

Double Award Biology Unit 4 – Topic 5 Response & Regulation

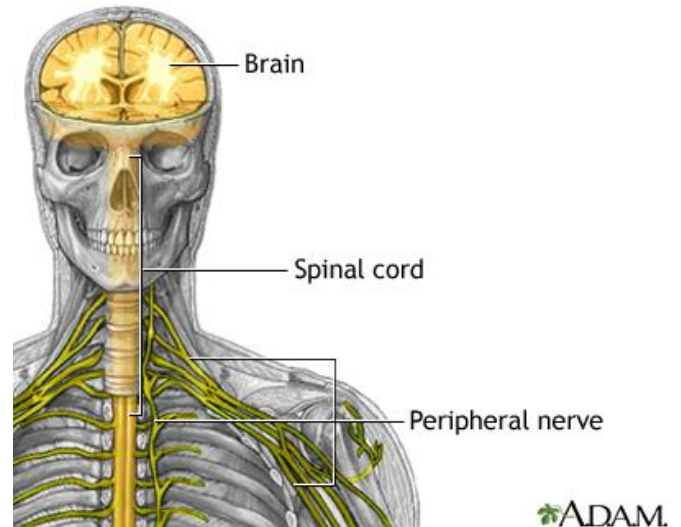


GCSE Exam Specifications:

Topic 5	Revision completed
Higher tier content is written in bold	
(a) sense organs as groups of receptor cells which respond to specific stimuli: light, sound, touch, temperature, chemicals and then relay this information as electrical impulses along neurones to the central nervous system	
(b) the brain, spinal cord and nerves forming the nervous system; the central nervous system consisting of the brain and spinal cord	
(c) the properties of reflex actions: fast, automatic and some are protective, as exemplified by the withdrawal reflex, blinking and pupil size	
(d) the components of a reflex arc: stimulus, receptor, coordinator and effector; be able to label a diagram of a reflex arc to show: receptor, sensory neurone, relay neurone in spinal cord, motor neurone, effector and synapses	
(e) the reasons why animals need to regulate the conditions inside their bodies to keep them relatively constant and protected from harmful effects – homeostasis	
(f) hormones as chemical messengers, carried by the blood, which control many body functions	
(g) the need to keep glucose levels within a constant range, so that when the blood glucose level rises, the pancreas releases the hormone insulin, a protein, into the blood, which causes the liver to reduce the glucose level by converting glucose to insoluble glycogen and then storing it	
(h) diabetes as a common disease in which a person has a high blood glucose level; type 1 diabetes caused by the body not producing insulin; type 2 diabetes caused by the body cells not properly responding to the insulin that is produced; the causes of both types of diabetes; treatments for diabetes	
(i) the structure of a section through the skin: hair, erector muscle, sweat gland, sweat duct, sweat pore, blood vessels; be able to label these structures on a diagram	
(j) the role of these structures in temperature regulation: change in diameter of blood vessels, sweating, erection of hairs; shivering as a means of generating heat	
(k) the principles of negative feedback mechanisms to maintain optimum conditions inside the body as illustrated by the control of glucose levels by insulin and glucagon and by the control of body temperature	
(l) the fact that some conditions are affected by lifestyle choices; the effects that alcohol and drug abuse have on the chemical processes in people's bodies; the incidence of diabetes (type 2) and the possible relationship with lifestyle	
Details of Specified Practical work	Revision completed
Investigation into factors affecting reaction time	

Sense Organs

Sense organs are groups of receptor cells which respond to specific stimuli e.g. light, sound, touch, temperature and chemicals and then relay this information as electrical impulses along neurons to the central nervous system

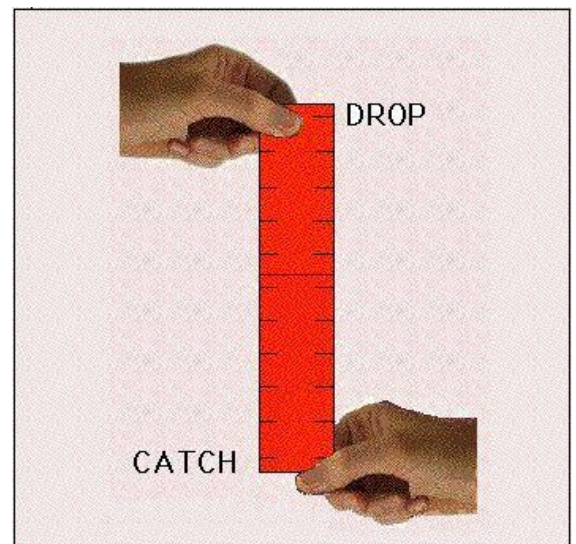


The nervous system is formed of the brains, spinal cord and nerves

*The **central nervous system** is made up of the **brain** and the **spinal cord** – this receives the information from the receptors and then decides on a reaction.*

How can we measure our reaction times?

- catching a falling ruler, measuring the distance and then converting this to a reaction time.
- We may see an improvement as we practice more, or our levels of concentration may vary as we do the experiment which will affect our results.

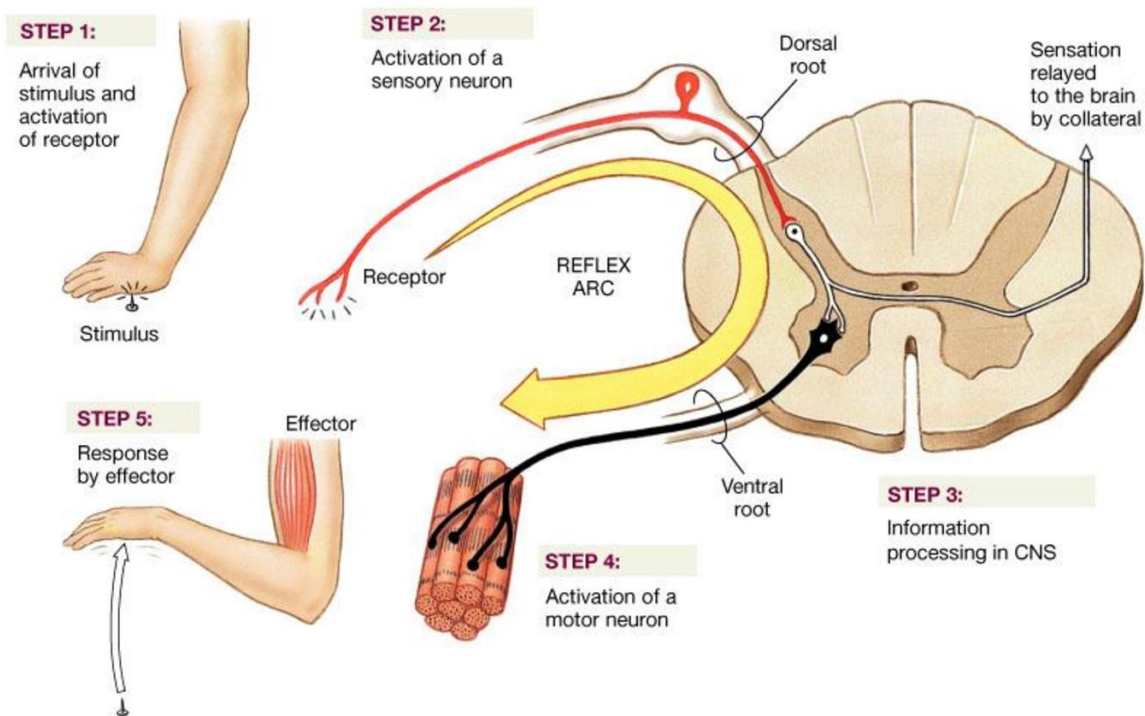


Reflex Actions

Reflex actions are **automatic** (do not require conscious thought) and are very **fast** (to protect our bodies from damage). An example of this is the **withdrawal reflex** – this happens when you touch something hot or sharp and you withdraw away from the stimulus to protect the body. The eye also has reflex actions – the iris reflex and blinking

Reflexes can be influenced by chemicals such as alcohol, caffeine and drugs. The laws associated with alcohol levels in the body when driving were introduced because of the effect of alcohol on response and reaction times.

The shortest route from stimulus through to response is called a REFLEX ARC



Stimulus – e.g. heat, pain, pressure or a change in temperature

Receptor – located in the skin and detect changes in the environment

Sensory neurone cell – carries information from sense organs to the spinal cord

Synapse – a 'gap' between two neurones – chemicals pass information across the gap

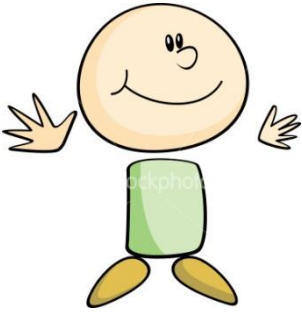
Relay neurone – found in the spinal cord - information passes from the sensory neurone to here, then across a synapse to the motor neurone

Motor neurone – this connects the spinal cord to the effector

Effector – this is usually a muscle (e.g. the biceps) or a gland (e.g. the salivary gland)

Response – this is usually moving away from the stimulus (heat/pain) or producing saliva

Homeostasis



Homeostasis is the 'maintenance of a constant internal environment'.



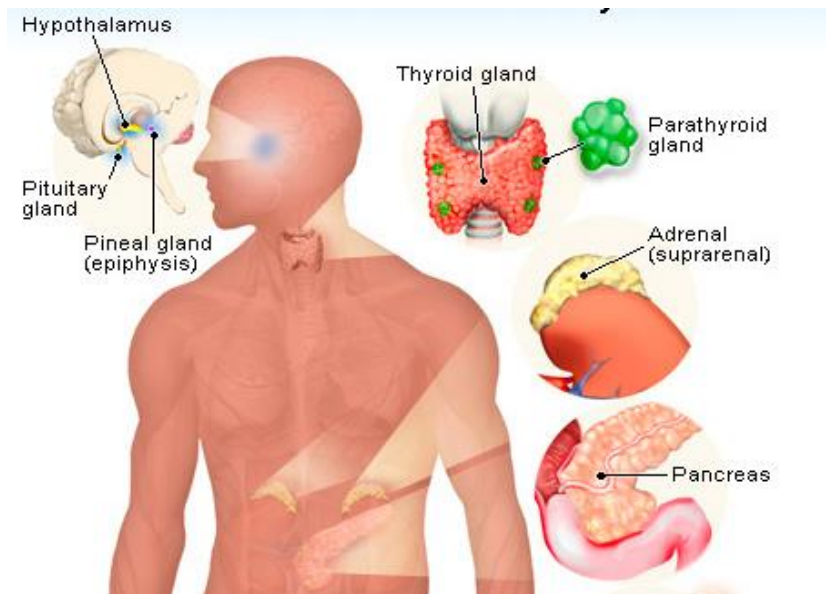
Metabolism (the reactions in your cells) operates only within a narrow

range of temperatures and pH and requires appropriate nutrients and

water to ensure conditions are kept constant and protected from harmful effects

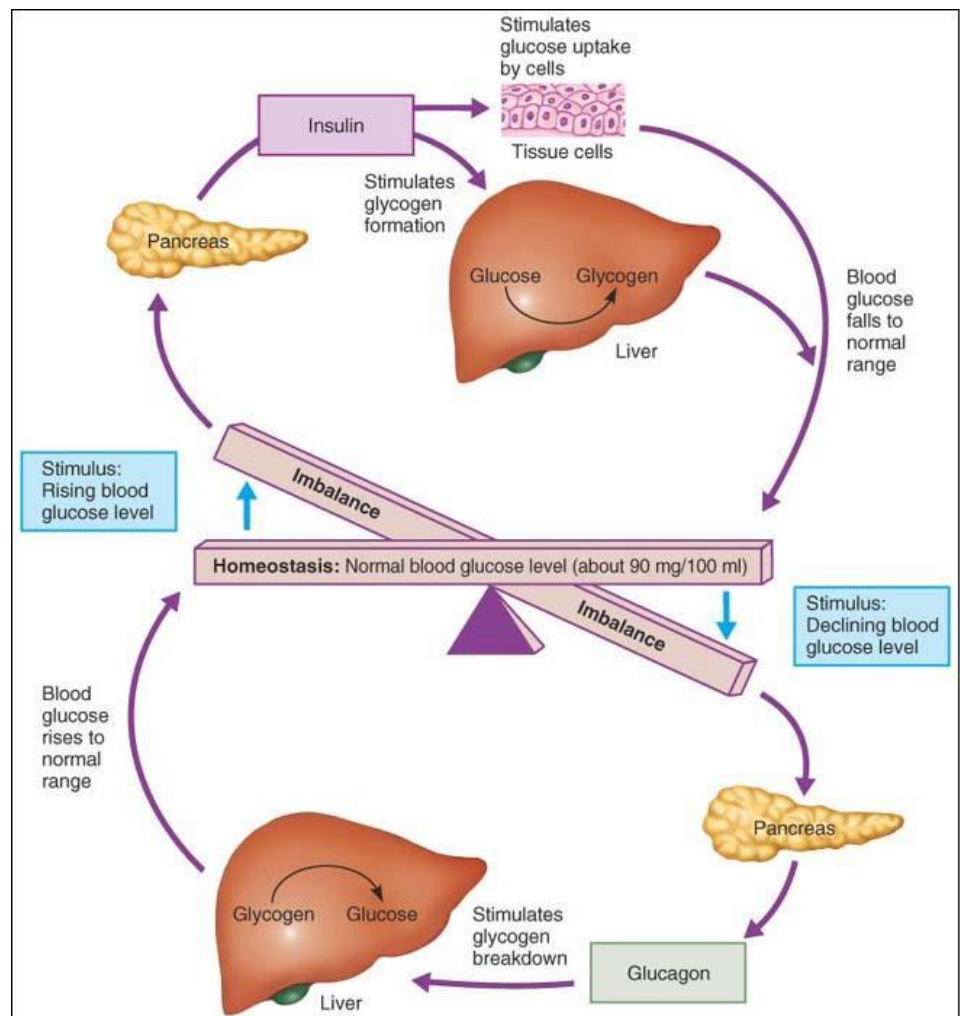
What is a hormone?

Hormones are chemical messengers, produced by glands and carried by the blood, which control many body functions.



Examples of hormones include insulin, adrenalin, oestrogen and testosterone.

Why does the level of glucose in the blood vary?



- Blood glucose levels need to be maintained within a constant range.
- The body experiences changes in glucose (sugar) levels throughout the day.
- When you eat and your food is digested, blood glucose levels rise, when you exercise and the glucose is used in respiration, blood glucose levels fall.
- The body needs to be able to store the glucose so when it requires glucose, it can release it back into the blood.
- The storage and release of glucose is controlled by hormones.
- When the blood glucose level **rises**, the pancreas releases the hormone **insulin (a protein)** into the blood. This causes the liver to reduce the glucose level by converting glucose to insoluble **glycogen** and then store it
- When blood glucose levels fall (e.g. when you have been exercising or you have not eaten for a long time), the pancreas releases another hormone called **glucagon** which causes the stored **glycogen** to be converted back to glucose which is released back into the blood.

What is Diabetes?

Type I diabetes is a condition where people not produce enough insulin

Type II diabetes is caused by the body cells not properly responding to the insulin that is produced

Treatment of Diabetes

- regularly injecting insulin –low sugar and low carbohydrate diet
- medication such as metformin tablets
- possibly transplant of pancreas tissue

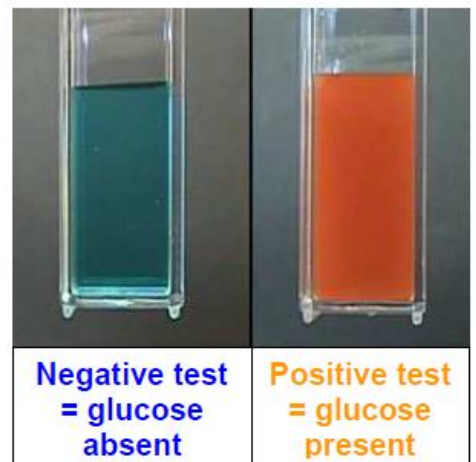
Diagnosis of Diabetes

- Urine can be tested for various substances, the presence of glucose in the urine may indicate diabetes
- One test for diabetes is to detect glucose in the urine, this can be done in two ways-

1. Using a clinistix which is dipped in the urine sample and changes colour to indicate the concentration of glucose present (this is the test usually used by doctors)

2. Using Benedict's solution which changes from blue to brick-red when heated with a sample of urine that contains glucose.

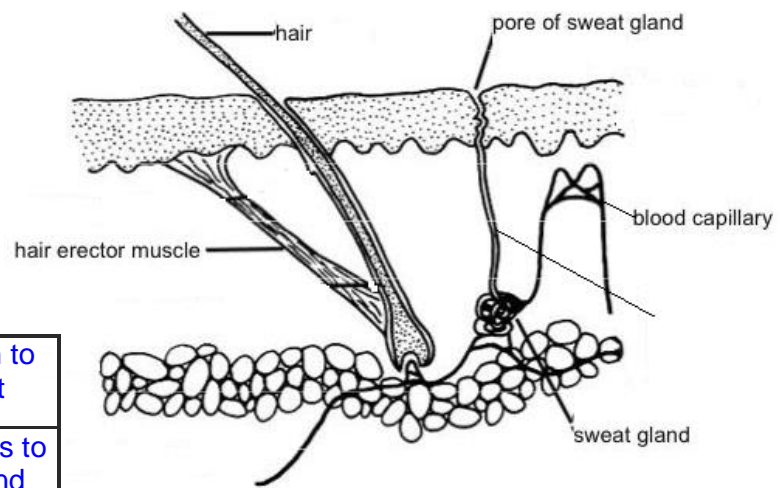
Urine without glucose does not change the colour of the Benedict's solution



Negative glucose test = Benedict's remains blue

Positive glucose test = Benedict's changes to brick red

How does the body maintain a constant temperature?



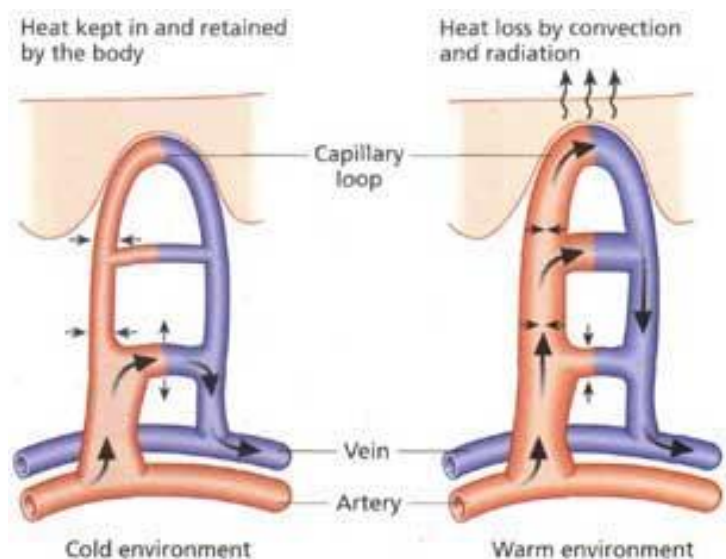
Hair	Moves up and down to retain or lose heat
Hair erector muscle	Contracts and relaxes to move the hair up and down
Sweat gland	Produces sweat
Sweat duct	Carries sweat from the sweat gland
Sweat pore	Releases sweat through the surface of the skin
Blood capillaries	Dilate (widen) and constrict (narrow) to control heat loss

How does the skin help to maintain a constant body temperature?

Blood vessels

- When we are **hot**, the capillaries near the surface of the skin dilate (widen), more blood can flow to the surface of the skin, we look red and we lose heat by radiation – the name for this process is **vasodilation**

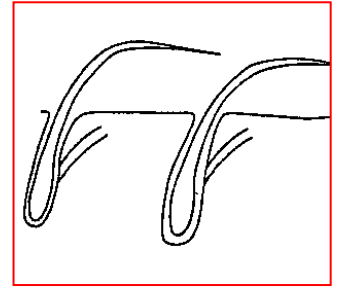
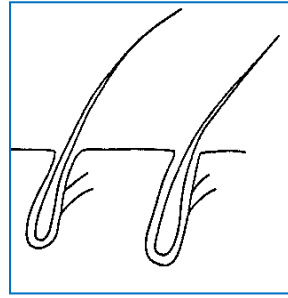
- When we are **cold**, the capillaries near the surface of the skin narrow, less blood can flow to the surface of the skin, we look pale and we lose less heat by radiation – the name for this process is **vasoconstriction**



Remember that the blood vessels do not move – they either widen or narrow

Hairs

When we are hot, the hair erector muscle relaxes and a *thinner* layer of air is trapped close to the skin surface and we can lose heat from the skin surface

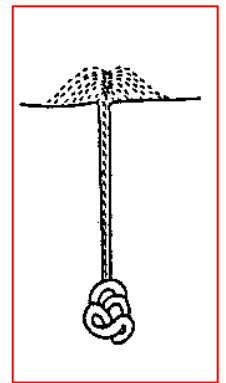
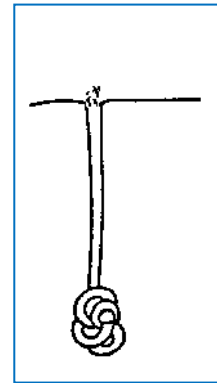


When we are cold, the hair erector muscle contracts and the hair stands up, a *thicker* insulating layer of air is trapped close to the skin surface and we lose less heat from the skin surface

Sweat

This relies on evaporation as a mechanism to remove heat

When we are hot, we produce **MORE** sweat from the sweat glands which allows us to lose heat by evaporation as the sweat is removed from the surface of the skin

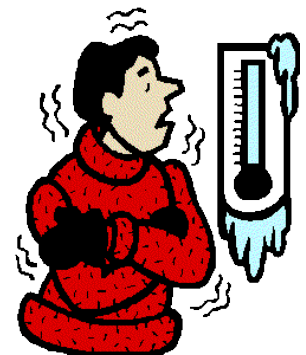


When we are cold we produce little sweat from the sweat glands which means we lose less heat by evaporation from the surface of the skin.

When a fan is used – the moving air increases the rate of evaporation of sweat from the surface of the skin. **When the sweat evaporates it requires heat in order to change the liquid sweat into a vapour – the heat is drawn from the skin and so cools it down**

Shivering

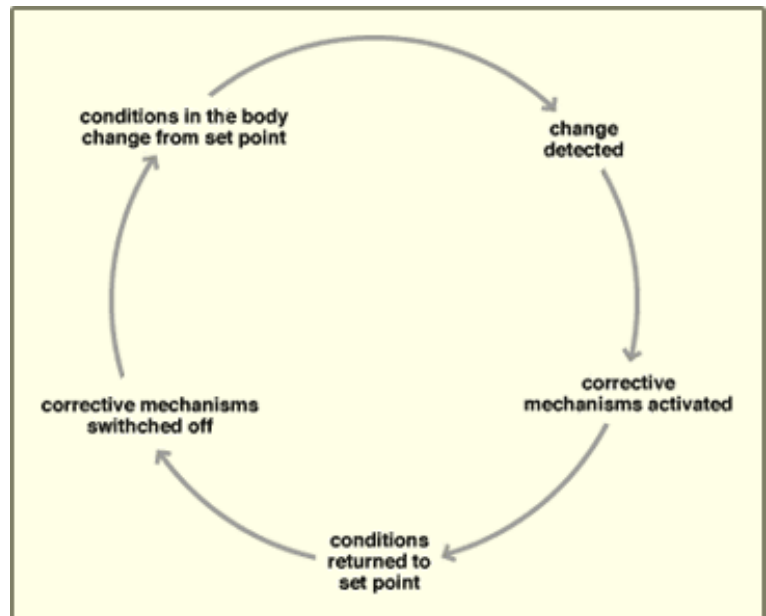
When we are cold we often shiver – this causes muscles to contract which increases metabolism (all the reactions inside our cells) which generates heat.



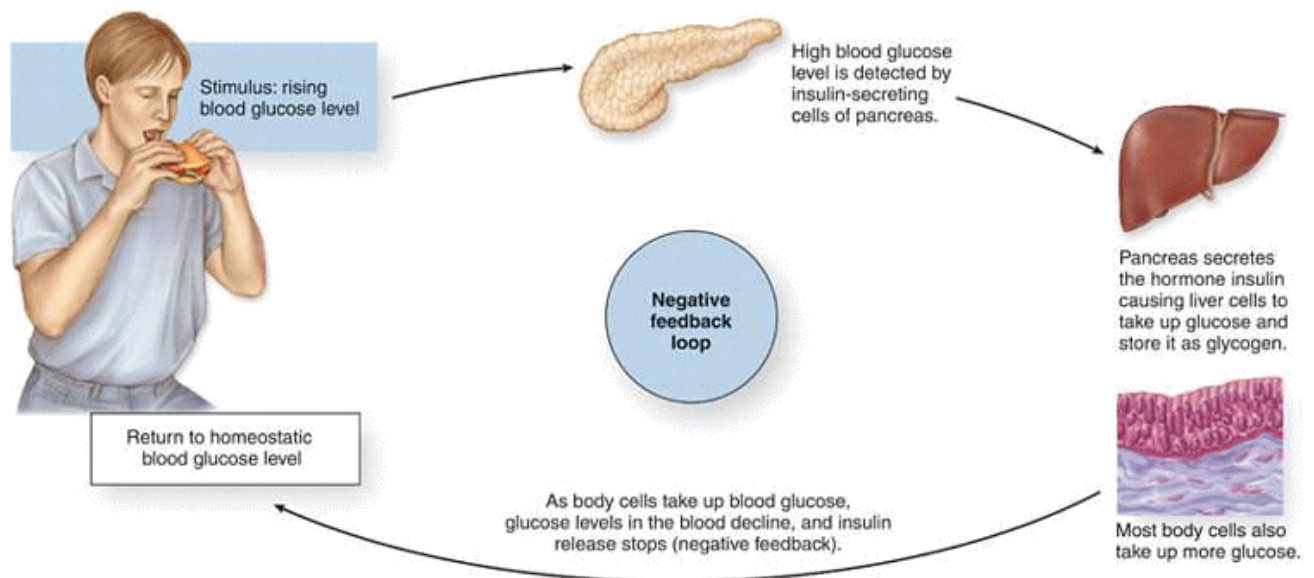
Negative Feedback

This is a system which works by

- detecting a change from the 'norm' value (e.g. blood glucose levels rise, temperature increases).
- deciding that something needs to be done to restore the original value e.g. instruction to produce insulin, vasodilation, increased sweating
- these mechanisms cause changes that brings the set original change back to the 'norm' level (insulin causes glucose to be converted to glycogen and blood glucose falls, heat is lost by radiation, and evaporation, temperature falls)
- when the blood glucose levels return to normal, insulin secretion is switched off or vasodilation and sweating are reduced.



Practise examples!!!!



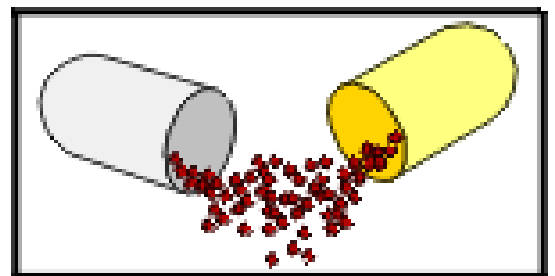
Lifestyle Choices

Alcohol changes various chemical processes in peoples' bodies **including reaction time** so that they may become dependent on or addicted to alcohol and suffer withdrawal symptoms without them. They can also cause long-term physical damage e.g. liver, circulatory and heart disease



Drugs

Some drugs are misused e.g. illegal drugs and these drugs can affect people's bodies



Lifestyle choices and links with Type 2 Diabetes

Type 2 diabetes develops when the body can still make some insulin, but not enough, or when the insulin that is produced does not work properly

In most cases this is linked with being overweight.

This type of diabetes usually appears in people over the age of 40.

Type 2 diabetes accounts for around 90 per cent of people with diabetes and is treated with a healthy diet and increased physical activity. In addition to this, medication is often required .

