# Vertebrate digestive system

Functions to break down food into molecules small enough to absorb, or pass across digestive membrane.

**Digestive tract**: tube extending from lips of mouth to anus or cloacae in bird, reptile or monotreme.

**Lumanal glands**: empty into inner body cavity (lumen: inner surface).

Tract divided into three main regions: 1. buccal cavity 2. pharynx 3. alimentary canal

Alimentary canal divided into four regions: 1. esophagus 2. stomach 3. small intestine 4. large intestine

**Accessory digestive glands**, outside digestive tract proper, secrete into lumen of tract through ducts. Includes the **salivary glands**, **liver** and **pancreas**.

**Buccal cavity**, which includes **palate** and **tongue**, develops from infolding of **stomadeum**, or second opening of blastula, whereas the rest of the digestive tract develops from the **primitive** gut**.**

**Teeth**: capture and hold prey. In mammals in particular further process and break down food into small particles, increasing surface area available for enzymatic action.

**Tooth anatomy**: 1. **crown** projects above gum, 2. **root** below gum, 3. **enamel** is outer coating of crown, hardest surface in body, of epideral origin 4. **dentin**, below enamel, bone-like and forms bulk of tooth, is harder than bone and contains nerves and blood vessels. (Remember that mammals are **heterodontic**, with different types of teeth).

**Pharynx**: air passage for adult, gill slits in embryo. Important in lower vertebrates, site of gills. Features derived from **pharyngeal** region: first pharyngeal pouch gives rise to parts of the ear, other pouches give rise to various other structures.

**Alimentary canal**: epithelium lines lumen, glands secrete into lumen, longitudinal and circular muscles help digestive movements (**peristalsis**).

**Esophagus**: tube carries food from mouth to stomach. Expands to fit large **bolus** (lump of chewed food). Secretes mucus for lubrication. Birds have **crop** for storage, enlargement of esophagus.

**Epiglottis**: keeps food out of air tube, an evolutionary “kludge,” or fix.

**Stomach**. Absorbs water, alcohol, nutrients, uses gastric juice with enzymes, mucous, HCl, released by **chief** and **parietal cells** (release protein enzymes) in gastric pits. **Rugae**: folds of stomach, disappear when full. **Sphincter** at both ends of stomach, control food passage.

**Chyme**: semi-digested food released to small intestine.

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**Small intestine**: three regions, **duodenum**, **jejunum**, and **ileum**.

**Duodenum** site of most intestinal digestion. **Jejunum** and **ileum** do most of intestinal absorption. Ileum ends with another sphincter, **ileocolic valve** or ileosecal valve. Structure: Circular folds covered with **villi** (singular is villus).

**Villi**: finger-like cellular projections, covered with **microvilli**, tiny projections which increase surface area. Increases surface area by 900x, speeds **digestion** (break down) and **absorption** (taking in nutrients).

**Large intestine**: larger diameter, shorter length than small intestine. No villi. In mammals, forms large gentle loop, colon, empties into straight region, rectum, empties into outside world through anal sphincter. Colon: absorbs water left over, also absorbs vitamins released by bacteria which live there (vitamin K).

**Food**: made up of 1. **proteins**, 2. **fats**, 3. **carbohydrates** 4. **fibrous material**.

Digestive system breaks foods down. **Proteins** must be broken to **amino acids** to be absorbed. **Polysaccharides** to **monosaccharides**, **lipids** to **fatty acids** and **monoglyc- erides** to absorb.

**Salivary glands** in mouth, saliva contains mucous, salt and a few enzymes (amalase, begins starch breakdown). Snake venom from oral gland, mixture of toxins and digestive enzymes. Breaks down blood vessels and disables nervous system.

**Stomach enzymes**: released in inactive form, **zymogene**, converts to active form in lumen of gut. Transformation is triggered by another enzyme, or the stomach’s low pH. **Pepsin** secreted as **pepsinogen** (-ogen means primitive form). Stomach glands secrete up to two or three liters a day of gastric juice, which is reabsorbed.

**Chyme** released to **duodenum**.

**Small intestine** has two major accessory glands: 1. **pancreas** 2. **liver**

**Pancreas** has **endocrine** and **exocrine** functions, releases large amounts of carbonate to neutralize acidic chyme, as intestinal enzymes work in neutral pH, and stuff to break down lipids and starch (zymogens, like tripsin)

**Liver** releases **bile**. Bile made from cholesterol, stored in **gall bladder**, released in duodenum, emulsifies fats.

**Emulsify**: keeps fats in tiny drops, which are suspended, increasing surface area and action of lipases. Protein and carbohydrates absorbed in intestine, taken to liver for processing. Fatty acids go to lymphatic system

**Appendix**: vestigial remnant. Much variation in digestive systems within mammals: herbivore, carnivore, insectivore, non-ruminant herbivore.

**Rumen**: four-chambered stomach of animals like cows (ruminant herbivores). Cellulose resistant to digestion, rely on microorganisms to break down cellulose. Some bacteria, protists and fungi can break down cellulose, almost no animals can. Bacteria break down cellulose in rumen, to be taken back to the mouth to chew their cud (ruminate). Later cow swallows to proceed with digestion. (Horses not like this).

Subphylum Vertebrata

**Coprophagy**: rabbits and other animals eat their own feces for the nutritious products of the cecum.