

# FRQ Friday – 2/19

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2019 #8

2018 #6

2017 #8

2013 #6



# FRQ 2019 #8

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TABLE 1. CHANGES IN MORNING GLORY PETAL CELLS DURING FLOWER OPENING

	BUD	OPEN FLOWER
Vacuole pH	6.6	7.7
Flower Color	Red	Blue
Cell Volume	Small	Large

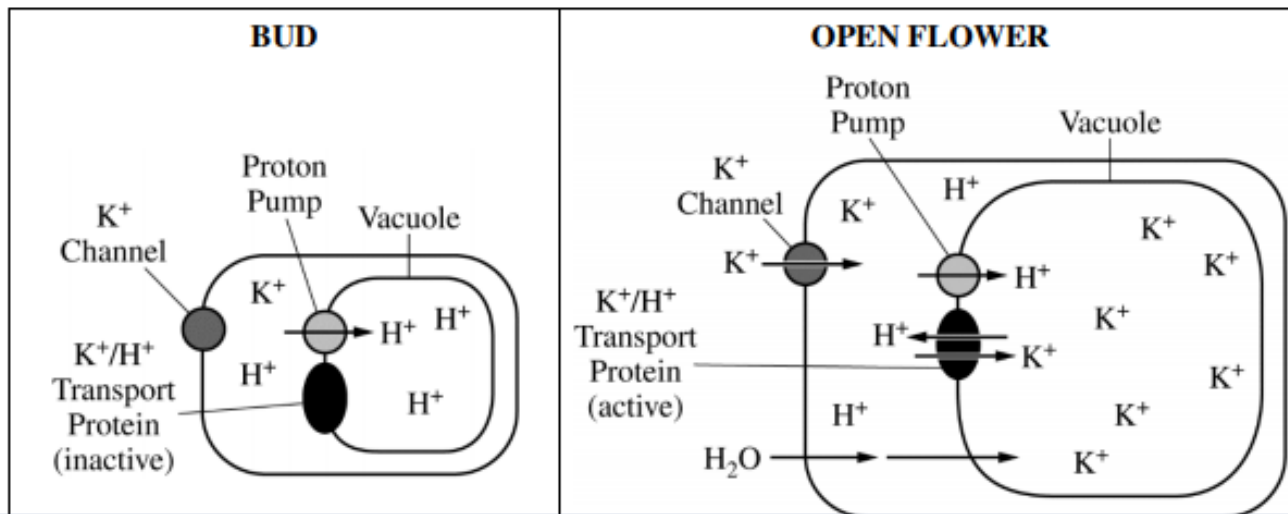
The petal color of the Mexican morning glory (*Ipomoea tricolor*) changes from red to blue, and the petal cells swell during flower opening. The pigment heavenly blue anthocyanin is found in the vacuole of petal cells. Petal color is determined by the pH of the vacuole. A model of a morning glory petal cell before and after flower opening is shown in Table 1.

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(a) **Identify** the cellular component in the model that is responsible for the increase in the pH of the vacuole during flower opening **AND describe** the component's role in changing the pH of the vacuole.

TABLE 1. CHANGES IN MORNING GLORY PETAL CELLS DURING FLOWER OPENING



Vacuole pH	6.6	7.7
Flower Color	Red	Blue
Cell Volume	Small	Large

## Identification (1 point)

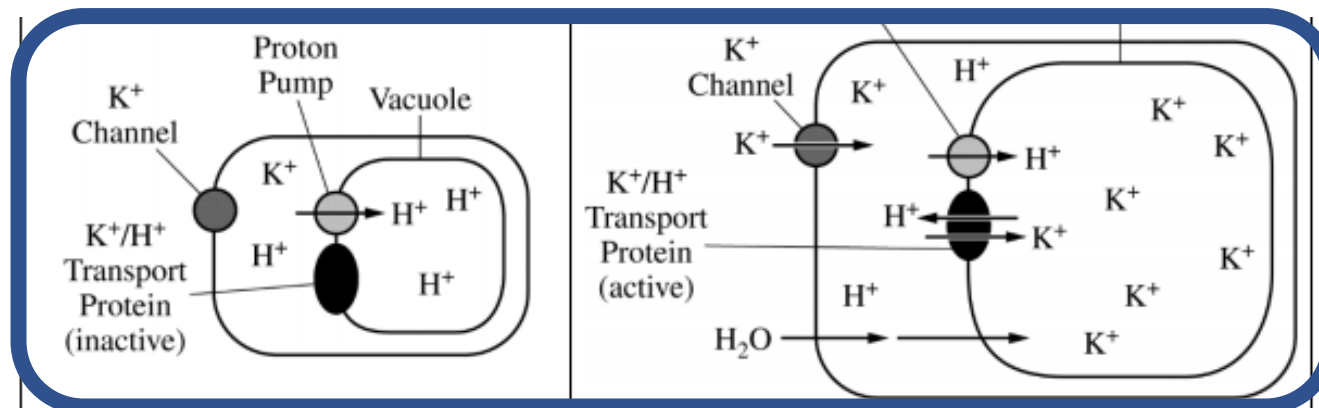
- (K<sup>+</sup> / H<sup>+</sup>) transport protein

## Description (1 point)

- It moves H<sup>+</sup> out of the vacuole.

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(b) A researcher claims that the activation of the  $K^+ / H^+$  transport protein causes the vacuole to swell with water. Provide reasoning to support the researcher's claim.



Vacuole pH	6.6	7.7
Flower Color	Red	Blue
Cell Volume	Small	Large

## Reasoning (1 point)

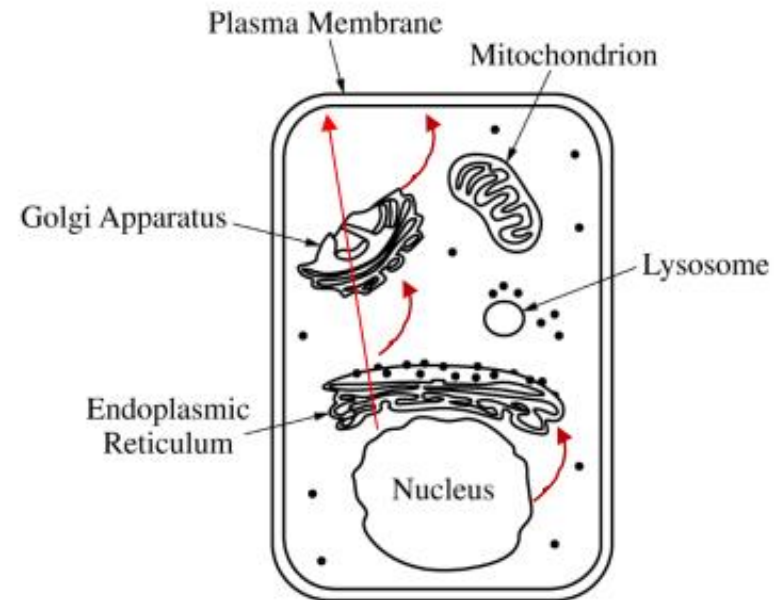
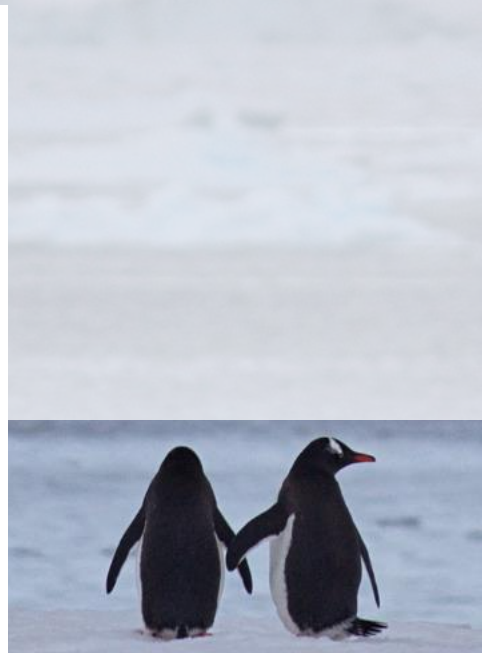
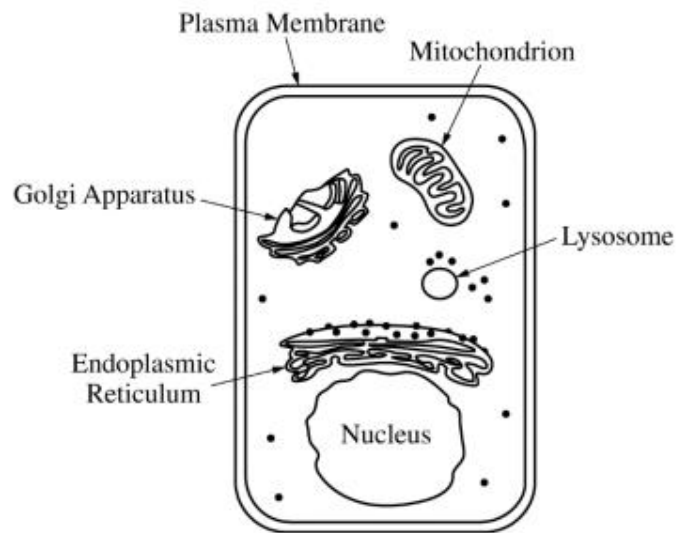
- The concentration of solute ( $K^+$ ) is increasing inside the vacuole.
- The solute ( $K^+$ ) is moving into the vacuole, making it hypertonic/hyperosmotic/lowering water potential.

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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 ( $\text{Cl}^-$ ) 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.

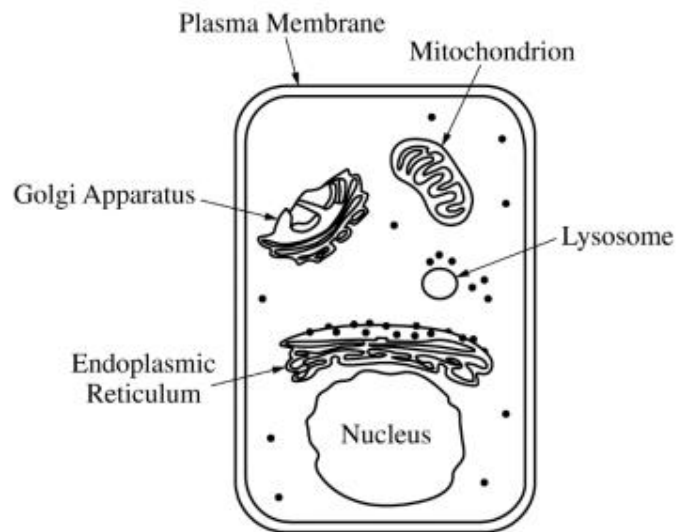


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(b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.



## Identification (1 point)

- (Rough) Endoplasmic Reticulum/ER

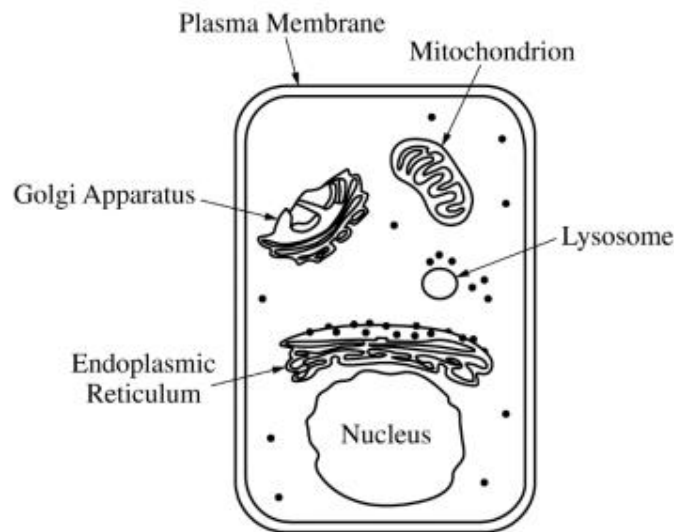


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Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions ( $\text{Cl}^-$ ) to diffuse across the membrane.

(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



# 2017 #8

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Estrogens are small hydrophobic lipid hormones that promote cell division and the development of reproductive structures in mammals. Estrogens passively diffuse across the plasma membrane and bind to their receptor proteins in the cytoplasm of target cells.

(a) **Describe ONE** characteristic of the plasma membrane that allows estrogens to passively cross the membrane.

## **Description (1 point)**

- Hydrophobic/nonpolar
- Space between phospholipids





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(b) In a laboratory experiment, a researcher generates antibodies that bind to purified estrogen receptors extracted from cells. The researcher uses the antibodies in an attempt to treat estrogen-dependent cancers but finds that the treatment is ineffective. **Explain** the ineffectiveness of the antibodies for treating estrogen-dependent cancers.

## **Explanation (2 points)**

- Antibodies are unable to enter the cell.
- (Extracellular) antibodies will not bind to (intracellular) estrogen receptors.



# 2013 #6

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The following data were collected by observing subcellular structures of three different types of eukaryotic cells.

RELATIVE AMOUNTS OF ORGANELLES IN THREE CELL TYPES

Cell Type	Smooth ER	Rough ER	Mitochondria	Cilia	Golgi Bodies
X	Small amount	Small amount	Large number	Present	Small amount
Y	Large amount	Large amount	Moderate number	Absent	Large amount
Z	Absent	Absent	Absent	Absent	Absent

Based on an analysis of the data, **identify** a likely primary function of each cell type and **explain** how the data support the identification.



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<u>Cell Type</u>	<u>Identify function</u>		<u>Explain how data support identification (1 point each correct pair).</u> <u>NOTE: No points for identification without explanation.</u>
X	<ul style="list-style-type: none"><li>Locomotion</li><li>Movement / surface transport</li></ul>	<b>AND</b>	Has cilia for movement <u>and</u> large amounts of mitochondria to provide energy for locomotion of cell itself (ciliated protist) or movement of particles (mucus / oocyte) along cell surface



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Y	<ul style="list-style-type: none"><li>• Secretion / exocytosis</li><li>• Protein synthesis</li></ul>	<b><u>AND</u></b>	Has large amounts of rough ER <u>and</u> Golgi to produce and package proteins
	<ul style="list-style-type: none"><li>• Lipid/hormone synthesis</li><li>• Detoxification</li></ul>	<b><u>AND</u></b>	Has large amounts of smooth ER to produce lipids / hormones

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<u>Cell Type</u>	<u>Identify function</u>		<u>Explain how data support identification (1 point each correct pair).</u> <b>NOTE: No points for identification without explanation.</b>		
Z	• Transport	<u>OR</u>	• Oxygen transport in animal cells • Water transport in plant cells	<u>AND</u>	Does not require these organelles
	• Protection	<u>OR</u>	• Epidermal cells (stratum corneum, cork, nails)	<u>AND</u>	
	• Support	<u>OR</u>	• Ground tissue (sclerenchyma) • Vascular tissue (xylem)	<u>AND</u>	
	• Storage	<u>OR</u>	• Maximizes volume / space available (hemoglobin, oxygen)	<u>AND</u>	
	• No function	<u>OR</u>	• Is a dead cell/is undergoing apoptosis	<u>AND</u>	

# Next FRQ Friday (2/26)

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2013 #2

2017 #5

