I. Cell Structure and Function

All living organisms are made up of one or more cells. A cell is the smallest unit that can carry out the activities of life.

These figures show some of the organelles and other parts of animal and plant cells.

1. Complete the following table.

<table>
<thead>
<tr>
<th>Activity of Life</th>
<th>Explain how one or more of the parts of an animal cell help the cell to carry out each of the listed activities of life.</th>
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<tbody>
<tr>
<td>Homeostasis (maintaining a stable internal environment)</td>
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<tr>
<td>Metabolism (using energy)</td>
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</tbody>
</table>

2. Plant cells have several structures that are not found in animal cells – chloroplasts, cell walls and central vacuoles. Choose two of these structures and explain why each of these is useful for plant cells, but not needed or even a disadvantage for animal cells.
Many cells in our bodies do not look like the "typical" animal cell shown on page 1. Differences in cell structure include different shapes and different amounts of specific types of organelles. These differences in structure are related to differences in the function of different types of cells, as illustrated by the examples below.

3. Sperm cells have a very specialized structure, including a flagellum and very little cytoplasm. Explain how the structure of a sperm cell contributes to its function.

4. A capillary is a tiny blood vessel where:
   - Oxygen and nutrients diffuse from the blood to the cells near the capillary.
   - Carbon dioxide and other waste molecules produced by the cells near the capillary diffuse into the blood.

   Explain why it is useful for the walls of capillaries to consist of a single layer of thin, flattened cells.

5. For some types of cell, a flexible structure that allows the cell to change shape is crucial for the cell's function. The white blood cell shown in this figure defends our body against infection by engulfing, killing and digesting bacteria (phagocytosis). Why do white blood cells need to be able to change shape in order to accomplish their function?
6. Describe examples that support the claim that "The structure of a cell is related to its function". Explain how each example supports this claim.

<table>
<thead>
<tr>
<th>Example</th>
<th>Explain how this example supports the claim that &quot;The structure of a cell is related to its function.&quot;</th>
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7. In a typical diagram of a cell, it looks as though nothing much is happening. In reality, cells are highly dynamic, with lots of activity at the cellular, organelle and molecular levels. Give examples to illustrate the kinds of activity observed in cells.

**Challenge Question.** A paramecium is a single cell organism with several differences in structure from the animal and plant cells shown on page 1. Use your textbook or other available resources to learn about the functions of the structures shown in this diagram. Explain how these structures support the characteristic activities of life (e.g. homeostasis, metabolism, and responding to the environment).
II. Structure and Function in the Digestive System

- A tissue is a group of similar cells that serve a common function. You have already seen one example of a tissue – the cells that make up the capillary wall.
- An organ is a body part consisting of two or more tissues that cooperate to carry out a specific function in the body. Familiar body organs include your heart and your stomach.
- Multiple organs that have related functions combine to form a body system that carries out a major function such as digestion. The organs of the digestive system cooperate to break down food into small molecules that are absorbed into the blood.

The organs in the human digestive system include the:

- **oral cavity** where teeth, jaw muscles and saliva work together to begin breaking down food into smaller particles
- **esophagus** which carries this mixture of food and digestive juices to the **stomach** where acid helps to kill any germs in the food; the stomach stores a meal and gradually releases small amounts of food for digestion in the small intestine
- **pancreas** and **liver** which supply the small intestine with enzymes and other molecules that aid in the digestion of food molecules
- **small intestine** where enzymes break down food molecules into smaller molecules that are absorbed into the blood; most digestion and absorption occurs in the small intestine which is much longer than shown here
- **large intestine** where water is absorbed and the feces are stored for excretion.

The diagram above clearly illustrates the sequence of organs in the digestive system, but it does not give a realistic picture of the relative sizes and arrangement of these organs. These features of the digestive system are shown in the diagram below.

8. Match each organ with its function or functions.

Organ A. ___
Organ B. ___
Organ C. ___ ___
Organ D. ___

- a. acid helps to kill germs in the food
- b. begins the breakdown of food into smaller particles
- c. carries mixture of food and digestive juices from oral cavity to stomach
- d. organ where most of the digestion by enzymes occurs and digested food molecules are absorbed into the blood
- e. stores a meal and gradually releases small amounts of food for digestion in the small intestine
"Structure is related to function" is a general principle that applies to cells, tissues, organs, and body systems. For example, in our digestive system, effective digestion depends on having each organ in the correct order from beginning to end.

9. Imagine a digestive system where food entered the small intestine directly without first going through the oral cavity and stomach. What would be the disadvantages of this type of digestive system? Why is it useful to have food processed in the oral cavity and stomach before entering the small intestine?

The small intestine is a very long and narrow tube (6-7 m long and 2.5 cm wide). The lumen (the space inside the small intestine) contains a mixture of digestive enzymes and food molecules that are broken down to small molecules that can be absorbed into the blood.

The structure of the wall of the small intestine contributes to the functions of digestion and absorption.

- The muscles in the wall of the small intestine contract repeatedly to mix the digestive enzymes with the food molecules.
- The many villi on the inner surface of the small intestine result in a very large surface area which increases the rate of absorption of digested food molecules from the lumen of the small intestine to the blood which carries nutrients to all the cells of the body.

10. Explain how the shape of the small intestine and the many villi on the inner surface of the wall of the small intestine increase the rate of absorption of digested food molecules from the lumen of the small intestine to the blood.

11. Why is it useful to have lots of capillaries inside each of the villi?
12. The circulatory system includes the:
   - blood
   - blood vessels (including the capillaries)
   - heart, which pumps blood through the blood vessels to all the parts of your body.

Explain how the digestive system and circulatory system work together to bring nutrients to all the cells in your body.

**Challenge Question.** The grass that cows eat is much harder to digest than the foods that humans eat because the cell walls of grass have lots of cellulose and mammals do not produce enzymes that can break down cellulose. Cows need the help of bacteria and other microorganisms that make enzymes that break down cellulose into smaller molecules that can be absorbed into the blood and used by a cow's cells. Use your textbook or other resources to learn about differences in the structure of the digestive system of cows vs. people. What special features of a cow's digestive system contribute to efficient digestion of grass?