— KEY —

MCAS OPEN RESPONSE PRACTICE QUESTIONS

Note: You should answer in complete sentences!

CELL BIOLOGY

I. Organisms in the kingdoms Animalia and Fungi are similar in some ways but are also different in many important ways.

a. List one organism classified in kingdom Animalia and one organism classified in kingdom Fungi.

Humans are classified in K. Animalia; Mushrooms are classified in K. Fungi

b. Describe **two** similarities between organisms in kingdom Animalia and kingdom Fungi.

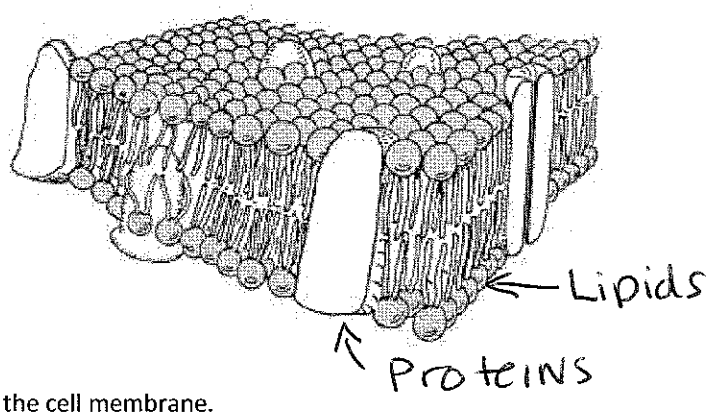
Organisms in both kingdoms are made up of eukaryotic cells and are consumers.

c. Describe **two** differences between organisms in kingdom Animalia and kingdom Fungi. (Also, undergo cellular resp.; Mitosis etc.)

K. Animalia: more complex; not decomposers

K. Fungi: more simple; decomposers

II. The diagram below shows a cross section of part of a cell membrane.



a. Describe the basic structure of the cell membrane.

phospholipid bilayer embedded w/ proteins

b. Describe **two** primary functions of the cell membrane.

The cell membrane acts as a barrier and regulates cell transport (wastes & nutrients)

c. Explain how the structure of the cell membrane allows it to perform the functions described in part (b). Lipids provide fluidity which is impt as the cell shrinks + expands based on different tonicity ↓ osmosis

III. The drawing below represents an organism that a student observed when examining a sample of pond water with a light microscope.

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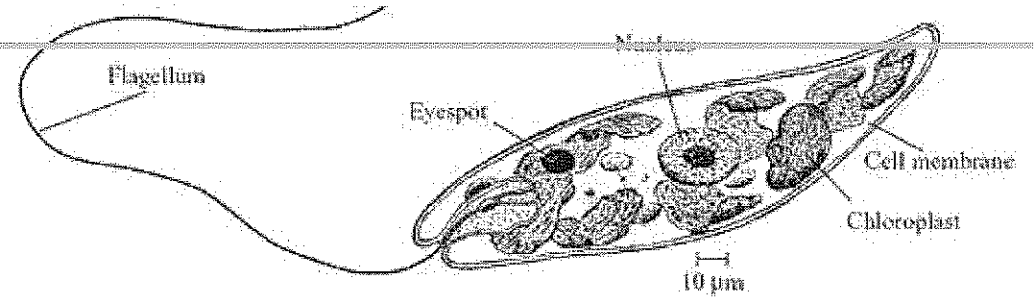


The student identified this organism as a prokaryote.

a. Is the student's identification accurate? Explain your answer using information from the diagram.

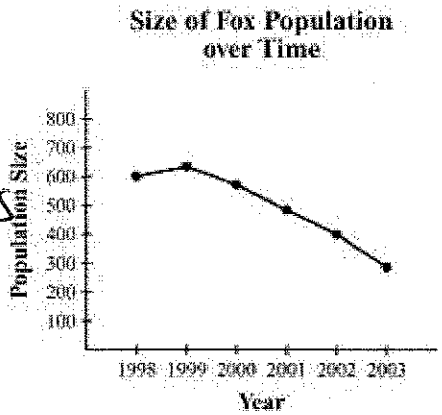
No, the organism is a eukaryote as it has a nucleus and membrane bound organelles.

b. Identify **three** similarities between the cells of prokaryotes and eukaryotes.

* both have DNA
* both respond to stimuli
* both have a cell membrane

ECOLOGY

IV. The graph below shows the changes in the size of a fox population over time.



a. Identify **three** different factors that could have caused the overall decrease in the fox population.

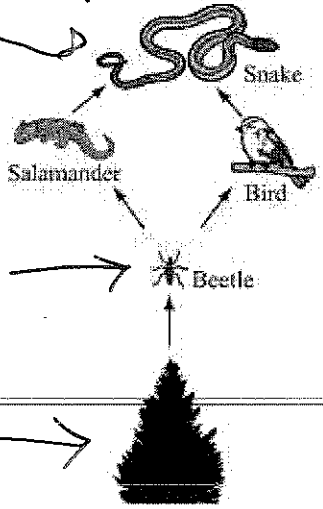
- increased hunting
- increase in natural predators
- decreased food / space

b. Explain, in detail, how **each** factor you identified in part (a) would have caused the decrease.

Hunting & predators could cause a decrease by increasing deaths. Decreased food and space increases competition.

V. A small part of a food web for a forest ecosystem is shown below.

a. Classify each of the five organisms in the food web as a producer, a primary consumer, a secondary consumer, or a tertiary consumer.



primary consumer

Producer

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b. Identify the type of ecological relationship between salamanders and birds in this food web.

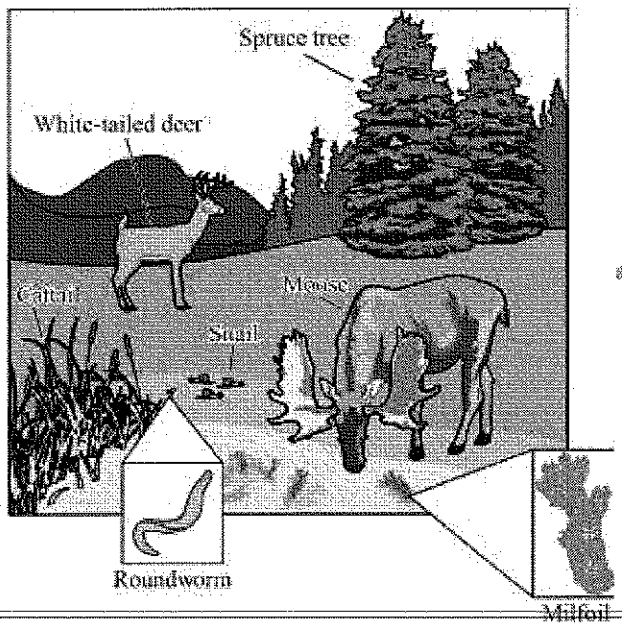
Salamanders and birds are both competing for the same food source.

c. Suppose there is a significant decrease in the bird population. Based on the relationships in the food web, explain why it would be difficult for ecologists to predict what would happen to the size of the salamander population.

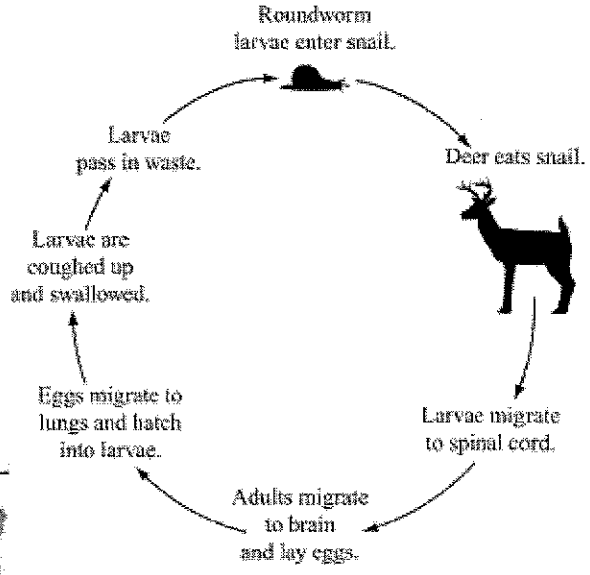
*they share the same food + predator due to ↑ food

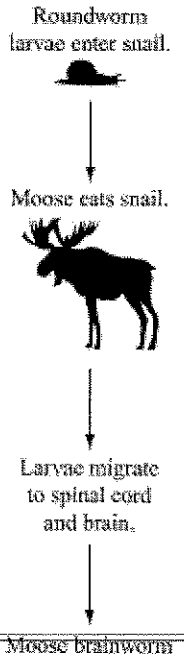
the salamandu pop. could increase↑ but its difficult to say for sure b/c of the snakes involvement in the web.

VI. Forest and wetland ecosystems in Canada and parts of the northern United States are home to moose, *Alces alces*. The illustration below shows a moose and some of the plants and other animals found in its typical habitat.One serious problem for moose is a disease called moose brainworm. Effects of the disease include aimless walking in circles, poor coordination and balance, weakness, and paralysis of the legs. Many cases of the disease result in death. The disease is caused by a parasitic roundworm, *Parelaphostrongylus tenuis*. The life cycle of this roundworm involves snails, white-tailed deer, and moose, as shown in the diagrams on the next page. Of these organisms, only the moose gets sick from infection by the roundworm.



Roundworm Life Cycle Diagrams





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The introductory information describes one relationship between organisms in the illustration: parasitism. All the organisms pictured in this habitat interact in other ways as well.

a. Describe one example of competition between the organisms in the illustration. Name the organisms involved, describe their interaction, and explain why their interaction is considered competition.

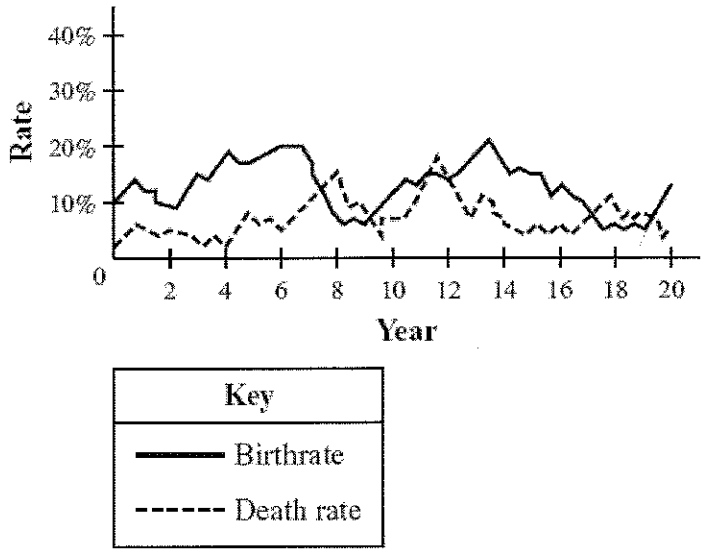
the white tailed deer and moose might Compete for space.

b. Describe one example of commensalism between the organisms in the illustration. Name the organisms involved, describe their interaction, and explain why their interaction is considered commensalism.

roundworm larvae use the snail as a host; this benefits the roundworm but the snail is not affected.

VII. The graph below shows changes in the birthrate and death rate for a large population of deer over a 20-year study period.

Changes in Deer Birthrate and Death Rate over Time



a. Describe and explain **two** factors that can affect the birthrate in the deer population.

By the # of healthy reproductive aged male & female deer and the amount of resources (food, space) available. A higher # of healthy reproducing adult could yield increased births.

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b. Describe and explain **two** factors that can affect the death rate in the deer population.

Two factors affecting the death rate of deer are the # of predators and disease. As the predator population increases ~~so could the deer~~ so could the death rate of deer. An outbreak of disease could also ↑ deaths.

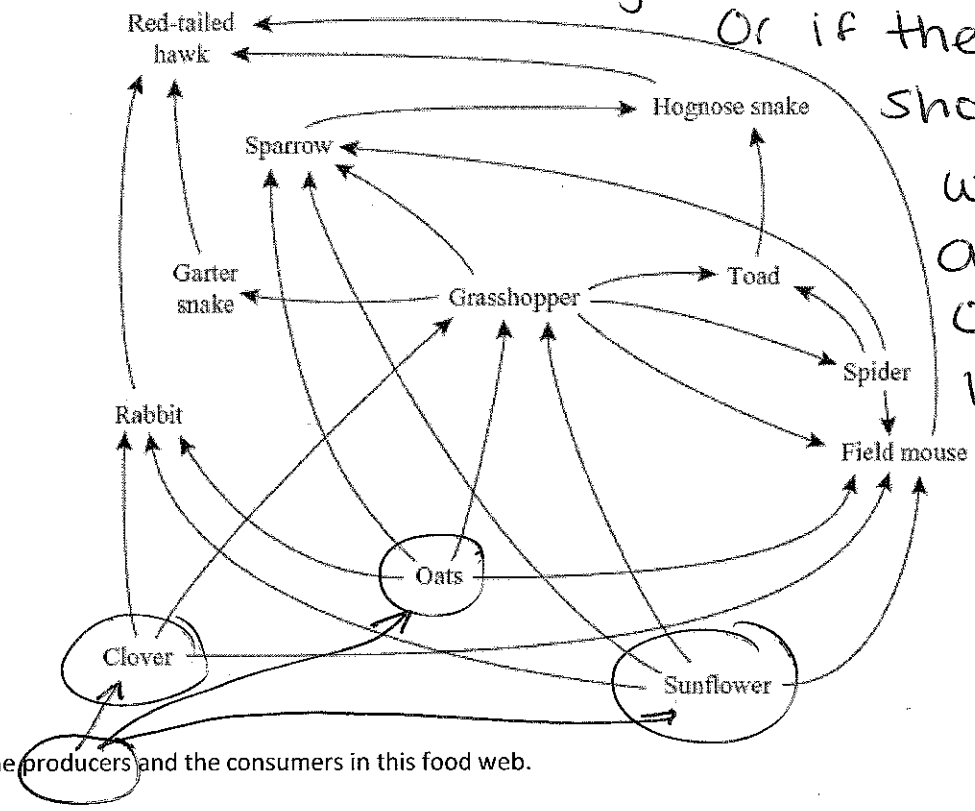
c. Identify **one** time period on the graph during which the deer population was increasing. Explain your answer.

The deer pop. was increasing between years 0 to 7 on the graph.

d. Do you think that it is a smart idea for humans to regulate animal populations like this one? Why or why not?

There are many factors that affect a pop. Size therefore it is not smart for humans to regulate these populations. Or if they do, they should proceed w/ caution as many other organisms will be affected.

VIII. The diagram below shows a food web for an ecosystem.



a. Identify the producers and the consumers in this food web.

b. In this ecosystem, is more energy available to the field mouse population from eating spiders or from eating oats? Explain your answer.

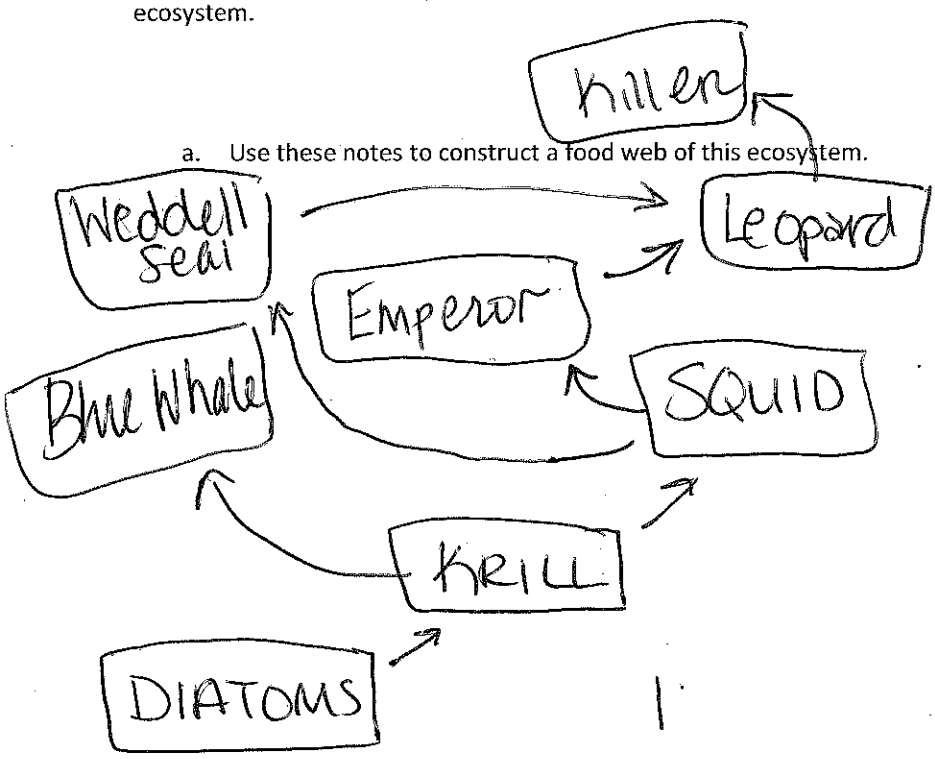
Only Ten percent of energy is transferred when an organism eats something. Each trophic level gets less and less energy. Producers offer the most available energy.

Also, the mouse competitors (rabbit) could increase.

c. What would happen if the field mouse population went extinct?

If the field mouse pop. went extinct many other organisms could be affected. All the things that the mouse ate could increase and the mouse predators could decrease.

IX. A biology student doing research collects the following information about feeding relationships in an Antarctic ecosystem.



Antarctic Ecosystem
Diatoms photosynthesize
Krill eat diatoms
Squid eat krill
Leopard seals eat emperor penguins
Emperor penguins eat squid
Killer whales eat Weddell seals
Blue whales eat krill
Weddell seals eat squid
Leopard seals eat Weddell seals
Killer whales eat leopard seals

a. Use these notes to construct a food web of this ecosystem.

b. In your food web, identify one organism at **each** of the following trophic levels: producer, primary consumer, secondary consumer, and higher-order consumer.

Producer → diatoms

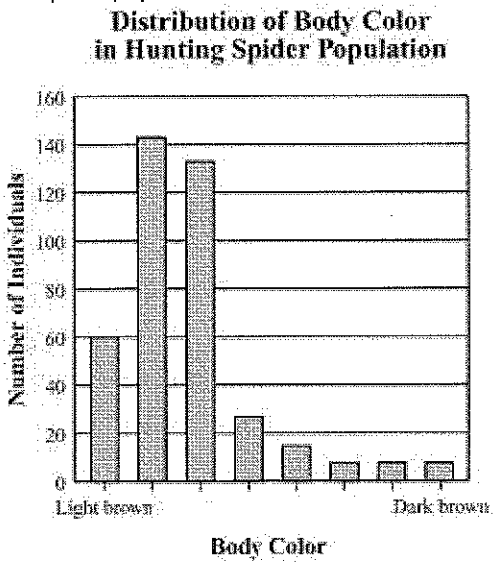
1° consumer → KRILL

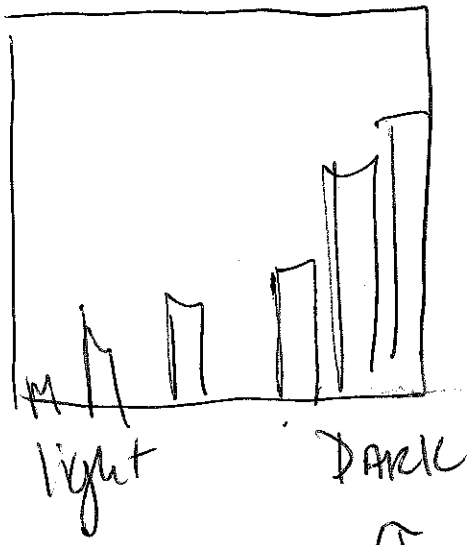
2° consumer → SQUID

higher order → Killer whale

EVOLUTION AND BIODIVERSITY

X. In contrast to web-building spiders, hunting spiders spend most of their time on the ground hunting prey. In a population of hunting spiders, a range of body colors from light brown to dark brown is observed. The graph below shows the distribution of body color in this particular spider population.





a. Describe the most likely appearance of the ground on which the spiders live and hunt. Explain your answer.

Spiders most likely live in a light brown environment, this would make the light brown trait advantageous which would explain why these spiders are more common in the graph.

Suppose the spiders' main prey begins to dwell primarily on dark vegetation rather than on the ground.

b. What will most likely happen to the distribution of body color in the spider population over the next 50 years? Make a graph to show the expected distribution, and explain your answer.

Due to the change it would be advantageous for the spiders to be dark in color bc spiders with this color would have an easier time catching prey.

Thus living to reproduce & pass on this trait.

MCAS OPEN RESPONSE PRACTICE QUESTIONS

XI. The table below shows the classifications of three different sea lions.

	California Sea Lion	Galapagos Sea Lion	New Zealand Sea Lion
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia
Order	Carnivora	Carnivora	Carnivora
Family	Otariidae	Otariidae	Otariidae
Genus	*Zalophus*	*Zalophus*	*Phocarctos*
Species	*californianus*	*wollebaeki*	*hookeri*

a. Identify which two of the sea lions are most closely related.

The california + galapagos sea lions are most closely related. This is represented as they share the same genus name.

b. Justify your answer to part (a).

c. Describe and explain **two** types of evidence scientists would have used to determine the proper classifications of these three sea lions.

- homologous structures
- DNA
- embryonic similarities
- Fossil Evidence

XII. Illustrations of a cactus and a *Euphorbia* are shown below.

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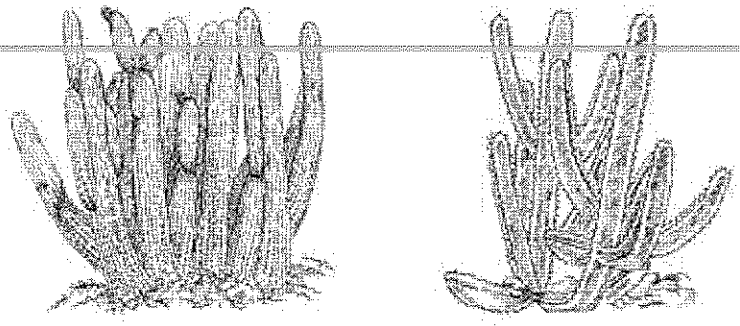


Cactus *Euphorbia*

Cacti in the Sonoran Desert in North America share many characteristics with *Euphorbia* in the Sahara Desert in Africa. Both types of plants have reduced leaves, prickly spines, and fleshy stems that contain water. Cacti and *Euphorbia*, however, are not closely related plants.

a. Describe how scientists used molecular evidence to determine that cacti and *Euphorbia* are not closely related plants.

scientists could analyze the DNA or amino acid sequences of both plants and det. how similar they are based on how many similarities they have.

b. Usually organisms that share many physical characteristics are closely related. Explain why cacti and *Euphorbia* evolved similar features.

The two cacti both live in similar environments, have spines, and long stems.

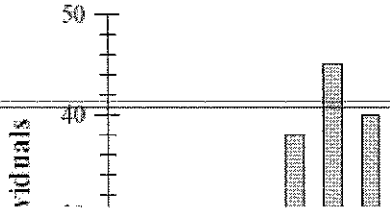
c. Choose **two** similar characteristics of cacti and *Euphorbia*. Describe how **each** characteristic benefits the plants in their environments.

Fleshy stems: stores water that is needed for photosynthesis

Spines: protection against predators

XIII. The graph below relates the number of gray squirrels in a small population to their coat colors.

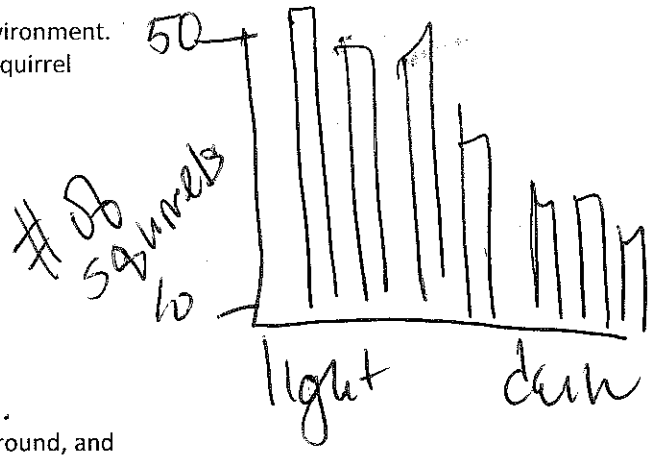
This squirrel population has been separated from other squirrel populations by a new highway



and several construction sites. The main predators of these squirrels are cats and hawks.

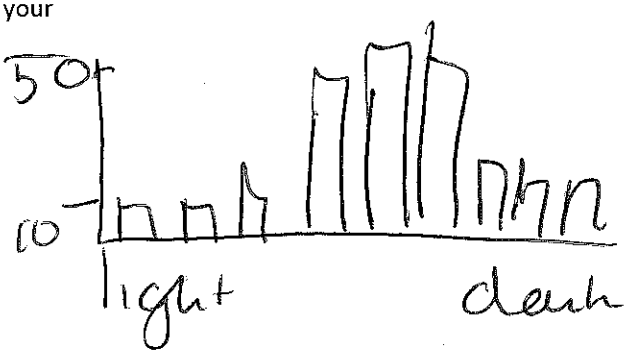
a. Assume that dark gray squirrels are very visible in this new environment. What is likely to happen to the distribution of coat color in this squirrel population over several generations?
Sketch a graph to show the predicted distribution, and explain your answer.

The # of dark sq. Could decrease due to Inc. exposure to predators.

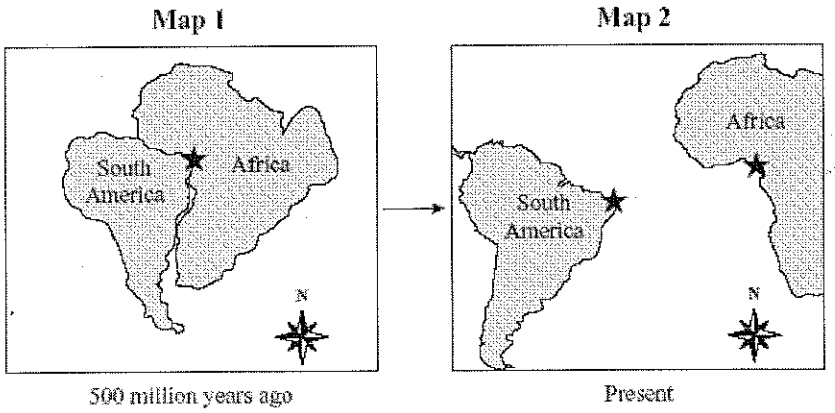


b. Assume that dark gray squirrels are very visible on the ground, and light gray squirrels are very visible in the trees. Explain what is likely to happen to the distribution of coat color in the squirrel population over several generations. You may sketch a graph as part of your explanation.

The middle colored sq. might survive more.



XIV. The maps below show South America and Africa. Areas where fossils of the same extinct plant species have been found are marked with a star.



a. Explain how the widely separated areas marked in Map 2 can have fossils of the same extinct plant species.

The two areas could have fossils of the same extinct plant species b/c at one time S. America + Africa were together. The ancestral species most likely lived here.

In both South America and Africa, there are plants descended from this extinct species. These modern plants are very different from one another.

b. Explain how the extinct species has modern descendants that came to be very different from one another.

As the continents divided the environments in each area were different. Characteristics that were advantageous in S. America may a may not have been advantageous in Africa. Having different adaptions the populations changed over time.

GENETICS

XV. In rabbits, a gene controlling fur color has four alleles. The four alleles and the phenotypes they produce are listed in the table below.

Allele	Phenotype
R	black fur
$\mathbf{r^h}$	Himalayan: white fur with colored tips of ears, nose, tail, and legs
$\mathbf{r^{ch}}$	chinchilla: light gray fur on entire body
r	white fur

The alleles are listed in order of their dominance. The **R** allele is dominant to $\mathbf{r^h}$, $\mathbf{r^{ch}}$, and **r**. The $\mathbf{r^h}$ allele is dominant to $\mathbf{r^{ch}}$ and **r**. The $\mathbf{r^{ch}}$ allele is dominant to **r**.

a. Gina has a rabbit with genotype $\mathbf{r^h r}$. Identify the phenotype of Gina's rabbit.

himalayan - white fur w/ colored tips

b. Identify **all** possible genotypes for a black rabbit.

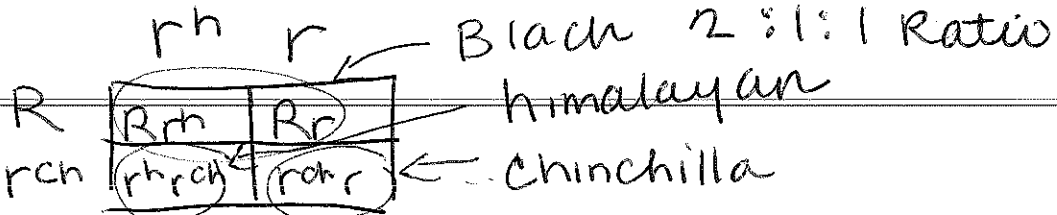
heterozygous Rr^h, Rr^{ch}, Rr, and RR homozygous

$r^h r^{ch}$ $r^h r$ or $r^h r^h$

XVI. Gina breeds her rabbit with a black rabbit. The phenotype ratio of the offspring of Gina's rabbit and the black rabbit is 2 black : 1 Himalayan : 1 chinchilla.

Rr^h, $r^{ch}r^{ch}$

c. Identify the genotype of the black rabbit in this cross. Support your answer by drawing the Punnett square for the cross.



XVII. DNA replication and transcription are important processes in cells.

a. Identify the end products of both DNA replication **and** transcription. Be specific in your answer.

DNA rep => 2 semiconservative strands of DNA

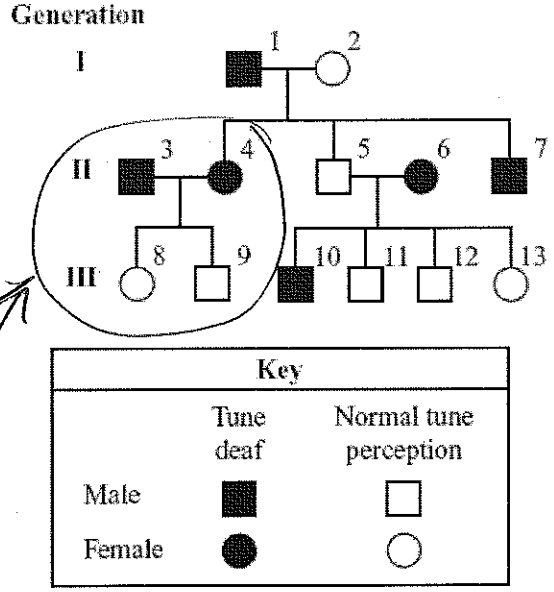
transcription => mRNA

b. Explain the importance of **each** process in eukaryotic cells.

DNA rep is needed for cell replication

Transcription is needed to carry to protein building inst. to the ribosome. (protein synthesis)

XVIII. People who are tune deaf are unable to follow a rhythm. Scientists have evidence that tune deafness can be genetic. The pedigree below traces the inheritance of tune deafness in a family. Individuals in the pedigree are numbered.



t t

t | tt

t |

Scientists have analyzed the inheritance patterns for tune deafness and have concluded that tune deafness is caused by an autosomal dominant allele, **T**.

a. Provide evidence from the pedigree that conclusively shows that the tune deafness allele is autosomal dominant, not autosomal recessive. Explain your reasoning.

if tune deafness was recessive two parents with the trait wouldn't be able to have children w/o the trait (ie. II 3+4 → III 8,9)

b. Identify the genotypes of individuals 5 and 6, and then draw the Punnett square for the cross of these two individuals.

T t

t | Tt | tt

t | Tt | tt

DNA Ind 5 = H

6 = Tt

c. Compare the expected percentage of each phenotype of the offspring from the cross in part (b) with the actual percentage of each phenotype observed in the children of individuals 5 and 6.

The expected and actual percentages are the same.

XIX. In 1950, Erwin Chargaff and colleagues examined the chemical composition of DNA and demonstrated that the amount of adenine always equals that of thymine, and the amount of guanine always equals that of cytosine. This observation became known as Chargaff's rule.

a. Based on current knowledge of the structure of DNA, explain the basis of Chargaff's rule.

Adenine equals thymine; guanine = cytosine in DNA

b. Diagram an explanation of Chargaff's rule.

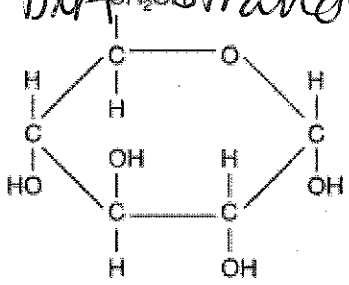
A=T
G≡C

c. Why is Chargaff's rule so important to DNA's ability to replicate itself accurately?

DNA replication produces new identical copies, the rule allows these copies to be identical to the parent DNA strand

CHEMISTRY OF LIFE

XX. The diagram below shows the molecular structure of glucose.



Glucose is a simple carbohydrate that is important to living organisms.

a. Describe the primary function of glucose in cells.

Glucose is broken down in the mitochondria to produce ATP

b. Simple sugars like glucose can be used to make larger organic molecules. Identify **two** larger molecules made from simple sugars.

Fructose & cellulose (Glycogen) are polymers w/ glucose

c. Identify a specific cellular process that would be affected by a glucose shortage, and discuss the effects of the shortage on the process you identified.

A shortage of glucose could lead to ~~A anaer~~ a decrease in cellular energy which could dec. cell function.

MCAS OPEN RESPONSE PRACTICE QUESTIONS

XXI. In a cell, the process begins at specific locations in the genome, called "origins". Unwinding of DNA at the origin, with the help of helicase, begins the synthesis of new strands. These new strands help to form a replication fork. DNA polymerase adds complimentary base pairs to each template. Additionally, a number of other proteins are associated with the fork and assist in the initiation and continuation of this integral process. Without this process individuals would not be able to create new cells.

Several types of organic molecules are mentioned in the paragraph above.

a. Select **two** different organic molecules mentioned in the paragraph above and classify each as one of the four major types of organic molecules. You may use a table like the one below in your response.

b. Briefly describe the structure and function of **each** organic molecule you identified in part (a). You may use a table like the one below in your response.

Molecule	Classification	Structure	Function
	Sample Only		

DNA	Nucleic Acid	nucleotides ↳ sugar phosphate nit. base A-T, G-C	carry the genetic code
Helicase	Protein	chains of amino acids held by peptide bonds	unwinds the DNA Enzyme: speeds up chem. rxns