

History of Digestion

Major Topic: Food Chemistry

Length of Unit: 4 – 45 minute classes

Unit Summary: Students will be researching and analyzing the history of different foods and how they are digested and processed by the body.

Interdisciplinary Connections: The students will complete double draft anticipation guides in which they answer questions about the story before hand and then take a second look at their answers after they have read the story and reflect on it. Then students will conduct experiments on foods to better understand there chemistry.

Understanding Goals: Students will understand some of the history behind how we know so much about how our bodies digest food.

Essential Questions:

- How does the scientific method work?
- How do our bodies digest food?
- What is the significance of what we eat?

Student Objectives:

Students will be able to:

LS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

- a) data are organized into tables showing repeated trials and means;
- f) dependent variables, independent variables, and constants are identified;
- g) variables are controlled to test hypotheses, and trials are repeated;
- h) data are organized, communicated through graphical representation, interpreted, and used to make predictions;
- i) patterns are identified in data and are interpreted and evaluated; and
- j) current applications are used to reinforce life science concepts.

Blooms Taxonomy	21st Century Skills
Creating Evaluating Analyzing Applying Understanding Remembering	Critical Thinking Problem Solving Communication Creativity & Innovation Collaboration Information & Media Contextual Learning Global/Multicultural Research

Performance Tasks:

Students will:

- Complete Anticipation Guide for each of the readings.
- Complete a Reflection Guide for the first reading.
- Complete a paragraph in the sandwich writing format for the second reading.
- Research and answers questions in complete paragraphs for the third reading.
- Create a cereal and write a slogan campaign for the fourth reading.

Evidence of formative assessment:

The writing assignments for the second and third readings will be used as a formative assessment.

Evidence of Summative Assessment:

The slogan campaign for the fourth reading will be presented to the class and used as a summative assessment.

Technology

Hardware	Software
Computers Internet Connection	Graphic Design Internet Web Browser

Resources from the web:

Students will be researching on their own.

Supplies:

- Copies of Breakfast Pioneers Anticipation Guide and article
- Copies of Follow the Sandwich Anticipation Guide and article
- Copies Living With Diabetes Anticipation Guide and article
- Copies Window Into A Stomach Anticipation/Reflection Guide and article
- Copies Living with Diabetes Writing Questions
- Copies of Sandwich chart
- Empty Cereal Boxes
- Crafting Materials (construction paper, glue, scissors, crayons, markers)

Lesson 1: (1 - 45 minute class)

- Students will complete the anticipation portion of the Anticipation/Reflection Guide for “Window into a Stomach”.
- Students will discuss their explanations as a class.
- Students will then read “Window into the Stomach”.
- Students will then complete the reflection portion of the Anticipation/Reflection Guide.
- Students will discuss their explanations as a class.

Lesson 2: (1 - 45 minute class)

- Students will complete the anticipation guide for “Follow the Sandwich”.
- Students will discuss their explanations as a class.
- Student will read “Follow the Sandwich”.
- Students will use the Sandwich Method and in their own words write a paragraph describing the movement of a sandwich through the digestive tract.

Lesson 3: (1 - 45 minute class)

- Students will complete the anticipation guide for “Living with Diabetes”.
- Students will then read “Living with Diabetes”.
- Students will then research the five questions about diabetes and write a five sentence paragraph for each using the sandwich method for writing a paragraph.

Lesson 4: (1 - 45 minute class)

- Students will complete the anticipation guide for “Breakfast Pioneers”.

Lesson Contributed by: Lisa Fain

Funded through 2013 State Council of Higher Education for Virginia (SCHEV) grant, Creativity & Innovation in STEM (CI STEM)

- Students will discuss their explanations as a class.
- Students will read “Breakfast Pioneers”.
- Students will make-up their own brand of cereal, design a box, and create a slogan for it that they would use in an advertisement campaign.
- Students will present their cereal boxes and slogans to the class.

“Window Into A Stomach” Anticipation / Reflection Guide

1. A person can survive with a hole in their stomach.

Anticipation

Agree: _____

Disagree: _____

Explanation:

Reflection

Agree: _____

Disagree: _____

Explanation:

2. The workings of the human stomach can be seen by observing a living person.

Anticipation

Agree: _____

Disagree: _____

Explanation:

Reflection

Agree: _____

Disagree: _____

Explanation:

3. Simple scientific experiments can lead to greater understanding of complex living organisms.

Anticipation

Agree: _____

Disagree: _____

Explanation:

Reflection

Agree: _____

Disagree: _____

Explanation:

“Follow the Sandwich” Anticipation Guide

1. Food is broken down and then reassembled for the body to use.

Agree: _____

Disagree: _____

Explanation:

2. The large intestine of the human body is 1.5 meters (5 feet) long.

Agree: _____

Disagree: _____

Explanation:

3. A sandwich can make it's way into your blood stream.

Agree: _____

Disagree: _____

Explanation:

"Living With Diabetes" Anticipation Guide

1. There are different kinds of diabetes.

Agree: _____

Disagree: _____

2. Anyone can get diabetes.

Agree: _____

Disagree: _____

3. It is important to control diabetes.

Agree: _____

Disagree: _____

"Breakfast Pioneers" Anticipation Guide

1. More than 2.7 billion packages of cereal are sold each year.

Agree: _____

Disagree: _____

Explanation:

2. The concept of cereal for breakfast is only 150 years old.

Agree: _____

Disagree: _____

Explanation:

3. Sometimes mistakes can result in great successes.

Agree: _____

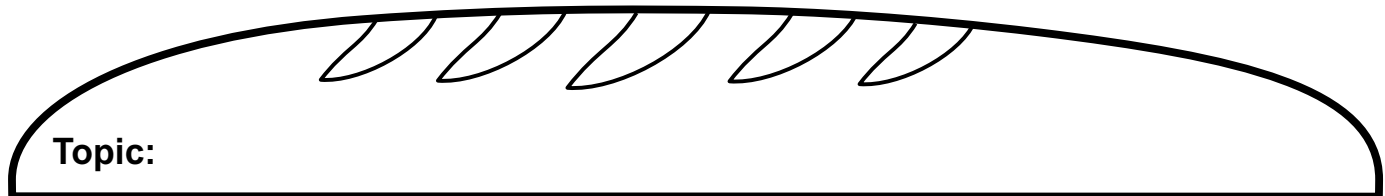
Disagree: _____

Explanation:

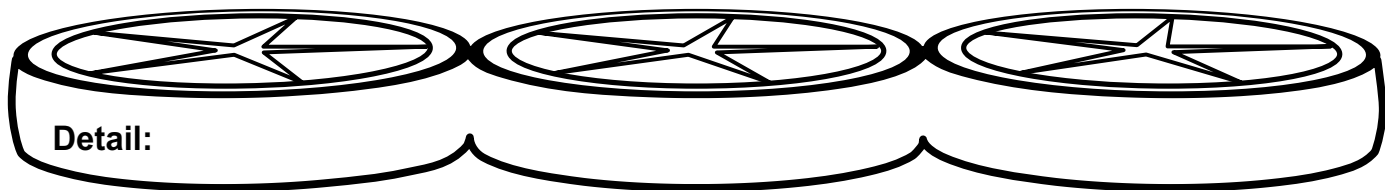
Name _____ Date _____

Sandwich Chart

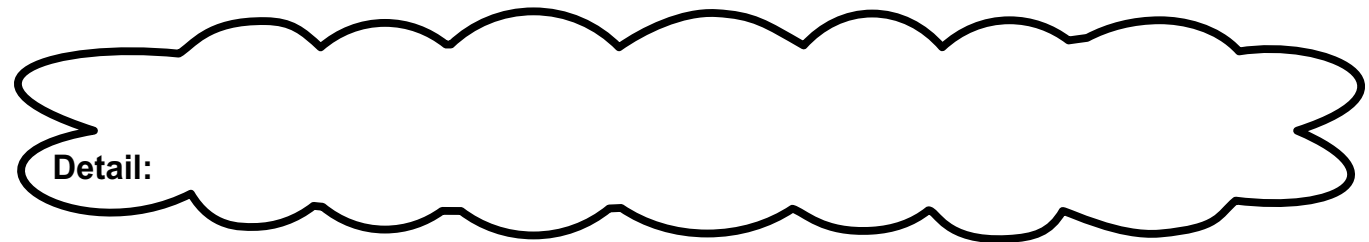
Write your topic at the top. Add details to the middle layers. Add a concluding sentence at the bottom.

A large, horizontal, rounded rectangle representing a slice of bread. It has a series of diagonal lines on its top surface, suggesting a loaf of bread.

Topic:

Three horizontal, rounded rectangles representing slices of tomato. Each slice has a star-shaped pattern on its top surface, representing seeds.

Detail:

A horizontal, rounded rectangle with a scalloped or wavy border, representing a slice of lettuce.

Detail:

A horizontal, rounded rectangle representing a slice of cheese.

Detail:

A large, horizontal, rounded rectangle representing the bottom slice of bread.

Concluding Sentence:

“Living with Diabetes” Writing Questions

Answer each question with a five sentence paragraph. You may use the computer to help you research each question.

1. Are there different kinds of diabetes?

2. Who gets diabetes?

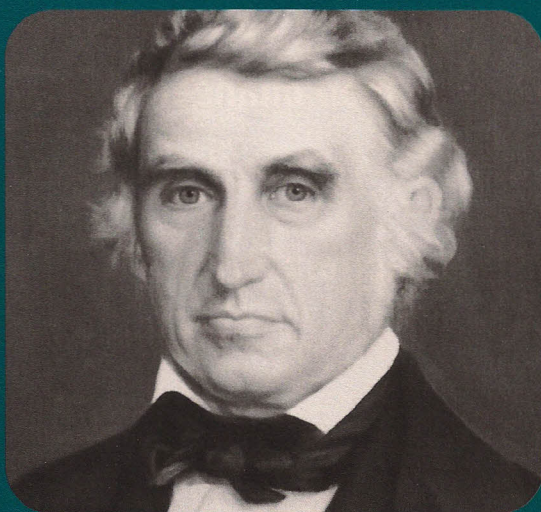
3. How do you get diabetes?

4. How do you treat diabetes?

5. Why is it important to control diabetes?

Window Into a Stomach

THE YEAR WAS 1820. WILLIAM BEAUMONT WAS A YOUNG DOCTOR FROM CONNECTICUT LOOKING FOR ADVENTURE AND A CHANCE TO MAKE MEDICAL HISTORY. HE ACCEPTED A JOB AS A FRONTIER DOCTOR AT AN ARMY OUTPOST IN NORTHERN MICHIGAN—A WILDERNESS AREA INHABITED BY FUR TRAPPERS AND AMERICAN INDIANS. BEAUMONT SOON FOUND THAT WORKING IN THIS AREA WAS RATHER DULL AND QUIET. SO MUCH FOR HIS DREAMS OF MEDICAL CHALLENGES.



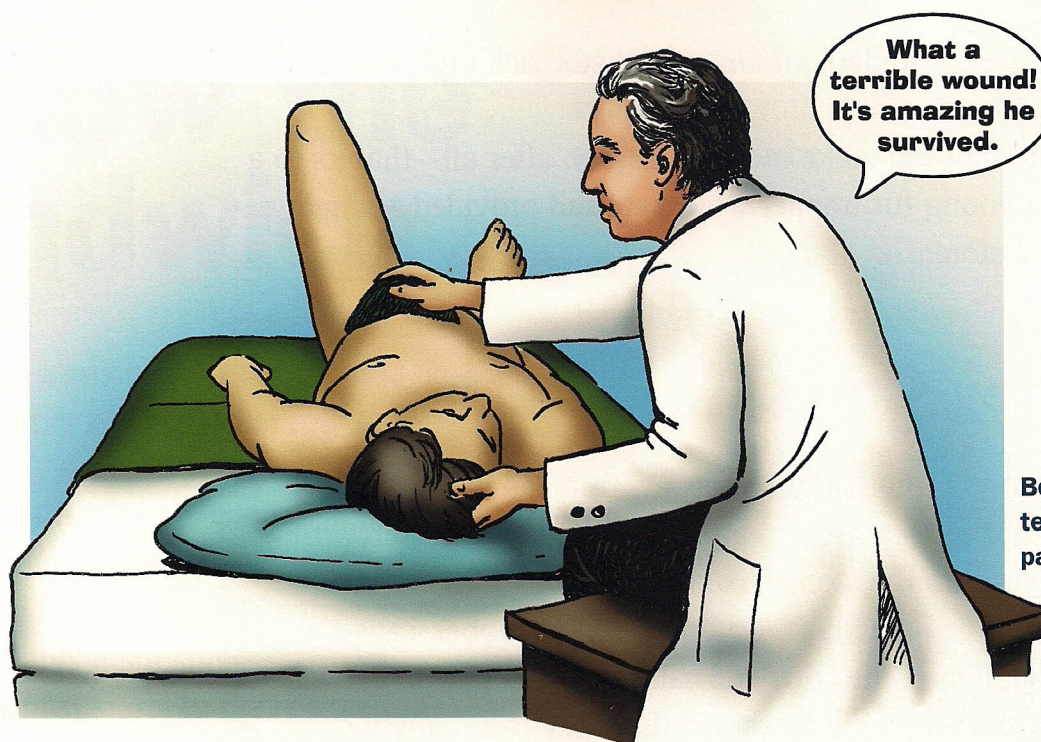
William Beaumont, frontier doctor

A Challenging Opportunity

Then one morning in June 1822, Beaumont's medical challenge arose. A young fur trapper, Alexis St. Martin, was chatting with friends at the general store when a shotgun accidentally fired. The shot blasted a deep hole in St. Martin's stomach. Someone sent for Dr. Beaumont. He cleaned St. Martin's wound, but he had little hope for his recovery. "The man cannot live 36 hours," Beaumont said sadly.

To Beaumont's surprise, St. Martin did survive. After several months, his wound healed. But there was still a hole in his stomach. To keep food from leaking out of the hole, Beaumont devised a small cover made of cloth. St. Martin's friends called him "the man with the lid on his stomach."

Beaumont realized that a rare opportunity had come his way. He had a chance to study how a living human stomach works. No one had ever done that before. So Beaumont persuaded St. Martin to stay with him and let him perform experiments.



Beaumont tends his patient.

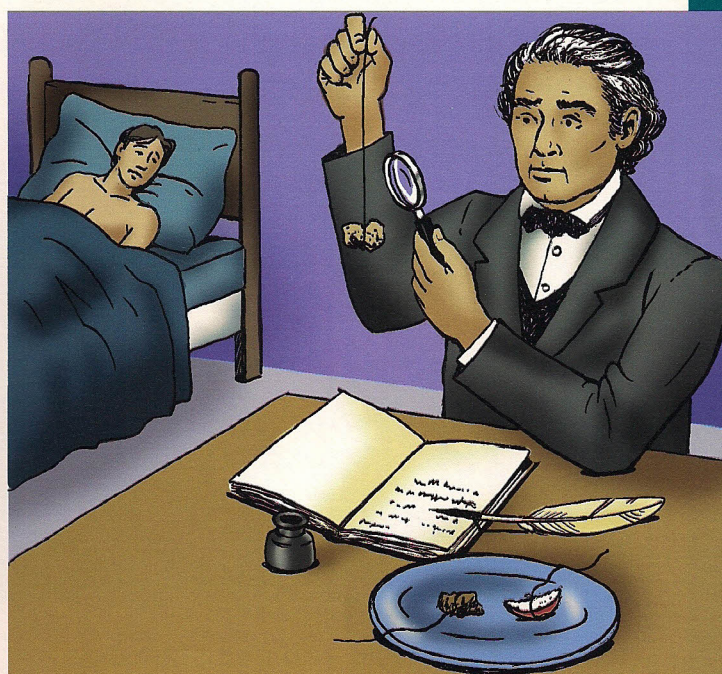
Beaumont's Experiments

Beaumont's experiments and observations were simple but effective. Here are a few things he tried:

- He removed samples of food from St. Martin's stomach and examined them.
- He tied threads around pieces of food and dropped them into the stomach. After a few hours, he pulled out the pieces to see what digestive juices had done to the food.
- He placed a thermometer in the stomach to measure its temperature when it was full and when it was empty.
- He took samples of gastric (stomach) juice and sent them to Sweden to be analyzed by a chemist.

Recording the Results

Beaumont performed 238 experiments on St. Martin's stomach and recorded his results. He published his findings in a book called *Experiments and Observations*. Doctors and scientists around the world read the book and ▶



Beaumont at work

gained a new understanding of the stomach and how it digests certain food.

Beaumont did make medical history, after all—thanks to a patient young fur trapper whose wound provided a window into his stomach.

Holey Cows

Holey cows? That's right—cows with holes in their stomachs, that is. Researchers at many universities insert artificial holes into the stomachs of cows. The holes are similar to a porthole on a ship. A piece of round rubber, called a cannula, fits on the cow. The cannula gives researchers access to the cow's stomach so that they can study it.

A cow's stomach has four sections. The largest section, called the rumen, is where most of the digestion takes place. The rumen allows cows to digest fiber, or cellulose. With a hole into the rumen, researchers can perform experiments and learn from their results—just like Beaumont was able to do.

Does this hurt a cow? Researchers say no. They insist that the “holey” cows are just like regular cows—they give milk, have babies, and lead normal lives. The cows experience no pain when the cannula is opened or when things are inserted into their stomachs. Special committees at universities ensure that all animals are treated humanely. ■



PHOTO BY STEPHEN AUSMUS, AGRICULTURAL RESEARCH SERVICE

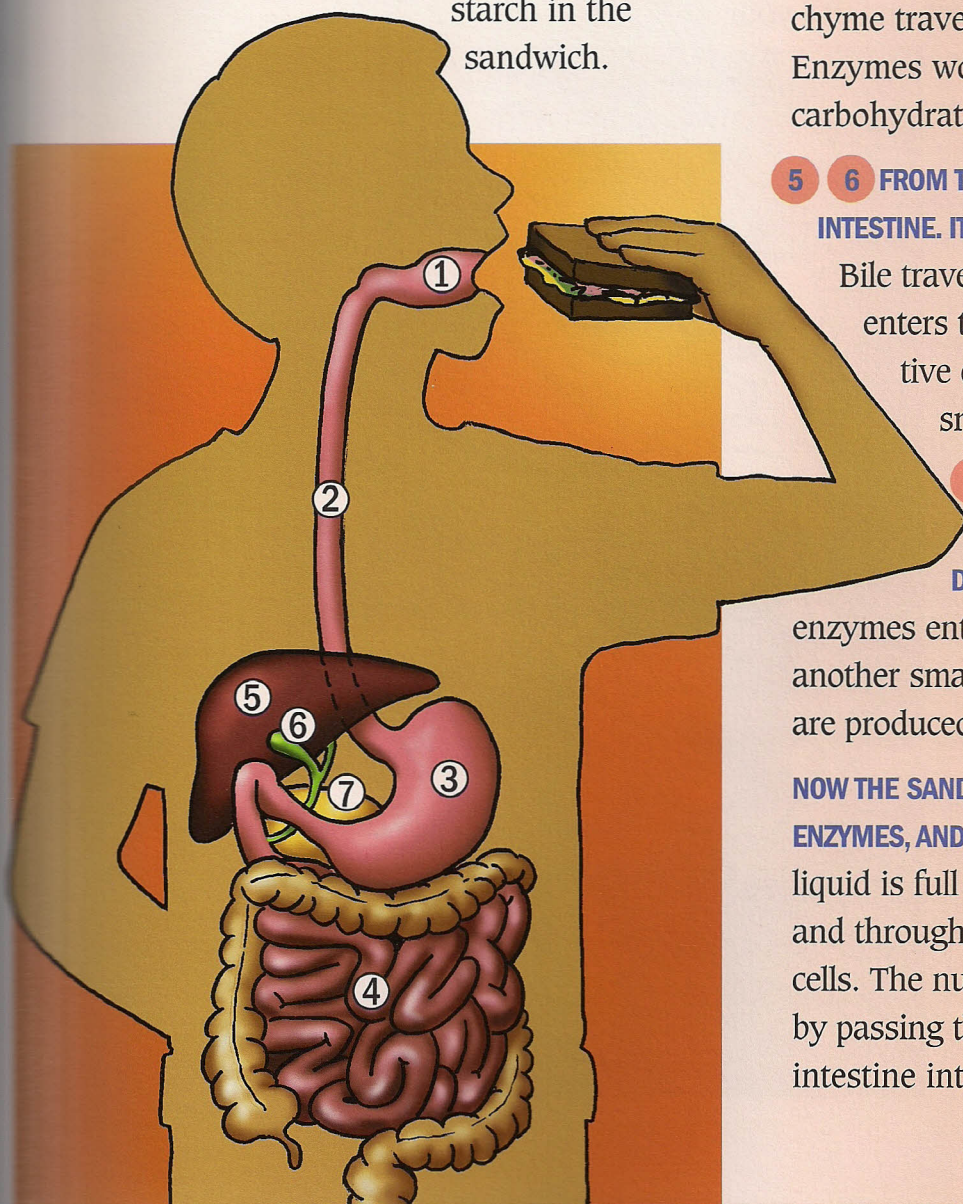
This cow has a closed cannula leading to its stomach.



Follow the Sandwich

WHEN YOU TAKE A BITE OF SANDWICH, WHERE DOES IT GO? FOLLOW THE SANDWICH AND FIND OUT.

- 1 INTO THE MOUTH.** Chomp, chomp. Teeth cut and grind the sandwich into smaller bits. Saliva (you know, spit) starts flowing. Saliva contains a substance, called an enzyme, which starts to break down the starch in the sandwich.



- 2 DOWN THE ESOPHAGUS.** This muscle-lined tube is about 25 centimeters (10 inches) long in an adult. It pushes the sandwich into the stomach.
- 3 HERE'S THE STOMACH**—a liter-size, J-shaped bag. Its strong, muscled walls squeeze and squash the sandwich. Glands lining the stomach walls ooze acid and enzymes to soften the food and break down some of the protein in it. After several hours, the sandwich is a soupy mush called chyme.
- 4 NEXT THE CHYME GOES TO THE SMALL INTESTINE**—a narrow tube about 6 meters (about 20 feet) long. For several hours, the chyme travels through the small intestine. Enzymes work to break down any fat, carbohydrates, and protein.

- 5 6 FROM THE LIVER, BILE ENTERS THE SMALL INTESTINE. IT IS STORED IN THE GALLBLADDER.**

Bile travels through a small tube and enters the small intestine. Other digestive enzymes are produced by the small intestine.

- 7 THE PANCREAS PRODUCES ENZYMES THAT DIGEST CARBOHYDRATES, FAT, AND PROTEIN.** These enzymes enter the small intestine through another small tube. Other digestive enzymes are produced by the small intestine itself.
- NOW THE SANDWICH, BROKEN DOWN BY ACIDS, ENZYMES, AND BILE, IS JUST LIQUID.** The soupy liquid is full of nutrients ready to travel into and through the bloodstream to your body's cells. The nutrients get to the bloodstream by passing through the wall of the small intestine into tiny blood vessels. ▶

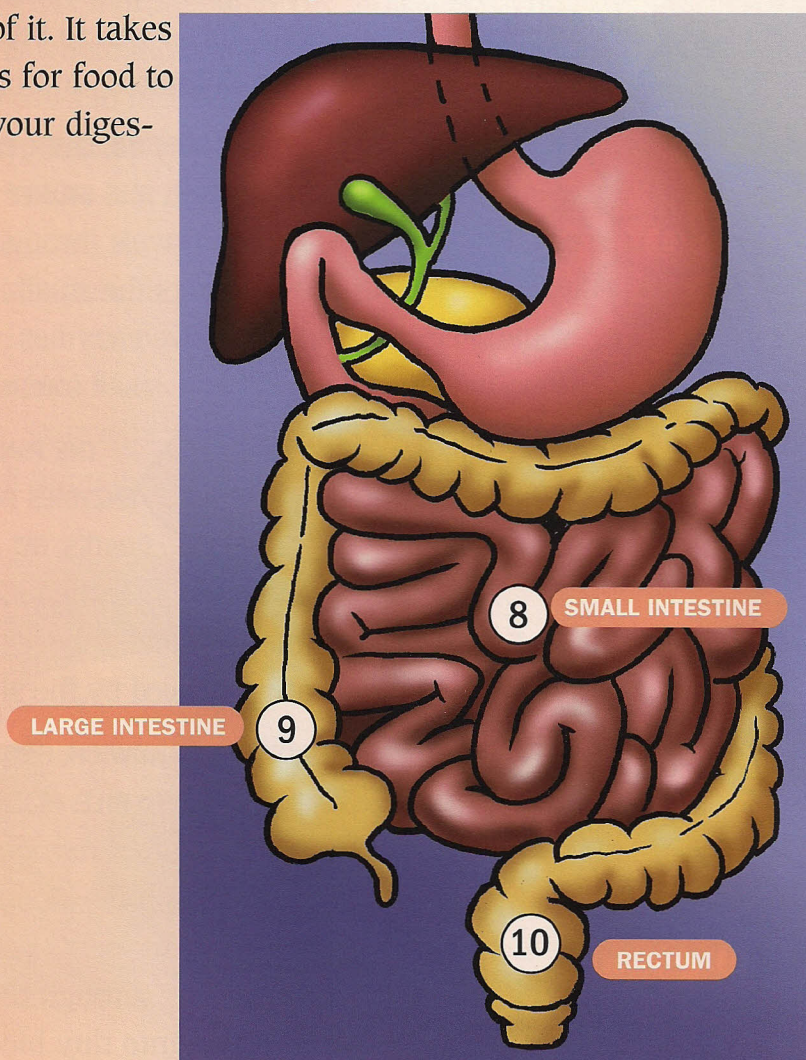
8 BLOOD GETS NUTRIENTS FROM THE SMALL INTESTINE. Then the blood passes through the liver. The liver breaks down some nutrients still further and removes poisonous substances.

9 ON TO THE LARGE INTESTINE. Anything that's left in the small intestine is pushed to the large intestine. It takes a short trip through this intestine—traveling only about 1.5 meters (5 feet)—but it's an important trip. Here, water and minerals that your body needs are absorbed back into the bloodstream.

10 FINAL STOP: THE RECTUM, The solid waste, called feces, sits in the rectum until your body gets rid of it. It takes about two days for food to pass through your digestive system.

Breakdown and Reassembly

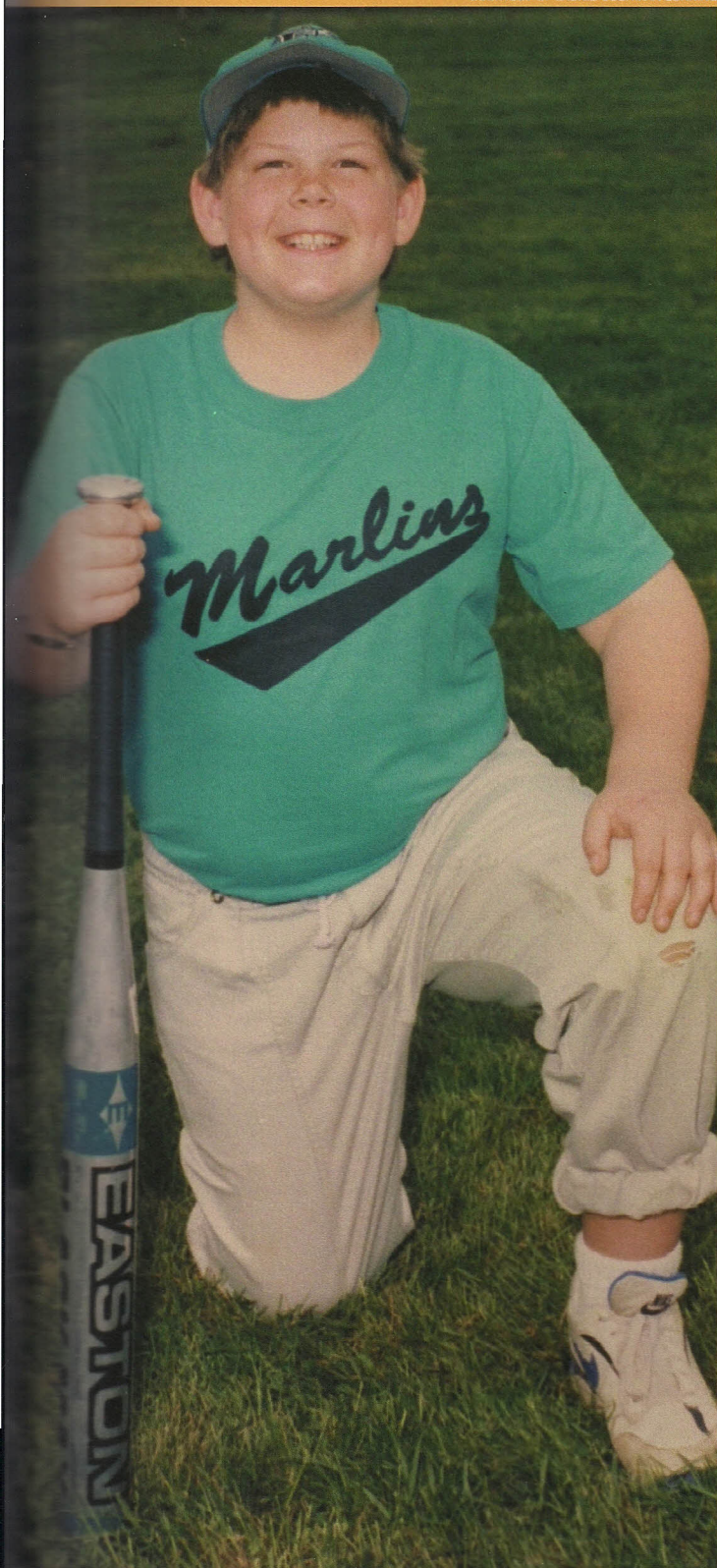
Carbohydrates, fats, and proteins have to be broken down into particles and dissolved in water before they can pass through the wall of the small intestine. Once the particles are small enough, they pass through the intestinal walls and enter the bloodstream. Blood delivers them to cells throughout your body. Later, the tiny particles are reassembled into more complex substances, such as protein and fat, which help form human cells.





Living with Diabetes

COURTESY OF LAURIE CUSHMAN LUHRING



MEET RUSSELL LUHRING. Although he's only a few years older than you, he's an expert at doing the chemical test for glucose, a kind of sugar. You can test different foods for glucose, but that's not what Russell does. He tests his own blood.

Russell and Type 1 Diabetes

Russell has type 1 diabetes. That means that his pancreas doesn't produce a substance called insulin. Normally, during digestion, most of the food you eat is broken down and converted into glucose. Glucose travels through the bloodstream to the body's cells. Meanwhile, insulin is released into the bloodstream by the pancreas. Insulin "opens the doors" of cells that convert the glucose into energy.

Without insulin, glucose can't enter the cells in the body; it just stays in the bloodstream. People with type 1 diabetes must get their insulin by taking shots. The results of the glucose test are important because they help people with diabetes figure out how much insulin to take.

Before breakfast and dinner, Russell takes a shot of two kinds of insulin. First, he does the glucose test to find out how much insulin to take. If the glucose level in his blood is high, he may need ▶

more insulin than usual. If it's low, he may need less. Sometimes Russell does glucose tests at other times of the day to help him understand how well each kind of insulin is working.

This is the kind of glucose monitor that Russell uses at home.

Taking the Test

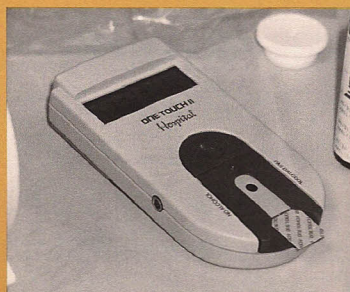
First, Russell inserts a glucose test strip into a glucose-monitoring machine. Then he pricks his finger with a tiny needle. He puts a drop of blood on the glucose test strip. The glucose-monitoring machine analyzes the blood for several seconds and then displays a number that corresponds to the amount of glucose in the drop of blood. Russell writes down his blood-sugar amount on a record sheet.

Russell says that the glucose test is easy, but doing several every day gets tiresome. So, although he can do the tests and shots himself, his parents sometimes help him. Russell's friends are impressed with his ability to give himself the tests and shots. "My friends like to watch me do the tests," Russell says. "If they're scared of needles, they have a hard time imagining what it's like. I'm not scared of needles."

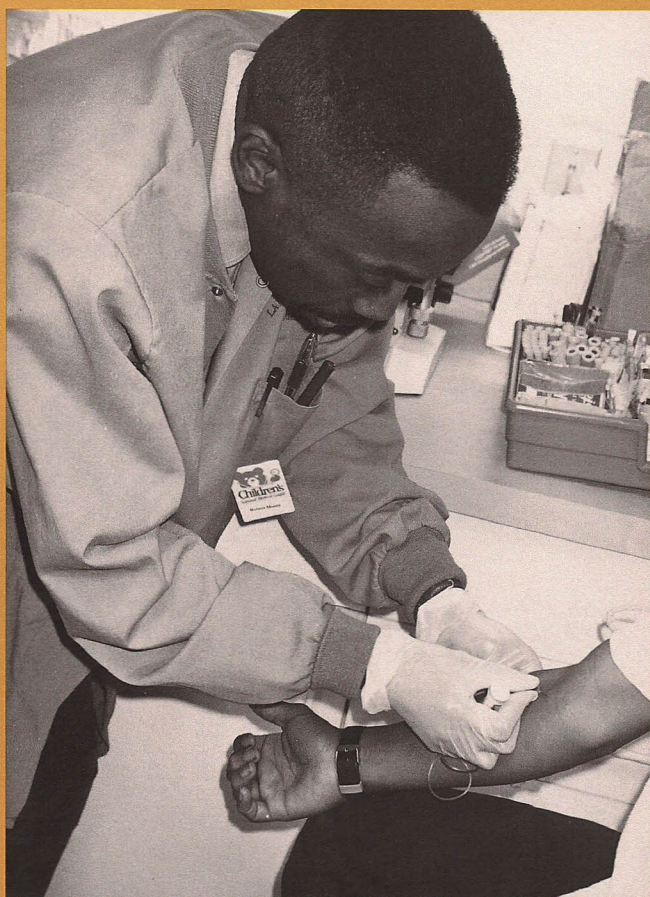
A Visit to the Clinic

Once every three months, Russell visits a diabetes clinic for a checkup. At the clinic, he gives blood for a different kind of test—one that shows the average amount of glucose in his blood for the past two to three months.

Russell says, "If you have diabetes, you feel bad if your blood sugar is too high or too low. It's good to take care of yourself." Doing regular glucose tests and keeping good records are important parts of that care.



Robert Moore, a technician at a diabetes clinic, draws blood to use for the glucose test.



Breakfast Pioneers

Did you know that breakfast cereal is the third most popular product at the super-market? More than 2.7 billion packages are sold each year. That's about a package a month for every man, woman, and child in the United States!

But if you sat down to breakfast 150 years ago, you wouldn't have seen a box of cereal anywhere. It hadn't been invented yet. Back then, most Americans ate meat and eggs for breakfast. A hearty breakfast at a restaurant might feature lamb chops, clams, wild pigeons, pigs' feet, oysters, beefsteak, sausages, fried ham, scrambled eggs, and chunks of fried pork. What a way to start the day! As you can imagine, many people had indigestion and other stomach complaints.

A New Kind of Breakfast

Dr. John Harvey Kellogg thought that people would feel better if they changed their diets—including what they ate for breakfast. "Stop eating meat. Start eating vegetables and whole grains," he urged.

Dr. John Harvey Kellogg believed in eating right and staying fit.



COURTESY OF GARTH STOLTZ, BATTLE CREEK, MI

COURTESY OF GARTH STOLTZ, BATTLE CREEK, MI



The spa
in Battle
Creek, Michigan

In the 1880s, Kellogg opened a medical resort, or spa, in Battle Creek, Michigan. People went there to improve their health. Kellogg's "cure" included drinking lots of water and eating whole grains and vegetables. But breakfast was always a problem. Kellogg tried serving whole-wheat biscuits. But they were hard to chew and not too tasty. In fact, some people broke their teeth on them!

John Kellogg hard at work in the kitchen



[BOTH] KELLOGG'S BUSINESS IN ACTION 1997, USED WITH PERMISSION
FROM KELLOGG COMPANY, BATTLE CREEK, MI

Kellogg dreamed of making a kind of grain food that would taste good and be healthy.

The First Cereal Flake

One night, an idea came to him: a cereal flake. Working with his brother William, Dr. Kellogg began a series of experiments. First, the brothers boiled some whole wheat. Then, they ran the wheat through a set of large rollers. Finally, they baked the wheat. But what they got wasn't cereal flakes.

The Kelloggs kept on experimenting. One day, after boiling the wheat, the brothers got busy with other tasks. The wheat sat around for several days. Although it got a little moldy, the brothers decided to run it through the rollers to see what would happen. To their amazement, the boiled wheat came out as large, thin flakes. The Kelloggs baked the flakes in the oven. They had created the first crisp cereal flakes! Letting the wheat sit for a while, but not long enough to get moldy, was the key. ▶



William
Kellogg
proved to
be quite
able in the
kitchen,
too.

Cereal Becomes Popular

Guests to the brothers' home liked the taste and texture of the new flaked food. But another innovation—advertising—caused cereal to become popular across America. Its promoter was C.W. Post, a guest at the Kelloggs' spa. Post had stomach troubles he wanted to cure. He also had a desire to make lots of money. At the spa, he found a way to do both.

Post borrowed some of the Kelloggs' food ideas and came up with his own cereal—Grape Nuts. Then he cleverly advertised his cereal and other products with catchy slogans and health claims. Within several years, Post's company, Postum Cereal, was one of the largest food-manufacturing companies in the world. Because Post was one of the first people in the United States to use large-scale advertising to sell a product, he's known as "the grandfather of American advertising."

Since the time of the Kelloggs and Post, hundreds of cereal brands have been created in the United States. Most of these have been promoted with extensive advertising. So the next time you open a box of cereal or reach down for the "free prize" inside, think of Kellogg and Post. They helped make breakfast what it is today. ■

A sample Post ad



**Food That's
Fit For a King!**

HILLWOOD MUSEUM, WASHINGTON, DC