. Answer the questions:

21. _____What percent of the day is spent watching TV?
22. _____How many hours are spend sleeping?
23. What activity takes up the least amount of time?
24. What activity takes up a quarter of the day?
25. What two activities take up 50% of the day?
26. What two activities take up 25% of the day?

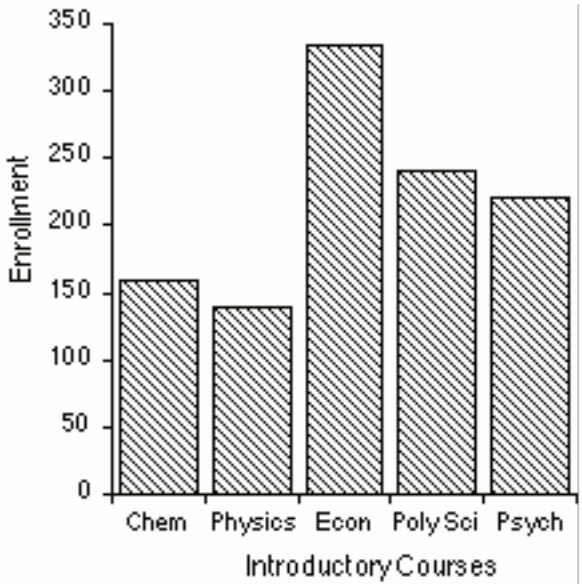


Answer the questions about the graph to the right:

27. How many total miles did the car travel?
28. Describe the motion of the car between hours 5 & 12.
29. What direction is represented by line CD?
30. How many miles were traveled in the first two hours of the trip?



The bar graph to the right represents the declared majors of freshman enrolling at a university. Answer the following questions:



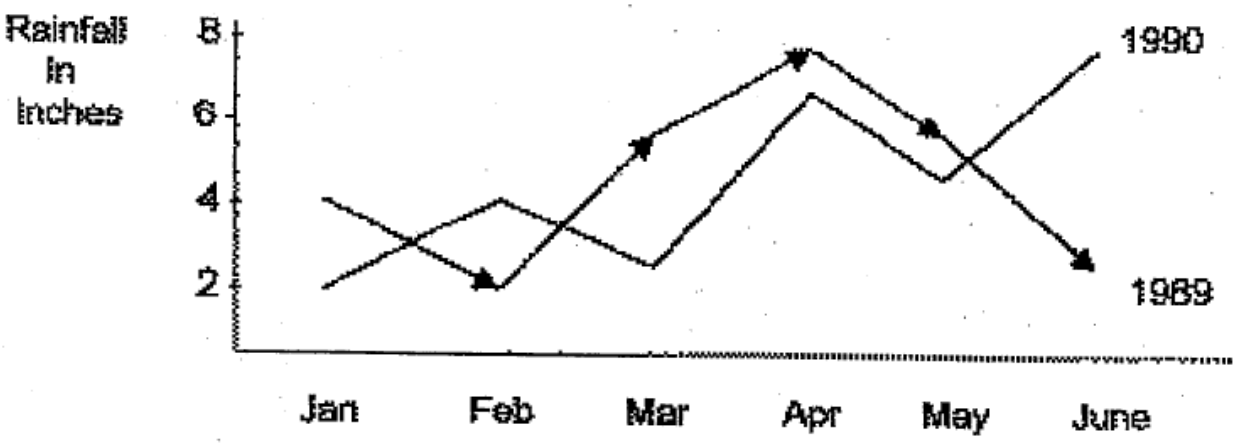
31. What is the total freshman enrollment of the college?

32. What percent of the students are majoring in physics?

33. How many students are majoring in economics?

34. How many more students major in poly sci than in psych?

Answer the following questions about the graph below.



35. How much rain fell in March of 1989?

36. How much more rain fell in Feb of 1990 than in Feb of 1989?

37. Which year had the most rainfall?

38. What is the wettest month on the graph?

More Graphing Information:

LINE GRAPHS:
Line graphs are most often used to show continuous change. Most scientific graphs are lines graphs. Examine the following data:

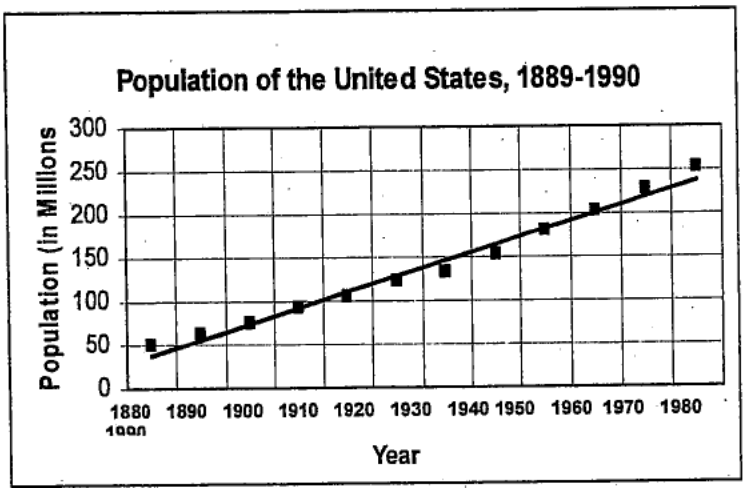
Population of the United States 1880-1990

Year	Population (Millions)	Year	Population (Millions)
1881	50.2	1940	131.7
1890	62.9	1950	151.3
1900	76	1960	179.2
1910	92	1970	203.2
1920	105.7	1980	226.5
1930	122.8	1990	251.4

In the example given above, both the year and the populations are variables. The factor which is *changed or manipulated*, in this case the year, is called the **independent variable (IV).** The *measured effect* of the IV is called the **dependent variable (DV).** The population is determined by the year; therefore, the population is the dependent variable. Another way to think about the IV and DV is to think about the amount of sleep you get. You know how alert or tired you feel often depends on the number of hours of sleep you got the night before. The amount of sleep is the IV an; your alertness is the DV. Throughout your year of AP Biology, you will be asked to identify variables in many different investigations.

Review "rules and tips for graphing" from front page for how to set up graphs.

Using line graphs to make predictions:
To predict what the population of the US was in the year 2000, you will need to go beyond the data points on the graph. This is called **extrapolation**. We can also use graph to find data point between two sets of plotted data pairs. For example, we can read the graph to determine that the population of the United States in 1905 was approximately 84 million people. Determining data points between two sets of data pairs is called **interpolating**.



Bar Graphs:
Bar graphs should be used for data that are not continuous. It is a good indicator fo trends if the data are taken of a sufficiently long period of time.

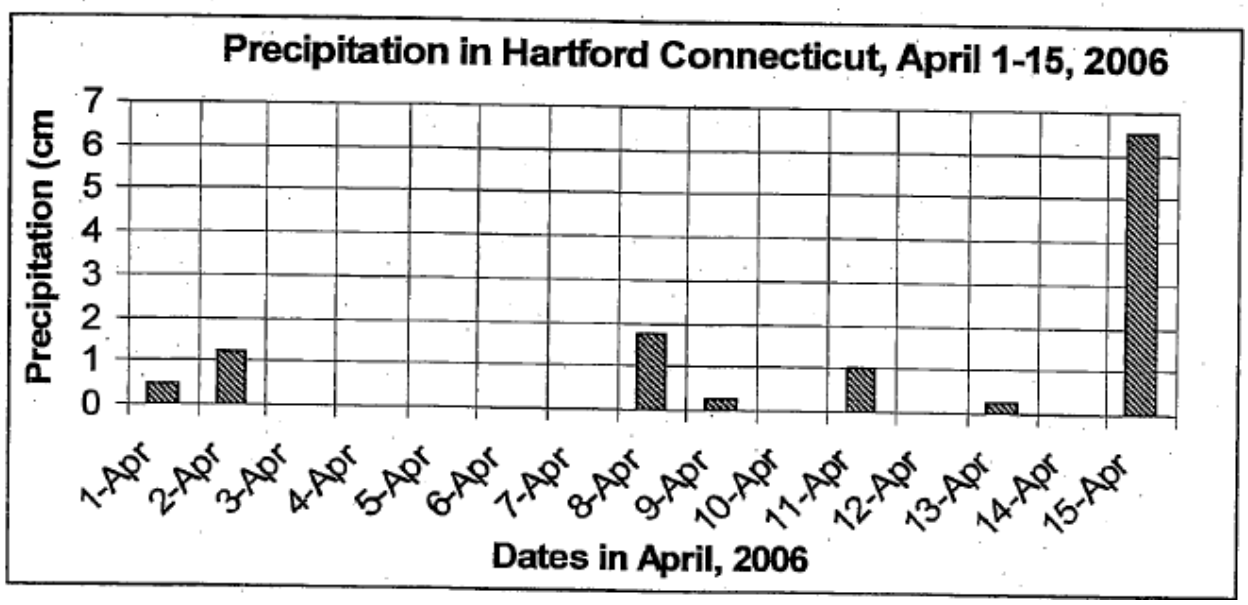
Examples of when to use bar graphs: When comparing different groups. When trying to measure **large** changes over time.

Practice:

Look at the line graph on the previous page called, "Population of the United States 1889-1990."

1. Predict what the population of the United States will be in 2010. _____
2. Determine the approximate population of the United States in:
   1935: _____ 1945: _____ 1985: _____
3. What was the approximate population of the Untied States in 1970? _____
4. What will be the approximate population in 2020? _____

5. Why would you use a bar graph instead of a line graph?



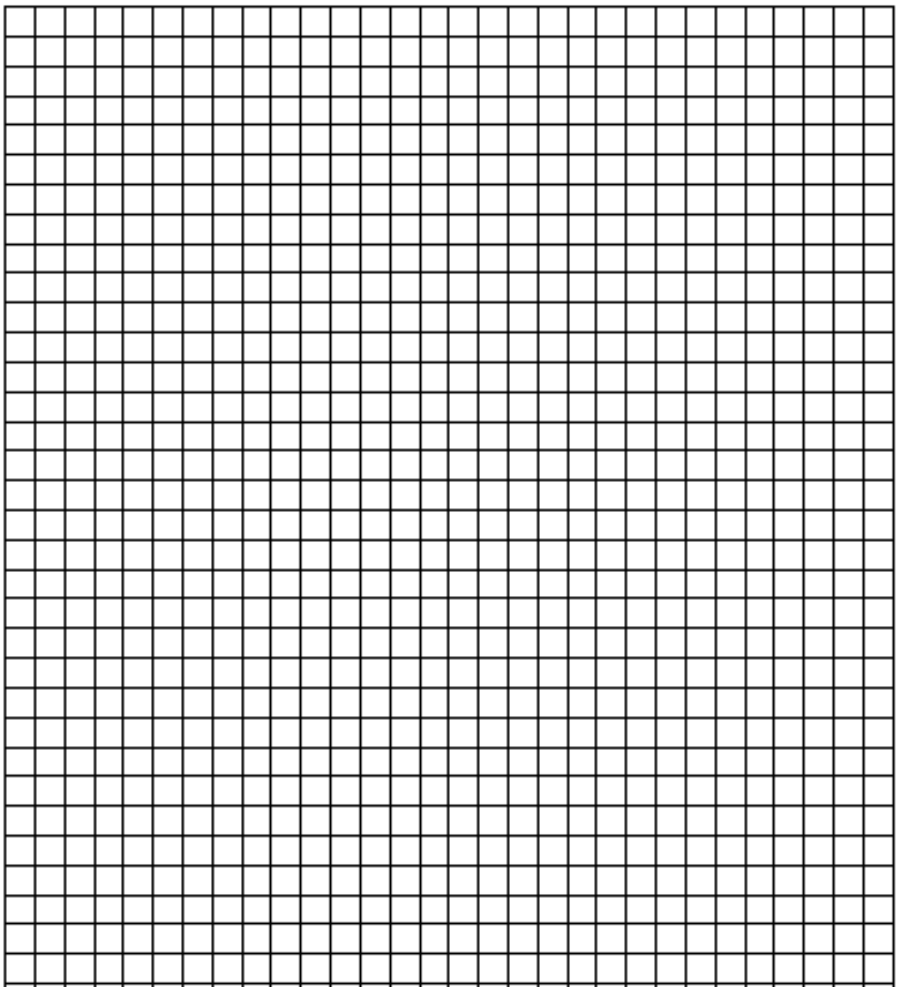
6. According to the bar graph above of precipitation in Harford, CT, how many centimeters of rain fell in Hartford on April 11?

7. Are you able to see any trends in this data set? If so, what is the trend? If not, why not?

8. Can a bar graph show a trend, even if the data are not continuous? Explain.

9. Can the bar graph be used to predict precipitation in Harford on April 20? Why or why not?

10. In 1989, the US Department of the Interior reported that were 360 endangered species of plants and animals in the United States. These endangered organisms included 32 species of mammals, 61 species of birds, 8 species of reptiles, 5 species of amphibians, 45 species of fishes, 3 species of snails, 32 species of clams, 8 species of crustaceans, 10 species of insects, 3 species of spiders, and 153 species of plants. Construct a bar graph of the total number of endangered plants and animals in 1989.



11. After an outbreak of influenza, a student gathered data on the number of students who became ill, until she became sick on the 14th day of her study. The information she gathered is shown below. Create a line graph of the data below.

Date (Feb., 1996)	Number of ill Students
1	12
2	18
3	30
4	49
5	115
6	127
7	125
8	107
9	108
10	115
11	117
12	95
13	60
14	52

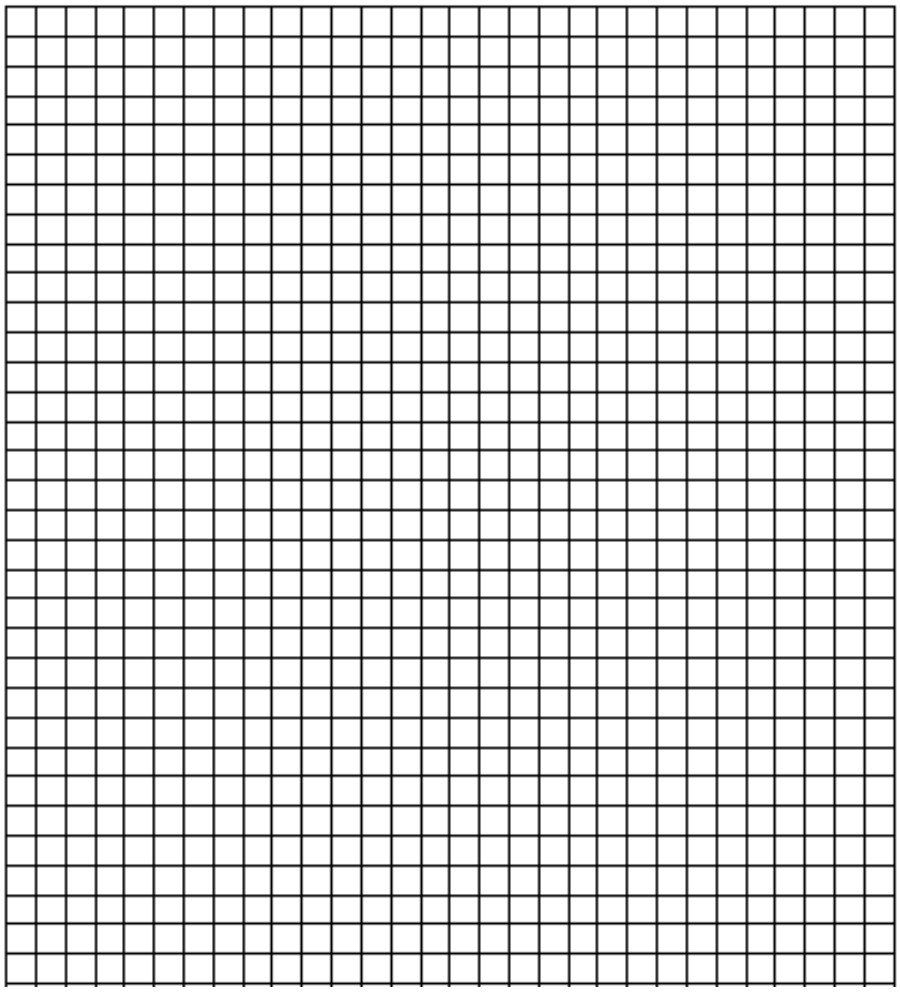
Questions:

12. On what day were most students ill?

13. During which period of time did the most students become ill?

14. What was the greatest number of students who were ill on any one day?

15. Estimate the total number of students who were ill on the 15th day.



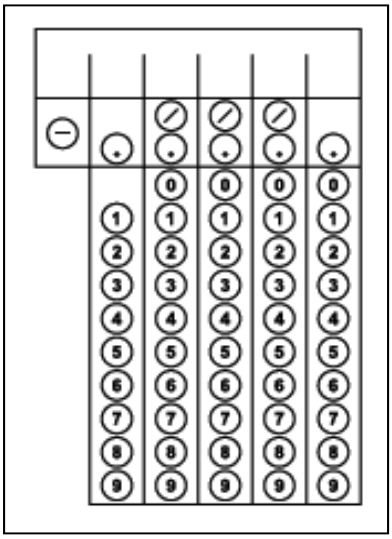
Name: _____

AP Biology Grid-In

This packet was designed to introduce some of the mathematics you will need to apply throughout the year to be successful in this course and on the May AP Biology exam. As your prospective AP Biology teachers, we realize that some of the formulas required for this packet may be new to you. One of the most important aspects of AP Biology is reading carefully and closely following directions. We ask that you read carefully, follow directions, and use any and all available resources necessary to answer the questions. We have included a copy of the AP Biology formula sheet for use on this assignment.

Directions: Answer the following questions using the required formula sheet (for this assignment the formulas have been provided) and a basic calculator. You will be able to use a graphing calculator on the AP test. After solving each question, transfer your answers to the "grid" and fill in the corresponding bubbles.

Tips for using "grids":
-Always use the formula sheet before answering the question
-Grid left to right
-Don't round until the end
-Make sure you know how the answer should be written.
Ex. "Round to the nearest…"



Example: .123

Directions: Place the example in the grid to the right.
The 1 is in the tenths place
The 2 is in the hundreds place
The 3 is in the thousandths place

Basic Calculations:
Mode = value that occurs most frequently in a data set
Median = middle value that separates the greater and lesser halves of a data set ($\bar{X}$)
Mean = sum of all data points divided by the number of data points
Range = value obtained by subtracting the smallest value from the greatest value

Standard Deviation = $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$

X = each score
$\bar{X}$ = mean (average)
n = number of values
$\sum$ = sum of values

Sample Problems:
A group of students measured their resting heart rates in beats per minute. The data collected is as follows:

Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9	Student 10
58	66	79	90	62	74	78	71	69	66

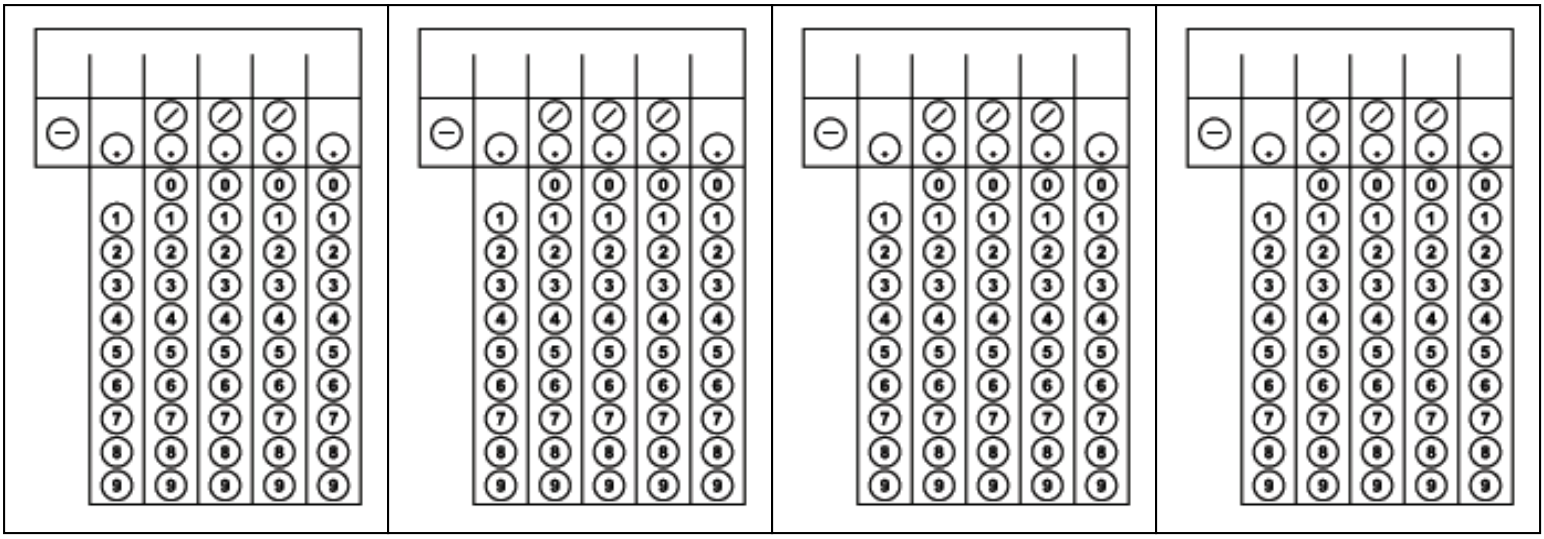
Find the mode, median, mean, and range for the data in the chart. Show work, grid in!

Mode:

Median:

Mean (Average):

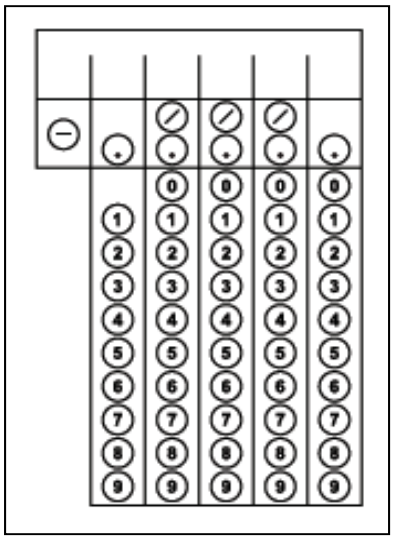
Range:



Using the chart below, calculate the standard deviation for the data set and grid in!

Heart Rates (BPM)	Mean ($\bar{X}$)	$(X - \bar{X})$	$(X-\bar{X})^2$
58			
66			
79			
90			
62			
74			
77			
71			
69			
67			

$\Sigma (X-\bar{x})^2$



Calculate standard deviation and "grid-in":

Standard Error:

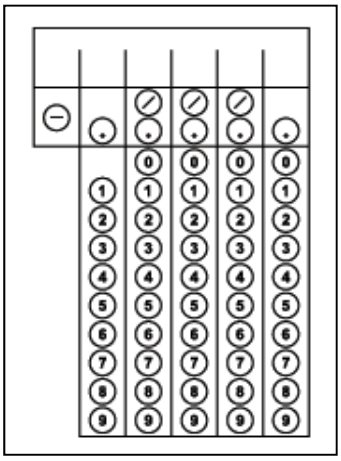
$$SE_{\bar{x}} = \frac{S}{\sqrt{n}}$$

$SE_{\bar{x}}$ = Standard error
S = Standard deviation
n = size of population/# of groups

In order to calculate standard error, you must first calculate the mean (average). You can then use the mean value to calculate standard deviation. You can then use the value for standard deviation to calculate the standard error.

The class crossed a hairless Wisconsin Fast plant with a hairy Wisconsin Fast plant to obtain an F1 generation. What is the standard error of this class data set? Report your answer to the nearest hundredth of a decimal number.

Table 1: Number of Hairs on F1 Plants (Class Data)						
Group Number	***1***	***2***	***3***	***4***	***5***	***6***
F1 Plants	19	22	19	20	22	28



Show work!

Grid-in!

Cell Size, Surface Area: Volume Ratio, and Transport Efficiency:

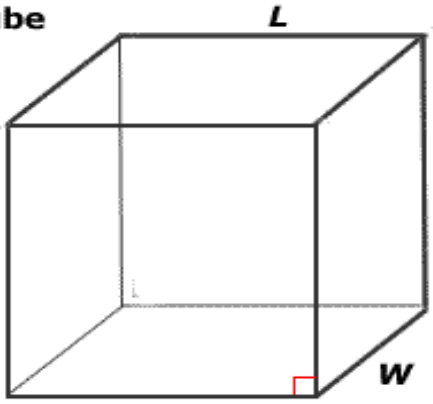
Cells make more cells by cell division. The cells that are produced must then grow to normal size. When a cell becomes too large, it must divide to maintain its surface area:volume ratio which, in turn, maintains the efficient transport of nutrients and oxygen into the cell and wastes and carbon dioxide outside of the cell.

Cuboidal Cells:

Surface Area of a Cube

In a cube, all sides are the same, find the area of one side and multiply by 6.

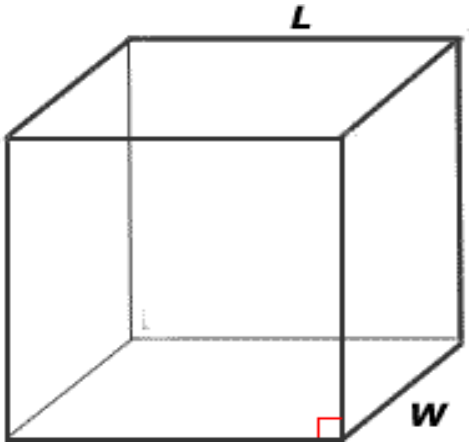
There are 6 sides, the surface area is the sum of each of the sides.



Volume of a Cube

Volume = L x W x h

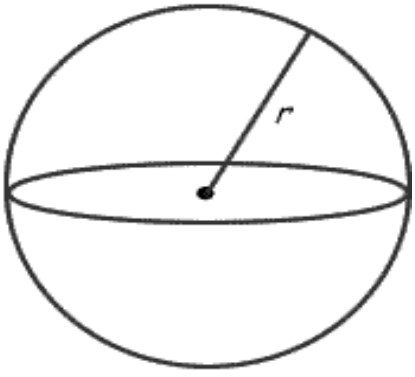
Like a rectangular solid, multiply the length, times the width times the height.



Sphere

Surface Area

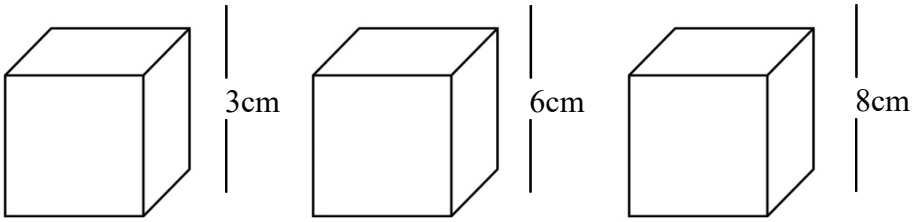
$$A = 4\pi r^2$$



Volume

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

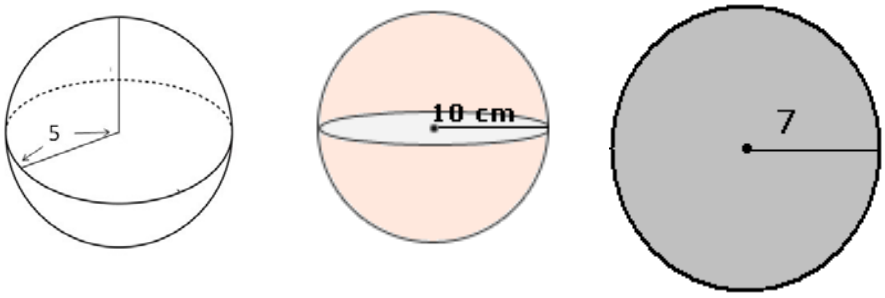
Calculate surface area, volume, and surface area:volume ratio for the following cubes:



1 2 3

Surface Area:		
Volume:		
Surface Area: Volume		

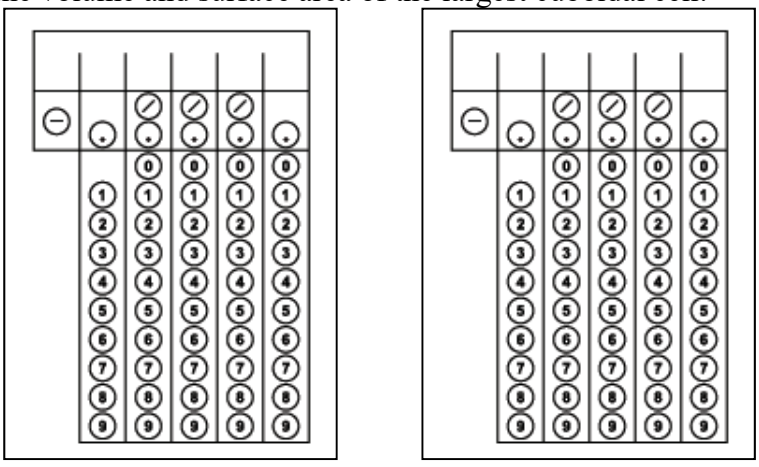
Calculate the surface area, volume, surface area:volume ratio for the following spheres:



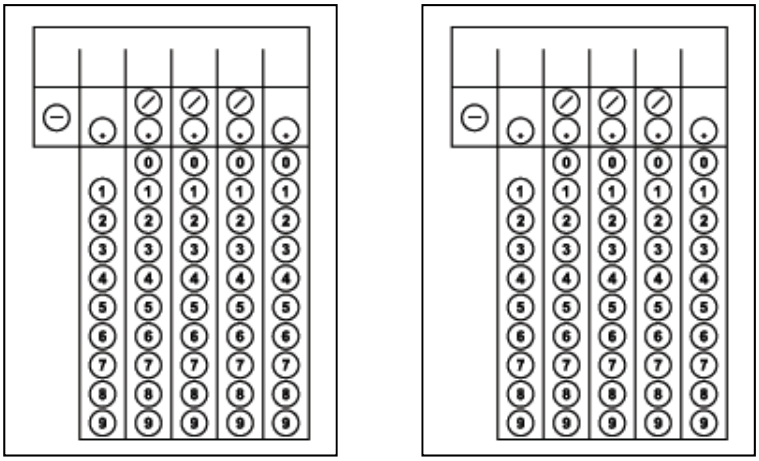
1 2 3

Surface Area:		
Volume:		
Surface Area: Volume		

"Grid in" the volume and surface area of the largest cuboidal cell:



"Grid in" the volume and surface area of the largest spherical cell:



Chi-square analysis and "goodness of fit":
The chi-square is used to test if experimental results are caused by chance or not

A student wishes to breed pea plants and to study the inheritance of two genes, height and pea color. This student believes that there is no linkage between the genes and that there will be equal numbers of each outcome. The following "null hypothesis" is formed. (Note: The null hypothesis ALWAYS favors what is expected based on probability and chance! Ex. You would expect 5 heads and 5 tails if you tossed a coin 10 times.)

Null Hypothesis:
If these pea plants are bred, then we expect that equal amounts of each type will result.

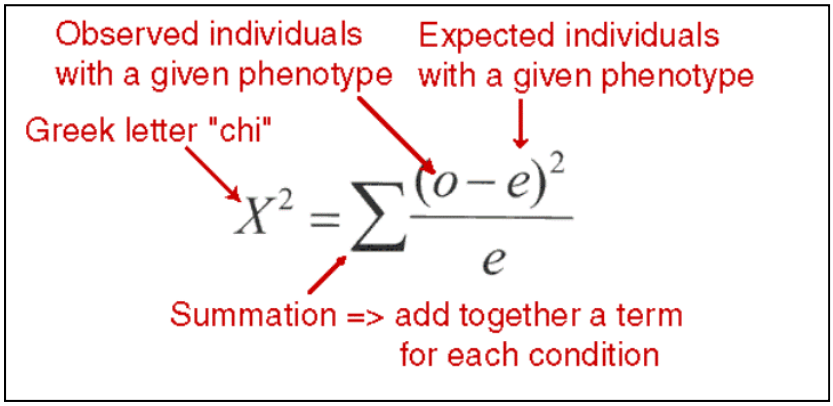
The experiment is conducted and yields 100 offspring.

The student observes the following:

Phenotypes	Number of offspring
Tall/Green	20
Tall/Yellow	33
Short/Green	32
Short/Yellow	15

Use the chi-square equation below to calculate your chi-square value:_____

Chi-square =



After you have calculated your chi-square value, you must calculate your degrees of freedom (df). You calculate your degrees of freedom as follows:

Degrees of Freedom (df) = number of possible outcomes (n) -1

In this experiment, how many possible outcomes are there?_____

How many degrees of freedom (df) do we have in this experiment? _____

In the biological sciences, a chi-square analysis always **uses .05** as a standard p-value.

	p value											
df	0.25	0.2	0.15	0.1	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
	25%	20%	15%	10%	5%	2.5%	2%	1%	0.05%	0.025%	0.01%	0.005%
1	1.32	1.64	2.07	2.71	3.84	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.6	11.98	13.82	15.2
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.59	6.74	7.78	9.49	11.14	11.67	13.23	14.86	16.42	18.47	20
5	6.63	7.29	8.12	9.24	11.07	12.83	13.33	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.53	14.45	15.03	16.81	13.55	20.25	22.46	24.1
7	9.04	5.8	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02
8	10.22	11.03	12.03	13.36	15.51	17.53	18.17	20.09	21.95	23.77	26.12	27.87
9	11.39	12.24	13.29	14.68	16.92	19.02	19.63	21.67	23.59	25.46	27.83	29.67
10	12.55	13.44	14.53	15.99	18.31	20.48	21.16	23.21	25.19	27.11	29.59	31.42

To use the chart above, you must first find the "critical value", the value on the chart that corresponds to the .05 p-value and your degrees of freedom.

What is your critical value? _____

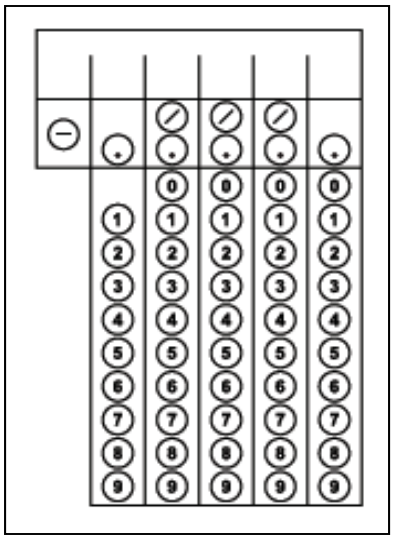
In order to accept the "null hypothesis" that favors chance, your chi-square value must be less than your critical value. If your chi-square value is greater than your critical value, there is a deviation greater than chance and the results must be cause by some other, potentially unknown factor.

Do you accept or reject the null hypothesis?

(Circle one) ACCEPT REJECT

Explain why you accepted or rejected the null hypothesis based on your chi-square value.

Now "grid-in" your chi-square value below before moving on. →



Laws of Probability; The Multiplicative Law:

If a particular outcome or event in one experiment does not affect the probability of outcomes or events in a second experiment, then the outcomes or events are said to be independent. For example, if you roll a dice twice, then the outcome in the first roll will not affect the probabilities of the outcomes when the dice is rolled a second time. The results of the two dice rolls are independent of each other.

Multiplication Law
If X and Y are two independent events with probabilities P(X) and P(Y) respectively, then the probability that X and Y will both happen is found by multiplying the two probabilities together:

$$P(X \text{ AND } Y) = P(X) \times P(Y)$$

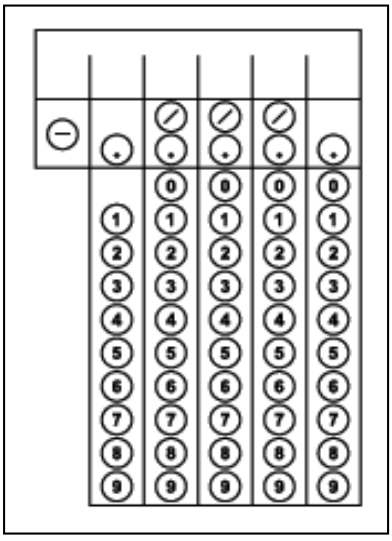
2 coins are flipped…

Coin 1: What are the odds of a head coming up?

Coin 2: What are the odds of a head coming up?

What are the odds of a head coming up on both flips? (Use the multiplicative law!)

Question: Calculate the probability of tossing three coins simultaneously and obtaining three heads. Express in fraction form.



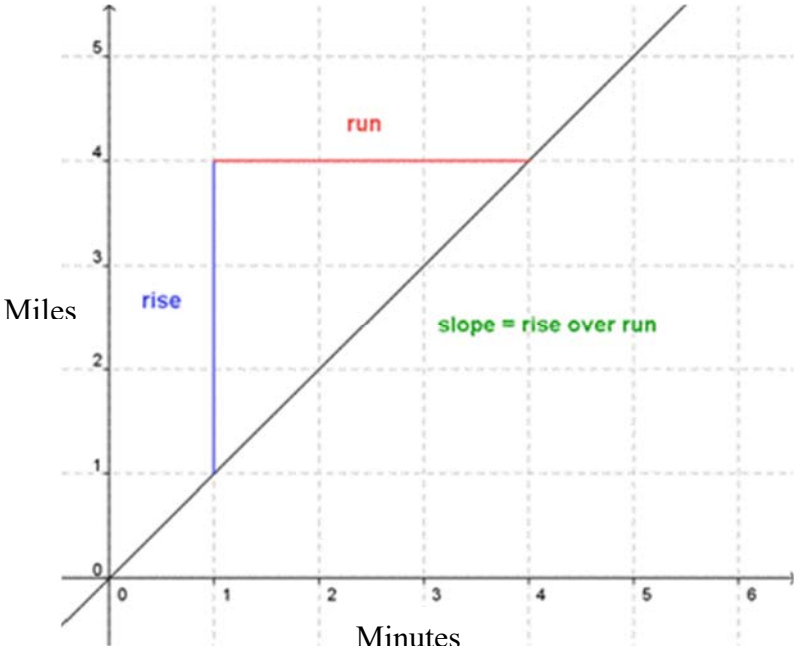
Rate:

A rate is a specific kind of ratio, in which two measurements are related to each other. In most cases, we will be calculating rate either from a chart or graph.

$$\text{Rate/Slope} = \frac{\text{Change in Y}}{\text{Change in X}} = \frac{\Delta Y}{\Delta X} = \frac{\text{Rise}}{\text{Run}}$$

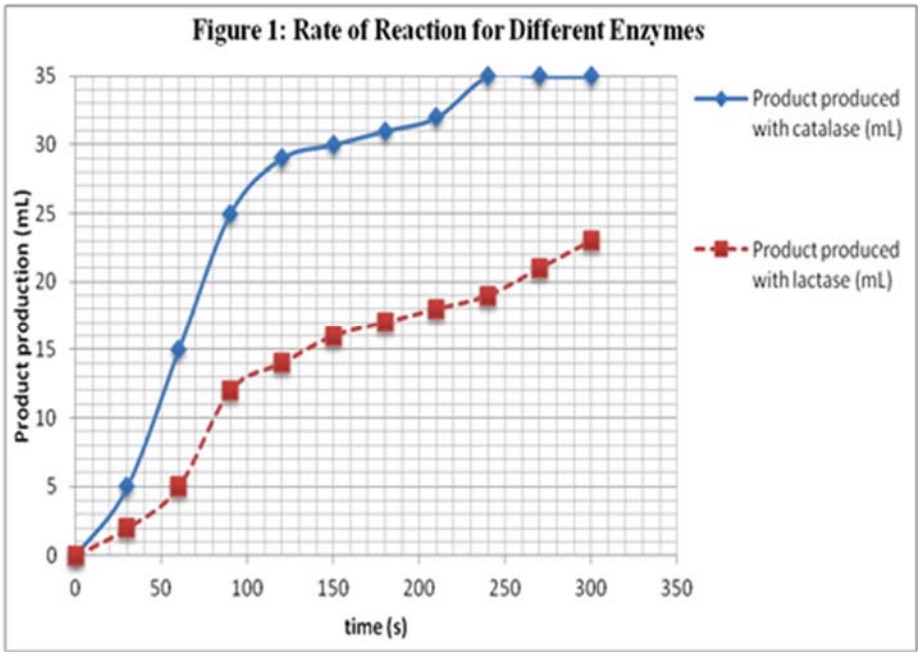
Ex.

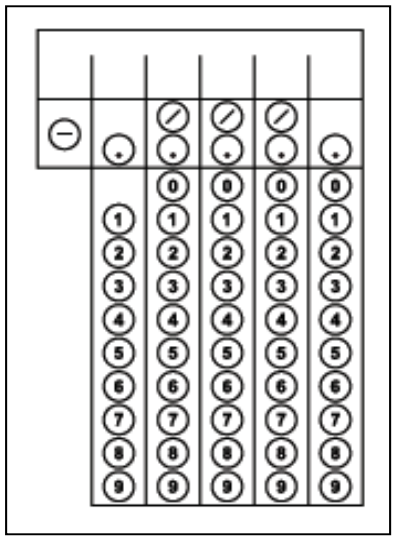
Minute (x-axis)	Miles (y-axis)
1	1
2	2
3	3
4	4
5	5
6	6



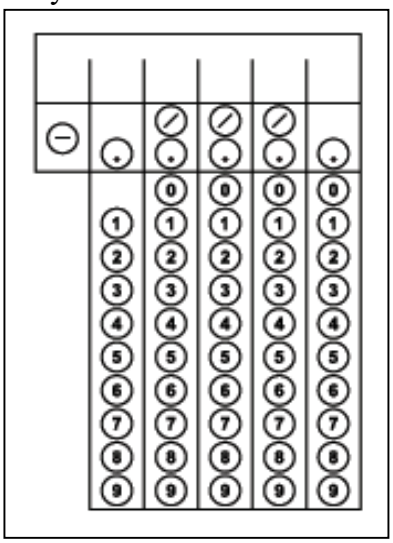
In the example above, the car is moving at a rate of 1 mile/minute. This is 60 miles/hour.

Using the graph plotted below, what is the rate of reaction for catalase? Report your answer to the nearest tenth of a decimal number.





Hydrogen peroxide is broken down to water and oxygen by the enzyme catalase. The following data were taken over 5 minutes. What is the **rate** of enzymatic reaction in mL/min from 2 to 4 minutes? Round to the nearest hundreds.



Hydrogen Peroxide Decomposition

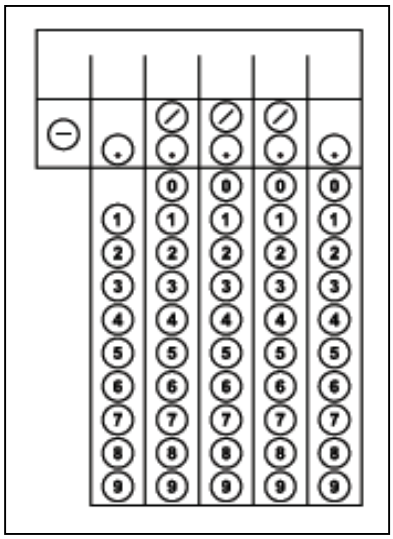
Time (min)	Amount of O_2 Produced (mL)
1	2.3
2	3.6
3	4.2
4	5.5
5	5.9

Population Growth: Logistic (realistic) and Exponential (uncontrolled):

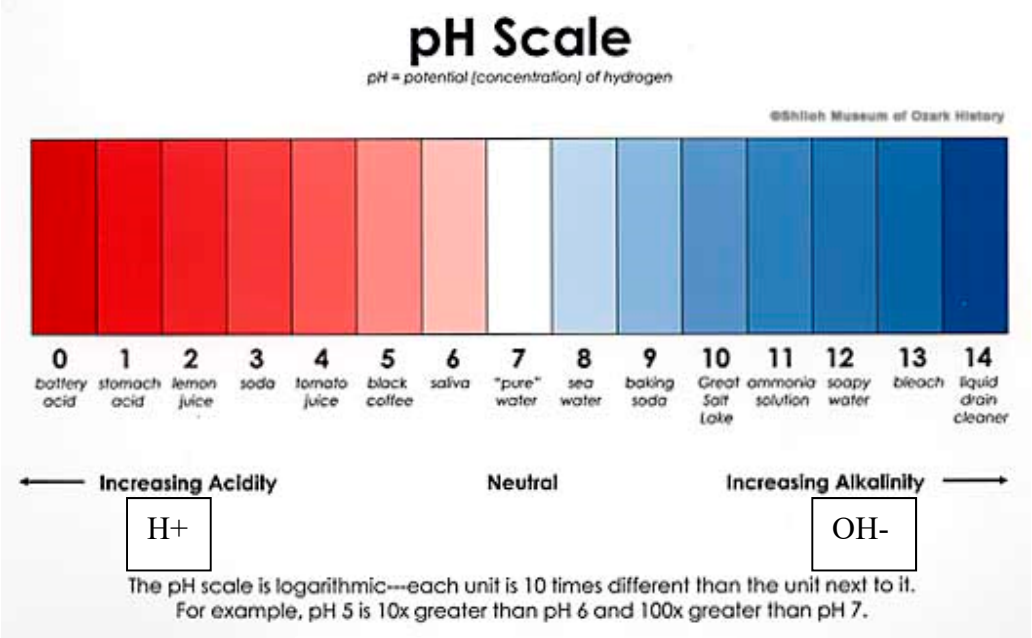
Rate and Growth	
Rate dY/dt	dY= amount of change t = time
Population Growth dN/dt=B-D	B = birth rate D = death rate
Exponential Growth $\frac{dN}{dt} = r_{max}N$	N = population size K = carrying capacity
Logistic Growth $\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$	r_{max} = maximum per capita growth rate of population

Logistic Growth:

What is the logistic per capita growth of a population of 800 mice if the field surrounding Hauppauge High School has a carrying capacity of 2000 mice and the current maximum growth rate is 2.0?



pH – Hydrogen Ion Concentration and Acidity

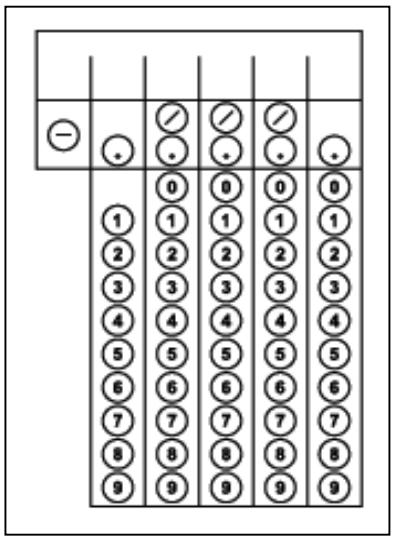


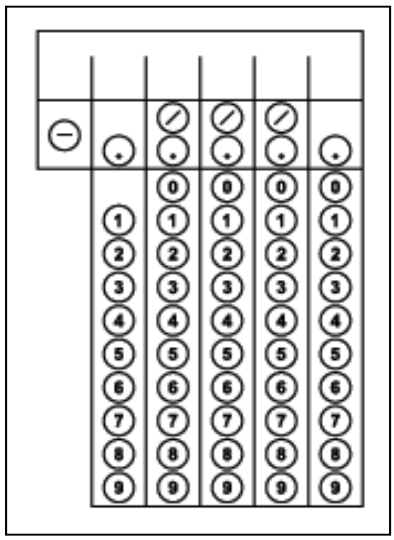
$$pH = -\log_{10}[H^+]$$

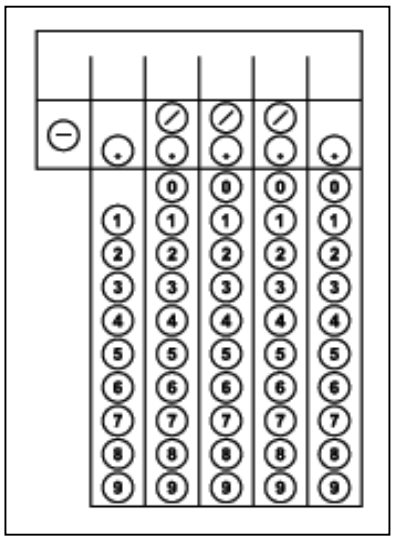
$$[H^+] = 10^{-pH}$$

Calculate the Hydrogen Ion (H+) concentration for the following solutions:

pH = 2 pH = 3 pH = 4







{ŜŎűĺ2ƴπ Vocabulary to Review for 1st Semester

These are the words you need to remember from Biology 1 to converse in AP Biology during the 1st semester.

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- ☐ activation energy
- ☐ active site
- ☐ active transport
- ☐ adhesion (in water)
- ☐ aerobic
- ☐ amino acid
- ☐ anaerobic
- ☐ antibiotics
- ☐ asexual reproduction
- ☐ atom
- ☐ ATP
- ☐ autotroph
- ☐ binary fission
- ☐ brain stem
- ☐ carbohydrate
- ☐ catalyst
- ☐ cell
- ☐ cell theory
- ☐ cellular respiration
- ☐ cerebellum
- ☐ cerebrum
- ☐ chemical reaction
- ☐ chloroplast
- ☐ chromosome
- ☐ cohesion (in water)
- ☐ covalent bond
- ☐ crossing over
- ☐ denature
- ☐ dependent variable
- ☐ dermal tissue
- ☐ diffusion
- ☐ diploid
- ☐ DNA
- ☐ endosymbiosis
- ☐ enzyme
- ☐ eukaryote
- ☐ fatty acid
- ☐ feedback inhibition
- ☐ fermentation
- ☐ fluid mosaic model
- ☐ gametes
- ☐ glycerol
- ☐ guard cell
- ☐ haploid
- ☐ heterotroph
- ☐ homeostasis
- ☐ homologous chromosomes
- ☐ hydrogen bond
- ☐ hypertonic
- ☐ hypothesis
- ☐ hypotonic
- ☐ independent variable
- ☐ inflammatory response
- ☐ ion
- ☐ isotonic
- ☐ joule (j)
- ☐ lipid
- ☐ lymphocyte
- ☐ macromolecule
- ☐ mean (math)
- ☐ mechanism (science)
- ☐ meiosis
- ☐ metabolism
- ☐ mitochondrion
- ☐ mitosis
- ☐ molecule
- ☐ monomer
- ☐ monosaccharide
- ☐ nucleic acid
- ☐ nucleotide
- ☐ nucleus
- ☐ organelle
- ☐ organic (as in, chemistry)
- ☐ osmosis
- ☐ passive transport
- ☐ pathogen
- ☐ pH scale
- ☐ phenotype
- ☐ phospholipids
- ☐ plasma membrane
- ☐ polar molecule
- ☐ polymer
- ☐ polypeptide
- ☐ polysaccharide
- ☐ products
- ☐ prokaryote
- ☐ protein
- ☐ rate (math)
- ☐ reactants
- ☐ ribosome
- ☐ RNA
- ☐ selective permeability
- ☐ sexual reproduction
- ☐ solution
- ☐ somatic cells
- ☐ specific heat
- ☐ stomata
- ☐ transpiration
- ☐ vaccine
- ☐ valence shell
- ☐ vascular tissue

Review : Biology Key Concepts

On notebook paper, answer the questions in each box and staple to the back of this packet.

	Molecular Scale	Cellular Scale	Organismal Scale	Population Scale
Homeostasis and Regulation	14. **Describe** how feedback inhibition can help regulate enzyme activity on the molecular level.	15. **Explain** how negative feedback helps regulate the amount of glucose in the blood stream.	16. **Compare** the strategies of endotherms and exotherms for maintaining homeostasis.	17. **Predict** how introducing an invasive species might disrupt the homeostasis in an environment.
Evolution	18. What are the different types of mutations? Briefly **describe** each OR provide an **illustration**.	19. **Discuss** the different results of mutations in somatic cells and gametes.	20. It is incorrect to say that an individual has evolved. **Explain** why and **propose** a more accurate statement.	21. Natural selection and genetic drift are two different mechanisms of evolution. **Compare** the two mechanisms.
Energy Transfer	22. **Describe** how energy is stored in and released from chemical bonds.	23. **Explain** why ATP is called the "molecular currency" of intracellular energy transfer.	24. **Describe** how energy from the sun can be captured by one organism but used by another.	25. Energy is lost as it moves up an energy pyramid. **Design** an experiment to estimate the loss.
Structure Confers Function	26. **Predict** the effect on enzyme function if you were to change its amino acid sequence (its primary structure).	27. Choose one organelle found in an animal or plant cell and **discuss** how its function relates to its physical structure.	28. **Explain** how the structure of an animal's teeth can reflect its dietary habits. How does the structure affect function?	29. **Explain** how convergent evolution results in features with a similar function but a dissimilar structure.
Interdependence in Nature	30. **Draw** a diagram to represent the interconnectedness of the formulas for photosynthesis and cellular respiration.	31. **Connect** the products of a chloroplast to the chemical "food" used by a mitochondrion.	32. **Justify** the following statement, "lichen are excellent examples of symbiosis."	33. **Discuss** how removing one organism from a food chain might negatively affect those above and below it.