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Level 1 Biology, 2016

90929 Demonstrate understanding of biological ideas relating to a mammal(s) as a consumer(s)

9.30 a.m. Wednesday 23 November 2016
Credits: Three

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of biological ideas relating to a mammal(s) as a consumer(s).	Demonstrate in-depth understanding of biological ideas relating to a mammal(s) as a consumer(s).	Demonstrate comprehensive understanding of biological ideas relating to a mammal(s) as a consumer(s).

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL 22

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QUESTION ONE: PHYSICAL AND CHEMICAL DIGESTION IN A CARNIVORE

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www.biolib.cz/IMG/GAL/40325.jpg

http://images.otagomuseum.govt.nz:8080/img/collectionitem/nc/2013/nc2011-74_1!pub.jpg?width=590

The kekeno, or the New Zealand fur seal (*Arctocephalus forsteri*), is a marine carnivore that eats mainly squid and fish. Seals, like other mammals, depend on both physical (mechanical) and chemical digestion to process the food that they eat.

Compare and contrast physical and chemical digestion, discussing these processes with respect to the structures and functions of the digestive system of a typical carnivore such as the kekeno / seal.

Your answer should:

- describe the processes of physical and chemical digestion, and explain how they are different
- explain why both processes are necessary to gain maximum nutrient value from the food eaten
- use specific examples of physical and chemical digestion in a carnivore like the kekeno / seal.

The process of physical (mechanical) digestion is to make the chunks of food smaller which increases the surface area of food particles in preparation for enzymes to work more and as efficiently as possible. The process of chemical digestion is when enzymes / gastric juices convert / catalyse the reaction of turning large insoluble material into small, soluble molecules that can be absorbed into the bloodstream by villi in the intestinal walls of the Small Intestine. Mechanical and chemical digestion are different as mechanical just increases surface area of the substrate but chemical actually breaks the food down into small enough molecules which can be absorbed into the bloodstream and then taken around the body //

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to be used for energy/respiration in cells. Both of these processes are vital and necessary in a carnivorous digestive system as they ensure the efficiency so the carnivore: seal, can gain maximum nutritional value as quickly as possible. Mechanical is necessary as for example: when a seal eats fish, its sharp canines and carnassials can rip/pierce/tear flesh off bone and cut meat/flesh up into smaller chunks (increasing surface area) by carnassials slicing together like a blade of scissors. Mastication is necessary because it speeds up the process of digestion otherwise mammals/carnivores would not get energy they need to carry out life processes such as: (Movement, respiration, sensitivity, growth, reproduction, excretion, nutrition) quick enough in order to stay alive. Chemical digestion is extremely necessary in a carnivore/seal as it means that food molecules are broken down small enough to be able to fit in the bloodstream and made use of around the body and also so that chemical digestion speeds up the overall digestion process. For example, in a seal: if enzymes such as protease pepsin were not present in the stomach, it would mean the seal would have to masticate/chew its food alot longer which does not suit its role in the world of hunting and slows down the time it takes for them to absorb nutritional value and gain energy. But thanks to HCl and protease pepsin in the stomach, the process is sped up as protein from the fish is denatured by HCl, unravelling it and exposing the ~~fcing~~ chemical bonds/peptide bonds holding the ing chains of amino acids together therefore protease pepsin can work even more efficiently by dividing it up into single molecules by catalysing the reaction.//

M6

QUESTION TWO: RESPIRATION

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When running a marathon, the muscles of a runner must contract and relax to generate movement for a distance of 42 kilometres. This can take from two to five hours, requiring a large amount of energy to be produced by the muscle cells through the process of respiration, and a large supply of the raw materials needed for respiration. Some of these raw materials are provided by eating selected food leading up to the race, and absorbing the digested nutrients.

Students were provided with four food samples, and carried out a range of tests on all samples.

Test results for food samples

Test	Test for starch	Test for glucose	Test for proteins	Test for lipids
Positive result	blue-black colour	orange-red colour	violet-purple colour	see-through
Food sample A	orange	orange-red	pale blue	not see-through
Food sample B	blue-black	blue	pale blue	not see-through
Food sample C	orange	blue	pale blue	see-through
Food sample D	orange	blue	violet-purple	not see-through

Discuss which food sample the students should recommend for a marathon runner to eat leading up to the race, considering the energy requirements of the runner's muscles as they carry out the process of respiration.

Your answer should:

- describe the two types of cellular respiration, including the raw materials used for each process
- explain which type of cellular respiration would be more beneficial for the runner during the marathon race
- explain how some of the raw materials needed for respiration are absorbed in the small intestine and transported to the runner's muscles
- justify your choice of food sample.

The two different types of cellular respiration are aerobic and anaerobic. Aerobic produces alot more ATP (energy) than anaerobic does. Aerobic occurs when there is a good supply of oxygen within the mammals body. Anaerobic produces very little ATP but does not require any oxygen. Aerobic is: glucose + oxygen → carbon dioxide + water + 38ATP. Anaerobic cellular respiration is: glucose → lactic acid + 2ATP. Aerobic is commonly used among mammals as it is the most efficient process for gaining energy needed

after oxygen has been inhaled / through the trachea → bronchi →

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to carry out life processes (MRS.C.GREN) because it produces the most ATP. It would be more beneficial for the marathon runner to use aerobic respiration rather than anaerobic as it provides lots of energy so the runner can run for a longer period of time (2-5 hours.) If the runner used anaerobic respiration the whole time, their muscles would get very sore because the lactic acid is incredibly toxic for cells and will begin to stop the muscles from working and it also does not provide enough ATP required for a marathon runner to run for so long without any breaks. A vital raw material needed for respiration is glucose. After the carbohydrate has been partially digested by salivary amylase in the mouth then fully broken down into small, soluble ~~par~~ molecules by pancreatic amylase in the duodenum, it enters the ileum which is the second section of the small intestine which has an incredible surface area which is increased by villi and microvilli (small-finger like projections). The individual, small, soluble glucose molecules (monosaccharides) are quickly absorbed into the capillary network inside the villus. A villus is one cell thick which means its an incredibly short distance for the food molecule to travel / diffuse into so it makes the process of digestion efficient by increasing the rate. After the glucose molecule is absorbed into the capillary network it is then sent to the liver via the hepatic portal vein. In the liver, the glucose is sent into the blood where it is transported to cells around the body ~~that require glucose~~ for cellular respiration to produce energy [redacted] for example; the runner needs energy in their muscles to continue running for a long period of time. I would recommend the marathon runner to consume / ingest //→

E8

QUESTION THREE: ENZYMES AND pH IN A HERBIVORE AND AN OMNIVORE

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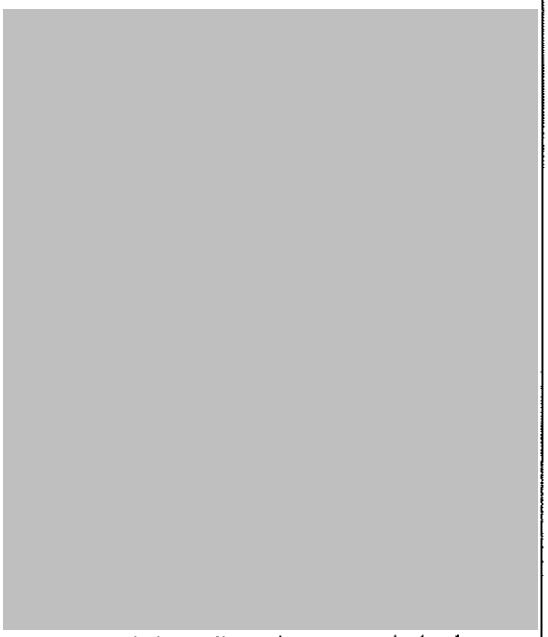
Horse digestive system

www.hygain.com.au/horses-digestive-system/

Human digestive system



www.2beingwell.com/wp-content/uploads/2013/11/digestive-system.jpg

The horse is a herbivore, consuming only plant material, whereas the human is an omnivore, consuming a wide range of foods. Both horses and humans have a range of enzymes in their digestive systems.

Discuss the role of specific enzymes within the digestive systems of a herbivore such as a horse and an omnivore such as a human, including the way that optimum pH levels are maintained.

Your answer should:

- describe the specific function of digestive enzymes within a herbivore such as a horse and an omnivore such as a human
- explain how pH can affect enzyme activity
- discuss similarities between how enzymes function in the digestive systems of a herbivore such as a horse and an omnivore such as a human, AND how optimum pH is maintained in different parts of these digestive systems.

Both omnivores (humans) and herbivores (horses) have digestive enzymes in their digestive system which speeds up the overall process of digestion by catalysing the reaction of breaking large, insoluble material → small, soluble food molecules. The role of digestive enzymes in horses and humans is the same but the digestive enzymes required are different to suit their diet. Enzymes are proteins shaped into complex shapes and have a very narrow range of what

that are small enough to be absorbed into the blood stream then transported around the body

pH they work best in. For most enzymes this is pH (7-8) to the exception of protease pepsin in the stomach with a pH of (1-2). Change of pH can affect enzyme activity as it denatures the protein and changes shape of the active site so the substrate can no longer fit and the large insoluble material cannot be transformed into small, soluble food molecules. The process of denaturing is irreversible and damages the enzyme, this slows down the process of digestion and eventually will kill the mammal as it is not getting the energy it needs quick enough to carry out it's life processes. For example a salivary amylase's optimum pH level is 7-8, neutral. At this pH it can work efficiently to help ~~the~~ catalyse the reaction of carbohydrates → maltose → glucose. It is denatured when it enters the stomach as it is very acidic with a low pH of (1-2) therefore cannot catalyse the reaction no longer. Vital digestive enzymes required in a herbivore (horse →) are: amylase and cellulase, these help with breakdown of the tough cell wall covered in cellulose of tough ~~plan~~ fibrous plant material in their diet. Both of these enzymes work at an optimum pH of (7-8) which is the same in a human (omnivore) for their digestive enzymes: salivary amylase, pancreatic amylase, pancreatic lipase. The optimum pH for these digestive enzymes is maintained by bile being secreted via the bile duct in the ~~pancre~~ duodenum which contains sodium bicarbonate which neutralise the acidic chyme from contents in the stomach. Sodium bicarbonate is able to do this because it is an alkaline fluid which balances with the acidic chyme in order to neutralize contents so digestive enzymes can work efficiently. Similarities between digestive enzymes in a herbivore (horse) and omnivore (human) //

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E8

Extra paper if required.
Write the question number(s) if applicable.

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QUESTION NUMBER

2 Food sample B. Food sample B is proven to have Starch present, which is a polysacharide / complex sugar made up of long chains of glucose molecules held together by a chemical bond. Because the runner is running long distance it requires a slow release of energy that will last for 2-5 hours. Starch is the most suited food to do this job as it takes a while to breakdown the chemical bonds between glucose molecules but then it is quickely absorbed and able to produce energy (1A9) cellular respiration in cells. Food sample A is not as efficient as food source B because it contains glucose which is already in small, soluble molecule form meaning it will rapidly be absorbed into bloodstream and used for energy well before the runner is due to finish their race. //

3 Is how the amylase is present in both mammals to help catalyse the reaction of carbonyorates → glucose. And also, cellulase is present in a horse which is produced by micro-organisms in the caecum to catalyse the reaction of tough plant material into smaler, soluble, particles the pH is also maintained by the bile. In a human protease pepsin in the stomach breaks down protens → amino acids, the optimum pH is maintained by the other acids in stomach such as hydrochloric acid which also has a pH of (1-2). //

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Annotated Exemplar

Excellence exemplar 2016

Subject:	Biology Level 1	Standard:	90929	Total score:	22

Q	Grade score	Annotation
1	M6	Identified that physical digestion breaks up the pieces of food (chunks) to increase the surface area in preparation for the enzymes and that chemical digestion uses enzymes to take the large insoluble material and make it small enough to become soluble so that it can be absorbed into the blood. (TWO M points) Has given an example of a types of teeth and what they are used for e.g. carnassial (But needed at least TWO teeth types for this to could as another M point.) Has given pepsin correctly as an example of chemical digestion in the stomach (M point) Has not gone on to compare and contrast the two process or really explained why each process is necessary for the seals survival therefore is not at the E level
2	E8	Has clearly told us what aerobic and anaerobic respiration is and why aerobic respiration is important for the long distance runner, explaining both amount of energy produced and that it does not produce toxic lactic acid. Has a very good understanding of how glucose gets form the digestive system to the muscle cells so that respiration can occur. Has correctly identified food sample B (starch) as it is a complex sugar made up of long chains of glucose molecules held together so it takes a long time for the starch to be broken down into sugar and absorbed into the blood stream them transported to the muscles cells where it will be used during respiration to produce the energy needed by the runner throughout the long race. Then goes on and discusses another type of food and why it isn't so good for the long distance runner. Food A is glucose which is a soluble molecule so it is rapidly absorbed into the bloodstream and used for energy. This part of the answer isn't as good as they could have discussed the other food samples but they clearly know why starch was best so where given E8. Could have also said that Sample D (protein) or Sample C (lipid) were no good as neither of these compounds are made up of glucose which is needed as a reactant for respiration.
3	E8	Clearly knows what enzymes are and that they are affected by pH. (pH specific and if the pH is outside the optimum the enzymes will denature and change shape) Gave examples of different enzymes found in the digestive systems of humans and horses and linked these to their optimum pH. Was able to discuss how the optimum pH was maintained throughout the body by the production of different digestive fluids e.g. bile secreted via the bile duct into the duodenum where it neutralises the acidic chyme from the stomach.

		Then goes on to discuss the similarities between the horses and humans digestive system