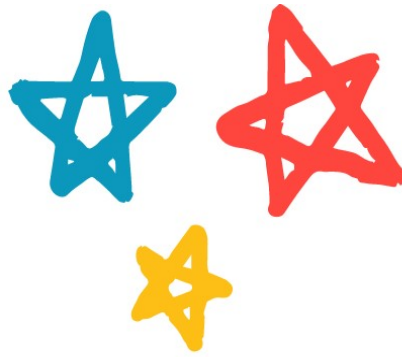
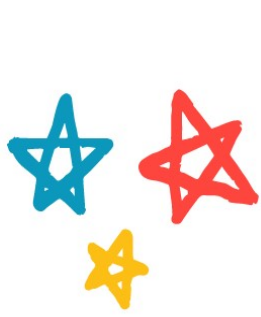
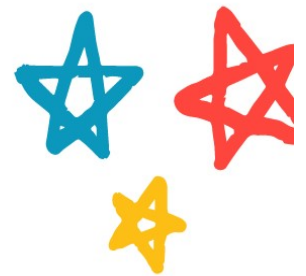
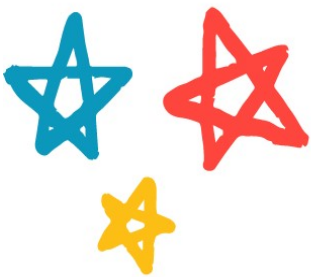
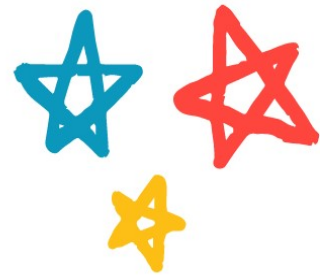
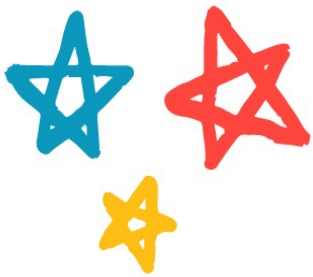
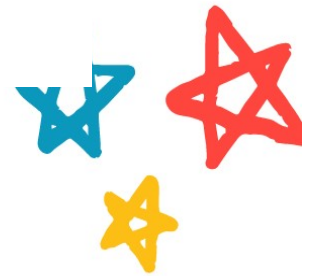
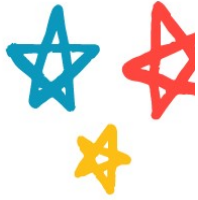
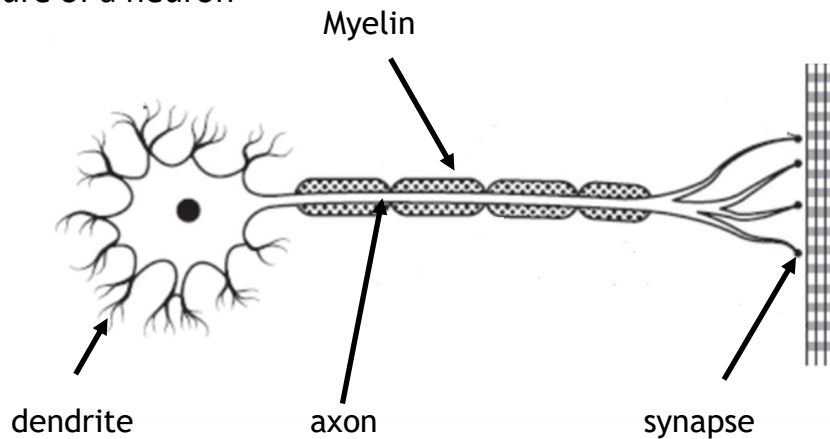


Unit 3 Revision Notes



Neurons

Structure of a neuron



Electrical impulses move along neurone via:

dendrite → cell body → axon

Myelin

This is a fatty substance that surrounds the action

Function of myelin

1. Insulates the axon
2. Increases the speed of transmission of nerve impulses.

Glial Cells

1. Produce myelin
2. Support neurons

Myelination

The formation of myelin starts at **birth & continues to adolescence**

Under two's responses to stimuli is not as rapid or co-ordinated as those due to unmyelinated neurons.

Demyelination

Certain diseases e.g. MS destroy the myelin sheath causing a loss of co-ordination

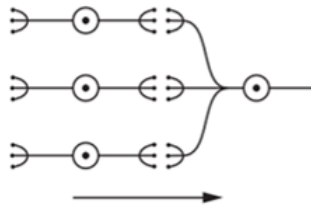
Types of Neural Pathways

3 Types of neural pathway:

1. Converging Neural Pathways

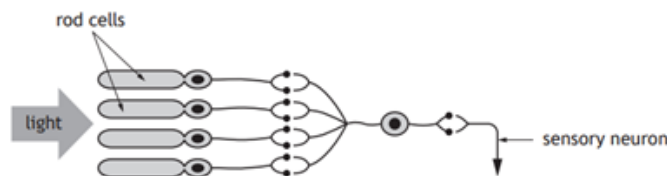
Impulses from several sensory neurons travel to one neuron.

This increases the sensitivity to signals as the signal are concentrated.



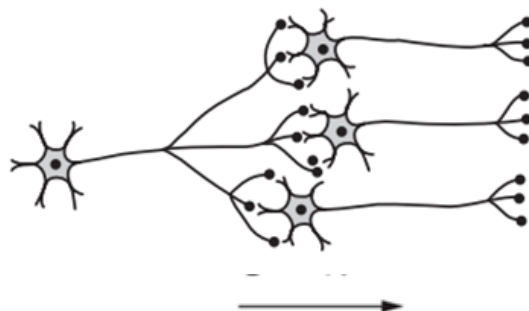
Retina Eye example

Convergence of rod neurons in the retina, increase sensitivity to low levels of light through summation



2. Diverging Neural Pathway

Impulses from one neuron travel to several MOTOR neurons and affect more than one destination at a time.



Finger Example

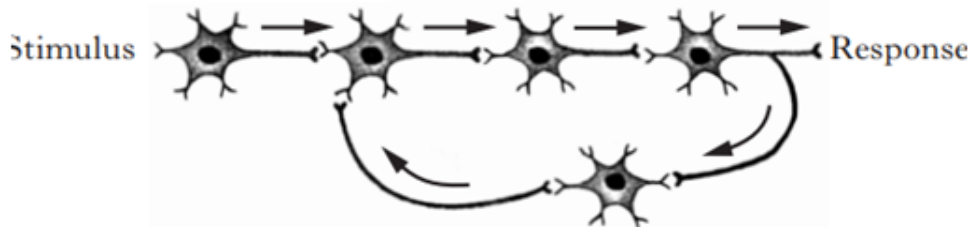
Divergence of motor neurones allows fine **motor** control of fingers.

Types of Neural Pathways

3 Reverberating Neural Pathways

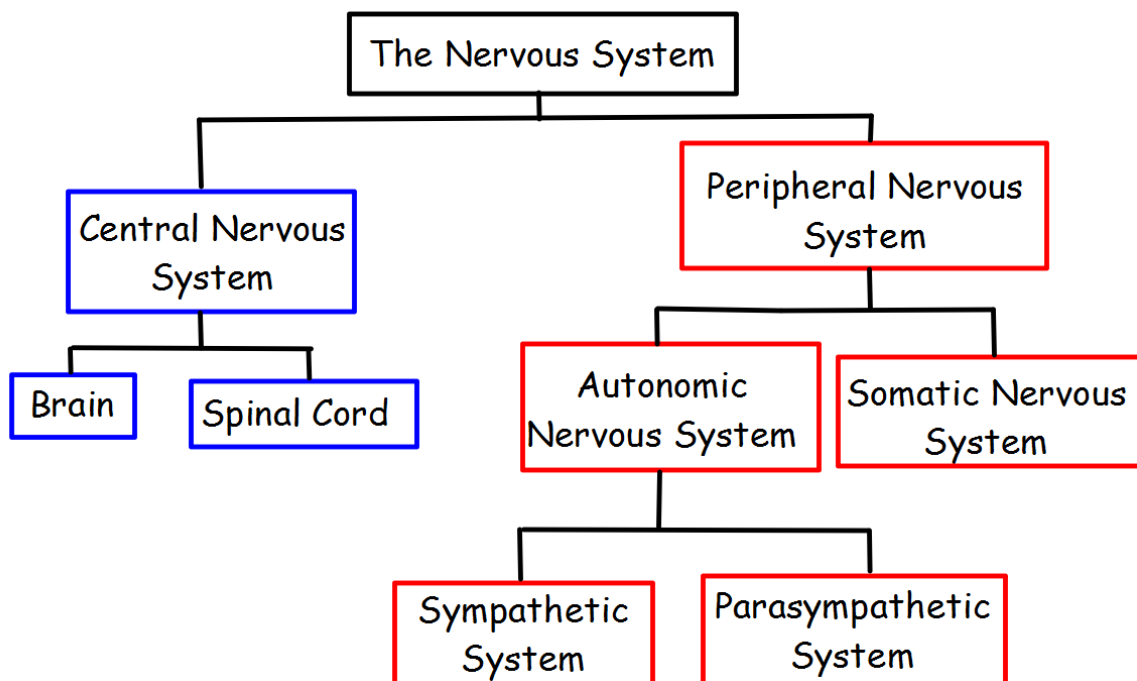
Neurons later in the pathway link with earlier neurons, sending the impulse back through the pathway.

This allows repeated stimulation of the pathway



Nervous System Summary

1. CNS
(brain & spinal cord)
2. PNS
(ANS & SNS)



Somatic Nervous System

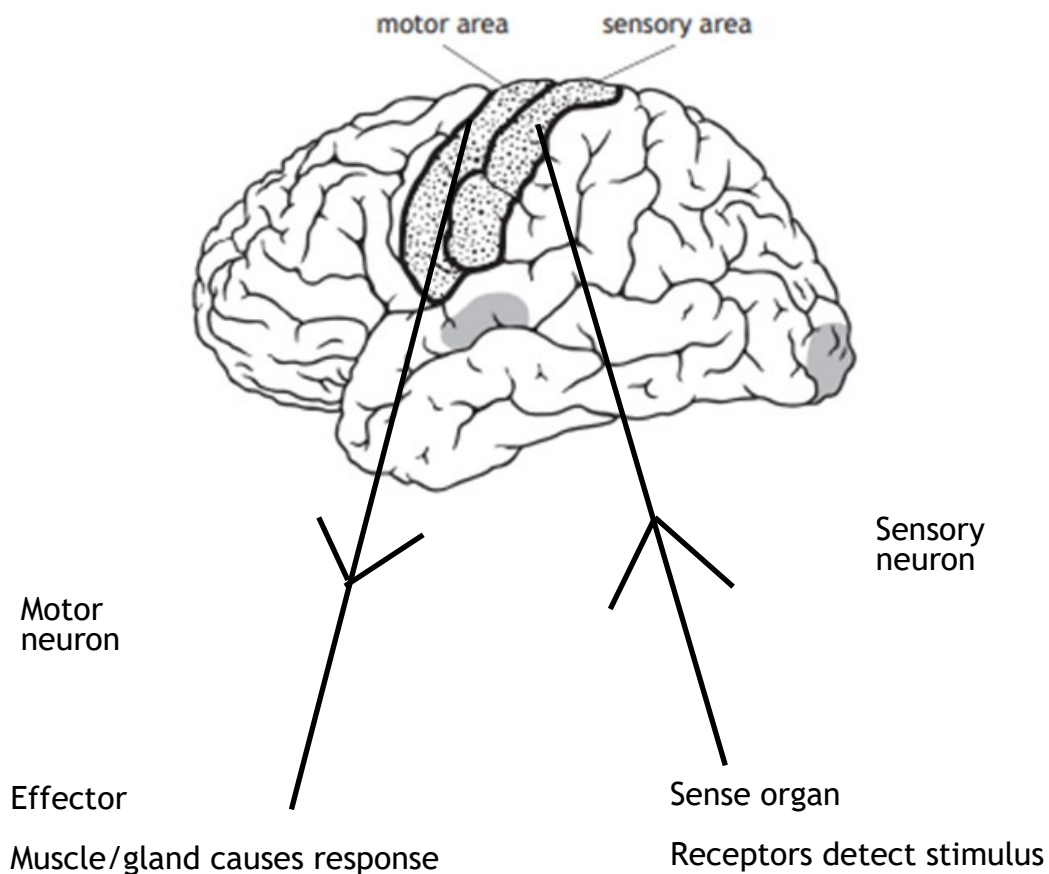
It is mostly in control of **voluntary actions** such as **contraction of** skeletal muscles .

1. Sensory neurons (converging neural pathway)

Carry impulses from the **sense organs** to the **CNS**.

2. Motor neurones (diverging neural pathway)

Carry impulses from the **CNS** to the **muscles/glands**.



Autonomic Nervous system

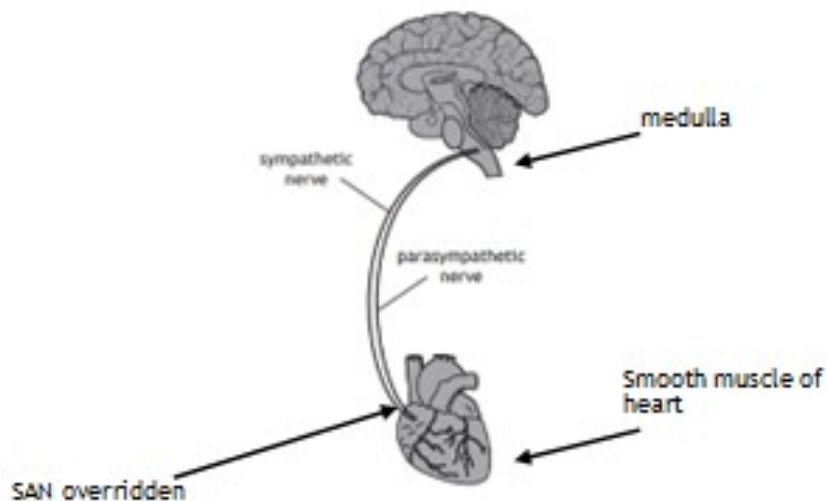
The **medulla** in the brain sends information to **smooth muscle** via the **antagonistic actions (opposing) actions** of sympathetic and parasympathetic neurones.

These sympathetic/parasympathetic neurones controls largely involuntary contraction and relaxation of smooth muscle

Heart

Diaphragm

Small intestine



Sympathetic Neurones

Produce Noradrenaline

Fight or flight response

Parasympathetic neurones

Produce acetylcholine

Rest or digest

Physiological Factor	Sympathetic Nervous System	Parasympathetic Nervous System
Heart Rate	increases	decreases
Breathing Rate	increases	decreases
Intestinal Secretions	decreases	increases
Peristalsis	decreases	increases

Cerebral Cortex

Structure of Cerebral Cortex

Outermost layer of the cerebrum & largest proportion of the brain.

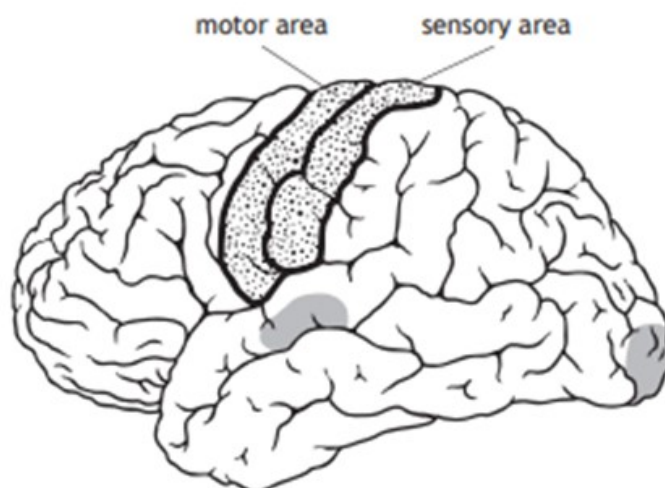
Functions of Cerebral cortex

- Conscious thought
- Recalls memories
- Alters behaviour in light of experience

Localisation of brain functions

This means that certain areas are responsible for certain functions, distinct from one another.

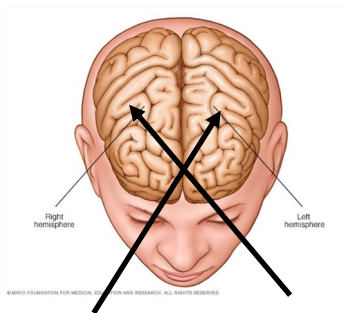
1. **Sensory areas of cortex**
Receive sensory information from receptors in sense organ via converging pathways of sensory neurones
2. **Motor areas of cortex**
Send information to muscles/gland effectors via motor neurones.
3. **Association areas of cortex**
 - language processing
 - personality
 - imagination
 - intelligence



Cerebral Hemispheres

Cerebral Hemispheres

The cerebral cortex is split into left and right hemispheres



Right hemisphere

1. Deals with information from the left visual field
2. Motor control for the right side of the body

Left Hemisphere

1. Deals with information from the right visual field
2. Motor control for right side of the body

Corpus Callosum

Allows the transfer of information

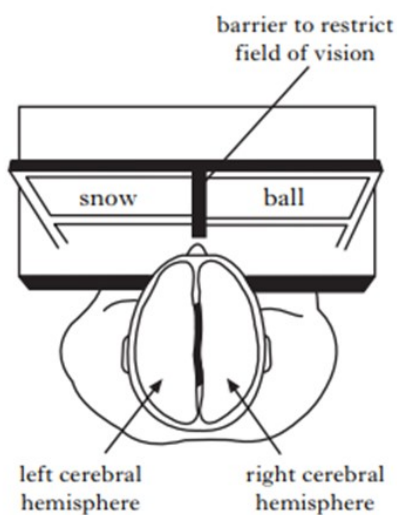
between the cerebral hemispheres.



Split Brain Studies

Information from only the right visual field can be said out loud using Speech centres in the left hemisphere.

This is because the corpus callosum has been severed, preventing **exchange of information** from right to speech centres in left hemisphere



<i>Left cerebral hemisphere</i>	<i>Right cerebral hemisphere</i>
processes information from right eye	processes information from left eye
controls language production	controls spatial task co-ordination

Type of Memory

1. Sensory memory

Retains all visual/auditory signals received for only a **FEW seconds**.

Only **selected images** and sounds are encoded into STM

2. Short-term memory (STM)

Limited capacity (5-9 item memory span)

Only retain information for a **short time** then information will be

1. Displaced (new information replacing old)
2. Decay (breakdown of memories).
3. **Encoded** into LTM

Improving Capacity of STM

1. Rehearsal
Repeating information over time can help to extend the time information remains in the STM.

2. Chunking

Grouping related information thereby reducing the number of items the brain needs to recall at any one time.

3. Long Term Memory (LTM)

Unlimited capacity

Holds information for a **long period of time**.

Contextual Cues

Assist retrieval of information from LTM

Pieces of information that relate to the **time/place** that the original memory was **encoded**,

Forming Memories

1. Encoding

Converting information to a form that the brain can process and store.

1. Sensory to STM
2. STM to LTM

1. Rehearsal

Repeating information over and over.

Shallow form; may not lead to long term retention.

2. Organisation- grouping related information into categories.

3. Elaboration

Adding information, e.g. adding a diagram to a definition.

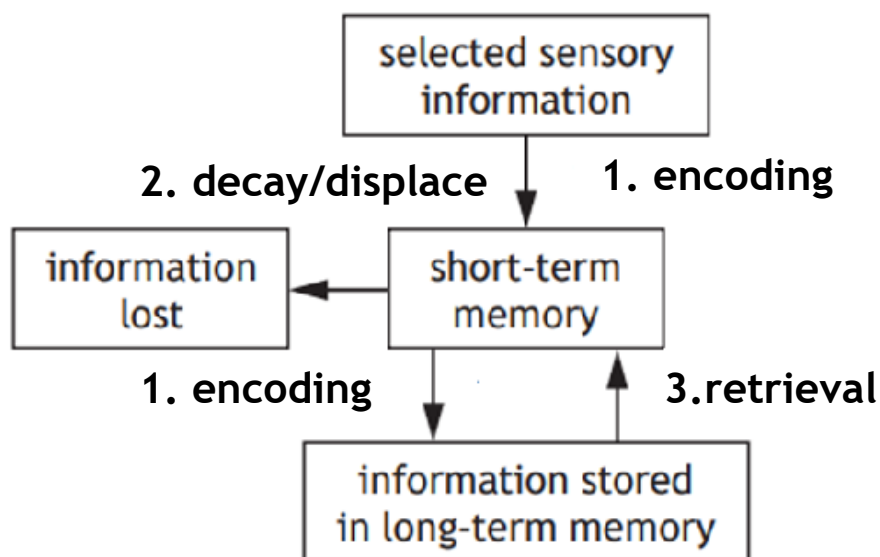
Deeper form ; may lead to improved information retention

2. Storage

Retention of information over a period of time.

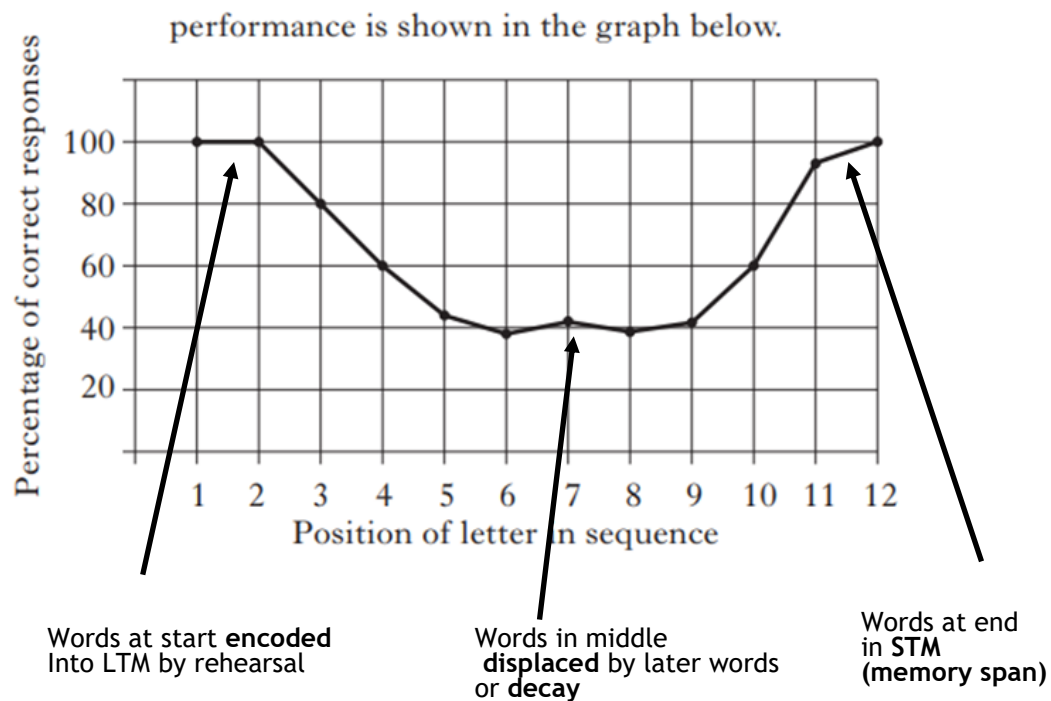
3. Retrieval-

Recovery of stored material from LTM which is aided by contextual cues.



Working Memory & Serial position Effect

This describes the fact that we are more likely to recall items at the start and end of a list from our STM.



Working memory

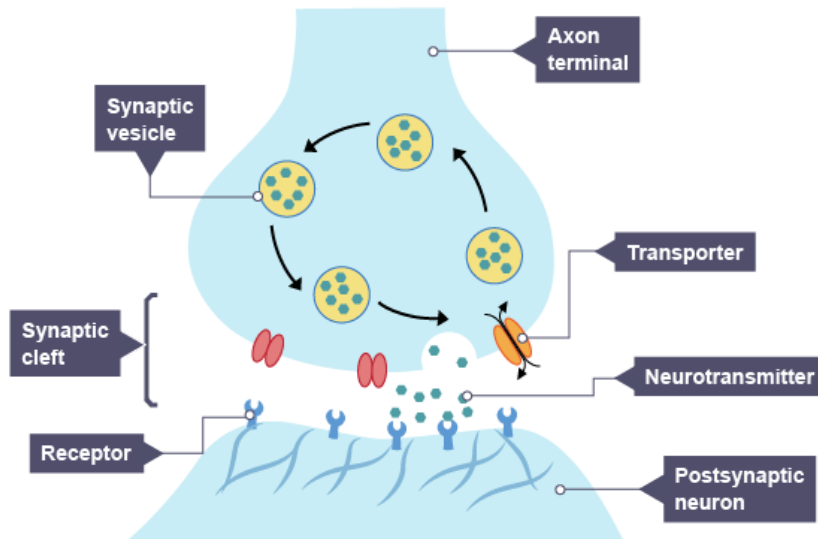
The STM is now thought to be able to process data, to a limited extent as well as store it.

Working memory allows our STM to carry out simple cognitive tasks.

Nerve transmission

Neurotransmitters at synapses

Neurons connect with other neurons/ muscle fibres via releasing neurotransmitters to relay impulses across the synaptic cleft



Stages of nerve impulse

1. Nerve impulse arrives at the pre-synaptic neuron.
2. Vesicles containing the chemical neurotransmitters are activated.
3. The vesicles move and release the neurotransmitters into the cleft.
4. Neurotransmitters diffuse across the cleft and bind to specific receptors on the post-synaptic neuron.
5. Nerve impulse is passed through the post synaptic neuron if threshold is met.

Threshold

The minimum number of neurotransmitter molecules attaching to receptors on the postsynaptic membrane for impulse to be transmitted.

Weak stimulus

If a weak stimulus cannot meet threshold with insufficient neurotransmitters released into the synapse, the synapse will filter out the weak stimulus.

Summation

Effect of a number of weak stimuli firing simultaneously from a number of different pre-synaptic neurons, cumulatively reaching threshold.

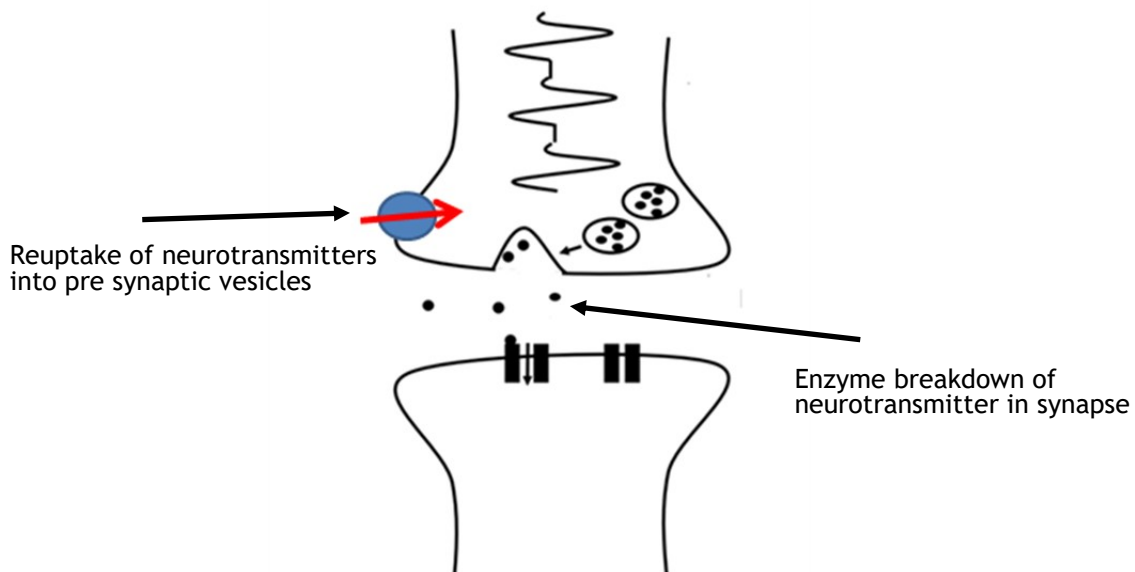
Example: Converging pathway

Nerve transmission

Removal of Neurotransmitters

The neurotransmitters need to be removed so that there is not continuous stimulation of the post-synaptic neuron after impulse has been transmitted.

1. Breakdown of the neurotransmitters by enzymes.
2. Reuptake of neurotransmitters by transporters into vesicles in the pre-synaptic neuron.



Excitatory and inhibitory signals

Signals generated at synapses can be

1. Excitatory (increase or cause activity)
2. Inhibitory (slow down or stop activity)

The type of signal generated depends on the type of receptor present on the post-synaptic neuron.

Some neurotransmitters can have an excitatory effect at one neuron and an inhibitory effect at another.

e.g. acetylcholine will have an excitatory effect at skeletal muscles but an inhibitory effect at cardiac muscle.

Neurotransmitters

Endorphins

Neurotransmitters that **reduce the intensity of pain**

Activities that produce endorphins

1. Sex
2. Eating food
3. Prolonged exercise

Severe injury and **stress** can also produce endorphins

Dopamine

Neurotransmitters induces feelings of **pleasure**.

Reinforces satisfying behaviour by activating the reward pathway in the brain.

Reward Pathway

Involves neurons which produce/respond to **dopamine**.

Activated when an individual engages in a behaviour that is perceived beneficial to them.

Example 1— Eating

When a person eats they are satisfying a fundamental need.

This stimulates the release of dopamine which activates the reward pathway ensuring eating behaviour continued.

Example 2—Taking illegal drugs

When a person takes an illegal drug they are inducing feelings of pleasure.

This stimulates the release of dopamine which activates the reward pathway ensuring drug taking behaviour continues.

Neurotransmitter Related Drugs

1. Agonists

Chemicals that **bind** to and **stimulate** specific receptors by **mimicking** the action of a neurotransmitter at a synapse.

2. Antagonists

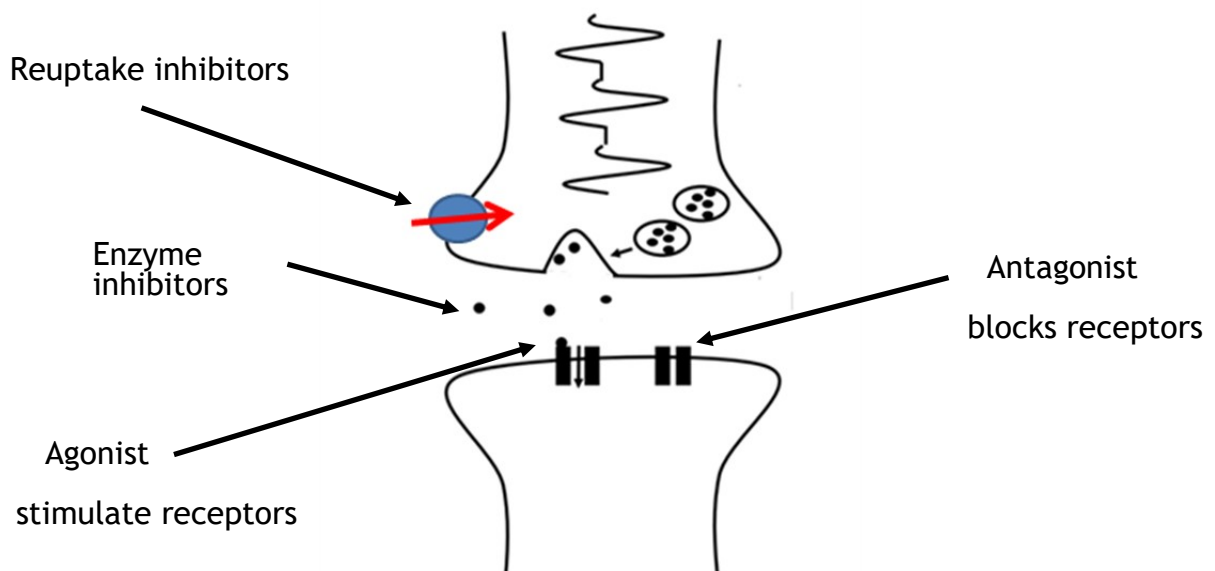
Chemicals that bind to specific receptors **blocking the action** of a neurotransmitter at a synapse.

3. Enzymes Inhibitors

Prevent degradation of neurotransmitters at synapse.
Neurotransmitter level at synapse remains high.

4. Reuptake inhibitors

Prevent re uptake of neurotransmitters which are normally recycled into pre synaptic vesicles.
Neurotransmitter level at synapse remains high.



Recreational Drugs

Mode of Action of Recreational Drugs

Recreational drugs can also act as **agonists/antagonists** & disturb the **normal neurotransmission** at synapses affecting:

1. **Mood**
2. **cognition** (ability to process information)
3. **perception** (interpreting what is around you)
4. **behaviour.**

Reward Pathway

Many recreational drugs affect neurotransmission in the **reward pathway of the brain.**

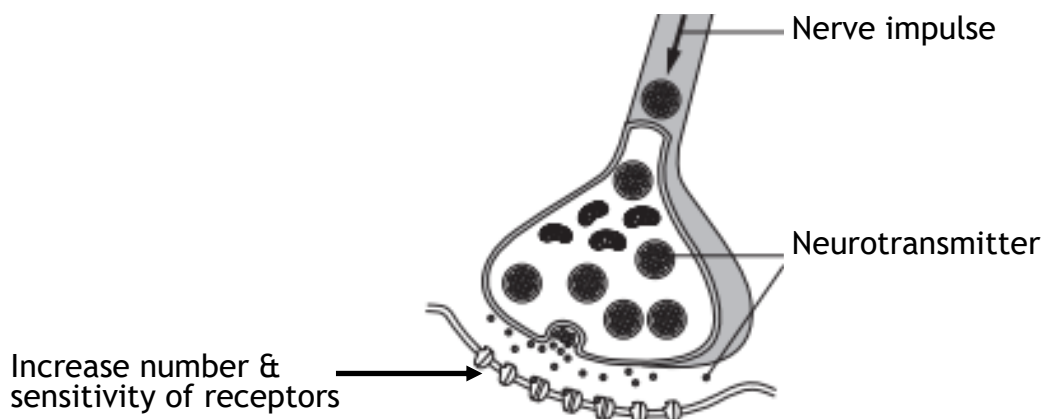
This explains why many recreational drugs give feelings of pleasure.

Drug addiction

Repeated use of antagonist drugs which block specific receptors.

The nervous system **increases both the number and sensitivity** of receptors.

This **sensitisation** leads to addiction where the individual craves more of the drug



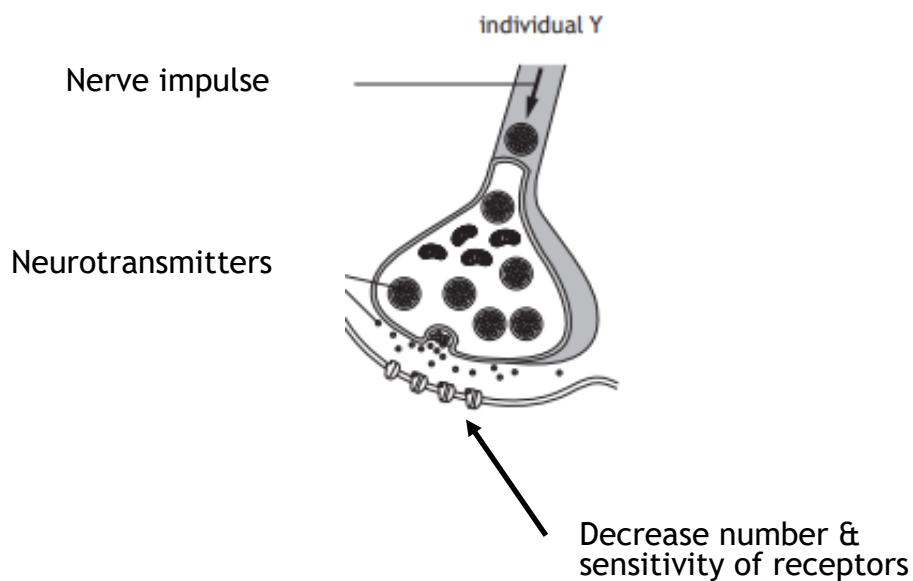
Recreational Drugs

Drug tolerance

Repeated use of **agonist drugs** which stimulates specific receptors

The nervous system **decreases both the number and sensitivity** of receptors.

This **desensitisation** leads to drug tolerance where the individual must take more of the drug to get an effect



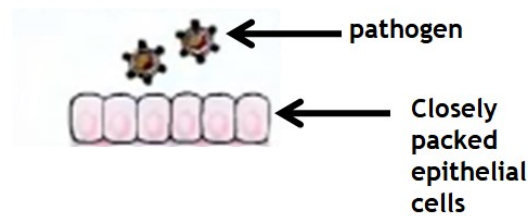
Non specific Body Systems

Defence against any type of pathogen (disease causing bacteria/virus/fungus)

1. Physical Barrier

Closely packed epithelial forms a physical barrier to invading pathogens.

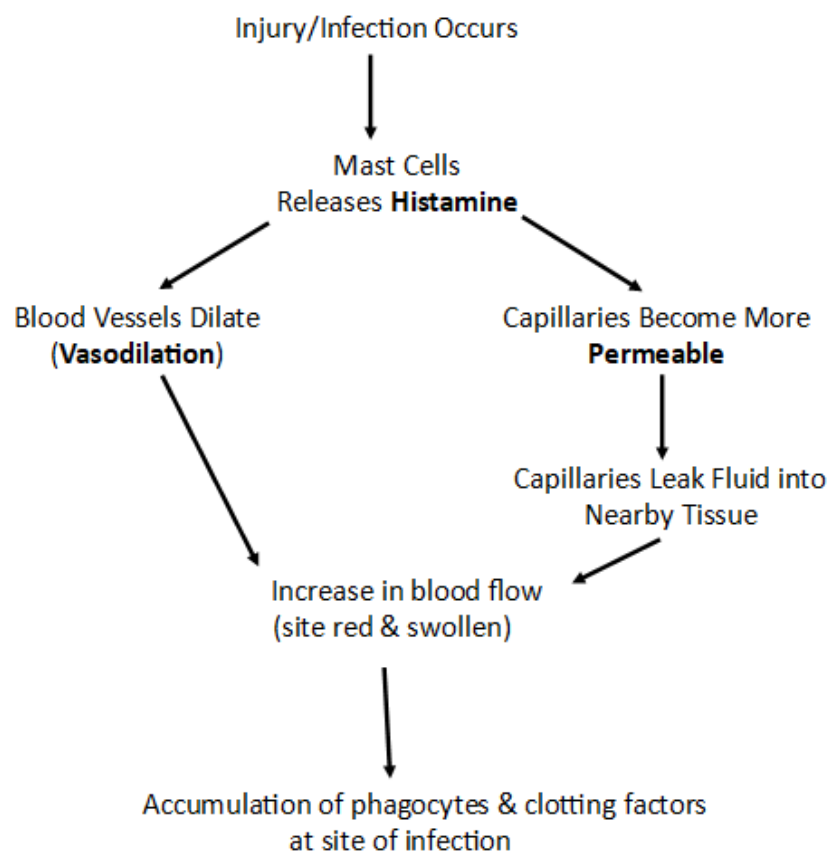
Location: skin & inner lining of digestive/respiratory tract.



2. Chemical Secretions

Tears, saliva, mucus and stomach acid are produced against invading pathogens.

3. The inflammatory response.



Phagocytes

Phagocytes

Type of WBC which recognises pathogens and degrades pathogens by **phagocytosis**-

2 Stages of phagocytosis: PEDE

Engulfment- the cell membrane of the phagocyte surrounds the pathogen and takes it into the cell .

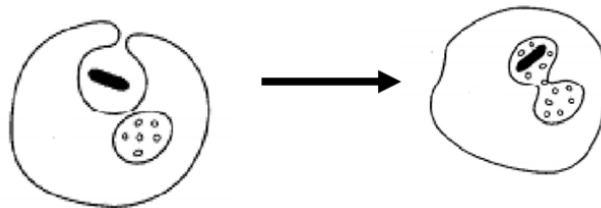
Digestion- **Vesicles** inside phagocytes release **digestive enzymes** which break down pathogen.

Phagocytosis

PEDE

Phagocyte Engulf

Digestive Enzyme

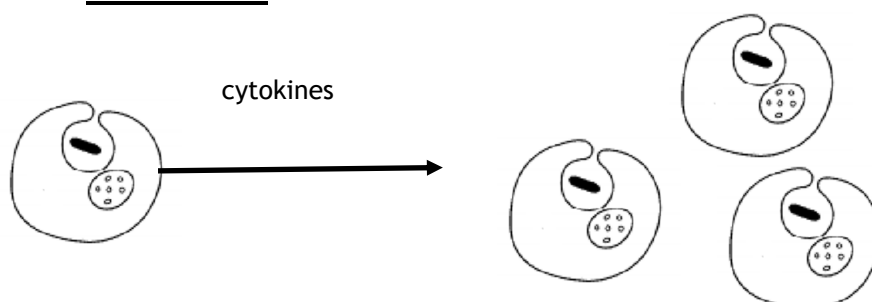


Phagocyte engulfs pathogen

Digestive Enzymes break down pathogen

Cytokines

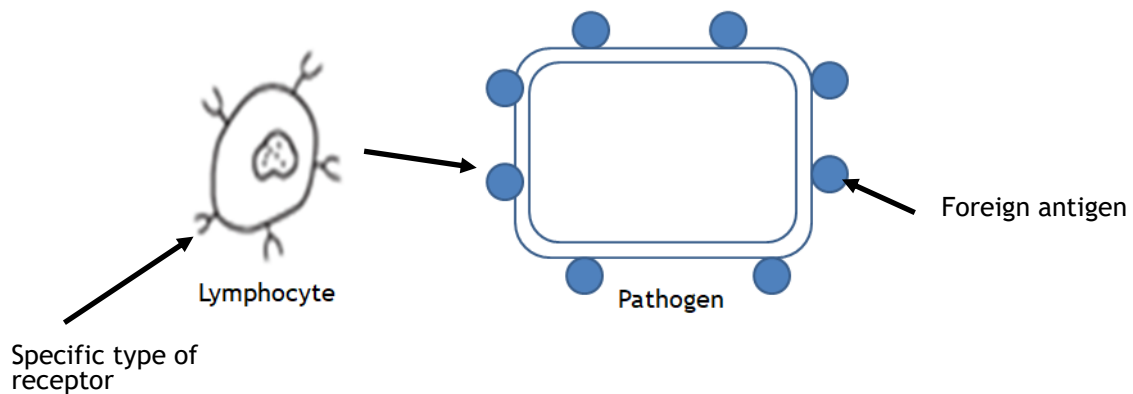
Phagocytes release protein signals that act as a **signal** to other phagocytes, causing them to **accumulate** at the site of the infection.



Specific Immune Response

Achieved via WBC's called B & T **Lymphocytes**.

Specific Lymphocytes have a single type of receptor which binds to a **specific foreign antigen proteins** on invading pathogens' cell membrane

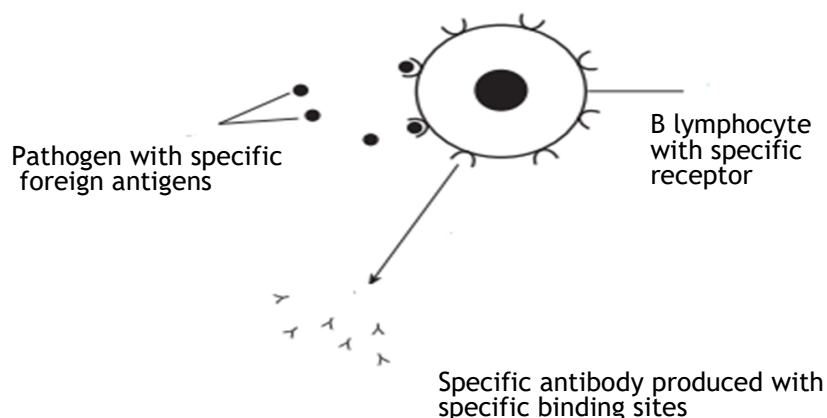


Clonal Population

This leads to repeated lymphocyte division resulting in the formation of a clonal population of identical lymphocytes.

B Lymphocytes

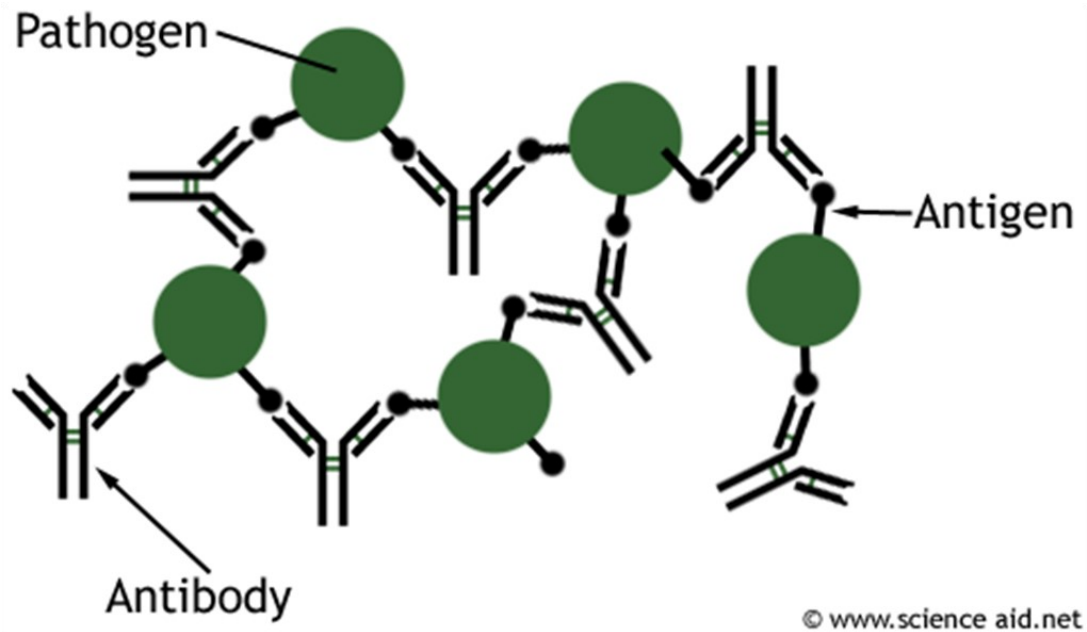
Produce specific Y shaped antibody proteins against foreign antigens that have specific receptor binding sites specific to a particular antigen on a pathogen.



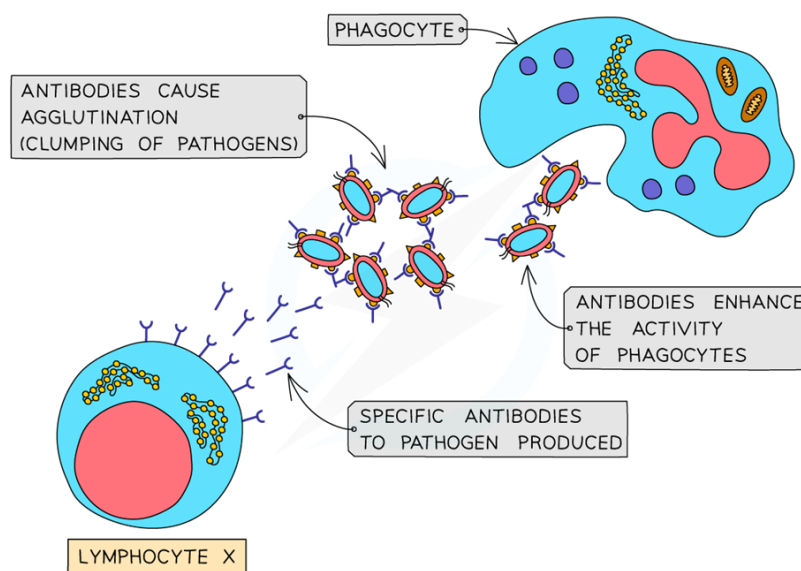
Antigen- Antibody Complex

Antibody-antigen complex

Antibodies become bound to antigens, inactivating the pathogen.



The resulting antigen-antibody complex can then be destroyed by phagocytosis



T Lymphocytes

Destroy infected body cells by inducing apoptosis aka programmed cell death.

T lymphocytes normally distinguish between self antigens on the body's own cells and non-self-antigens on infected cells.

4 step process

1. The T lymphocyte recognises foreign antigens of the pathogen on the surface of the cell membrane of the infected cell.
2. T lymphocyte attaches onto the infected cell and releases proteins.
3. Protein diffuse into the infected cell causing production of self-destructive enzymes which cause cell death.
4. The remains of the cell are removed by phagocytosis.

Diseases of the Immune System

Autoimmune Disease: T Lymphocytes

If T lymphocytes respond to self-antigens and attack the body's own cells.

1. Type 1 diabetes
2. Rheumatoid arthritis.



Allergic reaction: B Lymphocytes

If B lymphocytes respond to antigens on harmless substances this stimulates a

hypersensitive response.

1. Hay fever
2. Food allergy
3. Allergy to animals or dust



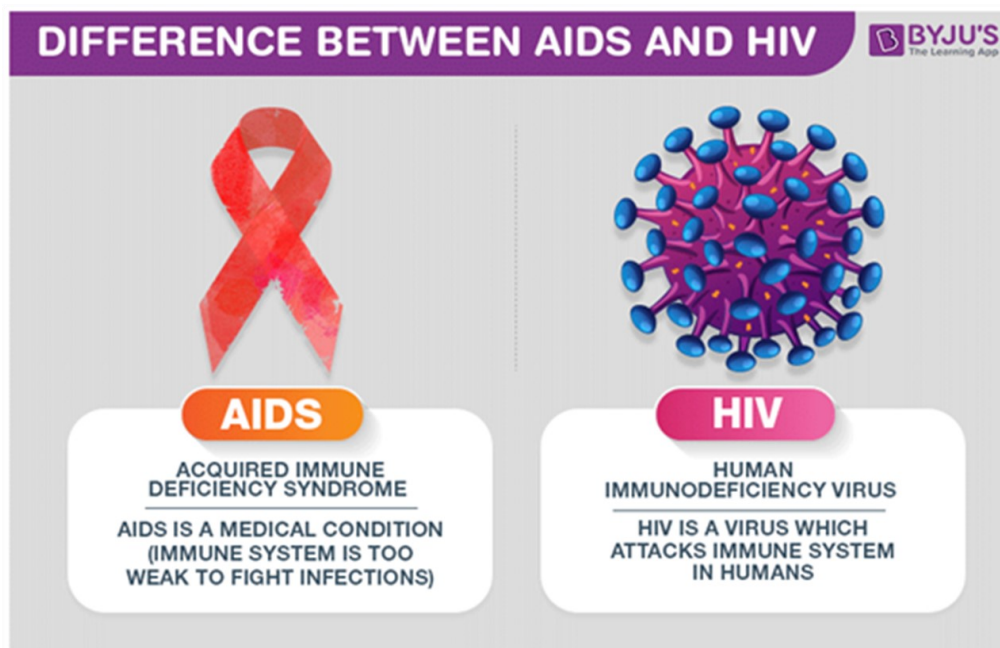
HIV & AIDS

HIV

A virus which attacks and destroys T lymphocytes.

This leads to the depletion of T lymphocytes leading to the development of **AID**.

Sufferers have a **weakened immune system** and are more vulnerable to opportunistic infections that would not affect those that are not immunocompromised.



Memory Cells & Secondary exposure

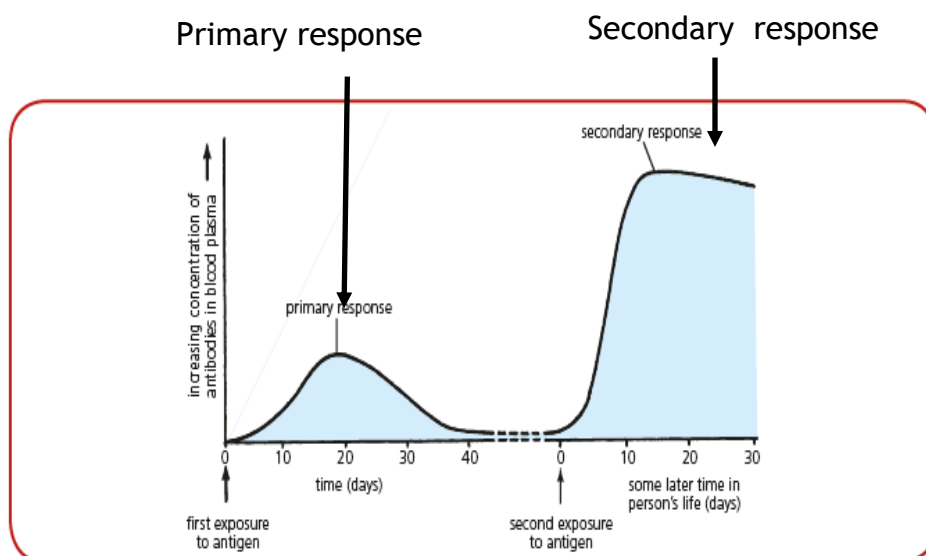
Memory Cells

After infection some of the cloned B and T lymphocytes survive as long term memory cells.

During a secondary exposure to the same antigen, memory cells rapidly produce a new clone of specific lymphocytes.

1. Antibodies produced more quickly
2. Antibody higher concentration
3. Antibodies last for longer.

This rapid response destroys invading pathogens before the individual shows symptoms and prevents illness.



Vaccinations & Herd Immunity

Vaccination Programmes

Provides immunity against infectious diseases.

Vaccine ingredients

1. Antigens from infectious pathogen

Creates **memory cells** from exposure to pathogen's foreign antigens without disease symptoms

Forms

1. Inactivated pathogen toxins
2. Dead pathogens
3. Part of pathogens
4. Weakened pathogens

2. Adjuvant

This enhances the immune response (vaccine more effective)

Herd Immunity

Occurs when a large percentage of the population is immunised .

Advantage of Herd Immunity

Non-immune individuals are protected as there is a **lower probability** they will come into contact with infected individuals and less disease spread.

Herd immunity threshold

Percentage of the population that must be vaccinated in order for herd immunity to be achieved.

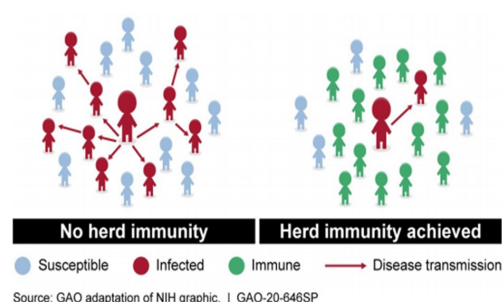
1. Type of disease
2. Effectiveness of vaccine
3. Population density

Mass vaccination programmes

Ensure herd immunity.

Problems with widespread vaccination

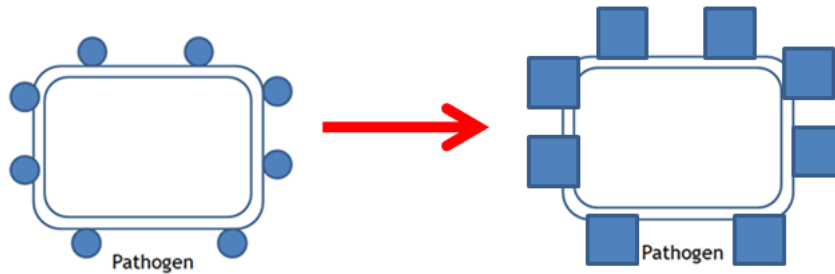
1. Poverty
2. Vaccine rejection



Antigenic Variation

Antigenic Variation

Pathogens can **change their foreign antigens** meaning that **memory cells are not effective** against them.



Flu Virus

The flu virus poses a **major public health risk** as it shows **high antigenic variation**

At risk individuals must be **vaccinated each year** to protect them from the ever changing virus.



Clinical Trials

Studies to test the **safety** and **effectiveness** of vaccines/drugs **before** they are **licensed** for use.

Features of Clinical Trials

1. Randomised

Subjects are split into groups up in a **random way**.

This **reduces bias in distribution of characteristics** that cannot be made to be the same e.g. age/gender

2. Double blind

Neither the subjects nor the researchers know if they are receiving drug/placebo,

This **reduce bias interpretation** of results

3. Placebo controlled

One group will receive the placebo drug/vaccine which is the exact same form but lacks the active ingredient.

This allows a valid comparison and proves the drug/vaccine causes the improvement in results

4. Large sample size

A large sample (100+ people)

This reduce the magnitude of experimental error & increase the reliability of the results.

Statistical Significance & Error Bars

Error bars

Show the **range of variation** of results around the mean value.

The **larger the range**, the **less reliable** the results.

Example: $20 \pm 10\text{mm}$

Mean results was 20mm

Range of values was 10-30mm

Less reliable results as bigger range

Example $20 \pm 5\text{ mm}$

Mean value was 20mm

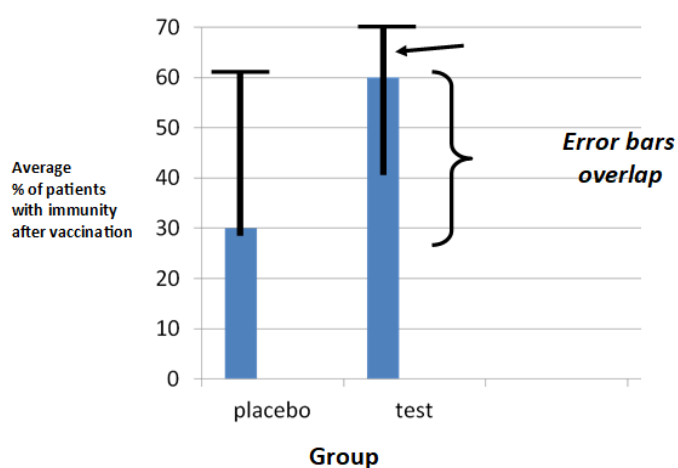
Range of values was 15-25mm

More reliable results as smaller range

Statistical Significance

For statistically significant results the **error bars DO NOT overlap** between the **placebo & treatment.**

Not statistically significant



Statistically significant

