

# **Lecture 2**

## **Digestion, absorption and metabolism**

# Digestive system – some facts

- When your body needs food, your brain and hormones alert your mind to the sensation of hunger (high levels of **ghrelin** promote food intake)
- When you eat, taste buds guide you in finding food acceptable or not
- 4 basic chemical tastes: *sweet, sour, bitter, and salty*
- Aroma, texture, temperature can also affect flavour
- Human ability to detect a food's aroma is 1,000 x as sensitive as our sense of taste

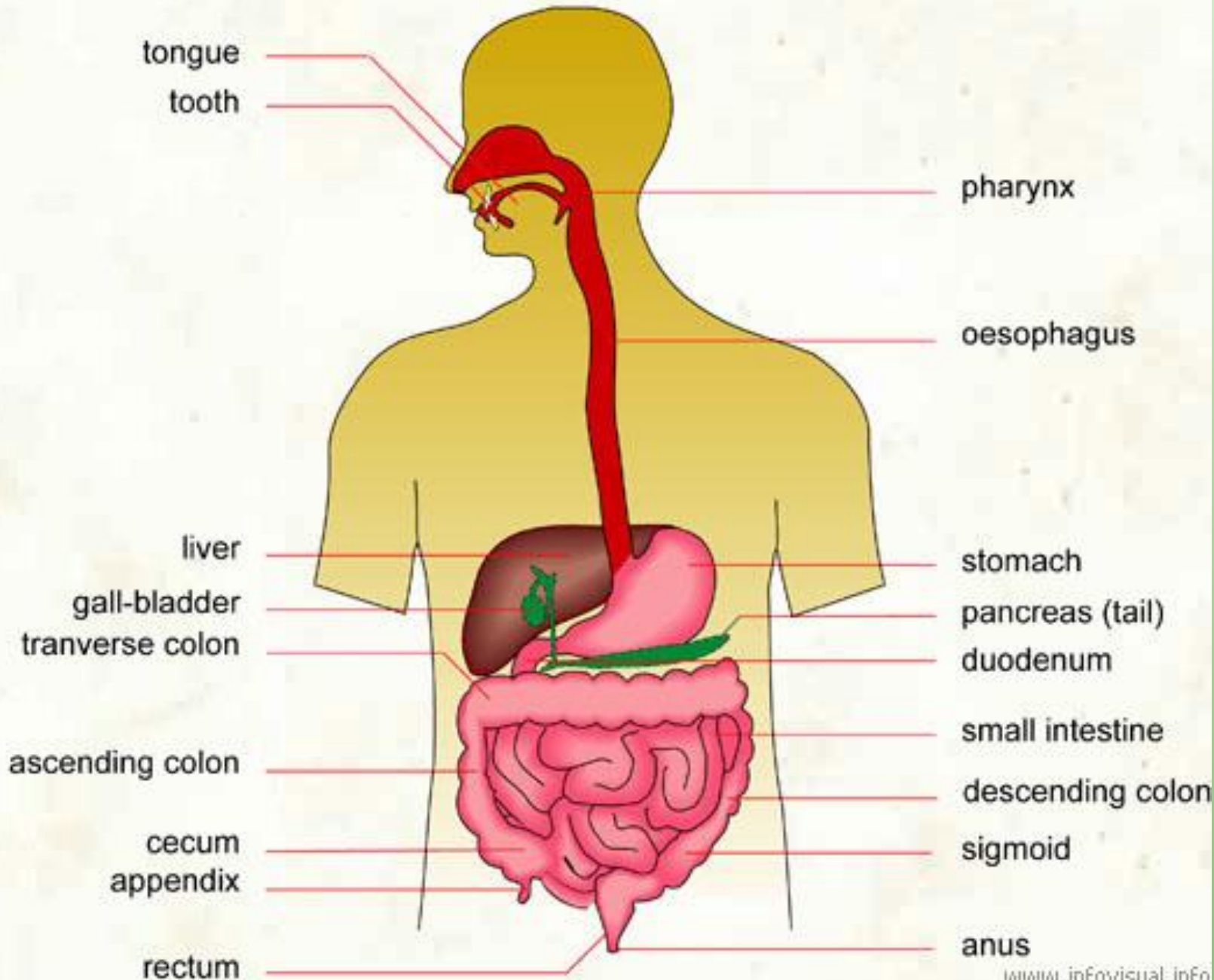
# Preference for sugar, fat and salt: inborn?

- Sweet, salty and fatty foods: universally desired
- Enjoyment of eating sugar: energy to the brain
- Fats: energy and essential nutrients to body tissues
- Minerals: salt and chloride important for muscles, neurons, blood pressure, blood pH
- Bitter and sour: most people have aversions to them (many toxins are bitter)

# Digestive Tract

- Once you have eaten, your brain and hormones direct organs of digestive system to digest and absorb the complex mixture of chewed and swallowed food

# DIGESTIVE SYSTEM

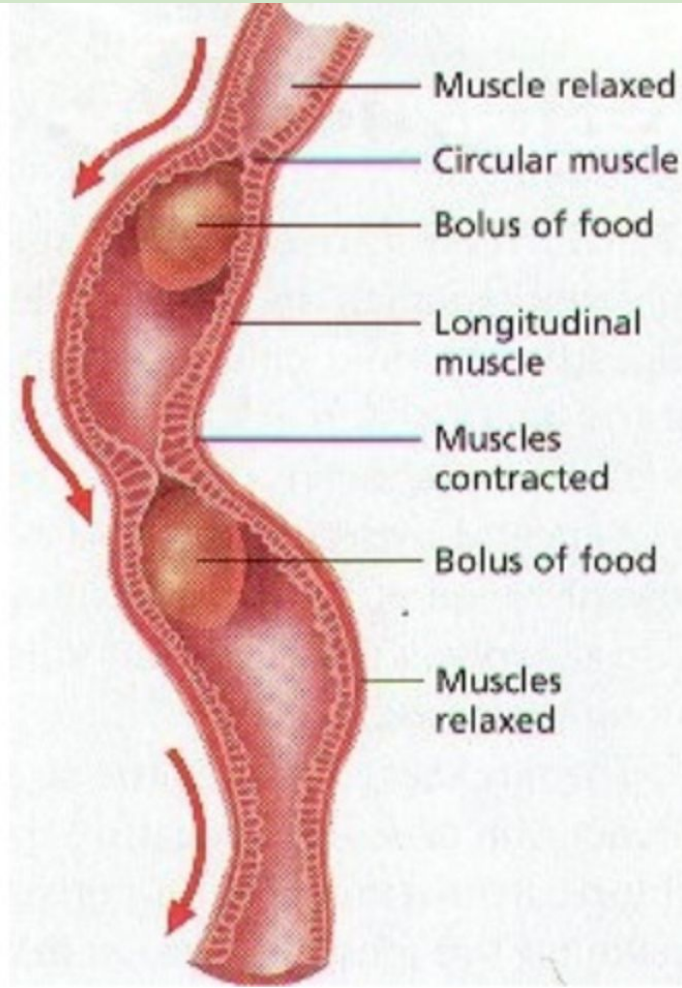


- Flexible, muscular tube, digests foods and absorbs its nutrients and some non-nutrients
- Digestive organs aid digestion
- When you swallow something, it is not inside your body, but inside the tube
- Only when nutrient passes through the wall of digestive tract it enters the body's tissues
- 2 levels: mechanical digestion and chemical digestion

# Mechanical aspect of digestion - peristalsis

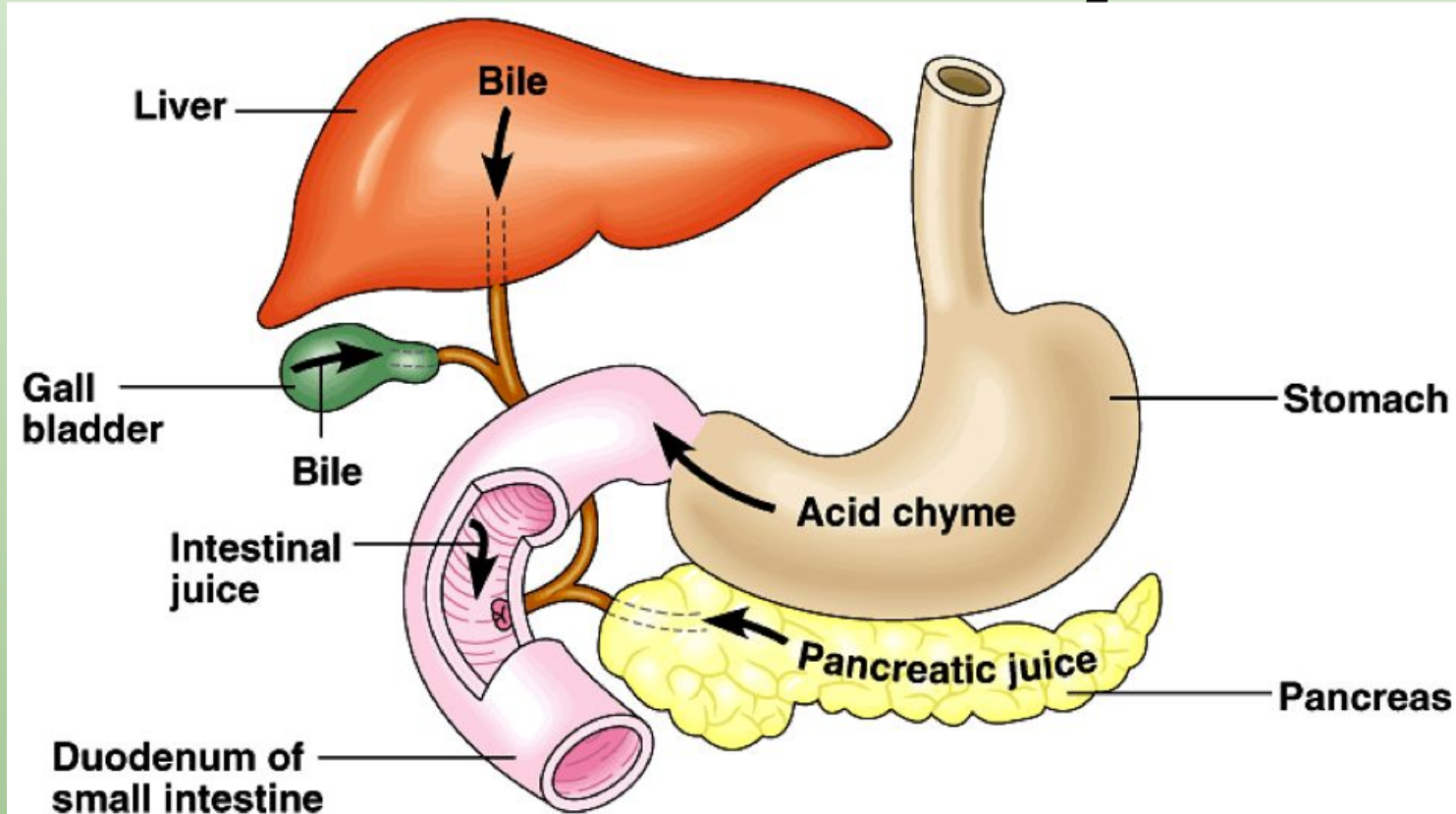
## Peristalsis

- series of involuntary wave-like muscle contractions which move food along the digestive tract



- Chewing, mixing by stomach, adding fluid, moving tract's contents by peristalsis.
- After digestion and absorption, wastes are excreted

# Chemical aspect of digestion – digestive juices

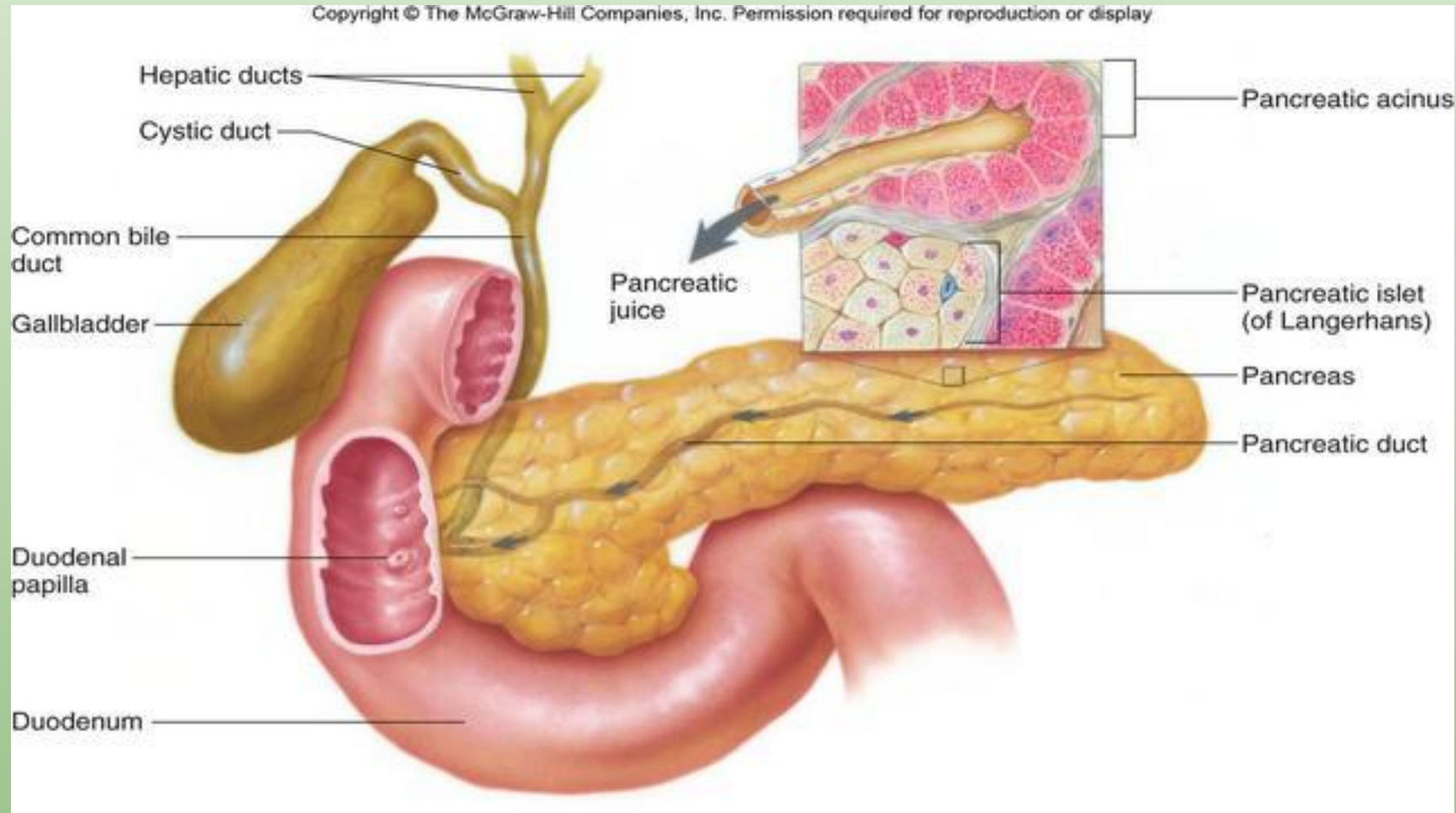


- Mouth: Salivary amylase breaks starch and lingual lipase starts digestion of fat Stomach: gastric juice (HCl, water, enzymes) activates pepsin
- Mucus protects stomach and digestive tract from being digested
- Bile: emulsifier
- Pancreatic enzymes, bicarbonate (neutralizes pH)

# Stomach Digestive Functions

- **Mucous cells** – secrete mucus to protect the lining of the stomach from stomach acid
- **Parietal cells** – produce *intrinsic factor* (needed for the absorption of vitamin B12) and hydrochloric acid (HCl)
- **Hydrochloric acid** – decreases stomach pH for denaturation of proteins to take place and *converts pepsinogen into pepsin*
- **Peptic cells** – secrete *pepsinogen* (pepsin) and *gastric lipase*
- **Pepsin** – breaks proteins down into amino acids
- **Gastric lipase** – breaks down triglycerides into fatty acids and monoglycerides

# Pancreas: endocrine and exocrine gland



## Endocrine:

Insulin

Glucagon

Somatostatin

## Exocrine:

Digestive  
enzymes  
to small  
intestine

# Pancreatic Enzymes

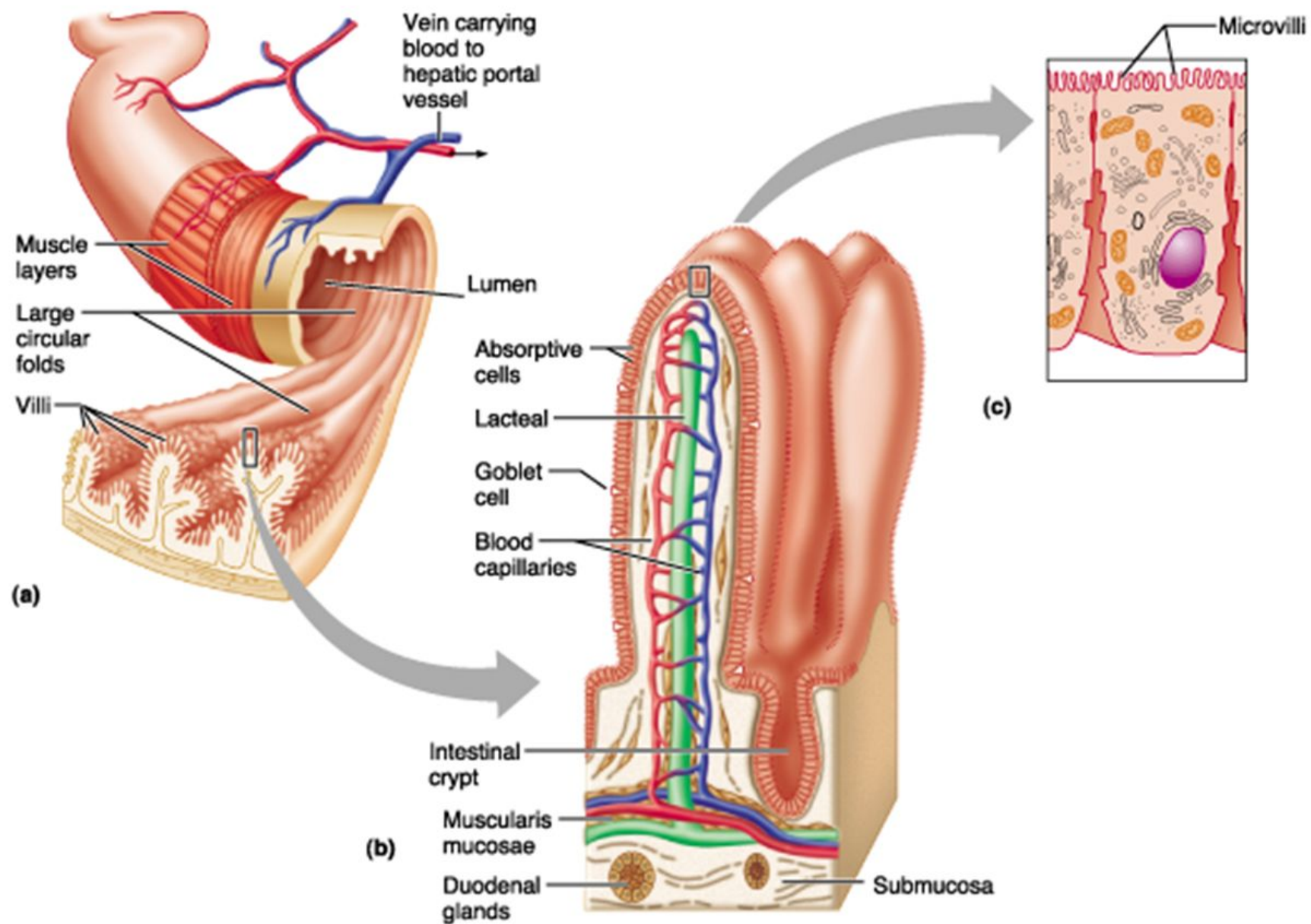
- Secreted along with other components in pancreatic juice
- 1-1.5Litres secreted daily
- **Pancreatic juice:** sodium bicarbonate, water, some salts, and enzymes
- **Pancreatic amylase** - breaks down carbohydrates
- **Trypsin** - Protein digestion
- **Chymotrypsin** - Protein digestion
- **Carboxypeptidase** - protein digestion
- Elastase - protein digestion
- Pancreatic lipase - lipid digestion
- **Ribonuclease (RNAse)**
- **Deoxyribonuclease (DNAse)**

# Liver and Gallbladder

- Hepatocytes (liver cells) secrete bile
- **Bile:** water, bile salts, cholesterol, lecithin, bile pigments, and ions
- **Bile salts** – emulsify fats so they can be more readily digested by pancreatic lipase
- Cholesterol is secreted in the bile as well – it can either be reabsorbed in the colon or, with the help of fibre binding to the cholesterol, can be excreted from the body in feces
- Gallbladder – storage for bile (constantly produced in liver)

# Intestinal Juice and Brush Border

- **Intestinal Digestive Juice** – 1-2 Litres secreted daily
  - Water and mucous – slightly alkaline
  - Role – to aid the absorption of digested macronutrients along with pancreatic secretions
- **Brush Border** – the fuzzy layer of the small intestine made up of microvilli
  - Digestive enzymes secreted to finalize digestion before absorption occurs
    - *Brush border enzymes* – carbohydrate and protein digestion primarily
      - Alpha-dextrinase, maltase, sucrase, and lactase
      - Peptidases (aminopeptidase, dipeptidase)
      - Nucleosidase and phosphatase



# Digestive Tract

## **Remarkable efficiency:**

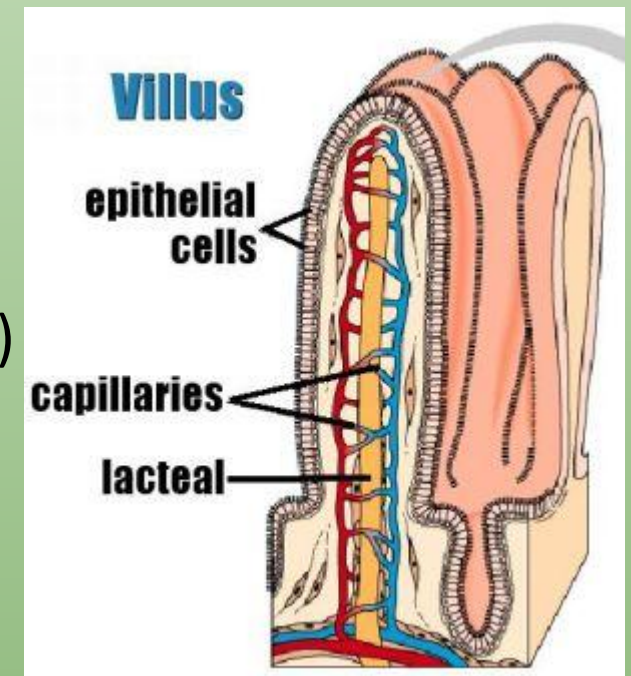
Within 24 to 48 hrs of eating, a healthy body digests and absorbs about 90% of carbohydrates, fat and protein in a meal

- <https://www.youtube.com/watch?v=goSC-1YvHVk> (~ 16 min)

# Absorption and transportation of nutrients

1. Nutrient molecules must traverse one of the cells of the intestinal lining
2. Cells absorb nutrients from mixture within intestine and deposit them in blood and lymph
3. Villi: finger-shaped projections in intestinal tract, with microvilli (hairlike projections) that can trap nutrient particles.
4. Each villus has its own capillary network and lymph vessel so nutrients can be easily transported

- <https://www.youtube.com/watch?v=-Zyk0H1HmjA> (~ 5:30 min)
- [https://www.youtube.com/watch?v=A2BW\\_UnX5c](https://www.youtube.com/watch?v=A2BW_UnX5c) (~ 23:14 min)



# When I eat more than my body needs, what happens to the extra nutrients?

Excess energy-containing nutrients mainly stored in 2 forms:

1. **Glycogen** (carbohydrate) in muscle and liver
2. **Fat (triglycerides)** in fat cells



*Chemical digestion of all nutrients mainly occurs  
in which organ?*

1. Mouth
2. Stomach
3. Small intestine
4. Large intestine

*Which chemical substance released by the pancreas neutralizes stomach acid that has reached the small intestine?*

1. Mucus
2. Enzymes
3. Bicarbonate
4. Bile

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*Bile starts the process of protein digestion in the stomach*

**TRUE**

**FALSE**