Essay Questions: Chapter 6 – Nutrition in Humans

Adaptations of villus

1. Describe the structure and adaptations of a villus in the small intestine. [5]

- Numerous microvilli are present on epithelial cells to increase surface area of small intestine for faster rate of absorption digested nutrients from lumen of small intestine into the villus.
- The epithelium is one cell thick to reduce diffusion distance between lumen of small intestine and villus for faster rate of absorption digested nutrients from lumen of small intestine into the villus.
- The villus has a dense blood capillary network to maintain a steep concentration gradient of digested nutrients between lumen of small intestine and villus in order to transport digested nutrients away quickly and continuously for faster rate of absorption of digested nutrients from lumen of small intestine into the villus.
- Epithelial cells on the epithelium have numerous mitochondria to increase rate of respiration for increased release of energy for active transport of digested nutrients from lumen of small intestine into the villus.
- Villus is a finger-like projection to increase surface area to volume ratio of small intestine for faster rate of absorption of digested nutrients from lumen of small intestine into the villus

Regulation of blood glucose concentration

2. Explain how the liver regulates the blood glucose concentration /
   Describe the role of the liver in the metabolism of carbohydrate. [6]

- When blood glucose concentration is higher than normal, islets of Langerhans in the pancreas secrete the hormone insulin to simulate liver cells to convert excess glucose into glycogen, stored in liver and muscles. The blood glucose concentration decreases back to normal.
- When blood glucose concentration is lower than normal, islets of Langerhans in the pancreas secrete the hormone glucagon to simulate liver cells to convert stored glycogen into glucose, which diffuses into blood and is transported to tissue cells for respiration to release energy. The blood glucose concentration increases back to normal.

Digestion of nutrients

source of enzyme + name of enzyme + action of enzyme + location + reaction

3. Describe the digestion of protein in the body. [3]

- Pepsin produced by the gastric glands in walls of stomach **hydrolyses** protein into polypeptides.
- Pancreatic protease produced and secreted by pancreas **hydrolyses** remaining proteins into polypeptides in the small intestine.
- Proteases produced and secreted by intestinal glands **hydrolyses** polypeptides into amino acids.

Parts of digestive system blocked

4. Gallstones are made of cholesterol, bile salts and other substances. These stones may become large enough to block the bile duct. Suggest how gallstones may affect the digestion of fat. [3]

- Bile is made in the liver and stored in the gall bladder. Bile is released through the bile duct into the duodenum to aid in fat digestion. If the gallstones become too large and block the bile duct, the gall bladder will not be able to release the bile.
- Bile emulsifies fats. It physically breaks down large fat droplets into many tiny fat droplets. The tiny fat droplets have a larger surface area to volume ratio, thus enabling lipase to hydrolyse them into fatty acids and glycerol faster. Without bile, fat digestion will become slower and inefficient.

5. Explain effects of hepatic portal vein blocked.
6. Explain effects of liver failure.
7. Explain effects of pancreas failure.

Roles of substances

8. Explain the functions of hydrochloric acid in the stomach. [4]

- In the stomach, hydrochloric acid kills harmful microorganisms in the food substances.
- It provides an optimum pH environment for the activity of enzymes, such as pepsin.
- It denatures salivary amylase on the boli from the mouth and buccal cavity.
- It converts enzymes from their inactive form into active form. For example, hydrochloric acid converts inactive pepsinogen into active pepsin, which hydrolyses proteins into polypeptides.

9. Explain the functions of bile. [3]

- Bile reduces acidity of chyme from stomach as it is alkaline in nature.
- It creates an optimal alkaline environment for the action of other digestive enzymes in the small intestine.
- It emulsifies fats by physically breaking down large fat droplets into tiny fat droplets, increasing the surface area to volume ratio of fats for faster rate of hydrolysis of fats into fatty acids and glycerol by lipase.