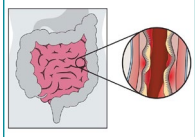


Digestive System Card Sort

hhmi | BioInteractive

Activity
Student Handout

INTRODUCTION

The organs of the digestive system act in a sequence, breaking food down into smaller and smaller pieces until it is small enough to be absorbed into the bloodstream. Cells use these food pieces for energy and to build the structures of the body. In this activity, you will investigate the functions of the digestive system's organs, put them in the order in which food passes through them, discuss the effects of different medical conditions on each organ, and discover the enzymes they produce to break down food. Understanding these concepts can help you make decisions about your own health.

MATERIALS

- access to the *Biomolecules on the Menu* Click & Learn
- three sets of cards ("Organ Cards" for Parts 1 and 2, "Pathology Cards" for Part 3, "Enzyme Cards" for Part 4)

PART 1: What Is Happening in the Digestive System?

1. The food you eat is quite different from your feces ("poop").
   a. Brainstorm **three** ways in which food and feces differ.

   b. Form a hypothesis about what the digestive system adds or removes when turning food into feces to account for these differences.

2. Without using any other resources, do your best to place the "Organ Cards" in the order in which they act upon food. List the order you chose using the letters found on the bottom left of each card.
   1)
   2)
   3)
   4)
   5)
   6)

3. How confident are you in the order you came up with? What do you still need to figure out?

PART 2: Digestive Organ Card Sort

4. Using the "How is food digested" tab of the *Biomolecules on the Menu* Click & Learn, complete each of the six "Organ Cards" as follows.
   a. Fill in the blank after "Organ:" with the organ's correct name.

b. Describe the function of the organ where noted.
c. Select the type of digestion (chemical and/or mechanical) performed by that organ. Some organs may perform one type of digestion, both types, or neither type.

5. Once you have completed the "Organ Cards," put them in the order in which food passes through them in the body. Set aside the card for the organ(s) that food does *not directly pass through.*
   a. List the *names* of the organs that food passes through, in order, below.
      1)
      2)
      3)
      4)
      5)

   b. List the organ(s) that food does not directly pass through.

   c. The secretions of the organ(s) in Part b must enter another organ to begin mixing with food. Put the card for the organ(s) in Part b next to the organ that the secretions enter, and write the name of that organ below.

6. Did the order in Question 5 change from your predictions in Question 2? If so, how?

7. Investigate the content of feces by reading the "Large Intestine" section (under the "How is food digested?" tab) of the Click & Learn. What are feces made of?

8. Most food items have a combination of carbohydrates, proteins, and fats. Feces have significantly lower levels of these biomolecules. Where do the biomolecules go when food is turned into feces?

PART 3: Digestive System Pathology

Pathology is the study of the causes and effects of diseases. You'll now consider what happens if someone gets a disease or medical condition in one of their digestive organs.

9. Read the "Pathology Cards," then match the condition on each one with the "Organ Card" it most directly affects. Fill out the following table with your findings.

Digestive organ	Example of a condition that affects the organ

10. Gum disease can result in tooth loss. This can affect the mouth's ability to perform which of the following types of digestion?
    a. mechanical
    b. chemical
    c. both mechanical and chemical

11. Uncontrolled gastroesophageal ("gastro" refers to the stomach, and "esophageal" to the esophagus) reflux would most likely affect which of the following processes?
    a. release of bile
    b. passage of food into the stomach
    c. passage of food into the large intestine

12. Gastric ulcers allow acid and enzymes produced by the stomach to make it past the layer of mucus lining the inner wall of the stomach. Which of the following best describes the role of mucus in the stomach?
    a. Mucus protects the walls of the stomach.
    b. Mucus breaks down proteins and fats.
    c. Mucus helps absorb nutrients into the bloodstream.

13. In some instances of dysentery, a person may have temporary lactose intolerance. People who are lactose intolerant cannot digest the carbohydrate lactose, which is found in milk.
    a. Which organ do you think dysentery most affects?

    b. Based on your knowledge about this organ's function, form a hypothesis about how dysentery might cause temporary lactose intolerance.

14. Pancreatitis can be caused by gallstones. This is because the pancreas and the gallbladder share a common opening that allows the substances they produce to enter the same organ. Which organ is this?

15. If gallstones cause symptoms, the gallbladder is often removed. One of the reasons that people can survive gallbladder removal is because the gallbladder only *stores* bile. Which organ *produces* bile?

16. One treatment for colorectal cancer is removal of the colon (the main part of the large intestine). Doctors attach the small intestine to the end of the large intestine (the rectum) instead. People who receive this treatment can continue their typical activities, just with some minor dietary considerations. Which of the following would be most affected by removal of the colon?
    a. absorption of carbohydrates
    b. functions of commensal bacteria
    c. digestion of fats

PART 4: Digestion at the Molecular Level

Digestion involves both mechanical and chemical breakdown of food. Chemical digestion is mostly accomplished by digestive **enzymes:** specialized proteins that speed up chemical reactions. You will now trace the chemical reactions that break down food as it passes through the digestive system.

Chemical reactions with enzymes are represented as shown in Figure 1. The enzyme acts upon the reactants to produce the products. In digestion, the reactants are broken down into smaller products by digestive enzymes.

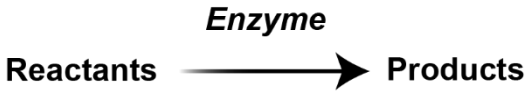


Figure 1. A diagram of a chemical reaction.

To understand these reactions, it helps to know the "roots" (parts) of the words used to name the molecules. Here are some commonly used word roots and their definitions:

- **oligo- or poly-:** many
- **tri-:** three
- **di-:** two
- **mono-:** one
- **-ase:** an enzyme
- **amyl-:** a carbohydrate or acting upon a carbohydrate
- **lip(o)-:** a fat or acting upon a fat
- **proteo:** a protein or acting upon a protein
- **-saccharide:** a carbohydrate or sugar
- **-glyceride:** a molecule containing a fatty acid
- **-peptide:** a partial protein or string of amino acids
- **lingual:** relating to the tongue

17. First, you will sort the "Enzyme Cards" based on organ.
    a. For each card, fill in the **organ** that releases the enzyme. (Note that some organs release more than one enzyme.) Sometimes the organ will be indicated by the name of the enzyme. Other times, you may need to refer to the "How is food digested" tab of the *Biomolecules on the Menu* Click & Learn.

b. Sort the "Enzyme Cards" by organ and fill out the following table.

Digestive organ	Enzymes released

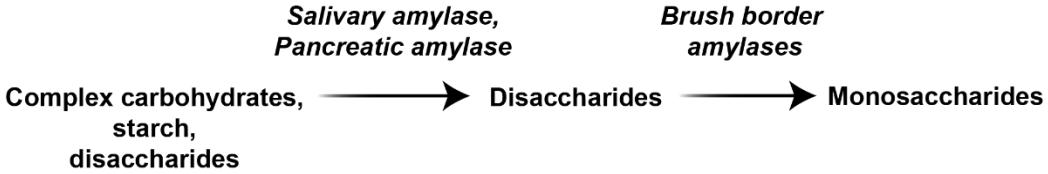
c. Which organ releases the most types of digestive enzymes?

d. The organ in Part b releases its enzymes into another organ of the digestive system. In this second organ, the enzymes act upon food particles. What is this second organ?

18. Next, you will sort the "Enzyme Cards" based on biomolecule.
    a. On each card, add a checkmark to the **biomolecule** each enzyme acts upon. Refer to the word roots listed above as needed.
    b. Sort the "Enzyme Cards" by the biomolecule they act upon (carbohydrates, fats, or proteins) and fill out the following table.

Biomolecule	Enzymes that act upon it
Carbohydrates	
Fats	
Proteins	

19. For the group of enzymes that act upon each biomolecule, sort the enzymes into the order in which they function to break down that biomolecule. Write the chemical reactions for breaking down fats and proteins below, using the standard format for chemical reactions. Carbohydrates are provided as an example.



20. After digestion is complete, the smallest molecules (monoglycerides, glycerol, fatty acids, amino acids, and monosaccharides) can be converted to ATP in the cells of the body. How do these molecules travel from the small intestine to cells throughout the body?

21. When monosaccharides (like glucose), amino acids, and/or fatty acids are available in excess, enzymes in the cells can link them together into storage molecules. Navigate to the "Nutrients to Storage" section (under the "How are nutrients used for energy?" tab of the Click & Learn) and investigate the three types of storage molecules. Fill in the following table with the storage molecules that each nutrient is used to make.

Nutrient	**Storage molecule**
Glucose	
Fatty acids	
Amino acids	

22. Why do you think it's important for the body to produce these storage molecules?