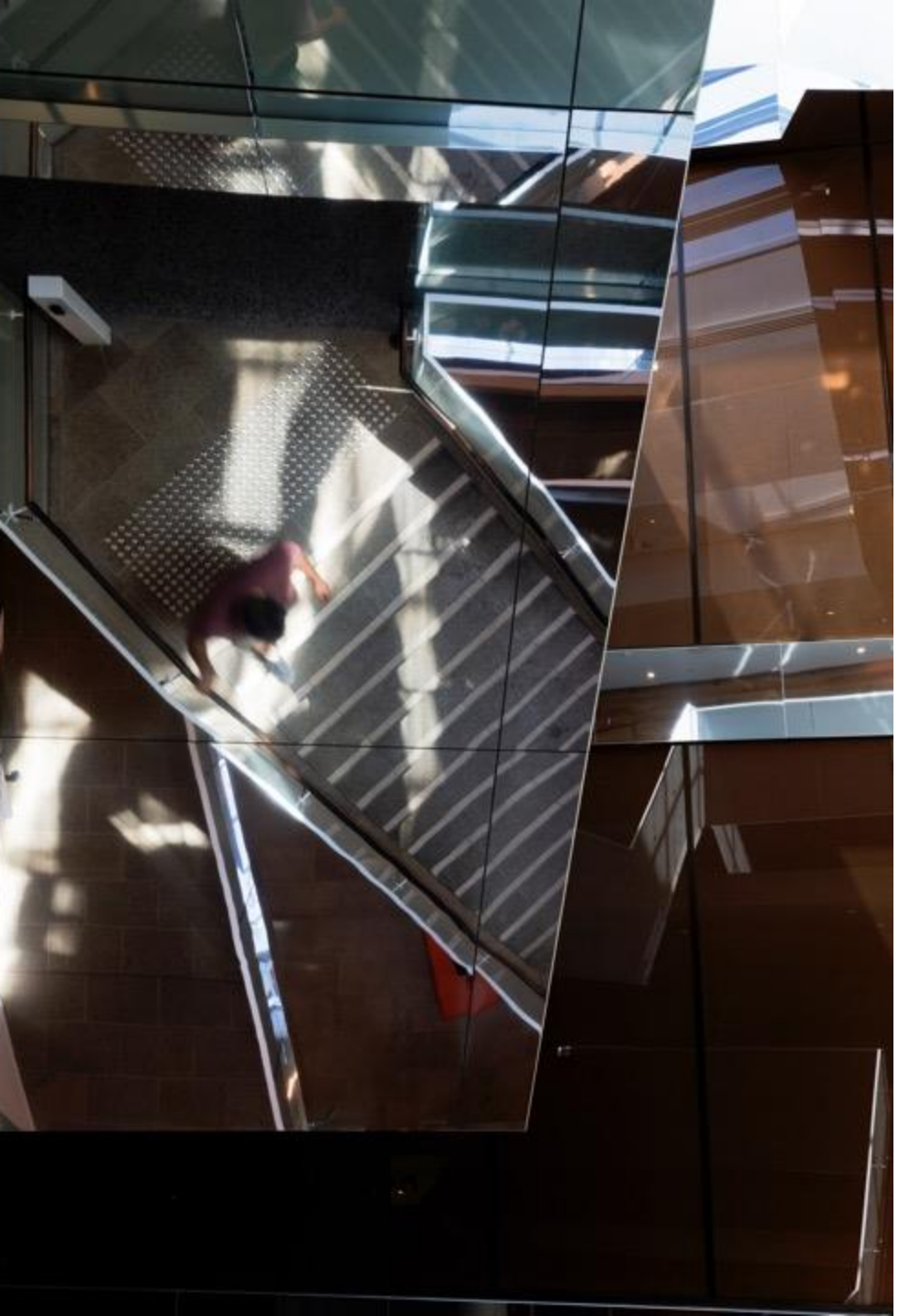

Ask Weber session 6

Weber Liu

THE UNIVERSITY OF SYDNEY

Digestion

Topic 16

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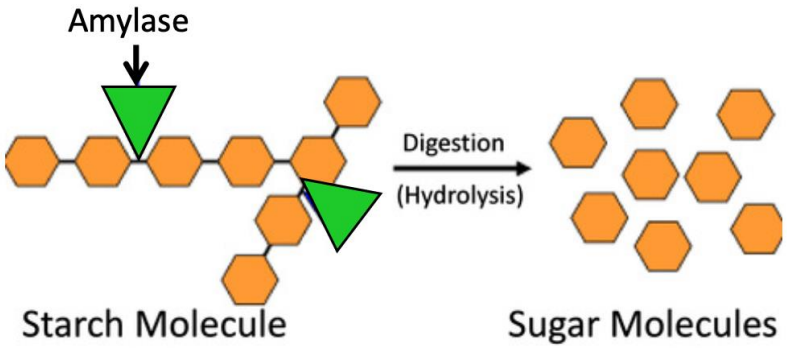
Alimentary canal anatomy

- **The alimentary canal is 9m long, but it covers 30-40m2 surface area – what structure within this canal allows it to maximise its surface area in this manner?**
  - Rugae (macro structures) and microvilli (micro structures) maximise the surface area by 'folding' the mucosa
  - Villi as well

- **Name the 3 pairs of major salivary glands, and relate their names to their anatomical locations**
  - Parotid
  - Sublingual
  - submandibular

Biomolecular metabolism

- **How are starch molecules metabolized in the body?**
  - Serous fluids in saliva moistens the food, dissolves it, and contains enzymes (e.g. amylase) to convert carbohydrates like starch into sugar



Physiology of swallowing

- **If you drank water whilst hanging upside down, the water would still flow against gravity – what process allows your body to achieve this?**
  - Peristaltic contractions along the oesophagus allows the pushing of a food bolus into the stomach – the remainder of the movement is enabled by continued peristaltic movement in the gut
- **Based on your understanding on peristalsis, what type of musculature would you guess the oesophagus is made of (i.e. what types of muscle cells – skeletal, smooth or cardiac?)**
  - Upper oesophagus is skeletal muscle (as you can control the initiation of swallowing), but the lower 2/3 of the oesophagus is not under conscious control – this component is smooth muscle

Stomach anatomy

- **What part of the stomach secretes HCl?**
  - Body of the stomach (from the parietal cells, which are from the gastric mucosa) forms HCl
- **Given that the stomach is described as a 'muscular sac', what kind of muscle cells is the stomach made of?**
  - Smooth muscle – no part of stomach contraction is under conscious control
- **Why does the stomach need to be made of muscle?**
  - Digestion and 'churning' involves muscular movements
  - Movement of food down the canal requires peristalsis, which involves muscular contractions

Digestive physiology

- **What are the components of 'gastric juice'**
  - HCl (acid)
    - Antimicrobial, aids in hydrolysis and proenzyme activation
  - Enzymes (e.g. pepsinogen)
    - Pepsin is largely a protease
  - Alkaline mucus
    - Protection of stomach lining from HCl and pepsin
  - Intrinsic factor
    - Allows VB12 absorption

- **When elderly people (e.g. with knee pain) take Non-steroidal anti-inflammatories (e.g. Nurofen, Diclofenac, Voltaren), the side effect of these drugs is that the stomach lining stops producing alkaline mucus – what issues will this cause**
  - HCl and pepsin can attack the stomach wall, break down the stomach tissue, leading to stomach ulcers, etc.

Digestive neurophysiology

- **Stage 1: Pre-consumption hunger**
  - Why do you get hungry BEFORE you eat food?
    - Sight, smell, thought of food stimulates medulla (midbrain)
    - Midbrain activates Cranial Nerve X (Vagus nerve)
    - Vagus nerve is **parasympathetic (think rest and digest)** which will activate digestive organs and increase blood flow for digestion
    - Gastrin is released, which stimulates hunger and further gastric 'juice' secretion
- **Stage 2: Acid release upon eating food**
  - Eat food – bolus fills the muscle bag that is the 'stomach'
  - Stomach stretch induces a local reflex which causes gastric glands to further secrete gastrin and other gastric 'juices'
  - This can also propagate movement of substances down into the intestine

Intestinal secretions

- **What are the accessory organs connected to the small intestine, and what do they secrete?**
  - Gall bladder and liver
    - Stores 'bile' – which is basic, and allows dissolving of fats
  - Pancreas
    - Creates enzymes – breaks down fats, proteins, etc.
    - Creates HCO3- which is basic

- **What causes the accessory organs connected to the intestines to secrete?**
  - Acid in duodenum
    - Wants the secretion of basic substances -> causes GB to secrete bile and causes pancreas to secrete HCO3-
    - *secretin*
  - Fat in duodenum
    - Wants the breakdown and dissolution of fat -> causes GB to secrete bile, and causes pancreas to secrete enzymes
    - *cholecystokinin*

Digestive endocrinology

- **Which hormones INCREASE gastric motility, and which ones REDUCE gastric motility?**
  - Gastrin – pushes stuff OUT of the stomach
  - Secretin and cholecystokinin – STOPS movement of stuff out of the stomach

Digestive biochemistry

- **Guess the function of the following enzymes**
  - Peptidase
  - Sucrase
  - Maltase
  - Lactase
  - Carboxypeptidase
  - Amylase
  - Lipase
- **Why do you think people with lactose intolerance get diarhoea after eating lactose?**
  - Lactose is not broken down as they lack lactase – this results in an osmotic drawing of fluid from the gut into the lumen, causing diarrhoea

Small intestine physiology

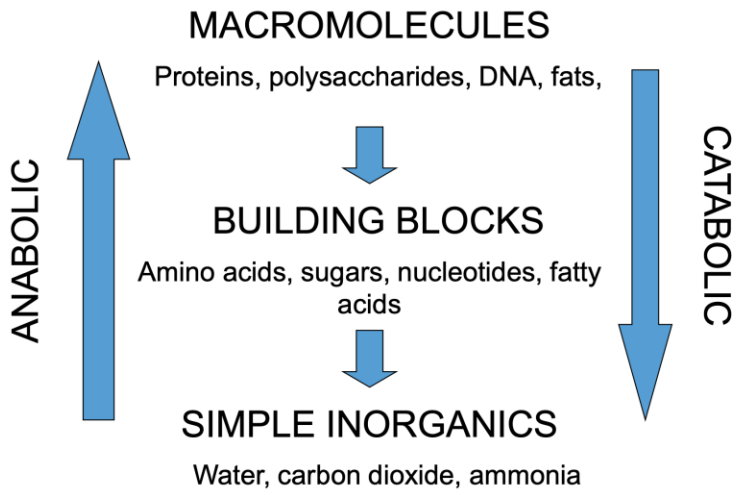
- **What are the two absorption routes for nutrients in the digestive system?**
  - Water soluble nutrients can be absorbed through the capillaries along the intestines
  - Long chain fatty acids are too big to fit in these capillaries – they generally need to be absorbed by nearby lymphatic vessels
- **What is the route taken by substances that are water soluble?**
  - Capillaries surrounding the intestines
  - These join together to form the **superior** or **inferior mesenteric veins**
  - These will join to form the portal vein
  - These will then move through the liver (where first-pass hepatic metabolism takes place)

Cellular respiration

Topic 17

Metabolic definitions

- **Explain the difference between catabolism and anabolism in terms of molecular formation/breakdown and use of energy**
  - Think of 'anabolic steroids'
    - i.e. what the body builders use to get BIG



Respiratory biochemistry

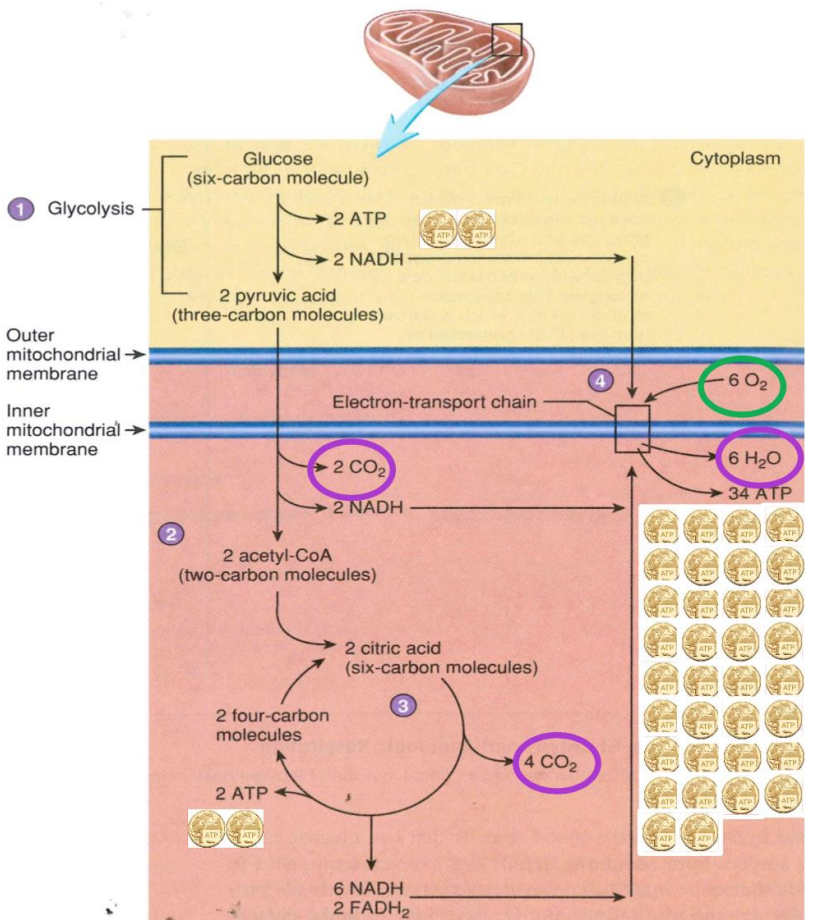
- **Where does glycolysis occur and what is its function?**
  - Cell cytoplasms
  - Glycolysis is the lysis 'breakdown' of glyco (glucose) – it is the first step for any respiration, but this process itself is catabolic and produces energy
- **What are the products of glycolysis?**
  - 2 x pyruvate
  - ATP (net 2 gain)
  - NADH
  - H2O

Respiratory biochemistry

- **How does your body determine if it should undertake anaerobic or aerobic respiration after glycolysis?**
  - Your body assess if there is enough oxygen for aerobic respiration (e.g. if there is ENOUGH in a situation of increased demand)
  - You will tend to see this happening if you reduce supply or increase demand
- **What does anaerobic respiration produce, and how does your body deal with it?**
  - Lactic acid – this can cause your body to become more acidic (part of the reason why you would also breathe faster – to remove acidic CO2)
  - Metabolised by the liver to form pyruvate again

Aerobic respiration biochemistry

- **What are the steps of aerobic respiration**
  1. Glycolysis - 'preparation of glucose'
  2. Acetyl-CoA formation – occurs as pyruvate moves into the mitochondria
  3. Citric acid cycle – Formation of (some) ATP, but produces the H+ and e- carriers (FADH2, NADH)
  4. Electron transport chain



Electron transport chain

- **Describe the function of the complexes within the electron transport chain**
  1. Complex 1 – breakdown of NADH (produces 2e- and H+)
  2. Complex 2 – breakdown of FADH2 (produces 2e- and 2H+)
  3. Complex 3 and 4 – uses e- to drive H+ into intermembrane space
  4. Complex 4 – Removes H+ in inner mitochondrial compartment through water formation (to maintain a H+ gradient)
  5. ATP-synthase – forms ATP through coupling reaction with H+ gradient movement (oxidative phosphorylation)
  6. Carrier molecules transports ATP out in return for ADP + P-