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Describe the microanatomy of small and large intestine. Note: you are expected to state the functions, segment, layers, general features and epithelium of each part of the small and large intestine.

SMALL INTESTINE

The small intestine is divided into three structural parts.

* The [duodenum](https://en.wikipedia.org/wiki/Duodenum) is a short structure ranging from 20 cm (7.9 inches) to 25 cm (9.8 inches) in length, and shaped like a "C”. It surrounds the head of the pancreas. It receives gastric chyme from the stomach, together with digestive juices from the [pancreas](https://en.wikipedia.org/wiki/Pancreas) ([digestive enzymes](https://en.wikipedia.org/wiki/Digestive_enzymes)) and the [liver](https://en.wikipedia.org/wiki/Liver) ([bile](https://en.wikipedia.org/wiki/Bile)). The digestive enzymes break down proteins and bile [emulsifies](https://en.wikipedia.org/wiki/Emulsify) fats into [micelles](https://en.wikipedia.org/wiki/Micelles). The [duodenum](https://en.wikipedia.org/wiki/Duodenum) contains [Brunner's glands](https://en.wikipedia.org/wiki/Brunner%27s_glands), which produce a mucus-rich alkaline secretion containing [bicarbonate](https://en.wikipedia.org/wiki/Bicarbonate). These secretions, in combination with bicarbonate from the pancreas, neutralize the stomach acids contained in gastric chyme.
* The [jejunum](https://en.wikipedia.org/wiki/Jejunum) is the midsection of the small intestine, connecting the duodenum to the ileum. It is about 2.5 m long, and contains the [plicae circulares](https://en.wikipedia.org/wiki/Plicae_circulares), and [villi](https://en.wikipedia.org/wiki/Intestinal_villus) that increase its surface area. Products of digestion (sugars, amino acids, and fatty acids) are absorbed into the bloodstream here. The [suspensory muscle of duodenum](https://en.wikipedia.org/wiki/Suspensory_muscle_of_duodenum) marks the division between the duodenum and the jejunum.
* The [ileum](https://en.wikipedia.org/wiki/Ileum): The final section of the small intestine. It is about 3 m long, and contains [villi](https://en.wikipedia.org/wiki/Intestinal_villus) similar to the jejunum. It absorbs mainly [vitamin B12](https://en.wikipedia.org/wiki/Vitamin_B12) and [bile acids](https://en.wikipedia.org/wiki/Bile_acids), as well as any other remaining nutrients. The ileum joins to the [cecum](https://en.wikipedia.org/wiki/Cecum) of the [large intestine](https://en.wikipedia.org/wiki/Large_intestine) at the [ileocecal junction](https://en.wikipedia.org/wiki/Ileocecal_junction).

The jejunum and ileum are suspended in the [abdominal cavity](https://en.wikipedia.org/wiki/Abdominal_cavity) by [mesentery](https://en.wikipedia.org/wiki/Mesentery). The mesentery is part of the [peritoneum](https://en.wikipedia.org/wiki/Peritoneum). Arteries, veins, lymph vessels and nerves travel within the mesentery.[[13]](https://en.wikipedia.org/wiki/Small_intestine#cite_note-GRAYS2005C-13)

The small intestine contains the standard 4 layers present in most parts of the gastrointestinal tract: the mucosa, submucosa, muscularis propria, and serosa.

The mucosa includes a columnar epithelium with glands called crypts of Lieberkuhn; mucus-secreting goblet cells; Paneth cells, which secrete lysozymes; enteroendocrine cells, which secrete hormones; fingerlike (leaflike) projections called villi, which increase its absorptive surface area several times; lamina propria (connective tissue); and muscularis mucosa.

The ileum has subepithelial aggregates of lymphoid tissue along the antimesenteric border; these are called Peyer patches. Mucosa is much thicker in the jejunum than in the ileum and is arranged in spiral folds called plicae circulares, which appear as valvulae conniventes on plain abdominal radiographs.

The submucosa contains the blood vessels and the Meissner nerve plexus; the muscularis propria contains inner circular and outer longitudinal muscles and myenteric (Auerbach) nerve plexus; and the serosa covering the organs of the peritoneal cavity is called the visceral peritoneum.

 Functions

1. Digestion: The small intestine is where most chemical digestion takes place. Many of the [digestive enzymes](https://en.wikipedia.org/wiki/Digestive_enzyme) that act in the small intestine are secreted by the [pancreas](https://en.wikipedia.org/wiki/Pancreas) and [liver](https://en.wikipedia.org/wiki/Liver) and enter the small intestine via the [pancreatic duct](https://en.wikipedia.org/wiki/Pancreatic_duct). Pancreatic enzymes and [bile](https://en.wikipedia.org/wiki/Bile) from the gallbladder enter the small intestine in response to the Hormone [cholecystokinin](https://en.wikipedia.org/wiki/Cholecystokinin), which is produced in the small intestine in response to the presence of nutrients. [Secretin](https://en.wikipedia.org/wiki/Secretin), another hormone produced in the small intestine, causes additional effects on the pancreas, where it promotes the release of [bicarbonate](https://en.wikipedia.org/wiki/Bicarbonate) into the duodenum in order to neutralize the potentially harmful acid coming from the stomach. The three major classes of nutrients that undergo digestion are [proteins](https://en.wikipedia.org/wiki/Protein), [lipids](https://en.wikipedia.org/wiki/Lipid) (fats) and [carbohydrates](https://en.wikipedia.org/wiki/Carbohydrate)
2. Absorption: Digested food is now able to pass into the blood vessels in the wall of the intestine through either [diffusion](https://en.wikipedia.org/wiki/Diffusion) or active transport. The small intestine is the site where most of the nutrients from ingested food are absorbed. The inner wall, or mucosa, of the small intestine, is lined with simple columnar [epithelial](https://en.wikipedia.org/wiki/Intestinal_epithelium) tissue. Structurally, the mucosa is covered in wrinkles or folds called [plicae circulares](https://en.wikipedia.org/wiki/Plicae_circulares), which are considered permanent features in the wall of the organ. They are distinct from [rugae](https://en.wikipedia.org/wiki/Rugae%22%20%5Co%20%22Rugae) which are considered non-permanent or temporary allowing for distention and contraction. From the plicae circulares project microscopic finger-like pieces of tissue called [villi](https://en.wikipedia.org/wiki/Intestinal_villus) ([Latin](https://en.wikipedia.org/wiki/Latin) for "shaggy hair").

 The individual epithelial cells also have finger-like projections known as [microvilli](https://en.wikipedia.org/wiki/Microvilli). The functions of the plicae circulares, the villi, and the microvilli are to increase the amount of surface area available for the absorption of [nutrients](https://en.wikipedia.org/wiki/Nutrient), and to limit the loss of said nutrients to intestinal fauna. Each villus has a network of [capillaries](https://en.wikipedia.org/wiki/Capillary) and fine lymphatic vessels called [lacteals](https://en.wikipedia.org/wiki/Lacteal) close to its surface. The epithelial cells of the villi transport nutrients from the lumen of the intestine into these capillaries (amino acids and carbohydrates) and lacteals (lipids). The absorbed substances are transported via the blood vessels to different organs of the body where they are used to build complex substances such as the proteins required by our body. The material that remains undigested and unabsorbed passes into the large intestine.

LARGE INTESTINE

The colonis the largest portion of the large intestine. In [mammals](https://en.wikipedia.org/wiki/Mammal), the colon consists of six sections: the [cecum](https://en.wikipedia.org/wiki/Cecum) plus the [ascending colon](https://en.wikipedia.org/wiki/Ascending_colon), the [transverse colon](https://en.wikipedia.org/wiki/Transverse_colon), the [descending colon](https://en.wikipedia.org/wiki/Descending_colon), the [sigmoid colon](https://en.wikipedia.org/wiki/Sigmoid_colon), and the [rectum](https://en.wikipedia.org/wiki/Rectum).

Sections of the colon are:

* The [ascending colon](https://en.wikipedia.org/wiki/Ascending_colon) including the [cecum](https://en.wikipedia.org/wiki/Cecum) and [appendix](https://en.wikipedia.org/wiki/Appendix_%28anatomy%29)
* The [transverse colon](https://en.wikipedia.org/wiki/Transverse_colon) including the [colic flexures](https://en.wikipedia.org/wiki/Colic_flexures) and [transverse mesocolon](https://en.wikipedia.org/wiki/Transverse_mesocolon)
* The [descending colon](https://en.wikipedia.org/wiki/Descending_colon)
* The [sigmoid colon](https://en.wikipedia.org/wiki/Sigmoid_colon) – the s-shaped region of the large intestine
* The [rectum](https://en.wikipedia.org/wiki/Rectum)

The wall of the large intestine is lined with simple columnar [epithelium](https://en.wikipedia.org/wiki/Intestinal_epithelium) with [invaginations](https://en.wikipedia.org/wiki/Invagination). The invaginations are called the [intestinal glands](https://en.wikipedia.org/wiki/Intestinal_gland) or colonic crypts. The colon crypts are shaped like microscopic thick walled test tubes with a central hole down the length of the tube (the crypt [lumen](https://en.wikipedia.org/wiki/Lumen_%28anatomy%29)). Four tissue sections are shown here, two cut across the long axes of the crypts and two cut parallel to the long axes.  The [nuclei](https://en.wikipedia.org/wiki/Cell_nucleus) of the cells (located at the outer edges of the cells lining the walls of the crypts) are stained blue-gray with [haematoxylin](https://en.wikipedia.org/wiki/Haematoxylin%22%20%5Co%20%22Haematoxylin). Cells are produced at the crypt base and migrate upward along the crypt axis before being shed into the colonic [lumen](https://en.wikipedia.org/wiki/Lumen_%28anatomy%29) days later. There are 5 to 6 stem cells at the bases of the crypts.

 The large intestine has the same 4 layers found in most parts of the GI tract. They are as follows:

* Mucosa - Includes a columnar epithelium with large number of mucus-secreting goblet cells (villi; present in small intestine; absent in colon), lamina propria, and muscularis mucosa; the appendix is rich in mucosa-associated lymphoid tissue (MALT)
* Submucosa - Contains the blood vessels and Meissner nerve plexus
* Muscularis propria - Contains continuous inner circular and outer longitudinal muscles arranged in bands and myenteric (Auerbach) nerve plexus; tenia coli are formed by bands of the outer longitudinal muscles (tinea are present in the colon only and are not present in the rectum, where the outer longitudinal muscle is continuous)
* Serosa - Visceral peritoneum

Functions

The 4 major functions of the large intestine are:

* reabsorption of water and mineral ions such as sodium and chloride
* formation and temporary storage of faeces
* maintaining a resident population of over 500 species of bacteria
* bacterial fermentation of indigestible materials.

By the time partially digested foodstuffs reach the end of the small intestine (ileum), about 80% of the water content has been absorbed. The colon absorbs most of the remaining water. As the remnant food material moves through the colon, it is mixed with bacteria and mucus, and formed into faeces for temporary storage before being eliminated.

 The large intestine absorbs water and any remaining absorbable nutrients from the food before sending the indigestible matter to the rectum. The colon absorbs vitamins that are created by the colonic bacteria, such as [vitamin K](https://en.wikipedia.org/wiki/Vitamin_K) (especially important as the daily ingestion of vitamin K is not normally enough to maintain adequate [blood coagulation](https://en.wikipedia.org/wiki/Blood_coagulation)), [thiamine](https://en.wikipedia.org/wiki/Thiamine) and [riboflavin](https://en.wikipedia.org/wiki/Riboflavin). It also compacts feces, and stores fecal matter in the rectum until it can be discharged via the [anus](https://en.wikipedia.org/wiki/Anus) in [defecation](https://en.wikipedia.org/wiki/Defecation). The large intestine also secretes K+ and Cl-. Chloride secretion increases in cystic fibrosis. Recycling of various nutrients takes place in colon. Examples include fermentation of carbohydrates, short chain fatty acids, and urea cycling.