



# Respiratory Systems Revision

---



## Part A Fish gills

---

Which of the following statements describe how fish gills take in oxygen? Select all that apply.

- ☐ water moves in through the mouth and **out** across the gills
  - ☐ water moves **in** across the gills and out through the mouth
  - ☐ blood is pumped through the gills in the **same** direction to the flow of water across the gills
  - ☐ blood is pumped through the gills in the **opposite** direction to the flow of water across the gills
  - ☐ because blood and water flow in the **same** direction, a steep diffusion gradient is maintained across the gill capillaries, thus increasing gas exchange efficiency
  - ☐ because blood and water flow in **opposite** directions, a steep diffusion gradient is maintained across the gill capillaries, thus increasing gas exchange efficiency
-

## Part B Mammalian lungs adaptations

Fill in the table below by matching the feature of the mammalian lungs to the description of how this feature improves efficiency of gas exchange between the air and the bloodstream.

Feature	How this feature improves efficiency of gas exchange
<input type="text"/>	ensures a very small distance for gases to diffuse across
<input type="text"/>	increases the surface area for diffusion of gases to occur
<input type="text"/>	increases the concentration gradient of oxygen by ensuring that the lungs are continuously supplied with oxygen-poor blood
<input type="text"/>	increases concentration gradient of oxygen by ensuring that the lungs are continuously filled with oxygen-rich air

Items:

lungs are composed  
of a large number  
of alveoli

alveoli are  
surrounded by  
blood capillaries

alveoli are lined with  
a thin layer of cells  
(squamous epithelium)

lungs are  
actively ventilated

## Part C Mammalian ventilation

Which of the following statements describe how mammalian lungs take in air? Select all that apply.

- ☐ The diaphragm **contracts**, changing from a more domed shape to a flatter shape, causing the lungs to expand downwards.
  - ☐ The diaphragm **relaxes**, changing from a flatter shape to a more domed shape, causing the lungs to expand downwards.
  - ☐ The external intercostal muscles **contract**, causing the lungs to expand outwards and upwards.
  - ☐ The external intercostal muscles **relax**, causing the lungs to expand outwards and upwards.
  - ☐ The expansion of the lungs **increases** thoracic pressure, which causes air to move into the lungs from outside the body.
  - ☐ The expansion of the lungs **decreases** thoracic pressure, which causes air to move into the lungs from outside the body.
- 

## Part D Pulmonary ventilation

A group of students were investigating the effect of exercise on pulmonary ventilation.

The table below shows some of the results recorded for one of the students in the group.

Tidal volume	0.45 dm <sup>3</sup>
Vital capacity	3.45 dm <sup>3</sup>
Mean breathing rate at rest	14 min <sup>-1</sup>
Mean breathing rate during exercise	18 min <sup>-1</sup>

Calculate the total volume of air that moved in and out of this student's lungs in a five minute period **before** the start of exercise.

---



# Circulatory Systems Revision

---



## Part A Double circulation

---

Which of the following statements about double circulation are correct? Select all that apply.

- ☐ double circulation refers to the fact that the heart has two types of chambers: atria and ventricles
  - ☐ double circulation refers to the fact that blood passes through the heart twice for each complete circuit of the circulatory system
  - ☐ all vertebrates have a double circulatory system
  - ☐ mammals and birds have a double circulatory system, whereas fish have a single circulatory system
  - ☐ double circulation ensures that blood travels through the body at a higher pressure and faster speed than in a single circulatory system
  - ☐ double circulation ensures that blood travels through the body at a lower pressure and slower speed than in a single circulatory system
-

---

## Part B Systole vs diastole

In the table below, show which process each statement refers to: systole or diastole.

Statement	Systole or Diastole
blood moves from the vena cava and pulmonary veins into the atria	<input type="text"/>
blood moves from the ventricles out into the aorta and pulmonary artery	<input type="text"/>
the semi-lunar valves open	<input type="text"/>
the atrioventricular valves open	<input type="text"/>
caused by electrical excitation (i.e. depolarisation)	<input type="text"/>

Items:

systole

diastole

---

---

## Part C Oxygen saturation

In mammalian blood, oxygen is mainly transported combined with haemoglobin. The presence of haemoglobin greatly increases the oxygen carrying capacity of blood.

- $100\text{ cm}^3$  of plasma contains  $0.3\text{ cm}^3$  of oxygen when fully saturated.
- $100\text{ cm}^3$  of blood contains  $20.1\text{ cm}^3$  of oxygen when fully saturated.

Calculate the percentage increase in oxygen carried in fully saturated blood compared with oxygen carried in fully saturated plasma. Give your answer to the nearest percent.

---

---

## Part D Cardiac output

The average stroke volume of a particular person is 60 ml, and their average heart rate is 82 bpm.

Calculate this person's cardiac output.

---

Created for isaacphysics.org by Lewis Thomson. Part C adapted with permission from OCR AS Level Biology A, May 2016, Breadth in Biology, Question 24

Gameboard:

**STEM SMART Biology Week 45**

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



# Digestive and Excretory Systems Revision



## Part A Insulin & glucagon

Fill in the table below to show the differences between insulin and glucagon.

	Insulin	Glucagon
Released from...	<input type="text"/>	<input type="text"/>
Released in response to...	<input type="text"/>	<input type="text"/>
Glycogen is...	<input type="text"/>	<input type="text"/>

Items:

$\alpha$  cells

$\beta$  cells

high glucose blood levels

low glucose blood levels

produced from glucose

broken down into glucose

---

## Part B    ADH

Which of the following statements about antidiuretic hormone (ADH) are correct? Select all that apply.

- ☐ It is released into the bloodstream from the adrenal glands
  - ☐ It is released into the bloodstream from the posterior pituitary gland
  - ☐ It is released in response to an **increase** in blood water potential
  - ☐ It is released in response to a **decrease** in blood water potential
  - ☐ It causes an **increase** in water reabsorption by the cells lining the collecting ducts of the nephrons
  - ☐ It causes a **decrease** in water reabsorption by the cells lining the collecting ducts of the nephrons
  - ☐ An increase in ADH causes **more** urine to be produced (and causes the urine to be more dilute)
  - ☐ An increase in ADH causes **less** urine to be produced (and causes the urine to be more concentrated)
-



---

## Part C Ultrafiltration part 1

The table below shows the concentration of some of the components of blood, glomerular filtrate and urine.

Component	Blood (g/100cm <sup>3</sup> )	Glomerular filtrate (g/100cm <sup>3</sup> )	Urine (g/100cm <sup>3</sup> )
Glucose	0.10	0.10	0.00
Urea	0.03	0.03	1.80
Amino acids	0.05	0.05	0.00
Large proteins	8.00	0.00	0.00
Inorganic ions (total)	0.90	0.90	variable, up to 3.60

Which of the following statements explain the changes in fluid composition shown in the table above?

- ☐ large molecules cannot be filtered out of the blood, whereas small molecules and ions can be
  - ☐ water is reabsorbed in the collecting ducts
  - ☐ glucose and amino acids do not pass from the glomerulus to the Bowman's capsule
  - ☐ all of the urea and inorganic ions are reabsorbed in the proximal convoluted tubules
  - ☐ urea and inorganic ions cannot be reabsorbed in the nephrons
  - ☐ all of the glucose and amino acids are reabsorbed in the proximal convoluted tubules
-

---

## Part D Ultrafiltration part 2

The table below shows the concentration of some of the components of blood, glomerular filtrate and urine.

Component	Blood (g/100cm <sup>3</sup> )	Glomerular filtrate (g/100cm <sup>3</sup> )	Urine (g/100cm <sup>3</sup> )
Glucose	0.10	0.10	0.00
Urea	0.03	0.03	1.80
Amino acids	0.05	0.05	0.00
Large proteins	8.00	0.00	0.00
Inorganic ions (total)	0.90	0.90	variable, up to 3.60

Calculate the percentage increase in urea concentration from the blood to the urine. Give your answer to the nearest percent.

---

Created for isaacphysics.org by Lewis Thomson. Part C adapted with permission from OCR A Level Biology A, June 2013, Communication, Homeostasis and Energy, Question 3a

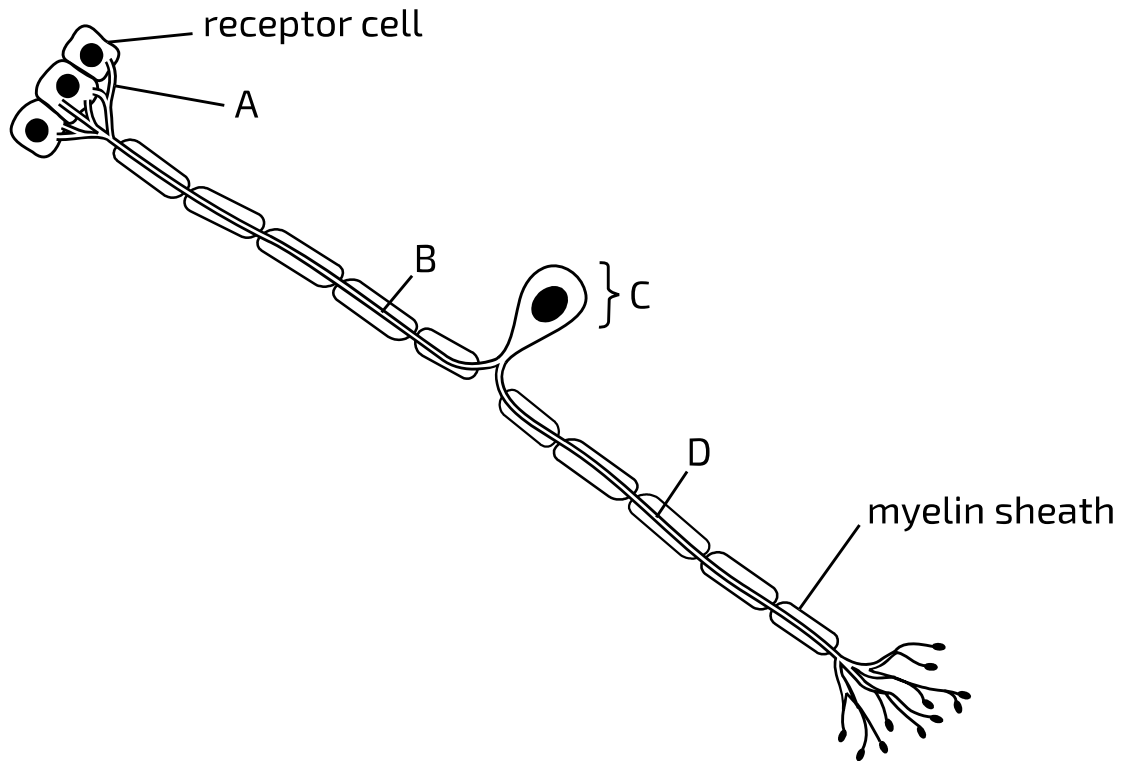
Gameboard:

**STEM SMART Biology Week 45**

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.

# Nervous Systems Revision

A Level



**Figure 1:** Diagram of a sensory neurone.

**Part A**    **Label the diagram**

---

What is the name of part A in **Figure 1**?

---

What is the name of part B in **Figure 1**?

---

What is the name of part C in **Figure 1**?

---

What is the name of part D in **Figure 1**?

---

---

**Part B**    **Name the gaps**

What is the name for the gaps in the myelin sheath?

---

## Part C Signal propagation

In which direction(s) would an action potential be propagated in **Figure 1**? Select all that apply.

- ☐ From A to B
  - ☐ From B to A
  - ☐ From B to D
  - ☐ From C to B
  - ☐ From D to B
- 

## Part D Action potential

Drag the items below into the correct order on the right to show how an action potential occurs.

### Available items

Na<sup>+</sup> channels open

K<sup>+</sup> ions move **out of** the cell and **repolarise** this region of the membrane

This region of the membrane becomes **hyperpolarised**

Voltage-gated K<sup>+</sup> channels open and voltage-gated Na<sup>+</sup> channels close

Voltage-gated K<sup>+</sup> channels close and this region of the membrane returns to resting membrane potential

Na<sup>+</sup> ions move **into** the cell and **depolarise** this region of the membrane (also causing Na<sup>+</sup> channels further along to open, triggering an action potential at that point)

---

Created for isaacphysics.org by Lewis Thomson. Parts A and C adapted with permission from OCR A Level Biology A, January 2013, Communication, Homeostasis and Energy, Question 1a

Gameboard:

**STEM SMART Biology Week 45**



# Muscular Systems Revision

A Level



## Part A Neuromuscular junction

Drag the items below into the correct order on the right to show how a motor neurone triggers muscle contraction at a neuromuscular junction.

### Available items

$\text{Na}^+$  channels on the sarcolemma open and  $\text{Na}^+$  ions move in to the sarcoplasm

vesicles containing neurotransmitters fuse with the axon terminal membrane

neurotransmitters are released into the synaptic cleft and bind to  $\text{Na}^+$  channels on the sarcolemma

$\text{Ca}^{2+}$  ions in the sarcoplasm allow myosin to bind to (and pull) actin in the sarcomeres, causing muscle contraction

voltage-gated  $\text{Ca}^{2+}$  channels in the membrane of the axon terminal open and  $\text{Ca}^{2+}$  ions move in

voltage-gated  $\text{Ca}^{2+}$  channels in the membrane of the sarcoplasmic reticulum open and  $\text{Ca}^{2+}$  ions move out into the sarcoplasm

## Part B Muscle contraction

Which of the following statements about muscle contraction are correct? Select all that apply.

- ☐ ATP binds to myosin heads, causing them to detach them from actin and enabling further muscle contraction
  - ☐  $\text{Ca}^{2+}$  ions are required to free up myosin-binding sites on the thin filaments (actin)
  - ☐ thick filaments (myosin) pull thin filaments (actin) **out** towards the **edges** of each sarcomere
  - ☐ ATP binds to actin, allowing it to bind to myosin and enabling muscle contraction
  - ☐ muscle contraction is triggered by the release of  $\text{Na}^{+}$  ions from the sarcoplasmic reticulum
  - ☐ thick filaments (myosin) pull thin filaments (actin) **in** towards the **centre** of each sarcomere
- 

## Part C Energy expenditure

Muscle cells primarily use glycogen to provide the energy they need. Glycogen is broken down into glucose, which is used in respiration to produce ATP.

An individual ("individual A") undergoes 45 minutes of high-intensity exercise. During this exercise, their muscles break down, on average, 2 g of stored glycogen per minute.

How many molecules of ATP did individual A's muscles produce during this period of exercise?

Assume that:

- an average molecule of glycogen is composed of 30 000 glucose molecules
- each molecule of glucose produces 30 ATP molecules during aerobic respiration
- all of the glucose molecules that are produced are aerobically respired
- the muscles are only using stored glycogen to produce ATP

Give your answer to 1 significant figure.

---



Physics. *You work it out.*

[Home](#)

[Gameboard](#)

[Biology](#)

[Physiology](#)

[Disease & Immunity](#)

[Immune Systems Revision](#)

# Immune Systems Revision

---

A Level



## Part A Cell type & response type

---

What type of cell secretes antibodies?

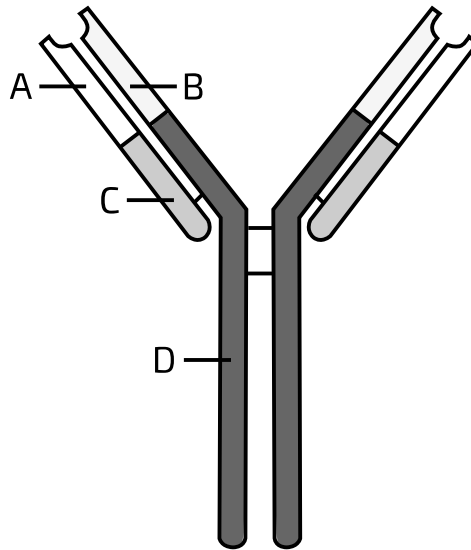
---

Antibodies are released as part of an adaptive immune response. What is the name given to this particular type of adaptive immune response that involves the release of antibodies?

---



**Part B** Variable region



**Figure 1:** Antibody structure. Four parts of the left side of the antibody are labelled (A-D).

Which letter(s) in **Figure 1** represent(s) the **variable region**?

- ☐ A
- ☐ B
- ☐ C
- ☐ D

---

## Part C Secondary immune response

Why are secondary immune responses faster than primary immune responses? Select all that apply.

- ☐ memory B cells divide and differentiate into plasma cells (effector B cells) more quickly than naïve B cells do
  - ☐ the antibodies produced in the primary immune response continue to circulate in the blood for many years
  - ☐ during a primary immune response, specific memory B cells are produced which continue to circulate in the blood for many years
  - ☐ activation of immune cells (by binding to antigens) occurs more quickly
  - ☐ the existing antibodies replicate themselves to produce more antibodies
  - ☐ memory B cells can produce and secrete antibodies into the bloodstream faster than naïve B cells
- 

---

## Part D Cell-mediated immune response

Antibodies inactivate and tag pathogens that are found outside of cells (e.g. in the bloodstream). What is the name of the cell type that destroys pathogens that are inside the body's cells by killing those infected cells?

---

Created for isaacphysics.org by Lewis Thomson

Gameboard:

**STEM SMART Biology Week 45**

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.

# Organ Blood Composition

A Level



The table shows concentrations of substances in blood entering and leaving three different organs of a person:

- kidney
- small intestine
- chambers of the right side of the heart

The blood sample was taken 10 minutes after the person had eaten a carbohydrate-rich meal.

(The oxygen concentration is given in arbitrary units (a.u.).)

Organ	Concentration in blood entering the organ			Concentration in blood leaving the organ		
	glucose / mg dm <sup>-3</sup>	oxygen / a.u.	urea / mg dm <sup>-3</sup>	glucose / mg dm <sup>-3</sup>	oxygen / a.u.	urea / mg dm <sup>-3</sup>
1	9.0	65	3.0	9.0	65	3.0
2	9.0	85	3.0	9.0	70	2.4
3	9.0	85	3.0	12.0	70	3.0

## Part A Organ identification

---

Match the organ/organ part to the table row number.

- Row 1:
- Row 2:
- Row 3:

Items:

small intestine

kidney

chambers of the right side of the heart

---

## Part B Kidney capillaries

Give the name of the network of blood capillaries in the kidney where blood is filtered to enable the excretion of urea.

---

## Part C Intestinal projections

Give the name of the internal projections of the small intestine wall that are composed of multiple tissue layers and which improve the efficiency of digestion and absorption.

---

## Part D Blood oxygenation

Give the name of the blood vessel that carries **oxygenated** blood to the heart.

---

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.