Amylase on the Move

Model how cell structures work together to release a digestive enzyme.

BIO.1C.1 "Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria, chloroplast, centrosomes…"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the cell structures that help make or release amylase, then number the five stages of amylase's route in order, from its synthesis at a ribosome to its arrival in a secretory vesicle.

From Pancreas to Intestine

1. When you eat a piece of bread, cells in your pancreas prepare an enzyme called amylase. This protein helps break starch into smaller sugars in your small intestine. Inside a pancreatic cell, the nucleus contains DNA instructions for making amylase. The cell copies the needed instructions into messenger RNA, which leaves the nucleus and reaches a ribosome attached to the rough endoplasmic reticulum, or rough ER. The ribosome joins amino acids to build amylase. As it is built, the growing protein enters the rough ER, where it begins to fold into a working shape.

2. Next, a transport vesicle buds from the rough ER with amylase inside. The vesicle travels to the Golgi apparatus, where the protein can be further processed and sorted for release. The Golgi packages amylase into a secretory vesicle. Motor proteins move this vesicle along the cytoskeleton, a network of tracks that helps direct its movement. When the vesicle reaches the cell membrane, it fuses with the membrane and releases amylase outside the cell. Amylase then passes through a pancreatic duct into the small intestine. It does not travel through the cytoskeleton or through the nucleus.

3. This route depends on more than the parts that directly hold amylase. Mitochondria supply ATP, a molecule cells use for energy, to power activities such as vesicle transport. The nucleus supplies the instructions, but amylase itself never enters the nucleus. If transport from the rough ER to the Golgi stops, amylase cannot reach secretory vesicles by the usual route. If vesicles cannot fuse with the cell membrane, amylase stays inside the cell instead of reaching food in the intestine. A model of this cell should show both the route amylase takes and the structures that support it.

2 ANSWER WITH EVIDENCE

Use the passage

1. Trace amylase from where it is built to the vesicle that carries it toward the cell membrane. Name the five stages in order.

2. A model shows amylase moving through the nucleus and then along the cytoskeleton. What two changes would make the model more accurate?

3. Suppose transport vesicles cannot move from the rough ER to the Golgi. Where does amylase's route stop, and how would this affect its release?

4. How do mitochondria and the cytoskeleton support the same step in amylase release without directly holding amylase?

3 YOUR TURN

Your own words

Draw two labeled panels: one showing a pancreatic cell releasing amylase normally and one showing what happens when motor proteins cannot move secretory vesicles along the cytoskeleton. Use arrows to show where amylase goes in each panel, then write one sentence predicting the effect on starch digestion.

ANSWER KEY

Amylase on the Move

HIGH SCHOOL · BIO.1C.1

PART 1 · READ AND MARK

Underline the cell structures that help make or release amylase, then number the five stages of amylase's route in order, from its synthesis at a ribosome to its arrival in a secretory vesicle. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Trace amylase from where it is built to the vesicle that carries it toward the cell membrane. Name the five stages in order.	**Ribosome attached to rough ER, rough ER, transport vesicle, Golgi apparatus, secretory vesicle.**
2	A model shows amylase moving through the nucleus and then along the cytoskeleton. What two changes would make the model more accurate?	**Show messenger RNA leaving the nucleus, not amylase moving through it. Show amylase inside a vesicle that motor proteins move along the cytoskeleton.**
3	Suppose transport vesicles cannot move from the rough ER to the Golgi. Where does amylase's route stop, and how would this affect its release?	**The route stops between the rough ER and Golgi. Amylase cannot reach secretory vesicles by the usual route, so less is released.**
4	How do mitochondria and the cytoskeleton support the same step in amylase release without directly holding amylase?	**Mitochondria supply ATP for vesicle transport, while the cytoskeleton provides tracks along which motor proteins move the vesicle.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: An arrow labeled messenger RNA goes from the nucleus to a ribosome on the rough ER. Amylase arrows lead from the rough ER through a transport vesicle, the Golgi apparatus, and a secretory vesicle to the cell membrane, then to the small intestine; motor proteins move the secretory vesicle along the cytoskeleton. Panel 2: Amylase remains in a secretory vesicle near the Golgi, with no arrow leading to the membrane. Less amylase reaches the small intestine, so starch digestion slows.

Accept models that distinguish the path of amylase from supporting structures such as the nucleus, mitochondria, and cytoskeleton. In the second panel, accept a secretory vesicle stalled inside the cell rather than a precise location near the Golgi.