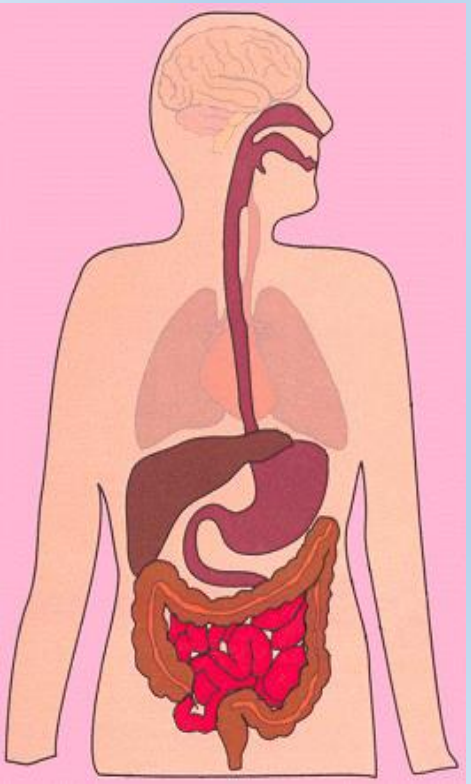
Biology Grade 9

CHAPTER 1: FROM FOOD TO NUTRIENTS: DIGESTION

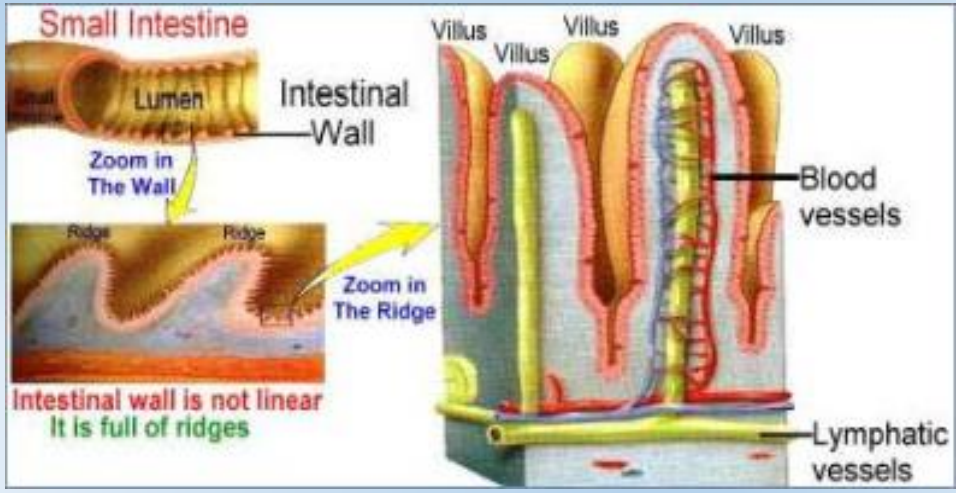


Activity 5: The Route of Nutrients

INSTRUCTOR: SUHAIB AUDI

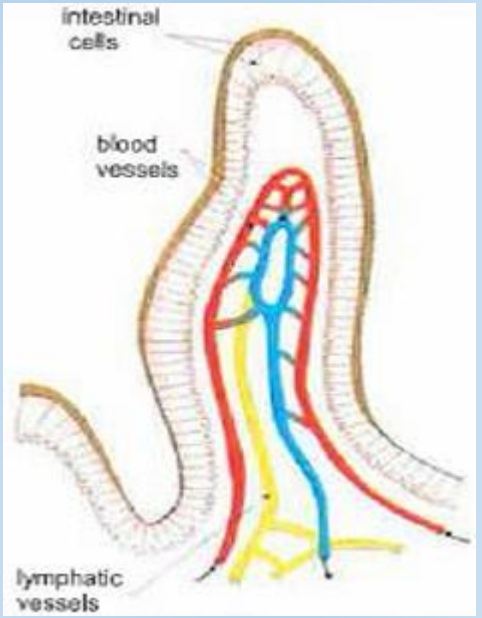
Activity 5: The Route of Nutrients

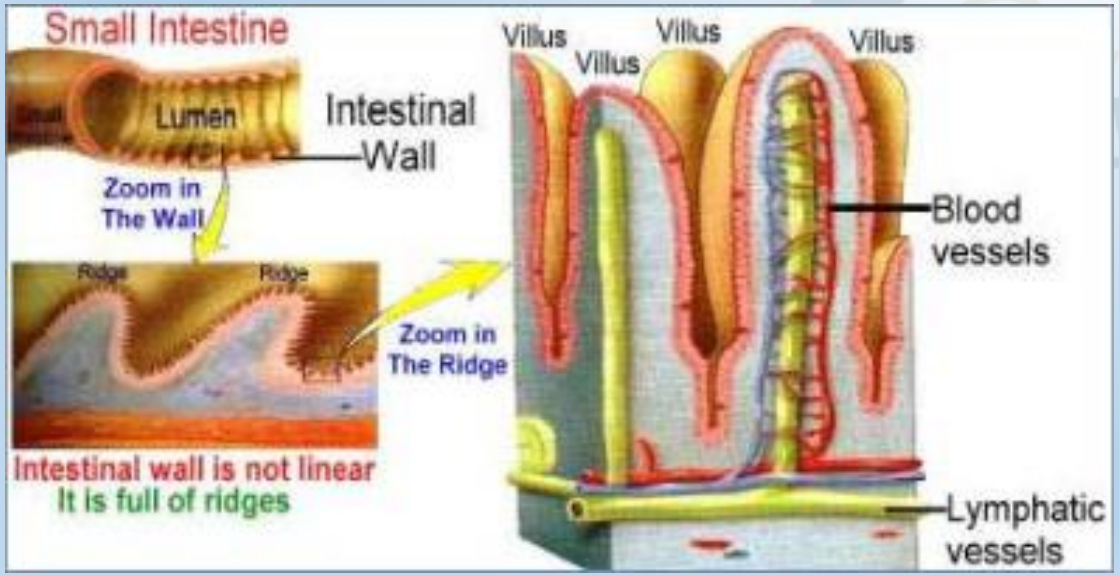
- The final digestion of food takes place at the level of the **small intestine**, and at this level nutrients are absorbed.
- The inner wall of the small intestine is the surface of exchange of nutrients with blood and lymph vessels.
- The route of nutrients digested food molecules are **absorbed** in the small intestine.
- **This means that they pass through the wall of the small intestine into our bloodstream**.
- Once in the bloodstream, the digested food molecules are carried around the body to where they are needed.



❖ Structure of the small intestine:

- The inner wall of the small intestine has many ridges that considerably increase its surface area.
- These ridges are covered with numerous fingers-like projections called villi that stand very close to each other.
- Each villus has its own network of blood and lymphatic vessels.
- All Chemical and mechanical phases in the digestive tract are important for changing food into nutrients that can pass through the intestinal cells into blood and lymphatic vessels.





❖ Absorption:

1. It is the passage of nutrients from the small intestine to the blood or lymph.

2. Villus is the unit of absorption (or structure of absorption) while the small intestine is the organ of absorption.

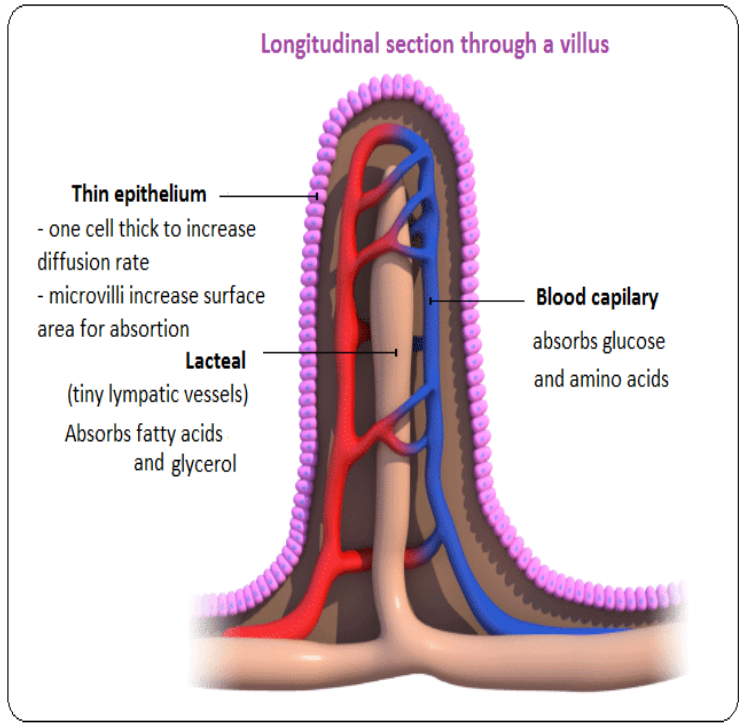
❖ The characteristics which favor the intestinal absorption are:

1) Large surface area of absorption.

- Since the inside wall of the small intestine is lined with tiny villi (one of them is called a villus).

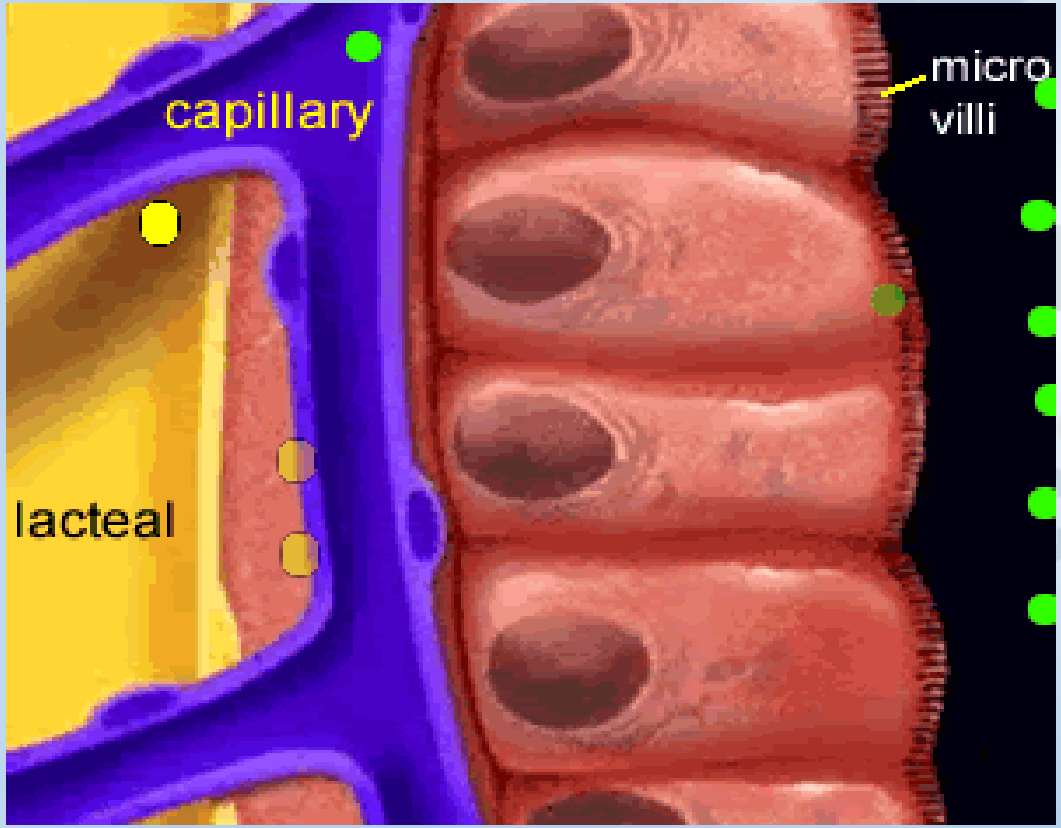
2) Thin intestinal wall

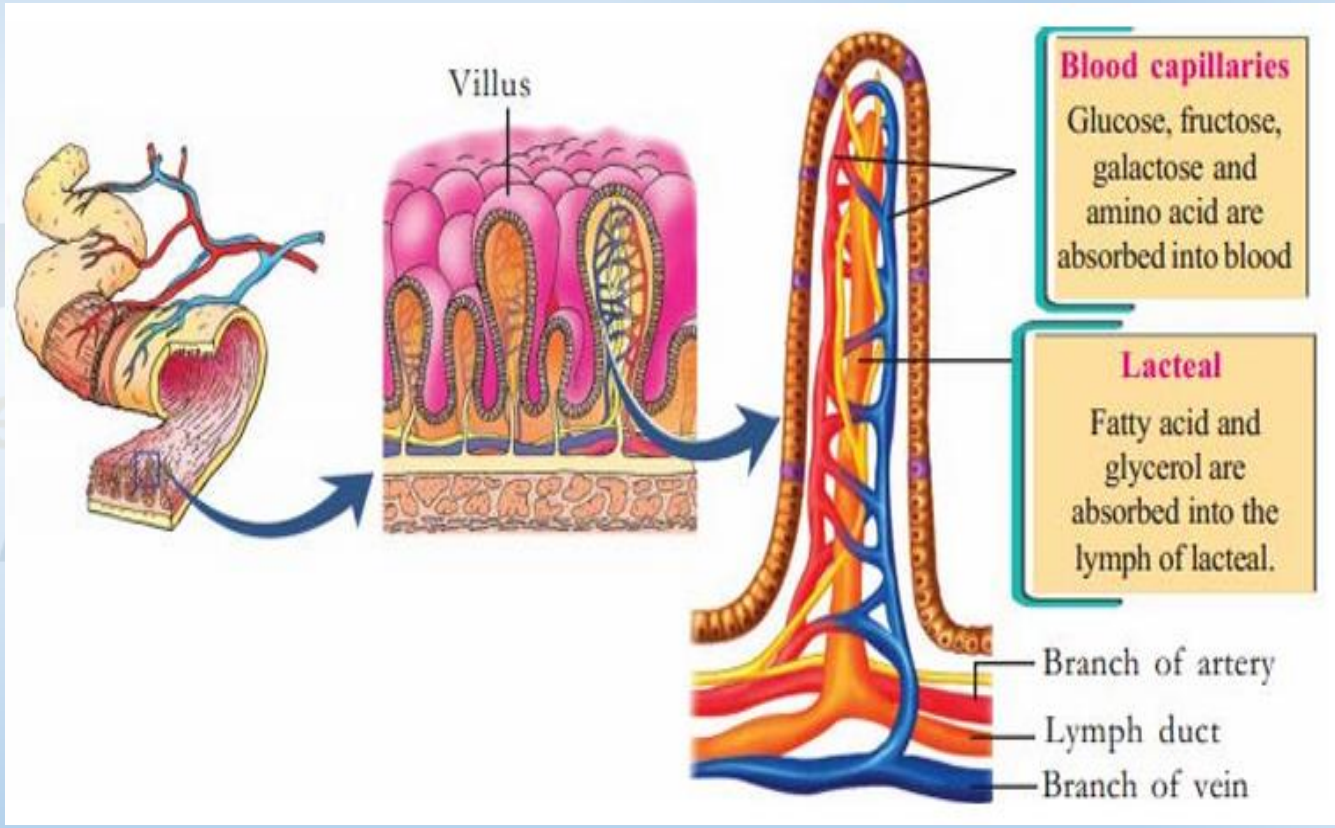
3) Rich in blood and lymphatic vessels.



❖ Routes / Fates of Nutrients:

All nutrients (water, vitamins, glucose, amino acid, minerals, galactose, fructose …)are absorbed by blood vessels, except fatty acid and glycerol are absorbed by lymphatic vessels (lacteal branch).





Summary

- **Nutrients** include the end products of digestion such as **glucose, amino acids, galactose, fructose, fatty acids, and glycerol**, in addition to **water, mineral salts, and vitamins**.
- **All nutrients** pass into the **blood vessels**, **except fatty acids and glycerol**, which pass into **lymphatic vessels**.
- **Villi** are the units of absorption. They are characterized by having a **thin wall**, a **large surface area**, and being **rich in blood and lymphatic vessels**.

Exercise 1:

Duodenum is the first part of the small intestine which receives the digested food (chyme) from the stomach.

Many scientists wondered if it is responsible for the absorption of the digested nutrients.

Sample from:	Blood Leaving the Duodenum	
Nutrient(g/l) / time	Before a meal	After a meal
Glucose	0.8	1.5
Amino-acids	0.4	0.7

1. Formulate the tested hypothesis.

Hypothesis: Duodenum (small intestine) is responsible for nutrients absorption.

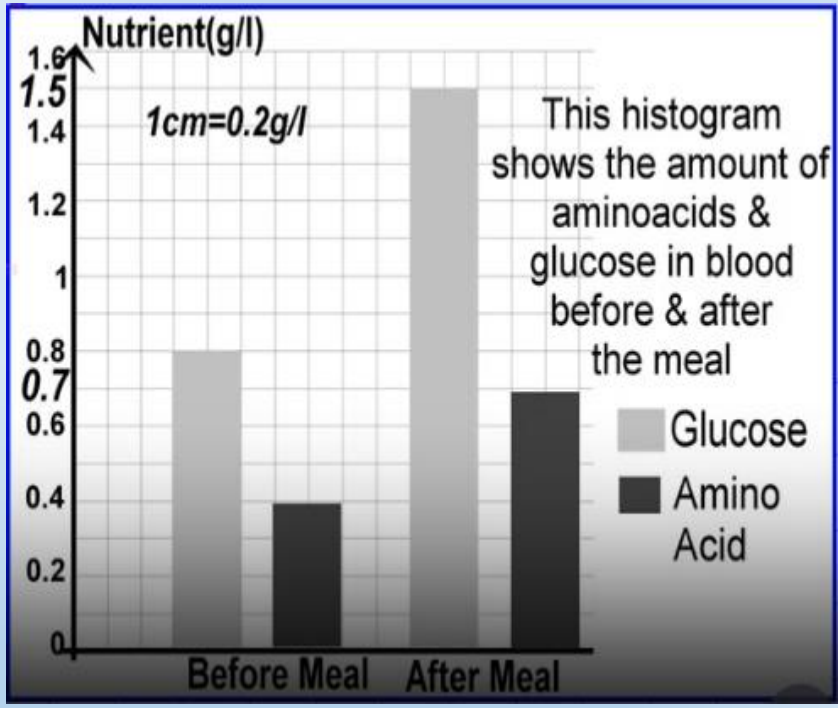
2. Compare the amount of glucose and amino acids before and after a meal.

The amount of glucose in the blood leaving the duodenum before the meal is 0.8 g/l **less than** that after the meal 1.5 g/l, similarly the amount of amino acid in the blood leaving the duodenum before the meal is 0.4 g/l **less than** that after the meal 0.7 g/l.

3. Derive a suitable conclusion.

Duodenum (small intestine) is responsible for nutrients absorption.

4. Transform the given table into a histogram.



In order to determine the nutrients absorbed by lymphatic vessels. We measured the amount of different nutrients in the lymph vessels entering and leaving the small intestine. The results are recorded in the given table:

In lymphatic vessel after the meal (g/l)	Lymph entering small intestine	Lymph leaving small intestine
Fatty acids	0.4	0.6
Amino acids	0.01	0.01
Glycerol	0.2	0.5
Glucose	0.02	0.02

4. Show that "Lymphatic vessel doesn't transport amino acids".

Since the amount of amino acid **remains the same** at 0.01g/l in the lymphatic vessels before and after the meal. Then, lymph doesn't transport any amino acid.

5. Precise/Specify the absorbed nutrient(s).

Fatty acids and glycerol since their amount increases in the lymph from 0.4 to 0.6g/l and from 0.2 to 0.5g/1 respectively after the meal.

6. Refer to whole document; indicate the route (fate/destiny) of absorption for each nutrient.

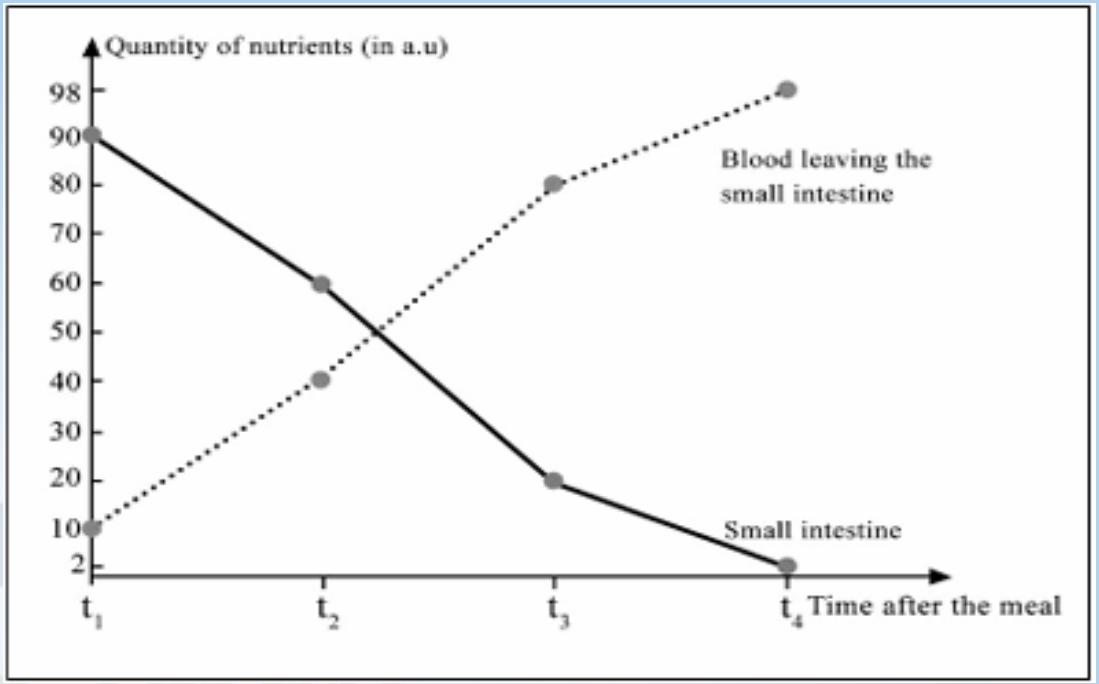
Glucose and amino acids into the blood while fatty acid and glycerol into the lymph.

Exercise 2:

Intestinal functions

In the framework of studying one of the functions of the small intestine, the quantity of nutrients is measured in this organ as well as in the blood leaving the small intestine after a meal. The results of the performed measurements are represented in the adjacent document.

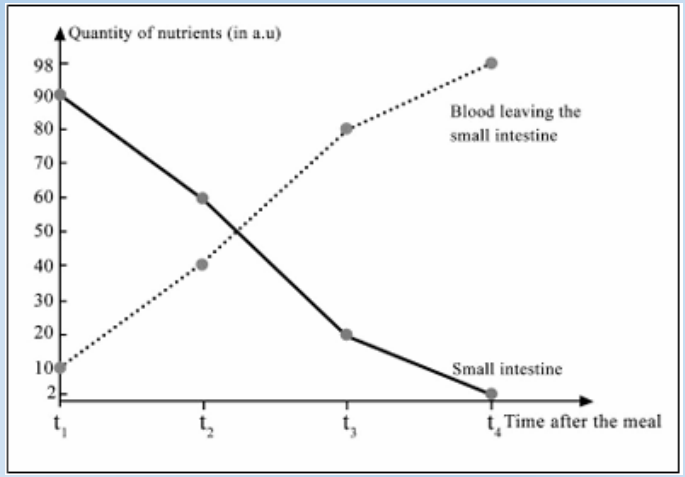
1. Draw a table showing the variation in the quantity of nutrients in the small intestine and in the blood as a function of time.



Time after a meal		t_1	t_2	t_3	t_4
Quantity of nutrients in (a.u.)	In the small intestine	90	60	20	2
	In the blood leaving the small intestine	10	40	80	98

Table showing the variation in the quantity of nutrients, as a function of time after the meal.

2-1. Analyze the results shown in the adjacent document.



At t1 the quantity of nutrients is 90 a.u. at the level of the small intestine which is **greater than that** at the level of the blood leaving the small intestine, 10 a.u. This quantity decreases from 90 a.u to 2 a.u. between t1 and t4 at the level of the small intestine. On the contrary, it increases from 10 a.u. to 98 a.u. at the level of the blood leaving the small intestine during the same duration.

2-2. What do you conclude concerning the intestinal function revealed in the document?

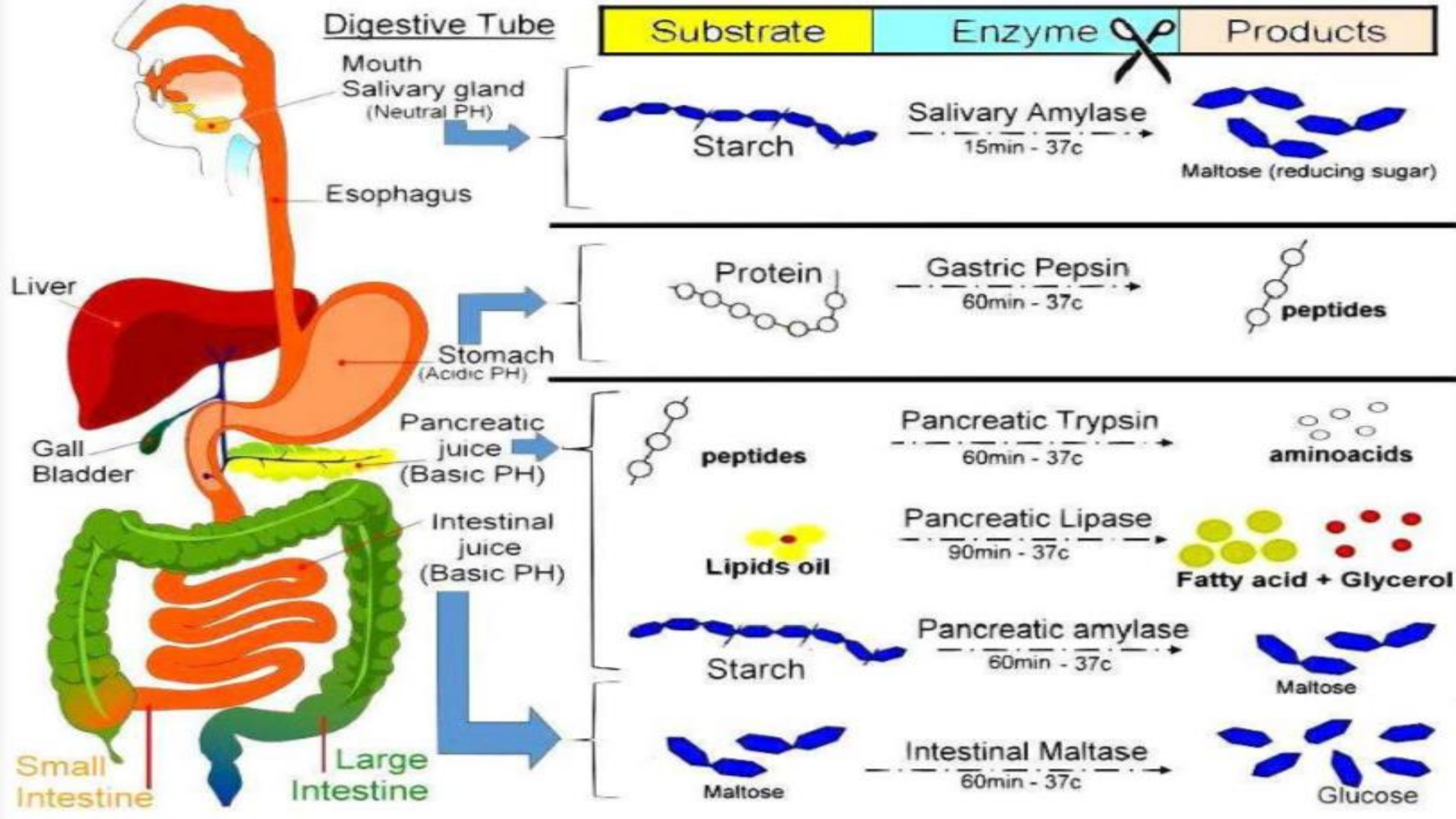
The revealed intestinal function is intestinal absorption.

3. Indicate another function ensured by the small intestine.

Chemical digestion by digestive enzymes. or - Mechanical digestion or - passage of food due to peristaltic movements.

4. List the characteristics of the surface of exchange of the small intestine.

The characteristic of the surface of exchange at the level of the small intestine are: - Thin wall - Large surface area of exchange - Highly vascularized.


Digestive Tube
Substrate
Enzyme
Products
Mouth
Salivary gland
(Neutral PH)
Esophagus
Starch
Salivary Amylase
15min - 37c
Maltose (reducing sugar)
Liver
Protein
Gastric Pepsin
60min - 37c
peptides
Stomach
(Acidic PH)
Gall
Bladder
Pancreatic
juice
(Basic PH)
peptides
Pancreatic Trypsin
60min - 37c
aminoacids
Intestinal
juice
(Basic PH)
Lipids oil
Pancreatic Lipase
90min - 37c
Fatty acid + Glycerol
Starch
Pancreatic amylase
60min - 37c
Maltose
Small
Intestine
Large
Intestine
Maltose
Intestinal Maltase
60min - 37c
Glucose

Summing Up again>>>> but in a table

Digestive tube	Digestive		Digestive Experimental Conditions				
	Juice	Enzyme	Substrate	Product	PH	T (min)	Temp °c
Mouth	Saliva	Amylase	Starch	Maltose	7	15	37
	Mastication (Mechanical Digestion)						
Esophagus	Peristaltic Movements (Mechanical Digestion)						
Stomach	Gastric juice	Pepsin	Protein	Peptides	2	60	
	Churning (Mechanical Digestion)						
S.I (Duodenum)	Intestinal juice / extract	Maltase	Maltose	Glucose	8		
	Pancreatic juice / extract	Amylase	Starch	Maltose			
		Trypsin	Peptide or protein	Amino acids			
		Lipase (facilitated by bile)	Lipid	Fatty acids + Glycerol		90	
	Peristaltic Movements (Mechanical Digestion)						
	Absorption of Nutrients into blood & lymph vessels (Act-5)						
Large Intestine	Peristaltic Movements						
	Absorption of Water						

From Food to Nutrients: The Chemical Digestion Process

	Digestive Juice	pH	Digestion Reaction (Hydroly sis)
Mouth	Saliva	Neutral (pH=7)	Starch —Salivary Amylase→ Maltose
Stomach	Gastric Juice	Acidic (pH=2)	Proteins —Pepsin→ Polypeptides
Small Intestine	Pancreatic Juice	Basic (pH=8)	Proteins/Polypeptides —Trypsin→ Amino Acids
			Starch —Amylase→ Maltose
			Lipids —Lipase (+ bile)→ Fatty Acids + Glycerol
	Intestinal Juice	Basic (pH=8)	Maltose —Maltase→ Glucose
			Lactose —Lactase→ **Glucose + Galactose**
			Sucrose —Sucrase→ Glucose + Fructose
			Polypeptides —Erepsin→ Amino Acids
			Lipids —Lipase (+ bile)→ Fatty Acids + Glycerol