# DIGESTIVE SYSTEM

TWO GROUPS OF ORGANS COMPOSE THE DIGESTIVE SYSTEM: THE GASTROINTESTINAL TRACT AND THE ACCESSORY DIGESTIVE ORGANS.

THE GI TRACT OR ALIMENTARY CANAL IS A CONTINUOUS TUBE THAT EXTENDS FROM THE MOUTH TO THE ANUS THROUGH THE VENTRAL BODY CAVITY.

ORGANS OF THE GI TRACT INCLUDE THE MOUTH, MOST OF THE PHARYNX, ESOPHAGUS, STOMACH, SMALL INTESTINE, AND LARGE INTESTINE.

THE ACCESSORY DIGESTIVE ORGANS ARE THE TEETH, TONGUE, SALIVARY GLANDS, LIVER, GALLBLADDER, AND PANCREAS.

OVERALL, THE DIGESTIVE SYSTEM PERFORMS SIX BASIC PROCESSES:

1. INGESTION.

2. SECRETION.

3. MIXING AND PROPULSION.

4. DIGESTION

5. ABSORPTION

6. DEFECATION

# LAYERS OF THE GI TRACT

THE WALL OF THE GI FROM THE LOWER ESOPHAGUS TO THE ANAL CANAL HAS THE SAME BASIC, FOUR LAYERED ARRANGEMENT OF TISSUES.

THE FOUR LAYERS OF THE TRACT, FROM DEEP TO SUPERFICIAL

ARE THE

- MUCOSA
- SUBMUCOSA
- MUSCULARIS
- SEROSA

# PERITONEUM

THE PERITONEUM IS THE LARGEST SEROUS MEMBRANE OF THE BODY: IT CONSISTS OF A LAYER OF SIMPLE SQUAMOUS EPITHELIUM WITH AN UNDERLYING SUPPORTING LAYER OF CONNECTIVE TISSUE. THE PERITONEUM IS DIVIDED INTO THE PARIETAL PERITONEUM , WHICH LINES THE WALL OF THE ABDOMINOPELVIC CAVITY, AND THE VISCERAL PERITONEUM, WHICH COVERS SOME OF THE ORGANS IN THE CAVITY AND IS THEIR SEROSA.

THE SLIM SPACE BETWEEN THE PARIETAL AND VISCERAL PORTIONS OF THE PERITONEUM IS CALLED THE PERITONEAL CAVITY, WHICH CONTAINS SEROUS FLUID.

ASCITES

PERITONITIS

# MOUTH

THE MOUTH, ALSO REFERRED TO AS THE ORAL OR BUCCAL CAVITY IS FORMED BY THE CHEEKS, HARD AND SOFT PALATES AND TONGUE.

THE **LIPS OR LABIA** ARE FLESHY FOLDS SURROUNDING THE OPENING OF THE MOUTH. THE INNER SURFACE OF EACH LIP IS ATTACHED TO ITS CORRESPONDING GUM BY A MIDLINE FOLD OF MUCOUS MEMBRANE CALLED THE **LABIAL FRENULUM**.

THE **VESTIBULE** OF THE ORAL CAVITY IS A SPACE BOUNDED EXTERNALLY BY THE CHEEKS AND LIPS AND INTERNALLY BY THE GUM AND TEETH. THE **ORAL CAVITY PROPER** IS A SPACE THAT EXTENDS FROM THE GUMS AND TEETH TO THE **FAUCES**, THE ORAL CAVITY AND PHARYNX OR THROAT.

THE HARD PALATE-THE ANTERIOR PORTION OF THE ROOF OF THE MOUTH-IS FORMED BY THE MAXILLAE AND PALATINE BONES, IS COVERED BY MUCOUS MEMBRANE, AND FORMS A BONY PARTITION BETWEEN THE ORAL AND NASAL CAVITIES. THE SOFT PALATE, WHICH FORMS THE POSTERIOR PORTION OF THE ROOF OF THE MOUTH, IS AN ARCH-SHAPED MUSCULAR PARTITION BETWEEN THE ORAL AND NASAL CAVITIES.

THE SOFT PALATE, WHICH FORMS THE POSTERIOR PORTION OF THE ROOF OF THE MOUTH, IS AN ARCH SHAPED MUSCULAR PARTITION BETWEEN THE OROPHARYNX THAT IS LINED BY MUCOUS MEMBRANE.

HANGING FROM THE FREE BORDER OF THE SOFT PALATE IS A CONICAL MUSCULAR PROCESS CALLED **THE UVULA**.

# SALIVARY GLAND

A SALIVARY GLAND IS ANY CELL OR ORGAN THAT RELEASES A SECRETION CALLED SALIVA INTO THE ORAL CAVITY.

THE MUCOUS MEMBRANE OF THE MOUTH AND TONGUE CONTAINS MANY SMALL SALIVARY GLANDS THAT OPEN DIRECTLY, OR INDIRECTLY VIA SHORT DUCTS, TO THE ORAL CAVITY. THESE GLANDS INCLUDE LABIAL, BUCCAL AND PALATAL GLANDS IN THE LIPS, CHEEKS AND PALATE, AND LINGUAL GLANDS IN THE TONGUE, ALL OF WHICH MAKE A SMALL CONTRIBUTION TO SALIVA.

THERE ARE THREE PAIRS OF MAJOR SALIVARY GLANDS: THE PAROTID

SUBMANDIBULAR

AND SUBLINGUAL GLANDS.

# TONGUE

THE TONGUE IS AN ACCESSORY DIGESTIVE ORGAN COMPOSED OF SKELETAL MUSCLE COVERED WITH MUCOUS MEMBRANE. TOGETHER WITH ITS ASSOCIATED MUSCLES, IT FORMS THE FLOOR OF THE ORAL CAVITY.

THE TONGUE IS DIVIDED INTO SYMMETRICAL LATERAL HALVES BY A MEDIAN SEPTUM THAT EXTENDS ITS ENTIRE LENGTH, AND IT IS ATTACHED INFERIORLY TO THE HYOID BONE, STYLOID PROCESS OF THE TEMPORAL BONE AND MANDIBLE. EACH HALF OF THE TONGUE CONSISTS OF AN IDENTICAL COMPLEMENT OF EXTRINSIC AND INTRINSIC MUSCLES.

# TEETH

THE TEETH OR DENTES ARE ACCESSORY DIGESTIVE ORGANS LOCATED IN SOCKET OF THE ALVEOLAR PROCESSES OF THE MANDIBLE AND MAXILLAE. THE ALVEOLAR PROCESSES ARE COVERED BY THE GINGIVAE OR GUMS, WHICH EXTEND SLIGHTLY INTO EACH SOCKET TO FORM THE GINGIVAL SULCUS. THE SOCKET ARE LINED BY THE PERIODONTAL LIGAMENT OR MEMBRANE, WHICH CONSISTS OF DENSE FIBROUS CONNECTIVE TISSUE AND IS ATTACHED TO THE SOCKET WALLS AND THE CEMENTAL SURFACE OF THE ROOTS.

A TYPICAL TOOTH HAS THREE MAJOR REGIONS.

THE CROWN

THREE ROOTS

THE NECK

HUMAN HAVE TWO DENTITIONS OR SETS OF TEETH: **DECIDUOUS AND PERMANENT.**

THE FIRST OF THESE – THE DECIDUOUS TEETH ALSO CALLED PRIMARY TEETH, MILK TEETH, OR BABY TEETH- BEGIN TO ERUPT AT ABOUT 6 MONTHS OF AGE, AND ONE PAIR OF TEETH APPEARS AT ABOUT EACH MONTH THEREAFTER, UNTIL ALL 20 ARE PRESENT.

# MECHANICAL AND CHEMICAL DIGESTION IN THE MOUTH

MECHANICAL DIGESTION IN THE MOUTH RESULT FROM CHEWING OR MASTICATION, IN WHICH FOOD IS MANIPULATED BY THE TONGUE GROUNDED BY THE TEETH AND MIXED WITH SALIVA. AS A RESULT, THE FOOD IS REDUCED TO A SOFT, FLEXIBLE, EASILY SWALLOWED MASS CALLED A **BOLUS.**

TWO ENZYMES, **SALIVARY AMYLASE** AND **LINGUAL LIPASE,** CONTRIBUTE TO CHEMICAL DIGESTION IN THE MOUTH.

**SALIVARY AMYLASE** INITIATES THE BREAKDOWN OF STARCH.

**LINGUAL LIPASE**, WHICH IS SECRETED BY GLANDS IN THE TONGUE.

# PHARYNX

WHEN FOOD FIRST SWALLOWED, IT PASSES FROM THE MOUTH INTO THE PHARYNX, A FUNNEL SHAPED TUBE EXTENDS FROM THE INTERNAL NARES TO THE ESOPHAGUS POSTERIORLY AND TO THE LARYNX ANTERIOLY. SWALLOWED FOOD PASSES FROM THE MOUTH INTO THE OROPHARYNX AND LARYNGOPHARYNX, THE MUSCULAR CONTRACTION OF WHICH HELP PROPEL FOOD INTO THE ESOPHAGUS AND THEN INTO THE STOMACH

THE MOVEMENT OF FOOD FROM THE MOUTH INTO THE STOMACH IS ACHIEVED BY THE ACT OF SWALLOWING, OR DEGLUTITION. DEGLUTITION IS FACILITATED BY SALIVA AND MUCUS AND INVOLVES THE MOUTH, PHARYNX AND ESOPHAGUS.

SWALLOWING OCCURS IN THREE STAGE:

1. THE VOLUNTARY STAGE IN WHICH THE BOLUS IS PASSED INTO THE OROPHARYNX.
2. THE PHARYNGEAL STAGE, WHICH IS THE INVOLUNTARY PASSAGE OF THE BOLUS THROUGH THE PHARYNX INTO THE ESOPHAGUS : AND
3. THE ESOPHAGEAL STAGE, WHICH IS THE INVOLUNTARY PASSAGE OF THE BOLUS THROUGH THE ESOPHAGUS INTO THE STOMACH.

# ESOPHAGUS

THE ESOPHAGUS (EATING GULLET) IS A COLLAPSIBLE MUSCULAR TUBE THAT LIES POSTERIOR TO THE TRACHEA.

IT IS ABOUT 25 CM LONG.

THE ESOPHAGUS BEGINS AT THE INFERIOR END OF THE LARYNGOPHARYNX AND PASSES THROUGH THE MEDIASTINUM ANTERIOR TO THE VERTEBRAL COLUMN.

# PHYSIOLOGY OF THE ESOPHAGUS

THE ESOPHAGUS SECRETES MUCUS AND TRANSPORTS FOOD INTO THE STOMACH. THE PASSAGE OF FOOD FROM THE LARYNGOPHARYNX INTO THE ESOPHAGEAL IS REGULATED AT THE ENTRANCE TO THE ESOPHAGUS BY A SPHINCTER CALLED THE UPPER ESOPHAGEAL SPHINCTER. IT CONSISTS OF THE CRICOPHARYNGEAL MUSCLE ATTACH TO THE CRICOID CARTILAGE.

DURING THE ESOPHAGEAL STAGE OF SWALLOWING, PERISTALSIS (CONSTRICTION) A PROGRESSION OF COORDINATED CONTRACTIONS AND RELAXATIONS OF THE CIRCULAR AND LONGITUDINAL LAYERS OF THE MUSCULARIS, PUSHES THE FOOD BOLUS ONWARD.

# STOMACH

THE STOMACH IS TYPICALLY A J-SHAPED ENLARGEMENT OF THE GI TRACT DIRECTLY INFERIOR TO THE DIAPHRAGM IN THE EPIGASTRIC, UMBILICAL, AND LEFT HYPOCHONDRIAC REGION OF THE ABDOMEN. THE STOMACH CONNECTS THE ESOPHAGUS TO THE DUODENUM, THE FIRST PART OF THE SMALL INTESTINE.

THE STOMACH HAS 3 MAIN REGIONS:

FUNDUS

BODY

PYLORUS

# MECHANICAL AND CHEMICAL DIGESTION IN THE STOMACH

SEVERAL MINUTES AFTER FOOD ENTERS THE STOMACH, GENTLE, RIPPLING, PERISTALTIC MOVEMENTS CALLED **MIXING WAVES** PASS OVER THE STOMACH EVERY 15 TO 25 SECOND. THESE WAVES MACERATE FOOD, MIX IT WITH SECRETIONS OF THE GASTRIC GLANDS, AND REDUCE IT TO A SOUPY LIQUID CALLED **CHYME (JUICE).**

AS FOOD REACHES THE PYLORUS, EACH MIXING WAVE FORCES SEVERAL MILLILITERS OF CHYME INTO THE DUODENUM THROUGH THE PYLORIC SPHINCTER.

PARIETAL CELLS SECRETE HYDROGEN IONS ($H^+$) AND CHLORIDE IONS ($CL^-$) SEPARATELY INTO THE STOMACH LUMEN, THE NET EFFECT IS SECRETION OF HYDROCHLORIC ACID (HCL).

THE ENZYME CARBONIC ANHYDRASE, WHICH IS ESPECIALLY PLENTIFUL IN PARIETAL CELLS, CATALYZES THE FORMATION OF CARBONIC ACID ($H_2CO_3$) FROM WATER AND CARBON DIOXIDE ($CO_2$).

# FUNCTIONS OF THE STOMACH

1. MIXES SALIVA, FOOD AND GASTRIC JUICE TO FORM CHYME.
2. RESERVOIR FOR HOLDING FOOD BEFORE RELEASE INTO SMALL INTESTINE.
3. SECRETES GASTRIC JUICE, WHICH CONTAINS HCL, PEPSIN, INTRINSIC FACTOR AND GASTRIC LIPASE.

4. HCL KILLS BACTERIA AND DENATURES PROTEINS. PEPSIN BEGINS THE DIGESTION OF PROTEINS. INTRINSIC FACTOR AIDS ABSORPTION OF VITAMIN **B12.** GASTRIC LIPASE AIDS DIGESTION OF TRIGLYCERIDES.

5. SECRETES GASTRIN INTO BLOOD.