

Name _____

On the Trail of Digestion

Read the following section on the history of medical science and answer the questions:

Spallanzani

Lazzaro Spallanzani lived in the second half of the 18th Century. You may remember Spallanzani's experiments on spontaneous generation. His work on digestion is also famous.

In Spallanzani's time, people knew that the stomach was a strong muscle that could grind and mash food. Investigations of bodies told scientists that. But Spallanzani believed that the stomach also held a chemical process. He began his studies using his own falcons. He would feed the falcons small pieces of meat attached firmly to a string, and when the meat had been in the birds stomachs for some time, he would remove it. (You might remember that birds regurgitate quite easily, and some birds feed their babies this way.)

Spallanzani believed that digestion was a chemical process. Another noted scientist, Rene Reaumur disagreed. He wrote: "the gastric juice has no more effect out of the living body in dissolving or digesting the food than water, mucilage, milk, or any other bland fluid." Reaumur claimed to have done experiments to see if digestion could take place outside the body as well as in it. He wrote that he "collected quantities of gastric juice, and placed it in suitable vessels containing crushed grain or flesh, kept the mixture at about the temperature of the body for several hours. After repeated experiments of this kind...conducted with great care...he claimed that no digestion took place." There is no evidence in Reaumur's writings to say why his experiments turned out the way they did.

Spallanzani repeated Reaumur's experiment carefully. He took small portions of well-chewed beef or mutton. He placed them in a vial with gastric juice that he had removed from an animal's stomach. He kept the vial warm and agitated it by carrying it in his armpit. He described his result this way, "...the meat being ...converted into the soft grayish mass of a pultaceous consistence called chyme..."

Even this experiment wasn't accepted. A noted doctor of Spallanzani's time wrote, "In some of the experiments, in order to give the flesh or grains steeped in the gastric juice the same temperature with the body, the phials were introduced under the armpits. But this is not a fair mode of ascertaining the effects of the gastric juice out of the body; for the influence which life may be supposed to have on the solution of the food would be secured in this case. The affinities connected with life would extend to substances in contact with any part of the system: substances placed under the armpits are not placed at least in the same circumstances with those unconnected with a living animal."

Spallanzani's theories were finally accepted when another biologist, John Hunter, who at first disagreed with him, carried the experiments further. Pathologists who examined the bodies of people who had died often found holes in their stomach walls. Many of these people had never had stomach problems in life. Hunter wrote this explanation for the Royal Society: "I was opening...the body of a patient...where the stomach was in part dissolved, which (was) unaccountable, as there had been no previous symptom...(of) any disease in the stomach...I had long been making experiments on digestion, and considered this as one of the facts which proved a converting power in the gastric juice...These appearances throw considerable light on the principle of digestion, and show that it is neither a mechanical power, nor contractions of the stomach, nor heat, but something secreted in the coats of the stomach, and thrown into its cavity, which there animalizes the food..."

Answer these questions:

1. Why did Spallanzani repeat the experiment of Reaumur? _____

2. Think of one reason why Spallanzani's experiments may have turned out differently than Reaumur's experiments. _____

3. What excuse did others have to question Spallanzani's experiments? _____

4. What observation did Hunter make that supported Spallanzani's work? _____

5. What term did Spallanzani invent for the digested material in the stomach (which we still use today?) _____

6. Hunter uses a strange term "animalizes" for what gastric juice does to food. From the context, what do you think that term means? _____

7. What two scientific methods were used in this reading? _____

Read this selection on William Beaumont and complete the questions below:



the tube to determine the time required for digestion.

About 50 years after the experiments of Spallanzani, a Michigan Army doctor made an amazing discovery. It was June 6, 1822 at Fort Mackinac on the upper peninsula of Michigan. Alexis St. Martin, a 19 year-old trapper for the American Fur Company, was accidentally shot in the abdomen. Surprisingly, he lived. But his wound healed in a strange way. The inner wall of the stomach healed to the outer skin. Part of the wound formed a small natural hole that led directly into the stomach. Doctor William Beaumont used this situation to study digestion in St. Martin's body. He inserted a small valve through the hole and experimented on the digestive processes from 1825 to 1833. He observed that the fluids in the stomach were different before and after St. Martin ate. He also used

Here are Beaumont's own words:

I had opportunities for the examination of the interior of the stomach, and its secretions, which has never before been so fully offered to any one. This most important organ, its secretions and its operations, have been submitted to my observation in a very extraordinary manner, in a state of perfect health, and for years in succession. I have availed myself of the opportunity afforded by concurrence of circumstance which probably can never again occur, with a zeal and perseverance proceeding from motives which my conscience approves; and I now submit the result of my experiments to an enlightened public, who I doubt not will duly appreciate the truths discovered, and the confirmation of opinions which before rested on conjecture. The gastric juice appears to be secreted from numberless vessels, distinct and separate from the mucous follicles. These vessels, when examined with a microscope, appear in the shape of small lucid points, or very fine papillae, situated in the interstices of the follicles. They discharge their fluid only when solicited to do so, by the presence of aliment, or by mechanical irritation...Pure gastric juice, when taken directly out of the stomach of a healthy adult, unmixed with any other fluid, save a portion of the mucus of the stomach with which it is most commonly, and perhaps always combined, is a clear, transparent fluid; inodorous; a little saltish; and very perceptibly acid.

St. Martin lived a long life for his time, and Dr. William Beaumont became famous for his revolutionary understanding of the process of digestion.

Answer these questions:

1. Most holes in the body would result in infection and death. But St. Martin was able to live with his stomach open. What is there about the stomach's contents that might have kept him from being infected? _____

2. Beaumont describes little finger-like structures called "papillae" on the inside of the stomach. What did these structures do? _____

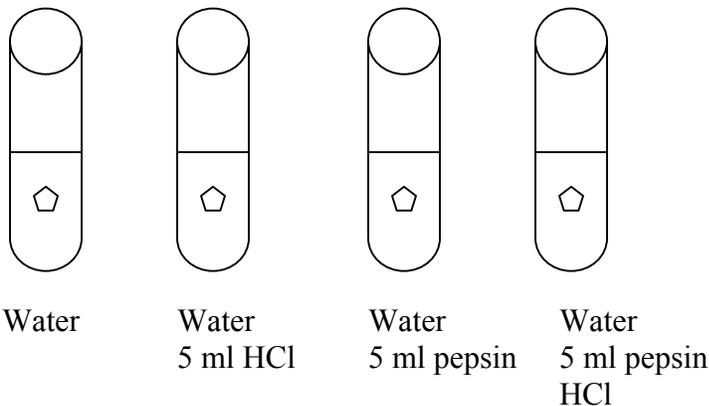
3. When does a stomach make gastric juice? _____

4. What part of Spallanzani's work is most like that of Dr. William Beaumont? _____

5. Why must foods be broken down to "chyme" before we can use them? _____

Our Observations:


 About 5 g
 Boiled egg
 White massed
 Carefully



Tube Contents	Initial Mass of Egg	Ending Mass of Egg
1.		
2.		
3.		
4.		

Questions about experiment:

1. What would you call the tube with just egg and water? _____

2. Why is the tube with just egg and water needed? _____

3. Why does the experiment work faster if you keep the water warm? _____

4. What do you think the stomach does to prevent acid from damaging its cells? _____
