2018

AP CollegeBoard

# AP Biology

## Sample Student Responses and Scoring Commentary

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**Free Response Question 6**

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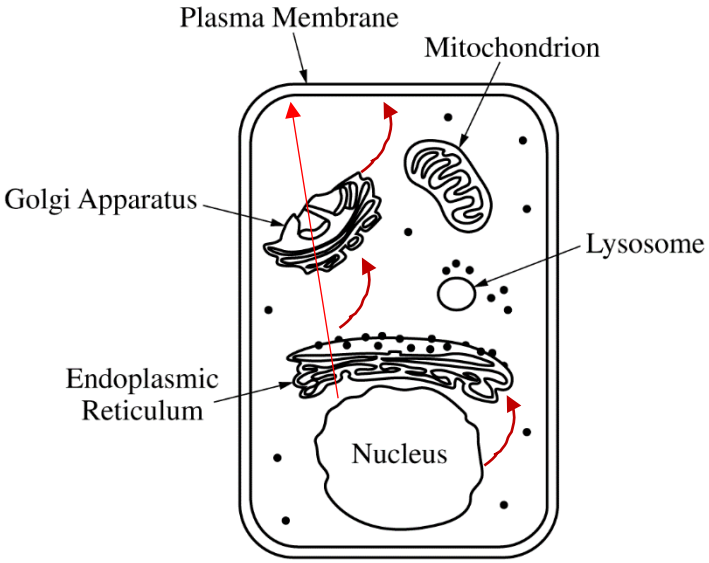
# AP® BIOLOGY
# 2018 SCORING GUIDELINES

## Question 6

Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions ($Cl^-$) to diffuse across the membrane.

(a) In the provided model of a cell, **draw** arrows to describe the pathway for production of a normal CFTR protein from gene expression to final cellular location.

**Drawing (1 point)**




The response must follow this pathway: nucleus/nuclear envelope → endoplasmic reticulum → Golgi apparatus → plasma membrane.

The response may be in the form of a continuous arrow or multiple discontinuous arrows.

(b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.

**Identification (1 point)**

- (Rough) Endoplasmic Reticulum/ER

(c) **Identify** the most likely cellular location of a mutant CFTR protein that has an amino acid substitution in the ATP-binding site.

**Identification (1 point)**

- In the (cellular/plasma) membrane

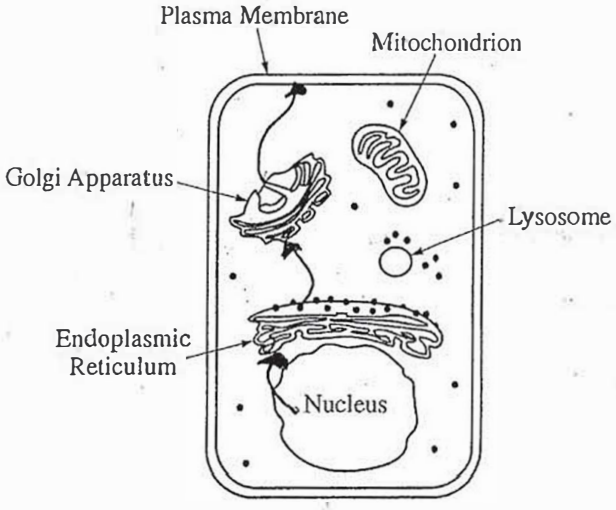
6. Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions ($Cl^-$) to diffuse across the membrane.

   (a) In the provided model of a cell, **draw** arrows to describe the pathway for production of a normal CFTR protein from gene expression to final cellular location.

   (b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.

   (c) **Identify** the most likely cellular location of a mutant CFTR protein that has an amino acid substitution in the ATP-binding site.

PAGE FOR ANSWERING QUESTION 6




B) The ribosomes that synthesize the CFTR protein would probably be found on the rough ER.

C) The mutant CFTR protein is likely embedded in the plasma membrane.

6B

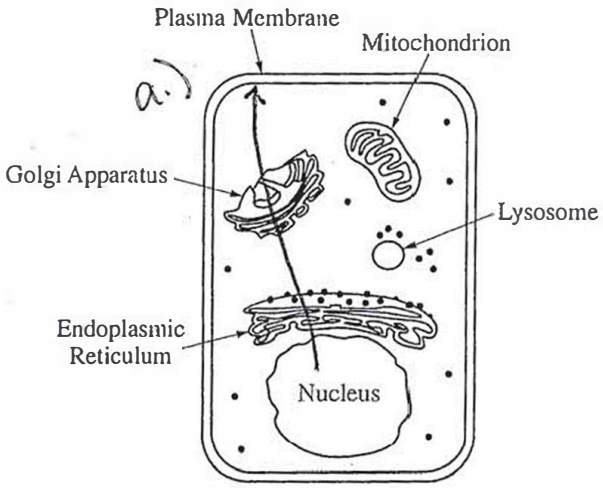
6. Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions ($Cl^-$) to diffuse across the membrane.

   (a) In the provided model of a cell, draw arrows to describe the pathway for production of a normal CFTR protein from gene expression to final cellular location.

   (b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.

   (c) **Identify** the most likely cellular location of a mutant CFTR protein that has an amino acid substitution in the ATP-binding site.

PAGE FOR ANSWERING QUESTION 6




b.) The ribosomes would be located on the rough endoplasmic reticulum.

c.) The mutant CFTR protein would likely be located in the cytosol, not being able to integrate into the membrane.



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6C

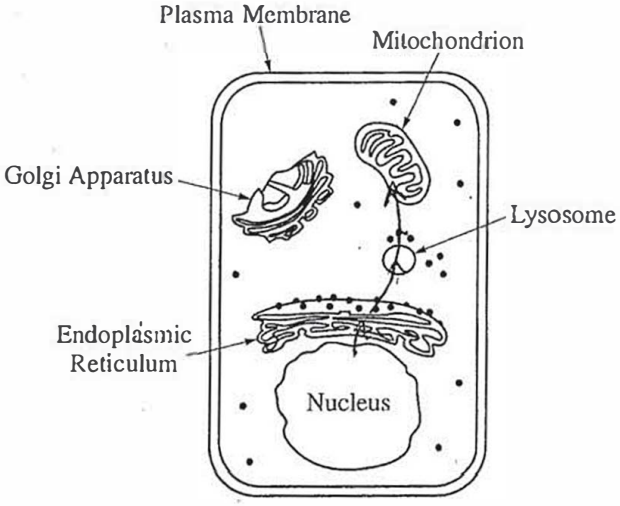
6. Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions ($Cl^-$) to diffuse across the membrane.

   (a) In the provided model of a cell, **draw** arrows to describe the pathway for production of a normal CFTR protein from gene expression to final cellular location.

   (b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.

   (c) **Identify** the most likely cellular location of a mutant CFTR protein that has an amino acid substitution in the ATP-binding site.

PAGE FOR ANSWERING QUESTION 6




b) the ribosomes that synthesize CFTR protein are most likely located in the endoplasmic reticulum

c) Mutant CFTR protein most likely occurs near the mitochondria as it needs ATP to synthesize.



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# AP® BIOLOGY
# 2018 SCORING COMMENTARY

## Question 6

**Overview**

This question presented students with information about CFTR, a gated ion channel that requires ATP binding to allow ions to diffuse across the plasma membrane. Students were shown a diagram of a cell with numerous subcellular structures drawn and labeled. Students were asked to draw arrows to describe the pathway for production of a CFTR protein from gene expression to final location in the cell. The students were then asked to identify the most likely cellular location of the ribosomes that synthesize this protein. The question then provided information about a particular mutation in the CFTR protein, and students were asked to identify the most likely final cellular location of that protein.

The key understandings and skills students were expected to demonstrate included the following:

- Knowledge of subcellular structures and organelles was used to predict the process of synthesizing a specific protein.
- Knowledge of protein domains was used to determine the impact of mutations on the structure and function of a protein.
- Representations and models were used to describe the interactions of cellular organelles and to predict the consequences of a mutation.

**Sample: 6A**
**Score: 3**

The response earned 1 point in part (a) for correctly describing the pathway for the production of a normal CFTR protein with arrows. The response earned 1 point in part (b) for identifying the rough ER as the most likely cellular location of the ribosomes that synthesize the CFTR protein. The response earned 1 point in part (c) for correctly identifying that the most likely cellular location of a mutant CFTR protein is embedded in the plasma membrane.

**Sample: 6B**
**Score: 2**

The response earned 1 point in part (a) for correctly describing the pathway for the production of a normal CFTR protein with a single continuous arrow. The response earned 1 point in part (b) for identifying the rough endoplasmic reticulum as the most likely cellular location of the ribosomes that synthesize CFTR protein.

**Sample: 6C**
**Score: 1**

The response earned 1 point in part (b) for identifying the endoplasmic reticulum as the most likely cellular location of the ribosomes that synthesize CFTR protein.