



Communication & Homeostasis

- Why and how do cells communicate with each other?
- Explain the principles of homeostasis in terms of receptors, effectors & negative feedback.
- Describe the physiological & behavioural responses that maintain a constant core body temperature in ectotherms & endotherms.



Constant Conditions

- All living things need to keep conditions within their cells constant.
 - Because cells rely on the activity of enzymes.
- What conditions do enzymes need to be kept constant?



External Environment

- The air, soil or water surrounding an organism.
- The external environment changes over time.
 - Slow changes: eg. Seasonal temperatures
 - Rapid changes: eg. Day/night temperatures



Internal environment

- Most cells of multicellular organisms are not exposed to the external environment.
- These cells are bathed in tissue fluid – this is the internal environment.
- The internal environment also changes over time.



Maintaining the Environment

- If an organism is to keep conditions within the cell constant it must react to these changes in the external & internal environments.
- To do this it must first detect these changes and then alter its behaviour or physiology.



Stimulus & Response

Stimulus

Daytime temperature decreases as clouds block the sun



Response

Put on a jacket

External

Internal

Stimulus

CO₂ levels increase as cellular respiration increases in muscles following exercise



Response

Heart rate increases



Communication

- In order for a stimulus to cause a response there must be some communication between the cells that detect the stimulus and those that bring about the response.
- What should a good communication system be like?



How can this be achieved?

- Cell to cell communication (**cell signalling**) can be achieved in one of two ways:
 - Neuronal system
 - Via neurones from one cell directly to another.
 - Rapid signals can be sent to specific parts.
 - Endocrine system
 - Via hormones released into the blood.
 - Slower signals but reaches all parts of the body



Cell Signalling

(Communication between receptor & effector, neuronal or hormonal)

Receptor

(temperature sensitive cells in skin/body)

Effector

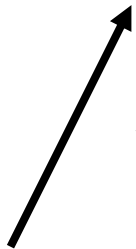
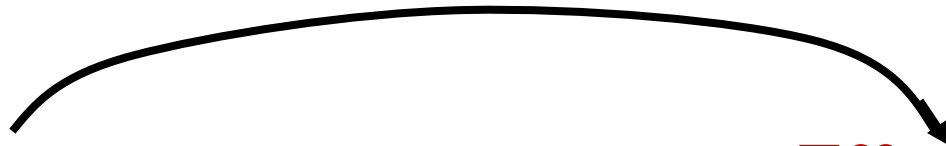
(sweat glands in skin)

Stimulus

(increase in external temperature)

Response

(Body temperature returns to normal)





Task

- Write 3 examples of a stimulus & response.
- For each, state whether it uses the neuronal system or endocrine system.



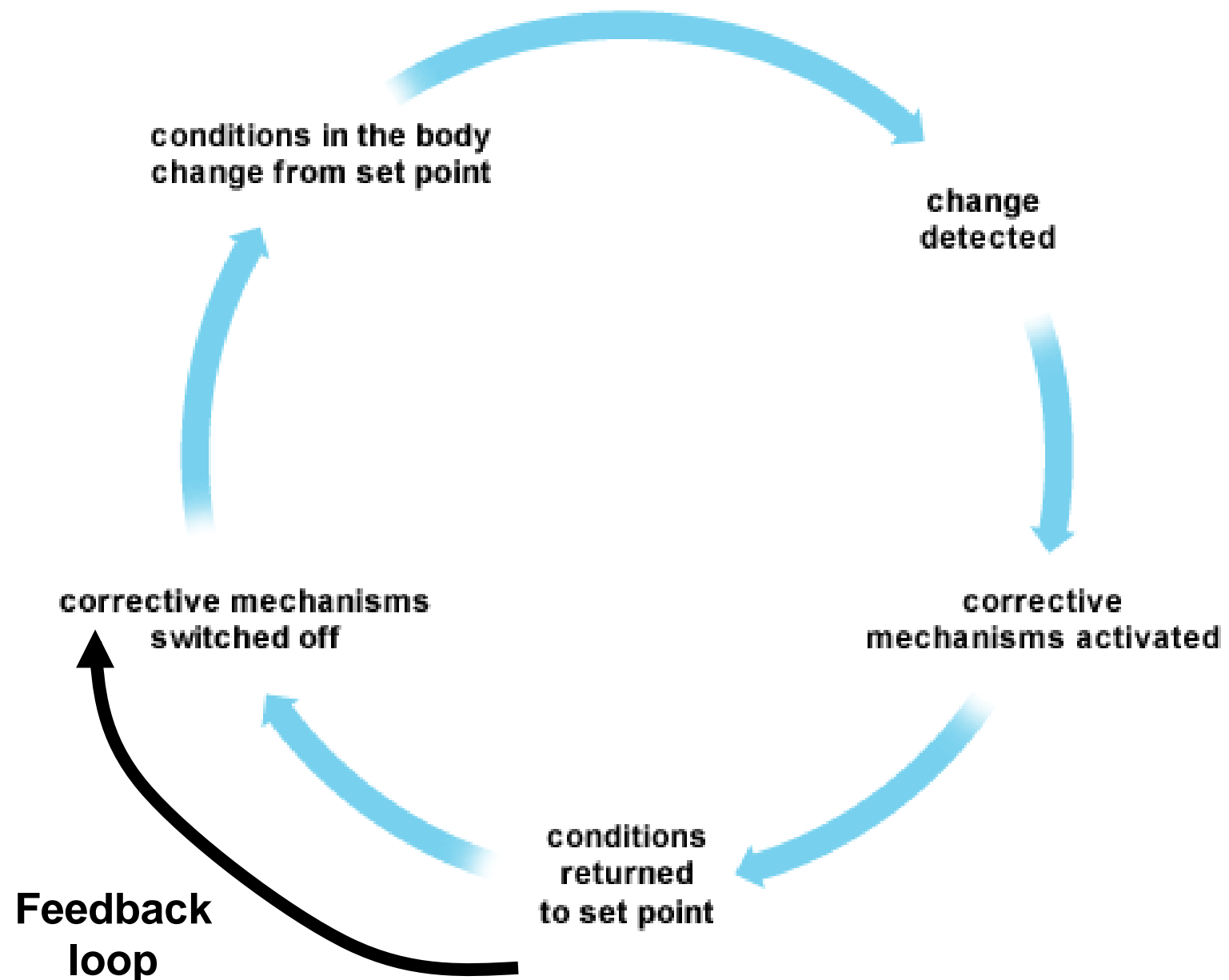
Receptors/Effectors

- The body has many sensory receptors that detect changes to the internal conditions.
- There are many effector organs to bring about the response.
- For each of your 3 examples earlier, identify the receptors and effectors



Homeostasis

- Definition:
 - Keeping the internal environment constant despite changes to the external environment.
- Conditions to be kept constant are:
 - Body temperature
 - Blood glucose concentration
 - Blood salt concentration
 - Water potential of blood
 - Blood pressure
 - CO₂ concentration





Feedback

- There are two types:
 - Negative feedback
 - Most systems use this method.
 - Positive feedback
 - Few systems use this method.



Negative Feedback

- Deviation from the set point causes changes that bring the level back towards the set point.
 - Temperature
 - Water potential
 - Blood glucose



Positive Feedback

- Deviation from the set point causes changes that result in an even greater deviation from the normal.
 - Excitation of neurones.
 - Onset of uterine contractions at birth.



Endotherms v Ectotherms

- Any ideas?
- Endothermic animals can maintain their body temperature to within very tight limits.
 - Independence from the external temperature.
- Ectothermic animals have a core body temperature that fluctuates with ambient.
 - They rely on external sources of heat to keep warm.



Advantages/Disadvantages

	Ectotherms
Advantages	<ul style="list-style-type: none">• Use less food for respiration.• Can survive longer periods without eating.• More energy from food can be used for growth.
Disadvantages	<ul style="list-style-type: none">• Less active in colder areas/times.<ul style="list-style-type: none">– At risk of predation in morning.• May not be active at all in Winter.<ul style="list-style-type: none">– Need sufficient stores of energy.



Temperature regulation in ectotherms

- Ectotherms use behavioural methods to adjust heat exchange with the environment.
- Some ectotherms are more specifically adapted to help this process.



Advantages/Disadvantages

	Endotherms
Advantages	<ul style="list-style-type: none">• Constant body temperature.• Activity possible in cold environments.• Ability to inhabit colder areas of the planet
Disadvantages	<ul style="list-style-type: none">• High proportion of food energy used in thermoregulation.• Need to eat more food.• Less energy for growth.



Temperature regulation in endotherms

- A variety of mechanisms are used by endotherms:
 - Sweat glands in skin
 - Mouth/nose/lungs
 - Hairs on skin
 - Arteriole vasodilation / vasoconstriction
 - Liver cell metabolism
 - Skeletal muscles
 - Behavioural methods



Control of temperature regulation

