We've Got A Gut Feeling About This Exhibit:

History of the Digestive System
How We Learned About Our Own Guts
"The stomach is lowest and has a hidden place in the body because of its uncleanness, as though nature had spared the principal members and had relegated the stomach or bowels farther away from the site of reason and of the mind and fenced it off with the diaphragm in order not to disturb the rational part of the mind with its importunity. These members serve the higher ones. Some of them concoct the food into juice, others digest it into various humors, others expel the superfluity." -- Alessandro Benedetti, 1497

Pre 11th century
Male figure, showing intestines, terracotta, Allahabad Municipal Museum, Allahabad, Uttar Pradesh, India. Image credit exact date unknown, pre-1000 AD.
"Intestine" in Sumerian cuneiform pictograph and Egyptian hieroglyph; "stomach" in Chinese

The Sumerian sign (Jaritz #103), depicts a 'length of intestine filled with contents, showing both tied ends'; and means 'qa, measure of capacity (approximately 60 in.3)', which I assume is the capacity of a then standard length of intestine, used as a container.

The Egyptian sign for intestine is (Gardiner #F46),

It has an unusual number of variants:

meaning: 'intestine/intestinal cavity', also 'coils of snake' and 'windings of waterway'.

This is the Chinese sign for "stomach."
Ancient and medieval anatomists had fairly accurate gross physiological knowledge of the structure of the stomach, colon, and intestines, dividing the later into six sections whose names are still retained today in modern anatomy. They recognized the importance of digestion as a key aspect of maintaining the humoral balance of the body, suggesting that, if the stomach and intestines' functions were impaired, other bodily functions would suffer. Initially medical practitioners viewed the stomach as an active, almost thinking agent in the body. Galen saw the stomach as an animate being that could feel its own emptiness and generate the sensation of hunger, writing: "[Nature] has granted to the stomach alone and particularly to the parts of it near its mouth the ability to feel a lack which rouses the animal and stimulates it to seek food." He additionally described it as a storehouse of nutrition that sorted the wheat from the chaff: "For just as workmen skilled in preparing wheat cleanse it of any earth, stones, or foreign seeds mixed with it that would be harmful to the body, so the faculty of the stomach thrust downward anything of that sort, but makes the rest of the material, that is naturally good, still better and distributes it to the veins extending to the stomach and intestines."

The intestines and colon, on the other hand, were more passive, relying on their physical attributes of length and thickness to absorb nutrients and contain waste. Galen further observed that the longer and varied size of the intestines was a sign of a higher being. He contrasted this kind of intestine to that of "voracious animals ... [that] both feed continually and as incessantly eliminate, leading a life truly inimical to philosophy and music, as Plato has said, whereas nobler and more perfect animals neither eat nor eliminate continually." The continued fascination with the shape of the human intestines as indicative of their special purpose is apparent in this early modern Islamic illustration:
11th Century
In the early eleventh century, the medieval Islamic medical philosopher Avicenna was much less concerned about descriptive anatomy. Instead, he recognized the importance of nutrition and the vulnerability of the stomach to illness, giving copious advice about diet and some about digestion, writing primarily about the stomach and intestines in relation to these two factors. Very practically he observed, "Mental excitement or emotion; vigorous exercise; these hinder digestion." Later medieval and Renaissance medical practitioners built upon these ideas by offering complexion theories of the stomach as a cold and dry organ that was among the principal organs of the body. In the Galenic tradition, it was the site of first digestion, since the body digested nutrients in multiple ways. Every aspect of its shape and texture -- even its location -- facilitated this process. Master Nicolaus in the twelfth century poetically wrote: "The stomach has the liver below it like a fire underneath a cauldron; and thus the stomach is like a kettle of food, the gall-bladder its cook, and the liver is the fire."
Medieval manuscript describing the stomach. (source unknown)
The illustration above, from a medieval anatomy book, demonstrates this idea in the way both the liver and stomach are drawn. Similarly, the names of parts of the digestive system recalled their specific functions. Many thought that the colon was a colander that strained the feces.

15th Century
Among Leonardo Da Vinci’s (1452-1519) many scientific achievements were his discoveries in anatomy. Besides artistic talent, he possessed the "stomach" to dissect of both humans and animals. Dissections weren't common in da Vinci’s day, but probably weren't illegal, either. Though his understanding of the respiratory system added little to medieval knowledge, his studies of skeletal and muscle tissue, brain anatomy, and digestive and reproductive systems advanced human anatomical understanding to a new level. Read more about Da Vinci's anatomy studies here.

Increased dissection led to more detailed descriptions of the organs involved in digestion, and to illustrations such as the one above reflecting this new approach to anatomy.

In 1497, Alessandro Benedetti lingered over its "denticulated or corrugated [appearance] with thick skin in the manner of a blackberry." At the end of the fifteenth century, Berengario da Carpi wrote: "The stomach's substance is predominantly sinewy. Its color is evident. Its form is round and arched like a Moorish gourd. It is connected to the heart by arteries, to the liver and spleen by veins, to the vein by descending nerves. It is attached to the anus by intestines and to the mouth by means of the gullet."

None of this new detail, however, fundamentally changed the image of the stomach. It was still a cold and dry organ, situated at the crossroads of the arterial and venal systems, that was literally roused to life within the body.

16th Century
The image shown above is a detail taken from the frontispiece of the 1555 edition of *De Fabrica*, in all probability designed by Johannes Stephan van Calcar, a pupil of Titian. The plate shows Vesalius at one of his lectures on anatomy. The bearded figure of Vesalius stands in the middle beside the dissecting table, performing an autopsy on the cadaver of a woman. The full frontispiece shows Vesalius surrounded by a crowd of about 70 students and spectators of all ages. Learn more about Vesalius, the father of modern medicine, [here](#).

16th Century
Some religious restrictions on dissection were lifted in the 15th & 16th centuries, leading to the wider study of anatomy using models like these as extra teaching aids.

18th Century
This is an anatomical figure of a pregnant women lying on a cloth-covered bier in a wooden box. It is made of ivory and the front can be removed to reveal the internal organs, some of which can themselves be removed. The figure may have been manufactured in Italy in the early 18th century. Image source: Science Museum/Science & Society Picture Library

19th Century

**William Beaumont** (November 21, 1785 - April 25, 1853) was a surgeon in the U.S. Army who became known as the "Father of Gastric Physiology" following his research on human digestion.

On June 6, 1822, an employee of the American Fur Company on Mackinac Island named Alexis St. Martin was accidentally shot in the stomach. Dr. Beaumont treated his wound, and expected St. Martin to die from his injuries. Despite this dire prediction, St. Martin survived with a hole in his stomach that never fully healed. Unable to continue work for the American Fur Company, he was hired as a handyman by Dr. Beaumont.
By the August of 1825, Beaumont had been relocated to Fort Niagara in New York, and Alexis St. Martin had come with him. It was at this location that Dr. Beaumont began to perform experiments on digestion using the stomach of St. Martin. Most of the experiments were conducted by tying a piece of food to a string and inserting it through the hole into St. Martin's stomach. Every few hours, Beaumont would remove the food and observe how well it had been digested. Beaumont also extracted a sample of gastric acid from St. Martin's stomach for analysis. In September, Alexis St. Martin left Dr. Beaumont and moved to Canada, leaving Beaumont to concentrate on his duties as an army surgeon.

In 1828 he was stationed in Prairie du Chien, Wisconsin for the next five years. While there, Beaumont arranged for Alexis St. Martin to come to serve as Beaumont's handyman again. In early 1831, Dr. Beaumont conducted another set of experiments on St. Martin, ranging from the simple observation of normal digestion to the effects that temperature and even emotions have on the digestive process. In April, St. Martin again left for Canada. Beaumont left the army in 1832 and moved to Washington, D.C.

In Washington, Dr. Beaumont met St. Martin once again, and performed another set of experiments on how various foods were digested in the stomach. In 1833, Beaumont left Washington and returned to Plattsburgh, New York, where he wrote a book about his experiments on digestion titled *Experiments and Observations on the Gastric Juice and the Physiology of Digestion*. ---[Wikipedia](https://en.wikipedia.org/wiki/Dr._William_Beaumont)

**Diagram of Alexis St. Martin's wound** (from Dr. Beaumont's book, *Experiments and Observations on the Gastric Juice and the Physiology of Digestion*, 1833)
"This engraving represents the appearance of the aperture with the valve depressed. 
A A A Edges of the aperture through the integuments and intercostals, on the inside 
and around which is the union of the lacerated edges of the perforated coats of the 
stomach with the intercostals and skin.
B The cavity of the stomach, when the valve is depressed.
C Valve, depressed within the cavity of the stomach.
E E E E Cicatrice of the original wound."

Details of the foods used in the Beaumont-St Martin digestion experiments:
It was not until August 1, 1825 that Dr. Beaumont — now stationed at Fort Niagara —
began his experiments with St. Martin, becoming the first person to observe human 
digestion as it occurs in the stomach. Beaumont tied quarter-ounce pieces of food to 
the end of a silk string and dangled the food through the hole into St. Martin's 
stomach. (The food items were "high seasoned alamode beef," raw salted lean beef, 
raw salted fat pork, raw lean fresh beef, boiled corned beef, stale bread, and raw 
cabbage.) St. Martin went back to his household duties. Beaumont pulled out the 
string one, two, and three hours later, to observe the rate of digestion for the different 
foods. Five hours after he first put the food into St. Martin's stomach, Beaumont 
removed the food pieces because St. Martin was suffering stomach distress. The next 
day, St. Martin still had indigestion, which Beaumont treated.
On August 7, 1825, Beaumont had St. Martin fast for 17 hours, and then took the 
temperature of St. Martin's stomach (it was 100 degrees) Beaumont removed gastric 
juice from St. Martin's stomach, then observed the rate of digestion of a piece of 
corned boiled beef "test-tube" style, while also placing the same-sized piece of meat 
directly into St. Martin's stomach. The stomach digested the meat in two hours; the 
vial of gastric juice took 10 hours (maintained at about 100 degrees). The next day, 
Beaumont repeated the experiments using boiled chicken, which he found digested 
slower than the beef. The experiments showed that gastric juice has solvent properties 
In January 1831, Beaumont just observed the normal process of digestion in the 
stomach. St. Martin would eat a normal meal and resume his work, and Beaumont 
would periodically take samples from St. Martin's stomach. Another experiment
compared what happened to food placed in a vial of gastric juice (temperature not controlled), food placed in a container of water, and food eaten by St. Martin; he learned that gastric juice needed heat to digest (i.e., that cold gastric juice has no effect on food). Beaumont used more variety of food samples while at Fort Crawford; he found that vegetables are less digestible than other foods, and milk coagulates before the digestive process. St. Martin sometimes became irritable doing experiments (it was stressful for him to have food removed from his stomach), and Beaumont observed that being angry can hinder one's digestion.

Late 1832 in Washington, D.C., Beaumont again tried different foods with St. Martin, including raw oysters, sausage, mutton, and "boiled salted fat pork." Beaumont focused on gastric juice, but did not study the importance of saliva on digestion; sometimes, he put food directly into St. Martin's stomach (once, he put in 12 raw oysters). He also observed that exercise helped the production and release of gastric juice. (Another limitation on Beaumont's work is that he could not obtain a chemical analysis of the gastric juice, as chemical analysis was severely limited in the mid-nineteenth century.)

What happened to both men and how they are remembered?
William Beaumont continued his private medical practice in St. Louis. In March 1853, Dr. Beaumont slipped on an icy step while exiting a patient's home, hitting his head severely. The occipital hematoma became infected, his condition deteriorated, and he died on April 25. He was buried in Bellefontaine Cemetery in St. Louis. He is memorialized now by a number of medical history organizations and buildings including:
- William Beaumont Hospital in Michigan
- Beaumont Memorial building on Mackinac Island
- Beaumont Life Sciences Building ("Beaumont Hall") on the SUNY Plattsburgh Campus
- William Beaumont Army Medical Center (WBAMC) in El Paso, Texas

Alexis St. Martin lived 58 years after his accident. After returning home to Canada for good, he worked as a farmer and itinerant laborer ("chopping wood by the cord," he described it). After the doctor's death, St. Martin did make a brief visit in 1856 to Dr. Beaumont's home in St. Louis, where he spoke with Deborah Beaumont. After Deborah's death, St. Martin frequently corresponded with Dr. Beaumont's son Israel; in 1879, he wrote that he had "been ill for six years . . . I am suffering a little from my gastric fistula, and my digestion grows worse than ever." His lawyer, Judge Baby of Montreal, said that St. Martin was "very much addicted to drink" in his 80's. When St. Martin died at age 86 on June 24, 1880 in St. Thomas de Joliette, Canada, his family deliberately let his body decompose in the hot sun for four days and then buried it in the Catholic churchyard in a deep unmarked grave, with heavy rocks atop the coffin, hoping to prevent anyone from examining his stomach or performing an autopsy. Years later, to commemorate St. Martin's contribution to medical science, a committee finally persuaded one of St. Martin's granddaughters to disclose the grave's...
location; in 1962, a plaque was placed on the church's wall near the grave, stating Alexis’ history, and that "through his affliction he served all humanity."
The cafeteria at the William Beaumont Army Medical Center in El Paso, Texas is named the "Saint Martin Dining Facility."
Learn more about Dr. Beaumont and Alexis St. Martin here.

**Details from two of a set of nine wax plaques showing different stages in the dissection of a female** figure and the development of the human embryo, probably made in Vienna, Austria, early 19th century. Here, the female figure has been superficially dissected to show the viscera - the heart, stomach, lungs and intestines.

Below, the female figure has been deeply dissected to show the alimentary canal and arterial supply to the lower regions.
20th Century
Fluoroscopy is an imaging technique commonly used by physicians to obtain real-time images of the internal structures of a patient through the use of a fluoroscope. In its simplest form, a fluoroscope consists of an x-ray source and fluorescent screen between which a patient is placed. However, modern fluoroscopes couple the screen to an x-ray image intensifier and CCD video camera allowing the images to be played and recorded on a monitor. The use of x rays, a form of ionizing radiation, requires that the potential risks from a procedure be carefully balanced with the benefits of the procedure to the patient. While physicians always try to use low dose rates during fluoroscopy procedures, the length of a typical procedure often results in a relatively high absorbed dose to the patient. Recent advances include the digitization of the images captured and flat-panel detector systems which reduce the radiation dose to the patient still further.
The fluoroscopic unit in the SMH Radiology Dept. **was used largely for the examination of the gastrointestinal tract.** In this 1926 image, a patient is stationed on the unit. Seated before her is Stafford L. Warren, radiologist. Minnie S. Hollingsworth passes the patient a cup containing a contrast medium. At the right of the image stands Walter W. Fray, M.D., asst. radiologist.

--- source
"The Flroscope" 1926 etching by John Sloan (1871-1951) showing the artist holding a glass of barium which traces a path through the digestive system. Due to the limited light produced from the fluorescent screens, early radiologists were required to sit in a darkened room, in which the procedure was to be performed, accustomizing their eyes to the dark and thereby increasing their sensitivity to the light. The placement of the radiologist behind the screen resulted in significant radiation doses to the radiologist.

Red adaptation goggles were developed by Wilhelm Trendelenburg in 1916 to address the problem of dark adaptation of the eyes, previously studied by Antoine Beclere. The resulting red light from the goggles' filtration correctly sensitized the physician's eyes prior to the procedure while still allowing him to receive enough light to function normally.

Learn more about fluroscopy here.
Gastroenterology or gastrology is the medical specialty developed in the 20th century concerned with digestive diseases. Traditionally, these are separated by anatomic or functional category. For example, disorders of the esophagus might be listed under "esophagus" and also included in a description of motility disorders (disorders of motor function.) Diseases of the liver fall under the branch of hepatology, which is traditionally classified under the umbrella of gastroenterology. Learn more about gastroenterology here.

Endoscopic equipment can be used to visualize and collect specimens from:
The gastrointestinal tract (GI tract):
--esophagus, stomach and duodenum (esophagostroduodenoscopy)
--small intestine, conventional enteroscopy can visualize the proximal small bowel; double balloon enteroscopy or the capsule camera can view the entire bowel
--colon (colonoscopy), the endoscope is used to examine the colon.
--sigmoid colon: (proctosigmoidoscopy)
--Bile duct

Learn more about endoscopy here.
Watch actual videos of gastrointestinal endoscopy exams at The DAVE Project, an acronym for the Digital Atlas of Video Education, is a collection of teaching tools. The project consists of a gastrointestinal endoscopy video atlas and medical lectures.
and presentations. The full spectrum of endoscopic imaging supported by pathologic, radiologic, and surgical images is available.

21st Century


**Magnetic resonance imaging (MRI)**, formerly referred to as magnetic resonance tomography (MRT) or nuclear magnetic resonance (NMR), is a method used to visualize the inside of living organisms as well as to detect the composition of geological structures. It is primarily used to demonstrate pathological or other physiological alterations of living tissues and is a commonly used form of medical imaging. Learn more about MRI and medical imaging here.

The above image was used to get an inside look at how fat affects the body's organs. For the article, two women were asked to spend five hours under a state-of-the-art open scanner to get a high-resolution magnetic resonance imaging scan (MRI). The above image was of a morbidly obese 5'6" woman aged 40 weighing 250 lbs with a Body Mass Index of 40.3.
The MRI clearly reveals the woman's digestive system. With regard to liver disease---many obese people develop deposits of fat inside the liver, a condition that can progress to cirrhosis in about 10% of cases leading to liver failure. Obese people are at greater risk of colon cancer. Abdominal fat appars to increase risk more than fat elsewhere, which may explain why men (who tend to store fat in their abdomens) have a higher risk.

Learn more about the History of the Stomach and Intestines here.