

Communication and Homeostasis

1. Fig. 11.1 shows the heat flow through the skin of an athlete during vigorous exercise. Exercise starts at 400 seconds.

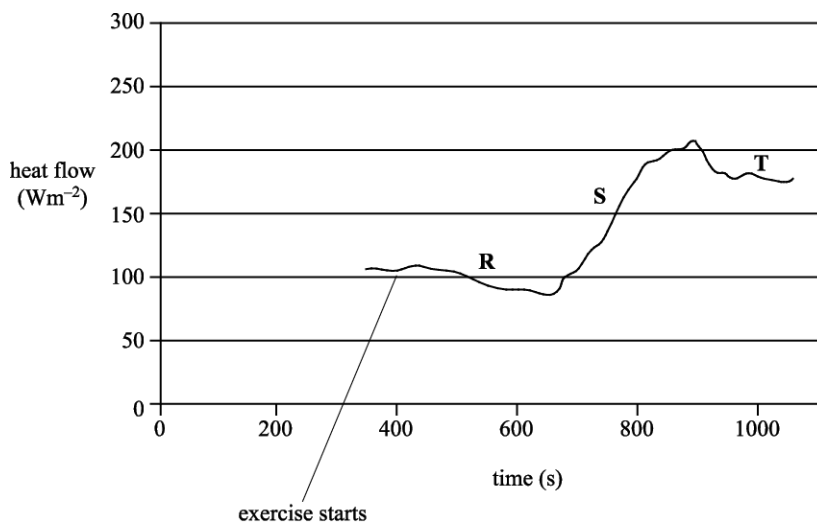


Fig. 11.1

Blood flow can be directed to those parts of the body that make the greatest demands.

Which row gives the best explanation of the stages in Fig. 11.1?

	R	S	T
A	Blood directed away from skin to avoid excess heat loss	Blood directed towards skin to release excess heat	Balance achieved between loss of excess heat and the need for oxygen in the muscles
B	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to release excess heat	Balance achieved between heat loss and excess heat created in the muscles
C	Blood directed away from skin to avoid excess heat loss	Blood directed towards skin to gain heat from the environment	Balance achieved between heat loss and excess heat created in the muscles
D	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to gain heat from the environment	Balance achieved between loss of excess heat and the need for oxygen in the muscles

Your answer

[1]

2. The following advice is given to mothers of babies under 6 months:

Don't let your baby get too hot or too cold. A room temperature of 16–20°C, with light bedding or a lightweight baby sleeping bag, will provide a comfortable sleeping environment for your baby.

Which of the statements, **A** to **D**, best explains this advice?

- A** newborn babies have poorly-developed osmoregulation mechanisms
- B** newborn babies have poorly-developed thermoregulation mechanisms
- C** newborn babies have poorly-developed ectothermic mechanisms
- D** newborn babies have poorly-developed glucoregulation mechanisms

Your answer

[1]

3. The table below shows features of the five kingdoms.

Kingdom	Nerves present	Hormones present
Prokaryotae	x	x
Protocista	x	x
Fungi	x	✓
Plantae	x	✓
Animalia	✓	✓

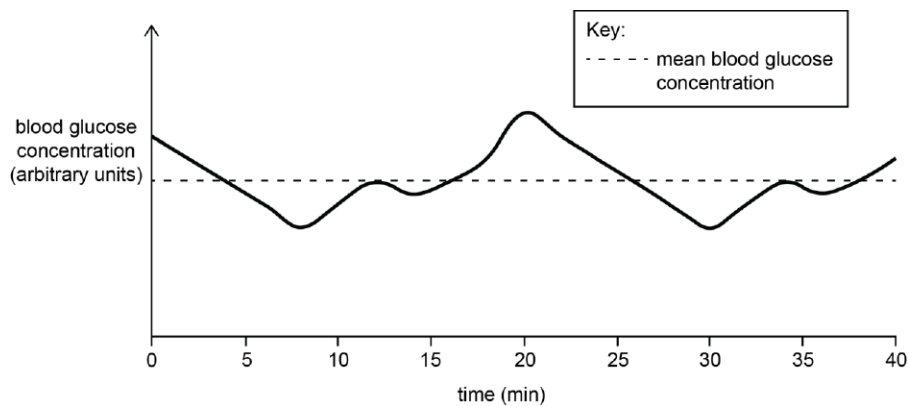
Which of the statements, **A** to **D**, is correct?

- A** only autotrophic organisms require hormones
- B** only heterotrophic organisms need to interact with their environment
- C** only multicellular organisms require hormones
- D** only unicellular organisms require nervous systems

Your answer

[1]

4. The graph below shows the change in glucose concentration in a rat's bloodstream over a short period of time.



Which of the statements, **A** to **D**, is correct?

- A** blood glucose concentration at 15 min > blood glucose concentration at 20 min
- B** blood glucose concentration at 9 min << blood glucose concentration at 20 min
- C** blood glucose concentration at 0 min < blood glucose concentration at 40 min
- D** blood glucose concentration at 5 min >> blood glucose concentration at 28 min

Your answer

[1]

5. The following terms relate to the metabolism of carbohydrates in the human body:

- 1 gluconeogenesis
- 2 glycogenesis
- 3 glycolysis

Which of these processes will be stimulated when glucagon is released into the bloodstream?

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

[1]

6. Which process, **A** to **D**, is a correct reason for cell signalling in multicellular organisms?

- A** homeostasis
- B** osmosis
- C** photosynthesis
- D** respiration

Your answer

[1]

7. Which of the following statements demonstrate that plant cells carry out cell signalling?

- 1 Plants have cell surface receptors that cause the cells to respond to specific molecules.
- 2 Binding to receptors at the plasma membrane can change chemical pathways within the cell.
- 3 Plant cells respond to soluble molecules which can be carried in both the xylem and the phloem.

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

[1]

8. Which of the options, **A** to **D**, correctly describes how an endotherm would respond to an increase in temperature?

- A** dilation of arterioles near the surface of the skin
- B** erector muscles contract, causing hairs to stand up
- C** rapid contractions of skeletal muscles
- D** sweat glands release less sweat

Your answer

[1]

9. The hormone ecdysone is synthesised in the prothoracic glands found in the upper thorax of some invertebrates and is released into haemolymph. It is then transported to cells near the surface of the body and causes the loss of the exoskeleton so that a new exoskeleton can form.

Which of the following statements explains how ecdysone is able to act on cells near the surface of the body?

- 1 Ecdysone is synthesised by specialised neurosecretory cells.
- 2 Ecdysone is soluble in haemolymph because it is a polar molecule.
- 3 Ecdysone is complementary to cell surface receptors on cells throughout the body of some invertebrates.

- A** 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer

[1]

10. Which of the following, **A** to **D**, is **not** an example of cell signalling?

- A** The hormone insulin being removed from the blood by the glomerulus.
B The neurotransmitter acetylcholine causing depolarisation.
C The hormone prolactin binding to a cell receptor in breast tissue.
D Epithelial cells releasing cytokines in response to histamine.

Your answer

[1]

11. FURA-2 is a fluorescent dye that can be used to measure the concentration of Ca^{2+} ions inside cells.

Scientists have used FURA-2 to study the role of Ca^{2+} ions in the synapses of living nerve tissue.

FURA-2 was injected into a single sensory neurone that was connected by a synapse to a relay neurone.

FURA-2 fluorescence inside the neurone was observed using a confocal microscope.

- i. Explain **one** advantage of using a confocal microscope in this study.

----- **[1]**

- ii. The sensory neurone was stimulated electrically and the FURA-2 fluorescence in the synaptic bulb was measured. At the same time, an electrode recorded the membrane potential in a postsynaptic neurone.

The results of this study are shown in the table.

Strength of electrical stimulation	FURA-2 fluorescence in synaptic bulb	Highest membrane potential in postsynaptic neurone (mV)
Low	Low	-60
Medium	Medium	+40
High	High	+40

The intensity of FURA-2 fluorescence is proportional to the concentration of Ca^{2+} ions.

The scientists concluded that changes in the concentration of Ca^{2+} ions in the presynaptic neurone caused an action potential in the postsynaptic neurone.

Evaluate and explain the scientists' conclusion.

----- [4]
12. Many insects such as moths and bumblebees are insulated with scales and hair, and are known as facultative endotherms.

Their metabolism during flight can cause the temperature of the flight muscles to increase 20–30 °C above the external temperature.

- i. Using the information provided, explain why many moths and bumblebees are described as endothermic.

----- [1]

- ii. It is more difficult for moths and bumblebees to maintain their body temperature than for mammals and birds to maintain their body temperature.

Explain why.

----- [2]

13. Fig. 2.1 shows a naked mole rat, *Heterocephalus glaber*.



Fig. 2.1

The naked mole rat is a mammal. However, it has several features that are unusual for mammals.

Naked mole rats regulate their temperature in a way that is different from most mammals.

i. Some features of thermoregulation in naked mole rats are listed below:

- They live in complex underground tunnel systems, which tend to have a stable temperature of 30–32 °C. However, sometimes the environmental temperature can increase or decrease outside this range.
- In experiments that examine environmental temperature changes, the core body temperature of naked mole rats remains close to that of the environmental temperature.
- When tunnel temperature increases they often move to cooler parts of the tunnel system.
- When tunnel temperature decreases they often lie together in large groups.

Outline **two** ways in which thermoregulation in naked mole rats is different from thermoregulation in most mammals.

[2]

- ii. In humans, when core body temperature falls below 35 °C, positive feedback causes this decrease in core body temperature to continue. This process is known as hypothermia.

Explain how positive feedback could accelerate the process of hypothermia.

[4]

- iii. Mammals, including naked mole rats, have temperature receptors that play a role in thermoregulation.

The table below lists four statements about mammalian temperature receptors.

Write either 'true' or 'false' in the empty boxes to indicate whether each statement is true or false.

Statement	True or False?
Peripheral temperature receptors detect the temperature of internal organs	
Receptors in the hypothalamus detect core body temperature	
Blood temperature is detected by the receptors in the hypothalamus	
Temperature receptors send impulses to the medulla oblongata, which regulates body temperature	

[2]