



**GCE AS/A LEVEL**

**2400U10 – 1**

**MONDAY, 13 MAY 2024 – MORNING**

**BIOLOGY– AS UNIT 1**

**BASIC BIOCHEMISTRY AND CELL ORGANISATION**

**1 hour 30 minutes plus your additional time allowance**

**Surname:** \_\_\_\_\_

**First name(s):** \_\_\_\_\_

**Centre Number:** \_\_\_\_\_

**Candidate Number:** 2 \_\_\_\_\_

<b>For Examiner's use only</b>		
<b>Question</b>	<b>Maximum Mark</b>	<b>Mark Awarded</b>
<b>1.</b>	<b>10</b>	
<b>2.</b>	<b>10</b>	
<b>3.</b>	<b>14</b>	
<b>4.</b>	<b>16</b>	
<b>5.</b>	<b>9</b>	
<b>6.</b>	<b>12</b>	
<b>7.</b>	<b>9</b>	
<b>Total</b>	<b>80</b>	

**(Turn over)**

**ADDITIONAL MATERIALS**

A calculator and a ruler.

**ITEMS INCLUDED WITH QUESTION PAPER**

A separate Diagram Booklet.

**The Diagram Booklet MUST be handed in to the invigilators and sent for marking.**

**INSTRUCTIONS TO CANDIDATES**

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

(Turn over)

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part – question.

The assessment of the quality of extended response (QER) will take place in question 7.

The quality of written communication will affect the awarding of marks.

**Answer ALL questions**

**1. Refer to IMAGE 1.1 in the separate Diagram Booklet. IMAGE 1.1 shows diagrams of two different cells. Scale bars are shown to illustrate the relative sizes of the cells.**

**(a) Both cells produce the enzyme RNA polymerase. This is involved in the production of mRNA which is needed for translation by ribosomes.**

**(i) State the names of TWO other types of RNA involved in protein synthesis.**

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**[1 mark]**

**continued on the next page . . .**

**(Turn over)**

**Question 1 (a) continued**

1. (a) (ii) Using your knowledge of cell structure, fill in the spaces below to compare the sites of translation and size of ribosomes in the two cells.

**BACTERIAL CELL**

location(s) of ribosomes involved in translation

= \_\_\_\_\_

**ANIMAL CELL**

location(s) of ribosomes involved in translation

= \_\_\_\_\_

**BACTERIAL CELL**

size of ribosome

= \_\_\_\_\_

**ANIMAL CELL**

size of ribosome

= \_\_\_\_\_

**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 1 continued**

**1. (b) Both cells contain membranes. The animal cell has considerably more membrane than the bacterial cell.**

**Use IMAGE 1.1 and your knowledge of the structure of these cells to suggest TWO reasons for this difference.**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 1 continued**

**1. (c) Refer to IMAGE 1.2 in the separate Diagram Booklet. IMAGE 1.2 shows the cell surface membrane of the animal cell.**

**(i) Identify components **A** and **B** in IMAGE 1.2 and describe their functions.**

**A** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**B** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**[3 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 1 (c) continued**

- 1. (c) (ii) The components labelled C in IMAGE 1.2 form the glycocalyx and are involved in cell recognition. The cell surface membranes of the animal cell have a different composition from the inner mitochondrial membrane.**

**The percentage composition of the three components in each membrane is shown in TABLE 1.3 provided in the separate Diagram Booklet.**

**Using the information in TABLE 1.3 and your knowledge of the function of plasma membranes, suggest why there is:**

- I. no component C in the inner mitochondrial membrane;**

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**(Turn over)**

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[1 mark]

II. more component **B** in the inner mitochondrial membrane than the cell surface membrane.

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[1 mark]

**(Total for Question 1 = 10 marks)**

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**(Turn over)**

**2. Nucleotides are involved in cell metabolism.**

**Refer to the IMAGE 2.1 in the separate**

**Diagram Booklet. Three nucleotides are shown in**

**IMAGE 2.1**

**(a) (i) State THREE structural similarities  
between all three nucleotides shown  
in IMAGE 2.1**

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**[1 mark]**

**continued on the next page . . .**

**(Turn over)**

**Question 2 (a) continued**

**2. (a) (ii) Refer to TABLE 2.2 in the separate Diagram Booklet. Complete TABLE 2.2 to describe ONE structural difference between each of the pairs of nucleotides shown.**

**(iii) Name TWO inorganic ions needed by plant cells in order to synthesise the molecules shown in IMAGE 2.1**

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**[1 mark]**

**continued on the next page . . .**

**(Turn over)**

**Question 2 continued**

- (b) (i) Each human body cell contains  $2.6 \times 10^{-11}$  g of nucleic acid, of which approximately  $2.0 \times 10^{-11}$  g is RNA. Calculate the percentage of nucleic acid that is RNA in a human cell.  
**GIVE YOUR ANSWER TO ONE DECIMAL PLACE.**

**Percentage of nucleic acid that is RNA**

= \_\_\_\_\_

**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 2 (b) continued**

**2. (b) (ii) Explain why the percentage of nucleic acid that is RNA in a human cell is variable.**

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**[1 mark]**

**continued on the next page . . .**

**(Turn over)**



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[3 marks]

**(Total for Question 2 = 10 marks)**

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3. Hydrogen peroxide is a product of respiration and is made in all cells. It is harmful and herefore removed as soon as it is produced. Catalase is an intracellular enzyme that converts hydrogen peroxide into water and oxygen.

(a) Hydrogen peroxide decomposes slowly without catalase. Explain how catalase speeds up the decomposition AND suggest why this is so important in living cells.

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[2 marks]

continued on the next page . . .

(Turn over)

**Question 3 continued**

**3. (b) Some students investigated how the concentration of hydrogen peroxide affected the rate of oxygen production. They used fresh potato puree and different concentrations of hydrogen peroxide. The apparatus was set up as shown in IMAGE 3.1 in the separate Diagram Booklet.**

- **A measuring cylinder was used to measure  $20 \text{ cm}^3$  potato puree which was poured into the conical flask.**
- **A  $50 \text{ cm}^3$  measuring cylinder was filled with water and inverted over the open end of the delivery tube.**
- **$2 \text{ cm}^3$  of  $5.0$  vol hydrogen peroxide was drawn up into the syringe and attached to the apparatus in the position shown.**
- **The plunger was pushed in and a timer was started immediately.**

**continued on the next page . . .**

**(Turn over)**

**Question 3 (b) continued**

- **After 30 seconds the volume of oxygen collected was measured using the scale on the measuring cylinder and recorded.**
- **The rate of oxygen production in  $\text{cm}^3 \text{s}^{-1}$  was calculated.**
- **The experiment was repeated using 3.5 vol, 2.0 vol, 1.5 vol, 1.0 vol and 0 vol hydrogen peroxide.**

**The results are shown in TABLE 3.2 in the separate Diagram Booklet.**

- (i) Calculate the rate of oxygen production in  $\text{cm}^3 \text{s}^{-1}$  for 1.5 VOL HYDROGEN PEROXIDE, TO ONE DECIMAL PLACE, and WRITE YOUR ANSWER IN TABLE 3.2**

**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 3 (b) continued**

**3. (b) (ii) Refer to GRAPH 3.3 in the separate Diagram Booklet. Use the data from TABLE 3.2 to complete GRAPH 3.3 to show the rate of oxygen production against the concentration of hydrogen peroxide.**

**[4 marks]**

**(iii) Describe AND explain the trend shown in GRAPH 3.3**

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**(Turn over)**

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**[3 marks]**

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**(Turn over)**

**Question 3 (b) continued**

**3. (b) (iv) Suggest TWO ways in which the validity of the data could be improved.**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 3 (b) continued**

3. (b) (v) Copper sulfate is a non – competitive inhibitor of catalase. On GRAPH 3.3 **DRAW A LABELLED LINE** to show how the result would be different if the experiment was repeated in the presence of copper sulfate.

[1 mark]

**(Total for Question 3 = 14 marks)**

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**(Turn over)**

4. (a) Different structural isomers of glucose are found in polysaccharides with very different properties. Parts of two polysaccharides (A and B) which are found in plants are shown in IMAGE 4.1 in the separate Diagram Booklet.

(i) State what is meant by the term structural isomer.

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[1 mark]

(ii) Refer to TABLE 4.2 in the separate Diagram Booklet. Complete TABLE 4.2 to describe the structure and function of the polysaccharides A and B, found in plants.

[6 marks]

continued on the next page . . .

(Turn over)

**Question 4 (a) continued**

- 4. (a) (iii) Polysaccharide A is hydrolysed by an enzyme which results in production of the disaccharide shown in IMAGE 4.3 in the separate Diagram Booklet.**

**State the meaning of the term hydrolysis AND name the disaccharide shown in IMAGE 4.3**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 4 continued**

4. (b) Refer to IMAGE 4.4 in the separate Diagram Booklet. Gentiobiose, shown in IMAGE 4.4 is a disaccharide which consists of two glucose monomers joined by a  $\beta$ -1,6-glycosidic bond.

Identify ONE structural similarity and TWO structural differences in the disaccharides shown in IMAGES 4.3 and 4.4

**Structural similarity** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Structural difference 1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

continued on the next page . . .

(Turn over)

Question 4 (b) continued

**Structural difference 2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**[3 marks]**

4. (c) Monosaccharides and disaccharides are polar molecules, they are soluble in water. Refer to IMAGE 4.5 in the separate Diagram Booklet. IMAGE 4.5 shows some water molecules and their bonds.

- (i) **ANNOTATE IMAGE 4.5** to show the polarity of a water molecule.

**[1 mark]**

continued on the next page . . .

**(Turn over)**

**Question 4 (c) continued**

- 4. (c) (ii) With reference to IMAGES 4.3, 4.4 and 4.5, explain why monosaccharides and disaccharides are soluble in water.**

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**[1 mark]**

**continued on the next page . . .**

**(Turn over)**

**Question 4 (c) continued**

**4. (c) (iii) State why it is important to plants that sugars are soluble.**

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**[2 marks]**

**(Total for Question 4 = 16 marks)**

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**(Turn over)**

**5. The Human Immunodeficiency Virus (HIV) was identified in the 1980s. It targets cells called lymphocytes which are part of the immune system. Refer to IMAGE 5.1 in the separate Diagram Booklet. IMAGE 5.1 shows a diagram of HIV.**

- **HIV contains reverse transcriptase, an enzyme involved in viral RNA replication.**
- **RNA and reverse transcriptase are contained within a capsid which is surrounded by a viral envelope.**
- **The viral envelope contains a phospholipid bilayer.**
- **Glycoproteins, projecting from the viral envelope, allow the virus to infect lymphocytes.**

**continued on the next page . . .**



**Question 5 (a) continued**

**5. (a) (ii) Use your knowledge of viral structure to give TWO reasons why HIV cannot reproduce without infecting a host cell.**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

## Question 5 continued

5. (b) Refer to IMAGE 5.2 in the separate Diagram Booklet. IMAGE 5.2 shows how HIV infects a human cell and makes copies of itself.

(i) Assuming the virus is spherical and that the diameter of HIV across the viral envelope is 120 nm, use the formula below to calculate the surface area of HIV.

$$\text{Surface area of a sphere} = 4 \pi r^2$$
$$\pi = 3 \cdot 14$$

Surface area = \_\_\_\_\_ nm<sup>2</sup>  
[2 marks]

continued on the next page . . .

(Turn over)



6. Refer to IMAGE 6.1 in the separate Diagram Booklet. IMAGE 6.1 shows a eukaryotic cell undergoing mitosis. Different structures have been stained with different fluorescent dyes.

(a) (i) On IMAGE 6.1 name the origin of the spindle fibres, labelled X.

[1 mark]

(ii) I. Name the stage of mitosis shown in IMAGE 6.1  
Explain your reasoning.

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[2 marks]

continued on the next page . . .

(Turn over)

**Question 6 (a) (ii) continued**

- II. In the space below DRAW A LABELLED DIAGRAM of ONE CHROMOSOME as it would appear at this stage of mitosis. Your diagram should have TWO labels.**

**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 6 continued**

**6. (b) The mitotic spindle is formed at the start of mitosis, it is made up of many small polypeptides called tubulin which are found in the cytoplasm of eukaryotic cells. Before cell division, microtubules must be assembled from the tubulin polypeptides which join together to form microtubules as shown in IMAGE 6.2 in the separate Diagram Booklet.**

**(i) Use the information provided to state the highest level of protein structure shown by the microtubule in IMAGE 6.2 Explain your answer.**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**



**Question 6 continued**

**6. (c) Refer to IMAGE 6.3 in the separate Diagram Booklet. When bacteria reproduce, they undergo a process called binary fission. This is shown in IMAGE 6.3**

**Use IMAGE 6.3 and your knowledge of eukaryotic cell division to give TWO reasons why cell division in bacteria is not referred to as mitosis.**

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**[2 marks]**

**(Total for Question 6 = 12 marks)**

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**(Turn over)**

- 7. A student carried out an experiment to investigate osmosis in plant tissues.**

**The student used the same volume of sucrose solutions of different concentrations.**

**Pieces of potato and sweet potato were weighed, added to each sucrose concentration and left for 20 minutes. The change in mass was recorded and the percentage change in mass calculated then plotted on a graph as shown in GRAPH 7 in the separate Diagram Booklet.**

**Use your knowledge of osmosis, describe and explain the general trend of the data plotted in GRAPH 7**

**Use information from GRAPH 7 to explain why there is a difference between the data for potato and sweet potato.**

**Give a description of the expected results if animal tissue was used instead of plant tissue and explain why the results might be different.**





















GCE A LEVEL

2400U10–1

MONDAY, 13 MAY 2024 – MORNING

**BIOLOGY – AS UNIT 1**

**BASIC BIOCHEMISTRY AND CELL ORGANISATION**

**The Diagram Booklet MUST be handed in  
to the invigilators and sent for marking.**

# Diagram Booklet

Surname: \_\_\_\_\_

First name(s): \_\_\_\_\_

Centre Number: \_\_\_\_\_

Candidate Number: 2 \_\_\_\_\_

**IMAGE 1.1**

**Bacterial cell**

**Animal cell**

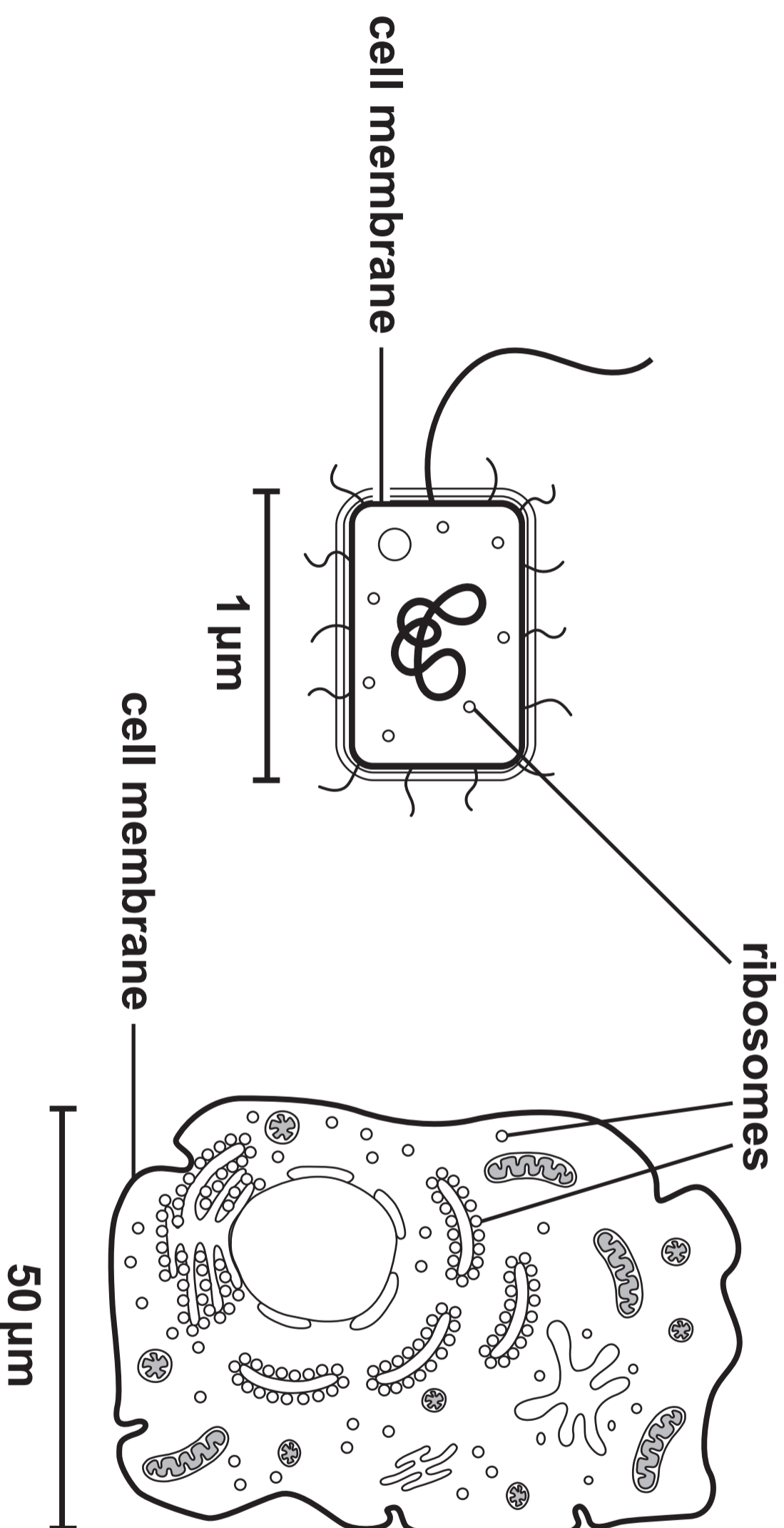
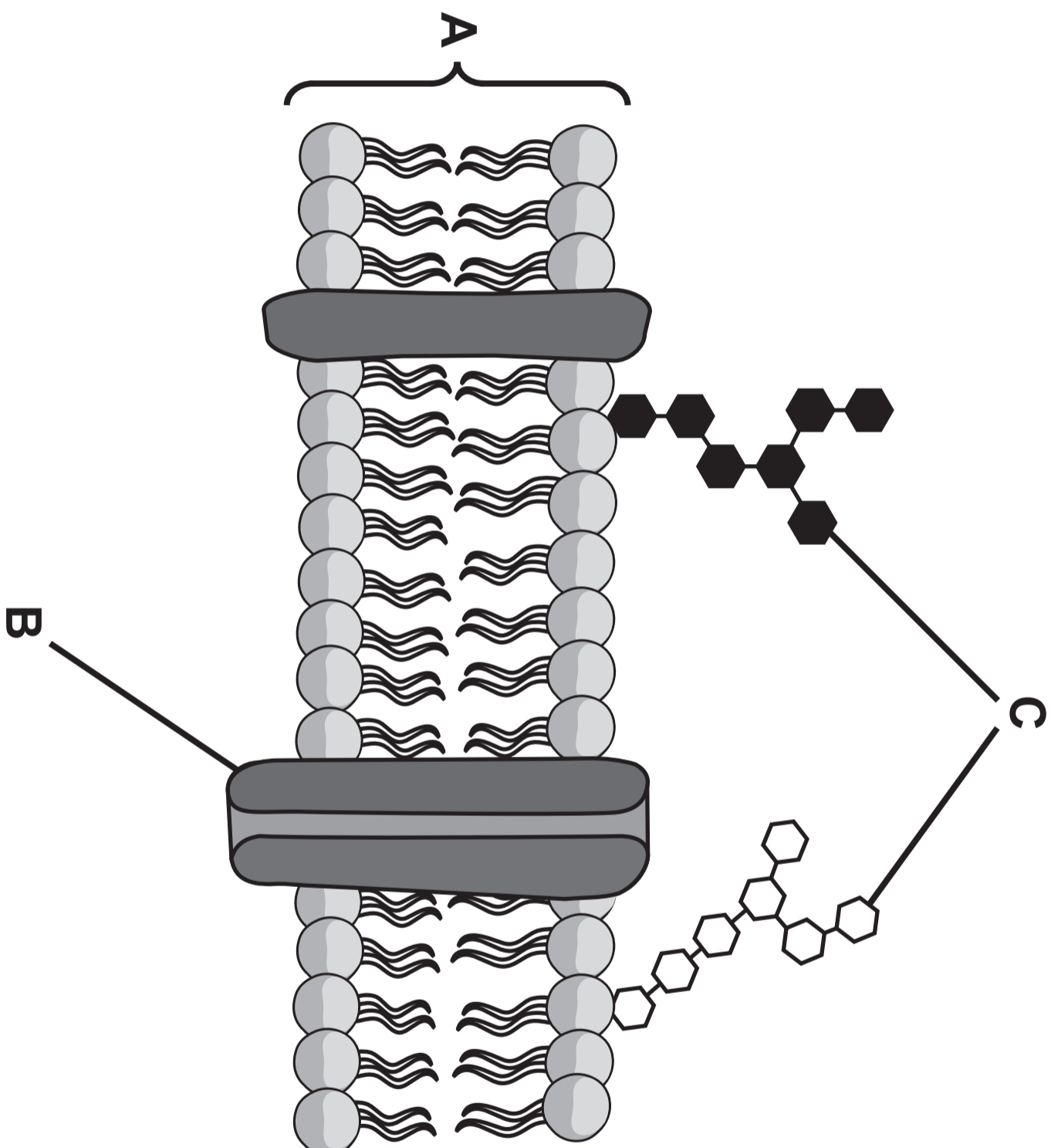


IMAGE 1.2



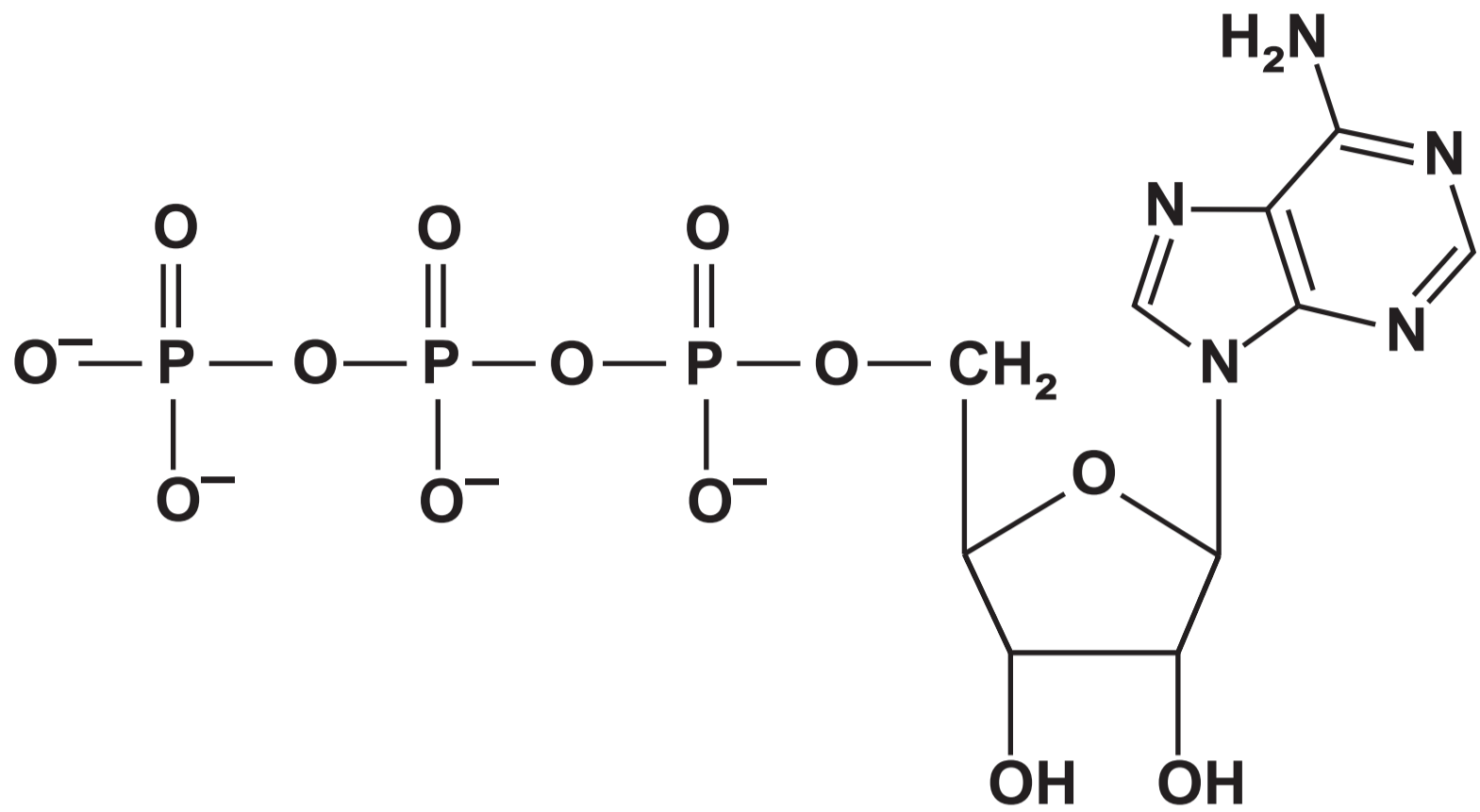
**TABLE 1.3**



<b>Membrane</b>	<b>Percentage composition (%)</b>		
	<b>Component A</b>	<b>Component B</b>	<b>Component C</b>
<b>animal cell surface membrane</b>	<b>53</b>	<b>42</b>	<b>5</b>
<b>inner mitochondrial membrane</b>	<b>22</b>	<b>78</b>	<b>0</b>

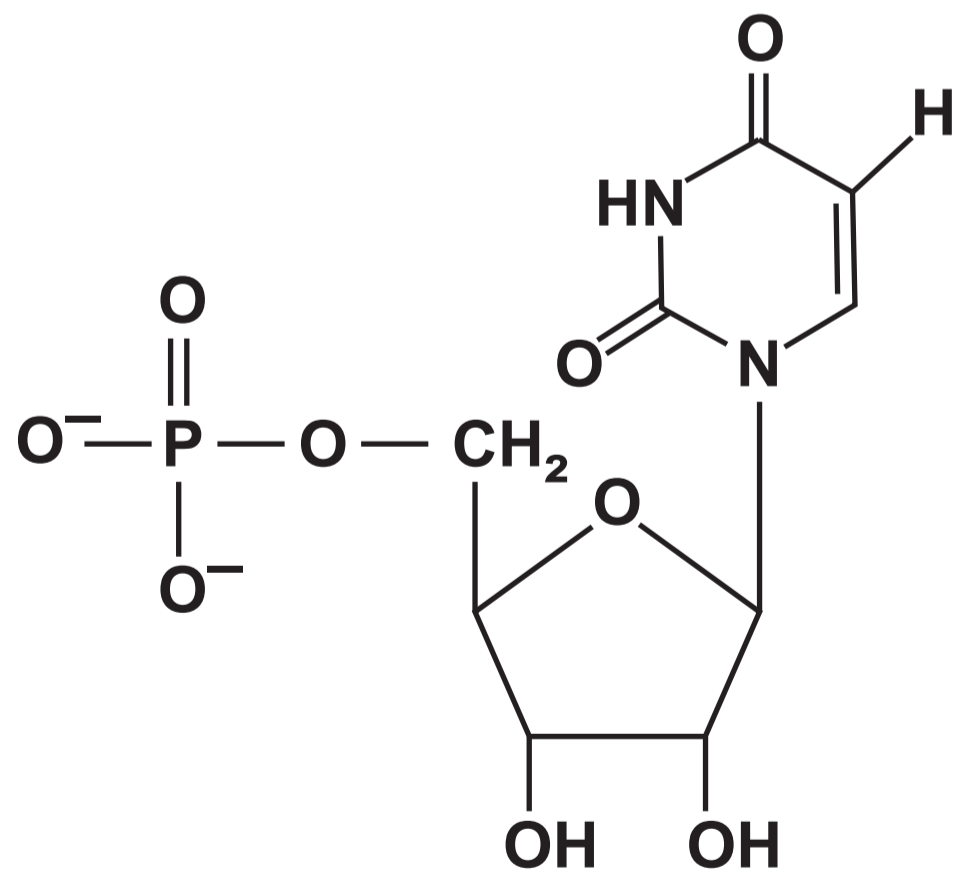
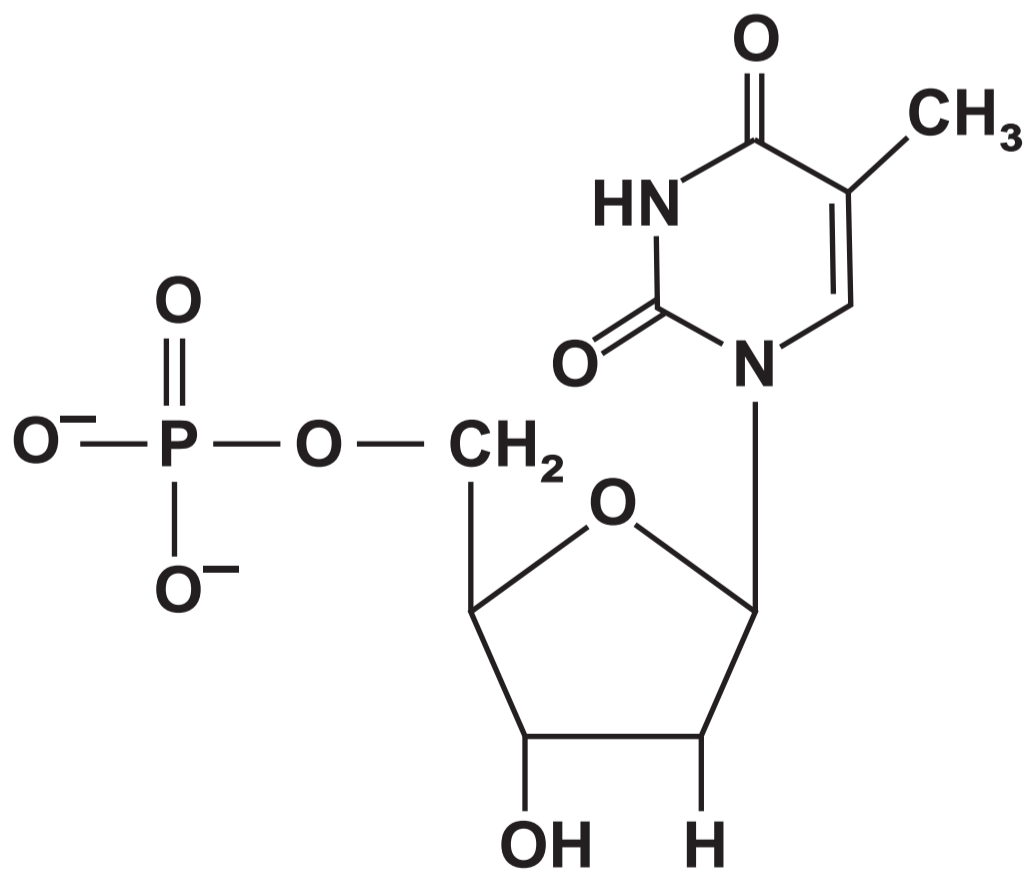
IMAGE 2.1

ATP



DNA nucleotide

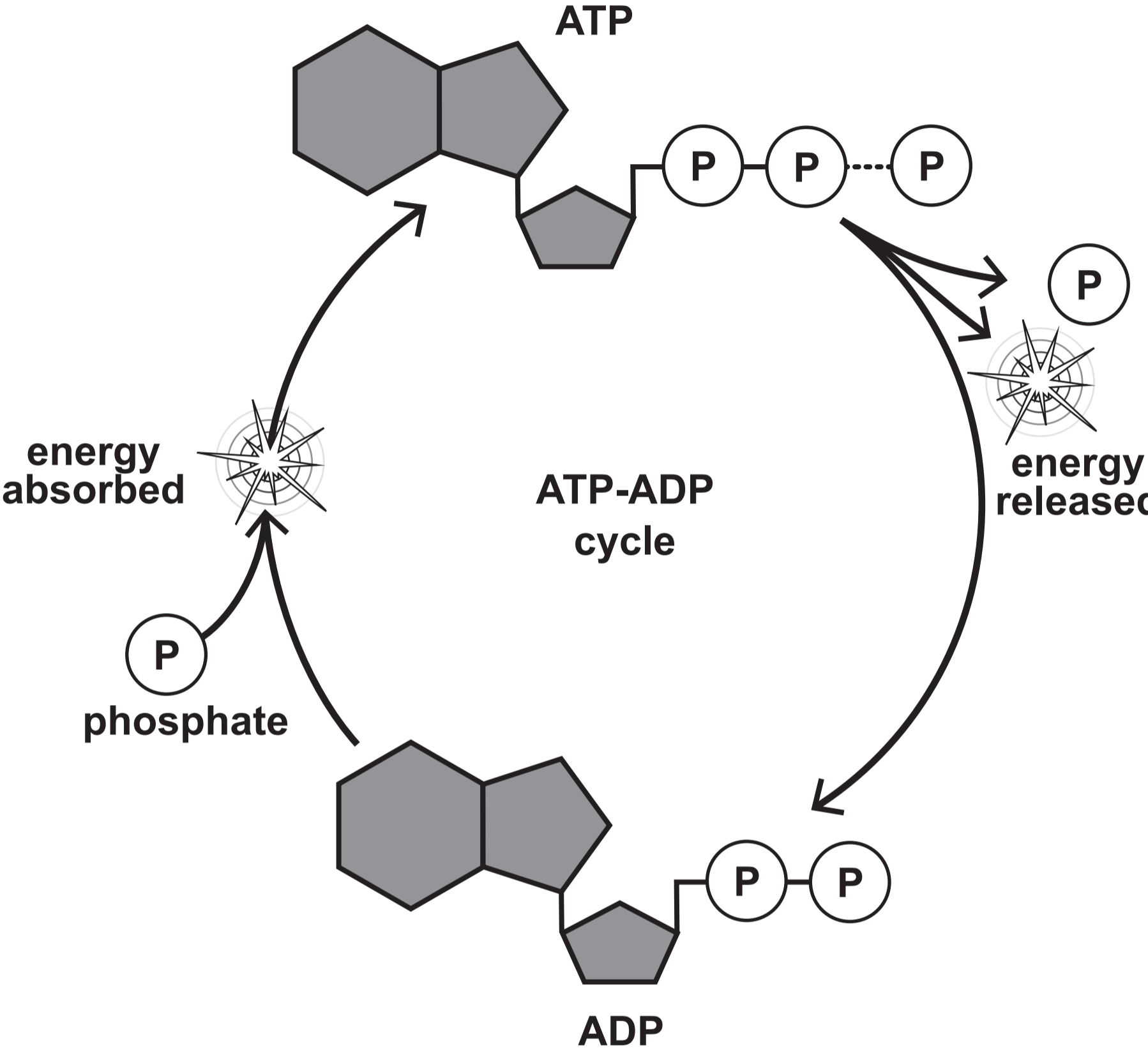
RNA nucleotide



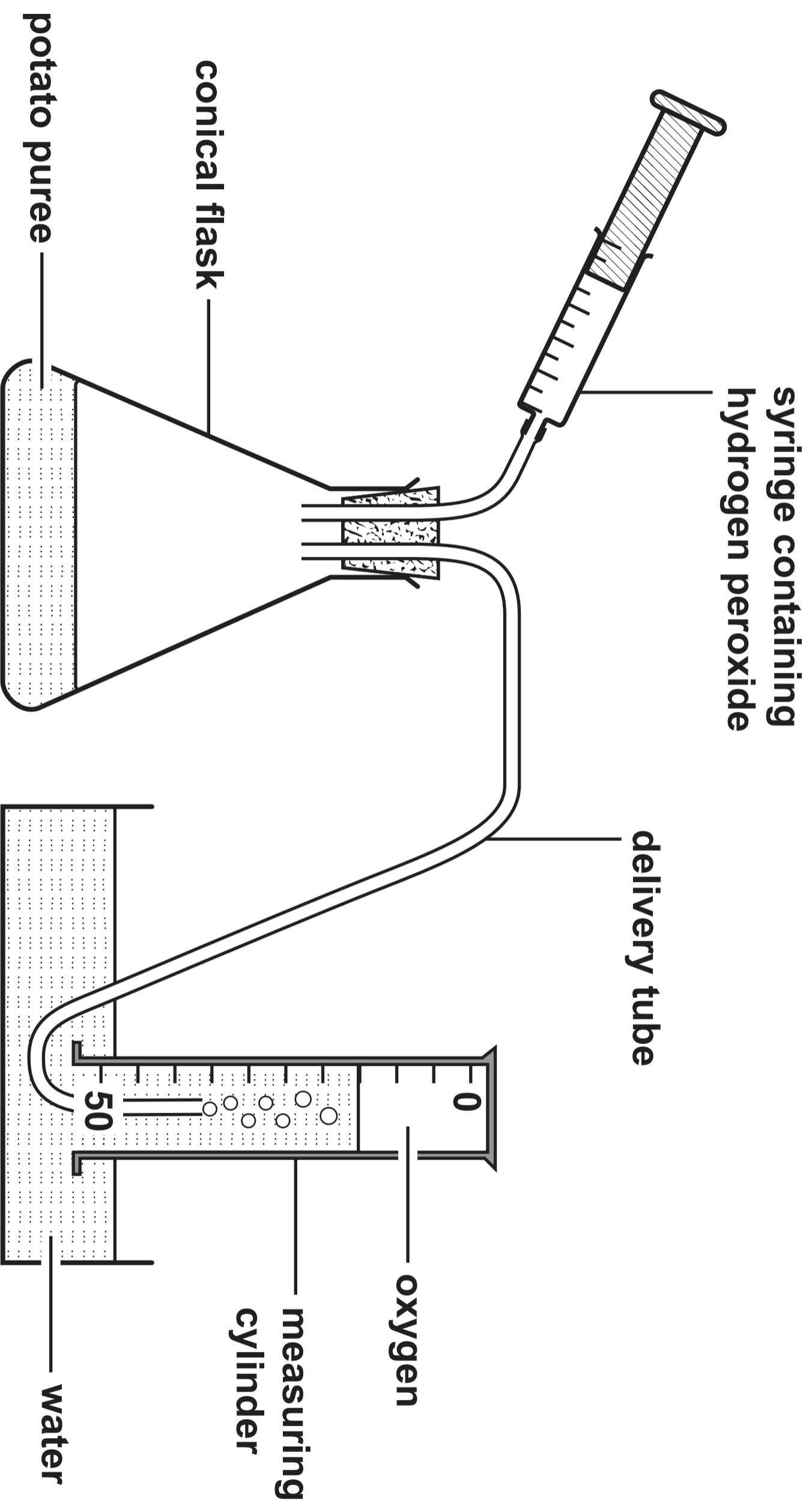
**TABLE 2.2**

<b>Nucleotides</b>	<b>Difference</b>
<b>ATP AND RNA</b>	<hr/> <hr/> <hr/>
<b>DNA AND RNA</b>	<hr/> <hr/> <hr/>

IMAGE 2.3



**IMAGE 3.1**





**TABLE 3.2**

<b>Concentration of hydrogen peroxide (vol)</b>	<b>Volume of oxygen collected in 30 seconds (cm<sup>3</sup>)</b>	<b>Rate of oxygen production (cm<sup>3</sup> s<sup>-1</sup>)</b>
0	0	0.0
1.0	18	0.6
1.5	26	_____
2.0	35	1.2
3.5	42	1.4
5.0	43	1.4

# GRAPH 3.3

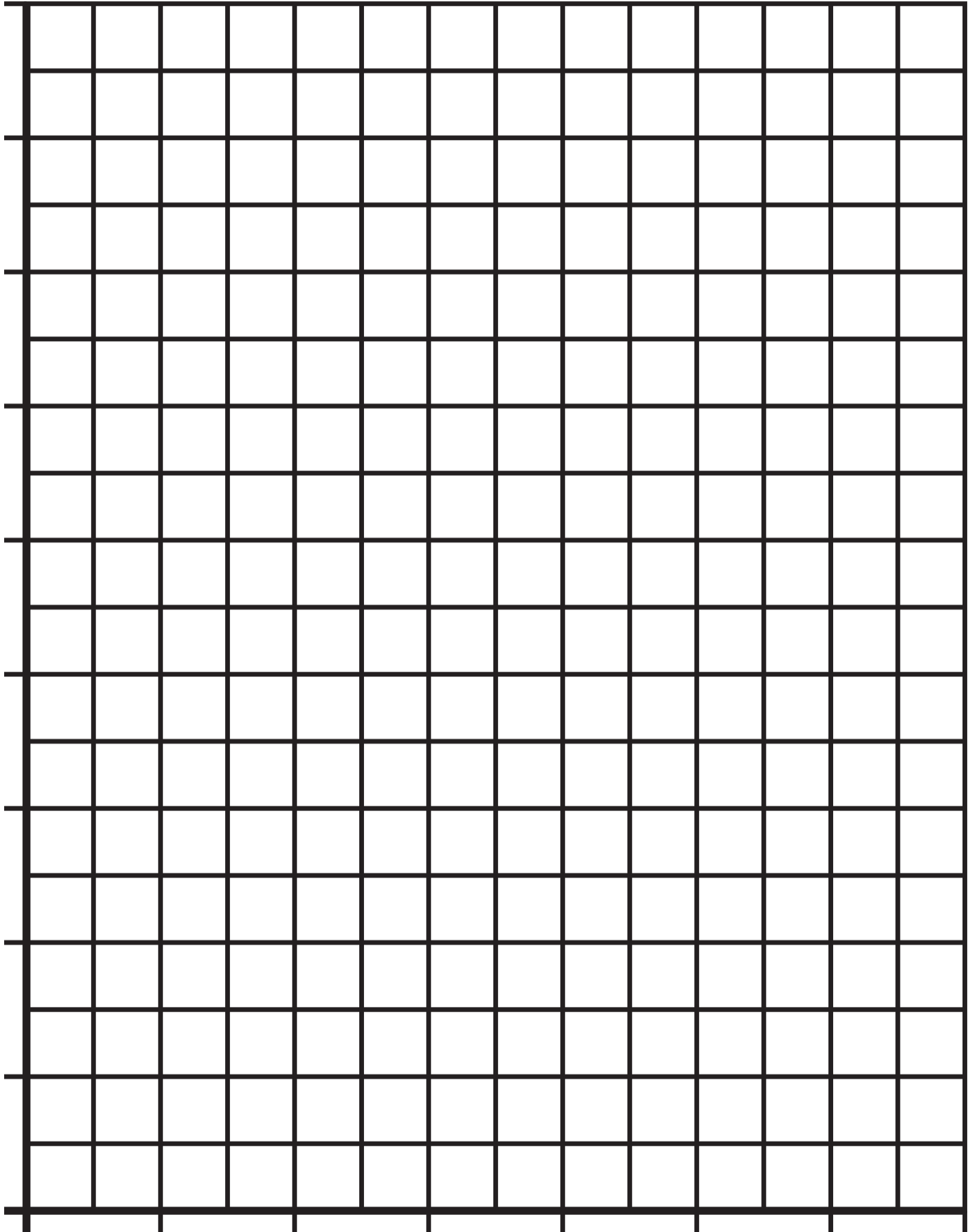
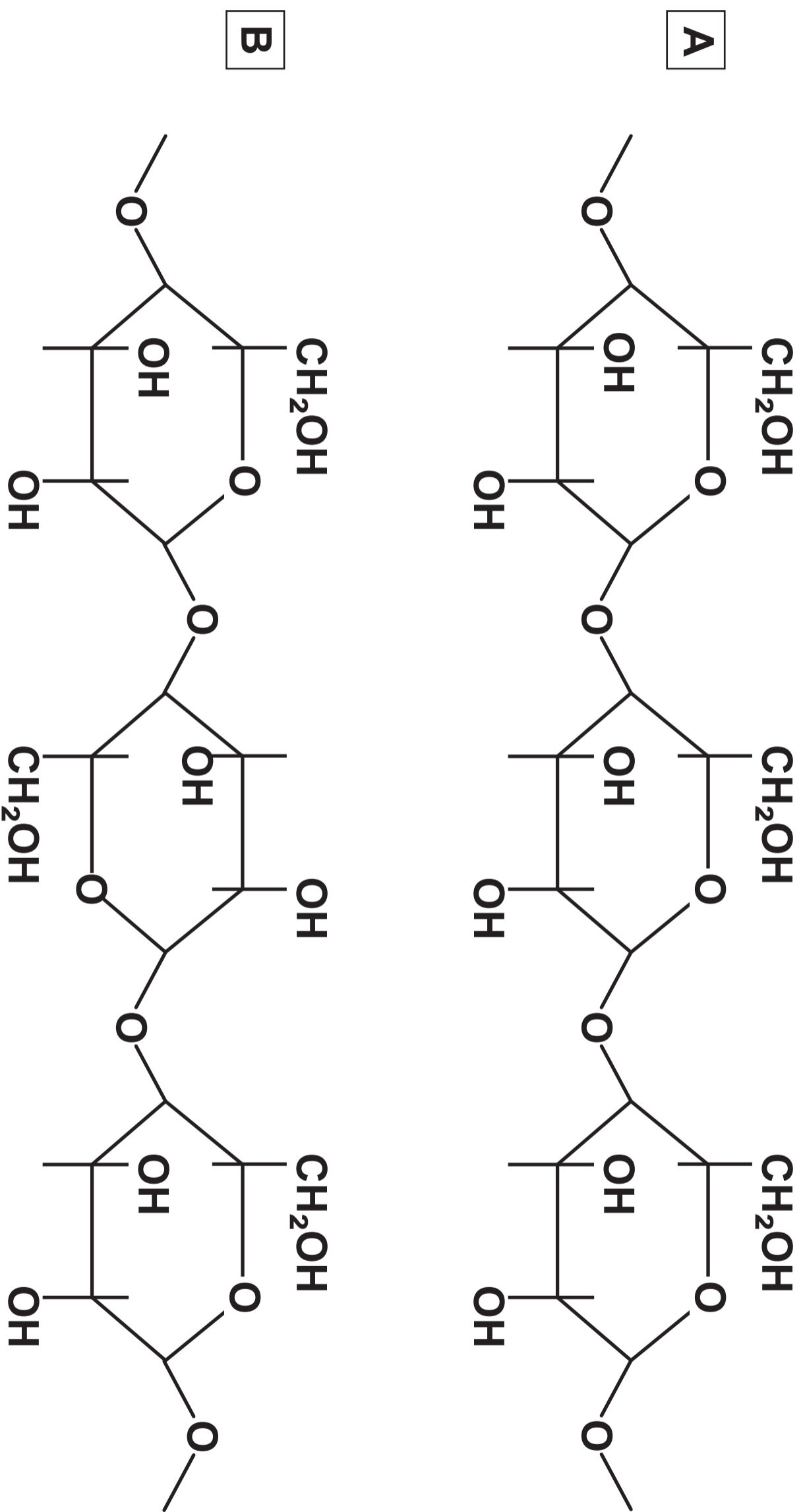


IMAGE 4.1



**TABLE 4.2**

	<b>Polysaccharide A</b>	<b>Polysaccharide B</b>
<b>Name of polysaccharide</b>	_____ _____	_____ _____
<b>Isomer of glucose present</b>	_____ _____	_____ _____
<b>Description of structure</b>	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____
<b>Function in a plant cell</b>	_____ _____ _____ _____	_____ _____ _____ _____

IMAGE 4.3

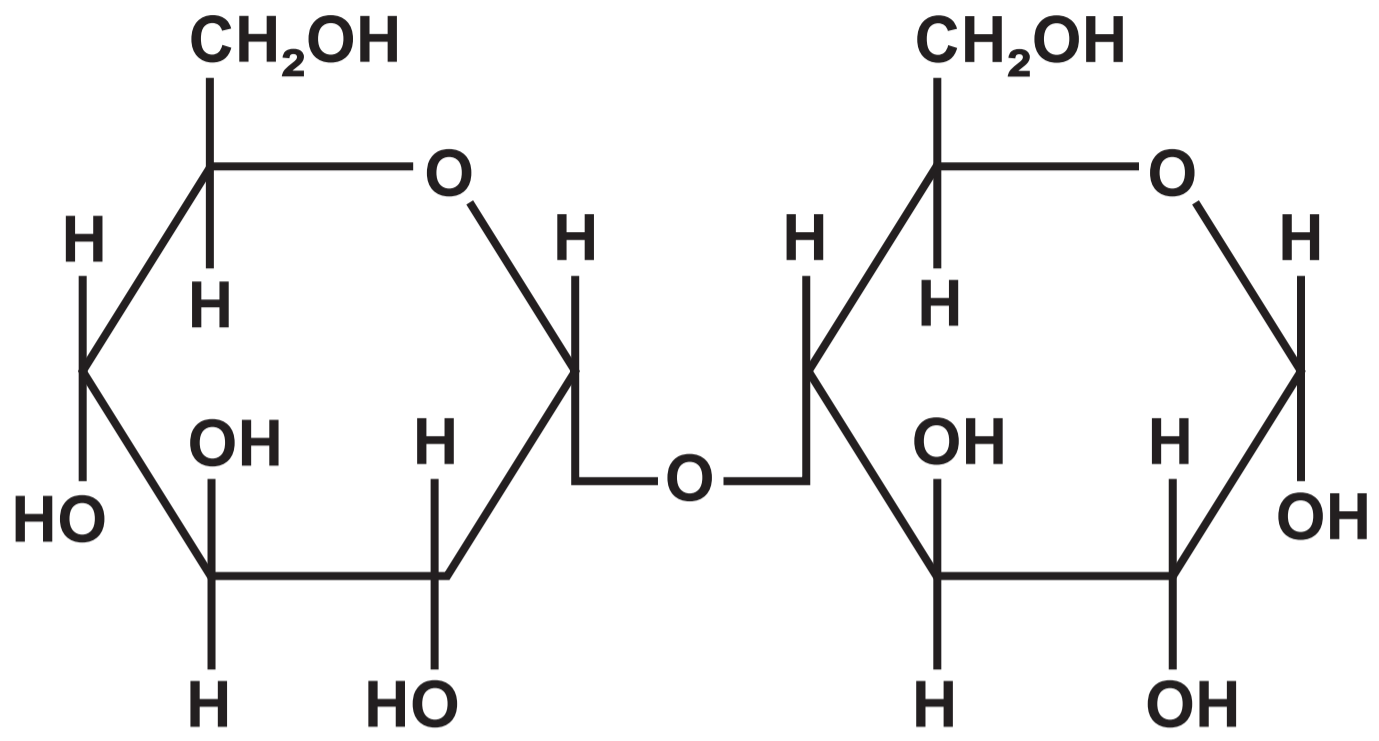
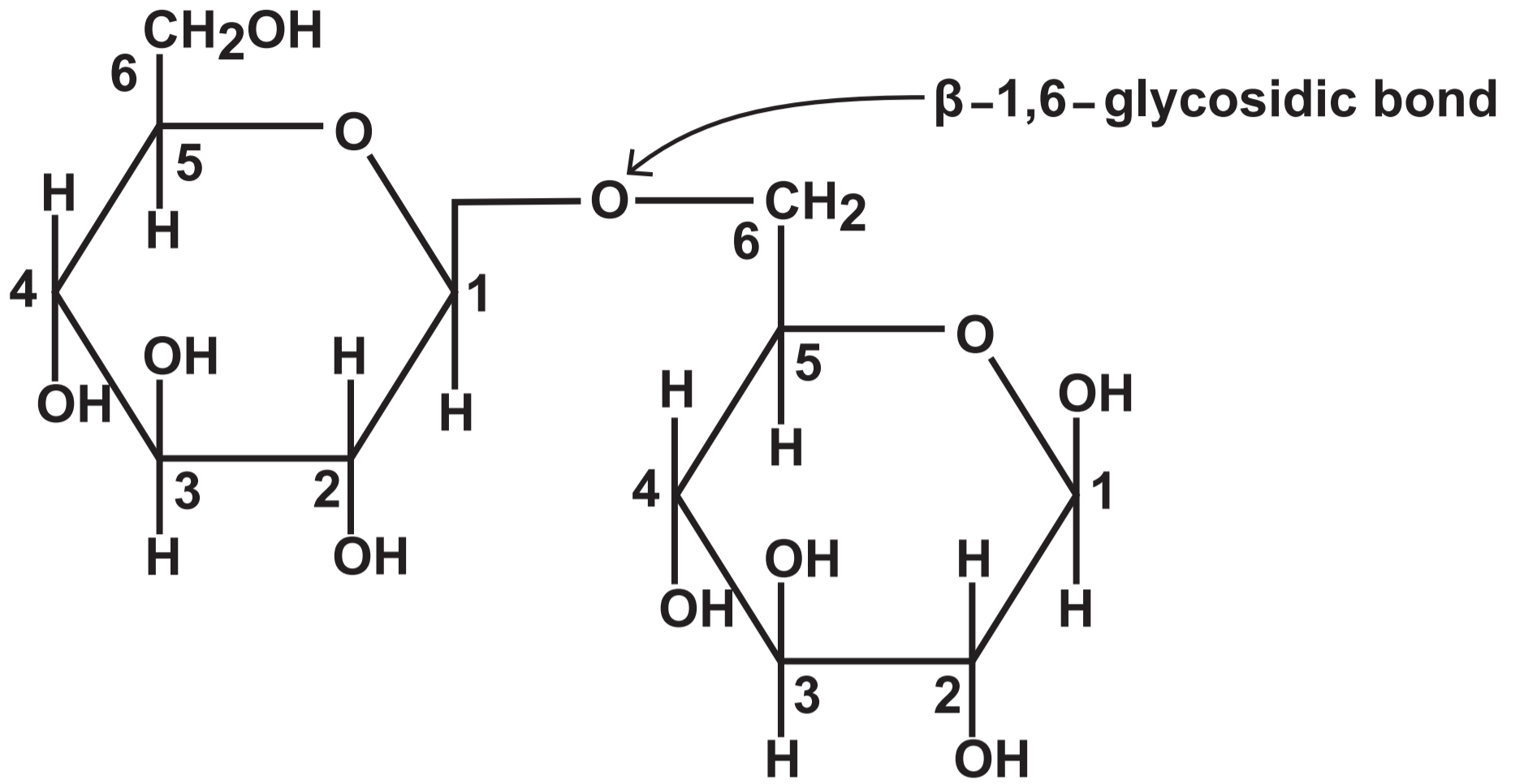
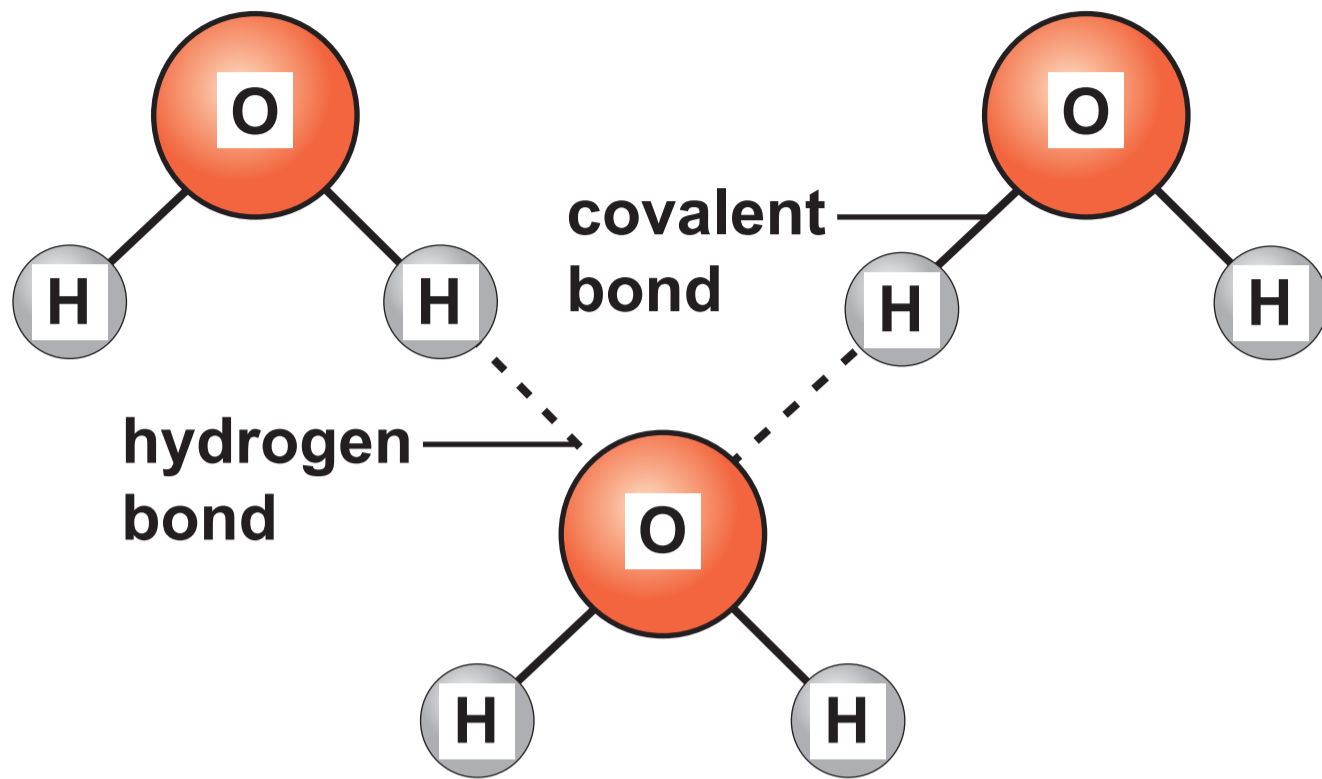


IMAGE 4.4



**IMAGE 4.5**



**IMAGE 5.1**

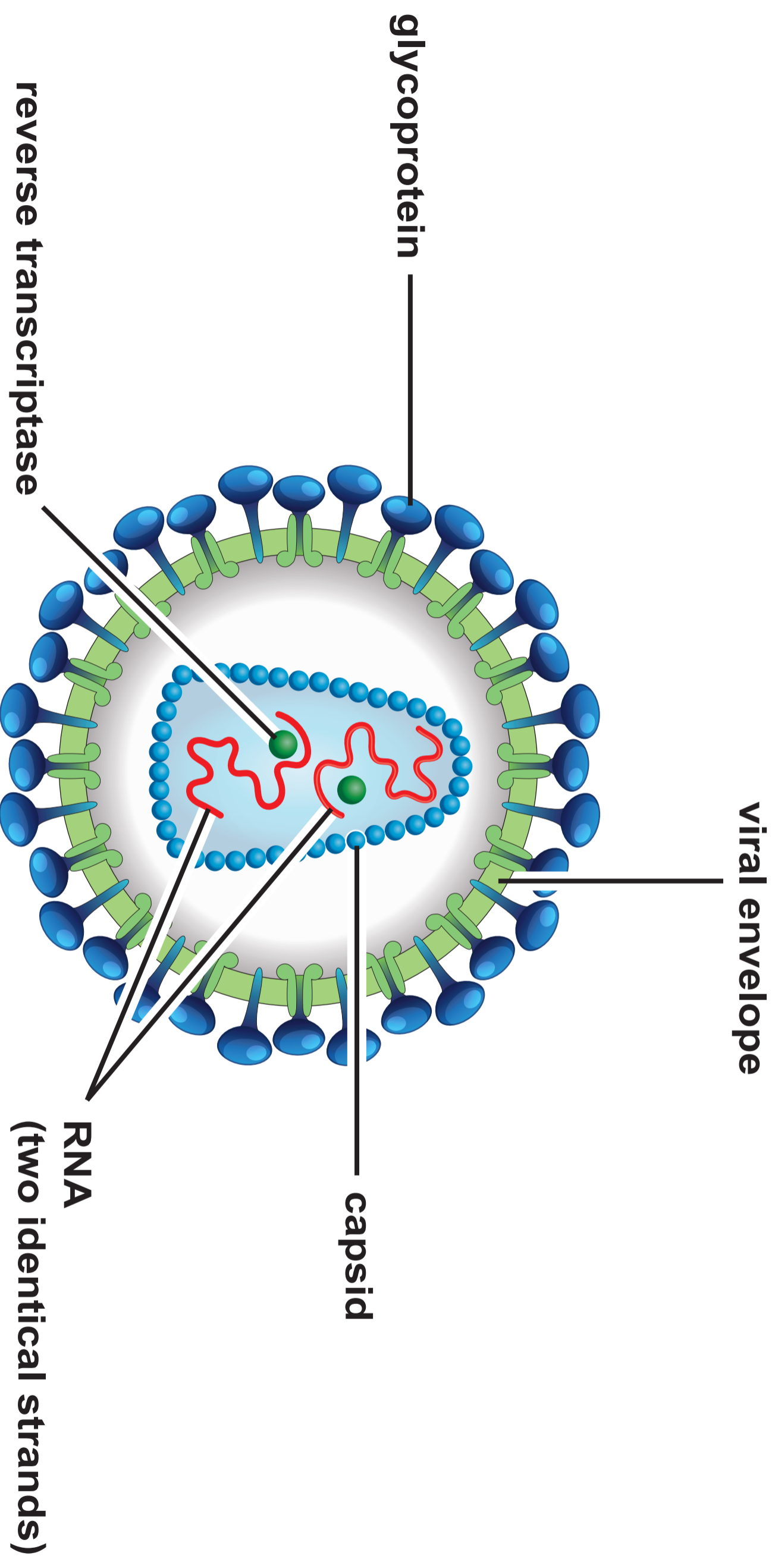
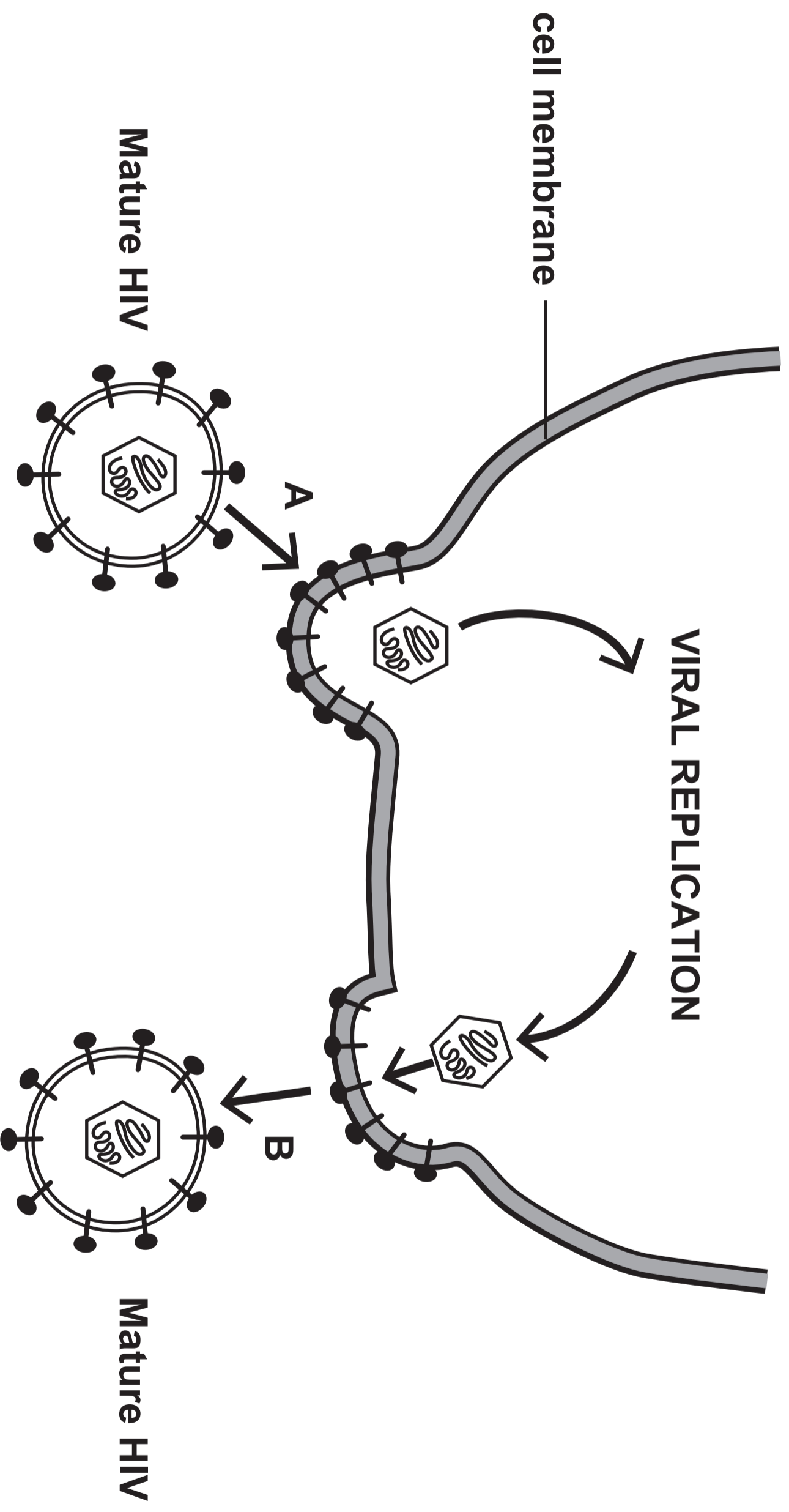
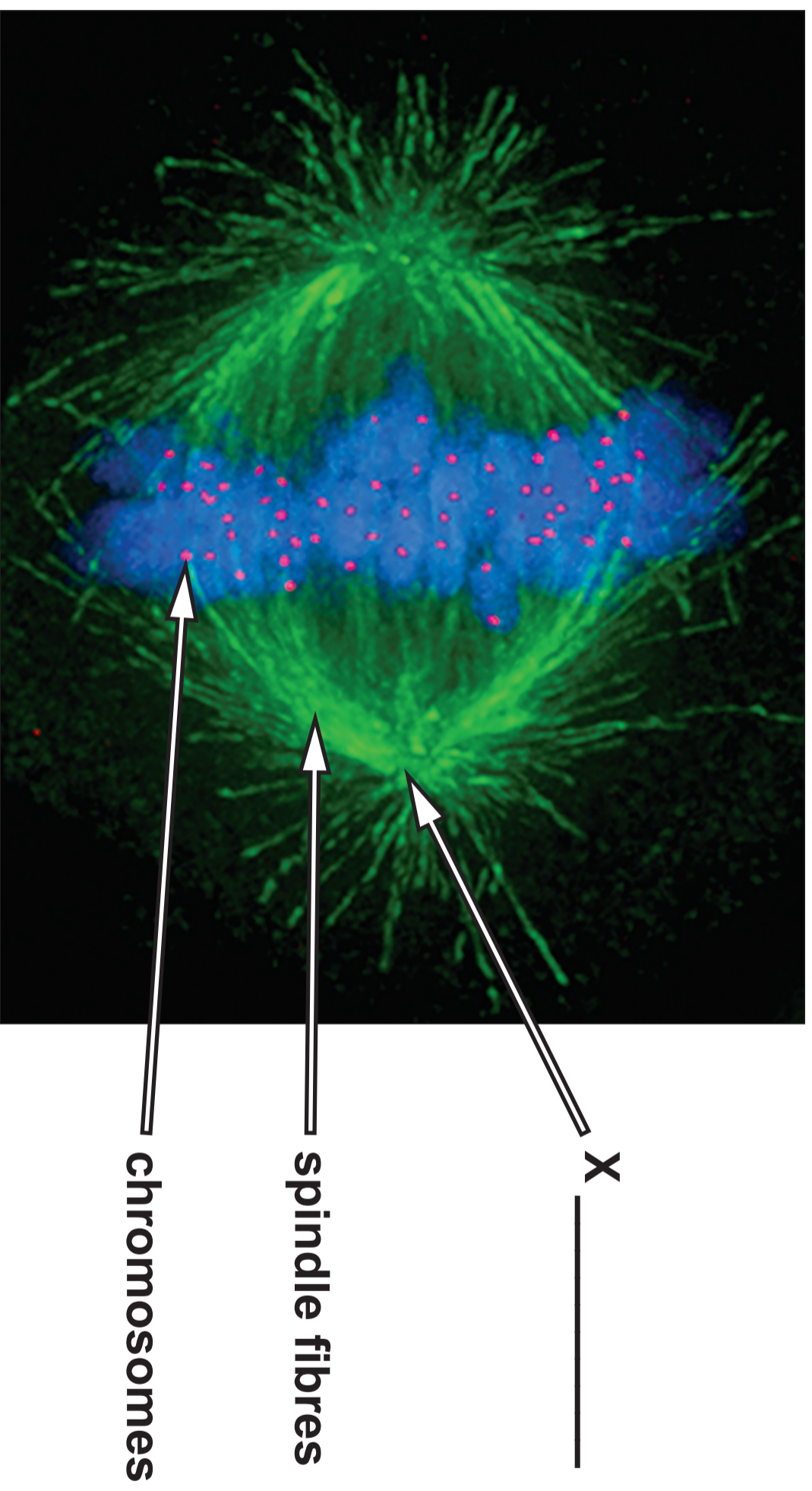


IMAGE 5.2



**IMAGE 6.1**



**IMAGE 6.2**

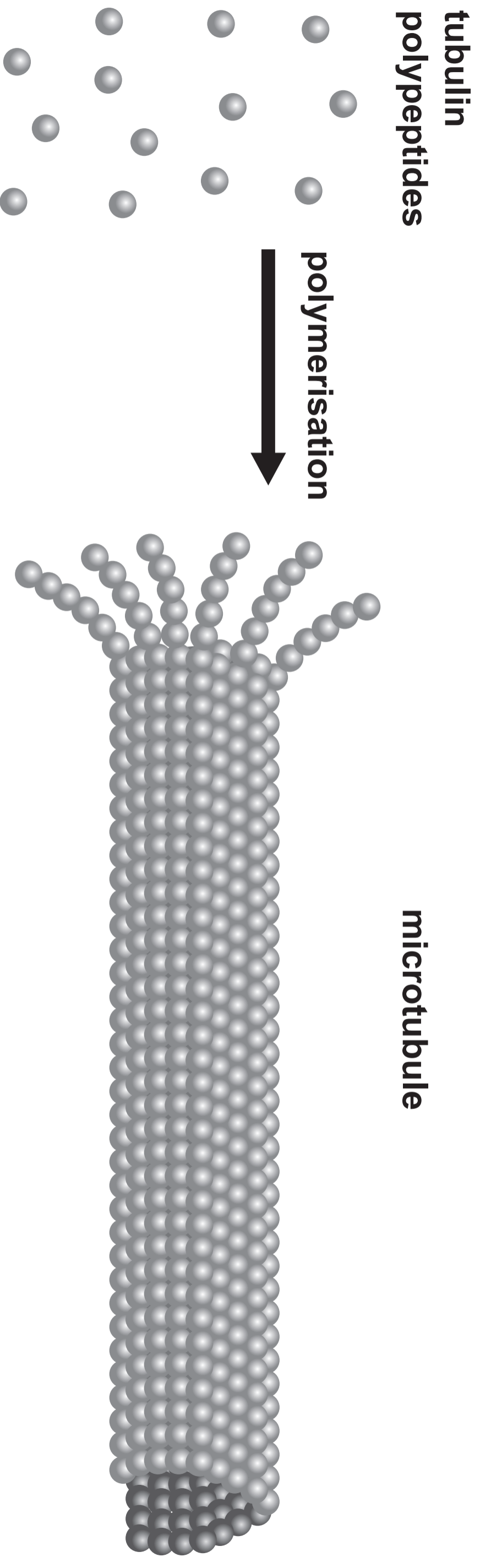
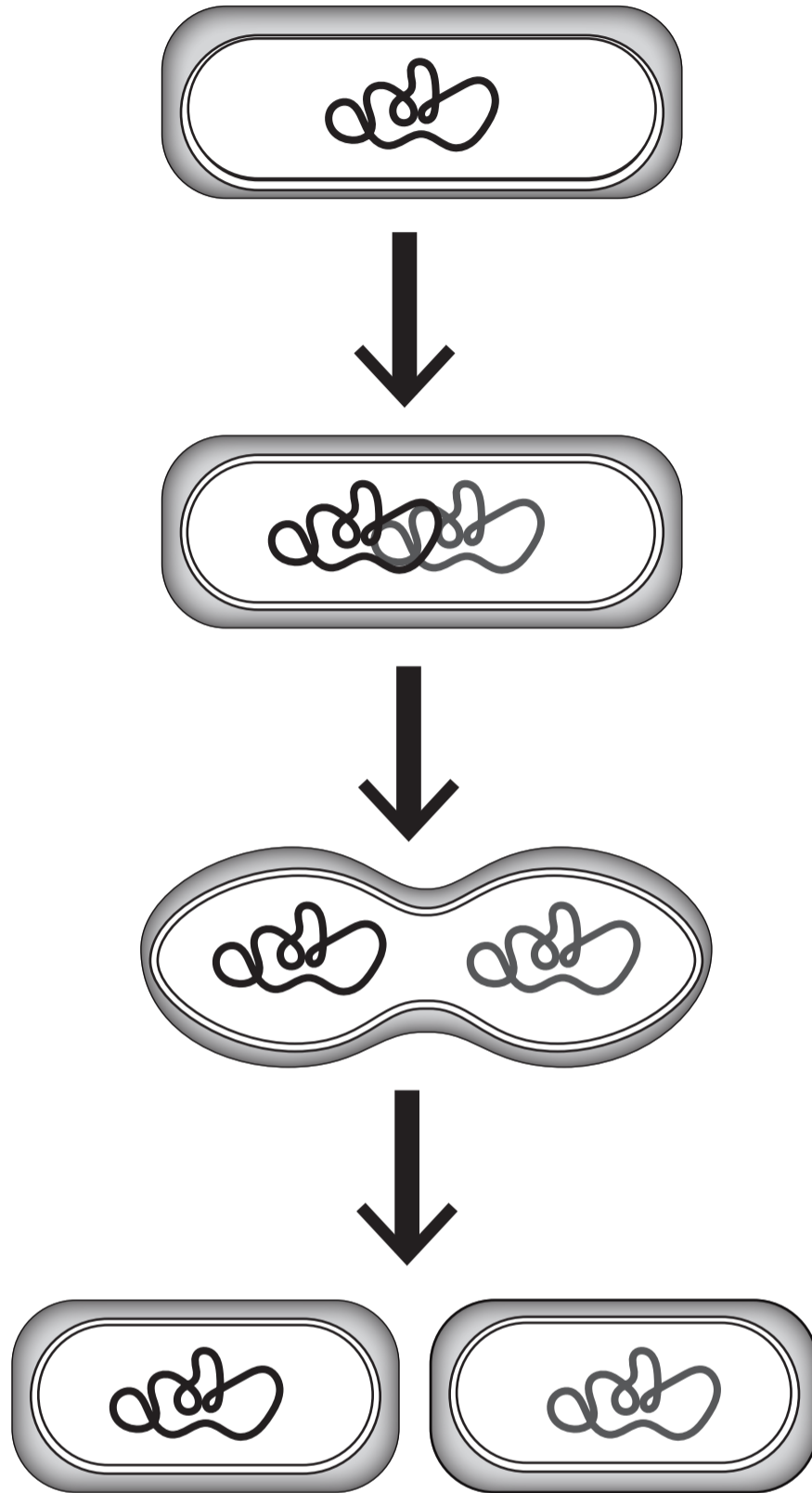


IMAGE 6.3



GRAPH 7

Key:

— potato

- - - sweet potato

