UNIVERSITY OF SWAZILAND
FACULTY OF EDUCATION
DEPARTMENT OF CURRICULUM AND TEACHING
MAIN EXAMINATION QUESTION PAPER, MAY 2015

TITLE OF PAPER	:	CURRICULUM STUDIES IN BIOLOGY II
COURSE CODE	:	EDC 378
STUDENTS	:	BEd. III, PGCE
TIME ALLOWED	:	THREE (3) HOURS

INSTRUCTIONS: 1.This examination paper has five (5) questions. Answer four (4) questions only.

2. There are 3 attachments

3. Each question has a total of 25 points.

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

1a) Compare and contrast how Botswana and Swaziland have developed relevant science curricula at the junior secondary level. [10]

b) The Swaziland Integrated Science Programme (SWISP) curriculum, a post-reform project, could not be implemented by science teachers in its original form. Discuss the following:

i) Teacher orientation or preparedness to utilise the curriculum materials. [5]
ii) Challenges faced by teachers in implementing the curriculum. [10]

2a) Science education has gone through various changes in the past hundred years which can be grouped into 3 periods or eras, namely, pre-sputnik curriculum, reform curriculum, and post reform or Science Technology and Society (STS) curriculum. Describe the characteristics of the curriculum during the 3 periods. [15]

b) i) The instructional sequence for teaching an STS curriculum depends on the goals the curriculum should meet in a given society. It may begin or end with any of the components of STS, that is, science, society or technology. Suggest a sequence for STS teaching and justify your choice. [6]
ii) The attached article 'Ezulwini E.Coli' highlights a social issue related to science. Suggest how you would use it in reference to outcome 13h in the attached Junior Certificate Syllabus. [4]

3a) The exclusion of women in Science, Mathematics and Technology (SMT) professions continues unabated in developing and developed countries. Discuss the efforts made by Women in Global Science and Technology (WIGSAT), Women in Science and Engineering (WISE) and Female Education in Mathematics and Science in Africa (FEMSA) to include women in SMT. [15]

b) Discuss the impact of Forum for African Women Educationalists' (FAWE's) SMT Model on girls' access to, participation and performance in SMT subjects. [5]

c) Gucuka High School, situated in an impoverished area in Swaziland, was launched as a Gender Responsive School/Centre of Excellence in 2010. Discuss the changes that have taken place over the past 5 years, that is, 2010 -2014. [5]

4a) A Form 2 science teacher is planning to teach a lesson on pollination. Select 4 teaching aids/resources and show how the teacher can use them to teach this lesson effectively. [16]

b) i) Discuss the role of practical work in language development and understanding of conceptual knowledge. [5]

ii) Explain how information processing in short term memory affects learner understanding of scientific knowledge. [4]

5a) According to Jerome Bruner, children can learn a subject even faster than adults if they are taught the fundamental structure of a subject and in terms they understand. Explain what this means. [10]

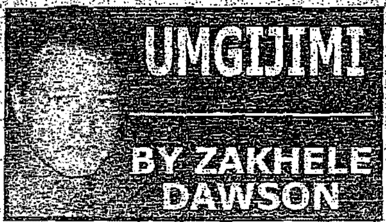
b) Using the attachment and/or your own knowledge of the topic, construct a concept map for the topic 'Digestion in the Stomach' reflecting the knowledge you would expect a Form IV Biology class to have. The concepts for this domain of knowledge are provided below.

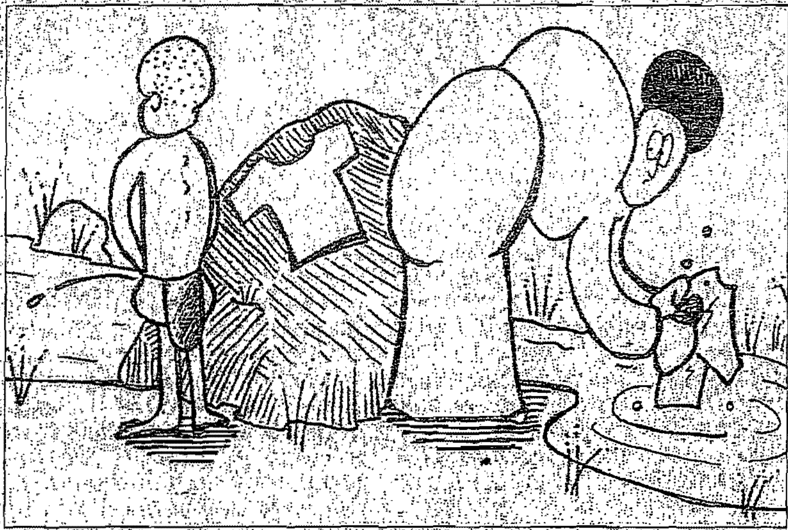
Digestion in the stomach, gastric juice, pepsin, pyloric sphincter, peristaltic movement, proteins, hydrochloric acid, protease, duodenum, gastric glands, peptides, enzyme, muscle, bacteria, stomach wall, acidic medium, chime, substrate.

The construction process should show the following steps:

Ranking of concepts that function at the same level	[2]
Clustering of concepts that function at the same level	[3]
Hierarchical arrangement of concepts	[3]
Labelled valid linkages that explain the nature of the relationships	[7]

Ezulwini, E.coli





I have been writing a bit about water and sanitation recently and while conducting a little research, I found some interesting figures.

Regular readers of my column (thanks, mum!) will know that I hail from the Valley of Heaven, Ezulwini. It really is the most beautiful little valley I have ever seen but it hides a dirty little secret. Well, not so little really – the Lusushwana River runs the length of Ezulwini, watering the most beautiful real estate in the country (not to be too biased) and the people lucky enough to live there.

The Lusushwana is a home, too, to all sorts of microbes. The one I'm concerned with at the moment, or concerned about, is a little bug called Escherichia coli.

This is the bacterium that gives us what we colloquially call 'food poisoning'. It can be fatal. More than half of the human body is made up of water. Diarrhoea, which is the most obvious symptom of food poisoning, can dehydrate a human being to the point where the very cells of our bodies collapse in upon themselves for a lack of fluids. An insidious little creature, E. coli, as it's normally written, will even get sucked into plants that are watered with contaminated water. It gets into our food and attacks us. That's how it got its common name, of course.

E. coli has been mankind's enemy for so long that our immune systems can deal with some of it, if we are healthy. However, too many microbes can overwhelm us.

The recommended 'safe' level of E. coli bacteria in 100 millilitres of water is 1-10. A litre is 1 000 ml. That's one to 10 actual 'faecal coliforms' as they are known in the sanitation trade. Remember this number.

The following water test readings were taken from the Lusushwana River at various points on the same day, at some time in the last three months:

From upstream to downstream:

The Ezulwini: 60 E. coli bacteria per 100 ml.

The Lobamba: 1 450 E. coli bacteria per 100 ml.

The Matsapha: 1 100 E. coli bacteria per 100ml.

On another day, this station recorded 1 700 E. coli bacteria in 100 ml of water.

That's 170 times the maximum recommended level of just these germs.

Choosing

What this means is that if you have any plans to drink the water from the river or go swimming, or wash your clothes in it or anything really – don't.

The problem is, so many people living in the valley of heaven have no other option and, since it's the valley of heaven, more and more people are choosing to live there. It's getting a little crowded. Every day people can be seen fetching water, washing clothes, swimming, and generally using the river as what the NGOs call a 'primary water source'. Also, of course, they use it for a toilet. This is how the E. coli got into the water in the first place.

Everytime someone goes to the toilet anywhere near an open body of water, or even worse, in it, the waste that is expelled from their bodies becomes one with the water. Which really sucks for the guy downstream. When the rains come, and they always do, all that rich living waste material by the side of the river gets washed into it. When the river swells and bursts its banks, or the flood-gates are opened, it scours the land of all those germs. A river can't be both a toilet and a water source. It has to be one or the other.

So the first thing we can do to make our beautiful, deadly, river safe again is to provide proper toilets for ourselves and others. We also need better access to tap-water, which is clean. In the meantime, if we have to use the river water for washing, we need to remember to wash our hands before and after every meal. The catch here is that it only does any good if you wash with soap and running water. We could do with more of these, too. Washing hands before and after eating also helps to minimise the transfer of germs.

Oh, and if you live or use any other rivers, the same warnings apply. You should check the stats on the Umbuluzi, that sucker hit 2 000 E. coli/100ml one day.

'DO NOT GIVE UP, BE COURAGEOUS' (I Kings 17)

HEALING

Unless you take heed or pay at-

EXAMINATIONS COUNCIL OF SWAZILAND

EXAMS COUNCIL OF SWAZILAND

E C O S

For Examination in October / November 2015 - 2017

INTEGRATED SCIENCE
CODE - 414

JUNIOR CERTIFICATE SYLLABUS

(k) describe the digestion of cooked starch to maltose by salivary amylase only.
(l) state the end products of the digestion of carbohydrates, proteins and fats.
(m) define photosynthesis as the process of making glucose in green plants using water and carbon dioxide in the presence of light.
(n) state the word equation for photosynthesis.
(o) investigate and describe the conditions necessary for photosynthesis.
(p) state that most photosynthesis occurs in the leaves.

13. Organisms in Their Natural Environment

All learners should be able to:

(a) list the three features which enable life on Earth as water, air and energy.
(b) state that the sun is the principal source of energy to all living systems.
(c) define food chains as simple feeding relationships between living organisms in a given habitat through which energy is passed from one organism to the other.
(d) construct simple food chains and describe energy flow in a food chain.
(e) identify and describe the use of equipment for collecting specimen; nets and quadrants.
(f) define:
- ecology as the study of relationship of organisms with each other and their environment,
-ecosystem as different organisms living together in a given environment and depending on each other, giving local examples.
(g) describe, giving local examples, the terms: producer, primary consumer, secondary consumer.
(h) state the human activities which bring about pollution: motor car exhaust, industrial/household smoke, dust from industries, insecticides, fertilizers, litter-plastics, non rotting wastes.
(i) define conservation as maintenance and protection of a habitat or species.

14. Energy

All learners should be able to:

(a) define energy as the ability to do work.
(b) give examples of energy in different forms and their conversion.
(c) Investigate and describe the energy of motion (kinetic) and energy of position relative to ground (gravitational potential).
(d) state the law of energy conservation.
(e) list some common fuels (wood, coal, cow dung, petroleum, natural gas).
(f) describe production of thermal energy by burning fuels.
(g) investigate and describe qualitatively the thermal expansion of solids, liquids and gases.
(h) describe some everyday applications and consequences of thermal expansion.
(i) investigate convection in liquids.
(j) describe melting and boiling in terms of energy input without change in temperature.
(k) investigate the properties of good and bad conductors.
(l) identify and explain some of the everyday applications and consequences of conduction, convection and radiation.
(m) explain how a vacuum flask works.

Peristalsis

The alimentary canal has layers of muscle in its walls (Figure 11.2). The fibres of one layer of muscles run round the canal (**circular muscle**) and the others run along its length (**longitudinal muscle**). When the circular muscles in one region contract, they make the alimentary canal narrow in that region.

A contraction in one region of the alimentary canal is followed by another contraction just below it so that a wave of contraction passes along the canal pushing food in front of it. The wave of contraction, called **peristalsis**, is illustrated in Figure 11.3.

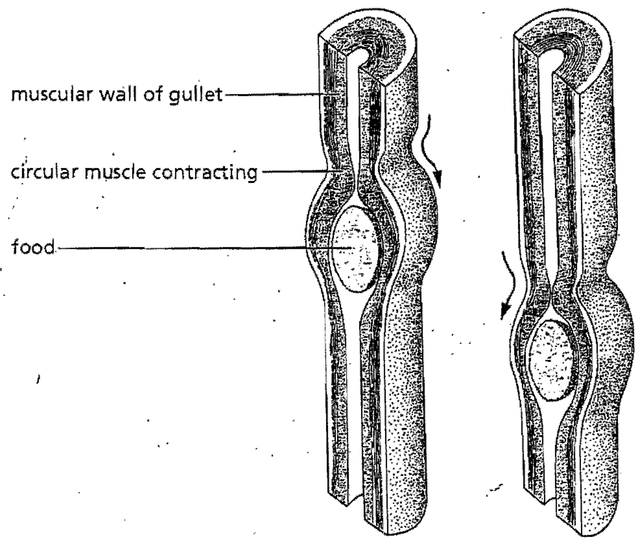


Figure 11.3 Diagram to illustrate peristalsis

Questions

1 What three functions of the alimentary canal are shown in Figure 11.1?
2 Into what parts of the alimentary canal do
 a the pancreas,
 b the salivary glands, pour their digestive juices?
3 Starting from the inside, name the layers of tissue that make up the alimentary canal.

Digestion

Digestion is mainly a chemical process and consists of breaking down large molecules to small molecules. The large molecules are usually not soluble in water, while the smaller ones are. The small molecules can pass through the epithelium of the alimentary canal, through the walls of the blood vessels and into the blood.

Some food can be absorbed without digestion. The glucose in fruit juice, for example, could pass through the walls of the alimentary canal and enter the blood vessels. Most food, however, is solid and cannot get into blood vessels. Digestion is the process by which solid food is dissolved to make a solution.

The chemicals which dissolve the food are **enzymes**, described on p. 14. A protein might take 50 years to dissolve if just placed in water but is completely digested by enzymes in a few hours. All the solid starch in foods such as bread and potatoes is digested to **glucose**, which is soluble in water. The solid proteins in meat, egg and beans are digested to soluble substances called **amino acids**. Fats are digested to two soluble products called **glycerol** and **fatty acids** (see p. 12).

The chemical breakdown usually takes place in stages. For example, the starch molecule is made up of hundreds of carbon, hydrogen and oxygen atoms. The first stage of digestion breaks it down to a 12-carbon sugar molecule called **maltose**. The last stage of digestion breaks the maltose molecule into two 6-carbon sugar molecules called glucose (Figure 11.4). Protein molecules are digested first to smaller molecules called **peptides** and finally into completely soluble molecules called amino acids.

starch → maltose → glucose
protein → peptide → amino acid

These stages take place in different parts of the alimentary canal. The progress of food through the canal and the stages of digestion will now be described (Figures 11.5 and 11.6).

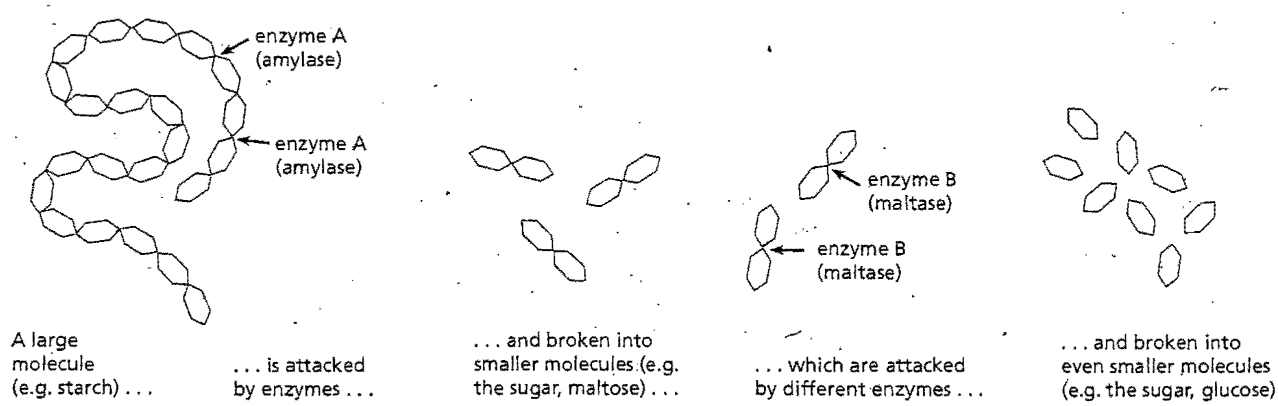


Figure 11.4 Enzymes acting on starch. A large molecule (e.g. starch) is attacked by enzymes (A) and broken into smaller molecules (e.g. the sugar maltose) which are attacked by different enzymes (B) and broken into even smaller molecules (e.g. the sugar glucose)

The mouth

The act of taking food into the mouth is called **ingestion**. In the mouth, the food is chewed and mixed with **saliva**. The chewing breaks the food into pieces which can be swallowed and it also increases the surface area for the enzymes to work on later. Saliva is a digestive juice produced by three pairs of glands whose ducts lead into the mouth (Figure 11.6). It helps to lubricate the food and make the small pieces stick together. Saliva contains one enzyme, **salivary amylase** (sometimes called **ptyalin**), which acts on cooked starch and begins to break it down into maltose.

Strictly speaking, the 'mouth' is the aperture between the lips. The space inside, containing the tongue and teeth, is called the **buccal cavity**. Beyond the buccal cavity is the 'throat' or **pharynx**.

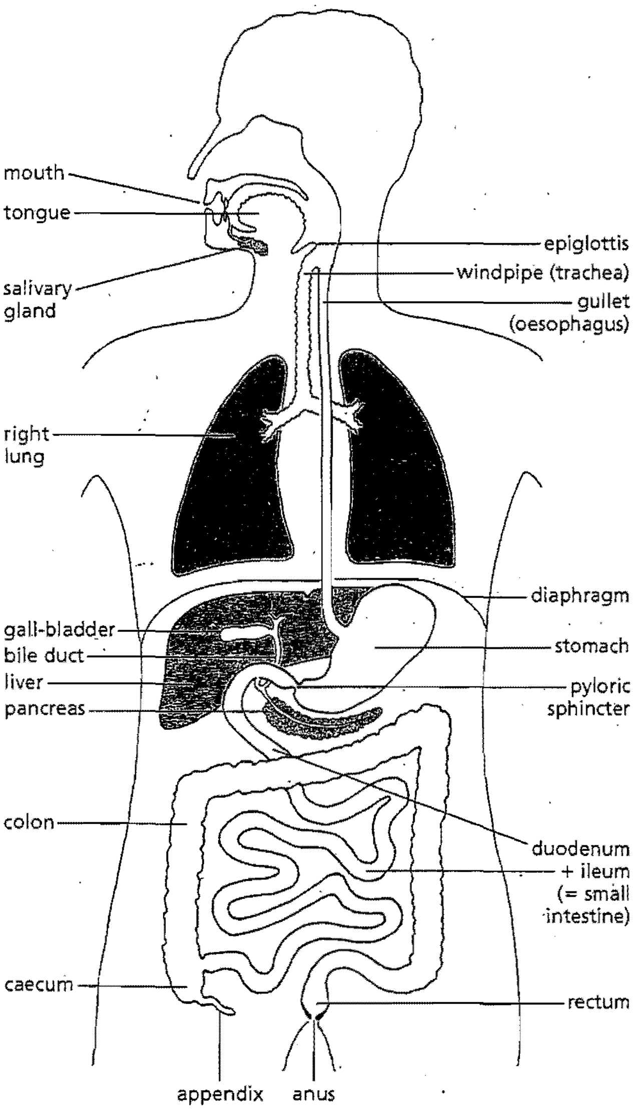


Figure 11.5 The alimentary canal

Swallowing

By studying Figure 11.6a, it can be seen that for food to enter the gullet (oesophagus), it has to pass over the windpipe. All the complicated actions which occur during swallowing ensure that food does not enter the windpipe and cause choking.

1 The tongue presses upwards and back against the roof of the mouth, forcing a pellet of food, called a **bolus**, to the back of the mouth.
2 The soft palate closes the nasal cavity at the back.
3 The larynx cartilage round the top of the windpipe is pulled upwards so that the opening of the windpipe (the **glottis**) lies under the back of the tongue.
4 The glottis is also partly closed by the contraction of a ring of muscle.
5 The **epiglottis**, a flap of cartilage (gristle) helps to prevent the food from going down the windpipe instead of the gullet.

The beginning of the swallowing action is voluntary, but once the food reaches the back of the mouth, swallowing becomes an automatic or reflex action. The food is forced into and down the oesophagus, or gullet, by peristalsis. This takes about 6 seconds with relatively solid food and then the food is admitted to the stomach. Liquid travels more rapidly down the gullet.

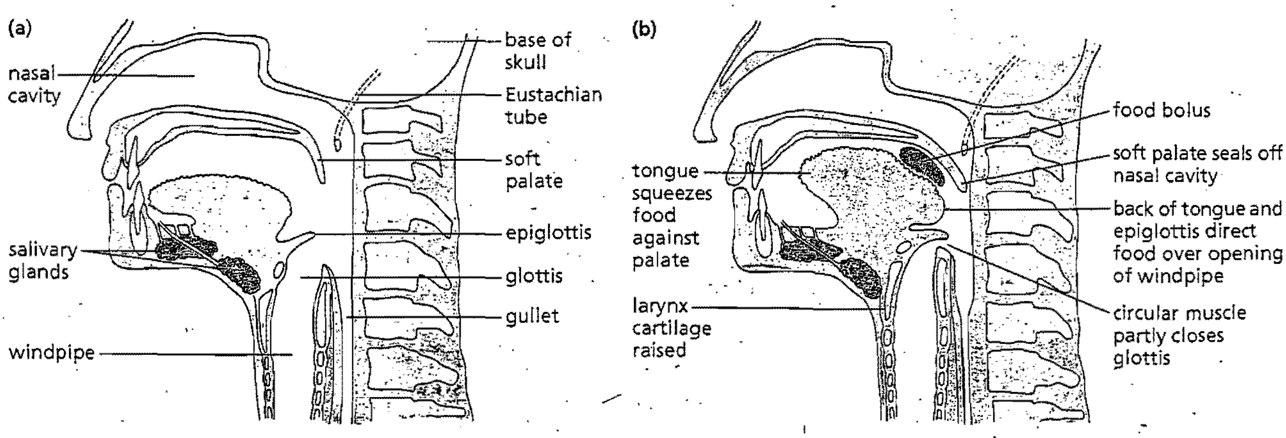


Figure 11.6 Section through head to show swallowing action

BRN 4568

The stomach

The stomach has elastic walls which stretch as the food collects in it. The **pyloric sphincter** is a circular band of muscle at the lower end of the stomach which stops solid pieces of food from passing through. The main function of the stomach is to store the food from a meal, turn it into a liquid and release it in small quantities at a time to the rest of the alimentary canal.

Glands in the lining of the stomach (Figure 11.7) produce **gastric juice** containing the enzyme **pepsin**. Pepsin is a **protease** (or proteinase), i.e. it acts on proteins and breaks them down into soluble compounds called peptides. The stomach lining also produces hydrochloric acid which makes a weak solution in the gastric juice. This acid provides the best degree of acidity for pepsin to work in (see p. 15) and kills many of the bacteria taken in with the food.

The regular peristaltic movements of the stomach, about once every 20 seconds, mix up the food and gastric juice into a creamy liquid. How long food remains in the stomach depends on its nature. Water may pass through in a few minutes; a meal of carbohydrate such as porridge may be held in the stomach for less than an hour, but a mixed meal containing protein and fat may be in the stomach for 1 or 2 hours.

The pyloric sphincter lets the liquid products of digestion pass, a little at a time, into the first part of the small intestine called the **duodenum**.

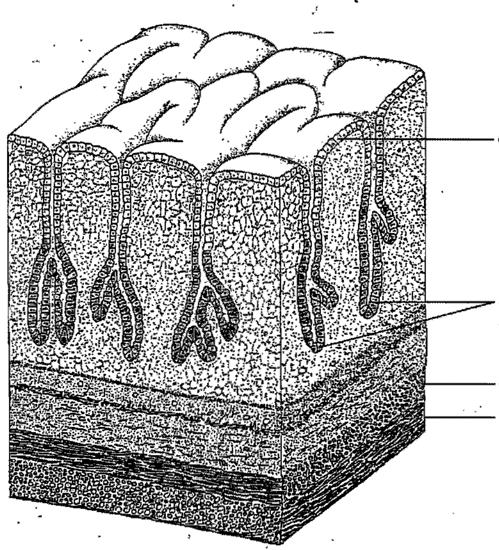


Figure 11.7 Diagram of section through stomach wall

The small intestine

A digestive juice from the pancreas (**pancreatic juice**) and bile from the liver are poured into the duodenum to act on food there. The pancreas is a digestive gland lying below the stomach (Figure 11.8). It makes a number of enzymes, which act on all classes of food.

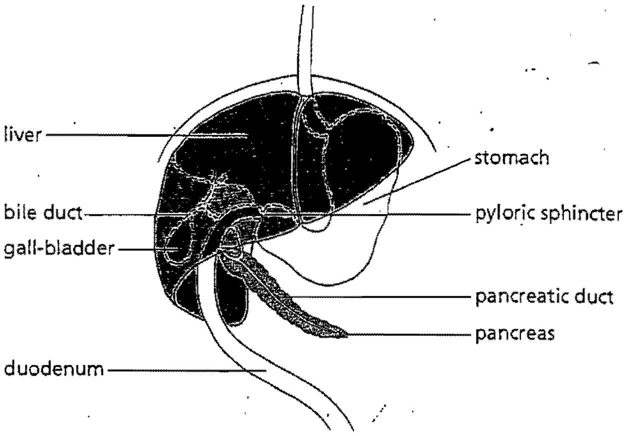


Figure 11.8 Relationship between stomach, liver and pancreas

There are several proteases which break down proteins to peptides and amino acids. **Pancreatic amylase** attacks starch and converts it to maltose. **Lipase** digests fats (lipids) to fatty acids and glycerol.

Pancreatic juice contains sodium hydrogencarbonate which partly neutralizes the acid liquid from the stomach. This is necessary because the enzymes of the pancreas do not work well in acid conditions.

Bile is a green, watery fluid made in the liver, stored in the gall-bladder and delivered to the duodenum by the bile duct (Figure 11.8). It contains no enzymes, but its green colour is caused by bile pigments which are formed from the breakdown of haemoglobin in the liver. Bile also contains bile salts which act on fats rather like a detergent. The bile salts **emulsify** the fats. That is, they break them up into small drops which are more easily digested by lipase.

All the digestible material is thus changed to soluble compounds which can pass through the lining of the intestine and into the bloodstream. The final products of digestion are:

food		final products
starch	→	glucose
proteins	→	amino acids
fats (lipids)	→	fatty acids and glycerol

The small intestine itself does not appear to liberate digestive enzymes. The structure labelled 'crypt' in Figure 11.10 on p. 102 is not a digestive gland, though some of its cells do produce mucus and other secretions. The main function of the crypts is to produce new epithelial cells (see 'Absorption', right) to replace those lost from the tips of the villi.

The epithelial cells of the villi contain, in their cell membranes, enzymes which complete the breakdown of sugars and peptides, before they pass through the cells on their way to the bloodstream. For example, the enzyme **maltase** converts the disaccharide maltose into the monosaccharide, glucose.

Prevention of self-digestion

The gland cells of the stomach and pancreas make protein-digesting enzymes (proteases) and yet the proteins of the cells which make these enzymes are not digested. One reason for this is that the proteases are secreted in an inactive form. Pepsin is produced as **pepsinogen** and does not become the active enzyme until it encounters the hydrochloric acid in the stomach. The lining of the stomach is protected from the action of pepsin probably by the layer of mucus.

Similarly, trypsin, one of the proteases from the pancreas, is secreted as the inactive **trypsinogen** and is activated by **enterokinase**, an enzyme secreted by the lining of the duodenum.

Control of secretion

The sight, smell and taste of food set off nerve impulses from the sense organs to the brain. The brain relays these impulses to the stomach and initiates gastric secretion. When the food reaches the stomach, it stimulates the stomach lining to produce a hormone (p. 169) called **gastrin**. This hormone circulates in the blood and, when it returns to the stomach in the bloodstream, it stimulates the gastric glands to continue secretion. Thus, gastric secretion is maintained all the time food is present.

In a similar way, the pancreas is affected first by nervous impulses and then by the hormone **secretin**. Secretin is released into the blood from cells in the duodenum when they are stimulated by the acid contents of the stomach. When secretin reaches the pancreas, it stimulates it to produce pancreatic juice.

Caecum and appendix

In some grass-eating animals (herbivores) such as horses and rabbits, the caecum and appendix are quite large. It is in these organs that digestion of plant cell walls takes place, largely as a result of bacterial activity.

In humans, the caecum and appendix are small structures, possibly without digestive function. The appendix, however, contains lymphoid tissue (p. 115) and may have an immunological function (p. 117).

Questions

1 Why can you not breathe while you are swallowing?

2 Why is it necessary for our food to be digested? Why do plants not need a digestive system? (See p. 35.)

3 In which parts of the alimentary canal is
  a starch
  b protein digested?

4 Study the characteristics of enzymes on pp. 14 and 15. In what ways does pepsin show the characteristics of an enzyme?

Absorption

The small intestine consists of the duodenum and the **ileum**. Nearly all the absorption of digested food takes place in the ileum, which is efficient at this for the following reasons:

- It is fairly long and presents a large absorbing surface to the digested food.
- Its internal surface is greatly increased by circular folds (Figure 11.9) bearing thousands of tiny projections called **villi** (singular = villus) (Figures 11.10 and 11.11, overleaf). These villi are about 0.5 mm long and may be finger-like or flattened in shape.
- The lining epithelium is very thin and the fluids can pass rapidly through it. The outer membrane of each epithelial cell has microvilli (p. 27) which increase by 20 times the exposed surface of the cell.
- There is a dense network of blood capillaries (tiny blood vessels, see p. 113) in each villus (Figure 11.10).

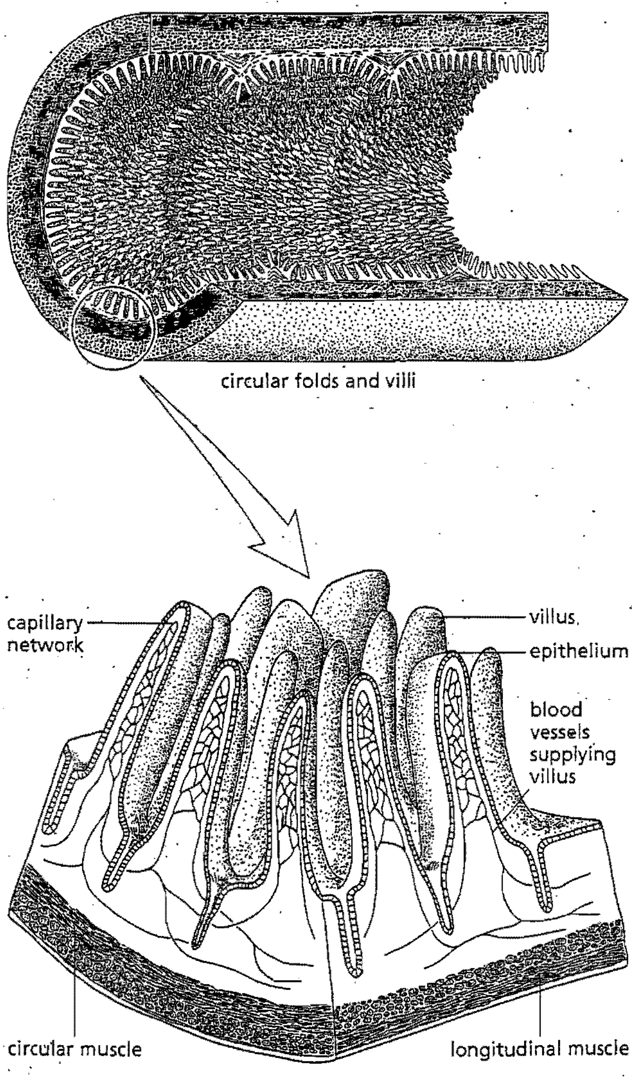


Figure 11.9 The absorbing surface of the ileum