GCE A LEVEL

A400U30–1

WEDNESDAY, 19 JUNE 2024 – MORNING

BIOLOGY– A LEVEL COMPONENT 3
REQUIREMENTS FOR LIFE

2 hours plus your additional time allowance

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
SECTION A	1.	11	
	2.	16	
	3.	22	
	4.	10	
	5.	12	
	6.	9	
SECTION B	Option	20	
	Total	100	

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.

INFORMATION FOR CANDIDATES

This paper is in 2 sections, A and B.

Section A: 80 marks. Answer ALL questions. You are advised to spend about 1 hour 35 minutes on this section.

Section B: Options; 20 marks. Answer ONE OPTION ONLY. You are advised to spend about 25 minutes on this section.

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 6

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

SECTION A

Answer ALL questions.

1. (a) **Refer to IMAGE 1.1 in the separate Diagram Booklet. IMAGE 1.1 is a photomicrograph of part of a transverse section of a privet (LIGUSTRUM) leaf.**

A student drew a low power plan of IMAGE 1.1 as shown in IMAGE 1.2 in the separate Diagram Booklet.

(i) ADD LABELS to IMAGE 1.2 to identify THREE tissue layers that contain PHOTOSYNTHESISING CELLS.

[3 marks]

continued on the next page . . .

Question 1 (a) continued

1. (a) (ii) The proportions of (A – C : A – B) in IMAGE 1.1 have a ratio of 3 • 5 : 1

I. Calculate the ratio of (A – C : A – B) in IMAGE 1.2

Ratio = _____ : 1

[1 mark]

continued on the next page . . .

Question 1 (a) (ii) continued

1. (a) (ii) II. IMAGE 1.2 has not been drawn in the correct proportions.
Tissue layer A – B has been drawn too thick.
Calculate how thick tissue A – B should have been drawn in IMAGE 1.2 to make the proportion of the plan correct.

Thickness = _____ mm

[2 marks]

continued on the next page . . .

Question 1 continued

1. (b) To photosynthesise effectively, a leaf is adapted for the absorption of light energy and for diffusion of gases.

State TWO adaptations of a leaf for the absorption of light and TWO adaptations for the efficient diffusion of gases.

Adaptations for the absorption of light.

1 _____

_____

2 _____

_____

Adaptations for the efficient diffusion of gases.

1 _____

_____

2 _____

_____

[4 marks]

continued on the next page . . .

Question 1 continued

1. (c) The vascular bundles in a leaf form a highly branched network. Two functions of the vascular bundles are transport of:

- **water and mineral ions in the xylem**
- **sugars and other organic materials in the phloem.**

State ONE other function of the vascular bundles.

_____

_____

[1 mark]

(Total for Question 1 = 11 marks)

2. Refer to IMAGE 2.1 in the separate Diagram Booklet. The efficient digestion of molecules in food substances requires many different enzymes and different conditions. IMAGE 2.1 is a schematic diagram representing the breakdown and absorption of starch and protein.

(a) (i) I. Use IMAGE 2.1 to complete TABLE 2.2 in the separate Diagram Booklet.

[3 marks]

II. Name the bond hydrolysed by enzyme D.

_____

[1 mark]

continued on the next page . . .

Question 2 (a) continued

2. (a) (ii) Many digestive enzymes are secreted into the lumen of the gut.
Describe the exact position of enzymes C and D in IMAGE 2.1 and suggest the advantage of the position of these enzymes.

[2 marks]

continued on the next page . . .

Question 2 continued

2. (b) When vinegar (ethanoic acid) is added to potato chips, enzyme A (produced in the mouth) is unable to break down the starch they contain. Suggest the reason for this.

[1 mark]

continued on the next page . . .

Question 2 continued

2. (c) Refer to the IMAGE 2.3 in the separate Diagram Booklet. The structure of the gut of a cow, horse and dog is shown in IMAGE 2.3 (not drawn to scale). Cows and horses are herbivores and dogs are carnivores.

Refer to TABLE 2.4 in the separate Diagram Booklet.

(i) Give TWO differences in the relative volume of the structures in the gut of a COW and the gut of a DOG and conclude how each of these differences reflect their respective diets.

1: Difference in relative volume

_____

_____

_____

continued on the next page . . .

Question 2 (c) (i) continued

How this reflects their diet

2: Difference in relative volume

How this reflects their diet

[4 marks]

continued on the next page . . .

Question 2 (c) continued

2. (c) (ii) Cows are classified as mammals and so their young feed on milk.
With reference to their diet, explain why the abomasum of a newborn calf is proportionally larger at birth than in an adult cow.

[2 marks]

(iii) Explain the advantage of 'chewing the cud' in ruminants such as cows.

[1 mark]

continued on the next page . . .

Question 2 (c) continued

2. (c) (iv) Horse manure is a better source of plant nutrients than cow manure. With reference to IMAGE 2.3, suggest why.

[2 marks]

(Total for Question 2 = 16 marks)

3. Refer to IMAGE 3.1 in the separate Diagram Booklet. Water lost by transpiration from the leaves of plants results in a flow of water across the roots, as shown in IMAGE 3.1

(a) (i) Use the information in IMAGE 3.1 to name the THREE pathways **A**, **B** and **C** by which water moves from the soil to the endodermis.

A _____

B _____

C _____

[2 marks]

continued on the next page . . .

Question 3 (a) continued

3. (a) (ii) Describe THREE differences between pathways A and B in IMAGE 3.1

Difference 1 _____

Difference 2 _____

Difference 3 _____

[3 marks]

3. (a) (iii) State the function of the Casparian strip.

[2 marks]

continued on the next page . . .

Question 3 continued

3. (b) Refer to GRAPH 3.2 in the separate Diagram Booklet. Water molecules in the xylem are attracted to each other by cohesion and to the inside of the xylem vessels by adhesion. The rate of water movement affects the diameter of the xylem vessels.

The variation in the diameter of xylem vessels over a 24 – hour period is shown in GRAPH 3.2

continued on the next page . . .

Question 3 (b) continued

3. (b) (i) The diameter of a tree trunk was measured over a 24 – hour period.
Use the information on the previous page to predict and explain what would happen to the trunk diameter between 6:00 hours and 12:00 hours.

[5 marks]

continued on the next page . . .

Question 3 (b) continued

Refer to IMAGE 3.3 in the separate Diagram Booklet. The diameter of the trunk was measured using a dendrometer. This is shown in IMAGE 3.3 The band detects changes in the diameter of the trunk. This is then recorded on a chart on a rotating drum.

3. (b) (ii) To increase confidence in results, the diameter of ten different tree trunks in one area of woodland was measured over the same time period.

Suggest THREE OTHER factors that would need to be controlled when obtaining these readings using the dendrometer.

[3 marks]

continued on the next page . . .

Question 3 continued

3. (c) Refer to TABLE 3.4 provided separately for this question. Maize is an agricultural crop which is grown throughout the world. TABLE 3.4 shows data relating to the growing of maize.

(i) Use the information given in TABLE 3.4 to calculate the volume of water lost through transpiration by $1\ m^2$ of maize per day during the growing season.

Volume of water lost = _____ $dm^3 m^{-2}\ day^{-1}$

[3 marks]

continued on the next page . . .

Question 3 (c) continued

Refer to GRAPH 3.5 in the separate Diagram Booklet. The effect of soil water availability on the transpiration rate of five plants of the same species is shown in GRAPH 3.5

3. (c) (ii) Describe the relationship shown in GRAPH 3.5 between transpiration rate and availability of water in the soil.

[2 marks]

continued on the next page . . .

Question 3 (c) continued

3. (c) (iii) Draw ONE conclusion about the confidence in the data shown in GRAPH 3.5 at lower water availability. Explain your answer.

[2 marks]

(Total for Question 3 = 22 marks)

4. Refer to IMAGE 4.1 in the separate Diagram Booklet. IMAGE 4.1 shows a transverse section through the spinal cord.

(a) Name the labelled structures A – E shown in IMAGE 4.1

A _____

B _____

C _____

D _____

E _____

[3 marks]

continued on the next page . . .

Question 4 continued

4. (b) Refer to IMAGES 4.2 and 4.3 in the separate Diagram Booklet. If sensory neurones in the skin of the chest of dogs are stimulated, the nearby hind limb reaches toward the area and scratches it. This is called the dog scratch reflex, shown in IMAGE 4.2

Sections through the spinal cord at the level of stimulation and at the level of the hind leg are shown in IMAGE 4.3

(i) Complete IMAGE 4.3 to LABEL the SENSORY and MOTOR neurones involved in the dog scratch reflex.
DRAW ARROWS on all the neurones involved to show the direction of the impulse.

[3 marks]

continued on the next page . . .

Question 4 (b) continued

4. (b) (ii) Use the information in IMAGES 4.2 and 4.3 to explain why the axon of the connector (relay) neurone is so long in this reflex arc.

[2 marks]

continued on the next page . . .

Question 4 continued

4. (c) In a dog, the nerve impulse takes 6 milliseconds to travel 0•3 m.

Calculate the rate of transmission of the nerve impulse.

GIVE YOUR ANSWER IN METRES PER SECOND.

Rate = _____ ms^{-1}

[2 marks]

(Total for Question 4 = 10 marks)

5. The kidneys play an important role in homeostasis through osmoregulation and the excretion of urine.

The volume of urine produced can be affected by both the glomerular filtration rate and the reabsorption of filtrate.

(a) To control the glomerular filtration rate, a protein is released by the body which causes vasoconstriction of the afferent arterioles. This protein functions as both an enzyme and a hormone.

(i) Describe what is meant by the term enzyme and explain why the tertiary structure of the enzyme is important to the function of the enzyme.

[2 marks]

5. (a) (ii) Describe what is meant by the term hormone and explain why the tertiary structure of this protein is important in its function as a hormone.

[2 marks]

continued on the next page . . .

Question 5 continued

5. (b) Refer to GRAPH 5 in the separate Diagram Booklet. The relationship between arterial blood pressure, renal blood flow (RBF) (volume of blood entering kidney) and the glomerular filtration rate (GFR) is shown in GRAPH 5

(i) Explain how increasing RBF results in an increase in GFR as arterial blood pressure increases from 0 to 80 mm Hg.

[1 mark]

continued on the next page . . .

Question 5 (b) continued

5. (b) (ii) Use your knowledge of vasoconstriction in the afferent arterioles to describe and explain the GFR between 80 and 180 mm Hg.

[2 marks]

continued on the next page . . .

Question 5 (b) continued

5. (b) (iii) Above 180 mm Hg GFR increases dramatically.
Suggest how the increase in GFR demonstrates that the kidneys are acting homeostatically to reduce blood pressure.

[1 mark]

(c) Antidiuretic hormone (ADH) is a hormone that affects the volume of urine produced.
Describe and explain the effect on the kidneys of a high concentration of antidiuretic hormone (ADH) in the blood.

[4 marks]

(Total for Question 5 = 12 marks)

6. Refer to IMAGES 6.1, 6.2 and 6.3 in the separate Diagram Booklet. Multicellular animals have evolved different ways of ventilating their gas exchange surfaces.

IMAGE 6.1 shows the thorax of a human (a mammal), IMAGE 6.2 shows a cross section through part of the head of a bony fish and IMAGE 6.3 shows the tracheal system in an insect.

Use the information shown in IMAGES 6.1 and 6.2 to describe and explain ventilation of the lungs in a human and ventilation of the gills in a bony fish. Describe the advantages and disadvantages of the insect tracheal system when compared to the gas exchange system of humans.

[9 QER marks]

(Total for Question 6 = 9 marks)

TOTAL FOR SECTION A = 80 MARKS

SECTION B: OPTIONAL TOPICS

Option A: **IMMUNOLOGY AND DISEASE** ☐

Option B: **HUMAN MUSCULOSKELETAL ANATOMY** ☐

Option C: **NEUROBIOLOGY AND BEHAVIOUR** ☐

Answer the question on ONE TOPIC ONLY.

Place a tick (✓) in ONE of the boxes above, to show which topic you are answering.

YOU ARE ADVISED TO SPEND ABOUT 25 MINUTES ON THIS SECTION.

OPTION A: IMMUNOLOGY AND DISEASE

7. (a) Malaria is a disease caused by a protoctistan parasite belonging to the genus PLASMODIUM. The disease is caused mainly by two species of PLASMODIUM (P. VIVAX AND P. FALCIPARUM) of which there are many antigenic types.

The life cycle of malaria consists of multiple stages within two host organisms; humans and the ANOPHELES mosquito. Some of these stages are free−swimming (for example, sporozoites) while other stages happen within human liver cells and red blood cells.

Refer to IMAGE 7.1 in the separate Diagram Booklet. IMAGE 7.1 shows the generalised life cycle of the malaria parasite.

(i) State the role of the mosquito in the life cycle of PLASMODIUM.

_____

[1 mark]

continued on the next page . . .

Question 7 (a) continued

7. (a) (ii) Explain why multiplying within liver cells and red blood cells helps the parasite to evade the host's immune system.

[2 marks]

continued on the next page . . .

Question 7 (a) continued

7. (a) (iii) The sexual stage involving meiosis helps to increase GENETIC VARIATION within parasite populations.
Explain why this means that a person may develop symptoms of malaria following re – infection.

[3 marks]

continued on the next page . . .

Question 7 continued

7. (b) There is great interest in the development of a vaccine to prevent malarial infection. One of the most promising candidates for a vaccine uses whole, live sporozoites which have been exposed to ionising radiation. Irradiating the sporozoites prevents them from replicating but does not affect the antigens they produce. Refer to IMAGE 7.2 in the separate Diagram Booklet. IMAGE 7.2 shows a photomicrograph of PLASMODIUM sporozoites

(i) USE ONLY THE SCALE BAR to calculate the magnification of IMAGE 7.2

Magnification = × _____

[2 marks]

continued on the next page . . .

Question 7 (b) continued

7. (b) (ii) Use the information given about the life cycle of malaria and your own knowledge of the specific immune response to suggest why sporozoites are the life cycle stage chosen for the vaccine.

[2 marks]

(iii) Explain why live irradiated sporozoites are used.

[1 mark]

continued on the next page . . .

Question 7 (b) continued

7. (b) (iv) PLASMODIUM sporozoites can be cultured in human cells in the laboratory under very specific conditions:

- **37 °C**
- **low oxygen concentrations.**

Use information from IMAGE 7.1 to suggest why PLASMODIUM sporozoites can only be cultured under these conditions.

[3 marks]

7. (b) (v) Explain how vaccination can give long–term protection against disease.

[2 marks]

continued on the next page . . .

Question 7 continued

7. (c) Refer to IMAGE 7.3 in the separate Diagram Booklet. An antigen test for malaria caused by P. FALCIPARUM is shown in IMAGE 7.3
This type of test uses labelled antibodies specific to antigens found on the infecting parasite. These antigens will be present in a blood sample from an infected person.

(i) Explain what the test shown in IMAGE 7.3 would look like if the blood sample was from someone infected with P. VIVAX.

[3 marks]

7. (c) (ii) Explain why penicillin would not be effective against malaria.

[1 mark]

(Total for Question 7 = 20 marks)

OPTION B: HUMAN MUSCULOSKELETAL ANATOMY

8. Refer to IMAGE 8.1 in the separate Diagram Booklet. IMAGE 8.1 shows a photomicrograph of a section taken from the trachea.

(a) (i) Identify the cells present in the hyaline cartilage shown in IMAGE 8.1 and explain how nutrients and oxygen are supplied to these cells.

[2 marks]

continued on the next page . . .

Question 8 (a) continued

8. (a) (ii) Describe the role of hyaline cartilage in the trachea.

_____

_____

_____

[1 mark]

(b) Refer to IMAGE 8.2 in the separate Diagram Booklet. IMAGE 8.2 shows a longitudinal section through the head of a femur.

(i) Identify the type of bone labelled A on IMAGE 8.2

_____

_____

[1 mark]

continued on the next page . . .

Question 8 (b) continued

8. (b) (ii) The tissue at **B** is known as cancellous spongy bone. It has many spaces known as trabeculae. This tissue is not as strong as the bone tissue at **A**. Cancellous bone comprises around **20%** of the volume of long bones such as the femur.

Suggest the benefit of this type of bone tissue in the human skeleton.
Explain your answer.

[2 marks]

continued on the next page . . .

Question 8 (b) continued

Refer to IMAGE 8.3 in the separate Diagram Booklet. IMAGE 8.3 shows a highly magnified section of tissue A.

8. (b) (iii) Use line C to calculate the width of the Haversian canal from IMAGE 8.3 STATE YOUR ANSWER IN µm.

Width = _____ µm

[2 marks]

(iv) Describe the role of the Haversian canal in bone.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 8 continued

8. (c) Refer to IMAGES 8.4A and 8.4B in the separate Diagram Booklet. IMAGES 8.4A and 8.4B show two X–ray images of the knee joint.

(i) State the type of synovial joint shown in IMAGE 8.4B.

_____

_____

[1 mark]

(ii) I. IMAGE 8.4A shows the knee joint of a patient who was otherwise generally healthy.
Suggest how IMAGE 8.4A shows arthritis.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 8 (c) (ii) continued

8. (c) (ii) II. The patient was 27 years old. Their weight was within normal range but they had low levels of physical activity. The patient's knee was swollen and warm to the touch. The patient was in a great deal of pain and had difficulty walking.

Use all the information provided to suggest why a diagnosis of rheumatoid arthritis was made rather than osteoarthritis.

[2 marks]

continued on the next page . . .

Question 8 continued

8. (d) Refer to GRAPH 8.5 in the separate Diagram Booklet. The energy for muscle contraction may be obtained from one of three different energy systems as shown on GRAPH 8.5

(i) With reference to GRAPH 8.5, suggest which of the three systems would provide the greatest percentage energy contribution in athletes performing each of the following activities. Explain your answers.

I. a 100–metre sprint;

[2 marks]

continued on the next page . . .

Question 8 (d) (i) continued

8. (d) (i) II. a 5 – kilometre race.

[2 marks]

Refer to GRAPH 8.6 in the separate Diagram Booklet.
Glycogen is the main carbohydrate storage compound in muscle cells.
GRAPH 8.6 shows the results of an experiment where two athletes were given standard daily training bouts and their muscle glycogen levels were then measured regularly over 72 hours.
One athlete was given a carbohydrate loading diet while the other was given a normal diet with no carbohydrate loading.

continued on the next page . . .

Question 8 (d) continued

8. (d) (ii) Explain why the intensity and duration of training bouts were controlled in this experiment.

[1 mark]

continued on the next page . . .

Question 8 (d) continued

8. (d) (iii) With reference to GRAPH 8.6 explain how carbohydrate loading might improve an athlete's performance.

[2 marks]

(Total for Question 8 = 20 marks)

OPTION C: NEUROBIOLOGY AND BEHAVIOUR

9. Refer to IMAGE 9.1 in the separate Diagram Booklet. IMAGE 9.1 shows two computerised tomography (CT) scans of the same brain.

(a) (i) Account for the different appearance of the brain in the two scans.

_____

_____

_____

[1 mark]

(ii) Identify structure X on IMAGE 9.1

_____

_____

[1 mark]

continued on the next page . . .

Question 9 (a) continued

9. (a) (iii) Structure X is part of the autonomic nervous system.

Describe the function of the autonomic nervous system.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 9 (a) continued

Refer to IMAGE 9.2 in the separate Diagram Booklet. IMAGE 9.2 shows an electron micrograph of a single neurone from a human brain showing many connections to other neurones.

9. (a) (iv) Calculate the actual diameter of the cell body of the neurone in IMAGE 9.2 along the line shown. STATE YOUR ANSWER IN µm.

Diameter = _____ µm

[2 marks]

continued on the next page . . .

Question 9 (a) continued

9. (a) (v) Following damage to the brain, there can be changes in neural pathways by establishing new connections between neurones.
State the term used to describe these changes.

_____

_____

[1 mark]

(b) An investigation was carried out into the relationship between the number of neurones in the cerebral cortex compared to the rest of the brain in different mammals. Researchers examined the brains of six species of primate (including apes and monkeys), six species of rodent (including rats and mice) and five species of insectivore (including shrews, moles and hedgehogs).

continued on the next page . . .

Question 9 continued

Refer to GRAPH 9.3 in the separate Diagram Booklet. GRAPH 9.3 shows the relationship between the number of neurones in the cerebral cortex compared to the rest of the brain in the three different groups of mammals.

9. (b) (i) Describe the general trend for the mammals shown in GRAPH 9.3

[1 mark]

continued on the next page . . .

Question 9 (b) continued

9. (b) (ii) Primates generally exhibit complex social behaviours such as imitation and insight. They are capable of higher levels of cognitive functioning than the other groups of mammals in this study.

The researchers concluded that these behaviours are linked to the relative number of neurones in the cerebral cortex. Explain how the data supports their conclusion.

[3 marks]

continued on the next page . . .

Question 9 continued

9. (c) Refer to IMAGE 9.4 in the separate Diagram Booklet. Cortisol is produced by the adrenal glands in response to stress via the pathway shown in IMAGE 9.4

(i) Use IMAGE 9.4 and your knowledge of cortisol production to describe and explain the effect on this pathway of increasing cortisol concentrations in the blood.

[3 marks]

continued on the next page . . .

Question 9 (c) continued

9. (c) (ii) Suggest the benefit of the response described in IMAGE 9.4

[1 mark]

(iii) Some individuals have an unusually high concentration of corticotropin releasing hormone in their bloodstreams.
Suggest a possible life event that may have caused such raised levels and explain how these raised levels would affect the way such individuals respond to stressful situations.

[2 marks]

9. (d) Black grouse are ground nesting birds found on moorland. Incubation of the eggs and care of the young is carried out by the female. Several black grouse males perform elaborate displays before groups of females in a ritual known as a lek. The male birds compete for the attention of the female birds. Refer to IMAGE 9.5 in the separate Diagram Booklet. IMAGE 9.5 shows a female (left) and male (right) black grouse.

(i) Use evidence from IMAGE 9.5 to explain how this species shows sexual dimorphism.

[1 mark]

continued on the next page . . .

Question 9 (d) continued

9. (d) (ii) Use all the information provided to identify the TWO types of selection that have resulted in sexual dimorphism in black grouse. Explain each answer.

[3 marks]

(Total for Question 9 = 20 marks)

TOTAL FOR SECTION B = 20 MARKS

END OF PAPER

TOTAL FOR PAPER = 100 MARKS

Question Number	Additional pages, if required. Write the question number(s) in the left – hand margin.

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GCE A LEVEL

A400U30–1

WEDNESDAY, 19 JUNE 2024 – MORNING

BIOLOGY – A LEVEL COMPONENT 3
REQUIREMENTS FOR LIFE

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 and IMAGE 1.2

IMAGE 1.1

magnification × 60

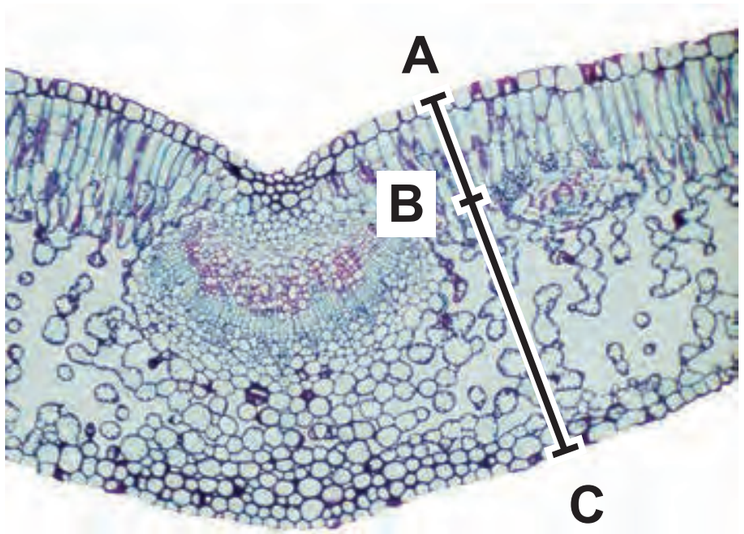


IMAGE 1.2

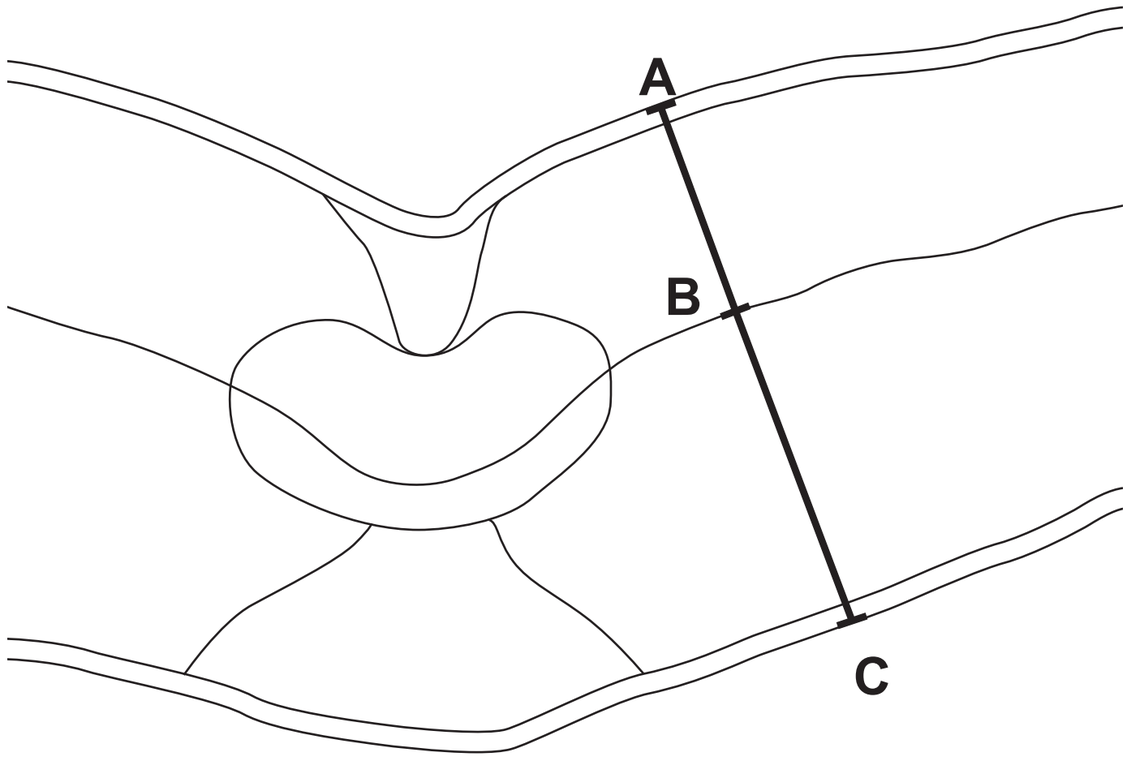


IMAGE 2.1

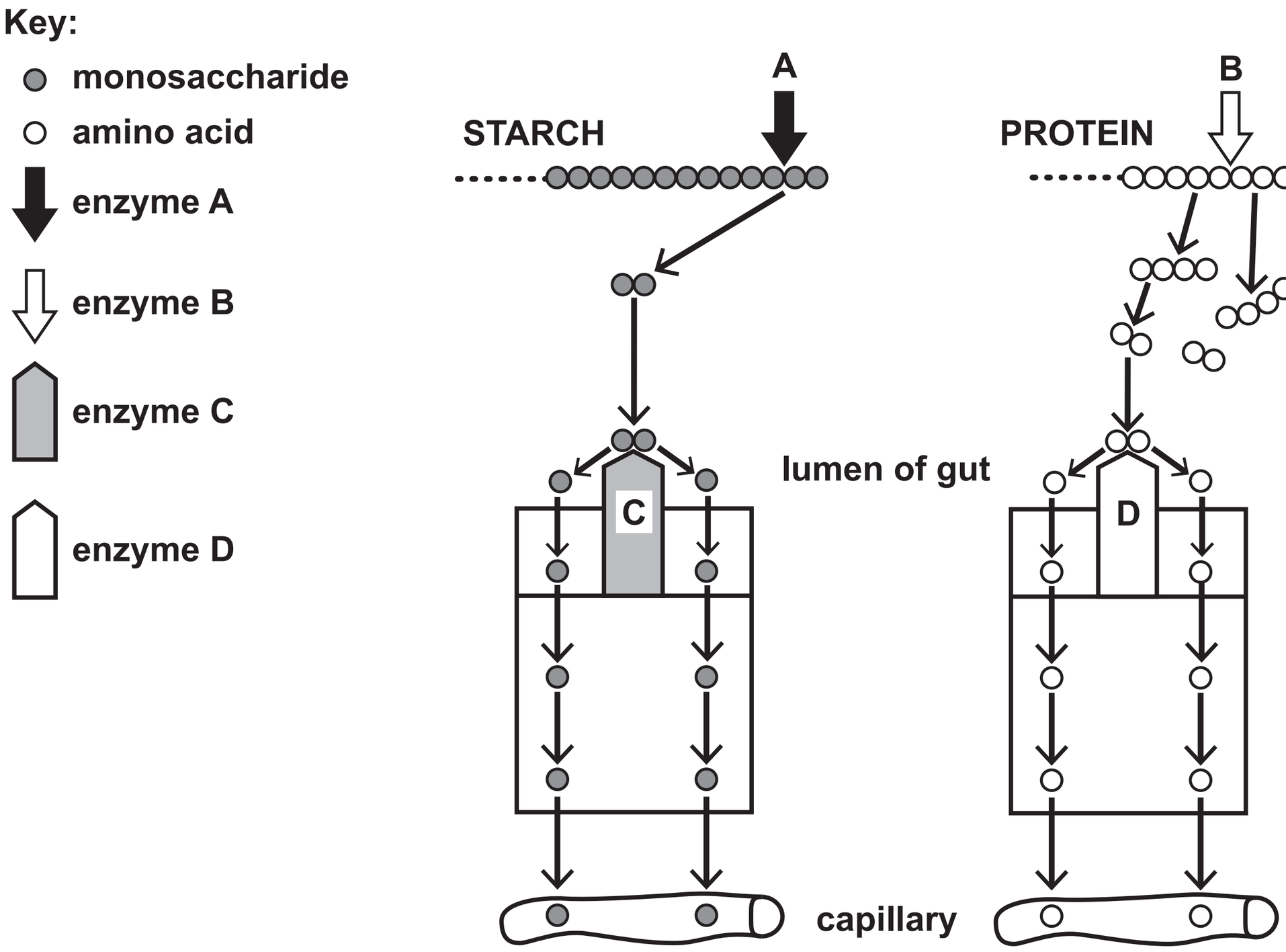

Key:
monosaccharide
amino acid
enzyme A
enzyme B
enzyme C
enzyme D
STARCH
A
PROTEIN
B
C
D
lumen of gut
capillary

TABLE 2.2

Label	Enzyme name	Product
A		
B		
C		

IMAGE 2.3

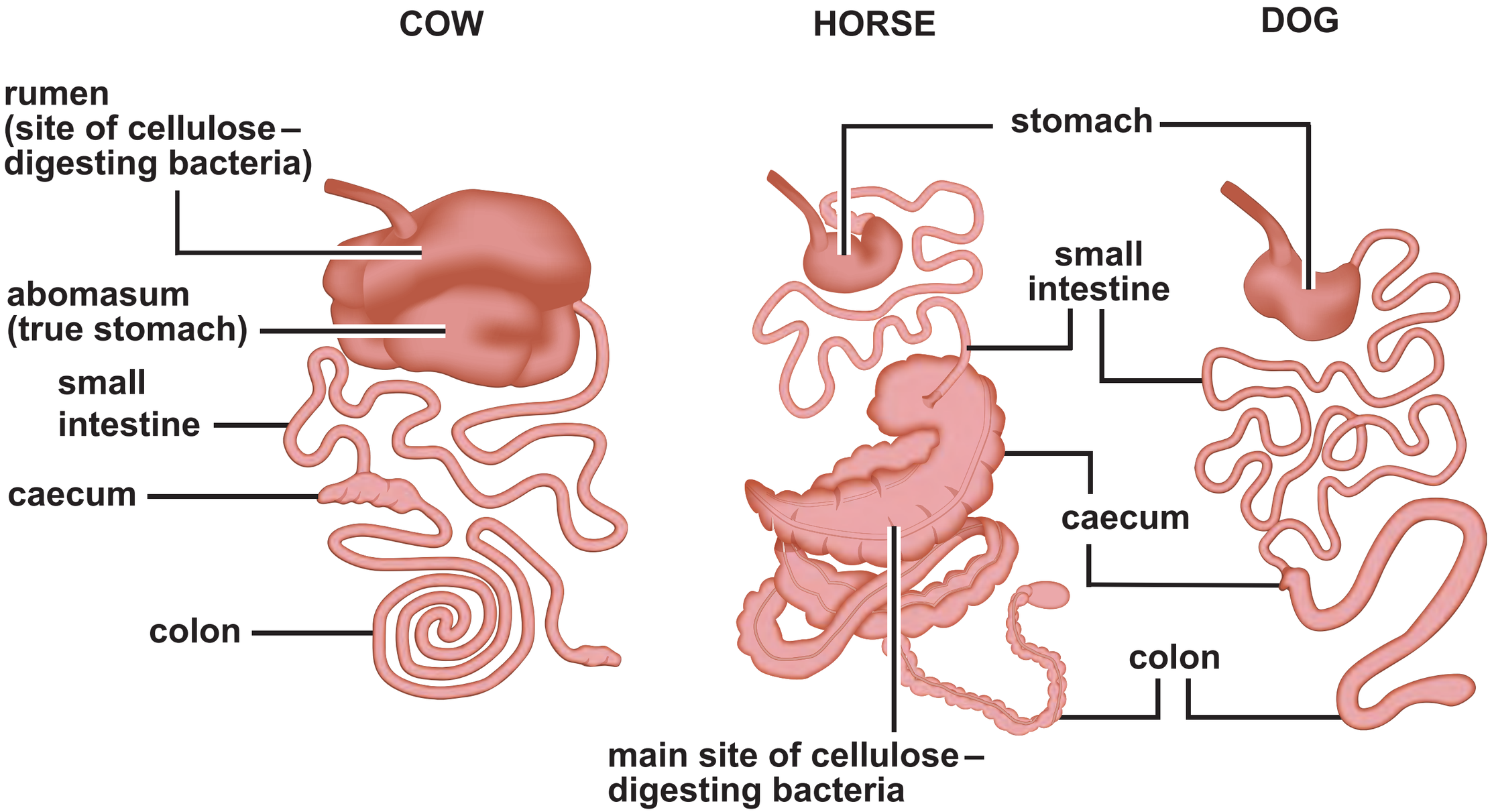
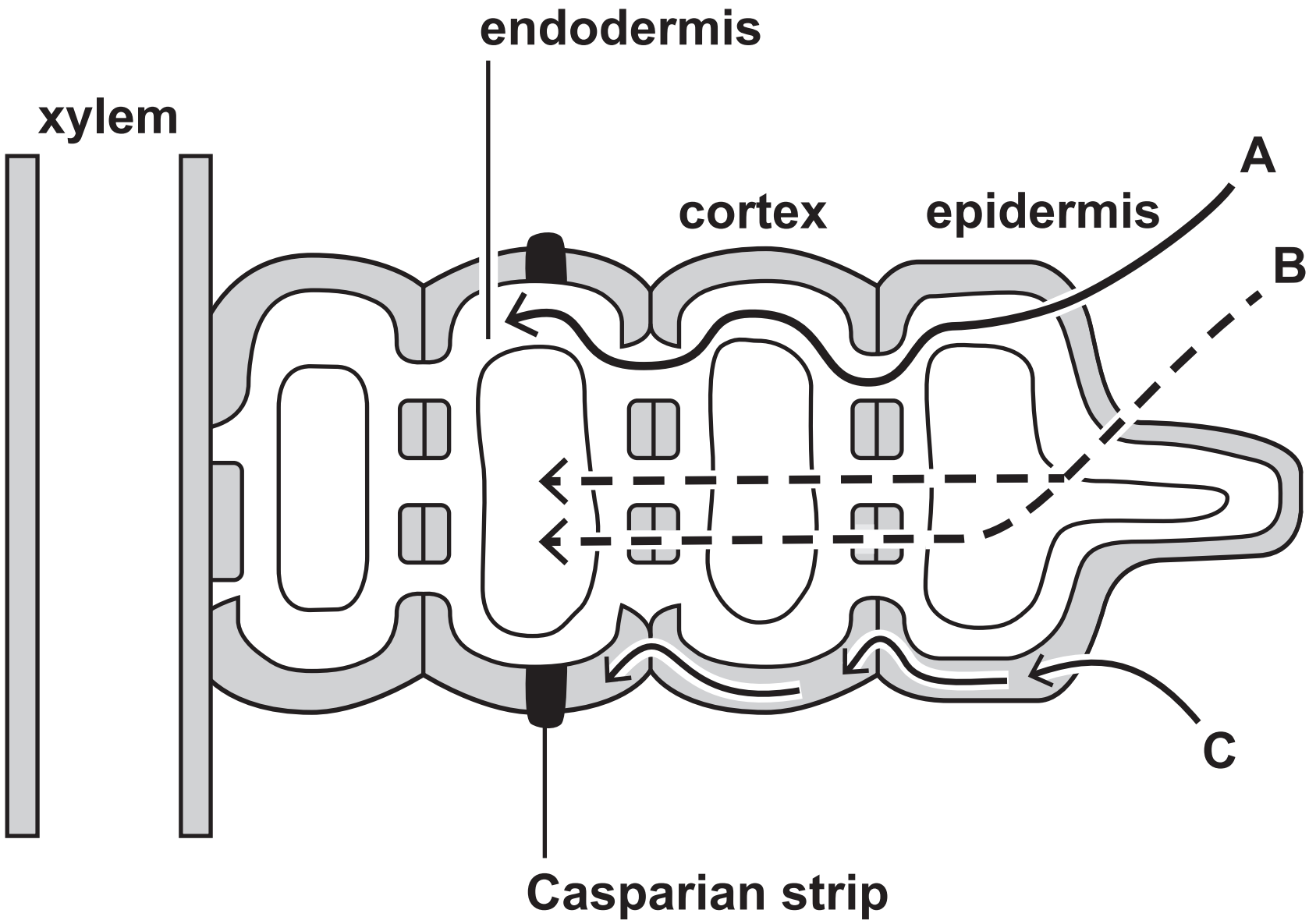

COW
HORSE
DOG
rumen
(site of cellulose–
digesting bacteria)
abomasum
(true stomach)
small
intestine
caecum
colon
stomach
small
intestine
caecum
colon
main site of cellulose–
digesting bacteria

TABLE 2.4

	Relative volume of entire gut (%)		
Part of gut	Cow	Horse	Dog
rumen	62•8	—	—
stomach	8	8•5	62•3
small intestine	18•5	30•2	23•3
caecum	2•8	15•9	1•3
colon	7•9	45•4	13•1

IMAGE 3.1



GRAPH 3.2

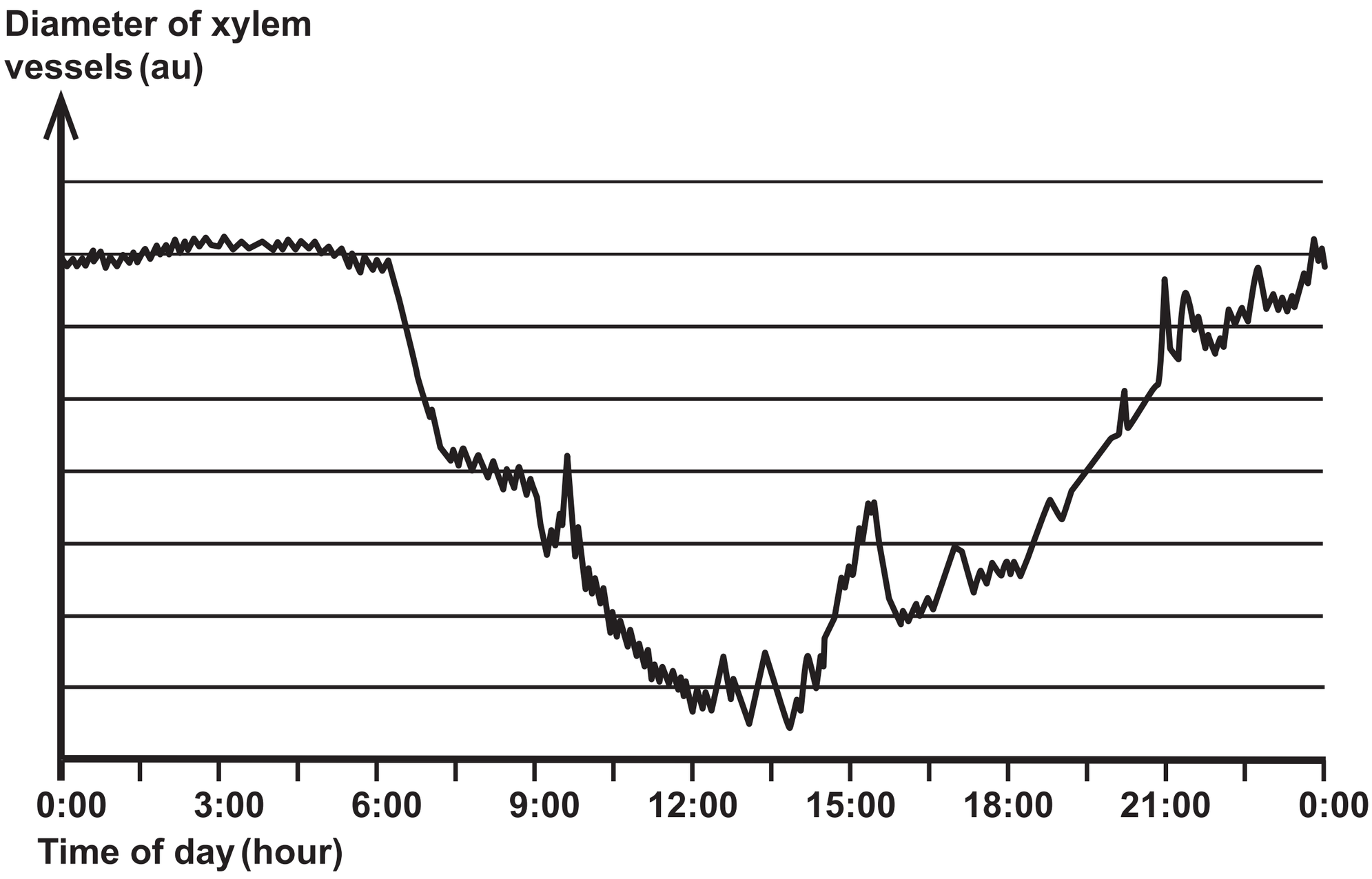

Diameter of xylem vessels (au)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time of day (hour)

IMAGE 3.3

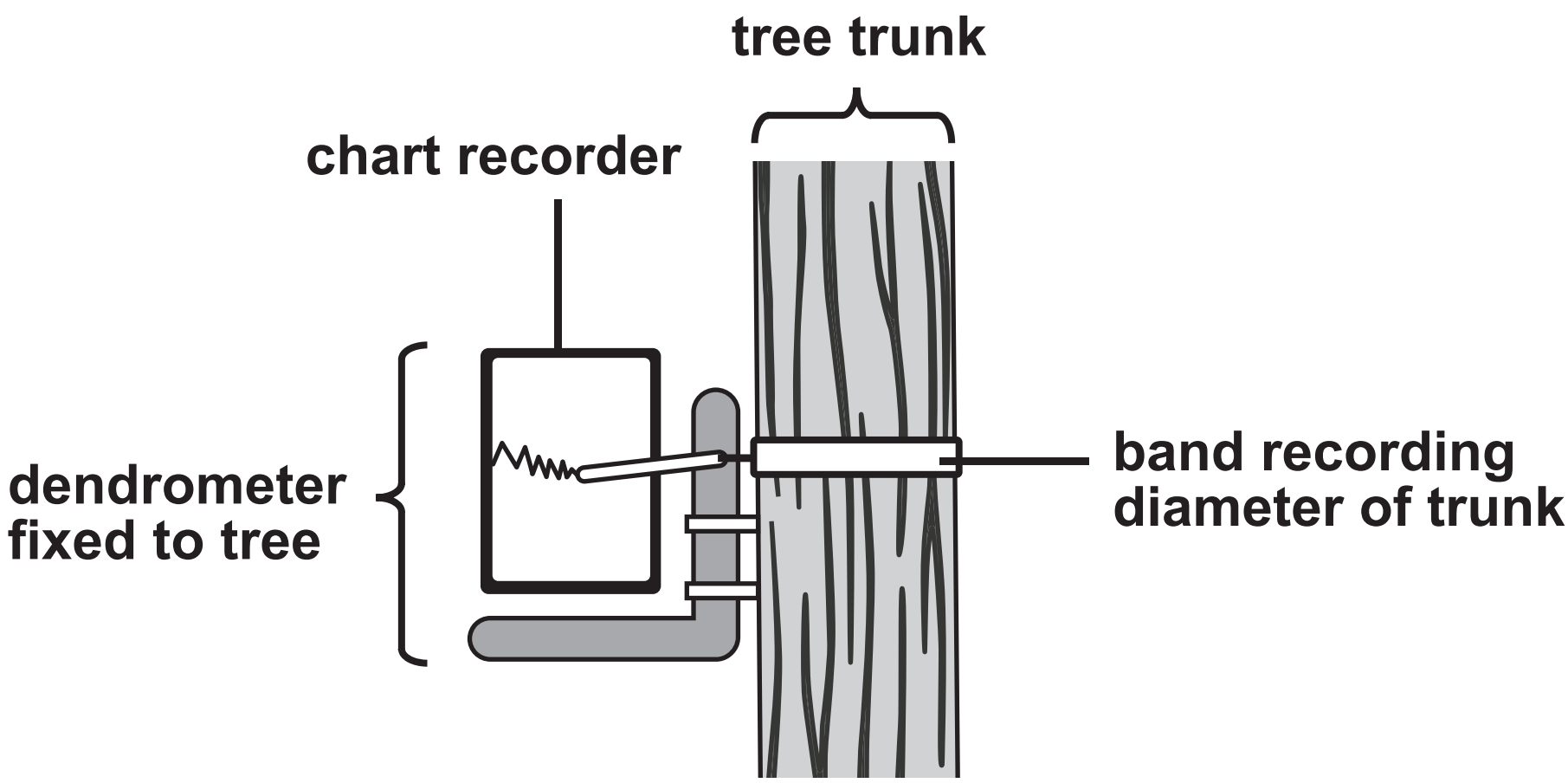

tree trunk
chart recorder
dendrometer
fixed to tree
band recording
diameter of trunk

TABLE 3.4

Volume of water lost by one maize plant in a growing season.	200 dm^3
Length of growing season	80 days
Density of maize plants	30 000 $acre^{-1}$

1 acre = 4047 m^2

GRAPH 3.5

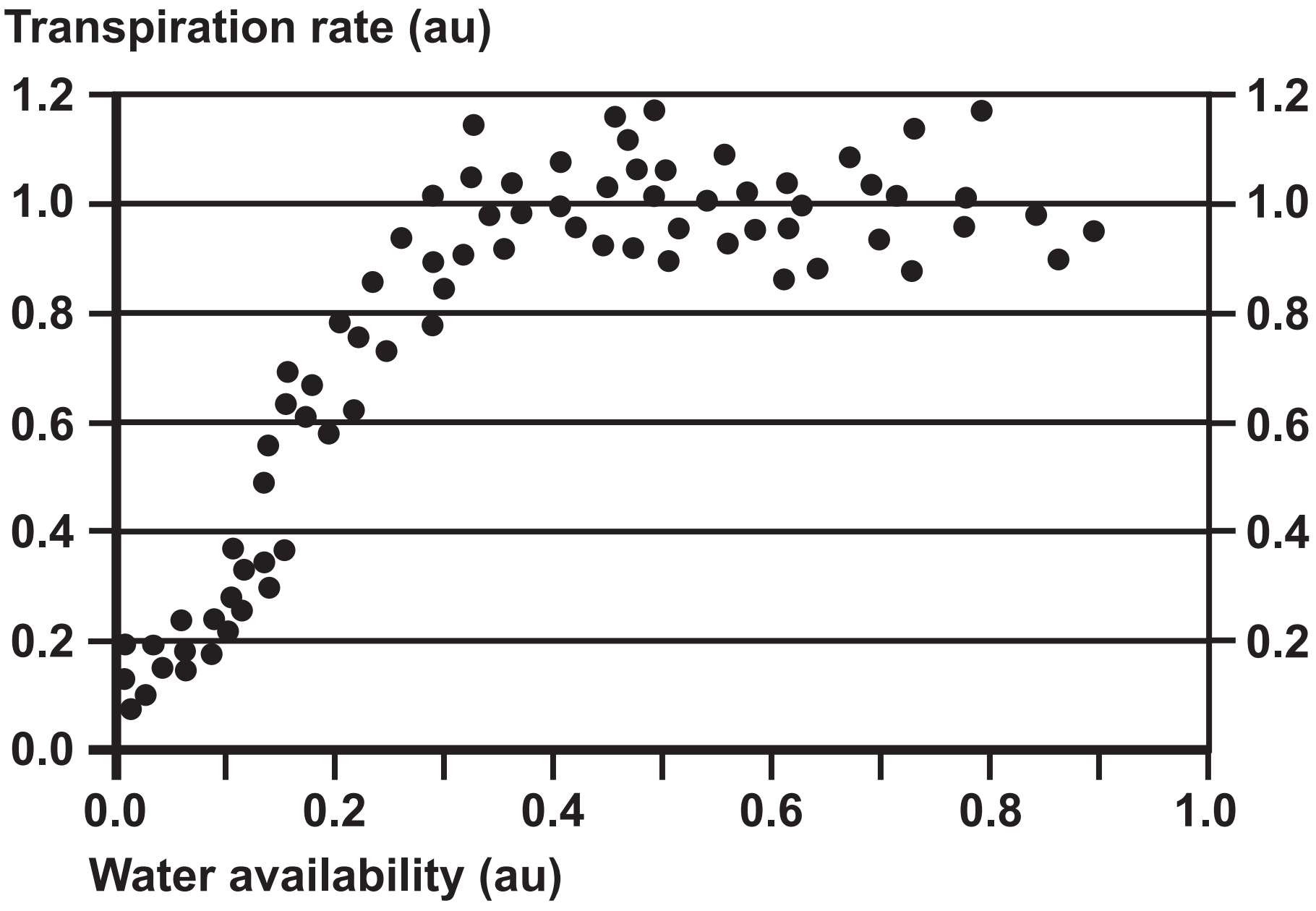

Transpiration rate (au)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Water availability (au)

IMAGE 4.1

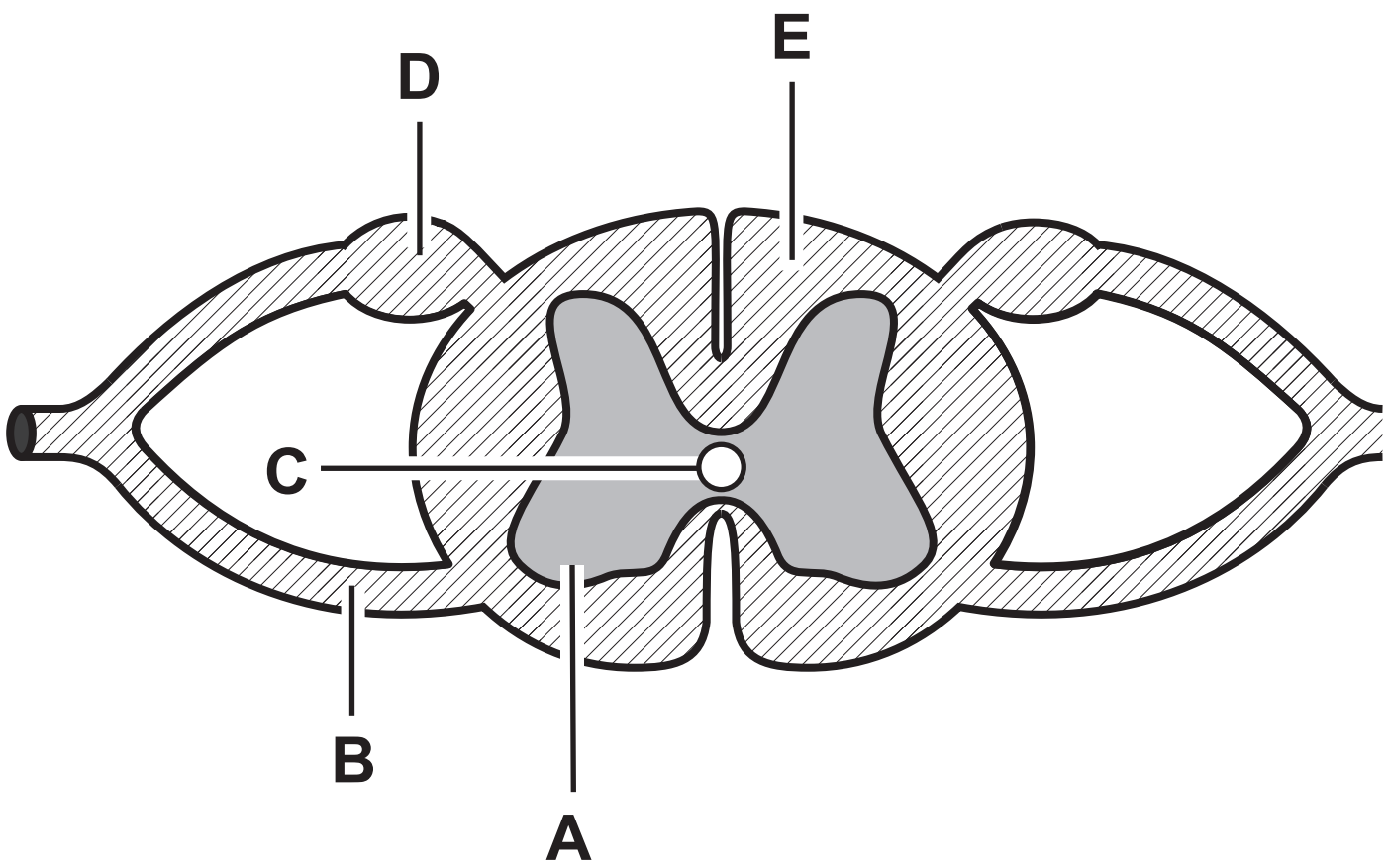
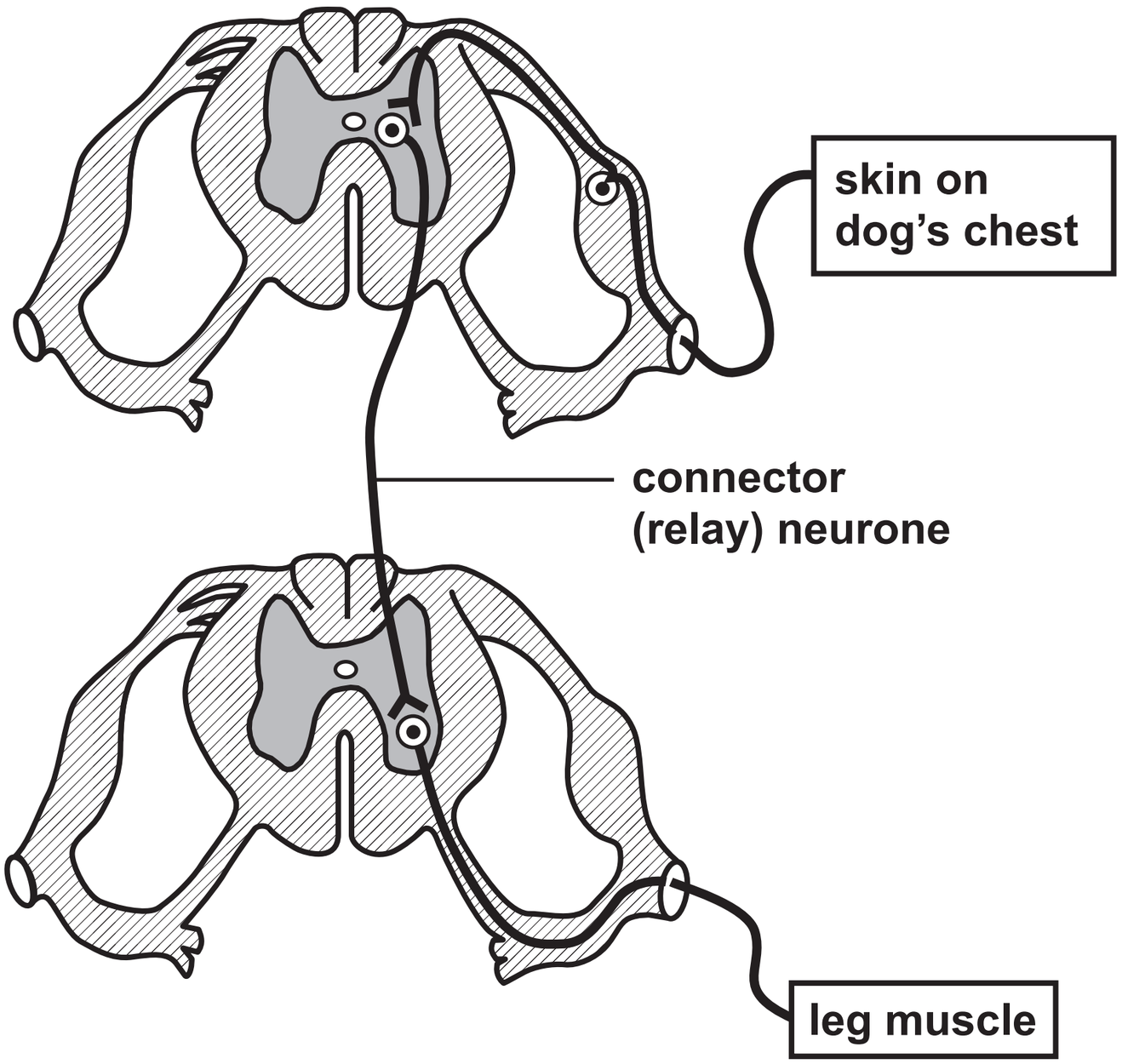


IMAGE 4.2 and IMAGE 4.3

IMAGE 4.2



IMAGE 4.3



GRAPH 5

RBF = renal blood flow per minute in cm^3
GFR = Volume of glomerular filtrate produced per minute in cm^3

The normal range of arterial blood pressue in a healthy human adult is between 80 mm Hg at rest to 180 mm Hg during exercise.

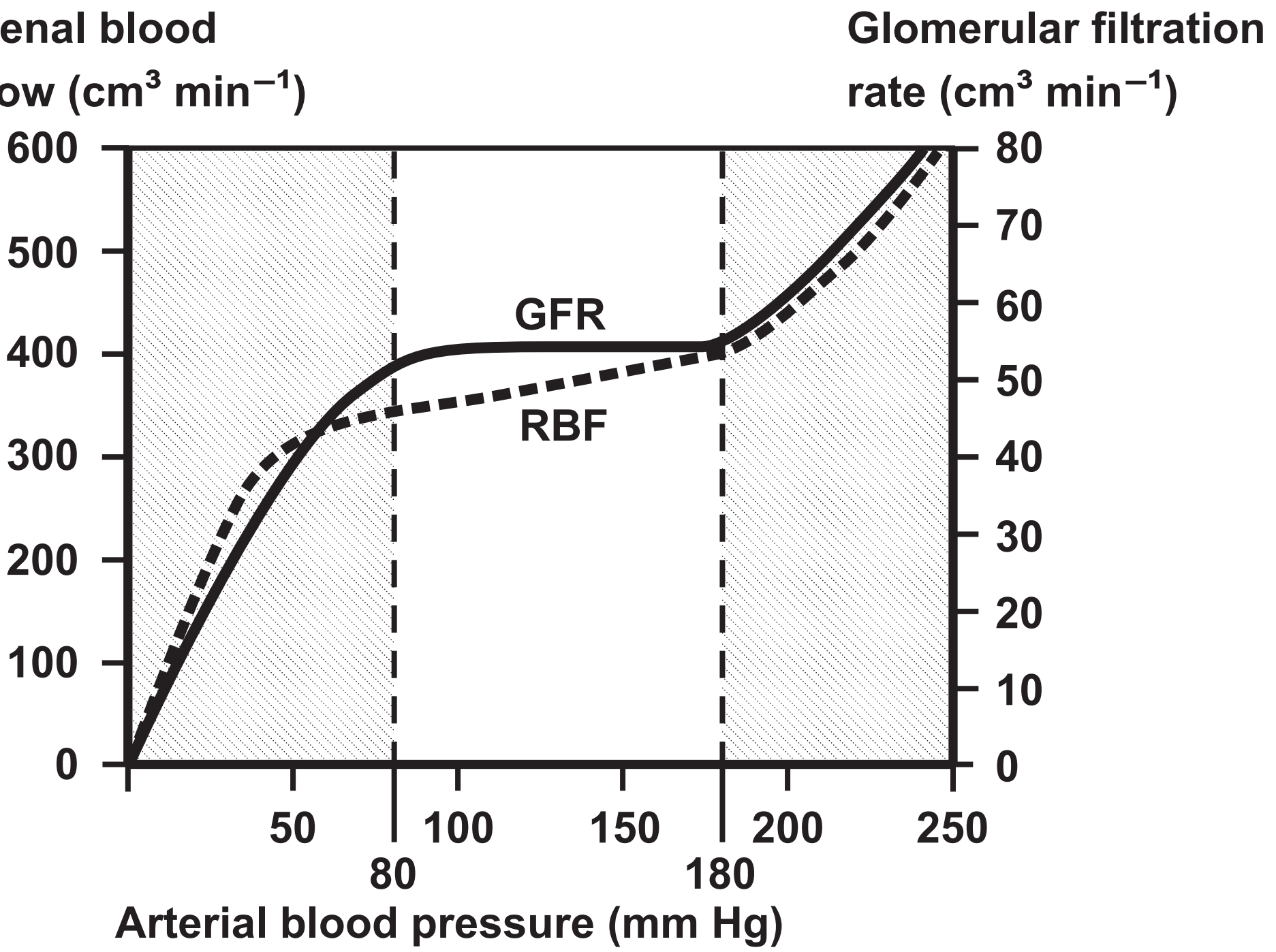


IMAGE 6.1

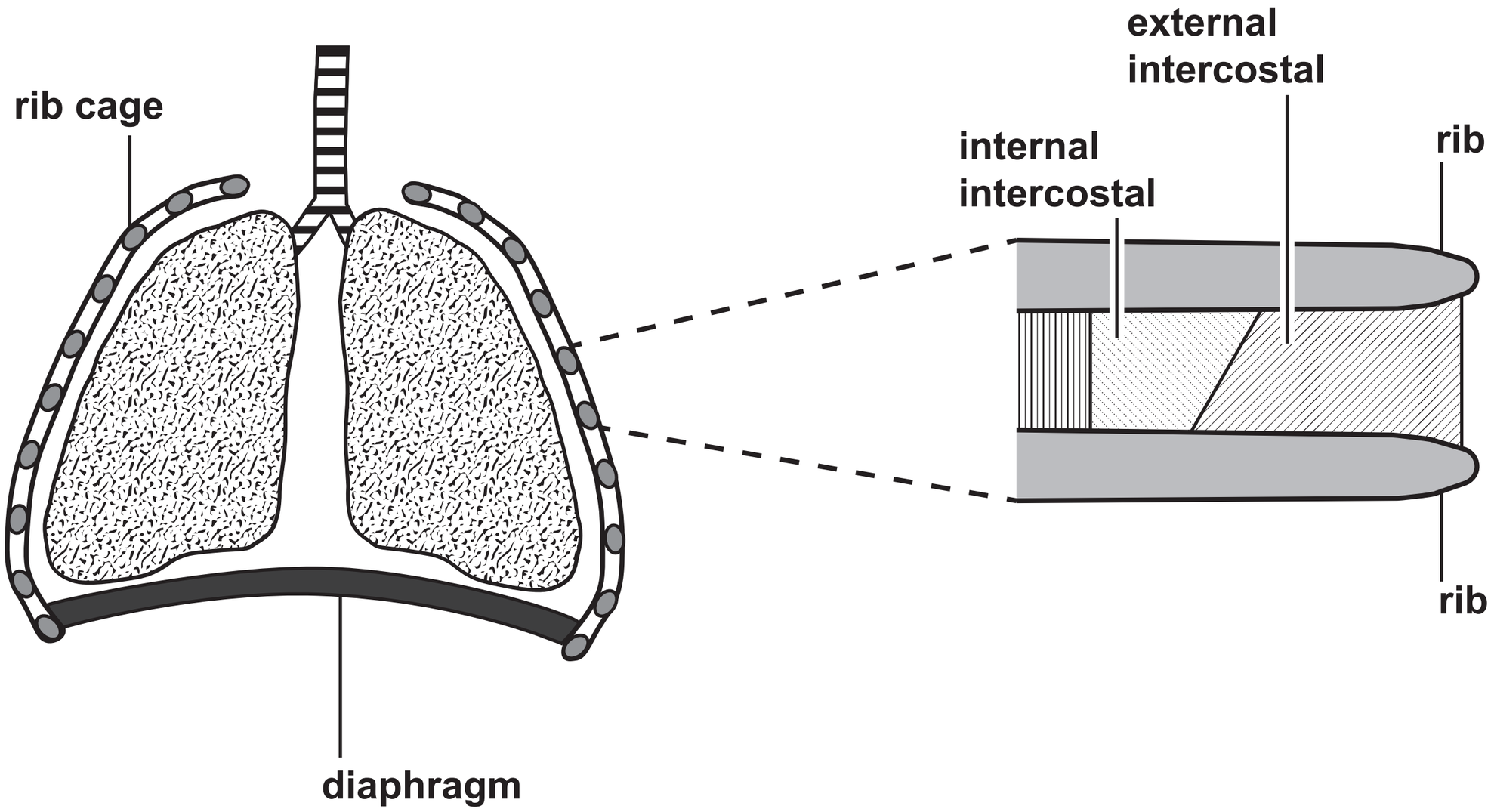

rib cage
diaphragm
external intercostal
internal intercostal
rib
rib

IMAGE 6.2

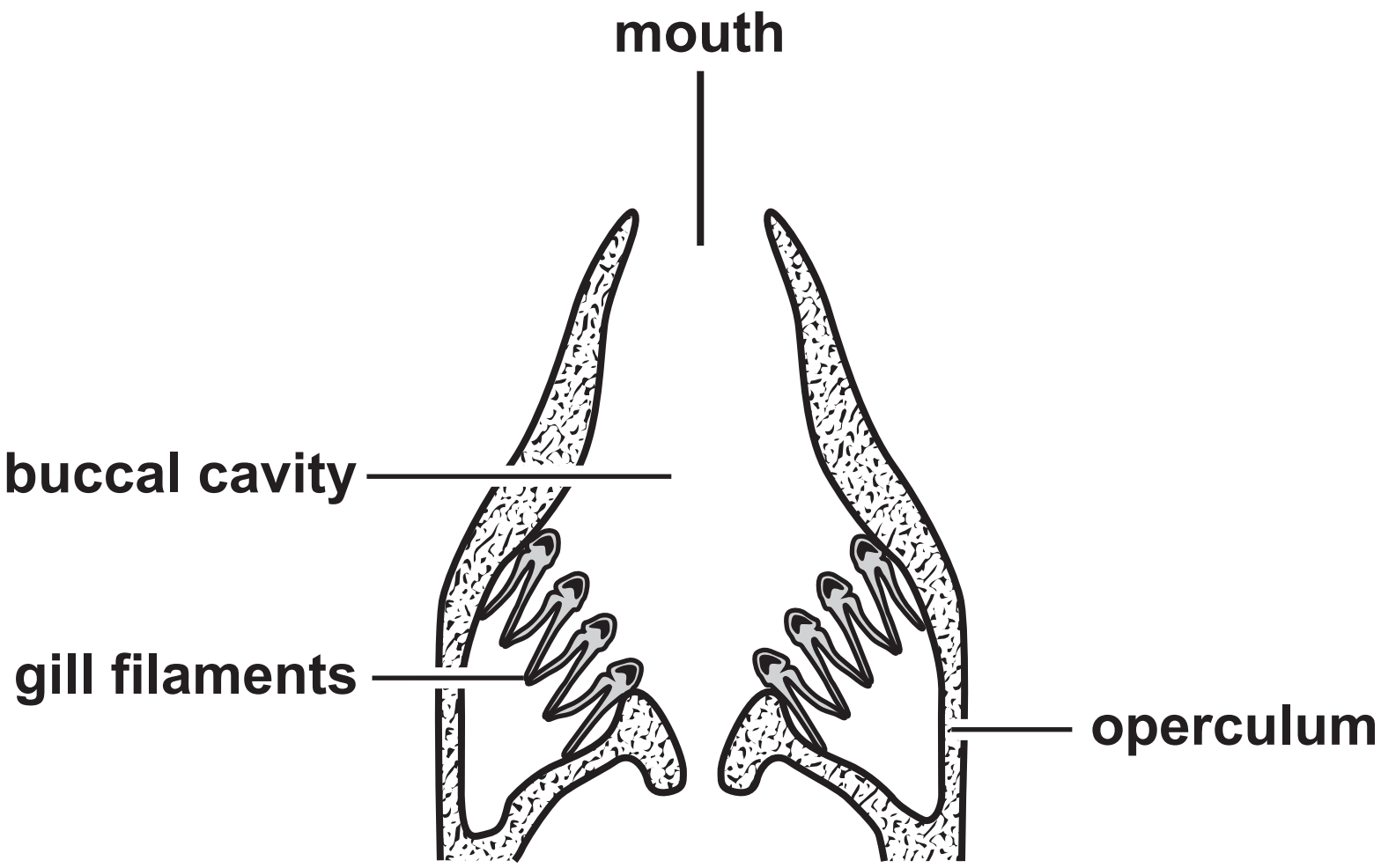


IMAGE 6.3

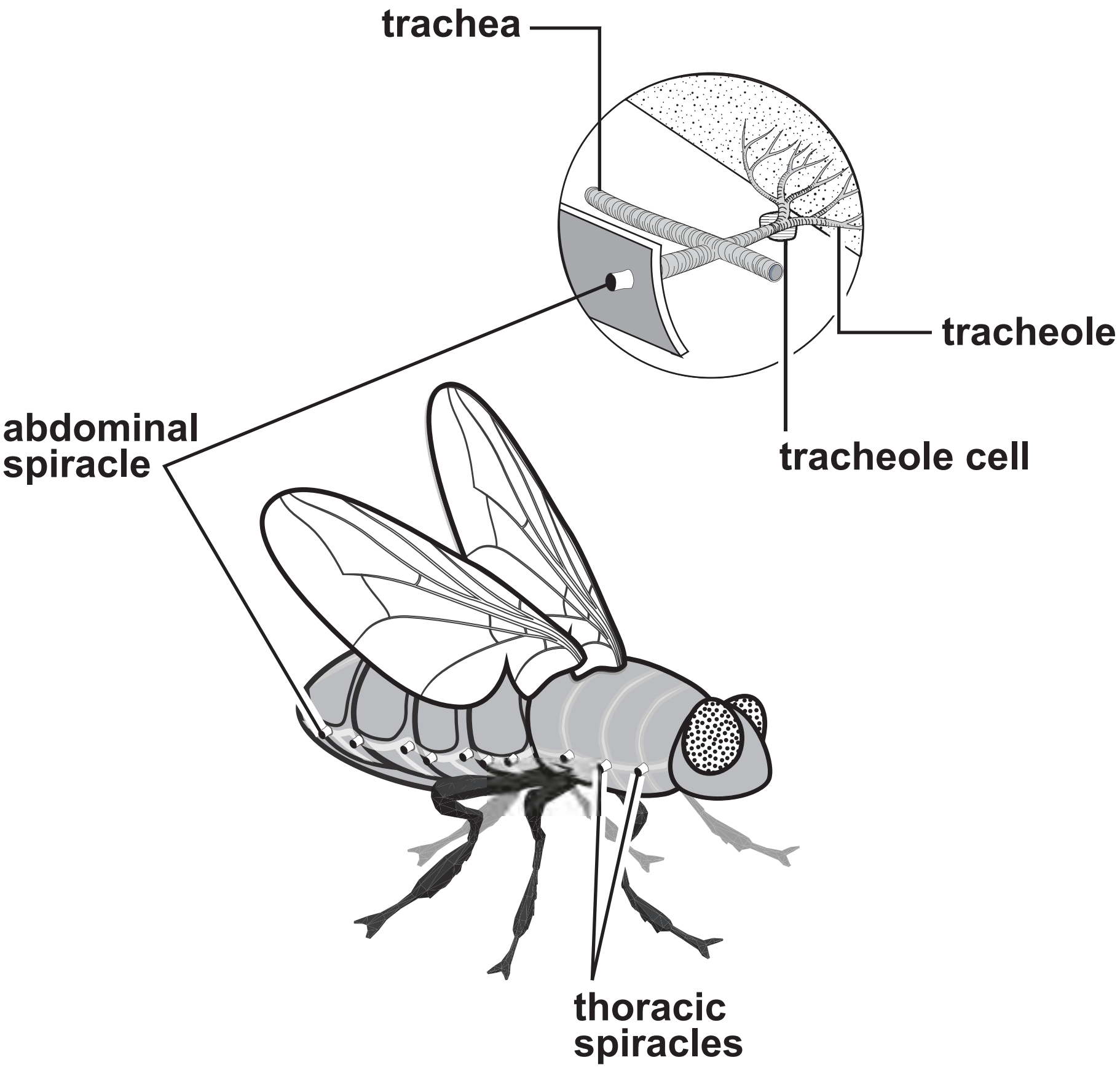

trachea
tracheole
abdominal spiracle
tracheole cell
thoracic spiracles

IMAGE 7.1

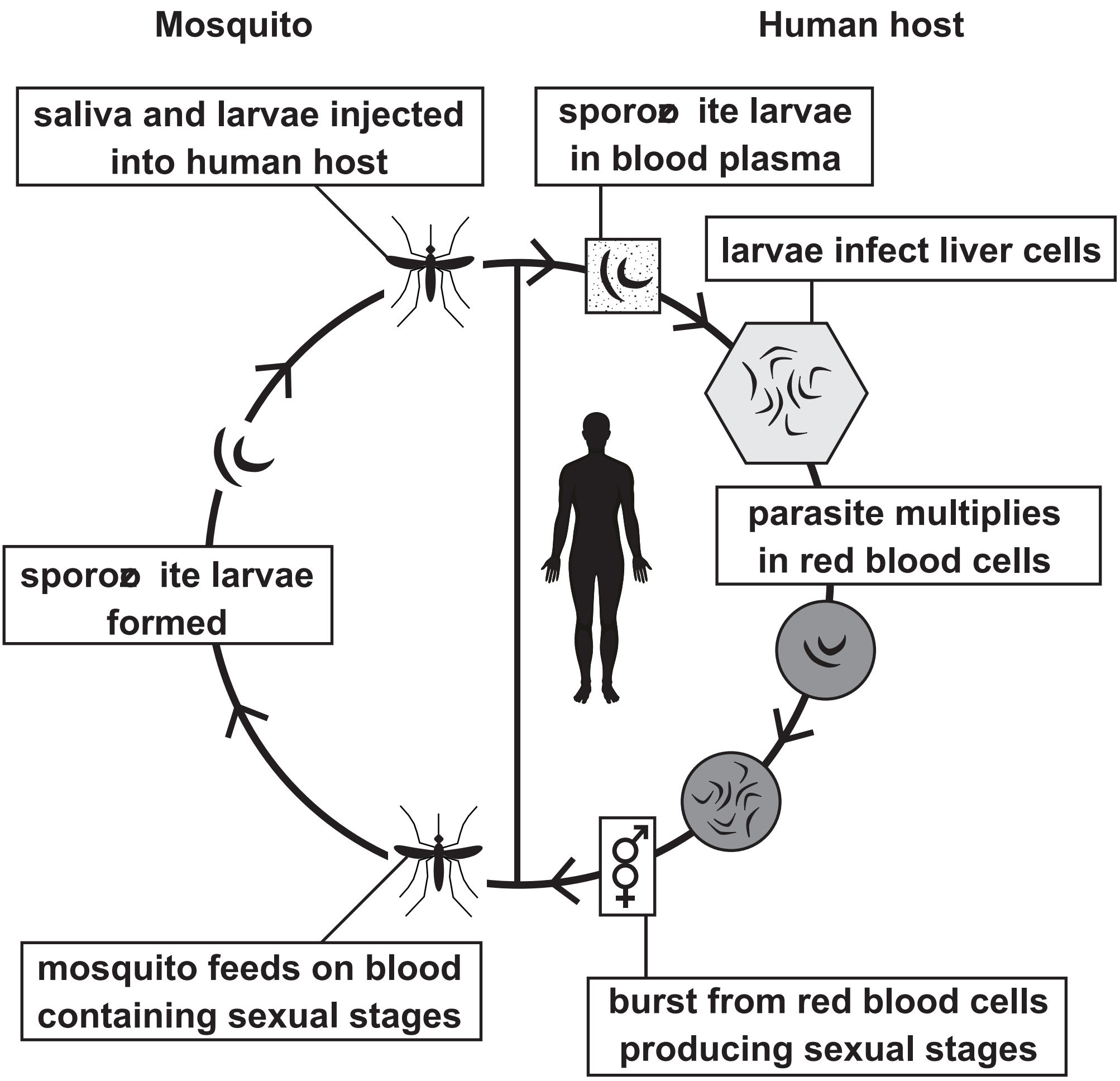

Mosquito
Human host
saliva and larvae injected into human host
sporozoite larvae in blood plasma
larvae infect liver cells
parasite multiplies in red blood cells
burst from red blood cells producing sexual stages
mosquito feeds on blood containing sexual stages
sporozoite larvae formed

IMAGE 7.2

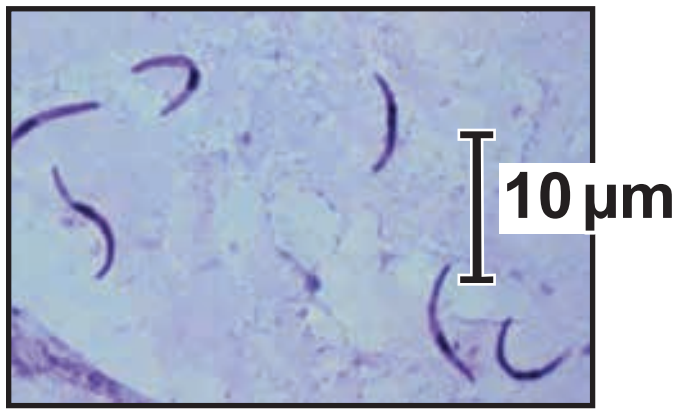


IMAGE 7.3

Key:
Ab = antibody
Ag = antigen

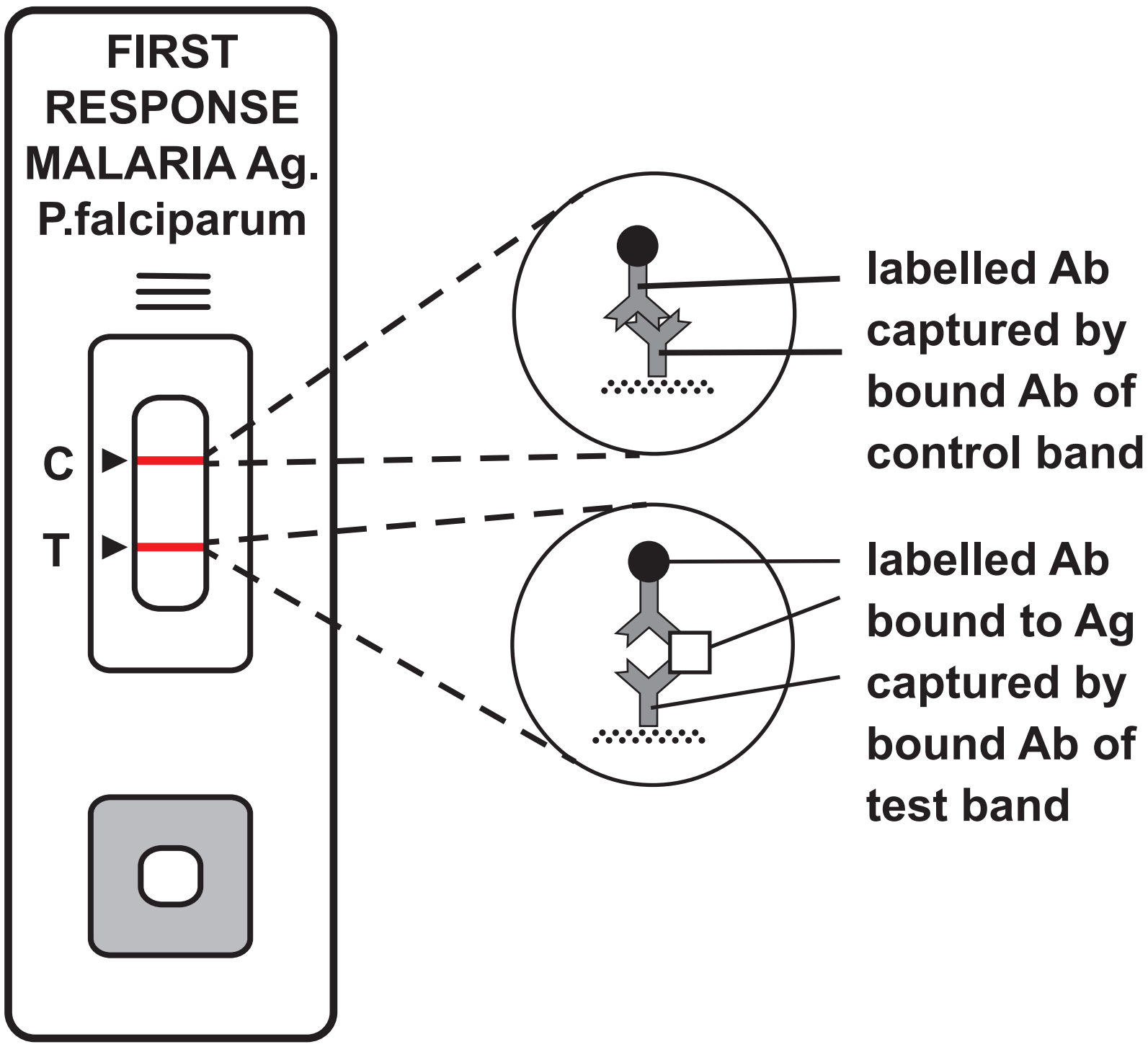


IMAGE 8.1

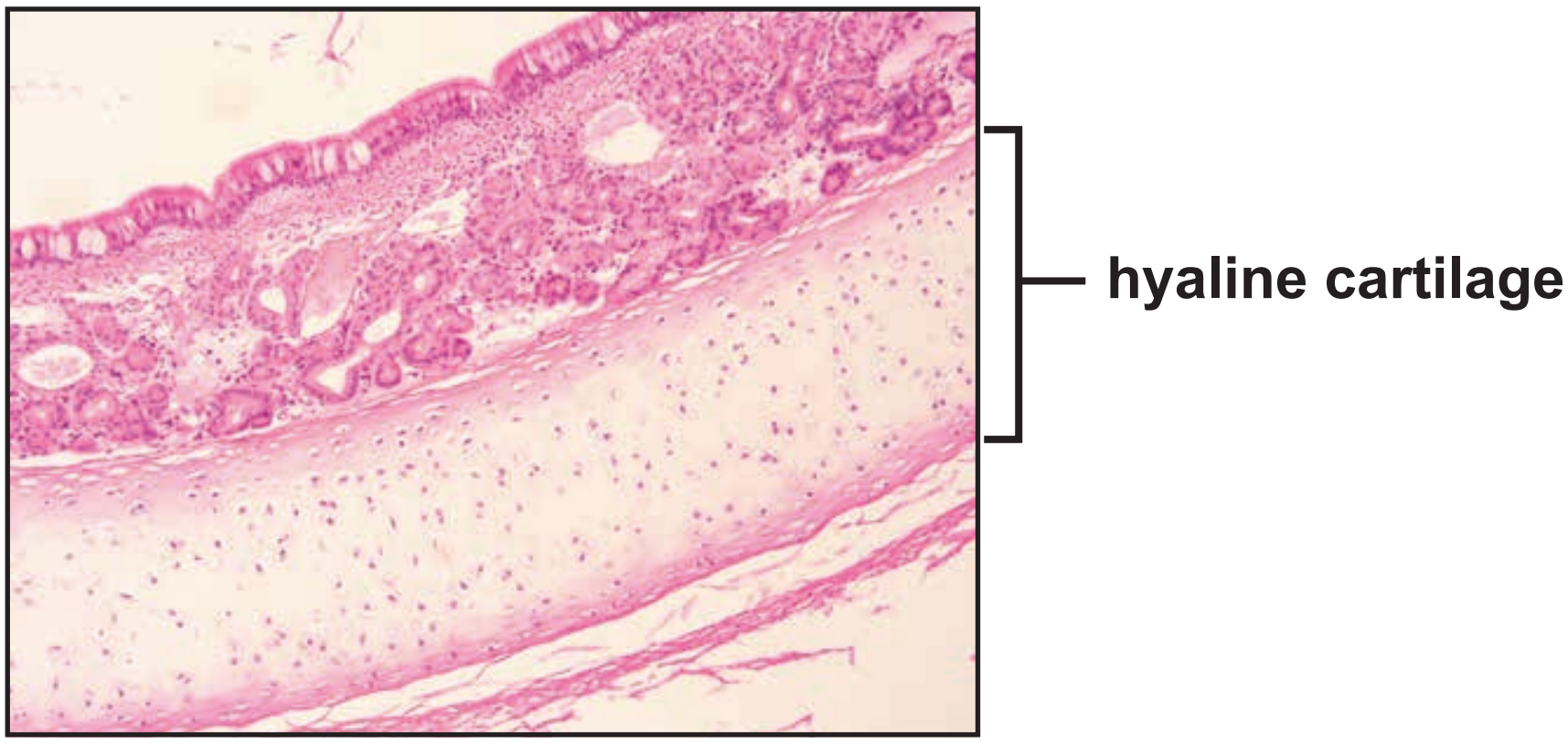


IMAGE 8.2

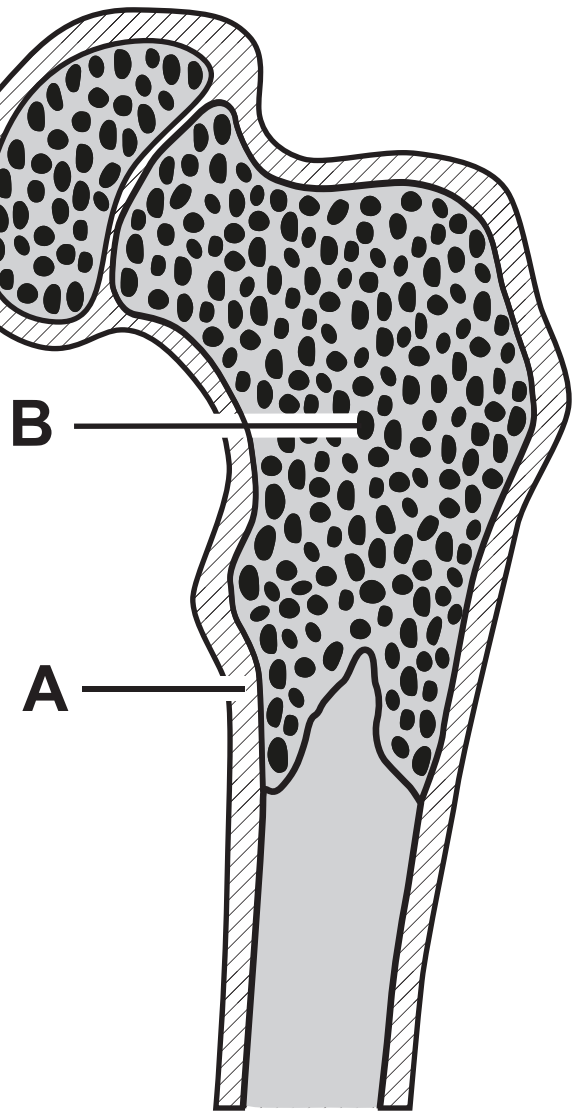


IMAGE 8.3

magnification × 200

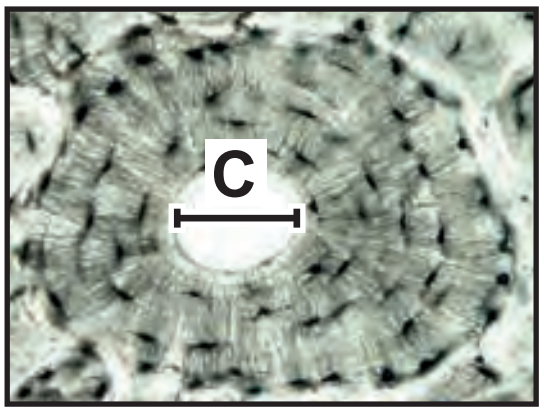


IMAGE 8.4

IMAGE 8.4A

Knee of patient

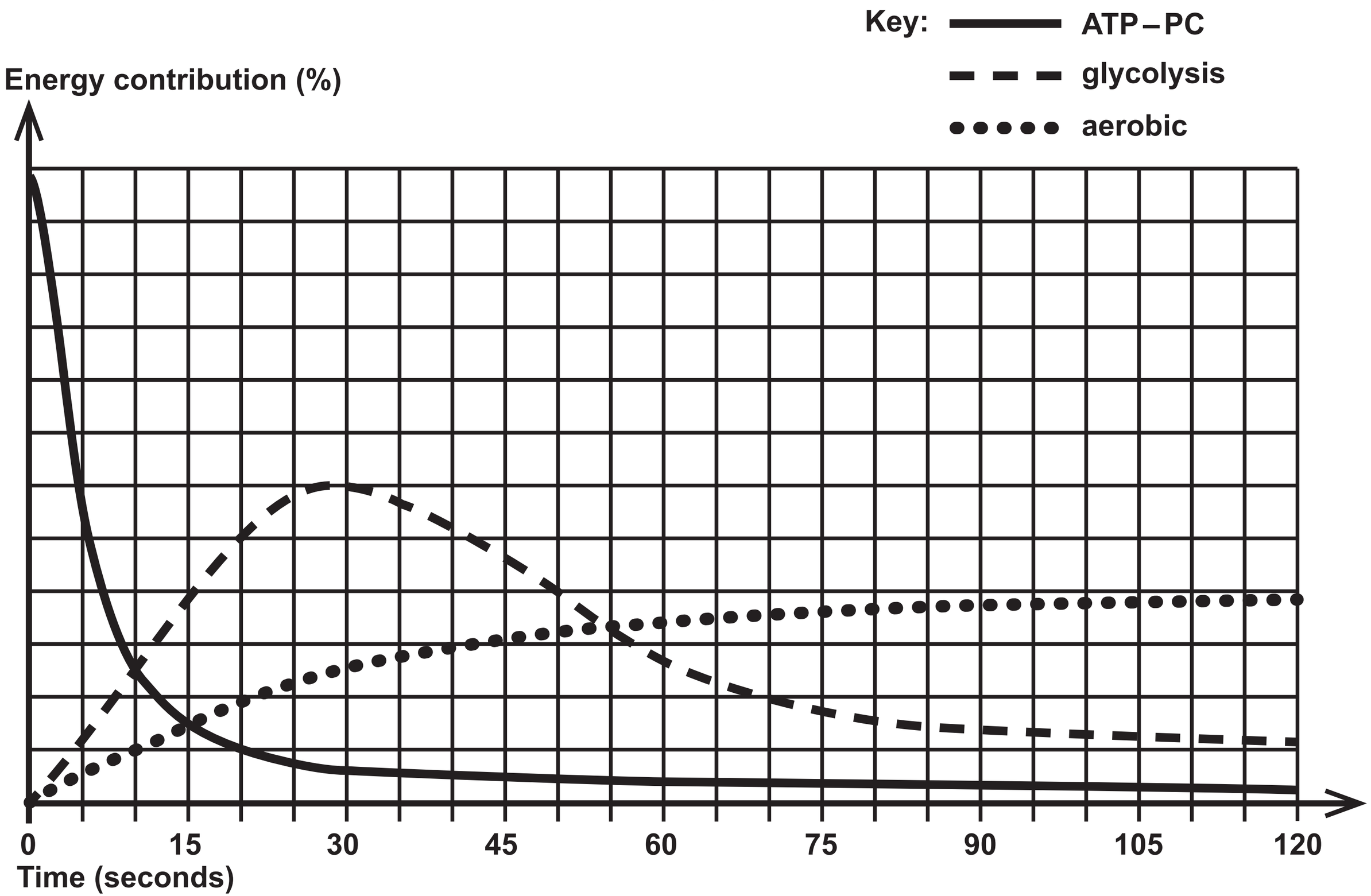


IMAGE 8.4B

Healthy knee



GRAPH 8.5


Key:
ATP – PC
glycolysis
aerobic
Energy contribution (%)
0
15
30
45
60
75
90
105
120
Time (seconds)

GRAPH 8.6

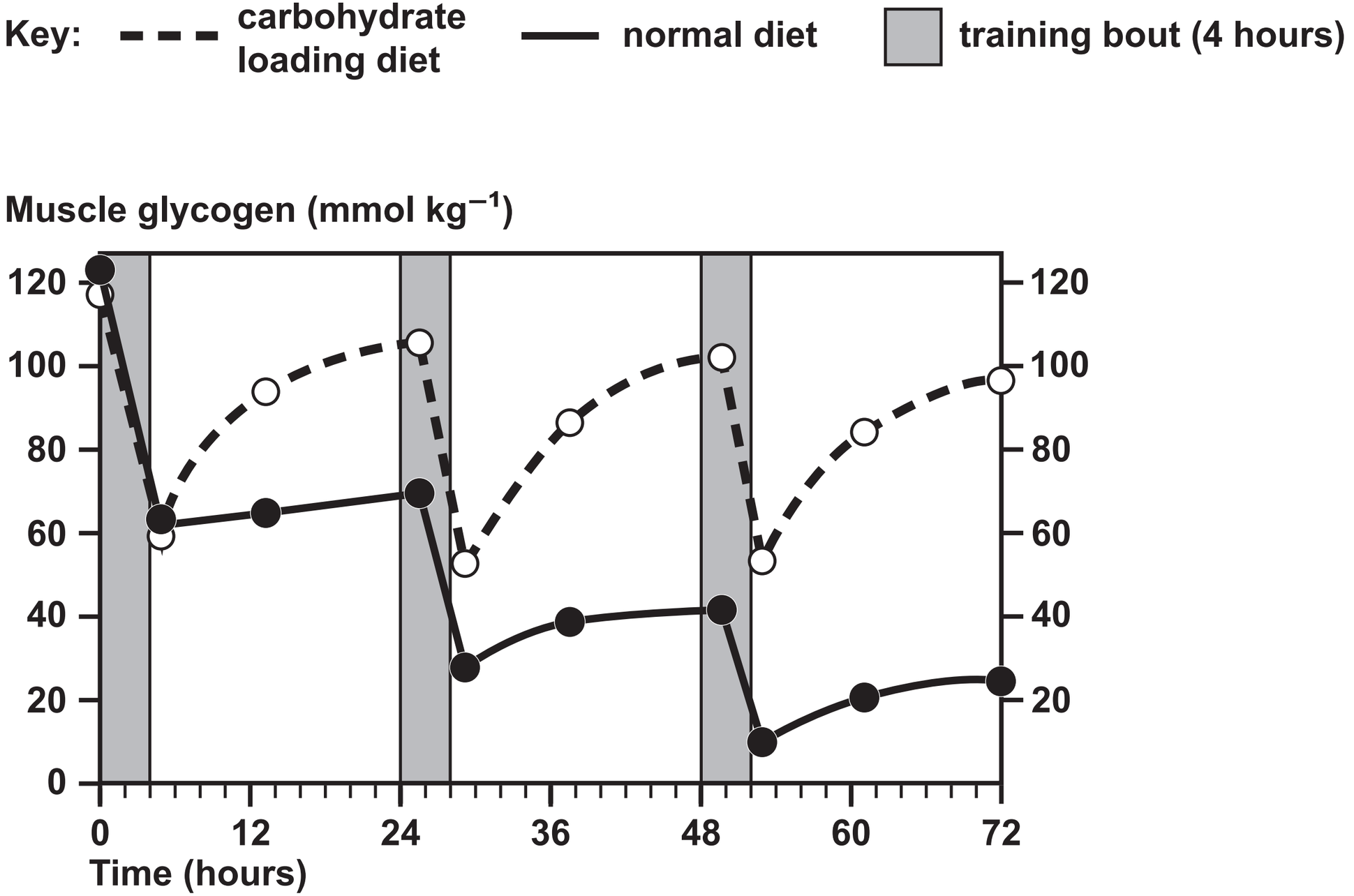

Key:
carbohydrate loading diet
normal diet
training bout (4 hours)
Muscle glycogen (mmol kg⁻¹)
120
100
80
60
40
20
0
0
12
24
36
48
60
72
Time (hours)

IMAGE 9.1

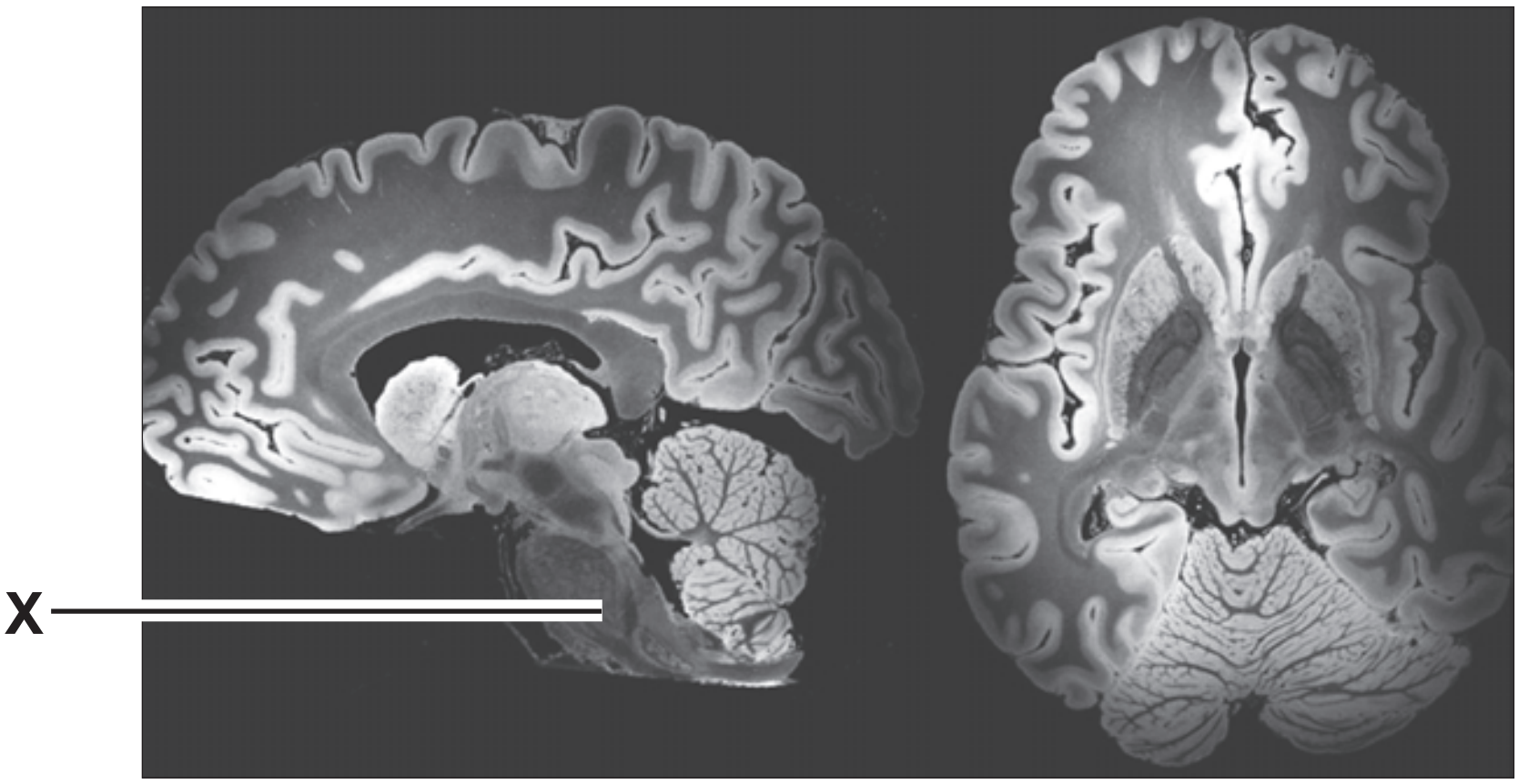
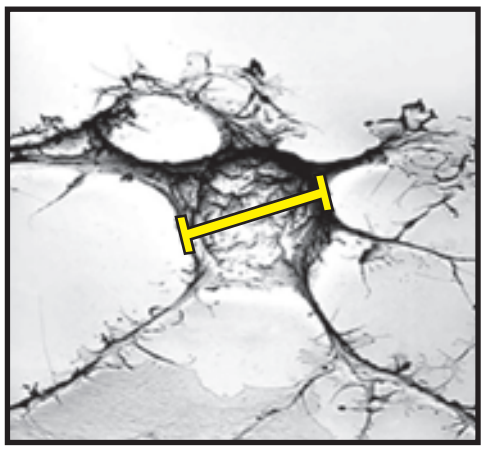


IMAGE 9.2

magnification ×1800



GRAPH 9.3

Key: ● rodents △ primates ✖ insectivores

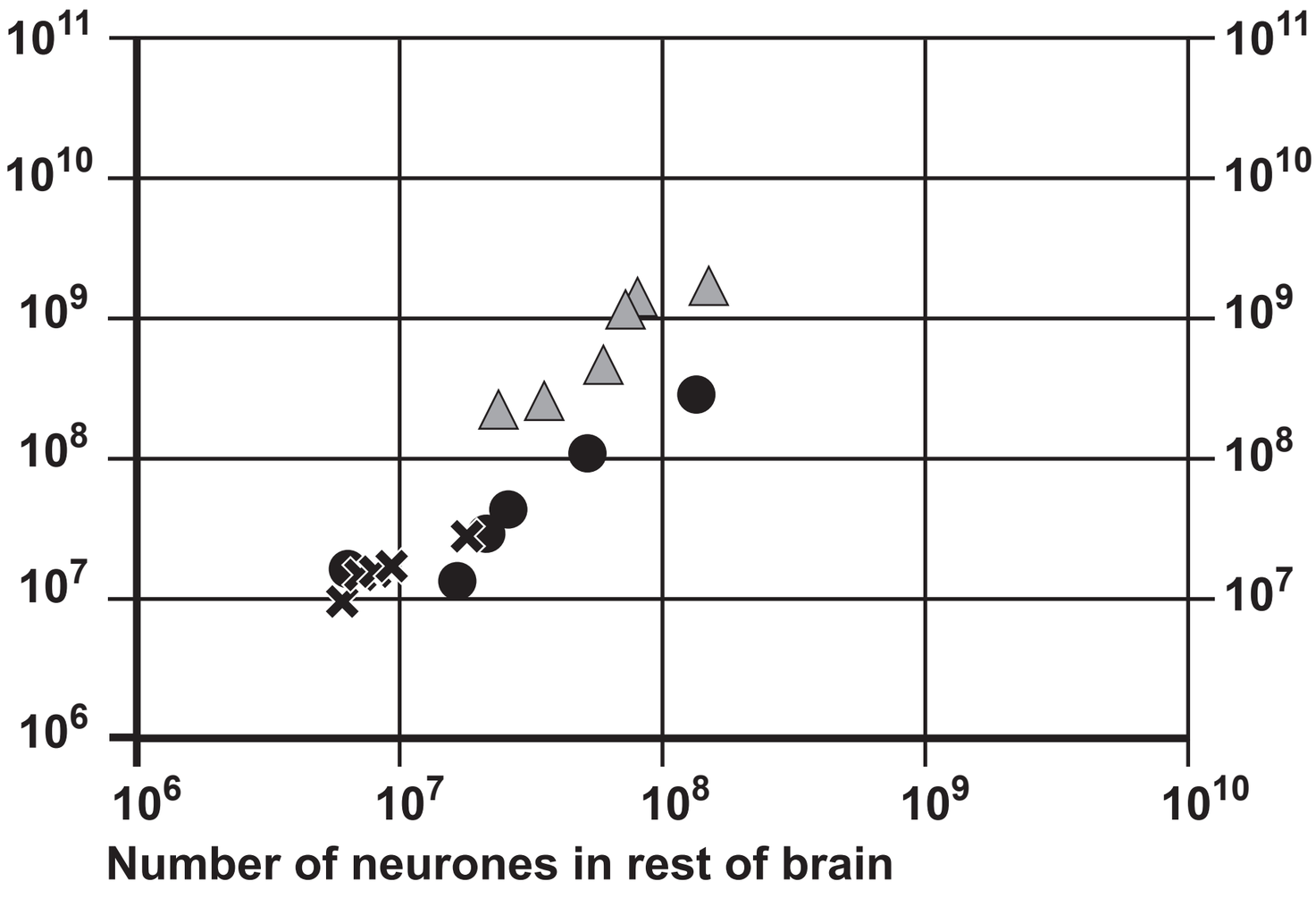


IMAGE 9.4

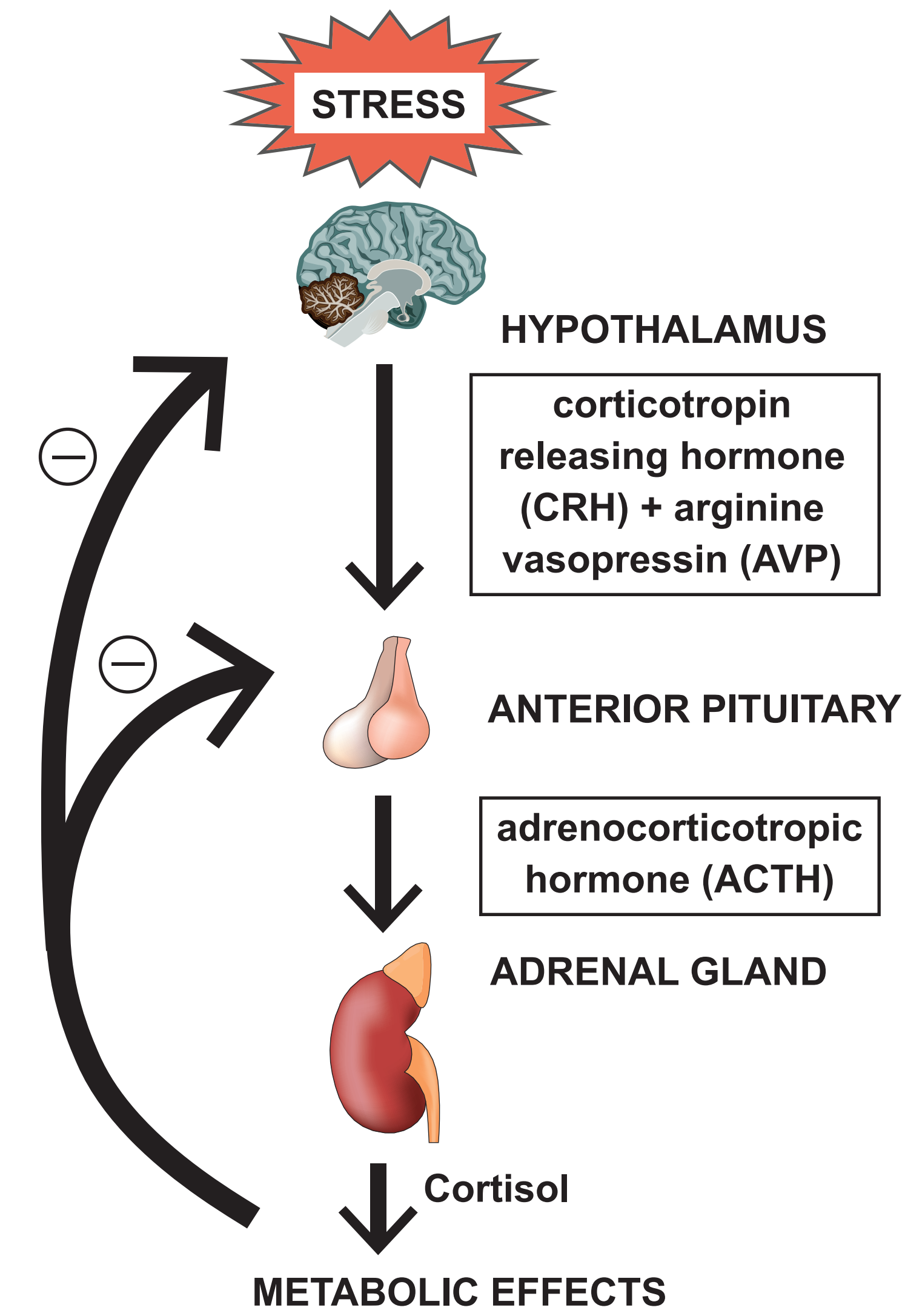

STRESS
HYPOTHALAMUS
corticotropin releasing hormone (CRH) + arginine vasopressin (AVP)
ANTERIOR PITUITARY
adrenocorticotropic hormone (ACTH)
ADRENAL GLAND
Cortisol
METABOLIC EFFECTS

IMAGE 9.5

Female grouse



Male grouse

