Bonds at Work

How molecular structure shapes digestion

FB.2.7 "Enrichment: Explore the structure of biomolecules using molecular models. Relate the structure of biomolecules to their function in living things (discuss types bonding, importance of the strength and weakness of the bond in function..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB As you read, underline statements about strong covalent bonds, circle statements about weaker attractions, and number two places where bond structure affects what a molecule does.

What Happens to a Bite of Bread?

1. Imagine chewing a piece of bread. Its starch is made of many glucose units joined by strong covalent bonds. The arrangement of bonds in these molecules represents chemical potential energy, but simply breaking a bond requires energy. During digestion, water participates in reactions that split starch into shorter sugars. Later, cells can release usable energy from sugars through reactions that rearrange bonds. Breaking bonds requires energy, while forming new bonds releases energy. These reactions release energy overall when forming the products' bonds releases more energy than breaking the starting bonds costs.

2. Saliva contains amylase, a protein that helps digest starch. Hydrogen bonds between different parts of the protein help hold its folded shape. Each hydrogen bond is weaker than a covalent bond, so the protein can change shape slightly as starch binds. Together, these attractions help form a pocket called an active site. Starch fits in the pocket, where amylase helps water break certain covalent links in starch. If high heat disrupts enough hydrogen bonds, the pocket may change shape. Then starch may bind poorly, even if the protein's covalent backbone remains intact.

3. In a tabletop model, sturdy snaps could represent covalent links between glucose units, while small magnets could represent weaker attractions that help a protein keep its shape. A fitted notch could stand for amylase's active site. These parts show why some connections must remain stable while others allow movement, although snaps and magnets do not reproduce real atoms or forces. Amylase positions starch and water so the reaction needs less activation energy, the energy needed to start a reaction. It speeds digestion without supplying the reaction's energy or changing the overall energy released.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does starch's structure let it hold many glucose units and still be split during digestion? Name the bond involved.

2. Why are weaker hydrogen bonds useful to amylase even though its protein backbone has covalent bonds?

3. If high heat disrupts many hydrogen bonds in amylase, how could that change starch digestion?

4. Why does breaking a bond in starch not, by itself, release energy? What does amylase change about the reaction's energy?

3 YOUR TURN

Your own words

Invent an enzyme that joins two small molecules in a cell. Describe a tabletop model with two kinds of connectors and a shaped active site. Explain what the connectors represent, how the fit helps the molecules join, and what the enzyme changes about activation energy and overall reaction energy.

ANSWER KEY

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HIGH SCHOOL · FB.2.7

PART 1 · READ AND MARK

As you read, underline statements about strong covalent bonds, circle statements about weaker attractions, and number two places where bond structure affects what a molecule does. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does starch's structure let it hold many glucose units and still be split during digestion? Name the bond involved.	**Strong covalent bonds join many glucose units in starch. During digestion, amylase helps water break certain covalent links, producing shorter sugars.**
2	Why are weaker hydrogen bonds useful to amylase even though its protein backbone has covalent bonds?	**Hydrogen bonds help hold amylase's folded active site while allowing slight shape changes as starch binds. Covalent bonds keep the backbone intact.**
3	If high heat disrupts many hydrogen bonds in amylase, how could that change starch digestion?	**The active site may lose its shape, so starch may bind poorly and amylase may digest it less effectively.**
4	Why does breaking a bond in starch not, by itself, release energy? What does amylase change about the reaction's energy?	**Breaking a bond requires energy. Amylase lowers the activation energy needed to start the reaction, but it does not change the overall energy released.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My model enzyme is a bent foam strip with a two-slot pocket that holds a round bead beside a square bead. Small magnets stand for hydrogen bonds that keep the strip folded but let the pocket shift slightly. A firm snap stands for the covalent bond that forms between the beads when they sit together in the pocket. If the magnets come apart, the pocket loses its fit and the beads seldom meet in the right position. The enzyme lowers the activation energy for joining them but does not change the reaction's overall energy.

Accept other workable model materials if the student distinguishes strong covalent bonds from weaker attractions and links active-site shape to function. The response should state that an enzyme lowers activation energy without changing the reaction's overall energy.