

Digestive System: Where does food go?

Student Version

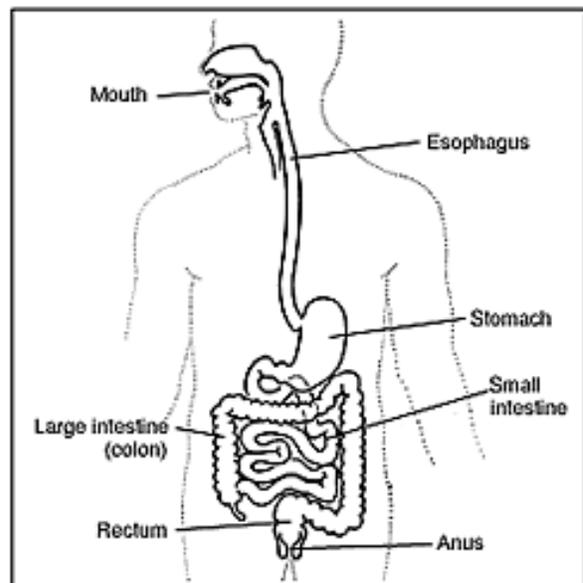
In this lab you will learn about your digestive system. We will use everyday objects like yarn and a ziplock bag to understand how long our digestive system is and how it breaks down all of the tasty food you eat.

Key Concepts:

- The digestive system is very long and contains multiple organs to help break down food and adsorb nutrients from the food we eat. This requires both **chemical digestion**, when chemicals and enzymes break the food down into its nutrient components, and **mechanical digestion**, when food is physically broken into smaller pieces.
- The **mouth** is the first organ in the digestive system. Both chemical digestion and physical digestion occur in the mouth.
- The **esophagus** connects the mouth to the next organ in the digestive system, the stomach.
- The **stomach** contains hydrochloric acid which helps to chemically digest proteins. Mechanical digestion also occurs in the stomach due to the churning motion.
- The **small intestine** is the longest part of the digestive system, and most of the nutrients are absorbed here.
- In the small intestine, other digestive juices from the **pancreas** and the **liver** are added. These digestive juices help to continue the chemical digestion of food.
- In the **large intestine**, water is removed from the food, and the final nutrient absorption occurs.

Part 1: How long is YOUR digestive system?

Look at the picture to the right of your digestive system. This system is one long tube that contains many parts that are folded up inside your body. If you were to take your digestive system out of your body and lay it out flat, it would surprise you how long it is. In this lab you will make models of your own digestive system by measuring & cutting yarn to represent lengths of different parts of the system, and knotting (or taping) the pieces of yarn together to form one long string.



Procedure:

- 1) Digestion begins in the **mouth**, so measure and cut a piece of **white yarn** from the front to the back of the mouth. (You can do this by stretching the yarn from the front of your lips to the back of your jaw along your cheek).
- 2) *Record this length of this “mouth” yarn in centimeters (cm) in the data table on the next page.*
- 3) The **esophagus** is a tube that connects the mouth and stomach. Measure & cut a piece of **yellow yarn** the length of the esophagus. (Measure from the back of your jaw to just below your rib cage).
- 4) *Record the length of this “esophagus” yarn in centimeters (cm) in the data table on the next page.* Tie or tape the esophagus yarn to the mouth yarn.
- 5) In the **stomach**, gastric juices break down solid food into a liquid. Find the length of the stomach by spreading the fingers of your hand and measuring the span from the thumb to the little finger. Measure and cut a piece of **pink yarn** to match this length.
- 6) *Record the length of this “stomach” yarn in centimeters (cm) in the data table on the next page.* Tie the stomach yarn to the esophagus yarn.
- 7) The **small intestine** is the longest part of the digestive system. It is folded up inside of you so it fits. Food is further digested and absorbed here. Measure your height in inches and **multiply it by four**. Use the **red yarn** to represent the length of the small intestine.
- 8) *Record the length of this “small intestine” yarn in centimeters (cm) in the data table on the next page.* Tie the small intestine yarn to the stomach yarn.
- 9) Last is the **large intestine**. It is much wider than the small intestine but much shorter. It is about as tall as you are. Undigested material from the small intestine moves to the large intestine before it leaves your body. Use **purple yarn** to represent the length of your large intestine.
- 10) *Record the length of this “large intestine” yarn in centimeters (cm) in the data table on the next page.* Then tie the large intestine yarn to the small intestine yarn.
- 11) Finally, add up each length to get the total length of your digestive tract in centimeters (cm).

DIGESTIVE ORGAN	LENGTH (CM)
Mouth	
Esophagus	
Stomach	
Small Intestine	
Large Intestine	
TOTAL	

Convert this to meters using the formula: (total # of centimeters) multiplied by (0.01 meters/centimeter)

Length of your digestive tract in meters: _____

Questions:

Q1. *How does the length of your digestive system compare to your height (if you know your height in feet and inches, convert your height to inches knowing that there are 12 inches in a foot, then multiply it by 0.0254 meters/inch to get your height in meters)? How do you think your digestive system is able to fit inside your abdomen?*

Q2. *Why do you think your digestive system is so long? How do you think this helps digestion? What is the longest section of your digestive system? What important processes do you think happen to the food in this section?*

Q3. *How long do you think it takes (on average) to digest food?*

Q4. *What percent of your entire digestive system is the small intestine?*

Part 2: What happens to the food you eat?

In this part of the lab, you will work in groups and use real food to simulate what happens to the food you eat as it travels along your digestive system. We will pause at each section of the digestive system to identify any unique features and to try to better understand how these features contribute to the digestive process.

Procedure:

- 1) **The quart ziplock bag represents your mouth.** Put 1 cup of corn flakes into the quart ziplock bag. Add 2 tablespoons of water, representing your saliva. Close the bag tightly. Let each person in your group crush the corn flakes in the bag for 5 seconds.
- 2) **The straw represents your esophagus.** Try to “swallow”, or pass the corn flake mixture through the straw esophagus by cutting a small hole in one corner of the bag and squeezing the mixture into the straw. Hold the gallon ziplock bag under the straw to catch anything that comes through the straw. This is really hard to do, so just do a little bit to demonstrate the process.

Q5. What do you have to do to get the mixture through the straw?

*Q6. Do you think gravity is necessary for food to pass through the esophagus? (optional)
Have one person in your group try to chew and swallow a cracker laying down flat on the ground. Were they able to do it?*

Q7. What is this movement of your real esophagus called?

- 3) **The gallon ziplock bag represents your stomach.** Move all of the corn flake mixture into the gallon ziplock bag. Add 1 cup of water and 1 teaspoon lemon juice to your bag. This represents the gastric juices in your stomach. Close the bag tightly. Let each person in your group squish around the mixture for 30 seconds.

Q8. What kind of digestion occurs in your stomach?

Q9. Your real stomach secretes hydrochloric acid (not lemon juice), which has a very low pH. What is the purpose of this acid? What other key ingredient in digestion is our simulated system missing?

- 4) **The paper towel roll represents your small intestine.** Have someone in your group hold the roll at a 45 degree angle over the plastic cup. Before pouring the mixture through the tube, add some food coloring to your gallon ziplock bag. This food coloring represents other digestive juices from the liver, gallbladder, and pancreas that are required to complete chemical digestion of food. Once you've added food coloring, pour your corn flakes mixture from the 1 gallon ziplock bag into the top end of the roll.

Q10. What do you notice about the food that emerges from the other end of the paper towel roll?

The small intestine has some interesting features which make it highly specialized for maximizing nutrient absorption. Although our paper towel roll intestine has smooth walls, your real small intestine has many folds, big folds you can see, and tiny folds that are only visible under the microscope. Let's calculate the surface area of your small intestine! The formula we will use is for calculating the surface area of a tube is: $2 \times \pi \times \text{radius} \times \text{length}$. Let's simplify by approximating π with 3, and the radius as 2 cm, which makes the formula: $2 \times 3 \times 2 \text{ cm} \times \text{length}$.

Q11. Using the length of your small intestine you just calculated, what is the surface area of your small intestine?

*Q12. The large folds increase the surface area of the small intestine by **three** times. What is the surface area of your small intestine now?*

*Q13. The microscopic folds (called villi) increase the surface area further by another **ten** times. What is the final surface area of your small intestine? (This is approximately the size of a tennis court!)*

5) The pantyhose represent your large intestine. Have everyone in your group put on a pair of gloves. Pour the cornflake mixture that you collected in your cup (after being passed through the paper towel roll) into the pantyhose (on the open end). Make sure that you are holding the pantyhose over the plastic tub. Let everyone in your group squeeze the corn flake mixture part of the way through the pantyhose. Continue squeezing trying to get out as much liquid as possible. Cut a small hole (representing the anus/rectum) to release the corn-flake mixture.

Q14. What is the consistency of your mixture now?

Concept Questions

Q15. Why do you think different animals have different digestive systems?

Q16. Why can some animals survive eating only plants and some can survive eating only meat?

Q17. Why are some things very high in calories and other things very low in calories? Does the number of calories correlate to how healthy/nutritious the food is?

Q18. How many calories do you think you need everyday? Why do some people need more or less calories than others?

Q19. There are other parts of your digestive system that food doesn't pass through, such as the liver, the gallbladder, and the pancreas. What functions do you think these organs perform?

Q20. Can you survive without any of the digestive organs you have learned about?