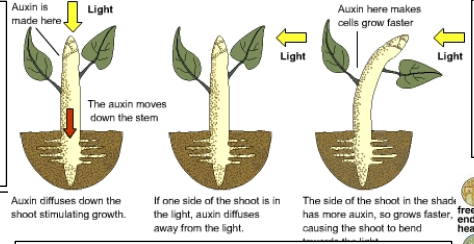
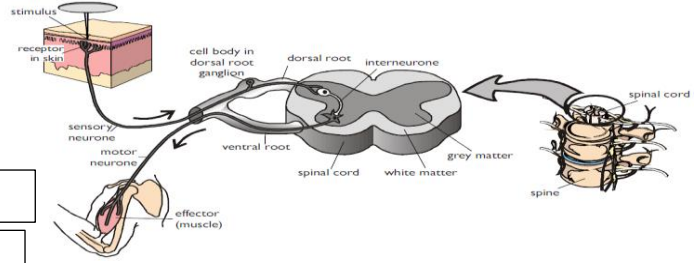
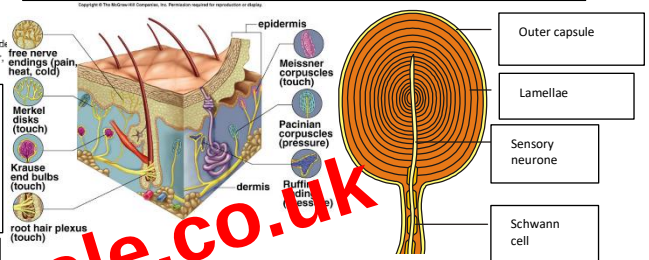
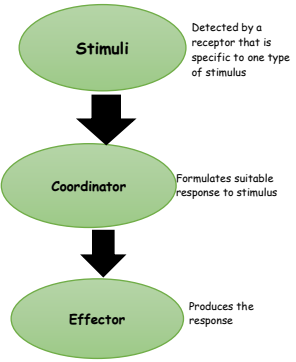
Stimulus: detectable change in the internal/external environment that causes a change and response in the organism.
Response: behaviour of a living organism due to a stimulus that increases chance of survival.



Receptors
Photoreceptors-detecting lights + e.m radiations
Mechanoreceptors-detecting movements, pressure, gravity and sound waves
Chemoreceptors-detecting specific chemicals
Thermoreceptors-detecting a change in temperature





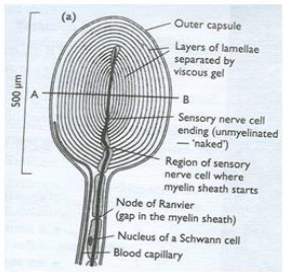


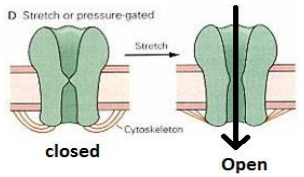
A coordinator acts at a molecular level or can affect the entire organism. It controls the specific stimuli and receptor to use.

Plants respond to directional growth stimuli, called tropisms. They can be positive(towards a stimulus) or negative(away from the stimulus) and respond to a variety of stimuli.

A chemical substance(the receptor to light) had diffused from the shoot tip into the agar, and that this substance stimulated growth further down the shoot. He called this substance auxin. He also concluded that the greater the amount of auxin, the greater the bending.

Meissner corpuscles are mechanoreceptors found in the skin. They detect a change in pressure and vibrations. Pressure distorts the cell membrane and opens the sodium gated channels. This allows sodium to diffuse into the axon, which causes an action potential. If the pressure reaches the threshold, the potential is triggered.

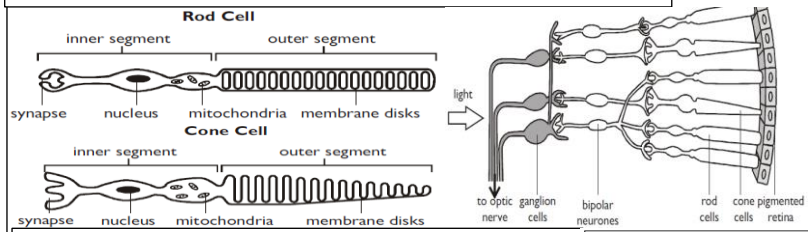




Stretch mediated: Pacinian corpuscle

Nervous response	Hormonal response
Fast communication and response	Slower response
Releases electrical impulses	Produced in endocrine glands
Short-lived	Long lasting
Localised response	Widespread response
Releases chemical messengers	Releases hormonal messengers/stimulates target cells through bloodstream

Phototropism in flowering plants
1.Cells in the tip produce IAA and it is transported down the shoot during negatively.
2.IAA is transported equally throughout the shoot
3.Light makes IAA move from the light side to the shaded side of the shoot
4.IAA builds up in the shaded side which causes elongation of the cells in the shaded side
5.The cells in the shaded side elongate faster than the ones on the light side so the shoot bends towards the light.



The detection of light is carried out by photoreceptor cells in the retina. The two photoreceptor cells found in the eye are called rod and cone cells. They form synapses with bipolar neurones which synapse with sensory neurones called ganglion cells. The ganglion cells cover the inner portion of the retina and form the optic nerve. Each cone cell is connected to one bipolar cell, but many rod cells are connected to one bipolar neurone.

TAXES: direction of response based on the direction of the stimuli.

TOWARDS	AWAY FROM
Favourable stimuli	unfavourable stimuli
POSITIVE TAXIS	**NEGATIVE TAXIS**

Examples of taxes:
1.Male moth moves toward pheromones: positive chemotaxis → find a mate
2.Bacteria move away from waste material they produce: negative chemotaxis
3.Algae move toward light: positive phototaxis → photosynthesis
4.Earthworm moves away from light: negative phototaxis → avoid predators
5.Bacteria move toward glucose: positive chemotaxis → get respiratory substrate

Gravitropism in flowering plants

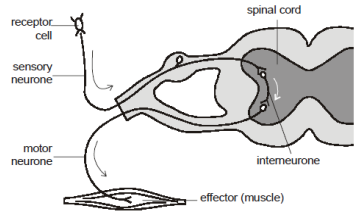
1.Cells on the tip of root produce IAA, and is transported along the root.
2.Gravity causes IAA to move from upper to lower side of the root.
3.More IAA is produced on the lower side of the root.
4.IAA inhibits the elongation of cells on the lower side, so more elongation occurs on the upper side
5.More elongation on upper side so root moves towards gravity

The membrane disks in the outer segments of the cells that detect light contain a photoreceptor protein called rhodopsin. When light is detected, rhodopsin molecules change shape and bind to the sodium channels in the receptor cells. This opens sodium channels which allow sodium to diffuse in, causing an action potential. This action potential is passed to the bipolar neurones and sensory neurones in the retina.

	Rods	Cones
Sensitivity (ability to detect low light intensity)	High sensitivity due to high concentration of rhodopsin, and to retinal convergence – one photon per rod will sum to cause an action potential. Used for night vision.	Low sensitivity due to lower concentration of rhodopsin and to no convergence – one photon per cone not enough to cause an action potential. Need bright light, so work best in the day.
Acuity (ability to resolve fine detail)	Poor acuity due to low density in periphery of retina, and retinal convergence (i.e. rods are not good at resolving fine detail).	Good acuity due high density in fovea and 1:1 connections with interneurones (i.e. cones are used for resolving fine detail such as reading).

Rods	Cones
More numerous in retina than cones	Less numerous
Spread evenly throughout the retina but not in fovea	Concentrated in fovea
Contain Rhodopsin as light sensitive pigment	Contain iodopsin
Only one type	3 types of iodopsin located in individual cone cells sensitive to red green and blue light
Unable to detect colour	Colour vision
Sensitive to low light intensity	Sensitive to high light intensity
Provide low acuity as several synapse (converge) one bipolar cell, but this allows high sensitivity to low light	Provide high acuity as each cone cell synapses with one bipolar cells sending separate action potentials to the brain low sensitivity
Rhodopsin is broken down by low light intensity	Iodopsin is broken down by high light intensity

Rod cells are responsible for sensitivity because many rod cells are connected to one bipolar cell. The summation creates a large depolarisation which generates an action potential. Cone cells are responsible for acuity because one cone cell is synapsed to one bipolar neurone so only a very small area of the retina is stimulated.

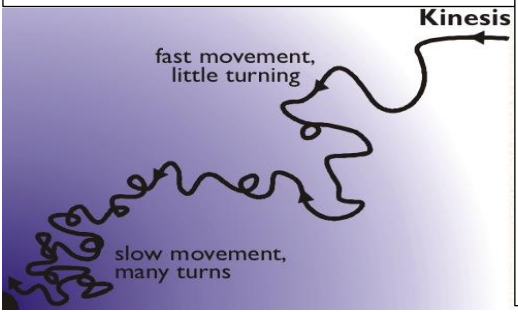


Kinesis
Non directional response to a stimulus.

Often the rate of movement is indicative of the stimulus intensity. But the response may also be determined by genes, age and gender.

Where the speed of movement is altered it is orthokinesis
Where the rate of turning is altered is is klinokinesis

Woodlice in light, warm, dry environment may move faster and in straighter lines (turn less) thus covering a greater distance and are more likely to leave the less favourable environment. In moist, dark, cooler environments the woodlice will move slowly and turn more, more likely to remain in that particular environment (hygrokinesis: response to humidity)



A reflex is a specific response to a specific stimulus. It has five key features:
Involves a few neurones
Involuntary
Invariable(a given reflex to a specific stimuli is always the same)
Innate(responses not learned, they are genetically-programmed)

Reflex arc can also be represented by a simple flow diagram:

Stimulus	→	Receptor	→	sensory neurone	Coordinator	→	motor neurone	Effector	→	Response
external stimuli internal stimuli		cell or organ			Brain or spinal cord *(interneurones)*			muscles or glands		movement, secretion, behaviour

RESPONSE TO STIMULI