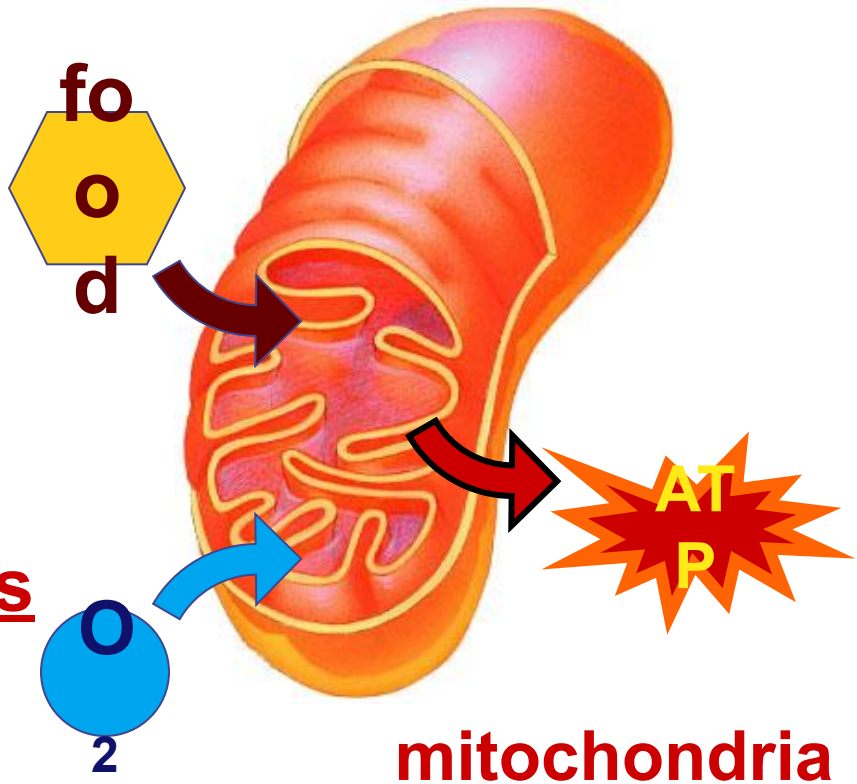
Animal Nutrition
Human Digestion

What do animals need to live?

- Animals make energy using:
  - food
  - oxygen
- Animals build bodies using:
  - food for raw materials
    - amino acids, sugars, fats, nucleotides
  - ATP energy for synthesis



How do animals get their food?

filter feeding

living in your food

fluid feeding

bulk feeding

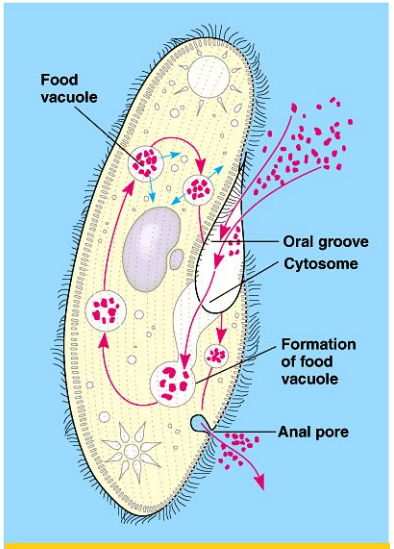

Benjamin
Cummings

Different diets; different lives

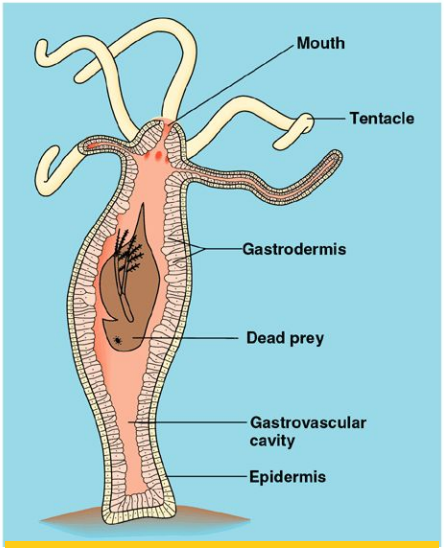
- All animals eat other organisms
  - Herbivores
    - eat mainly plants
      - gorillas, cows, rabbits, snails
  - Carnivores
    - eat other animals
      - sharks, hawks, spiders, snakes
  - Omnivores
    - eat animals & plants
      - cockroaches, bears, raccoons, humans
      - humans evolved as hunters, scavengers & gatherers

Getting & Using Food

- **Ingest**
  - taking in food
- **Digest**
  - **mechanical digestion**
    - breaking up food into smaller pieces
  - **chemical digestion**
    - breaking down food into molecules small enough to be absorbed into cells
    - enzymes
- **Absorb**
  - absorb nutrients across cell membranes
    - diffusion
    - active transport
- **Eliminate**
  - undigested material passes out of body



intracellular digestion

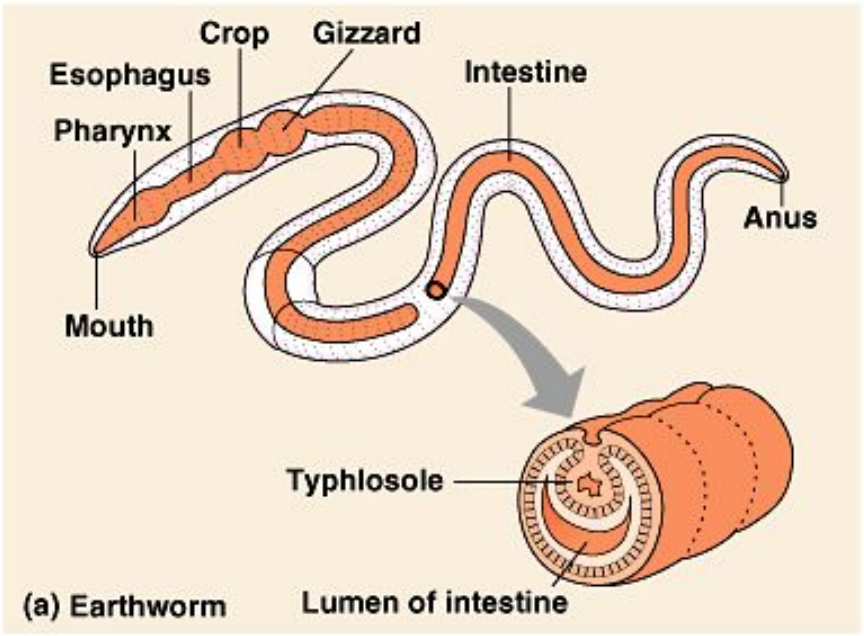


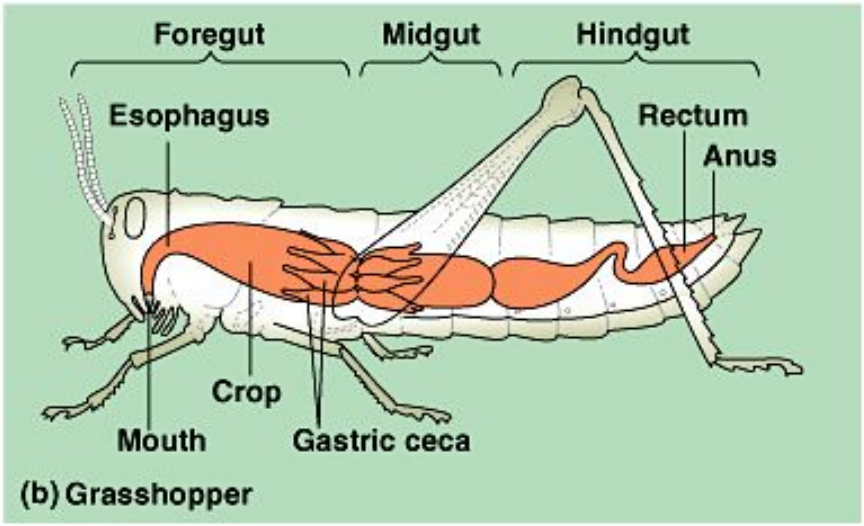
extracellular digestion

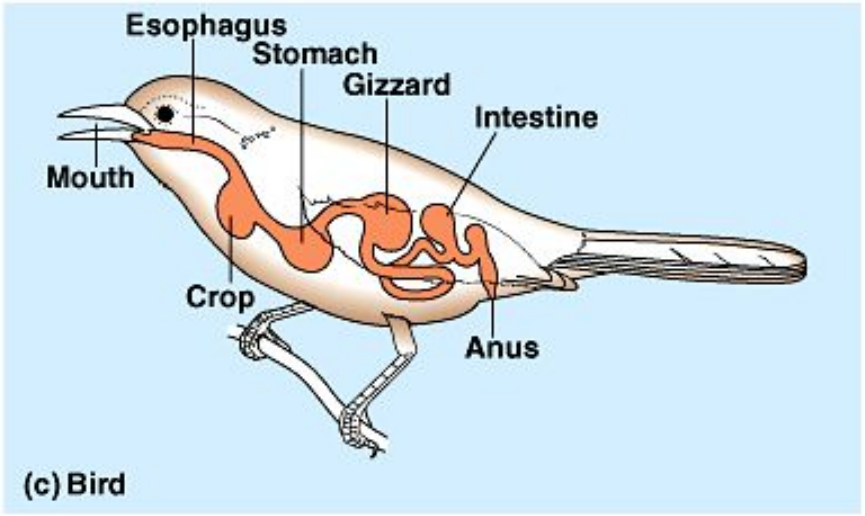
Reg

Digestive systems

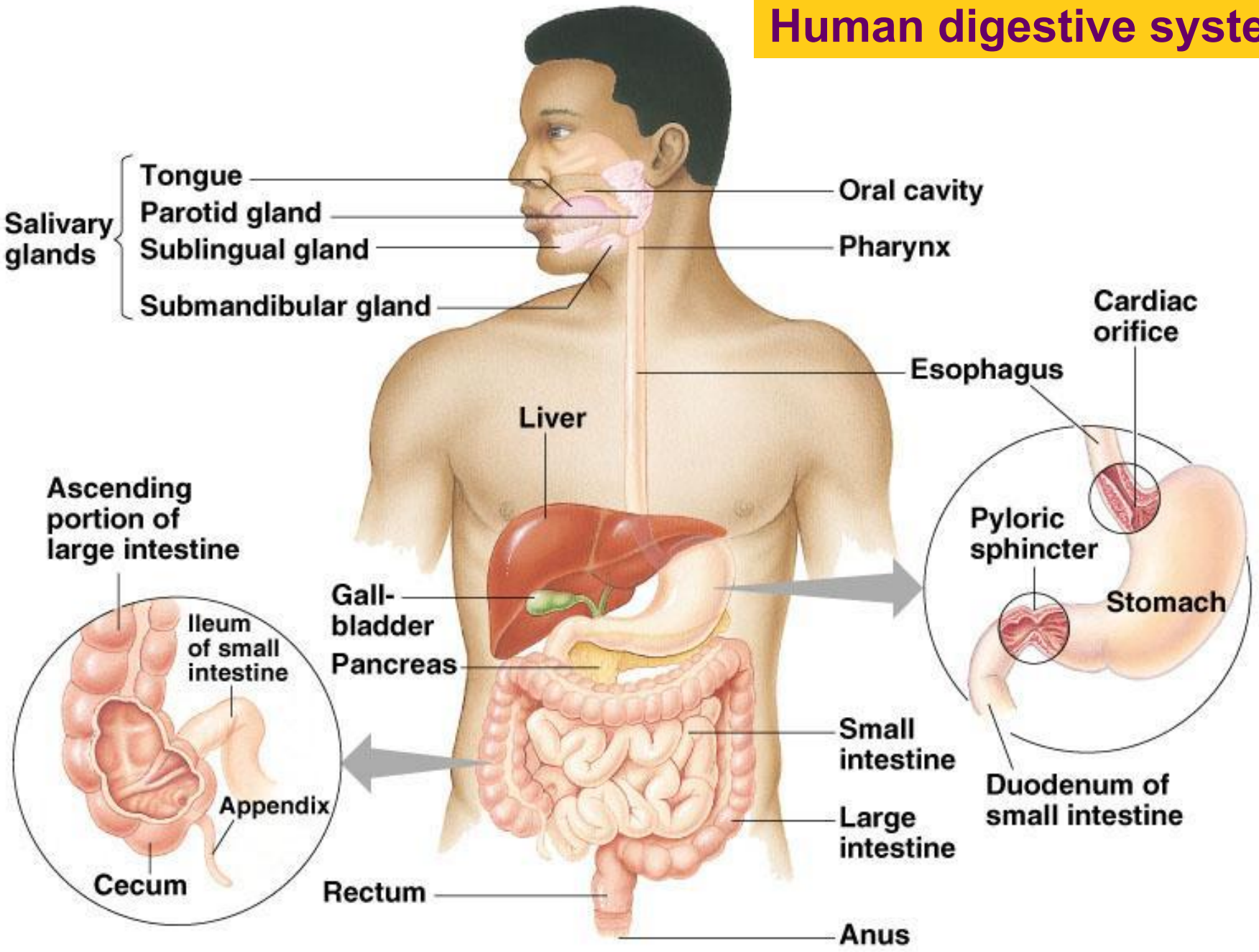
Everybody's got one!





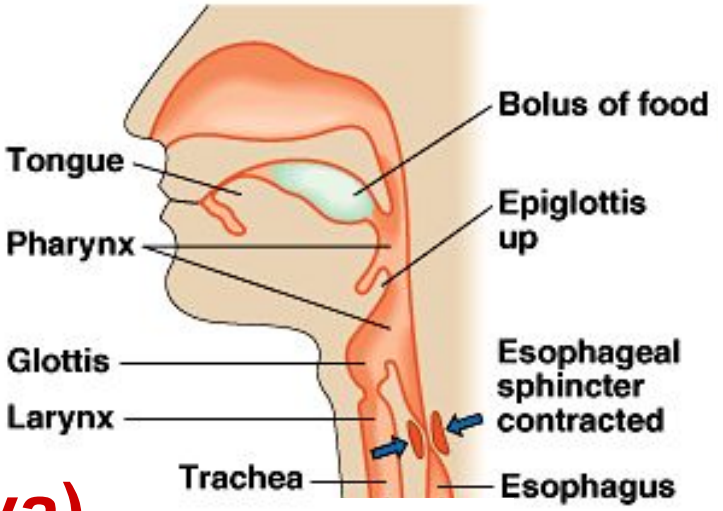


Human digestive system

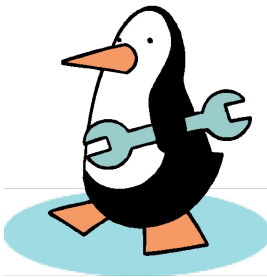


Mouth

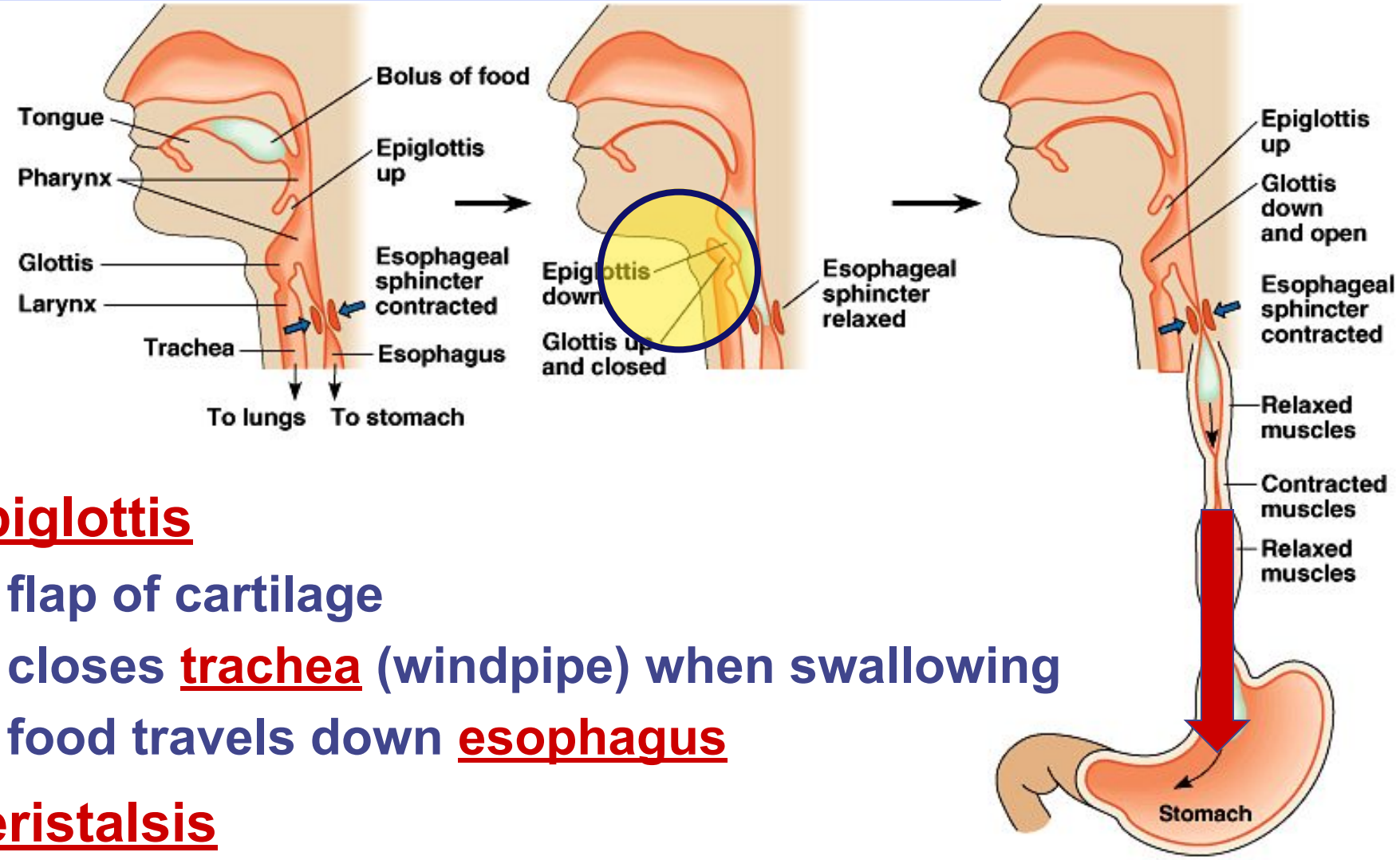
- Functions
  - mechanical digestion
    - teeth
      - break up food
  - chemical digestion (saliva)
    - amylase enzyme
      - digests starch
    - mucus
      - protects soft lining of digestive system
      - lubricates food for easier swallowing
    - buffers
      - neutralizes acid to prevent tooth decay
    - anti-bacterial chemicals
      - kill bacteria that enter mouth with food



All that in spit!



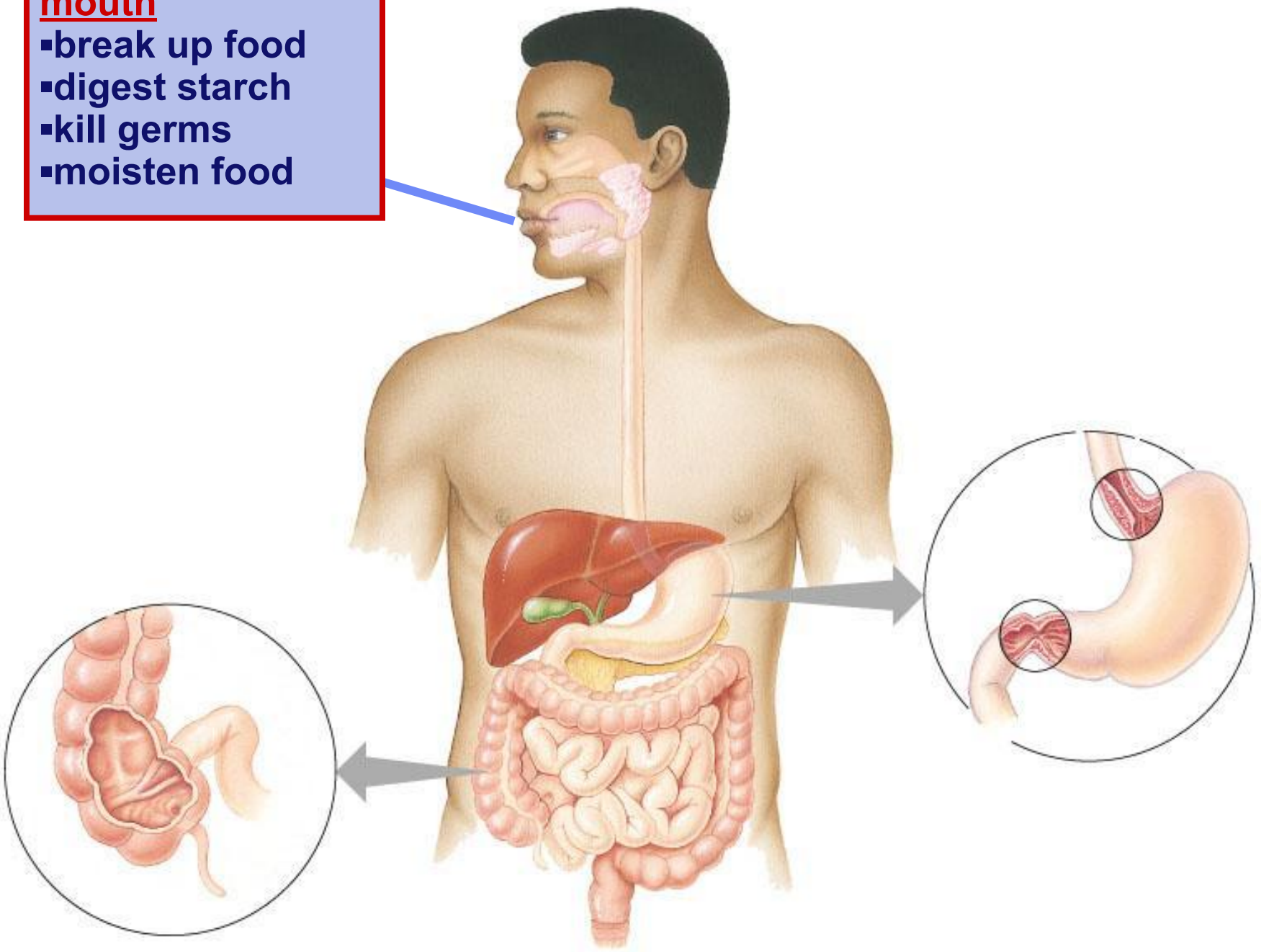
Swallowing (& not choking)



- **Epiglottis**
  - flap of cartilage
  - closes **trachea** (windpipe) when swallowing
  - food travels down **esophagus**
- **Peristalsis**
  - involuntary muscle contractions to move food along

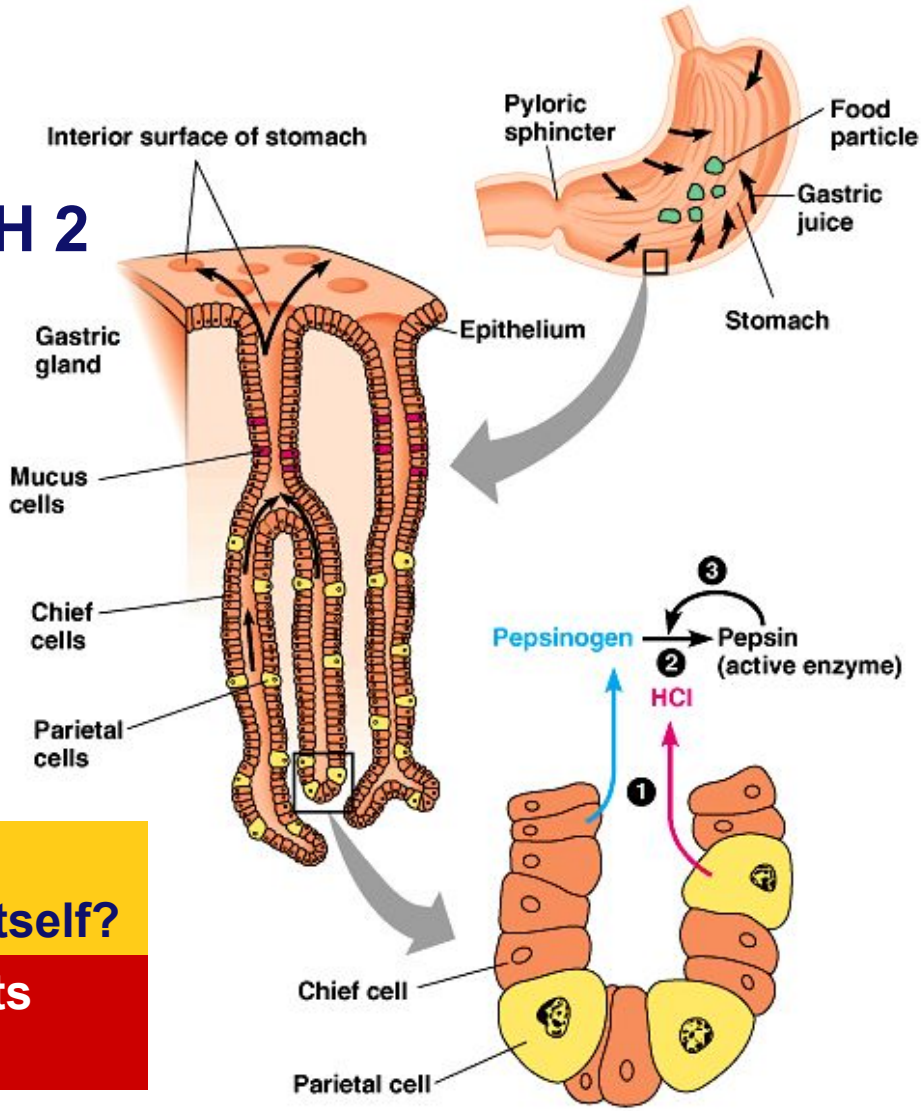
mouth

- break up food
- digest starch
- kill germs
- moisten food



Stomach

- **Functions**
  - **disinfect food**
    - hydrochloric acid = pH 2
      - kills bacteria
  - **food storage**
    - can stretch to fit ~2L food
  - **digests protein**
    - pepsin enzyme

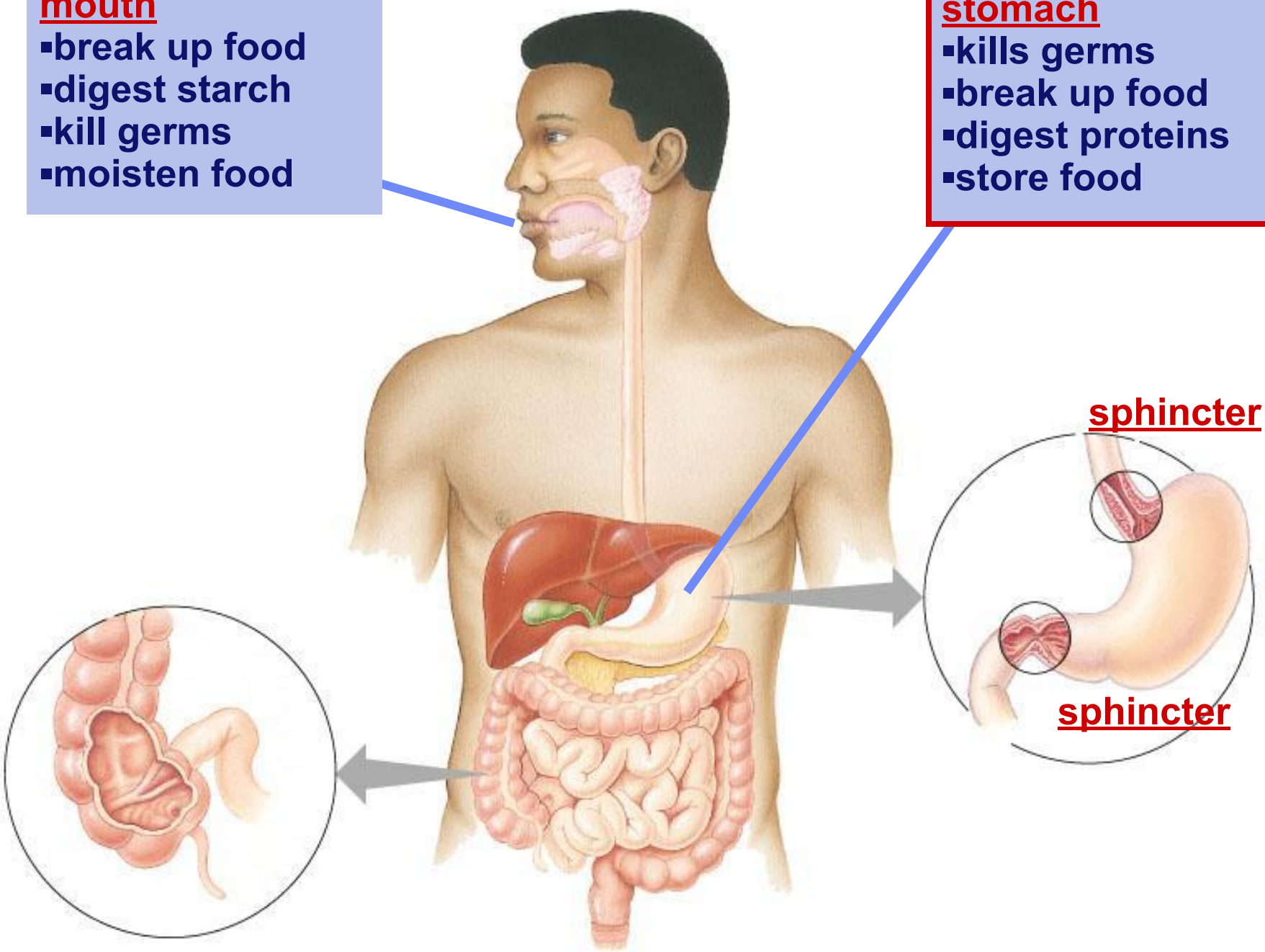


But the stomach is made out of protein! What stops the stomach from digesting itself?

mucus secreted by stomach cells protects stomach lining

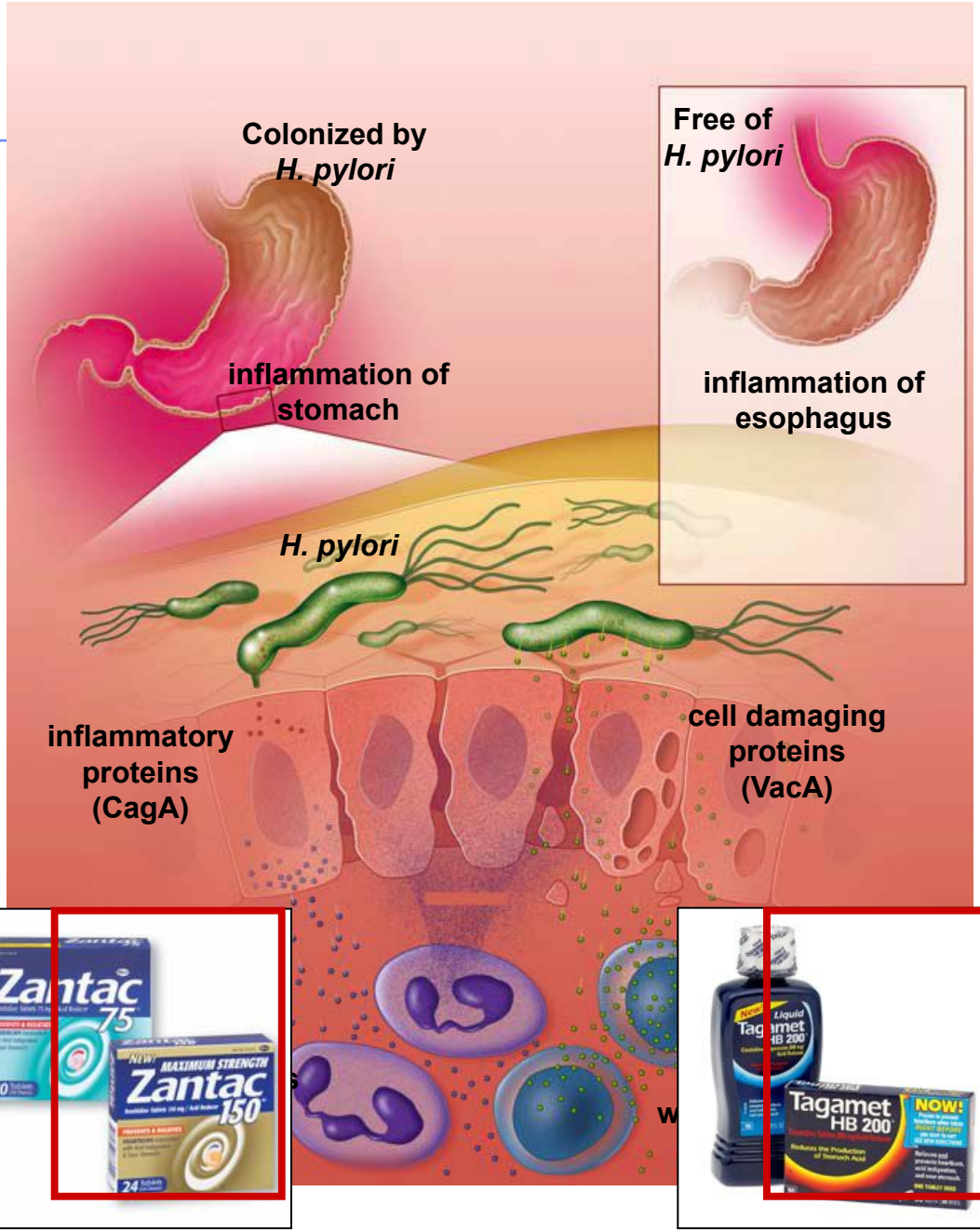
mouth
- break up food
- digest starch
- kill germs
- moisten food

stomach
- kills germs
- break up food
- digest proteins
- store food

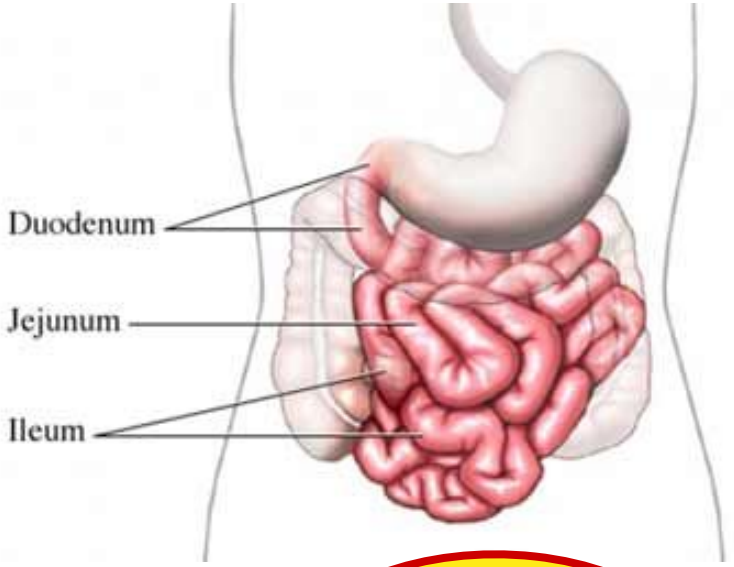


Ulcers

- Used to think ulcers were caused by stress
  - tried to control with antacids
- Now know ulcers caused by bacterial infection of stomach
  - H. pylori bacteria
  - now cure with antibiotics

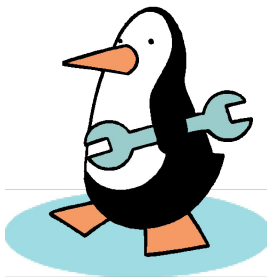


Small intestine



This is where all the work is done!

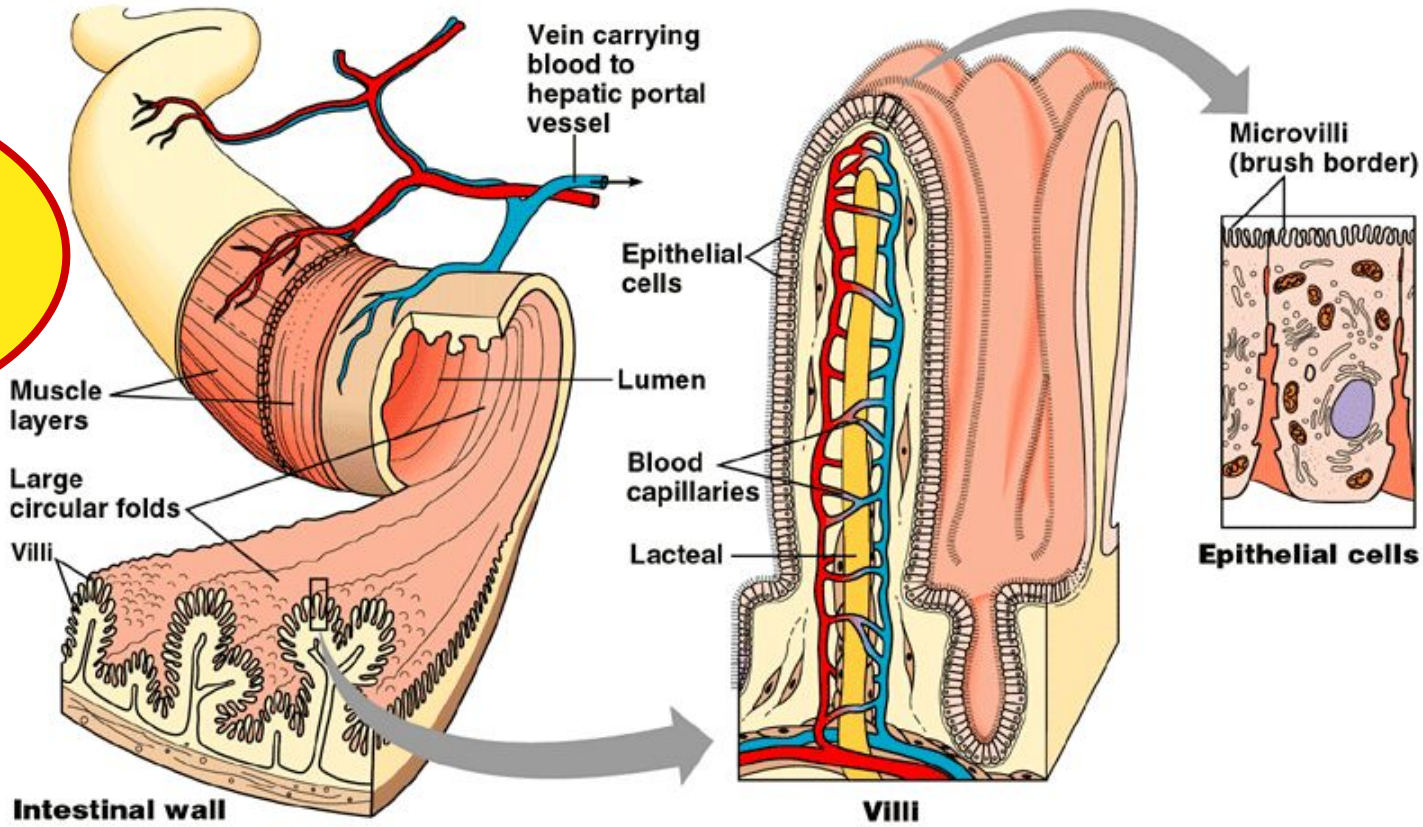
- Functions
  - digestion
    - digest carbohydrates
      - amylase from pancreas
    - digest proteins
      - trypsin & chymotrypsin from pancreas
    - digest lipids (fats)
      - bile from liver & lipase from pancreas
  - absorption
    - nutrients move into body cells by:
      - diffusion
      - active transport



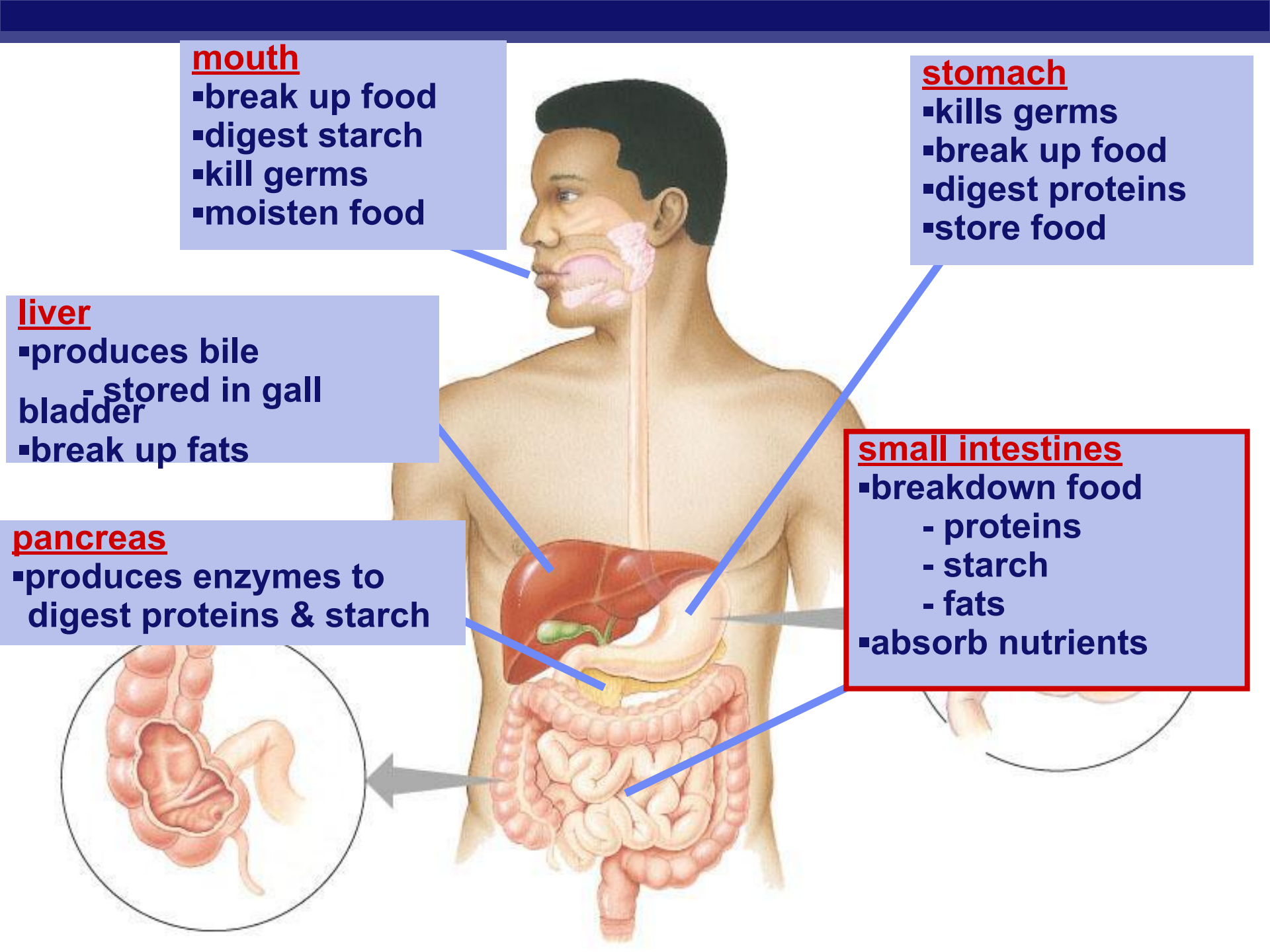
Absorption in Small Intestines

- **Absorption through villi & microvilli**
  - finger-like projections
  - increases surface area for absorption

SMALL INTESTINES 6 meters long, but can stretch to cover a tennis court

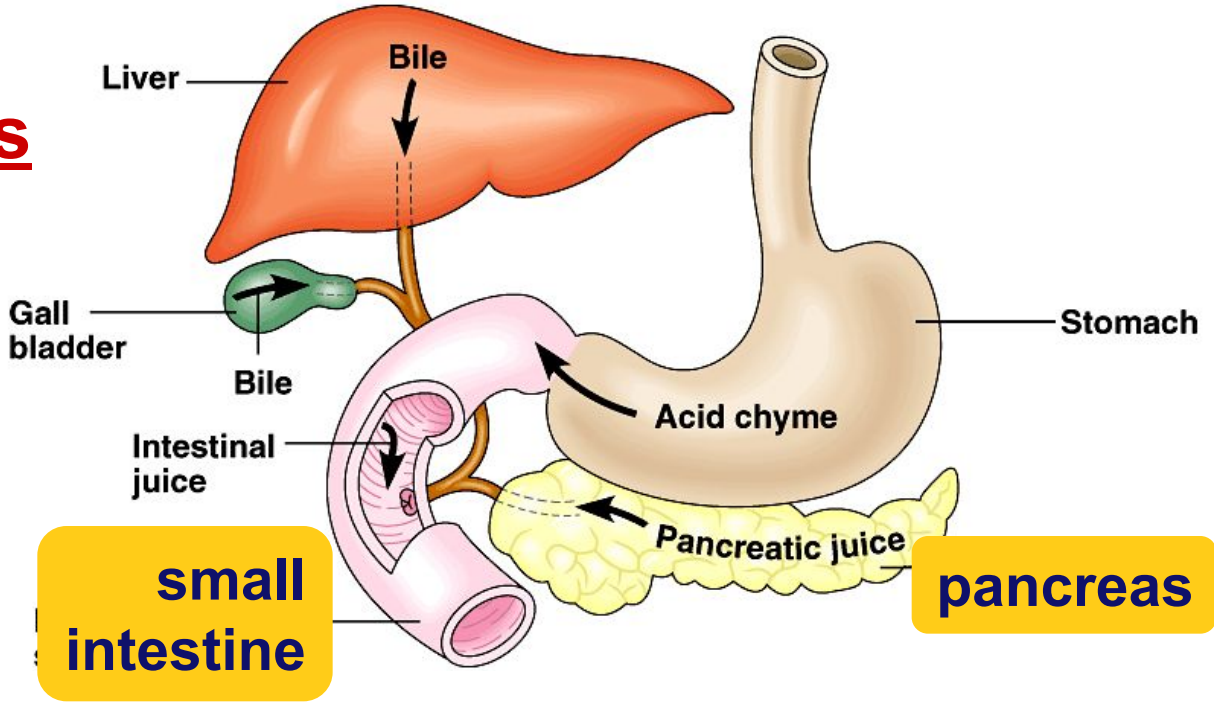


iology


mouth
▪break up food
▪digest starch
▪kill germs
▪moisten food
stomach
▪kills germs
▪break up food
▪digest proteins
▪store food
liver
▪produces bile
- stored in gall bladder
▪break up fats
small intestines
▪breakdown food
- proteins
- starch
- fats
▪absorb nutrients
pancreas
▪produces enzymes to digest proteins & starch

Pancreas

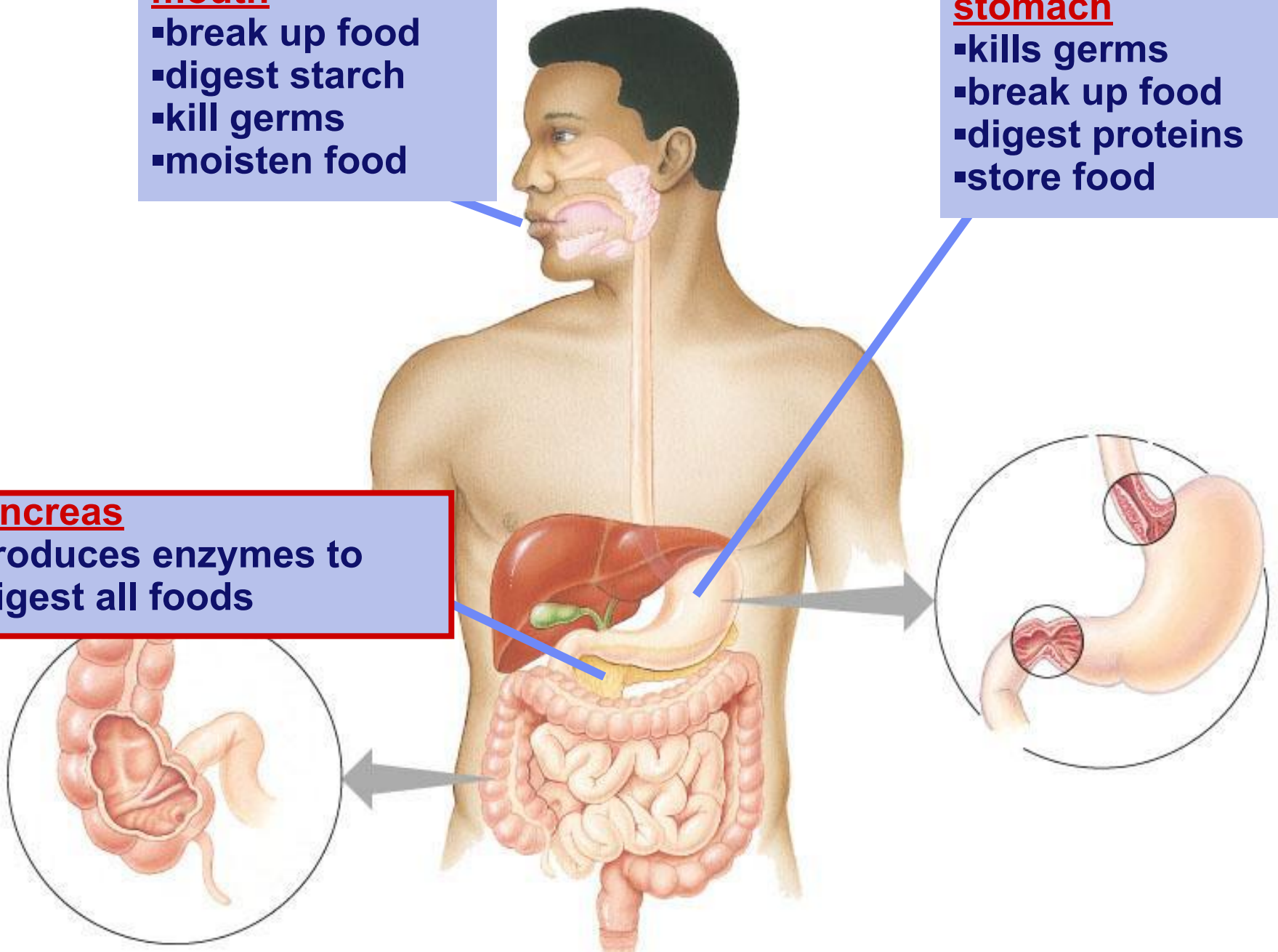
- **Produces digestive enzymes**
  - **digest proteins**
    - trypsin, chymotrypsin
  - **digest starch**
    - amylase
  - **digest lipids**
    - lipase
- **Buffers**
  - neutralizes acid from stomach



mouth
- break up food
- digest starch
- kill germs
- moisten food

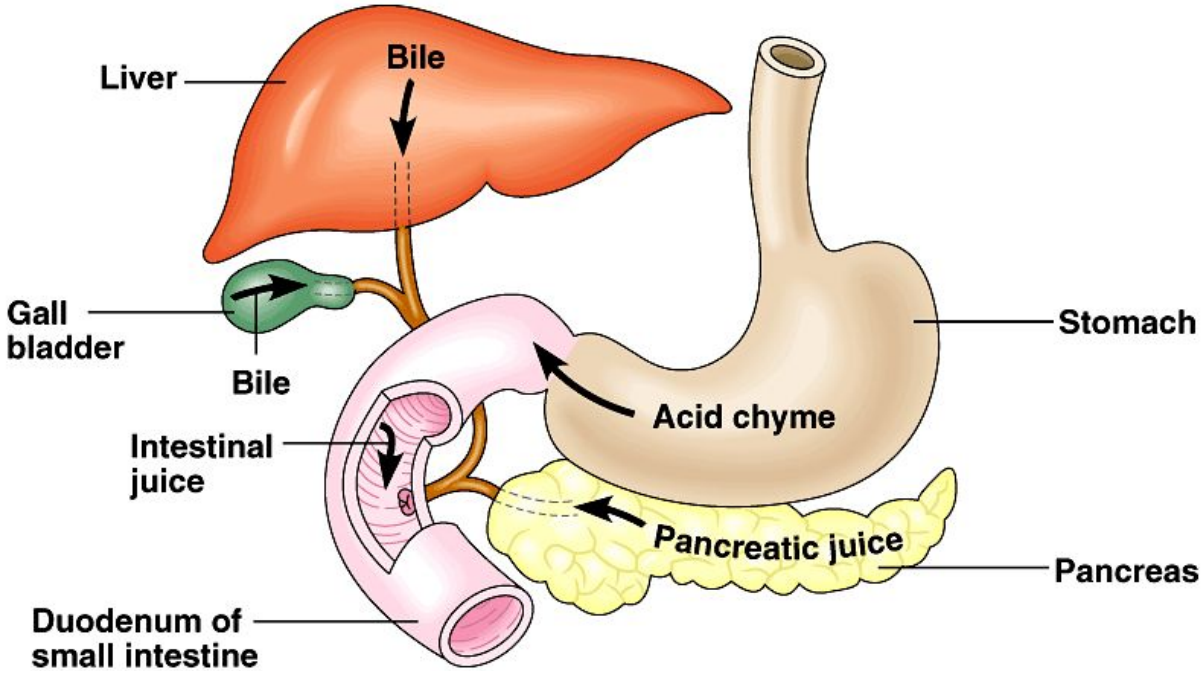
stomach
- kills germs
- break up food
- digest proteins
- store food

pancreas
- produces enzymes to digest all foods



Liver & Gall Bladder

- **Produces bile**
  - **breaks up fats**
  - **gallbladder only stores bile**
    - **that's why you can have your gall bladder removed**



bile contains colors from old red blood cells collected in liver =

iron in RBC rusts & makes feces brown

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stomach
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- digest proteins
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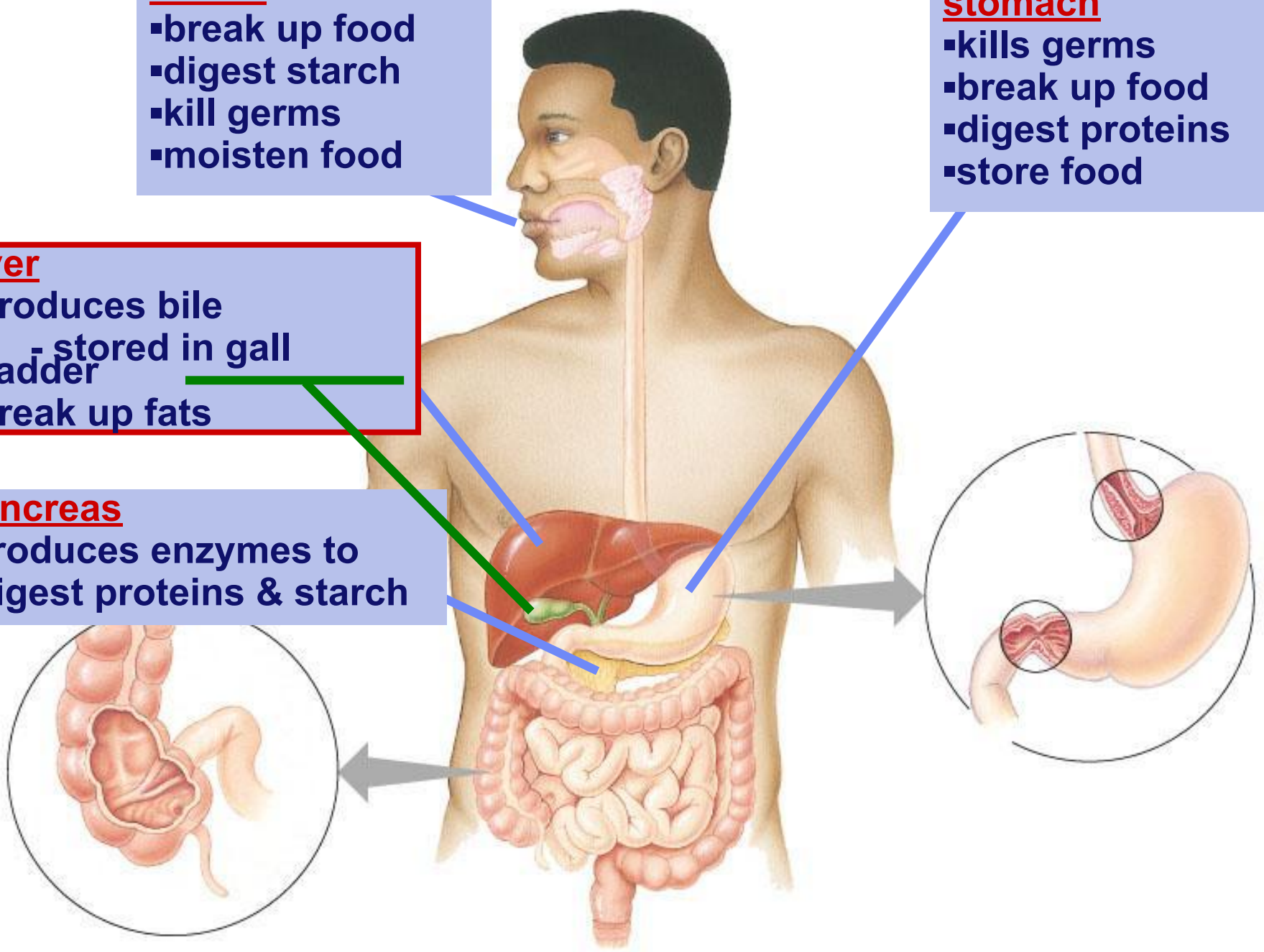
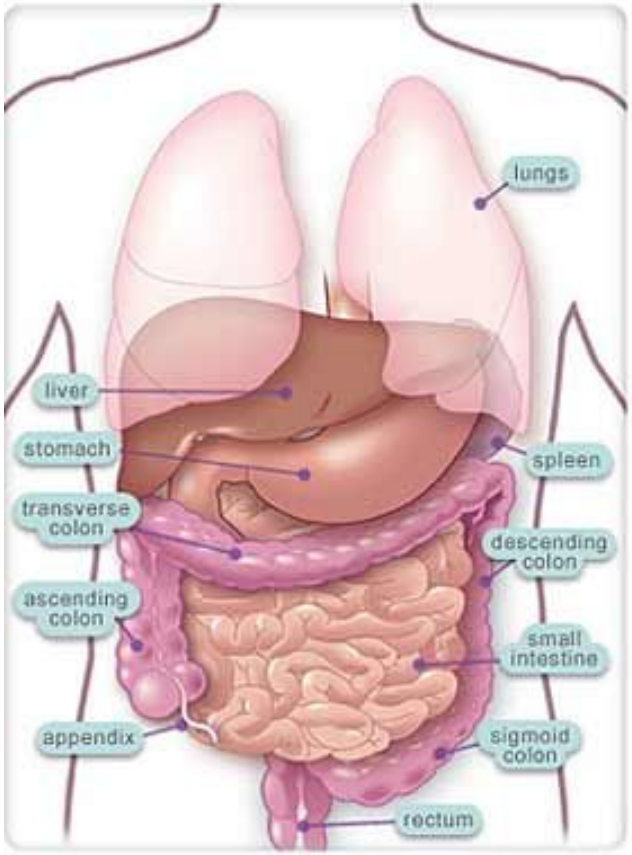
liver
- produces bile
  - stored in gall bladder
- break up fats

pancreas
- produces enzymes to digest proteins & starch



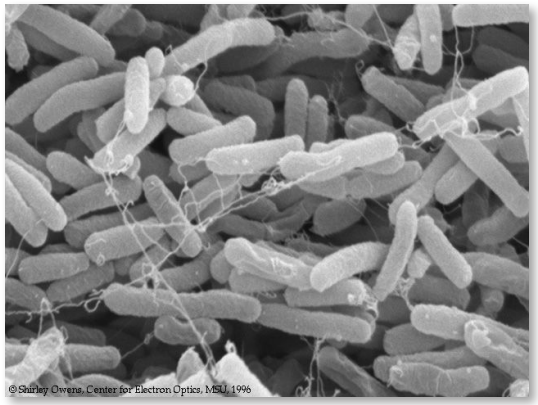
Large intestines (colon)

- Function
  - re-absorbs water
    - use ~9 liters of water every day in digestive juices
      - if don't reabsorb water would die of dehydration
    - > 90% of water re-absorbed
      - not enough water re-absorbed
        - diarrhea
        - can be fatal!
      - too much water re-absorbed
        - constipation
    - reabsorb by diffusion

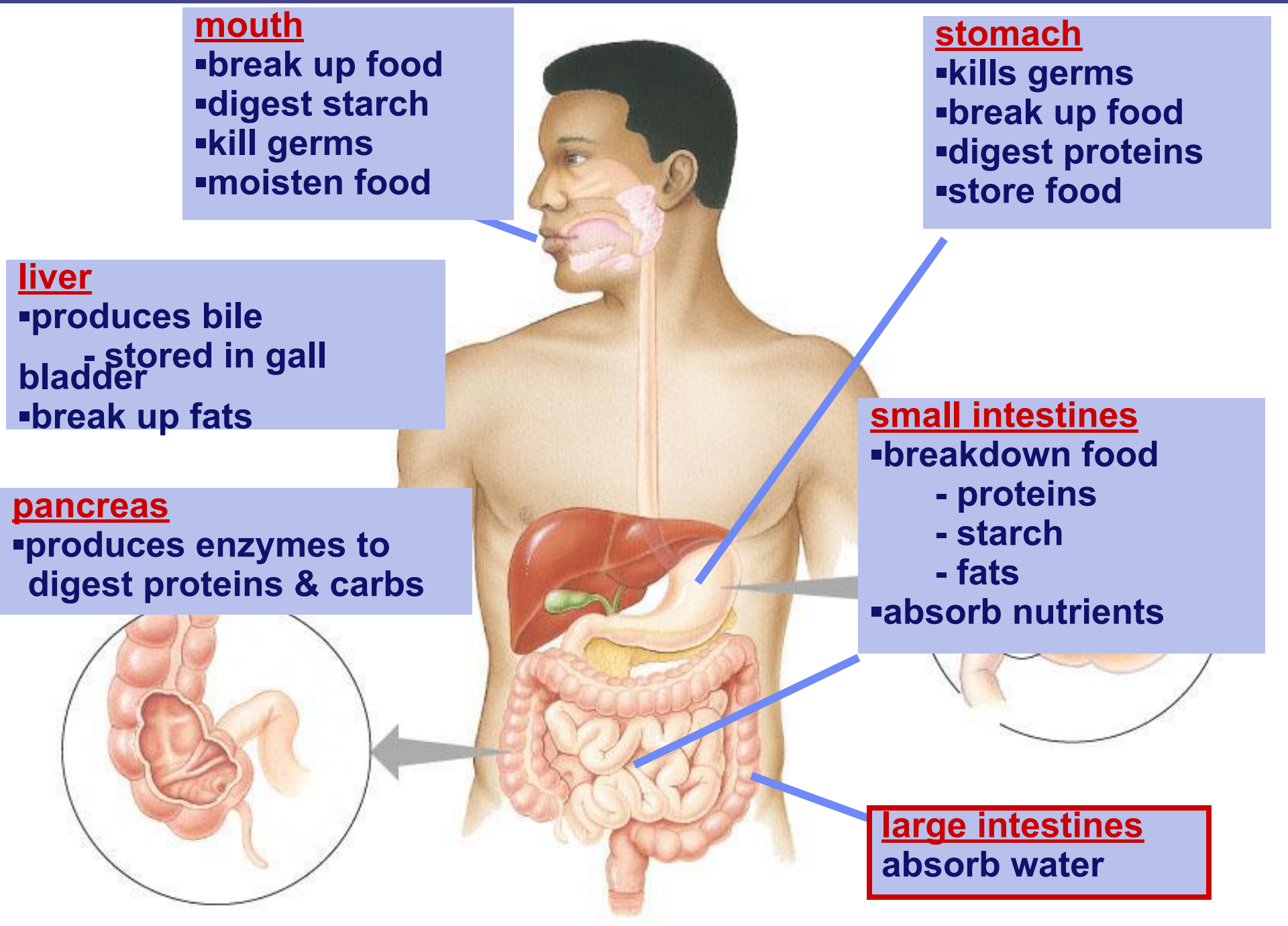


You've got company!

- Living in the large intestine is a community of helpful bacteria
  - Escherichia coli: E. coli
    - digest cellulose
      - digests fruits & vegetables
    - produce vitamins
      - vitamin K & B vitamins
    - BUT generate gases
      - by-product of bacterial metabolism
      - methane, hydrogen sulfide
      - STINKY!



PEE-YOO!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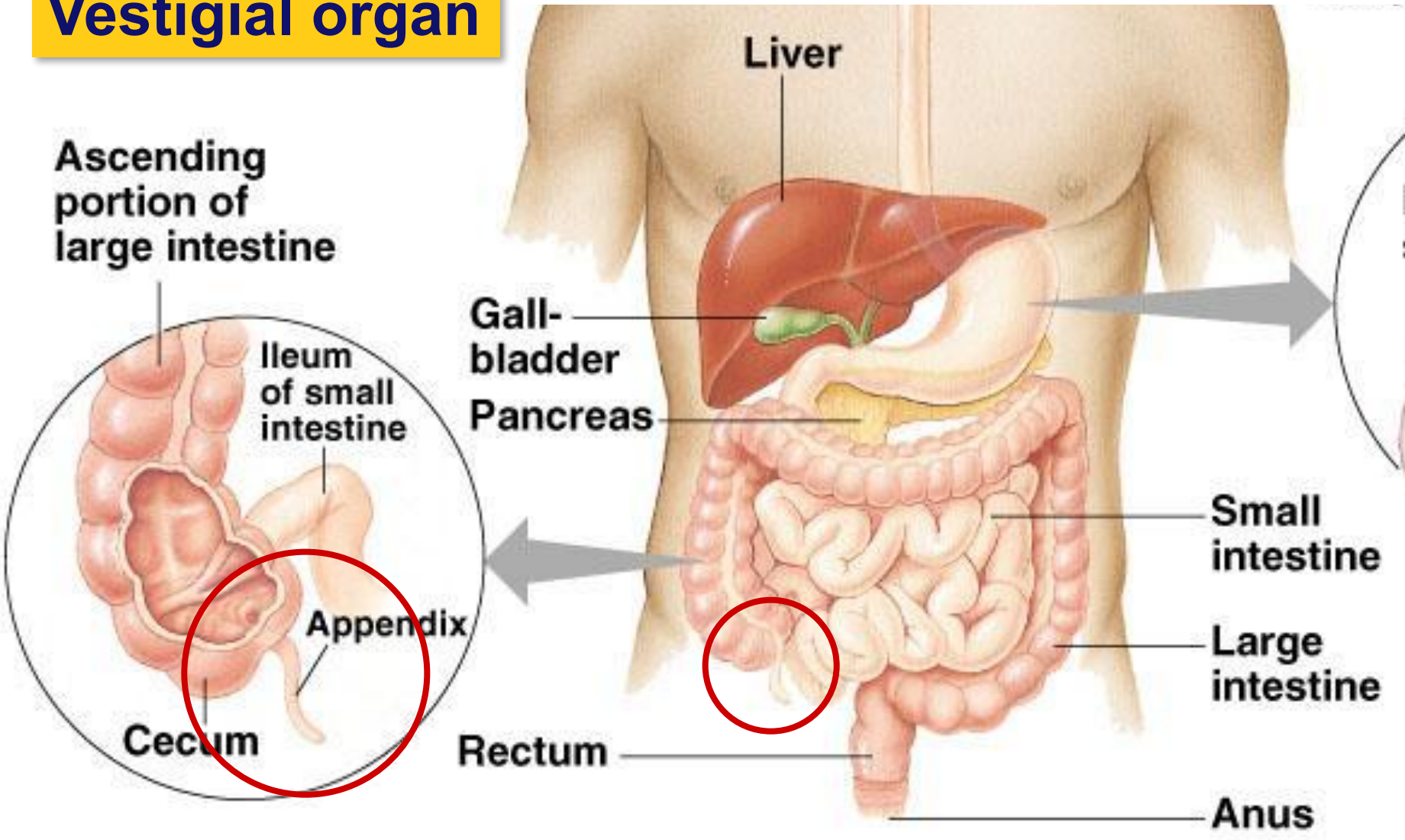
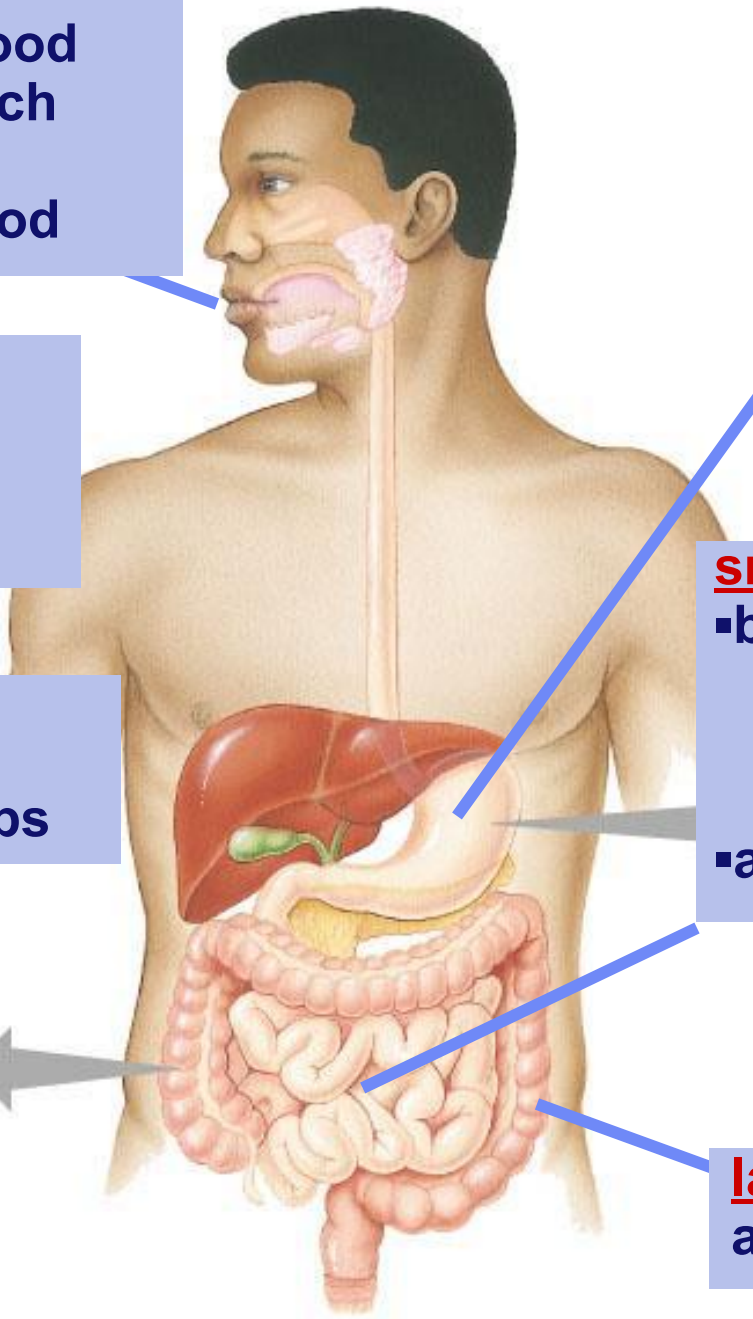
small intestines
▪breakdown food
- proteins
- starch
- fats
▪absorb nutrients
pancreas
▪produces enzymes to digest proteins & carbs
large intestines
absorb water

Appendix

Vestigial organ





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small intestines
- breakdown food
  - proteins
  - starch
  - fats
- absorb nutrients

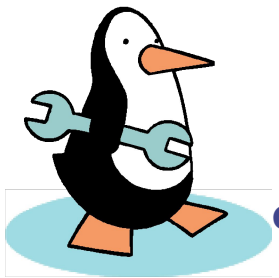
pancreas
- produces enzymes to digest proteins & carbs

appendix

large intestines
absorb water

Rectum

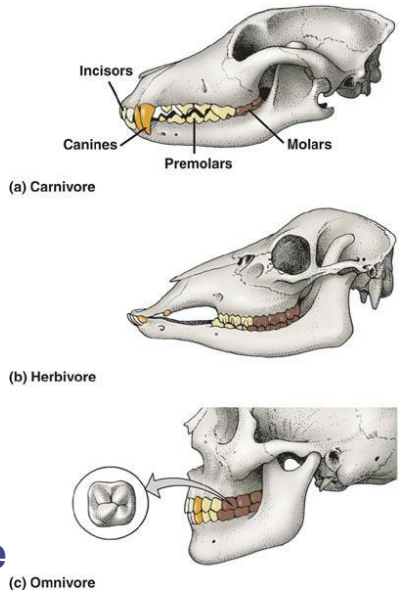
- Last section of large intestines
  - eliminate feces
  - what's left over?
    - undigested materials
      - mainly cellulose from plants
      - called roughage or fiber
      - keeps everything moving & cleans out intestines
    - masses of bacteria

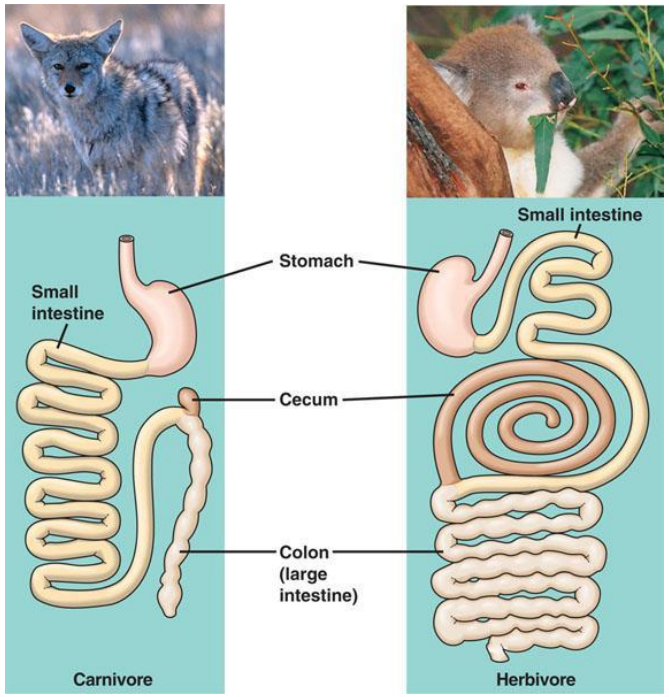


ology

Different diets; different bodies

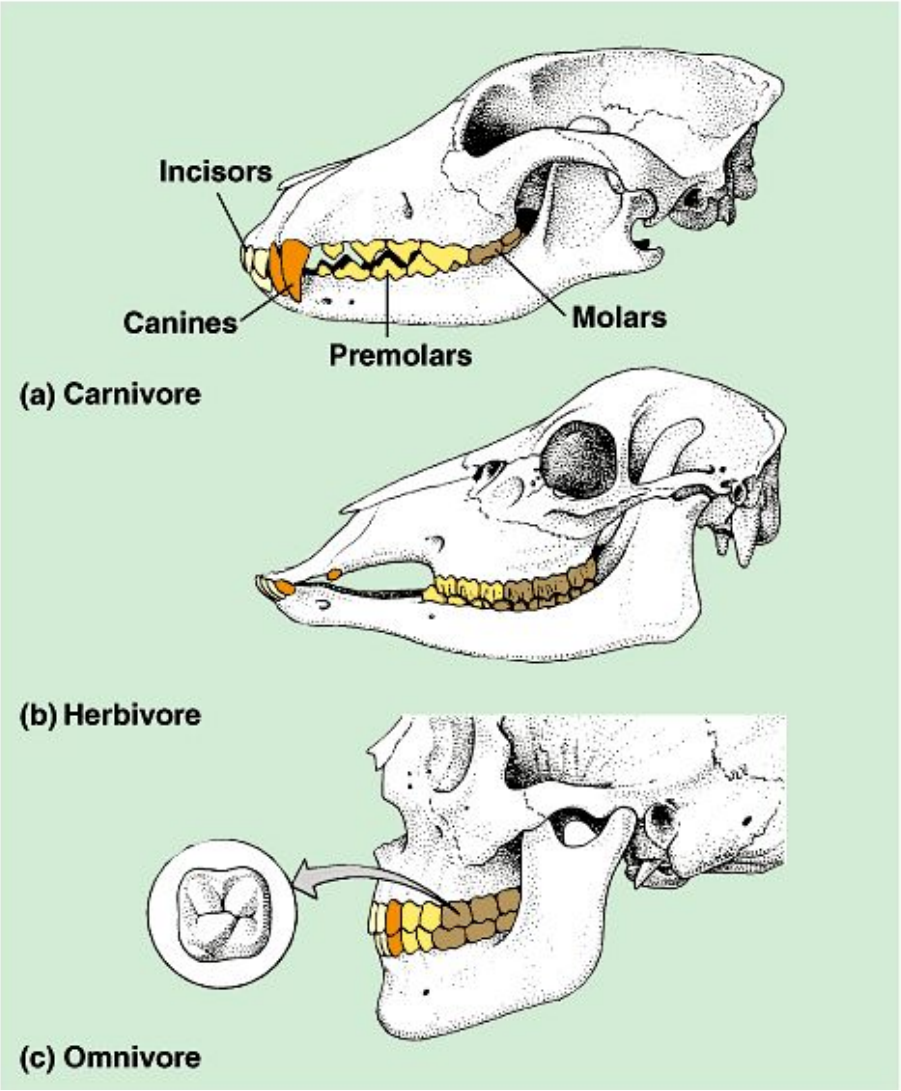
- Adaptations of herbivore vs. carnivore
  - teeth
  - length of digestive system
  - number & size of stomachs





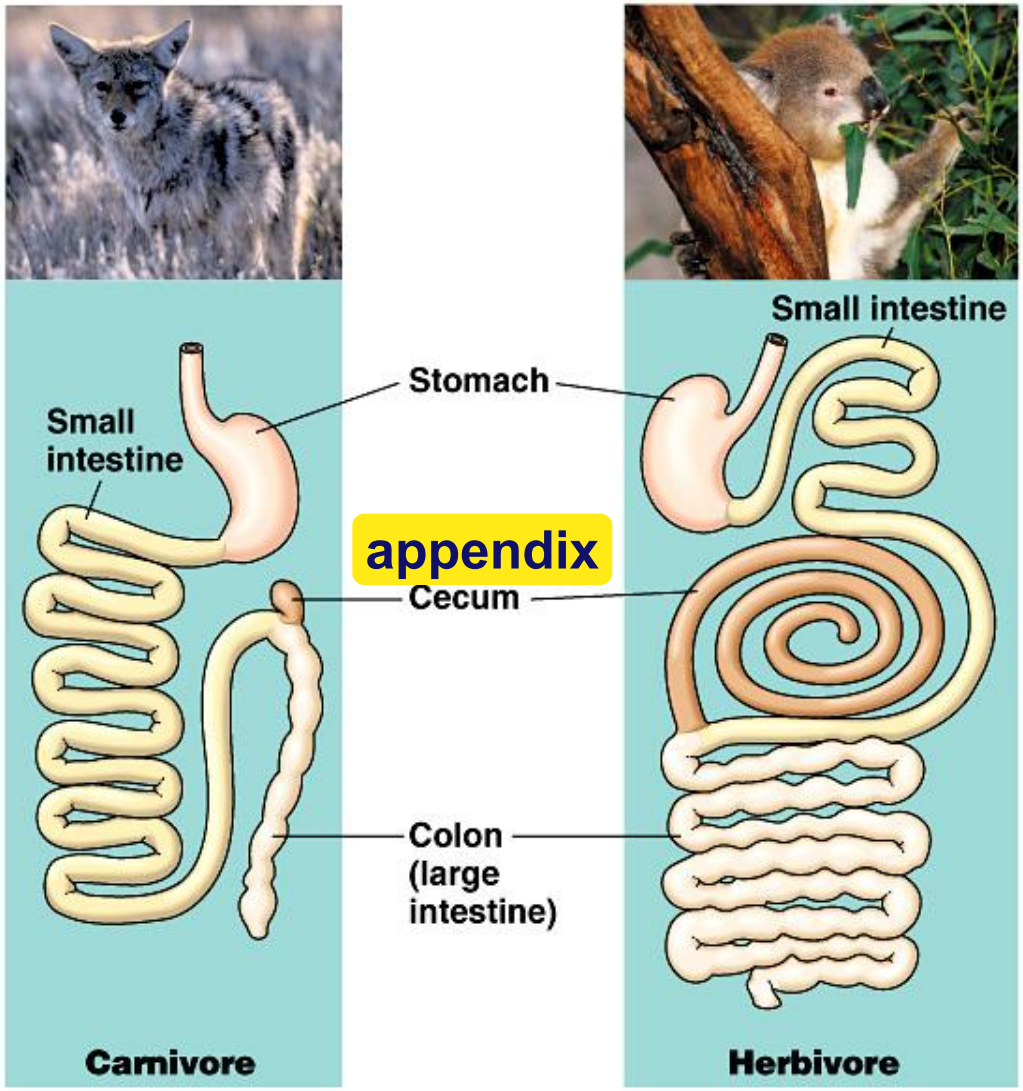
Teeth

- **Carnivore**
  - sharp ripping teeth
  - "canines"
- **Herbivore**
  - wide grinding teeth
  - molars
- **Omnivore**
  - both kinds of teeth



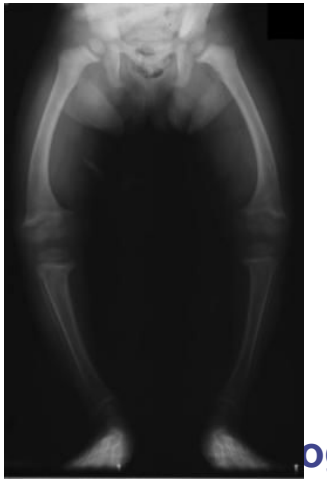
Length of digestive system

- **Herbivores & omnivore**
  - long digestive systems
  - harder to digest cellulose (cell walls)
    - bacteria in intestines help
- **Carnivores**
  - short digestive systems
  - protein easier to digest than cellulose



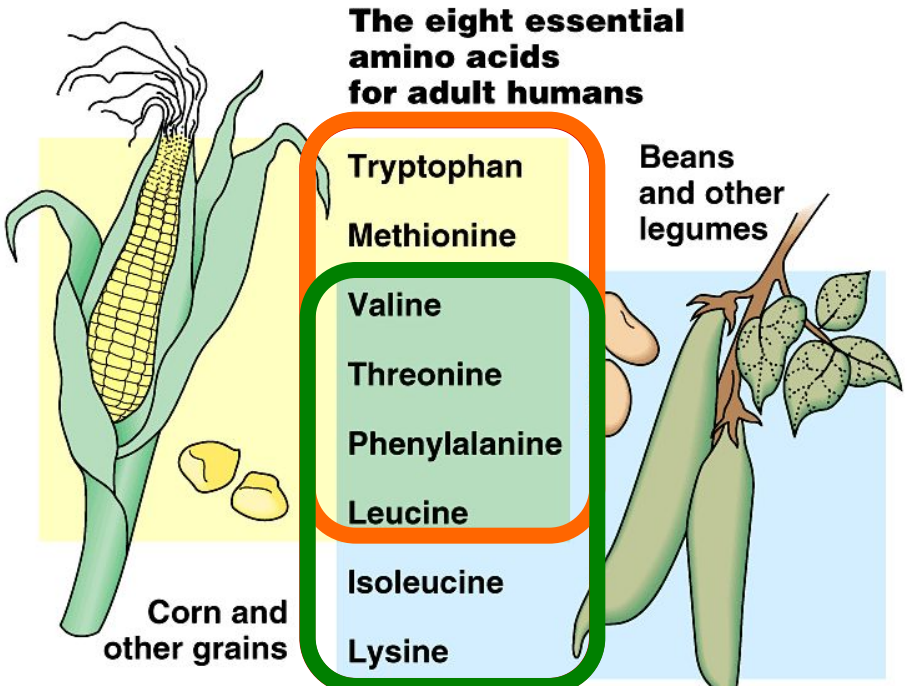
Eating a balanced diet

- What happens if an animal's diet is missing an essential nutrient?
  - deficiency diseases
    - scurvy — vitamin C (collagen production)
    - rickets — vitamin D (calcium absorption)
    - blindness — vitamin A (retinol production)
    - anemia — vitamin B_{12} (energy production)
    - kwashiorkor — protein

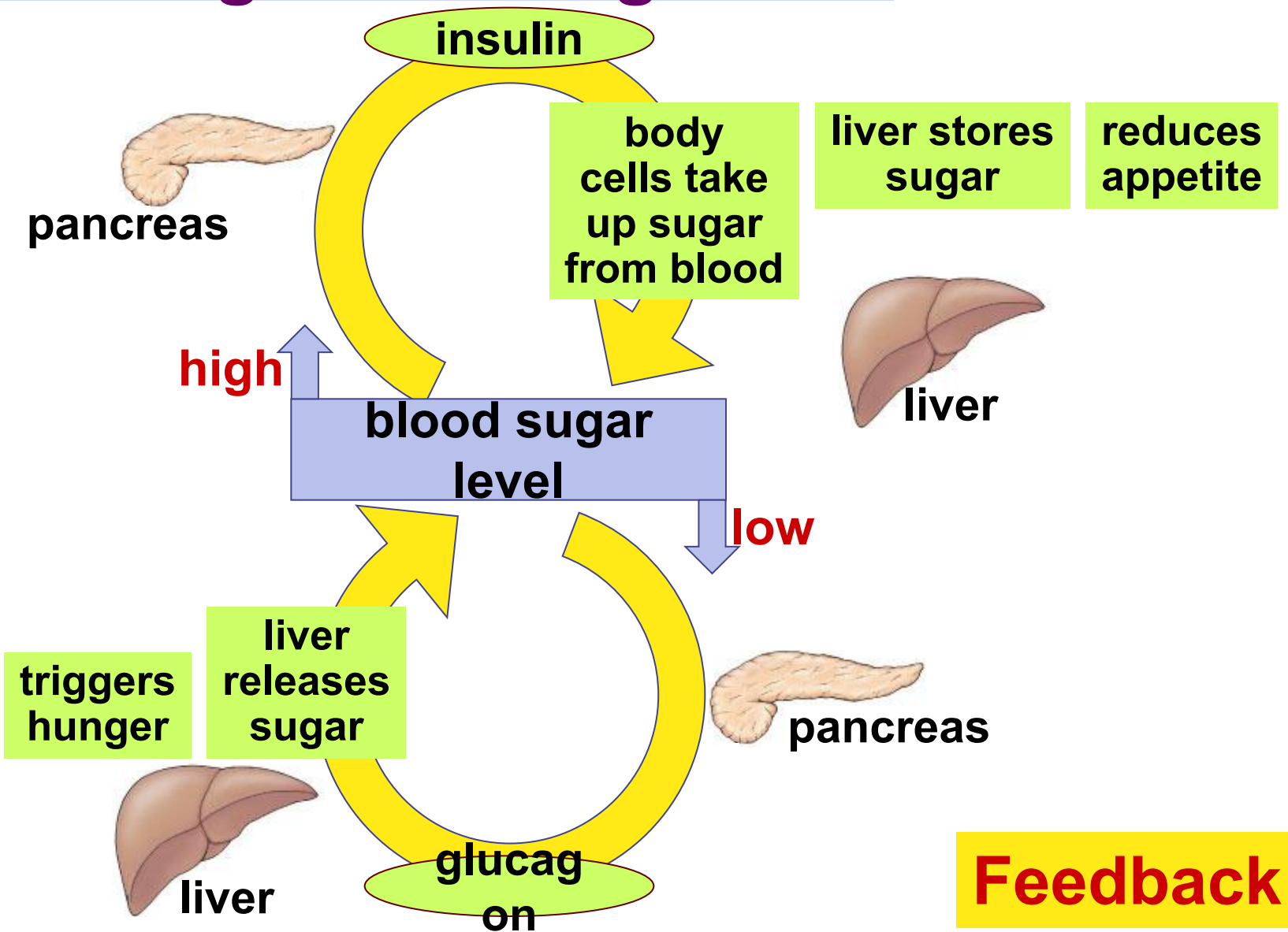


Vegetarian diets

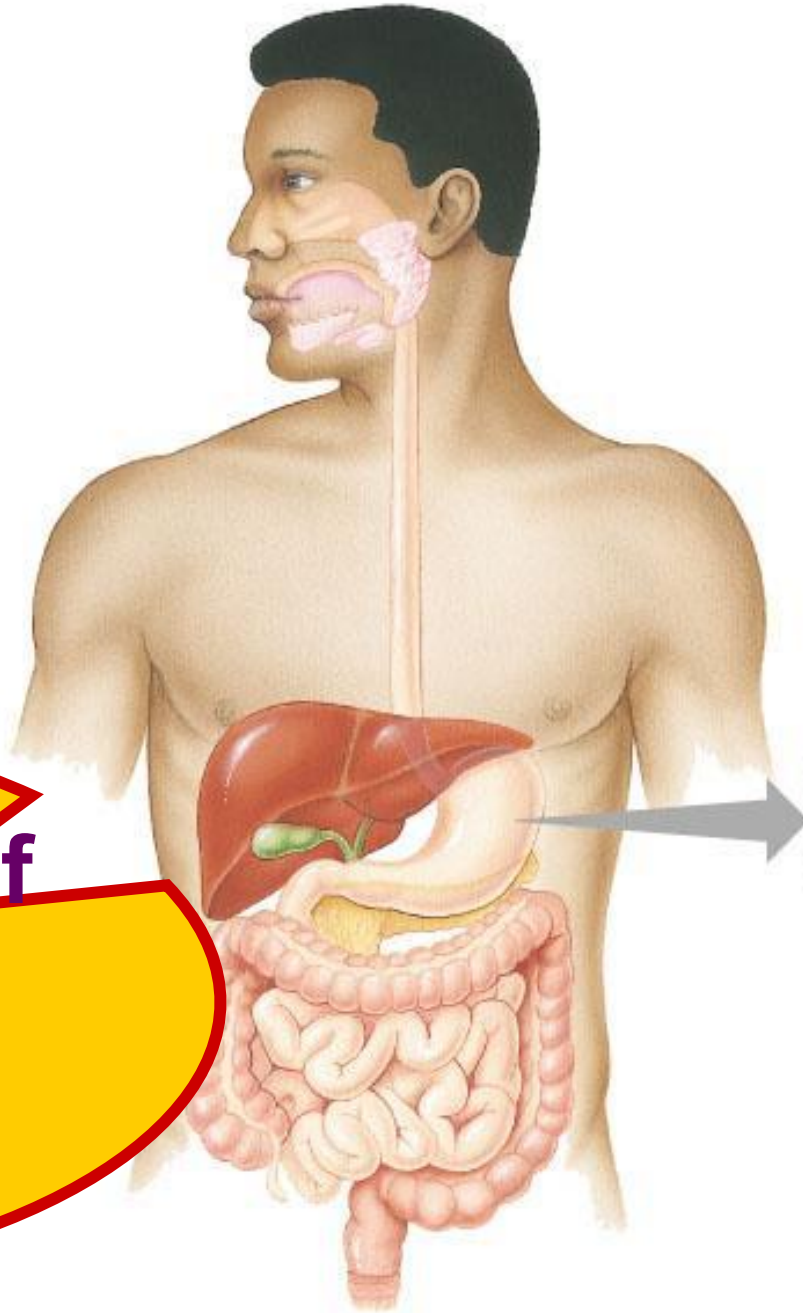
- **Need to make sure you get enough protein**
  - 20 amino acids to make protein
    - 12 amino acids humans can produce
    - 8 we have to eat = “essential amino acids”
  - Grains (like corn) have 6 amino acids
    - missing 2
  - Beans (like soybean & red bear have 6 amino acids
    - missing different 2
    - mix beans & grains for complete group of amino acids
      - rice & beans
      - taco/tortilla & beans
      - tofu & rice
      - peanut butter & bread



Balancing Blood Sugar levels



Feedback



Don’t turn yourself inside out…

Ask Questions*!!*

Feedback: Maintaining Homeostasis

- Balancing glucose levels in blood