

**Higher Human Biology**

**Unit 3**

**Summary Notes with Fill in the Blanks**

# **Neurobiology and Immunology**

## The small print: Key Area 1

### Divisions of the nervous system & neural pathways

- Identify the structures and functions of the nervous system.
- Distinguish between the central nervous system (CNS) & the peripheral nervous system (PNS).
- State that the peripheral nervous system includes the autonomic and somatic nervous system.
- State that the somatic nervous system contains sensory & motor neurons.
- State that the autonomic nervous system (ANS) consists of the sympathetic & parasympathetic systems.
- Describe the antagonistic action of the sympathetic and parasympathetic systems.
- Explain how the sympathetic nervous system increases heart rate.
- Explain how the sympathetic nervous system increases breathing rate.
- Explain how the sympathetic nervous system slows down intestinal secretions.
- State that the sympathetic nervous system is involved in fight or flight.
- Explain how the parasympathetic nervous system decreases heart rate.
- Explain how the parasympathetic nervous system decreases breathing rate.
- Explain how the parasympathetic nervous system speeds up intestinal secretions.
- State that the parasympathetic nervous system is involved in rest and digest.
- Define a converging neural pathway as several neurons sending an impulse to one receiving neuron in order to increase the intensity of the impulse e.g. used to see in the dark.
- Define a diverging neural pathway as a motor neurone sending an impulse to multiple neurons in order to provide fine motor control and hypothalamus co-ordinated control of body temperature.
- Define reverberating neural pathways as those which can repeat the original impulse.

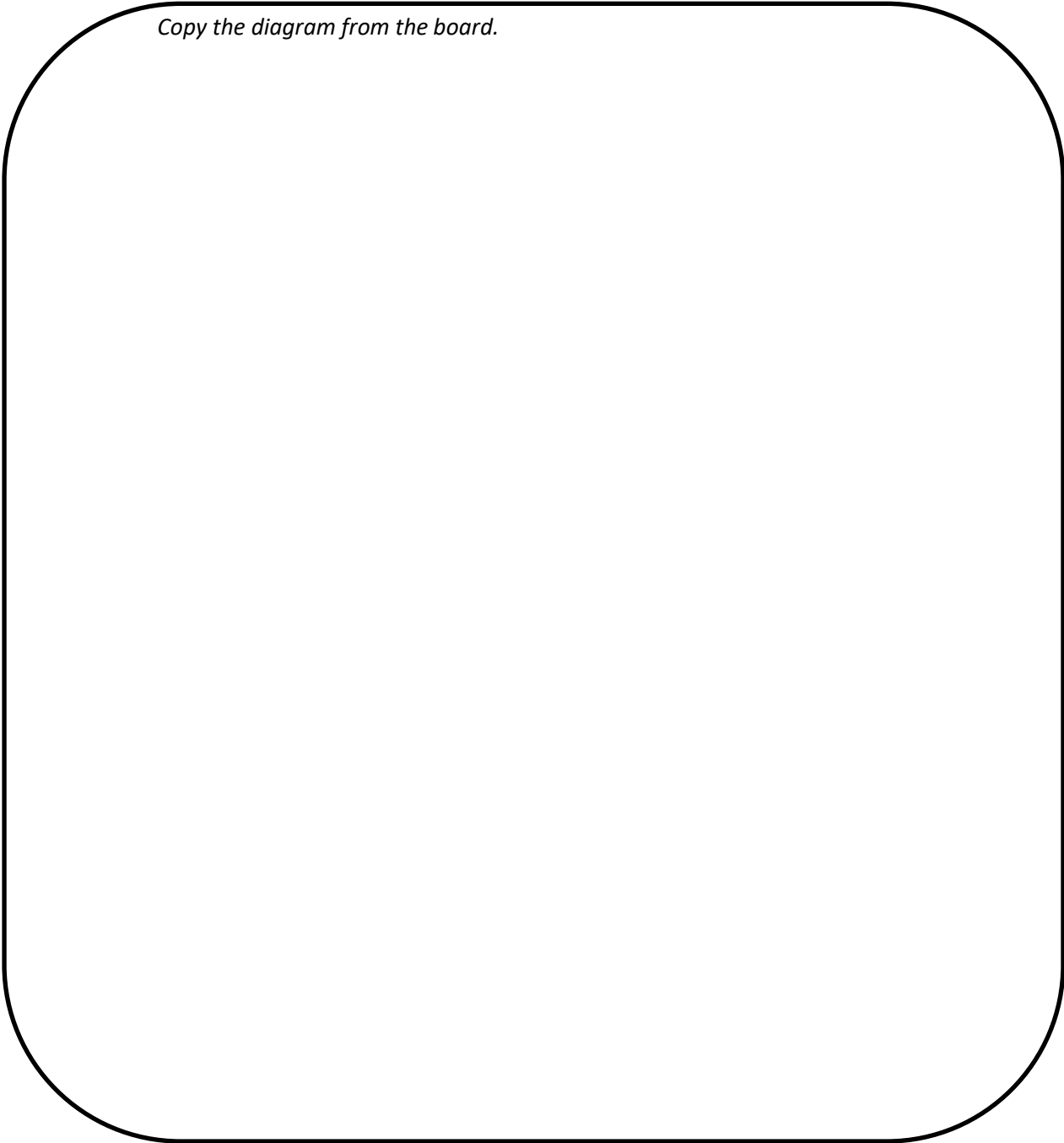
## Key Area 1 - Divisions of the Nervous System and Neural Pathways

The nervous system analyses \_\_\_\_\_ information from the body and the \_\_\_\_\_ environment stores some aspects and makes decisions regarding appropriate responses and behaviours.

It makes motor responses by initiating \_\_\_\_\_ or glandular secretions.

The nervous system can be divided as shown below...

*Copy the diagram from the board.*



The central nervous system (CNS) consists of the \_\_\_\_\_ and \_\_\_\_\_ . The peripheral nervous system (PNS) consists of the somatic nervous system (SNS) and the autonomic nervous system (ANS).

The \_\_\_\_\_ nervous system contains sensory and motor neurons.

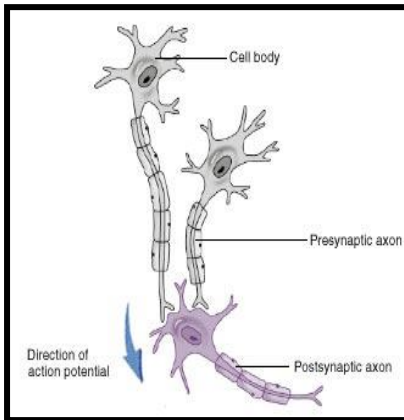
The \_\_\_\_\_ nervous system consists of the sympathetic and parasympathetic systems, which work \_\_\_\_\_ .

The sympathetic system speeds up the heart rate and breathing rate while slowing down peristalsis and production of \_\_\_\_\_ . The parasympathetic system does the opposite.

Process		Sympathetic Effects	Parasympathetic effects
Heart rate			
Breathing rate			
Digestive processes	Peristalsis		
	Production of intestinal secretions		

## Neural Pathways

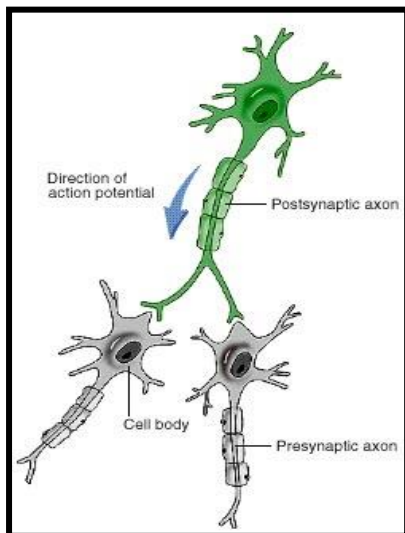
Neurons connected to each other through synapses form neural pathways through the nervous system.



### Converging Neural Pathway

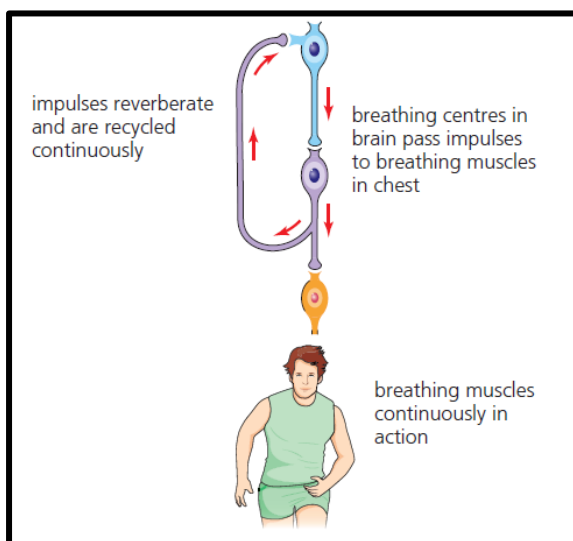
Impulses from \_\_\_\_\_ neurons travel to \_\_\_\_\_ neuron.

This increases the \_\_\_\_\_ to excitatory or inhibitory signals.



### Diverging Neural Pathway

In a diverging neural pathway, impulses from \_\_\_\_\_ neuron travel to \_\_\_\_\_ neurons so affecting more than one destination at the same time.



### Reverberating Neural Pathway

In a \_\_\_\_\_ pathway, neurons later in the pathway link with earlier neurons, sending the impulse back through the pathway. This allows \_\_\_\_\_ stimulation of the pathway.

### **CONSOLIDATION TASKS**

- **Essay question (specimen paper 2018)** - Describe the autonomic nervous system (ANS) and how it affects heart rate and digestive processes. (8 marks)
- **Textbook**
  - Page 212 q1-4
  - Name and describe an example of a converging, diverging and reverberating pathway (page 260-262).
  - Page 267 q1

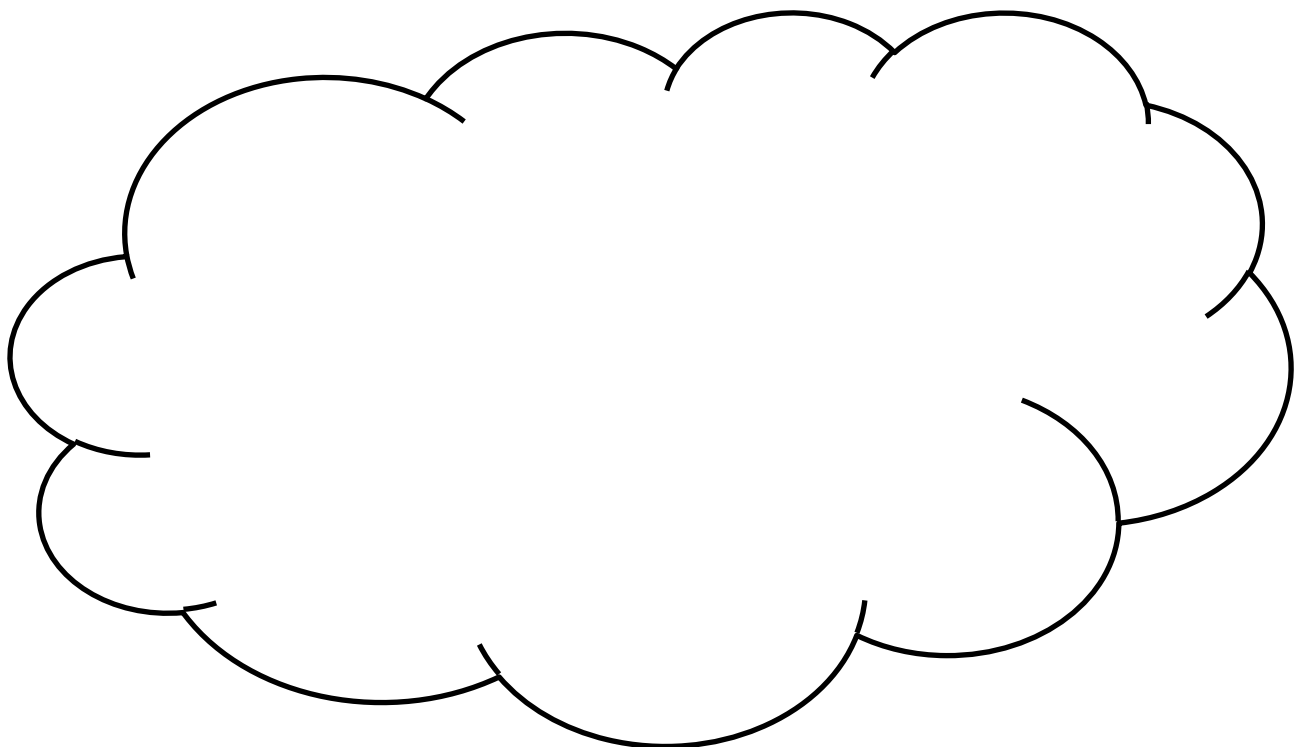
## KEY AREA 1 GLOSSARY

Central Nervous System	
Peripheral Nervous System	
Autonomic nervous system	
Somatic nervous system	
Sympathetic	
Parasympathetic	
Converging Neural Pathway	
Diverging Neural Pathway	
Reverberating Neural Pathway	

**The small print: Key Area 2**  
**The Cerebral Cortex**

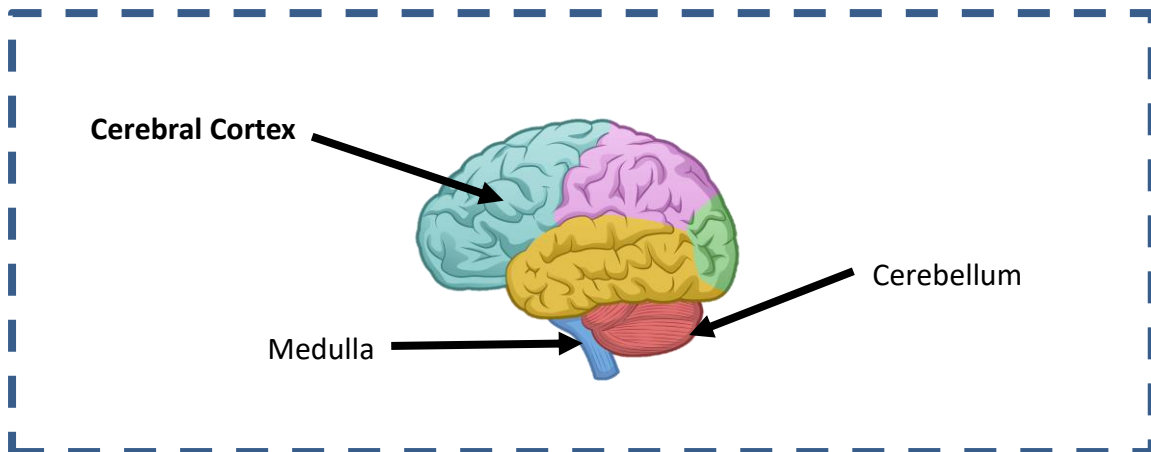
- State that the cerebral cortex (cerebrum) receives sensory information from your surroundings.
- State that the cerebral cortex is the centre for conscious thought.
- State that the cerebral cortex recalls memories and alters behaviour in the light of experience.
- State that the cerebral cortex co-ordinates voluntary movement.
- Describe what is meant by the term localisation of function.
- Explain localisation of function in terms of sensory, motor and association areas.
- Explain that some association areas deal with thought processes including language, personality, imagination and intelligence.
- State that information is passed from one side of the brain to the other through a bundle of nerve fibres called the corpus callosum.
- State that the left cerebral hemisphere deals with information from the right visual field and controls the right side of the body and vice versa.

Fill the bubble below with facts you already know about the brain...





## Key Area 2 - The Cerebral Cortex

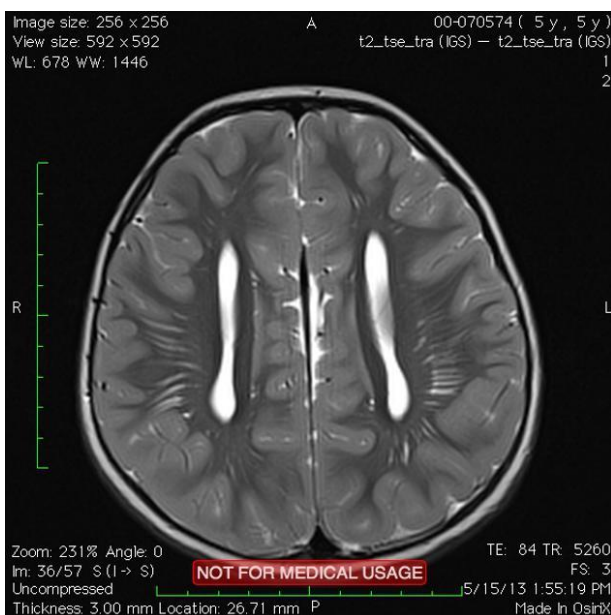


The \_\_\_\_\_ is the centre of conscious thought. It also recalls \_\_\_\_\_ and alters behaviour in the light of experience.

There is \_\_\_\_\_ of brain functions in the cerebral cortex. This means that certain areas of the cortex deal with different things. There are sensory areas, motor areas and association areas.

There are association areas involved in language processing, \_\_\_\_\_, imagination and intelligence.

## Transfer of Information Between Hemispheres



Information from one side of the body is processed in the opposite side of the \_\_\_\_\_.

The left cerebral hemisphere deals with information from the \_\_\_\_\_ visual field and controls the right side of the body and vice versa.

Transfer of information between the cerebral hemispheres occurs through the \_\_\_\_\_

## EXTRA - SPLIT BRAIN PATIENTS

### Revised Higher 2013 Question 11

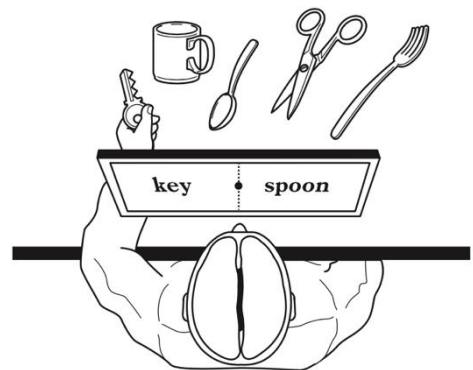
Split brain patients cannot transfer information between their left and right cerebral hemispheres because the band of nerve fibres connecting these areas of the brain has been cut.

- a) Name the band of fibres that connects the two hemispheres.

\_\_\_\_\_ 1

- b) Some of the functions of each hemisphere are described in the table below. These functions are unaffected in split brain patients. The diagram shows an experiment on a split-brain patient

<i>Left cerebral hemisphere</i>	<i>Right cerebral hemisphere</i>
processes information from right eye	processes information from left eye
controls language production	controls movements of left hand



The patient was asked to stare at a spot in the centre of a screen and the words "key" and "spoon" were flashed briefly onto the screen in the positions shown.

- i) The patient was then told to use his left hand to pick up the objects he saw named on the screen. Explain why the patient picked up the key but not the spoon. (2)

- ii) The patient was then asked to say what he saw written on the screen. Predict what he would have said and give a reason for your answer. (2)

## **CONSOLIDATION TASKS**

### **Questions -**

1. Explain what is meant by the term 'localisation of function' in the cerebral cortex.
2. State the role of the corpus callosum.

### **Past Papers -**

Revised Higher 2012 q10b

Higher 2016 q9

## KEY AREA 2 GLOSSARY

Cerebral cortex	
Cerebrum	
Localisation of function	
Corpus callosum	
Split brain patient	

### The small print: Key Area 3

#### Memory

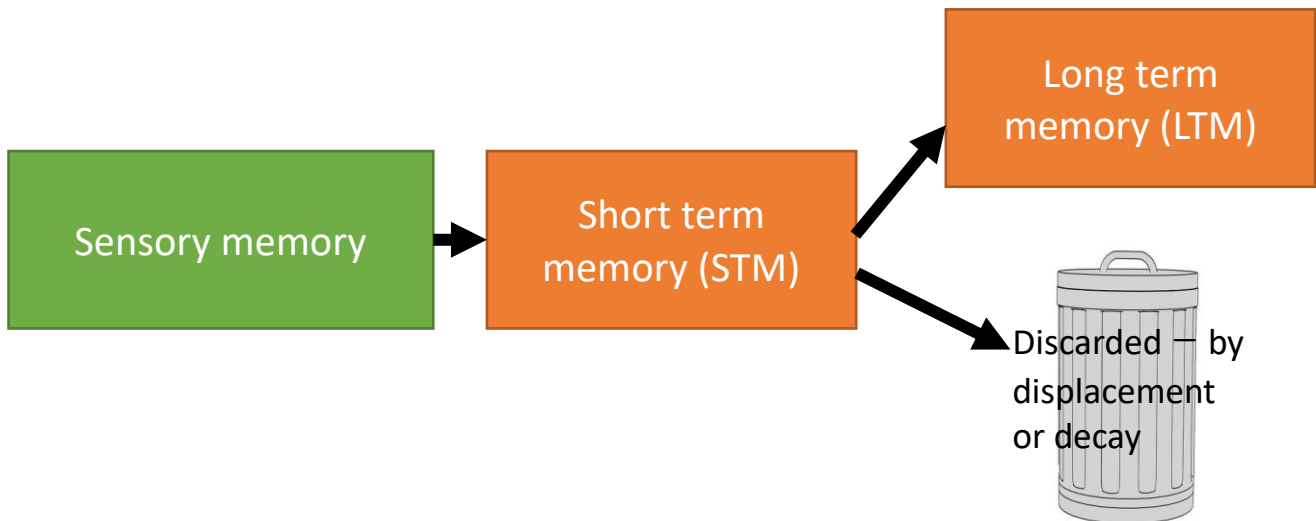
- Define memory as encoding, storage and retrieval of information.
- State that memories include past experiences, knowledge and thoughts.
- Describe the path of information entering the brain as from sensory memory to short-term memory (STM) and transferral to long-term memory (LTM).
- State that information not transferred to long term memory is discarded.
- State that sensory memory lasts a few seconds and retains all of the visual or auditory input.
- State that short term memory lasts approximately 30 seconds and can hold 7 +/- 2 pieces of information = memory span.
- Explain how the capacity of short term memory can be improved using chunking.
- Explain how rehearsal of information improves retention within the short term memory.
- Explain serial position effect:
- most recent items recalled as still in STM
  - items in middle of sequence displaced/discarded
  - first items recalled as transferred to long term memory by process of rehearsal
- State that LTM has an unlimited capacity & holds information for a long time.
- State that information can be transferred from STM to LTM due to rehearsal, organisation and elaboration.
- Define rehearsal as the repetition of items.
- Define organisation of memories as the grouping together of similar information.
- Define elaboration as adding meaning to information.
- State that retrieval of memories is aided by the use of contextual cues.
- Describe contextual cues as pieces of information stored at the same time or link memories together.

### Key area 3 - Memory

Memory involves \_\_\_\_\_, storage and retrieval of information.

Memories include past experiences, \_\_\_\_\_ and thoughts.

All information entering the brain passes through sensory memory and enters \_\_\_\_\_ (STM). Information is then either transferred to long term memory (LTM) or is discarded.



### Sensory Memory

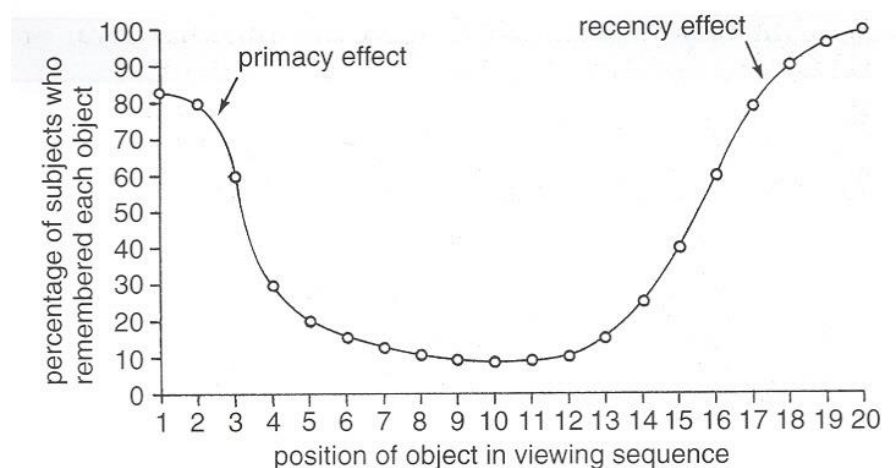
The sensory memory retains all the \_\_\_\_\_ and \_\_\_\_\_ input received for a few seconds.

Only selected images and sounds are \_\_\_\_\_ into the short-term memory.

### Memory Span

Memory span is the number of pieces of information that can be stored in the STM.

The \_\_\_\_\_  
\_\_\_\_\_ is  
\_\_\_\_\_ when, within a longer list of pieces of information, the ones at the start and end are more likely to be remembered than the ones in the middle.



\_\_\_\_\_ (repeating a piece of information) can extend the period of time that a piece of information is held in the STM.

**Repetition**  
**Repetition**  
**Repetition**

#### **IMPORTANT - LOSS OF MEMORIES**



#### **Long Term Memory**

The LTM has an unlimited capacity and can hold information for a long time.

**Use page 240-241 of the Torrance textbook to write notes on:**

- **Elaboration**
- **Rehearsal**
- **Organisation**

## IMPORTANT - CONTEXTUAL CUES



### CONSOLIDATION TASKS

- **Essay (How to Pass)** - Give an account of memory under the following headings:
  - Sensory memory (2 marks)
  - Short term memory (3 marks)
  - Long term memory (4 marks)
- **Past paper questions** -
  - Higher 2015 q10a+b
  - Higher Specimen Paper q12
  - Revised Higher 2014 q10a
  - Revised Higher 2012 q12 **GOOD PROBLEM SOLVING PRACTICE**



### KEY AREA 3 GLOSSARY

Encoding	
Storage	
Retrieval	
Sensory memory	
Short-Term Memory	
Long-Term Memory	
Memory span	

Chunking	
Rehearsal	
Serial position effect	
Organisation	
Elaboration	
Contextual cues	
Displacement	
Decay	

**The small print: Key Area 4**

**The cells of the nervous system & neurotransmitters at synapses**

Identify the structures of a neurone including dendrites, cell body and axon.

Identify sensory, motor and inter (relay) neurons.

State that sensory neurons take impulses from sensory receptors to the central nervous system.

State that motor neurons take impulses from central nervous system to an effector (e.g. muscle).

State that inter neurons transmit impulses between sensory and motor neurons within the central nervous system.

State that myelin sheath is composed of fatty material and surrounds the axon.

Explain why myelination increases the speed of impulse transmission.

State that myelination increases from birth to adolescence.

State that certain diseases destroy the myelin sheath causing a loss of co-ordination.

State that glial cells support the function of neurons and produce myelin sheath.

Describe a synapse as an area of communication between axon of one neuron and dendrite of another.

Explain that a neurotransmitter is a chemical that relays the message from the pre-synaptic neuron to the post-synaptic neuron.

Describe the chemical transmission at a synapse from vesicles containing neurotransmitter crossing the synaptic cleft to receptors.

State why it is important to remove neurotransmitters from the synapse.

State that the type of receptor determines whether a signal is inhibitory or excitatory.

State that synapses can filter out weak stimuli arising from insufficient secretion of neurotransmitters.

State that insufficient neurotransmitter at the synapse results in failure of transmission of the impulse.

State that a summation of a series of weak stimuli can trigger enough neurotransmitter to fire an impulse.

State that endorphins are neurotransmitters that stimulate neurons involved in reducing the intensity of pain.

State that endorphins are also connected to feelings of euphoria, appetite control and release of sex hormones.

State that endorphin production increases in response to severe injury, prolonged exercise, stress and certain foods e.g. chocolate.

Describe dopamine as a neurotransmitter that induces feelings of pleasure and reinforces particular behaviours in the reward pathway.

State that some disorders are caused by changes to neurotransmitter release e.g. Alzheimer's, Parkinson's and some anxiety disorders.

State that some drugs used to treat neurotransmitters are similar to neurotransmitters e.g. agonists and antagonists.

State that an agonist binds to and stimulates receptors mimicking the neurotransmitter.

State that antagonists bind to specific receptors blocking the action of the neurotransmitter.

State that other drugs inhibit the enzymes which breakdown neurotransmitters or inhibit re-uptake at the synapse.

State that recreational drugs can also mimic neurotransmitters.

Explain that as a consequence of taking recreational drugs changes in neurochemistry alter mood, cognition, perception and behaviour.

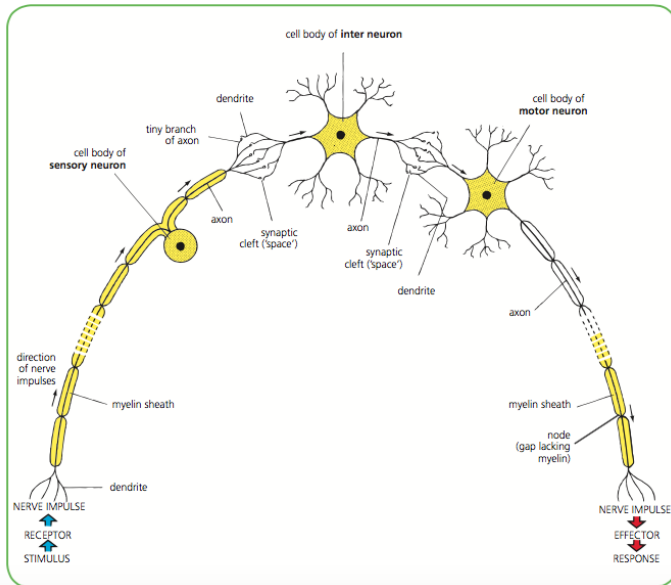
State that many recreational drugs affect neurotransmission in the reward circuit of the brain.

State that recreational drugs can be either antagonistic or agonistic.

Explain that antagonists block specific receptors leading to an increase in sensitivity and number of receptors and as a consequence results in addiction = sensitisation - individual craves more of the drug.

Explain that agonists stimulate specific receptors leading to a decrease in sensitivity and number of receptors and as a consequence results in drug tolerance = desensitisation - individual must take more of the drug to get an effect.

## Key Area 4 - The Cells of the Nervous System and Neurotransmitters at Synapses



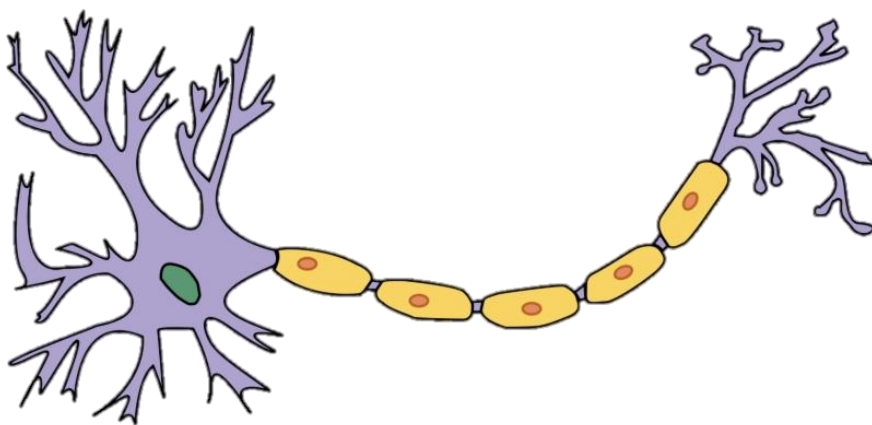
Three types of neurons exist in the body:

1. **Sensory** -
2. **Motor** -
3. **Inter** -

Each neuron contains the following three structures:

Structure	Function
Cell body	
Axon	
Dendrites	

Label the diagram below



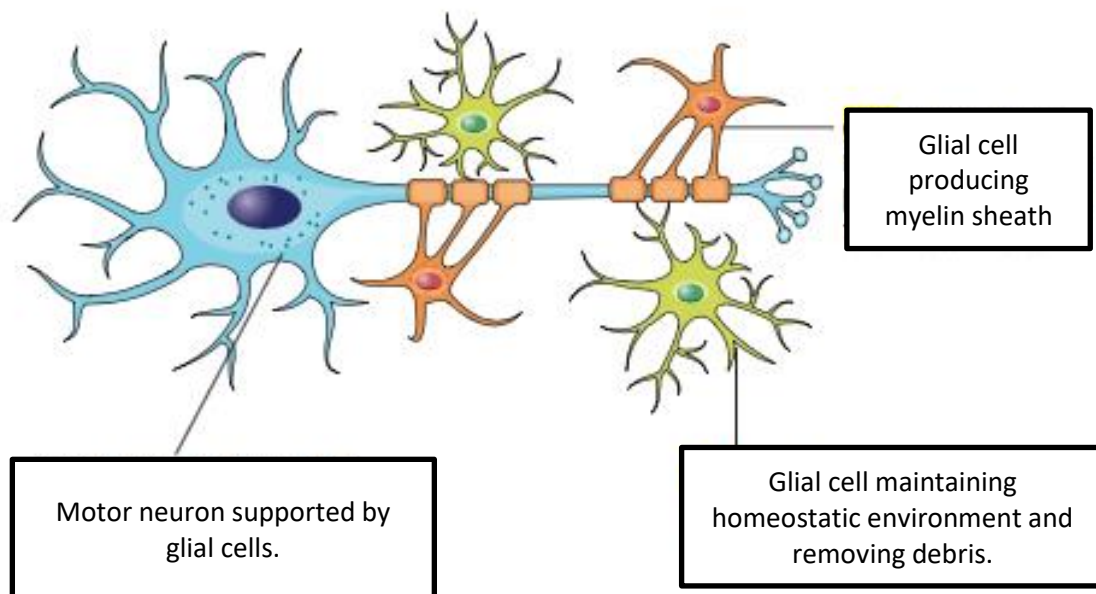
## Myelin Sheath

Axons are surrounded by a \_\_\_\_\_ which insulates the axon and increases the speed of \_\_\_\_\_.

Myelination continues from birth to adolescence. This is why responses to stimuli in the first two years of life are not as rapid or co-ordinated as those of an older child or adult.

Certain diseases (e.g. \_\_\_\_\_) destroy the myelin sheath causing a loss of \_\_\_\_\_.

\_\_\_\_\_ produce the myelin sheath and support neurons.

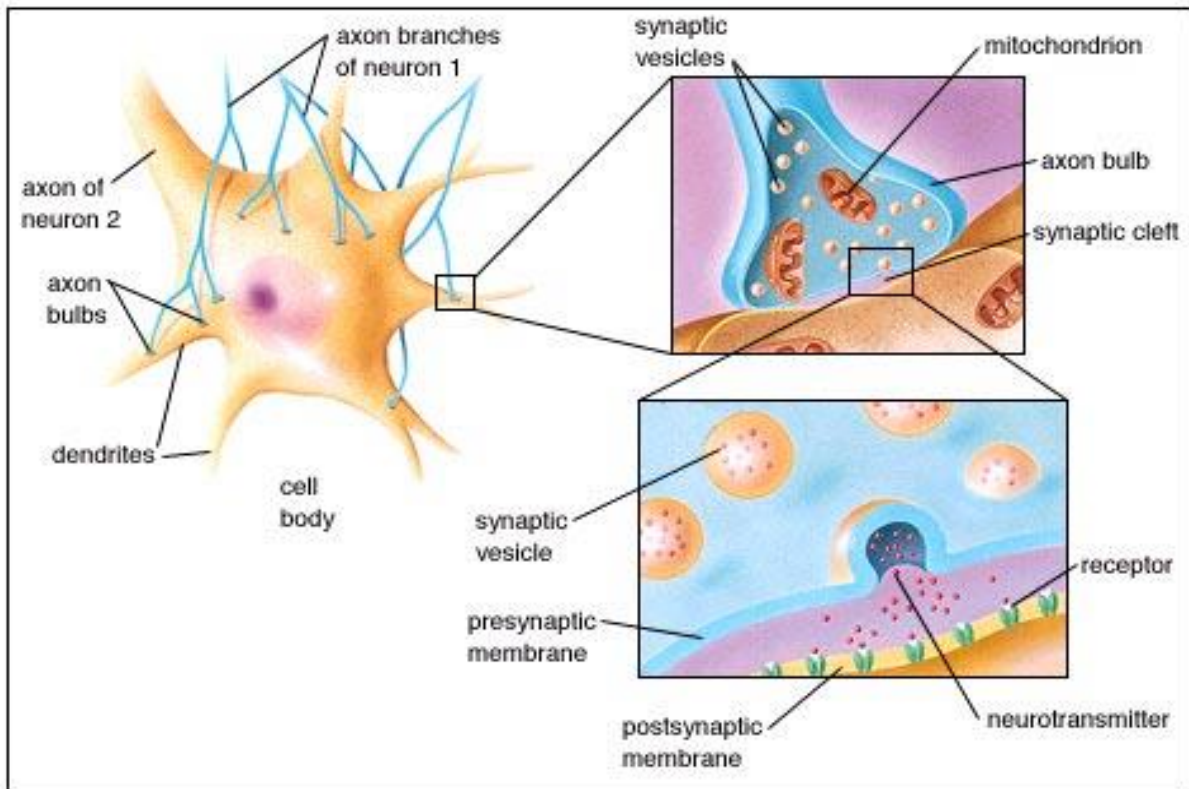


## Neurotransmitters at Synapses

Neurons connect with other neurons or muscle fibres at a synaptic cleft. Neurotransmitters relay impulses across the \_\_\_\_\_.

Neurotransmitters are stored in \_\_\_\_\_ in the axon endings of the presynaptic neuron. They are released into the cleft on arrival of an impulse.

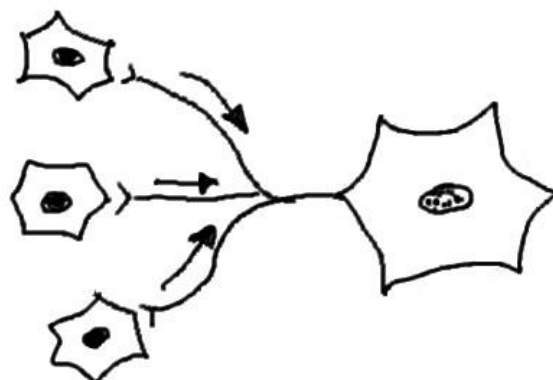
They diffuse across the cleft and bind to \_\_\_\_\_ on the membrane of the postsynaptic neuron.

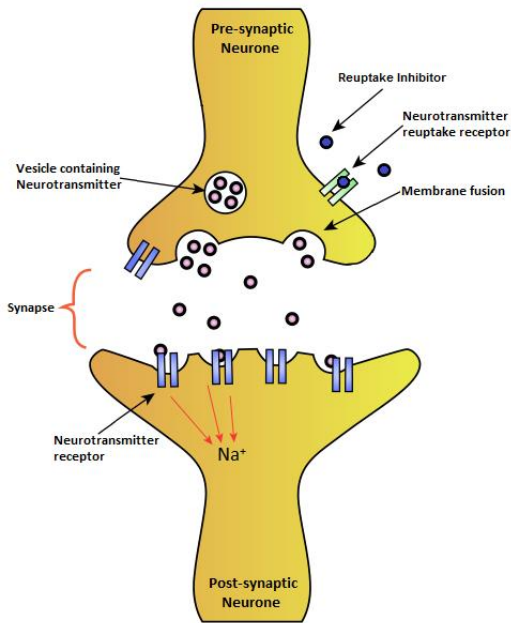


Receptors determine whether the signal is \_\_\_\_\_ (increases a response) or \_\_\_\_\_ (decreases a response).

Synapses can filter out weak \_\_\_\_\_ arising from insufficient secretion of neurotransmitters. A minimum number of neurotransmitter molecules must attach to receptors in order to reach the \_\_\_\_\_ on the postsynaptic membrane to transmit an \_\_\_\_\_.

\_\_\_\_\_ of a series of weak stimuli can release enough neurotransmitter to trigger an impulse. Convergent neural pathways can release enough neurotransmitter molecules to reach threshold and trigger an impulse (e.g. seeing in dim light).





## Removal of Neurotransmitters

Neurotransmitters need to be removed immediately after impulse to prevent continuous \_\_\_\_\_ and the system being unable to respond to new signals.

Removal achieved in one of two ways:

- \_\_\_\_\_ - some neurotransmitters (such as acetylcholine) are broken down by enzymes and the non-active products are reabsorbed by the pre-synaptic membrane.
- \_\_\_\_\_ - other neurotransmitters, such as noradrenaline, are taken back up directly by the presynaptic membrane.



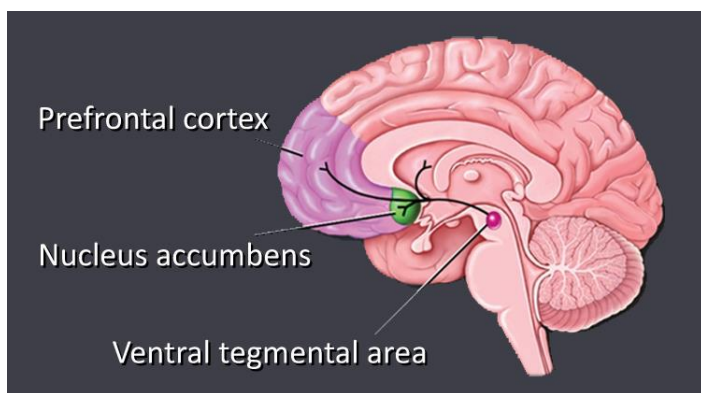
## Effect of Neurotransmitters on Mood and Behaviour

### Endorphins

Endorphins are neurotransmitters that stimulate neurons involved in reducing the \_\_\_\_\_ of pain.

Endorphin production increases in response to \_\_\_\_\_, prolonged and continuous exercise, \_\_\_\_\_ and certain foods. Increased levels of endorphins are also linked to feelings of pleasure obtained from activities such as eating, sex and \_\_\_\_\_.

### The Function of Dopamine



The reward pathway is between nucleus accumbens and ventral tegmental.

When a survival need such as hunger/thirst/sexual need is being satisfied, V releases dopamine, carried to centre N, centre N also releases dopamine which induces a pleasurable feeling.

\_\_\_\_\_ is a neurotransmitter that induces feelings of pleasure and reinforces particular behaviour by activating the reward pathway in the brain.

The \_\_\_\_\_ involves neurons which secrete or respond to dopamine.

The reward pathway is activated when an individual engages in a behaviour that is \_\_\_\_\_ to them, for example eating when hungry.

### Neurotransmitter-Related Disorders and their Treatment

Many drugs used to treat neurotransmitter-related disorders are \_\_\_\_\_ or \_\_\_\_\_.

Agonists are chemicals that bind to and stimulate specific receptors mimicking the action of a neurotransmitter at a \_\_\_\_\_.

Antagonists are chemicals that bind to specific receptors \_\_\_\_\_ the action of a neurotransmitter at a synapse.

Choose two of the neurotransmitter-related diseases listed below and use pages 269-271 of the Higher Human Biology textbook to write down some brief notes about how they could be treated with agonist/antagonist drugs.

- Alzheimer's
- Parkinson's
- Schizophrenia
- Generalised anxiety
- Depression

Other drugs act by inhibiting the enzymes that \_\_\_\_\_ neurotransmitters or by inhibiting reuptake of the neurotransmitter causing an enhanced effect.

## Mode of Action of Recreational Drugs

With the people at your table, make a mindmap or list of as many recreational drugs as you can. Highlight those that are legal in one colour and illegal in another colour.

Recreational drugs can also act as \_\_\_\_\_ or \_\_\_\_\_.

Recreational drugs affect neurotransmission at synapses in the brain altering an individual's mood, \_\_\_\_\_, perception and \_\_\_\_\_.

Many recreational drugs affect neurotransmission in the \_\_\_\_\_ pathway of the brain.

Type of Drug	What does it cause?	How does it work?

## Drug Addiction

Drug addiction is caused by repeated use of drugs that act as \_\_\_\_\_.

Antagonists block specific receptors causing the nervous system to increase both the number and \_\_\_\_\_ of these receptors.

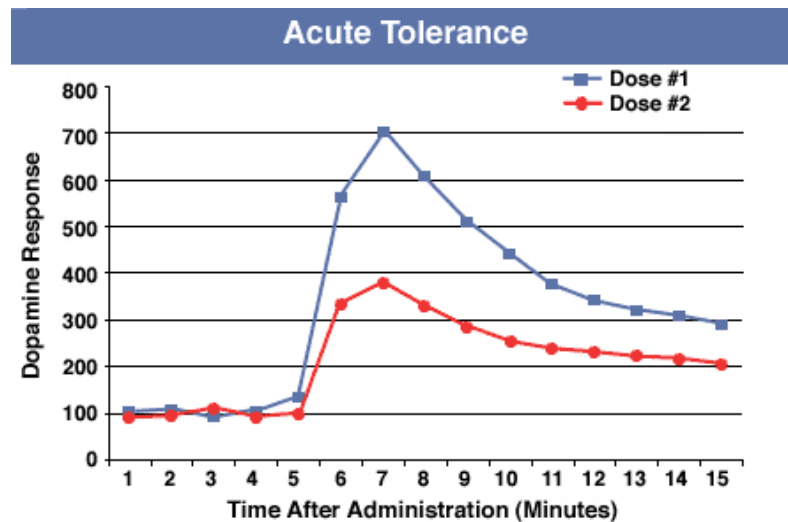
This \_\_\_\_\_ leads to addiction where the individual craves more of the drug.

## Drug Tolerance

Drug \_\_\_\_\_ is caused by repeated use of drugs that act as agonists.

Agonists stimulate specific receptors causing the nervous system to \_\_\_\_\_ both the number and sensitivity of these receptors.

This \_\_\_\_\_ leads to drug tolerance where the individual must take more of the drug to get an effect.



### CONSOLIDATION TASKS

#### Essays

- **Specimen Paper 2018** - Describe how neurotransmitters relay impulses across the synapse. (8)
- **Revised Higher 2012** - Give an account of the nervous system under the following headings:
  - Role of neurotransmitters at the synapse. (6)
  - Structure and function of neural pathways. (4)

#### Past Paper Questions

- Revised Higher 2013 q10
- Revised Higher 2014 q11a-c
- Higher 2015 q9
- Higher 2016 q10

## KEY AREA 4 GLOSSARY

Dendrite	
Cell body	
Axon	
Sensory neuron	
Motor neuron	
Inter neuron	
Myelin sheath	
Synapse	

Post-synaptic neuron	
Pre-synaptic neuron	
Receptor	
Inhibitory	
Excitatory	
Summation	
Vesicle	
Neurotransmitter	

Endorphin	
Dopamine	
Reward pathway	
Agonist	
Antagonist	
Recreational drugs	
Drug addiction	
Drug tolerance	

**The small print: Key Area 5  
Non-Specific Body Defences**

Give examples of physical (e.g epithelial cells) and chemical (e.g secretions, stomach acid) defences against infection.

Describe the inflammatory response to include release of histamine by mast cells, causing vasodilation and increased capillary permeability.

State that this response results in increased blood flow and subsequent accumulation of phagocytes and clotting elements at the site of infection.

Describe the function of phagocytosis and how phagocytes release cytokines which attract more phagocytes to the site of infection.

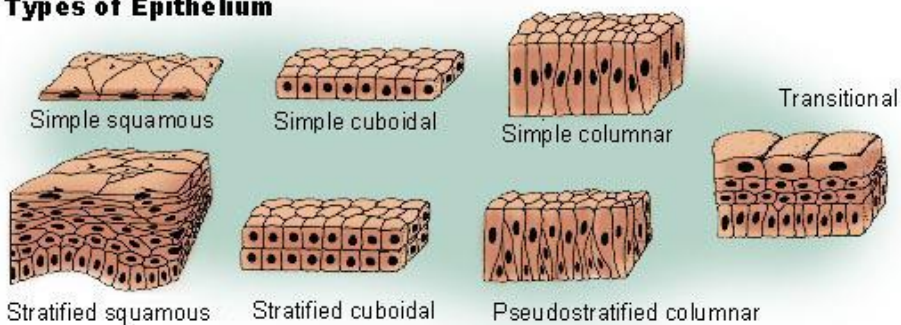
**Brainstorm - how does your body defend you against disease?**

**Key Area 5 - Non-Specific Body Defences**

The human body has the capacity to protect itself against \_\_\_\_\_, some toxins and cancer cells through the immune system.

Epithelial cells form a \_\_\_\_\_ and are find in the skin and inner linings of the digestive and respiratory systems.

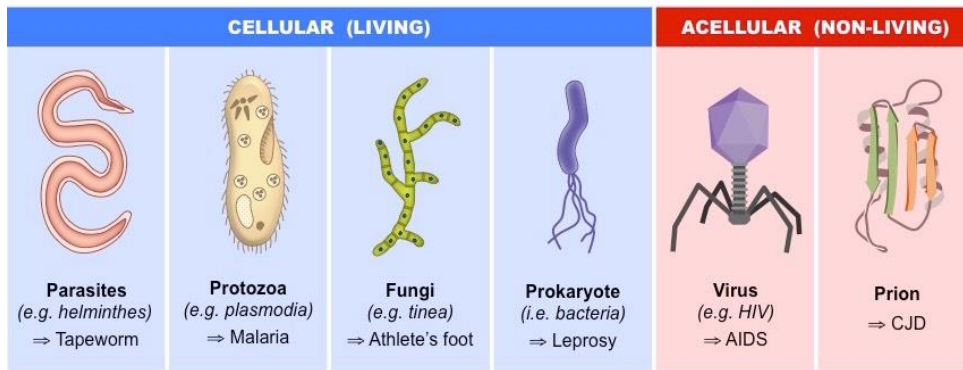
**Types of Epithelium**





Chemical secretions can be produced by epithelial cells against invading pathogens. These include tears, saliva, \_\_\_\_\_ and stomach acid.

A pathogen is a \_\_\_\_\_, virus or other organism that can cause disease.

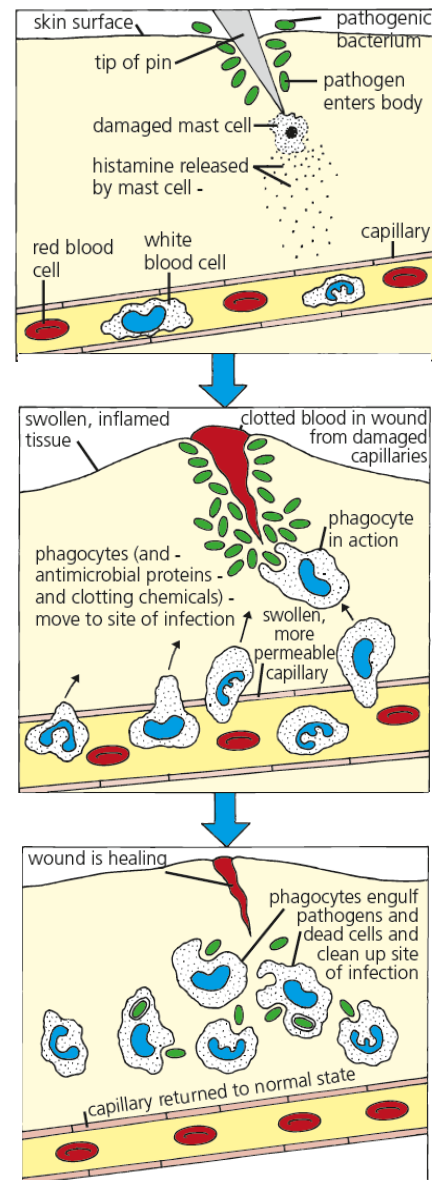


### Inflammation

During inflammation, \_\_\_\_\_ is released by mast cells causing vasodilation and increased capillary \_\_\_\_\_.

The increased blood flow leads to an \_\_\_\_\_ of phagocytes and clotting elements at the site of infection.

Use the diagram to summarise the inflammatory response into steps.

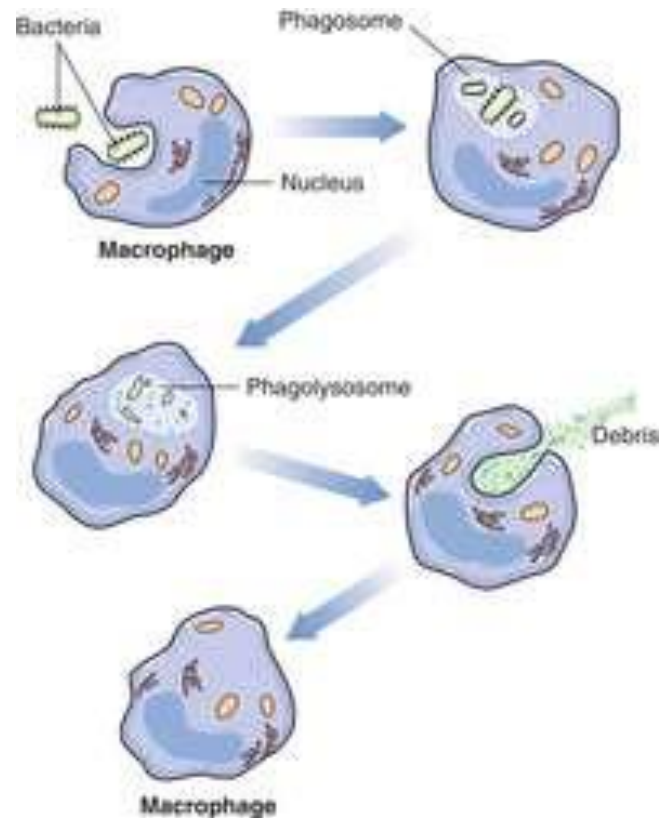


## Phagocytosis

\_\_\_\_\_ recognise pathogens and destroy them by \_\_\_\_\_.

\_\_\_\_\_. This involves the engulfing of pathogens and their destruction by digestive enzymes contained in \_\_\_\_\_.

\_\_\_\_\_ are protein molecules that act as a signal to specific white blood cells (including phagocytes) causing them to \_\_\_\_\_ at the site of infection.



### CONSOLIDATION TASKS

**Essays** - Taken from How to Pass Higher Human page 174

- Describe non-specific defences that the body uses to protect itself from pathogens. (8)
- Give an account of inflammation under the following headings:
  - Role of mast cells (3)
  - Phagocytosis (4)

**Past Paper Question** - Revised Higher 2012 q14

**Extension task** - Draw a flow chart of the process of inflammation.

## KEY AREA 5 GLOSSARY

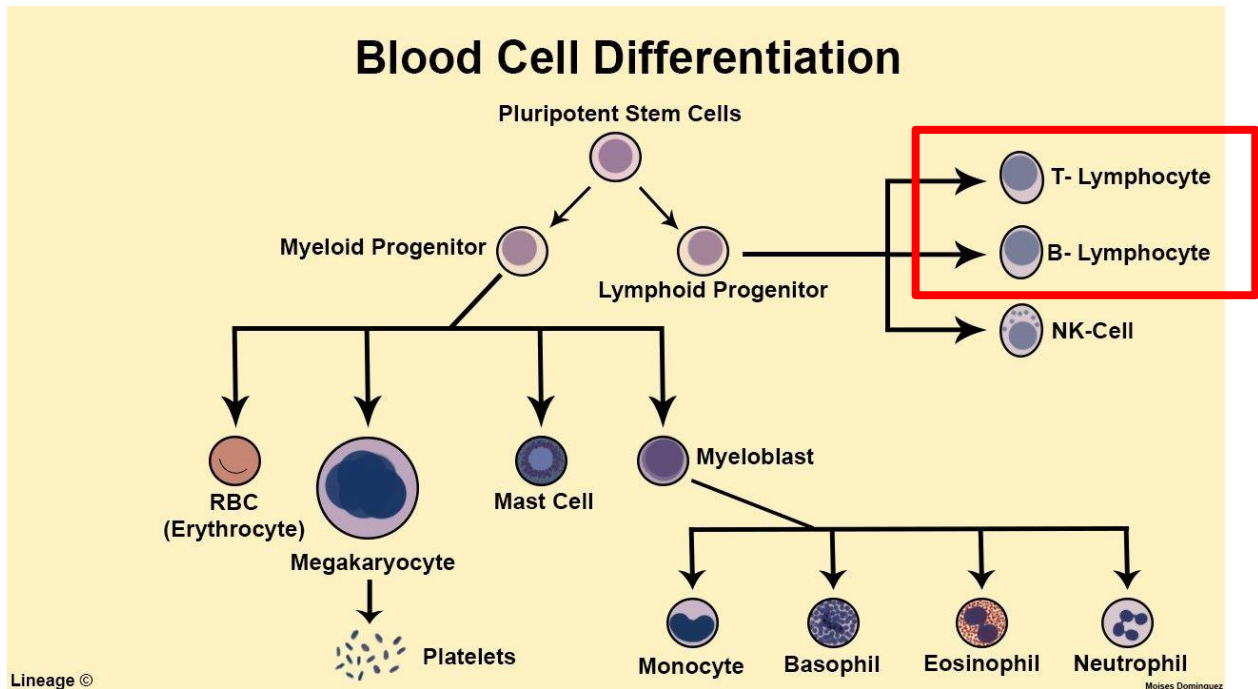
Barrier defences	
Epithelial cells	
Chemical defences	
Inflammation	
Mast cells	
Histamine	
Vasodilation	
Capillary permeability	
Phagocytosis	
Cytokine	

## The small print: Key Area 6

### Specific Cellular Defences against Pathogens

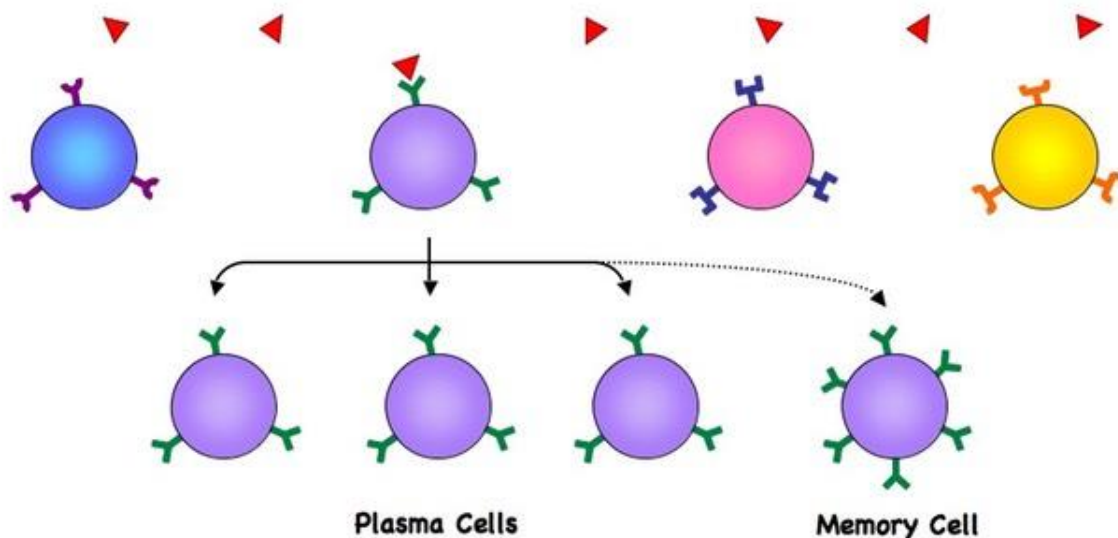
- Define lymphocytes as the white blood cells involved in the specific immune response.
- Define antigens as molecules (often proteins) located on the surface of cells that trigger a specific immune response.
- Explain clonal theory to include lymphocytes having a single type of membrane receptor specific for one antigen.
- State that antigen binding to these sites leads to repeated division of the lymphocyte, resulting in a clonal population of lymphocytes.
- State that lymphocytes are responsible for a specific response to foreign antigens and come in T and B forms.
- Explain the role of T lymphocytes in immunity to include their ability to identify cells as non-self, due to recognition of specific surface proteins.
- State that an auto immune disease is a failure by T lymphocytes to recognise self-antigens.
- State that one group of T lymphocytes destroy infected cells by inducing apoptosis.
- State that B lymphocytes produce specific antibodies that recognise specific antigens.
- State that the resulting antibody-antigen complex may inactivate a pathogen or toxin, rendering it more susceptible to phagocytosis.
- State that these cloned B lymphocytes secrete antibodies into lymph and blood that make their way to the infected area.
- State that an allergy is a normally harmless hypersensitivity by B lymphocytes to an antigen.
- State that some B and T lymphocytes produced as a result of clonal selection survive long term as memory cells.
- State that the specific lymphocytes produced by these memory cells can destroy the invading pathogens before the individual shows symptoms.
- State that the presence of these memory cells result in a more rapid and greater secondary immune response.
- State that HIV directly attacks lymphocytes, which is the major cause of AIDS.
- Explain how individuals with AIDS are more vulnerable to opportunistic infections.

## Key Area 6 - Specific Cellular Defences against Pathogens



\_\_\_\_\_ are white blood cells involved in the specific immune response. They have a single type of membrane receptor specific to one antigen.

\_\_\_\_\_ are molecules (often proteins) that are located on the surface of cells and can trigger an immune response.



Antigen binding leads to repeated lymphocyte division resulting in a \_\_\_\_\_ population of identical lymphocytes.

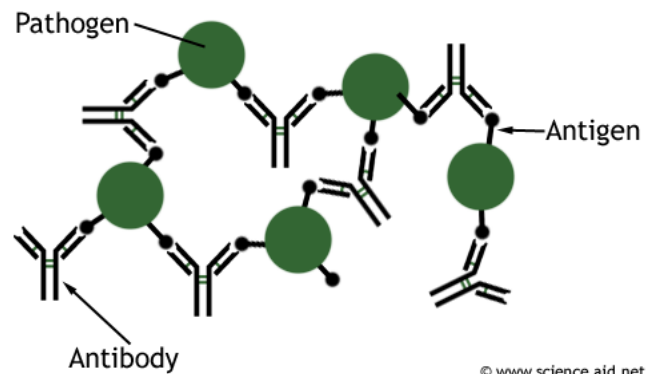
## B Lymphocytes

There are two types of lymphocytes - B and T.

B lymphocytes produce \_\_\_\_\_ against antigens and this leads to the destruction of the pathogen.

Antibodies are Y-shaped \_\_\_\_\_ that have receptor binding sites specific to a particular antigen on a pathogen. Antibodies become bound to pathogens, \_\_\_\_\_ the pathogen.

The resulting antigen-antibody \_\_\_\_\_ can then be destroyed by \_\_\_\_\_.

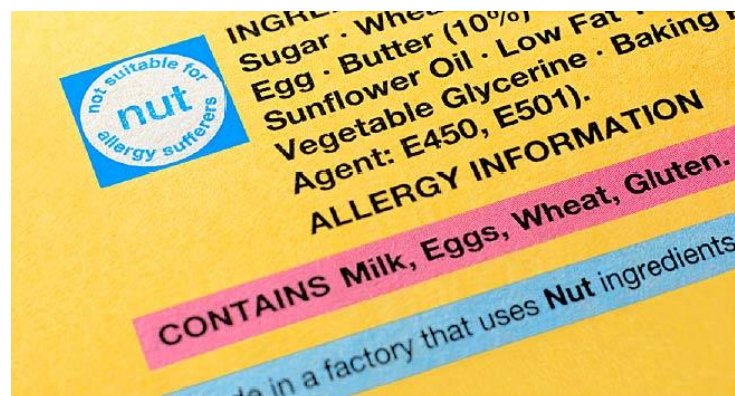


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## Allergy

Sometimes, B lymphocytes respond to antigens on substances that are \_\_\_\_\_ to the body (e.g. pollen).

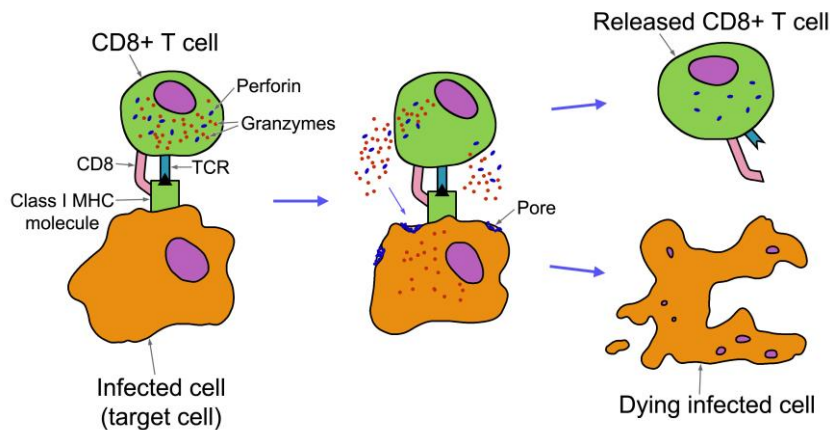
This \_\_\_\_\_ response is called an allergic reaction.



## T Lymphocytes

T lymphocytes destroy infected body cells by recognising antigens of the pathogen on the membrane and induce \_\_\_\_\_ (programmed cell death).

T lymphocytes attach onto infected cells and release proteins. These proteins diffuse into the infected cells causing production of \_\_\_\_\_ enzymes which cause cell death.



The remains of the cell are then removed by \_\_\_\_\_.

## Autoimmunity

T lymphocytes can normally distinguish between \_\_\_\_\_ on the body's own cells and \_\_\_\_\_ on infected cells.

Failure of the regulation of the immune system leads to T lymphocytes responding to self-antigens. This causes \_\_\_\_\_ disease.

In autoimmunity, the T lymphocytes attack the body's own cells. This causes autoimmune diseases such as type 1 diabetes and \_\_\_\_\_.

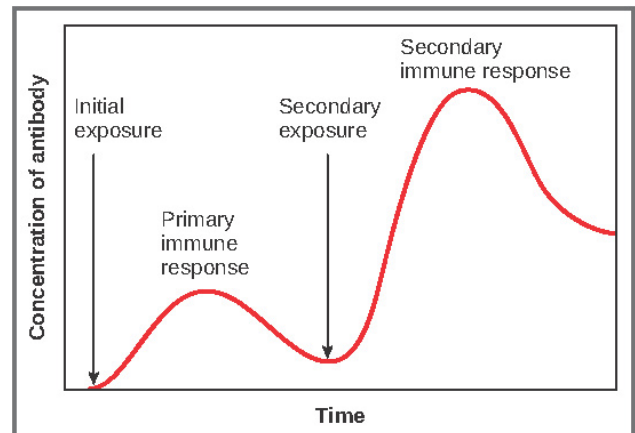


## Immunological Memory

Some of the cloned B and T lymphocytes survive long-term as memory cells.

When a \_\_\_\_\_ exposure to the same antigen occurs, these memory cells rapidly give rise to a new clone of specific lymphocytes. These destroy invading \_\_\_\_\_ before the individual shows symptoms.

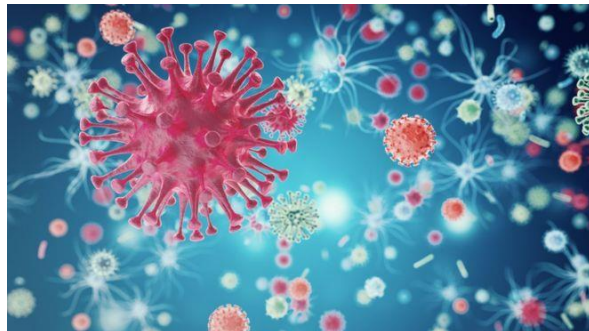
During the secondary response, \_\_\_\_\_ production is greater and more rapid than in the primary response.



## HIV

The human \_\_\_\_\_ virus (HIV) attacks and destroys T lymphocytes. HIV causes depletion of T lymphocytes which leads to the development of AIDS (\_\_\_\_\_ immune deficiency syndrome).

Individuals with AIDS have a \_\_\_\_\_ immune system and are more vulnerable to \_\_\_\_\_ infections.



### CONSOLIDATION TASKS

**Essay** - Taken from How to Pass Higher Human page 180

- Write notes on specific cellular defence against infection under the following headings:
  - Action of B lymphocytes (4)
  - Action of T lymphocytes (3)

**Textbook** - Use page 348 of the textbook to find out about HIV.

**Past Paper Questions** -

- Higher 2016 q12
- Higher 2017 q10
- Higher Specimen q16



## KEY AREA 6 GLOSSARY

Lymphocyte	
Antigen	
Clonal selection	
T lymphocyte	
Self antigen	
Non-self antigen	
Autoimmune Disease	
B lymphocyte	
Antibody	
Allergy	
Memory cells	
HIV	

**The small print: Key Area 7**  
**Immunisation**

State that active immunity can be developed by vaccination with antigens from infectious pathogens and this leads to immunological memory.

State that vaccines can contain inactivated pathogen toxins, dead pathogens, parts of pathogens or weakened pathogens.

State that antigens are usually mixed with an adjuvant when producing the vaccine to enhance the immune response.

State that herd immunity occurs when a large percentage of a population are immunised.

Describe the importance of herd immunity in infectious disease control.

State that non-immune individuals are protected due to a lower chance of them coming into contact with infected individuals.

State that herd immunity threshold depends on the type of disease, the efficacy of the vaccine and the density of the population.

Explain how public health immunisation programmes establish herd immunity to a number of diseases.

State that difficulties in establishing widespread vaccination include malnutrition, poverty and rejection of the vaccine by a percentage of the population in the developed world.

State that some pathogens (e.g. influenza) can change their antigens, avoiding the effect of the immunological memory (antigenic variation).

## Key Area 7 - Immunisation

Use the internet to research the vaccinations for two of the following diseases (use the space below to write notes)

- Polio
- Human Papilloma Virus (HPV)
- Measles
- Rubella

Immunity can be developed by \_\_\_\_\_ using antigens from infectious pathogens, so creating \_\_\_\_\_ cells.

The antigens used in vaccines can be inactivated pathogen toxins, dead pathogens, parts of pathogens and \_\_\_\_\_ pathogens.

Antigens are usually mixed with an \_\_\_\_\_ when producing the vaccine.

An adjuvant is a substance which makes the vaccine more effective, so \_\_\_\_\_ the immune response.

### **Herd Immunity**

Herd immunity occurs when a large percentage of a population is immunised.

Establishing herd immunity is important in reducing the \_\_\_\_\_ of diseases.

Non-immune individuals are protected as there is a lower \_\_\_\_\_

they will come into contact with \_\_\_\_\_

individuals. The herd immunity \_\_\_\_\_

depends on the type of disease, the

effectiveness of the vaccine and the \_\_\_\_\_ of the population.

*Glue in your herd immunity diagram here...*

Mass vaccination programmes are designed to establish \_\_\_\_\_ to a disease.

Difficulties can arise when widespread vaccination is not possible due to \_\_\_\_\_ in the developing world, or when vaccines are \_\_\_\_\_ by a percentage of the population in the developed world.

### **Antigenic Variation**

Some pathogens can change their \_\_\_\_\_. This means that memory cells are \_\_\_\_\_ effective against them.

Antigenic variation occurs in the \_\_\_\_\_ virus explaining why it remains a major public health problem and why individuals who are at \_\_\_\_\_ require to be vaccinated every year.

**CONSOLIDATION TASKS**

**Essay** - Taken from How to Pass Higher Human Biology page 189

- Give an account of the immunisation under the headings:
  - Vaccination
  - Difficulties encountered achieving widespread vaccination.

**Textbook Questions page 349**

**Past Paper Questions**

- Revised Higher 2012 q12
- Higher 2016 q11
- Higher 2015 q13
- Higher Specimen q11

**KEY AREA 7 GLOSSARY**

Vaccination	
Adjuvant	
Herd immunity	
Poverty	
Rejection of vaccine	
Antigenic variation	

### The small print: Key Area 8

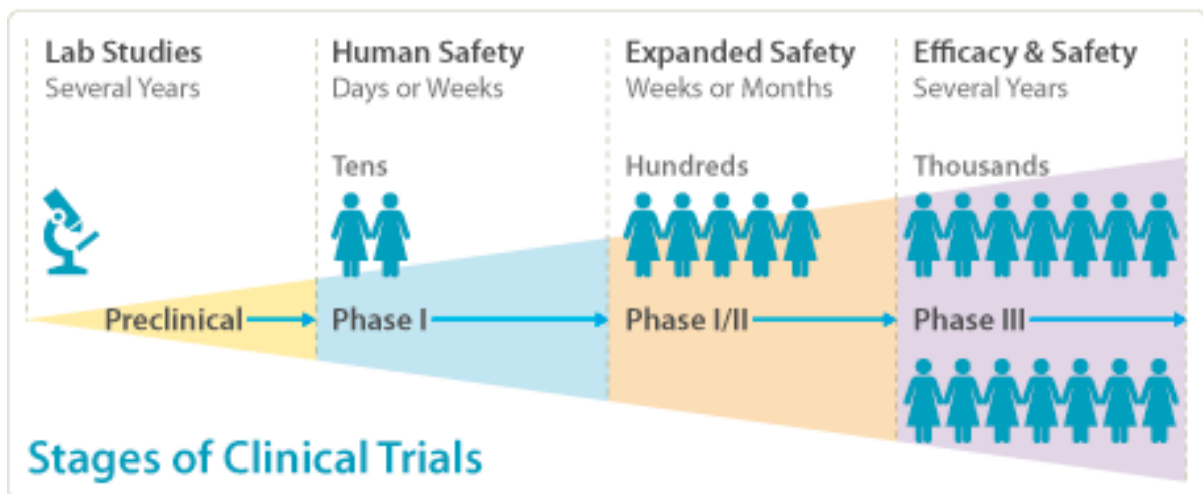
#### Clinical Trials

State that vaccines and drugs are subjected to clinical trials to establish their safety and effectiveness before being licensed for use.

State that an effective clinical trial design to test vaccine and drugs should be randomised, double-blind and placebo controlled.

Explain the importance of group size in reducing experimental error and establishing statistical significance.

### Key Area 8 - Clinical Trials of Vaccines and Drugs

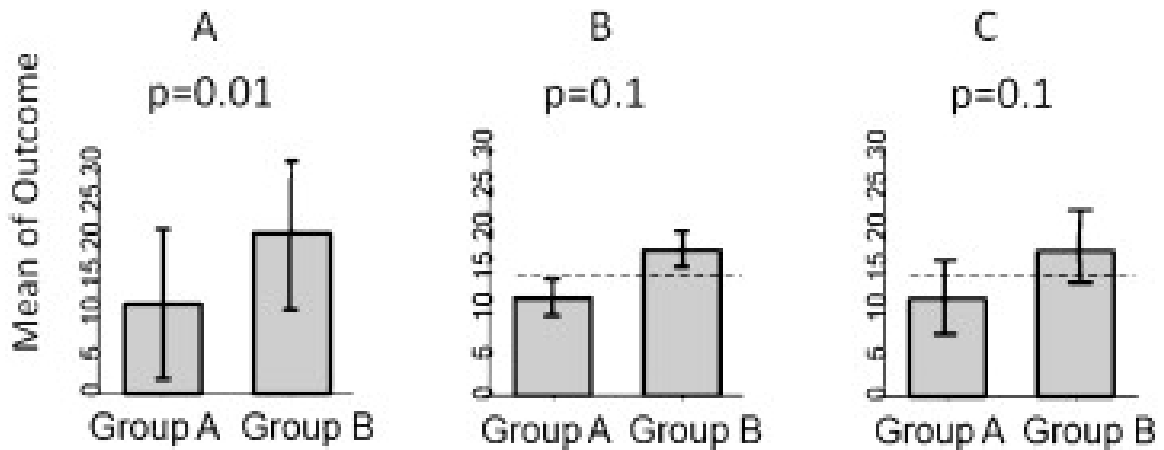


Vaccines and drugs are subjected to clinical trials to establish their \_\_\_\_\_ and \_\_\_\_\_ before being licenced for use.

The design of clinical trials to test vaccines involves \_\_\_\_\_, double-blind and placebo-controlled protocols. Subjects in clinical trials are divided into groups in a randomised way to reduce \_\_\_\_\_ in the distribution of characteristics such as age and gender.

In a \_\_\_\_\_ trial neither the subjects nor the researchers know which group subjects are in to prevent biased interpretation of the results.

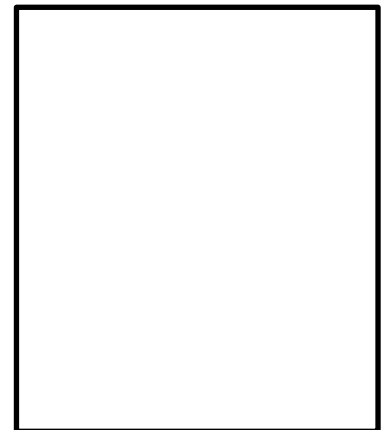
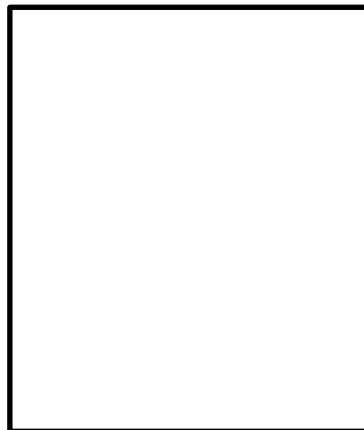
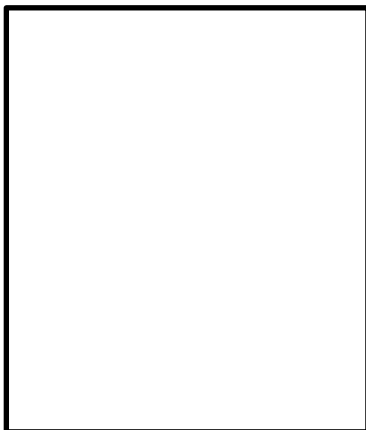
One group of subjects receives the vaccine or drug while the second group receives a \_\_\_\_\_-control to ensure valid comparisons.



Error-bar: SD

SE

95% CI



At the end of the trial, results from the two groups, which must be of a suitable size to reduce the magnitude of experimental \_\_\_\_\_, are compared.

This allows us to determine whether there are any \_\_\_\_\_ significant differences between the groups.

## CONSOLIDATION TASKS

Textbook - page 339 q3b

### Past Paper Questions -

- Revised Higher 2012 q13
- Revised Higher 2013 q14
- Higher Specimen q14

## KEY AREA 8 GLOSSARY

Clinical trial	
Randomised	
Double-blind	
Placebo	
Experimental error	
Statistical significance	