Breakdown and absorption

Carbohydrates

Digestion starts in the mouth, turning the carbs into disaccharides using lingual lipase and salivary amylase to make starch into maltose.

Digestion mostly happens in the stomach with the pancreas producing and releasing the enzymes.

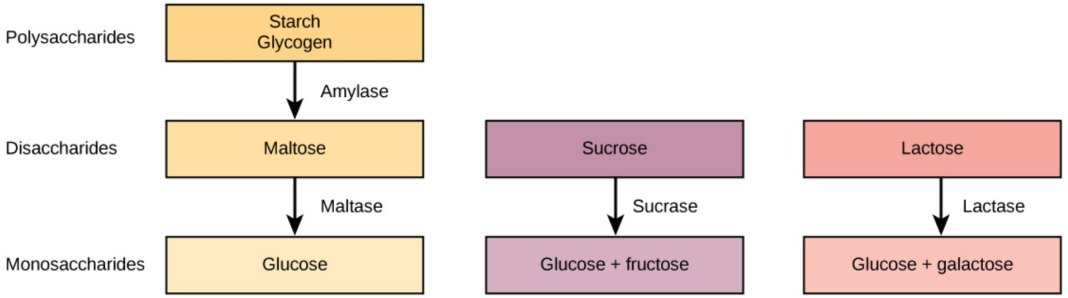
Monosaccharides like glucose and galactose go into the cell using a sodium glucose symporter. It is active because it uses sodium potassium ATPase to pump into the cells to make an osmotic gradient.

Transporter types

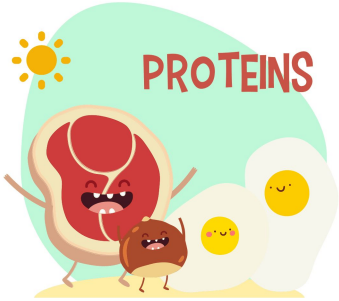
GLUT2 receptors push sugars from the basolateral membrane to the blood then the liver.

Fructose uses GLUT5 to enter cell which

(doesn't depend on sodium)



Proteins



HCl in the stomach will break up the tertiary structure of the proteins.

Proteins are broken down in the stomach using pancreatic protease into monopeptides, dipeptides, tripeptides and amino acids. These will then be broken down further into amino acids using peptidase in the brush border.

Protease enzymes are activated by zymogens into their active form.

Pepsinogen is released from enterokinase cells and becomes pepsin, but the other protease such as chymotrypsinogen and trypsinogen are made in the pancreas.

Peptides are transported across the apical membrane using active transport or Na+ dependent transporters

Lipids

In the mouth the fats are broken down into smaller pieces, then bile salts will mix with the lipid droplets into micelles.

Micelles can be broken down by lipase into fatty acids and monoglycerides.

These are absorbed into the phospholipid bilayer into mucosal cells endoplasmic reticulum.

In the ER the triglycerides become chylomicrons, which transport triglycerides and cholesterol from the intestines.

The chylomicrons are then exocytosed into the adipose tissue in the lymph system.

In the adipose tissue chylomicrons are broken down into fatty acids and a chylomicron remnant.

The fatty acid are stored as triacylglycerol in the adipose.

The chylomicron moves to the liver to become cholesterol and binds to triacylglycerol (made by glucose)

This complex goes back to the adipose as very low density lipoprotein.

Small intestine

Vitamin D,E,A,K are absorbed in the jejunum - these are fat soluble.

Calcium, iron and magnesium are absorbed in the duodenum.

- Fe3+ is reduced into Fe2+ using membrane transporter protein ferrireductase
- Fe2+ enters the cell through membrane by divalent metal transporter 1.
- Once it goes to the blood it becomes Fe3+ using hephaestin
- Fe3+ in the blood binds to transferrin
- Calcium is associated with vitamin D.

Bile salts and vitamin B12 (cobalamin) are absorbed in the terminal ileum.

- B12 needs intrinsic factor for absorption
- B12 is used in making RBC

Short chain fatty acids such as butyrate are absorbed in the colon.

Question 1

What is used to absorb glucose and galactose?

1. GLUT2 receptor
2. Active transport
3. Diffusion
4. GLUT5 receptor
5. Na+ cotransport

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Question 2

Which vitamin needs intrinsic factor to be absorbed?

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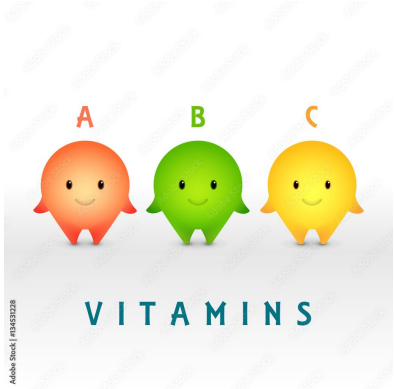
2. Vitamin B12
3. Vitamin K
4. Vitamin A
5. Vitamin E



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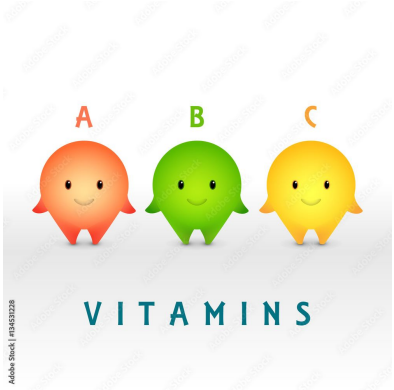


Water absorption

In the small intestine water is mostly absorbed in the jejunum using a nutrient sodium coupled transport.

Water is absorbed through aquaporins transcellular proteins through cells, using aquaporin 10 on the apical surface and aquaporin 3 from the cell into the blood.

Water can pass paracellularly using osmosis with sodium in the same direction

When water is secreted it goes through paracellularly into the lumen through osmosis. This is stipulated by acetylcholine and VIP by increasing chloride ion output into the lumen.

Mechanical GI defence

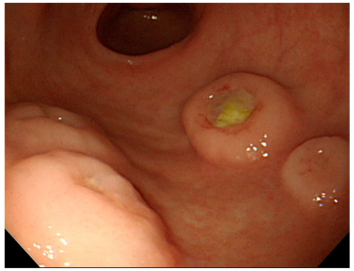
Vomiting is used to remove toxins from the body, and can be triggered by the taste of a food, a toxin, irritation in the mouth or the foods contents itself.

It is detected by the vagal afferent nerve to the nucleus tractus solitarius and postrema area in the medulla oblongata (AKA the vomiting centre)

Mechanism

- Phrenic nerve contracts diaphragm to increase abdominal pressure
- Vagus nerve causes duodenum and pylorus to contract and stop food from exiting the stomach
- The antrum contracts and the upper and lower esophageal sphincters relax
- The pressure increase forces the stomach contents up and out the mouth

GI defence



Mucus - bicarbonate barrier

Mucous is made up of mucin glycopeptides that is used to trap water and bicarbonate and pathogens from entering the cells..

If there is an excess of H+ then the mucous will stop it from entering the cell and the tight junctions between the cells cause H+ diffusion to slow down and the H+ is carried away safely by the blood.

Prostaglandins (made of arachidonic acid) will stimulate the release of bicarbonate, inhibit histamine and HCl release and maintain mucosal blood flow and epithelial restitution.

Restitution of mucus - bicarbonate barrier

If the HCl gets to the epithelial cells and damages them, then peptic ulcers can form.

They are detected by vagal afferent fibres to the CNS to detect pain, and then vagal efferent fibres will release NO and CGRP.

These cause local vasodilation to i increase blood flow to remove acid and prevent harm.

Other factors used in healing growth mucosa are gastrin, prostaglandins and growth factors

Peyer's patches

Peyer’s patches - Tiny lymph nodes that keep intestinal flora at an appropriate level to stop pathogens and prevent infection.

M cells are found inside Peyer’s patches and are in the ileum and aggregate into little lymphoid tissues.

These cells will detect pathogens, absorb them and present them to the immune system on the basolateral membrane to promote an immune response using mast cells, macrophages and T cell.

It promotes the adaptive immune response through IgA,

IgA is released into the gut lumen to increase mucous production and peristalsis and clears out the pathogen. Pro-inflammatory cytokines mediate T and B response and acute inflammation

Taste buds

It is a myth that different parts of the tongue taste for different tastes. It is all around the tongue.

Umami

- Found in foods with L-amino acids, monosodium glutamate and high protein
- Uses TIR1 and TIR3

Sweet

- Uses TIR2 and TIR3

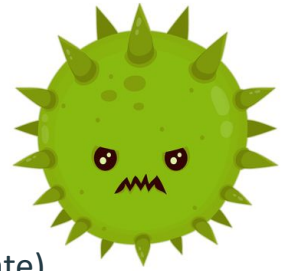
Bitter

- Uses T2R

Saltiness

- Uses ENaC

Gut microbiota



Gut microbiota synthesise vitamin K and ferment dietary fibres in SCFA (acetate and butyrate)

This allows SCFA to be absorbed in the colon and fo to the portal vein to the liver to go through first pass metabolism.

Entering metabolic pathway

- Acetate and butyrate may be converted into acetyl-CoA and utilised to form lipids and ketone bodies.
- SFTA may also enter the krebs cycle and is utilised for glucose production by gluconeogenesis

- Acetate can pass through peripheral circulation and be detected in the peripheral blood.

Question 3

What taste buds are used for foods with L - amino acids?

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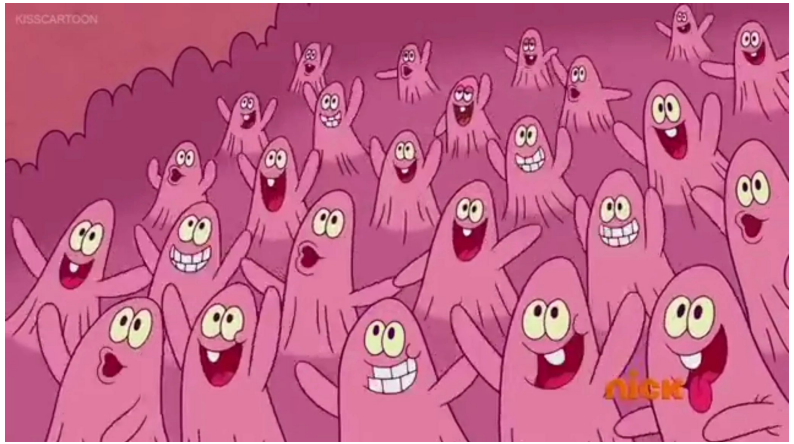
2. TIR1
3. TIR1 and TIR3
4. ENaC
5. TR2



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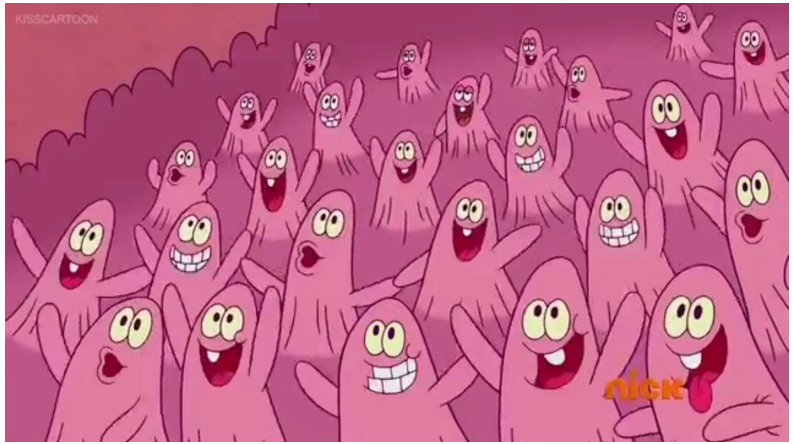

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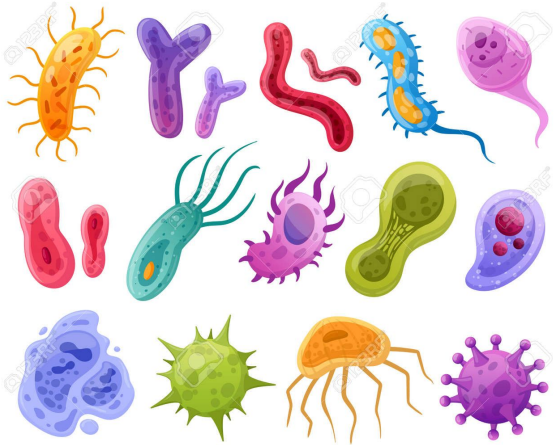
2. Vomiting
3. Increase peristalsis
4. IgA secretion
5. Macrophage recruitment



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