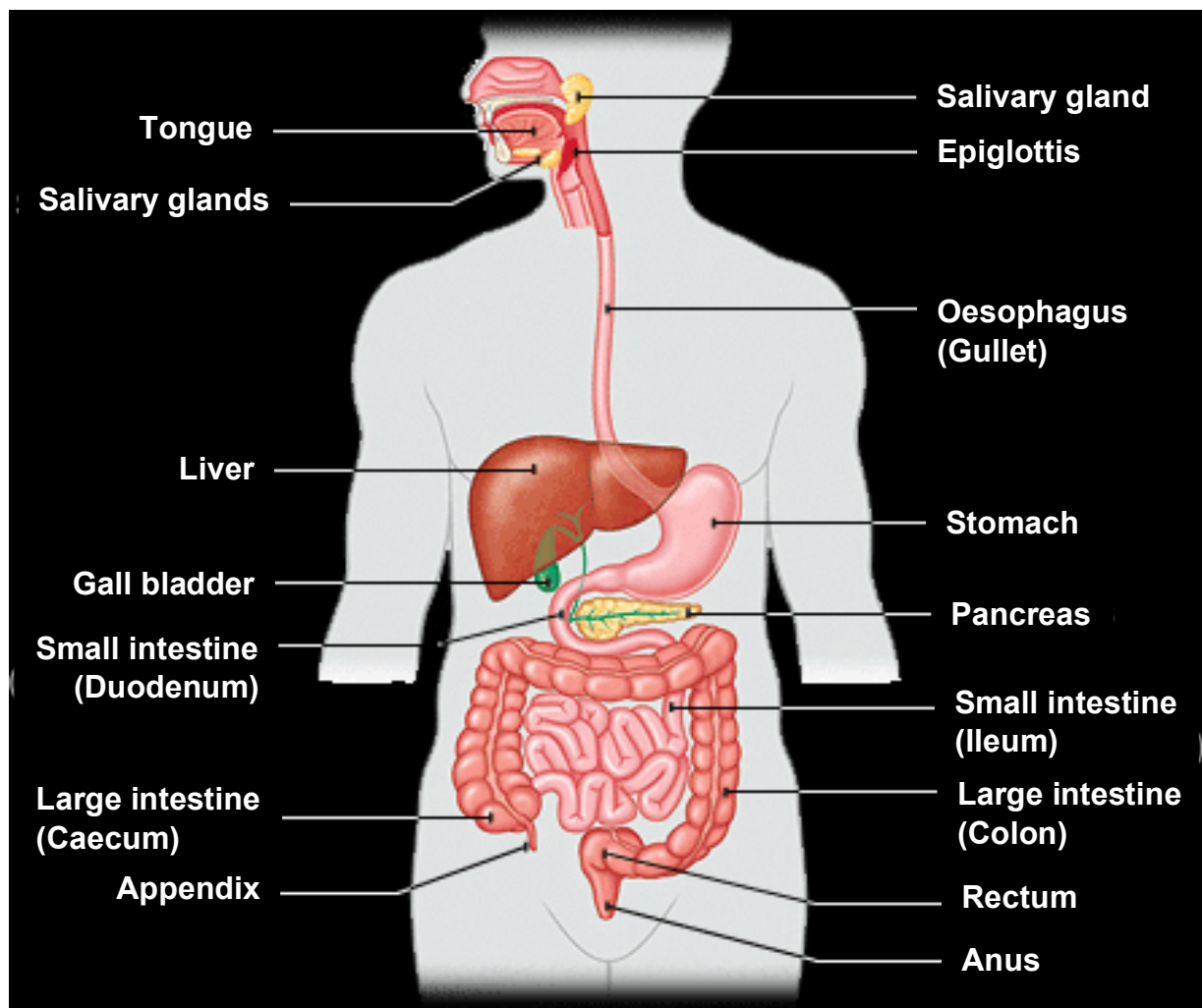## A. WHY DIGEST FOOD?

- To make it **smaller** so it can pass **through** the **small intestine wall** and **enter** the **blood**.

- To make it **soluble** so it can **dissolve** in the **blood** and be **transported** to **cells**.

B. THE HUMAN ALIMENTARY CANAL

- The **epiglottis** is a flap of skin that **covers** the **trachea**, when **eating** or **drinking**, to **prevent food** and **water** from **entering** the **lungs**.

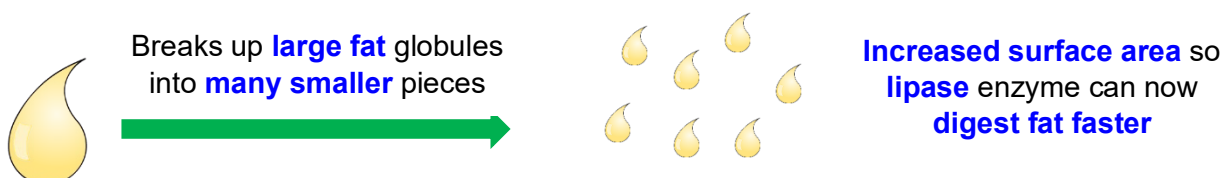- This explains why you **stop breathing** when **drinking**.

C. FUNCTIONS OF THE DIFFERENT ORGANS

ORGAN	FUNCTION
MOUTH	• **Ingestion** and **chewing** • **Carbohydrate digestion** starts here
OESOPHAGUS	• **Lined** with **mucus** to **help swallowing**
STOMACH	• **Kills pathogens** in **food** • **Protein digestion** starts here
LIVER	• **Produces bile**
GALL BLADDER	• **Stores bile**
PANCREAS	• Produces **all types** of **digestive enzyme**: - amylase (**carbohydrase**) - endopeptidase and exopeptidase (**protease**) - **lipase** - **nuclease**
SMALL INTESTINE	• **Digestion** • **Absorption** of **digested food**
LARGE INTESTINE	• **Absorption** of **water**
ANUS	• **Egestion** of **faeces**

D. BILE

• **Produced** by the **liver** and **stored** in the **gall bladder**.

• **Squirted** onto **food** as it **enters** the **small intestine** from the **stomach**.

Function 1: Emulsification

Breaks up **large fat** globules into **many smaller** pieces

Increased surface area so **lipase** enzyme can now **digest fat faster**

Function 2: Neutralisation & Optimum pH

• Bile is an **alkali**. This allows it to:

- **neutralise** the **acid** in **food** coming from the **stomach**
- provide the **optimum pH** for **enzymes** to **work** in the **small intestine**

E. STARCH DIGESTION

- Starch is made from **two** types of molecule:

- **Amylose** (unbranched with α1-4 glycosidic bonds)

- **Amylopectin** (branched with α1-4 and α1-6 glycosidic bonds)

Three enzymes are needed to fully **digest starch:**

- Amylase
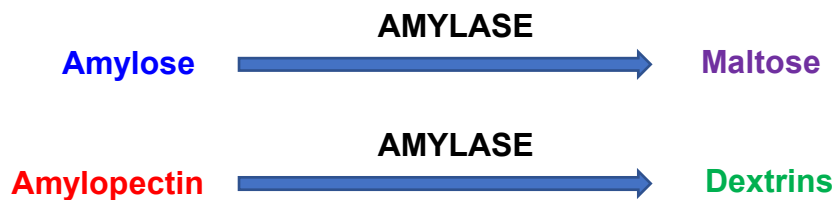- Maltase
- Dextrinase

α1-6

α1-4

alpha 1-4 and alpha 1-6 glycosidic bonds

Amylose   Amylopectin
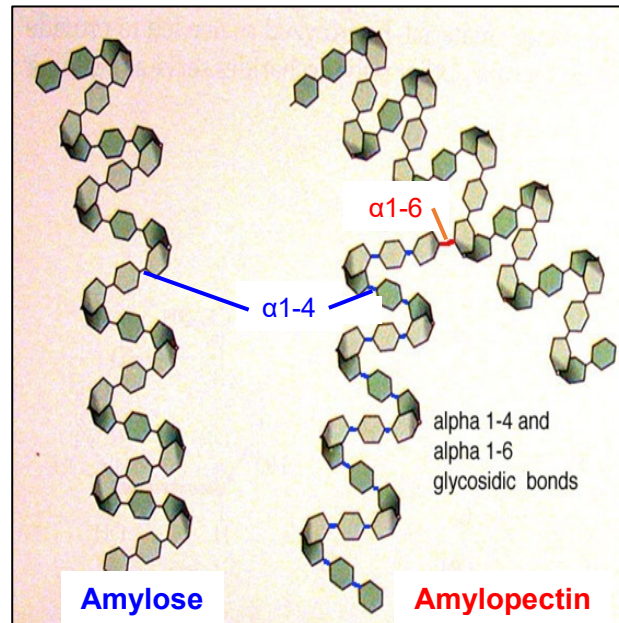
Amylase is produced by the **mouth** and **pancreas**

Maltase and **dextrinase** are produced by the **pancreas** and **microvilli membranes** of the **small intestine**

1. AMYLASE

AMYLASE

Amylose ⟶ Maltose

AMYLASE

Amylopectin ⟶ Dextrins

- Amylase can only **partially digest amylopectin** as it **cannot break α1-6 bonds**.

2. MALTASE

MALTASE

Maltose ⟶ Glucose

3. DEXTRINASE

DEXTRINASE

Dextrins ⟶ Glucose

F. DIGESTIVE ENZYMES

ENZYME	WHERE IT IS PRODUCED	WHAT IT BREAKS DOWN	WHAT IS PRODUCED
AMYLASE	SALIVARY GLANDS (MOUTH) PANCREAS	STARCH	MALTOSE DEXTRINS
MALTASE DEXTRINASE	PANCREAS MICROVILLI MEMBRANES	MALTOSE DEXTRINS	GLUCOSE
ENDOPEPTIDASE EXOPEPTIDASE	STOMACH PANCREAS	PROTEIN SHORTER PEPTIDES	SHORTER PEPTIDES AMINO ACIDS
LIPASE	PANCREAS	LIPID / FAT / TRIGLYCERIDE	GLYCEROL & FATTY ACIDS

■ = fully digested

> **Why should humans not eat lots of grass?!**

- Cows contain **bacteria** that produce an enzyme called **cellulase**.

- Cellulase **digests** the **cellulose** in **plant cell walls** to **glucose**.

- **Humans** do not produce **cellulase**.

G. STRUCTURE OF THE SMALL INTESTINE

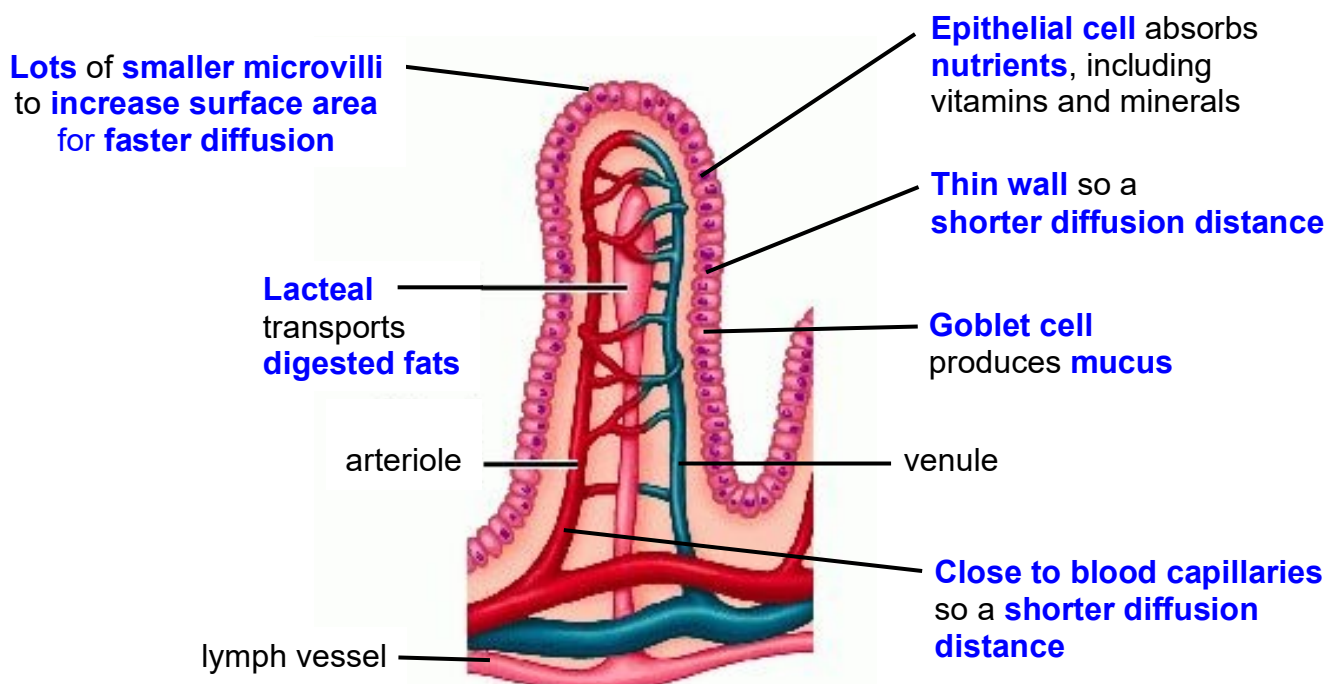circular muscles
serosa
submucosa
lumen
mucosa
villi
longitudinal muscles
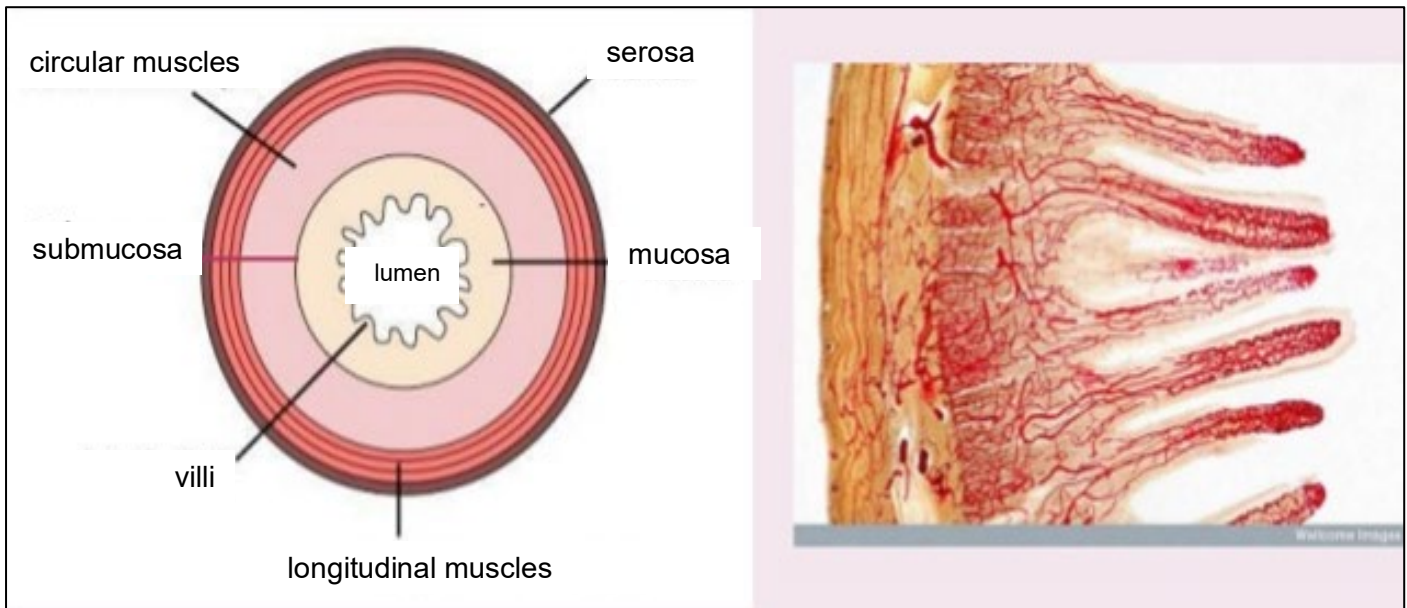
- Contraction of **circular muscles behind** food = **prevents** food going **backwards**
- Contraction of **longitudinal muscles at** food = **moves** food **forward**

Contraction of both sets of muscles

1. **produce waves that push the food along = peristalsis**

2. **mixes food with enzymes in the small intestine = faster digestion**

H. A VILLUS

Lots of **smaller microvilli** to **increase surface area** for **faster diffusion**

Epithelial cell absorbs **nutrients**, including vitamins and minerals

Thin wall so a **shorter diffusion distance**

Lacteal transports **digested fats**

Goblet cell produces **mucus**

arteriole

venule

Close to blood capillaries so a **shorter diffusion distance**

lymph vessel

I. METHODS OF ABSORPTION

METHOD	WHAT IT IS	EXAMPLES
SIMPLE DIFFUSION	Molecules travel: • **DOWN** a concentration gradient • from **HIGH → LOW** concentration • through the **PHOSPHOLIPID BILAYER**	**Hydrophobic** molecules e.g. **fatty acids** & **monoglycerides**
FACILITATED DIFFUSION	Molecules travel: • **DOWN** a concentration gradient from • **HIGH → LOW** concentration through • **CHANNEL PROTEINS** in the membrane	**Hydrophilic** molecules e.g. **glucose** and **fructose**
ACTIVE TRANSPORT	Molecules travel: • **AGAINST** a concentration gradient from • **LOW → HIGH** concentration through • **PUMP/CARRIER PROTEINS** in the membrane.	e.g. **minerals** such as calcium, sodium, potassium. Iron
ENDOCYTOSIS	• **SMALL DROPLETS OF FLUID** are passed through the membrane • using **VESICLES**	e.g. **triglycerides** & **cholesterol**

• In exams, you are expected to know the method **name**, **what it is** and to give **examples** of **substances** that are transported in this way.