## **Stomach Functions and Other Facts**

## **Function[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=10)**]**

### Digestion**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=11)**]**

*Further information:*[*Human digestive system*](https://en.wikipedia.org/wiki/Human_digestive_system)

*See also:*[*Gastric acid*](https://en.wikipedia.org/wiki/Gastric_acid)

In the [human digestive system](https://en.wikipedia.org/wiki/Human_digestive_system), a [bolus](https://en.wikipedia.org/wiki/Bolus_(digestion)) (a small rounded mass of [chewed up](https://en.wikipedia.org/wiki/Mastication) food) enters the stomach through the [esophagus](https://en.wikipedia.org/wiki/Esophagus) via the [lower esophageal sphincter](https://en.wikipedia.org/wiki/Esophagus#Sphincters). The stomach releases [proteases](https://en.wikipedia.org/wiki/Proteases) (protein-digesting [enzymes](https://en.wikipedia.org/wiki/Enzyme) such as [pepsin](https://en.wikipedia.org/wiki/Pepsin)) and [hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid), which kills or inhibits [bacteria](https://en.wikipedia.org/wiki/Bacteria) and provides the acidic [pH](https://en.wikipedia.org/wiki/PH) of 2 for the [proteases](https://en.wikipedia.org/wiki/Protease) to work. Food is churned by the stomach through muscular contractions of the wall called [peristalsis](https://en.wikipedia.org/wiki/Peristalsis) – reducing the volume of the bolus, before looping around the fundus[[27]](https://en.wikipedia.org/wiki/Stomach#cite_note-27) and the [body of stomach](https://en.wikipedia.org/wiki/Body_of_stomach) as the boluses are converted into [chyme](https://en.wikipedia.org/wiki/Chyme) (partially digested food). Chyme slowly passes through the [pyloric sphincter](https://en.wikipedia.org/wiki/Pyloric_sphincter) and into the [duodenum](https://en.wikipedia.org/wiki/Duodenum) of the [small intestine](https://en.wikipedia.org/wiki/Small_intestine), where the extraction of nutrients begins.

Gastric juice in the stomach also contains [pepsinogen](https://en.wikipedia.org/wiki/Pepsinogen). [Hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid) activates this inactive form of enzyme into the active form, pepsin. Pepsin breaks down proteins into [polypeptides](https://en.wikipedia.org/wiki/Polypeptides).

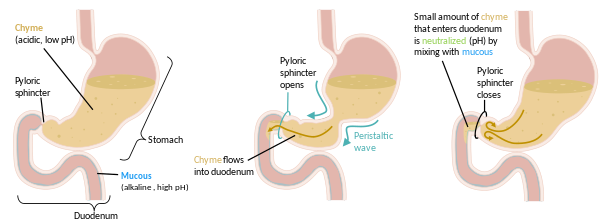
### Absorption**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=12)**]**

Although the absorption in the human digestive system is mainly a function of the small intestine, some absorption of certain small molecules nevertheless does occur in the stomach through its lining. This includes:

* Water, if the body is [dehydrated](https://en.wikipedia.org/wiki/Dehydration)
* Medication, such as [aspirin](https://en.wikipedia.org/wiki/Aspirin)
* [Amino acids](https://en.wikipedia.org/wiki/Amino_acids)[[28]](https://en.wikipedia.org/wiki/Stomach#cite_note-28)
* 10–20% of ingested [ethanol](https://en.wikipedia.org/wiki/Ethanol) (e.g. from alcoholic beverages)[[29]](https://en.wikipedia.org/wiki/Stomach#cite_note-intox-29)
* [Caffeine](https://en.wikipedia.org/wiki/Caffeine)[[30]](https://en.wikipedia.org/wiki/Stomach#cite_note-30)
* To a small extent water-soluble [vitamins](https://en.wikipedia.org/wiki/Vitamin) (most are absorbed in the small intestine)[[31]](https://en.wikipedia.org/wiki/Stomach#cite_note-31)

The [parietal cells](https://en.wikipedia.org/wiki/Parietal_cell) of the human stomach are responsible for producing [intrinsic factor](https://en.wikipedia.org/wiki/Intrinsic_factor), which is necessary for the absorption of [vitamin B12](https://en.wikipedia.org/wiki/Vitamin_B12). B12 is used in cellular metabolism and is necessary for the production of [red blood cells](https://en.wikipedia.org/wiki/Red_blood_cell), and the functioning of the [nervous system](https://en.wikipedia.org/wiki/Nervous_system).

### Control of secretion and motility**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=13)**]**

[](https://en.wikipedia.org/wiki/File:Stomach_emptying_into_duodenum.svg)

Emptying of stomach chyme into the duodenum through the pyloric sphincter.

Chyme from the stomach is slowly released into the [duodenum](https://en.wikipedia.org/wiki/Duodenum) through coordinated [peristalsis](https://en.wikipedia.org/wiki/Peristalsis) and opening of the pyloric sphincter. The movement and the flow of chemicals into the stomach are controlled by both the [autonomic nervous system](https://en.wikipedia.org/wiki/Autonomic_nervous_system) and by the various [digestive hormones](https://en.wikipedia.org/wiki/Digestion#Digestive_hormones) of the digestive system:

|  |  |
| --- | --- |
| [Gastrin](https://en.wikipedia.org/wiki/Gastrin) | The hormone *gastrin* causes an increase in the secretion of HCl from the parietal cells and pepsinogen from chief cells in the stomach. It also causes increased motility in the stomach. Gastrin is released by [G cells](https://en.wikipedia.org/wiki/G_cell) in the stomach in response to distension of the antrum and digestive products (especially large quantities of incompletely digested proteins). It is inhibited by a [pH](https://en.wikipedia.org/wiki/PH) normally less than 4(high acid), as well as the hormone [somatostatin](https://en.wikipedia.org/wiki/Somatostatin). |
| [Cholecystokinin](https://en.wikipedia.org/wiki/Cholecystokinin) | *Cholecystokinin* (CCK) has most effect on the [gall bladder](https://en.wikipedia.org/wiki/Gall_bladder), causing gall bladder contractions, but it also decreases gastric emptying and increases release of [pancreatic](https://en.wikipedia.org/wiki/Pancreas) juice, which is alkaline and neutralizes the chyme. CCK is synthesized by I-cells in the mucosal epithelium of the small intestine. |
| [Secretin](https://en.wikipedia.org/wiki/Secretin) | In a different and rare manner, *secretin*, which has the most effects on the pancreas, also diminishes acid secretion in the stomach. Secretin is synthesized by [S-cells](https://en.wikipedia.org/wiki/S_cell), which are located in the duodenal mucosa as well as in the jejunal mucosa in smaller numbers. |
| [Gastric inhibitory peptide](https://en.wikipedia.org/wiki/Gastric_inhibitory_peptide) | *Gastric inhibitory peptide* (GIP) decreases both gastric acid release and motility. GIP is synthesized by K-cells, which are located in the duodenal and jejunal mucosa. |
| [Enteroglucagon](https://en.wikipedia.org/wiki/Enteroglucagon) | *Enteroglucagon* decreases both gastric acid and motility. |

Other than gastrin, these hormones all act to turn off the stomach action. This is in response to food products in the [liver](https://en.wikipedia.org/wiki/Liver) and gall bladder, which have not yet been absorbed. The stomach needs to push food into the small intestine only when the intestine is not busy. While the intestine is full and still digesting food, the stomach acts as storage for food.

### Other**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=14)**]**

**Effects of EGF**

[Epidermal growth factor](https://en.wikipedia.org/wiki/Epidermal_growth_factor) (EGF) results in cellular proliferation, differentiation, and survival.[[32]](https://en.wikipedia.org/wiki/Stomach#cite_note-Herbst-32) EGF is a low-molecular-weight polypeptide first purified from the mouse submandibular gland, but since then found in many human tissues including the [submandibular gland](https://en.wikipedia.org/wiki/Submandibular_gland), and the [parotid gland](https://en.wikipedia.org/wiki/Parotid_gland). Salivary EGF, which also seems to be regulated by dietary inorganic [iodine](https://en.wikipedia.org/wiki/Iodine), also plays an important physiological role in the maintenance of oro-esophageal and gastric tissue integrity. The biological effects of salivary EGF include healing of oral and gastroesophageal ulcers, inhibition of gastric acid secretion, stimulation of DNA synthesis, and mucosal protection from intraluminal injurious factors such as gastric acid, bile acids, pepsin, and trypsin and from physical, chemical, and bacterial agents.[[33]](https://en.wikipedia.org/wiki/Stomach#cite_note-33)

**Stomach as nutrition sensor**

The human stomach can "taste" [sodium glutamate](https://en.wikipedia.org/wiki/Sodium_glutamate) using glutamate receptors[[34]](https://en.wikipedia.org/wiki/Stomach#cite_note-34) and this information is passed to the [lateral hypothalamus](https://en.wikipedia.org/wiki/Lateral_hypothalamus) and [limbic system](https://en.wikipedia.org/wiki/Limbic_system) in the [brain](https://en.wikipedia.org/wiki/Brain) as a [palatability](https://en.wikipedia.org/wiki/Palatability) signal through the [vagus nerve](https://en.wikipedia.org/wiki/Vagus_nerve" \o "Vagus nerve).[[35]](https://en.wikipedia.org/wiki/Stomach#cite_note-35) The stomach can also sense, independently of tongue and oral taste receptors, [glucose](https://en.wikipedia.org/wiki/Glucose),[[36]](https://en.wikipedia.org/wiki/Stomach#cite_note-Araujo-36) [carbohydrates](https://en.wikipedia.org/wiki/Carbohydrate),[[37]](https://en.wikipedia.org/wiki/Stomach#cite_note-Perez-37) [proteins](https://en.wikipedia.org/wiki/Protein),[[37]](https://en.wikipedia.org/wiki/Stomach#cite_note-Perez-37) and [fats](https://en.wikipedia.org/wiki/Fat).[[38]](https://en.wikipedia.org/wiki/Stomach#cite_note-38) This allows the brain to link [nutritional](https://en.wikipedia.org/wiki/Nutritional) value of foods to their tastes.[[36]](https://en.wikipedia.org/wiki/Stomach#cite_note-Araujo-36)

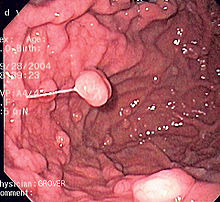
**Thyrogastric syndrome**

This syndrome defines the association between thyroid disease and chronic gastritis, which was first described in the 1960s.[[39]](https://en.wikipedia.org/wiki/Stomach#cite_note-39) This term was coined also to indicate the presence of thyroid autoantibodies or autoimmune thyroid disease in patients with pernicious anemia, a late clinical stage of atrophic gastritis.[[40]](https://en.wikipedia.org/wiki/Stomach#cite_note-40) In 1993, a more complete investigation on the stomach and thyroid was published,[[41]](https://en.wikipedia.org/wiki/Stomach#cite_note-41) reporting that the thyroid is, embryogenetically and phylogenetically, derived from a primitive stomach, and that the thyroid cells, such as primitive gastroenteric cells, migrated and specialized in uptake of iodide and in storage and elaboration of iodine compounds during vertebrate evolution. In fact, the stomach and thyroid share iodine-concentrating ability and many morphological and functional similarities, such as cell polarity and apical microvilli, similar organ-specific antigens and associated autoimmune diseases, secretion of glycoproteins (thyroglobulin and mucin) and peptide hormones, the digesting and readsorbing ability, and lastly, similar ability to form iodotyrosines by peroxidase activity, where iodide acts as an electron donor in the presence of H2O2. In the following years, many researchers published reviews about this syndrome.[[42]](https://en.wikipedia.org/wiki/Stomach#cite_note-42)

## **Clinical significance[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=15)**]**

[](https://en.wikipedia.org/wiki/File:Stomach_endoscopy_1.jpg)

An [endoscopy](https://en.wikipedia.org/wiki/Endoscopy) of a normal stomach of a healthy 65-year-old woman.

[](https://en.wikipedia.org/wiki/File:Fundic_gland_polyposis0001.jpg)

Endoscopic image of a fundic gland [polyp](https://en.wikipedia.org/wiki/Polyp_(medicine)).

### Diseases**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=16)**]**

*Main article:*[*Stomach disease*](https://en.wikipedia.org/wiki/Stomach_disease)

A [series of radiographs](https://en.wikipedia.org/wiki/Upper_gastrointestinal_series) can be used to examine the stomach for various disorders. This will often include the use of a [barium swallow](https://en.wikipedia.org/wiki/Upper_gastrointestinal_series). Another method of examination of the stomach, is the use of an [endoscope](https://en.wikipedia.org/wiki/Endoscopy). A [gastric emptying study](https://en.wikipedia.org/wiki/Gastric_emptying_study) is considered the gold standard to assess the gastric emptying rate.[[43]](https://en.wikipedia.org/wiki/Stomach#cite_note-43)

A large number of studies have indicated that most cases of [peptic ulcers](https://en.wikipedia.org/wiki/Peptic_ulcer), and [gastritis](https://en.wikipedia.org/wiki/Gastritis), in humans are caused by [*Helicobacter pylori*](https://en.wikipedia.org/wiki/Helicobacter_pylori) infection, and an association has been seen with the development of [stomach cancer](https://en.wikipedia.org/wiki/Stomach_cancer).[[44]](https://en.wikipedia.org/wiki/Stomach#cite_note-Brown-44)

A [stomach rumble](https://en.wikipedia.org/wiki/Stomach_rumble) is actually noise from the intestines.

### Surgery**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=17)**]**

In humans, many [bariatric surgery](https://en.wikipedia.org/wiki/Bariatric_surgery) procedures involve the stomach, in order to lose weight. A [gastric band](https://en.wikipedia.org/wiki/Adjustable_gastric_band) may be placed around the cardia area, which can adjust to limit intake. The [anatomy of the stomach may be modified](https://en.wikipedia.org/wiki/Sleeve_gastrectomy), or the stomach may be [bypassed entirely](https://en.wikipedia.org/wiki/Gastric_bypass_surgery).

Surgical removal of the stomach is called a [gastrectomy](https://en.wikipedia.org/wiki/Gastrectomy), and removal of the cardia area is a called a **cardiectomy**. "Cardiectomy" is a term that is also used to describe the removal of the [heart](https://en.wikipedia.org/wiki/Heart).[[45]](https://en.wikipedia.org/wiki/Stomach#cite_note-45)[[46]](https://en.wikipedia.org/wiki/Stomach#cite_note-BARLOW-46)[[47]](https://en.wikipedia.org/wiki/Stomach#cite_note-MELTZER-47) A gastrectomy may be carried out because of gastric cancer or severe perforation of the stomach wall.

[Fundoplication](https://en.wikipedia.org/wiki/Nissen_fundoplication) is stomach surgery in which the fundus is wrapped around the lower esophagus and stitched into place. It is used to treat [gastroesophageal reflux disease (GERD)](https://en.wikipedia.org/wiki/Gastroesophageal_reflux_disease).[[48]](https://en.wikipedia.org/wiki/Stomach#cite_note-Minjarez06-48)

## **History[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=18)**]**

There were previously conflicting statements in the academic anatomy community[[49]](https://en.wikipedia.org/wiki/Stomach#cite_note-49)[[50]](https://en.wikipedia.org/wiki/Stomach#cite_note-50)[[51]](https://en.wikipedia.org/wiki/Stomach#cite_note-51) over whether the cardia is part of the stomach, part of the esophagus or a distinct entity. Modern surgical and medical textbooks have agreed that "the gastric cardia is now clearly considered to be part of the stomach."[[52]](https://en.wikipedia.org/wiki/Stomach#cite_note-accessmedicine.com-52)[[53]](https://en.wikipedia.org/wiki/Stomach#cite_note-53)

### Etymology**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=19)**]**

The word *stomach* is derived from the [Latin](https://en.wikipedia.org/wiki/Latin) *stomachus* which has roots from the [Greek](https://en.wikipedia.org/wiki/Ancient_Greek) word *stomachos* (στόμαχος), ultimately from *stoma* (στόμα), "mouth".[[54]](https://en.wikipedia.org/wiki/Stomach#cite_note-54) *Gastro-* and *gastric* (meaning "related to the stomach") are both derived from the Greek word *gaster* (γαστήρ, meaning "belly"[[55]](https://en.wikipedia.org/wiki/Stomach#cite_note-55)[[56]](https://en.wikipedia.org/wiki/Stomach#cite_note-56)).[[57]](https://en.wikipedia.org/wiki/Stomach#cite_note-57)

## **Other animals[**[**edit**](https://en.wikipedia.org/w/index.php?title=Stomach&action=edit&section=20)**]**

|  |  |
| --- | --- |
| Comparison of stomach glandular regions from several mammalian species. Frequency of glands may vary more smoothly between regions than is diagrammed here. Asterisk (ruminant) represents the omasum, which is absent in [Tylopoda](https://en.wikipedia.org/wiki/Tylopoda" \o "Tylopoda) (Tylopoda also have some cardiac glands opening onto ventral [reticulum](https://en.wikipedia.org/wiki/Reticulum_(anatomy)) and [rumen](https://en.wikipedia.org/wiki/Rumen)[[58]](https://en.wikipedia.org/wiki/Stomach#cite_note-58)) Many other variations exist among the mammals.[[59]](https://en.wikipedia.org/wiki/Stomach#cite_note-59)[[60]](https://en.wikipedia.org/wiki/Stomach#cite_note-60) | **Yellow**  [Esophagus](https://en.wikipedia.org/wiki/Oesophagus)  **Green**  [Esophageal (nonglandular) region](https://en.wikipedia.org/w/index.php?title=Oesophageal_(nonglandular)_region&action=edit&redlink=1).[[61]](https://en.wikipedia.org/wiki/Stomach#cite_note-APFA-61)  **Purple**  [Cardiac gland region](https://en.wikipedia.org/w/index.php?title=Cardiac_gland_region&action=edit&redlink=1).[[61]](https://en.wikipedia.org/wiki/Stomach#cite_note-APFA-61)  **Red**  [Fundic gland region](https://en.wikipedia.org/w/index.php?title=Fundic_gland_region&action=edit&redlink=1).[[61]](https://en.wikipedia.org/wiki/Stomach#cite_note-APFA-61)  **Blue**  [Pyloric gland region](https://en.wikipedia.org/w/index.php?title=Pyloric_gland_region&action=edit&redlink=1).[[61]](https://en.wikipedia.org/wiki/Stomach#cite_note-APFA-61)  **Dark blue**  [Duodenum](https://en.wikipedia.org/wiki/Duodenum) |

Although the precise shape and size of the stomach varies widely among different vertebrates, the relative positions of the esophageal and duodenal openings remain relatively constant. As a result, the organ always curves somewhat to the left before curving back to meet the pyloric sphincter. However, [lampreys](https://en.wikipedia.org/wiki/Lamprey), [hagfishes](https://en.wikipedia.org/wiki/Hagfish), [chimaeras](https://en.wikipedia.org/wiki/Chimaera), [lungfishes](https://en.wikipedia.org/wiki/Lungfish), and some [teleost](https://en.wikipedia.org/wiki/Teleost) fish have no stomach at all, with the esophagus opening directly into the intestine. These animals all consume diets that require little storage of food, no predigestion with gastric juices, or both.[[62]](https://en.wikipedia.org/wiki/Stomach#cite_note-VB-62)

The gastric lining is usually divided into two regions, an anterior portion lined by fundic glands and a posterior portion lined with pyloric glands. Cardiac glands are unique to [mammals](https://en.wikipedia.org/wiki/Mammal), and even then are absent in a number of species. The distributions of these glands vary between species, and do not always correspond with the same regions as in humans. Furthermore, in many non-human mammals, a portion of the stomach anterior to the cardiac glands is lined with epithelium essentially identical to that of the esophagus. [Ruminants](https://en.wikipedia.org/wiki/Ruminant), in particular, have a complex stomach, the first three chambers of which are all lined with esophageal mucosa.[[62]](https://en.wikipedia.org/wiki/Stomach#cite_note-VB-62)

In [birds](https://en.wikipedia.org/wiki/Bird) and [crocodilians](https://en.wikipedia.org/wiki/Crocodilian), the stomach is divided into two regions. Anteriorly is a narrow tubular region, the [proventriculus](https://en.wikipedia.org/wiki/Proventriculus), lined by fundic glands, and connecting the true stomach to the [crop](https://en.wikipedia.org/wiki/Crop_(anatomy)). Beyond lies the powerful muscular [gizzard](https://en.wikipedia.org/wiki/Gizzard), lined by pyloric glands, and, in some species, containing stones that the animal swallows to help grind up food.[[62]](https://en.wikipedia.org/wiki/Stomach#cite_note-VB-62)

In [insects](https://en.wikipedia.org/wiki/Insect) there is also a crop. The insect stomach is called the [midgut](https://en.wikipedia.org/wiki/Insect#Midgut).

Information about the stomach in [echinoderms](https://en.wikipedia.org/wiki/Echinoderm) or [molluscs](https://en.wikipedia.org/wiki/Mollusc" \o "Mollusc) can be found under the respective articles.