Name: _____ Date:_____ HR:_____

Standard BIO.A.2.2.3

Proteins are a major part of every living cell and have many different functions within each cell. Carbohydrates also perform numerous roles in living things.

Part A: Describe the general composition of a protein molecule.

Part B: Describe how the structures of proteins differ from the structures of carbohydrates.

Part C: Describe how the functions of proteins differ from the functions of carbohydrates.

Possible responses that will receive credit:

Part A (1 point):
• Proteins are composed of amino acid molecules linked together by peptide bonds. C, H, N, S, and O are typical atoms that compose amino acids.

Part B (1 point):
• The amino acids contain amino and carboxyl groups. Primary, secondary, tertiary, and quaternary structures of a protein molecule are necessary for the protein to function correctly. Interactions occur between amino and carboxyl groups of amino acids. Carbohydrates are composed of C, H, and O. Monosaccharides are the building blocks of carbohydrates. Two monosaccharides form a disaccharide. Many monosaccharides form a polysaccharide, such as starch, cellulose, or chitin.

Part C (1 point):
• Proteins function as enzymes, antibodies, and structural components. Carbohydrates function in short-term energy storage (starch, glycogen) or structural components (chitin, cellulose, glycogen).

Part A: Describe the general composition of a protein molecule.

Proteins are made of carbon, hydrogen, oxygen, nitrogen and some have sulfur. These elements form amino acids. Amino acids form proteins.

Part B: Describe how the structures of proteins differ from the structures of

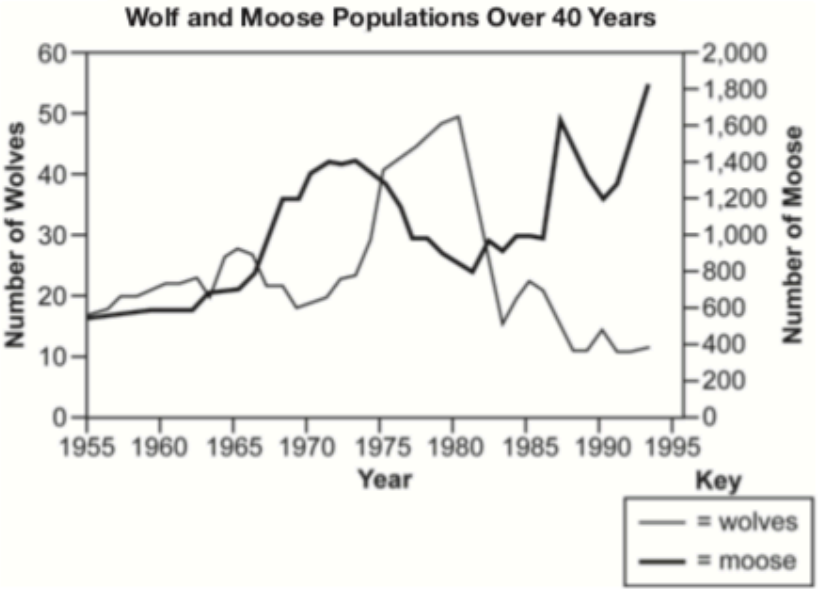
Carbohydrates are in long chains formed by sugars that are bonded together. Proteins can be in sheets or folded shapes. Carbohydrates only have carbon, hydrogen and oxygen in them.

Part C: Describe how the functions of proteins differ from the functions of carbohydrates.

Proteins make up the enzymes that speed up the reactions in living things. Proteins also make antibodies. Carbohydrates give us energy (starch) and make plant cell walls (cellulose).

Standard BIO.B.4.2.5

Use the graph below to answer the question.



Isle Royale is located in Lake Superior. Isle Royale is home to populations of wolves and moose. The interactions between the wolves and moose, as well as the individual population sizes, have been studied since 1958. The graph shows the population sizes over time for both wolves and moose.

Part A: Describe one limiting factor for the moose population.

Part B: Explain one likely reason why the wolf population rapidly increased between 1975 and 1980.

Part C: Predict what will happen to the moose population's size after 1994 by describing the shape of the curve. In your answer, be sure to explain the reasoning behind your prediction.

Score	Student Response Descriptions
3	The response demonstrates a *thorough* understanding of the effects of limiting factors on population dynamics and potential species extinction by completing all of the following: • describing one limiting factor for the moose population, **and** • explaining a likely reason the wolf population rapidly increased between 1975 and 1980, **and** • predicting and explaining the shape of the moose population curve after 1994. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of the effects of limiting factors on population dynamics and potential species extinction by completing any **two** of the following: • describing one limiting factor for the moose population, • explaining a likely reason the wolf population rapidly increased between 1975 and 1980, • predicting and explaining the shape of the moose population curve after 1994. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of the effects of limiting factors on population dynamics and potential species extinction by completing any **one** of the following: • describing one limiting factor for the moose population, • explaining a likely reason the wolf population rapidly increased between 1975 and 1980, • predicting and explaining the shape of the moose population curve after 1994. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

Part A: Describe one limiting factor for the moose population.

Food supply is a limiting factor on an island because the moose cannot move somewhere else when their food supply runs out. Moose eat plants so there needs to be enough plants for moose to survive

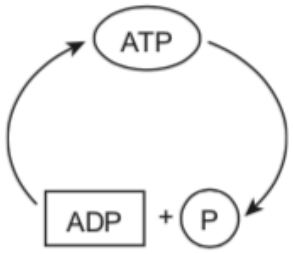
Part B: Explain one likely reason why the wolf population rapidly increased between 1975 and 1980.

The wolf population increased because they had plenty of food. Wolves can eat moose. The moose population increased between 1970-1975 so there was a lot of food for the wolves to eat on the island.

Part C: Predict what will happen to the moose population's size after 1994 by describing the shape of the curve. In your answer, be sure to explain the reasoning behind your prediction.

The moose line could level out and become almost flat. This means the moose have reached carrying capacity for the island. The wolf line would likely level out, too. The moose line cannot continue to go up because the moose will run out of food with toomany animals on the island.

Use the diagram below to answer question 14.



14.

Part A: Explain why ATP is important in biochemical reactions.

Part B: Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation

Score	Description
3	The response demonstrates a *thorough* understanding of the role of ATP in biochemical reactions by • explaining why ATP is important in biochemical reactions **and** • giving **two** examples of biochemical reactions **and** • explaining how an organism uses ATP within the reactions. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of the role of ATP in biochemical reactions by • explaining why ATP is important in biochemical reactions **and** • giving **two** examples of biochemical reactions **OR** • explaining why ATP is important in biochemical reactions **and** • giving **one** example of a biochemical reaction and explaining how an organism uses ATP within the reaction **OR** • giving **two** examples of biochemical reactions and explaining how an organism uses ATP within the reactions. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of the role of ATP in biochemical reactions by • explaining why ATP is important in biochemical reactions **OR** • giving **two** examples of biochemical reactions **OR** • giving **one** example of a biochemical reaction and explaining how an organism uses ATP within the reaction. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

Note: No deductions should be taken for misspelled words or grammatical errors.

Part A: Explain why ATP is important in biochemical reactions.

It provides energy that cells need to carry out all other biochemical reactions.

Part B: Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation
digestion	ATP provides energy for digestive enzymes to break down food.
respiration	ATP provides energy for oxygen and glucose to be converted to energy which forms ATP and continues the cycle

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: _____

Change 2: _____

Change 3: _____

Score	Description
3	The response demonstrates a *thorough* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how **three** changes experienced by the students represent homeostatic mechanisms. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how **two** changes experienced by the students represent homeostatic mechanisms. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how **one** change experienced by the students represents a homeostatic mechanism. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

Note: No deductions should be taken for misspelled words or grammatical errors.

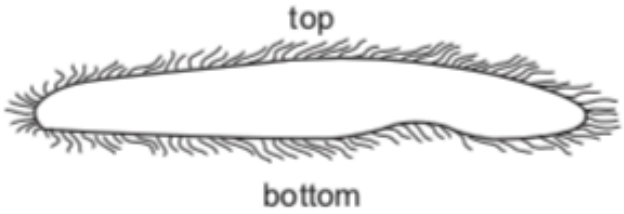
Change 1: Sweating can represent a homeostatic mechanism because when your body is hot it cools itself by activating the sweat glands which cool you by evaporation.

Change 2: Increased heart rate can represent a homeostatic mechanism because when you run your muscles need more oxygen and blood so your heart pumps faster to abide to those needs.

Change 3: Increased thirst represents a homeostatic mechanism because it is caused by sweating out moisture which your body then wants to replenish causing your body to tell you to get a drink.

Use the illustration below to complete question 14.

Side View of *Trichoplax*



14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

Part A: Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

Part B: Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

Score	Description
3	The response demonstrates a *thorough* understanding of cellular division by • describing the cellular process used by the *Trichoplax* when it reproduces asexually **and** • describing **one** benefit of how the *Trichoplax* reproduces **and** • describing **one** limitation of how the *Trichoplax* reproduces. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of cellular division by fulfilling **two** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of cellular division by fulfilling **one** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

Part A: Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

The cellular division process called binary fission, starts with one organism. It then completely replicates itself, and then divides into 2 organisms, both of which are completely alike.

Part B: Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

One benefit is that it can reproduce by itself, increasing its population rapidly. A limitation is that there will be no genetic variation if each offspring is an exact copy of itself.

Use the table below to complete question 15.

Organism Relationships in an Ecosystem

Animal	Food Sources	Predators
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

15. An ecosystem includes the organisms listed in the table.

Part A: Identify the initial source of energy for the ecosystem.

_____

Part B: Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

_____ → _____ → _____

Part C: The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

_____

_____

_____

_____

_____

_____

Score	Description
3	The response demonstrates a *thorough* understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by: • identifying the initial energy source as the Sun **and** • completing a food chain that includes a producer, a primary consumer, and a secondary consumer from one row of the table **and** • describing the effect on one other organism if the number of beavers in this ecosystem suddenly decreases. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by fulfilling **two** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by fulfilling **one** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

Part A: Identify the initial source of energy for the ecosystem.

sunlight

Part B: Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

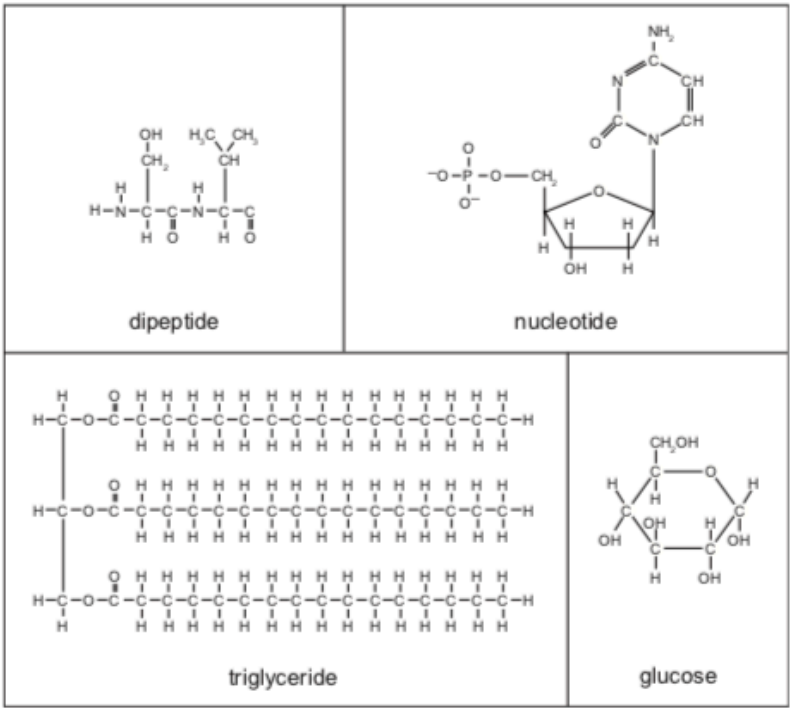
pond lilies → beaver → black bear

Part C: The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

This may cause the population of water lilies to increase since there are less beavers around to eat them.

Use the illustration below to answer question 14.

Four Organic Molecules



Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1: _____

_____

_____

_____

Similarity 2: _____

_____

_____

_____

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

_____

_____

_____

_____

Part A (2 points; 1 point for each correct similarity):

- They all have C, H, and O (carbon, hydrogen, and oxygen).
- They all have covalent bonds.
- They are all branched to some degree.
- They are all carbon-based molecules.
- They all have single or double bonds.

Part B (1 point):

- Glucose—small size allows it to pass (through the intestines and into the bloodstream and then) into cells that need glucose for energy.
- Glucose is soluble in water.
- Glucose is an energy source because of its large proportion of hydrogen atoms.

  OR
- Triglyceride—has long carbon chains that are a good source of energy.
- The long alkyl group ("alkane end") is hydrophobic, which is good for forming the bilayer plasma membrane (when combined with a phosphate group and glycerol).

  OR
- Dipeptide—has a peptide bond, which is how amino acids are combined to form proteins.
- It also contains nitrogen, which is necessary for new tissue formation.

  OR
- Nucleotide (deoxycytidine monophosphate is pictured)—the phosphate group of the nucleotide can bind (through a dehydration reaction) to the (deoxy)ribose of another nucleotide, forming a phosphodiester bond. Long chains of nucleotides form RNA and DNA. The double-stranded structure of DNA is formed by hydrogen bonding between bases on two strands.

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1:

One similarity that the four organic molecules have is that they all have carbon and hydrogen.

94 / 1000

Similarity 2:

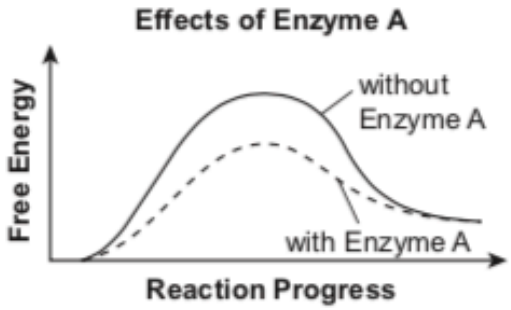
Another similarity is that they all have oxygen.

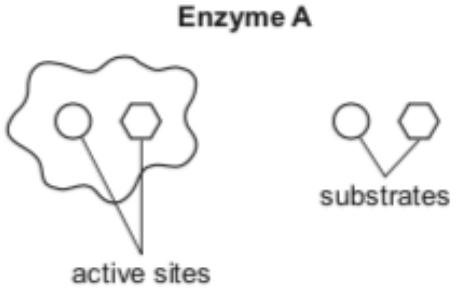
49 / 1000

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

In the triglyceride its structure relates to its function because the three long strands of carbon and hydrogen allow it to store lots of energy that can be used at a later time. The triglycerides also have hydrophobic ends that when the triglycerides bond to make a chain they are great for cell membranes.

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

Responses that will receive credit:

Part A (2 points):

- Enzyme A acts as a catalyst by reducing the activation energy, or the energy that is needed to get the reaction started. (When the substrates attach to the enzyme's active sites, they are brought close together, facilitating the reaction.) The reaction takes less time to occur ("the reaction is faster" is also acceptable).

Part B (1 point):

- When the shape of an enzyme's active site is changed, the substrate cannot attach to the active site; it will not "fit." The enzyme would not be able to catalyze the reaction.
- When the shape of the enzyme's active site is slightly changed (caused by a change in pH, for example), the enzyme activity can become greatly reduced.

(Note: Information in parentheses is not necessary to receive full credit for Part A or Part B.)

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Enzyme A acts a catalyst because with enzyme A their is less free energy being used. With enzyme A, it speeds up the reaction time. That is how it acts as a catalyst.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

It would affect the enzyme's ability to catalyze the reaction because they might not react right. The active sites could change, and then they wouldn't fit like a lock and key anymore, so therefore, the enzyme would no longer act as a catalyst.

14. White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

Responses that will receive credit:

Part A (1 point):

- The white-tailed deer is native to North America and was brought to New Zealand.
- The white-tailed deer did not evolve from ancestors in New Zealand.
- The white-tailed deer did not live in New Zealand before humans brought them to the islands.

Part B (2 points):

Possible effects:

- A decrease in the number of native plants in the areas where the nonnative species is present
  - Explanation: The nonnative species becomes a consumer of some of the native species of plants.
  - Explanation: The nonnative species has no natural predators and is able to outcompete native organisms for resources.

- Limited food available for native species
  - Explanation: The nonnative species becomes a consumer of some of the native species of plants and may outcompete some native herbivores.

- The nonnative species migrating to another area in search of food after it depletes existing food sources in the area in which it was introduced
  - Explanation: The nonnative species consumes native plant species in an area until there is not enough food to sustain its population and it must migrate, if possible.

- Increase in the population of the nonnative species if the conditions for survival remain favorable
  - Explanation: If the nonnative species moves into the area and has enough food and water to sustain its population and reproduce, its population will increase.

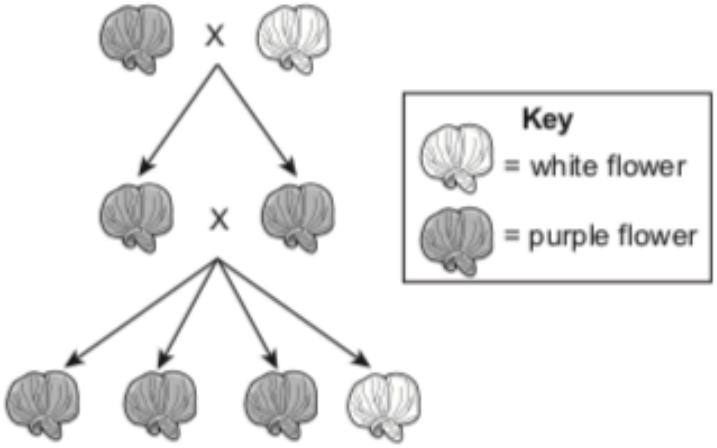
- Native species moving into a different area or dying
  - Explanation: Nonnative species may move into the habitat of native species and/or consume their food resources, causing the native populations in the area to either move or risk dying if the nonnative species is a better competitor for resources.

Other effects students may describe and explain:

- Nonnative species can increase the exotic diseases brought into the ecosystem.
- Nonnative species could become pests in the ecosystem.
- Nonnative species may grow faster and withstand diseases better than native species do.
- Nonnative species can cause predatory animal populations to increase due to greater numbers of available prey.

Use the diagram below to answer question 15.

Pea Flower Color Cross



15. In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

Part B: Explain how farmers could ensure that they only grow white flowers.

Responses that will receive credit:

Part A (2 points):

- Purple color is dominant; white color is recessive.
- Dominant/recessive inherited pattern

AND

- When a purple-flowered plant was crossed with the white-flowered plant, the offspring (F1 generation) all have purple flowers, because purple flower color is a dominant trait. However, each offspring also received the allele for white flower color; so, when the F1 generation pea plants were crossed, the F2 generation had three offspring with purple flowers and one with white flowers (see Punnett square).

	P	w
P	PP	Pw
w	Pw	ww

Part B (1 point):

- If farmers want only white flowers, they should only cross white-flowered plants, because white-flowered plants are homozygous for white flowers (they only have alleles for white flowers).

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this patt

In this pea flower cross, the purple flower is dominant and the white flower is recessive. The first cross we can assume that the purple flower is homozygous dominant (PP) and the white flower is homozygous recessive (ww). This would produce two heterozygous dominant offspring (Pw). When the two heterozygous dominant (Pw) flowers are crossed the result is one homozygous dominant offspring (PP), two heterozygous dominant offspring (Pw), and one homosygous recessive offspring (ww).

494 / 1000

Part B: Explain how farmers could ensure that they only grow white flowers.

If a farmer wished to only grow white flowered pea plants, then he should only cross white flowered plants. This is because the white flower allele is recessive to the purple flower allele, so when a dominant purple flower is present in any case, the resulting flower will be purple.

283 / 1000