

# Form 5 Biology Notes

The annual this year will include all topics covered during the three years of the course so it is suggested that you start revision and allow at least one hour each day for biology course work or revision. I also recommend starting to work out previous SEC past papers.

## Materials you'll be needing for this year:

- Copy of the SEC syllabus for the year \_\_\_\_\_ (see [www.freewebs.com/gozobiochem](http://www.freewebs.com/gozobiochem))
- SEC past papers for the years \_\_\_\_\_ (both May and September papers)
- Two (2) A4 notebooks for coursework and Homework
- Practical file with 5 dividers (You should have this from previous years)

## Topics to be covered during this year:

1. Co-ordination involving hormones and nervous control
2. DNA: the blueprint of life
3. Reproduction
4. Management of Resources

## Paper A or B?

The examination will consist of two written papers and an assessment of practical work.  
The examination will be structured as follows:

**Paper I** (55% of the total marks) consists of a written paper (40% of the total marks) and a practical component (15% of the total marks) and is to be taken by all candidates registered for the examination.

The written paper of a two hour duration will consist of a number of compulsory short and longer structured questions testing the candidates' breadth of knowledge and understanding of the whole subject content as well as a range of skills. Questions may involve the analysis and interpretation of photographs, diagrams, graphs and data as well as the working out of simple mathematical calculations. Questions testing the application of biological principles to everyday situations will be included in this paper.

There will be two versions of **Paper II**: *Paper II A* or *Paper II B*, each of a two-hour duration. Questions in Paper II A will be more difficult than those in Paper I. Questions in Paper II B will be easier than those in Paper I. In the September supplementary session only Paper I and Paper II B will be offered. Candidates will be required to indicate on the registration form which option in Paper II (A or B) they wish to sit for. No change in the choice of paper will be allowed after the registration period.

**Paper II A** (45% of the total marks) will be divided into two sections and questions may be set on any part of the syllabus.

Section A will consist of two compulsory structured questions which will involve the design, planning, and analysis of simple experiments, or the critical evaluation of an investigation or the interpretation of a passage relating to an area of applied biology, or they may test the candidates' experience of practical skills.

Section B will consist of five structured essay-type questions of which candidates will be required to answer three. Questions will be set to test the candidates' knowledge and understanding of biological topics.

**Paper IIB** (45% of the total marks) will consist of eight structured essay-type questions of which candidates will be required to answer four.



# 1 Co-ordination of body functions

See GCSE Biology Chapter 19 – Co-ordination – pg. 163 - 173

**Co-ordination** is making our organs and systems work together. This is controlled by the nervous and endocrine systems which also makes use of hormones.

In general, the **ENDOCRINE SYSTEM** is in charge of body processes that happen slowly, such as cell growth. Faster processes like breathing and body movement are monitored by the nervous system.

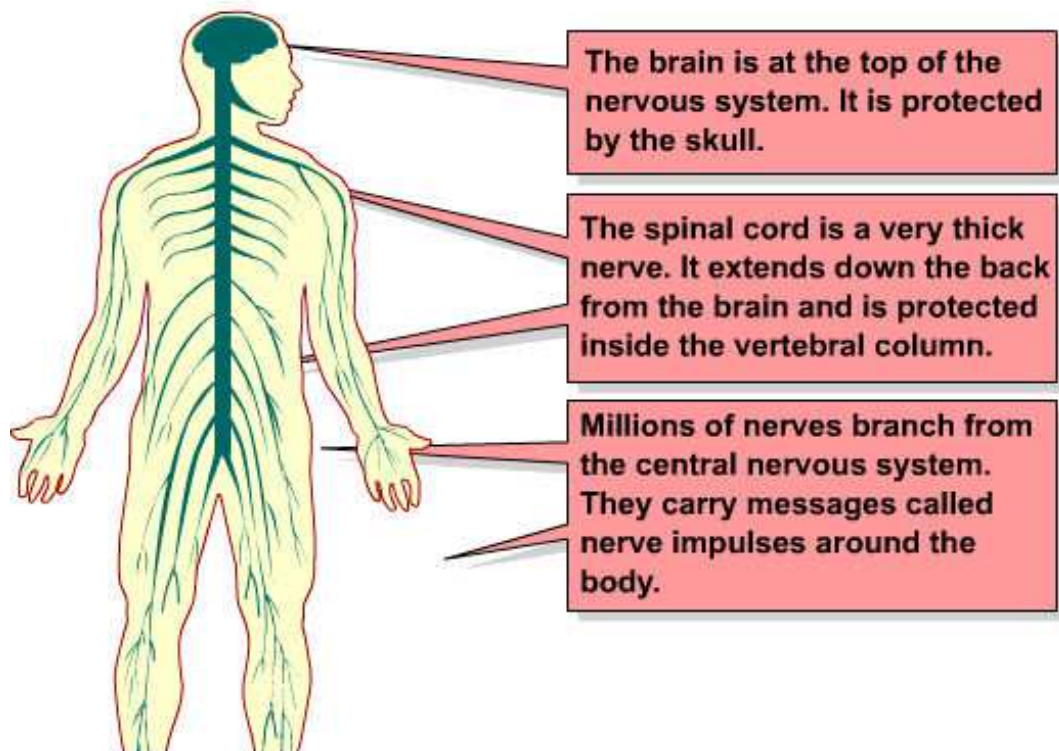
The **NERVOUS SYSTEM** is controlled by the brain, which sends nervous impulses to the rest of the body while the endocrine system involves coordination, which is brought about by the release of chemicals called hormones from the endocrine glands. Hormones are carried by the blood.

But even though the nervous system and endocrine system are separate systems, they often work together to help the body function properly. **TWO (2)** co-ordinating systems are required:

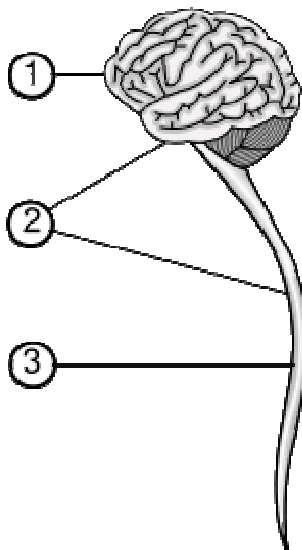
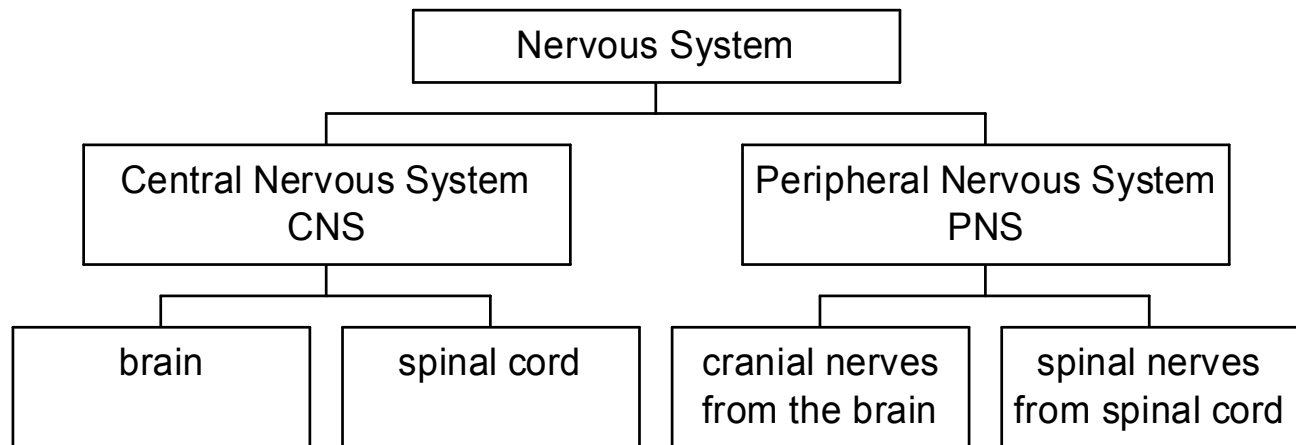
- (i) one involving a slow but sustained action that usually has long-term effects on the body,
- (ii) one that is quick and achieves immediate, short-term control over specific body parts.

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## Co-ordination and the Nervous System:



## Organisation of the Nervous System

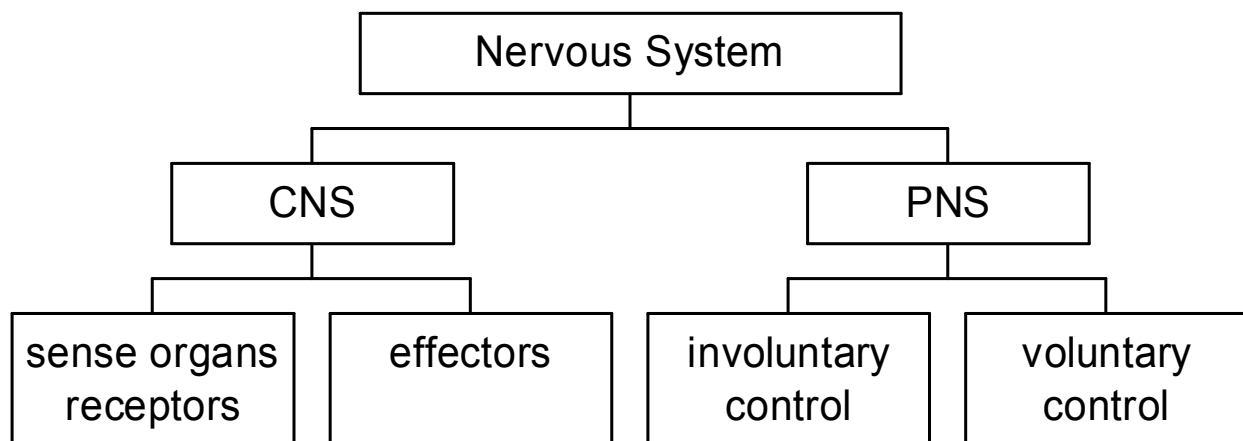


A diagram showing the CNS:  
 1. Brain  
 2. Central nervous system (brain and spinal cord)  
 3. Spinal cord

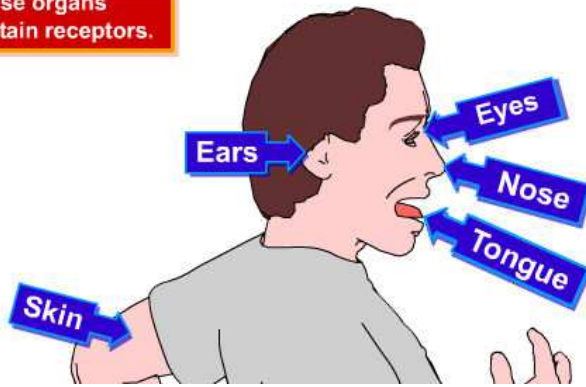
### **The PNS is subdivided into:**

- **The autonomic nervous system** (involuntary control of internal organs, blood vessels, smooth and cardiac muscles), consisting of the sympathetic NS and parasympathetic NS
- **The somatic nervous system** (voluntary control of skin, bones, joints, and skeletal muscle).

The CNS receives impulses from the organs, muscles and other body parts. It also sends electrical impulses (carrying information) along nerves to muscles, organs and other body parts.



Sense organs  
contain receptors.



( [www.skool.co.uk](http://www.skool.co.uk) )

Cells called receptors are located in our sense organs, which are the eyes, ears, nose, tongue, and skin. Receptors detect changes in our surroundings. These changes are called STIMULI.

**STIMULUS** – any change inside an organism or its environment, which leads to a response

**RESPONSE** – any action carried out by an organism when a stimulus is received.

**RECEPTORS** - cells that detect stimuli and send messages to the brain

**EFFECTORS** – glands, muscles etc., which carry out the instructions, they receive from the brain.

- Nerve impulses going from the sense organs to the CNS are called **SENSORY IMPULSES**.
- Nerve impulses going from the CNS to the effectors are called **MOTOR IMPULSES**.

### Nerve cells/Neurones

The basic unit of impulse transmission is the neurone/nerve cell. There are different kinds of neurones namely:

1. **sensory neurone** – carry impulses from the receptors to the CNS  
*Also called afferent neurone*
2. **relay neurone** (intermediate neurones) connect one neurone to another. Found in the CNS.  
*Also called multipolar, connector, connecting or intermediate neurone*
3. **motor neurone** – carry impulses from the CNS to the effectors.  
*Also called efferent neurones*

### See GCSE Biology Chapter 19, pg. 164

Figure 19.2 – The human nervous system

Figure 19.3 – Nerve cells a, b, c *You must be capable of drawing them*

Figure 19.3 - Nerve fibres grouped into a nerve

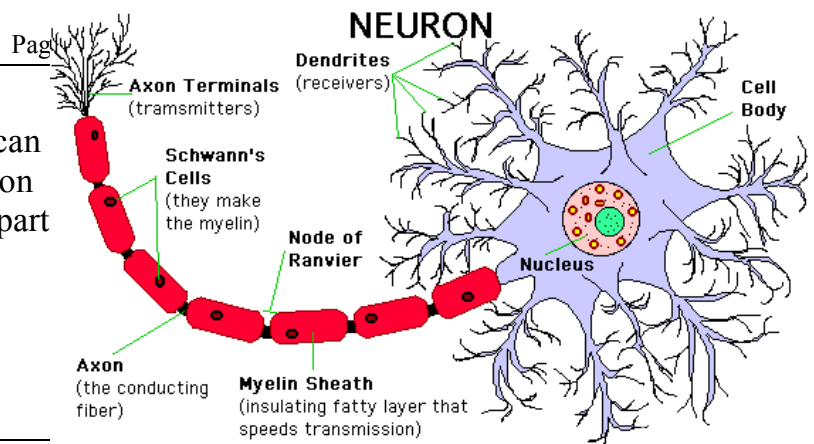
**All neurones have the same basic structure. Neurones are specialised cells. They are specialised to carry impulses from one region to another. A single nerve may contain both sensory and motor neurones.**



Impulses are **electrical in nature**.

All nerve impulses are similar, the brain can distinguish between them since information from eyes, ears, arms etc. go to different part of the brain.

**Nervous transmission consists of various structures:**

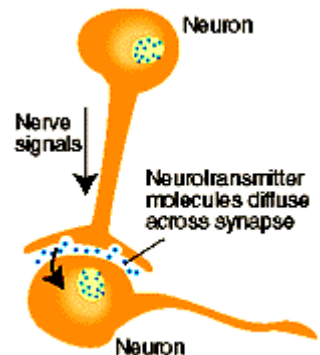


Part	Function
Cell body	Contains the nucleus (located in the CNS)
Dendron	Thin fibre which carries impulses towards the cell body
Axon	Thin fibre which carries impulses away from the cell body
Myelin sheath	Layer of fatty cells wrapped around the axon and dendron. Provides insulation to prevent loss of electrical energy.
Dendrites	Finely branched endings, connecting the neurones to other cells
Sensory nerve ending	Usually receptive to stimuli, and therefore acts as a receptor
Motor nerve ending	Transmits impulses to an effector e.g. a muscle
Synapse	Junction between two neurones (See figure 19.5 pg. 165 GCSE Biology)
Nerve fibre	Name used for any long length of a neurone, axon or dendron

**The synapse** (make sure you can draw a diagram of it)

Here an impulse crosses from one neurone to another. In a synapse, nerve endings of one neurone are in close contact with dendrites of another neurone.

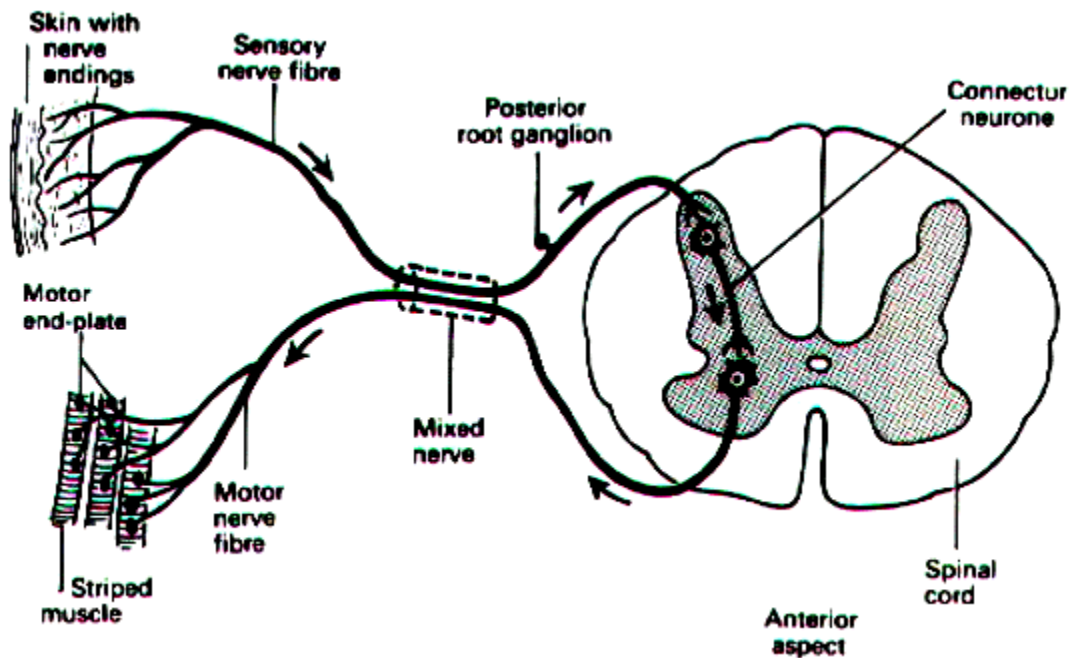
An electrical impulse **cannot cross** a synapse. When an impulse reaches a synapse, a chemical transmitter (neurotransmitter – acetylcholine) is produced at the end of the nerve fibre of the first neurone. This transmitter diffuses rapidly across the gap between the two neighbouring fibres, and triggers off an impulse in the dendrites of the second neurone.



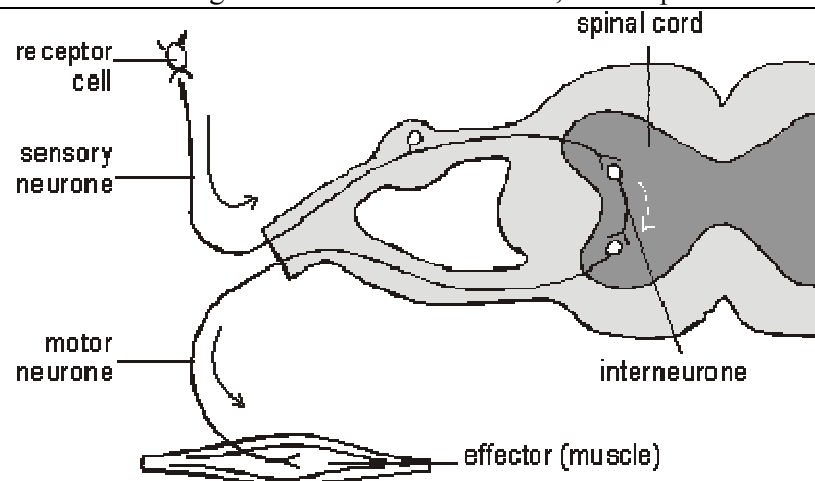
**The reflex arc**

Reflex actions are rapid, automatic responses to stimuli. We don't have any control over them and most of the time we're not even aware they're taking place. Examples are the blinking of our eyes or a knee jerk. The nervous pathway taken for such reflexes is called **reflex arc** and takes place in the spinal cord. Reflex actions are called **involuntary** as we can't control them.

## The Reflex ARC (see GCSE Biology chapter 19 – The Reflex Arc, pg. 165, 166)

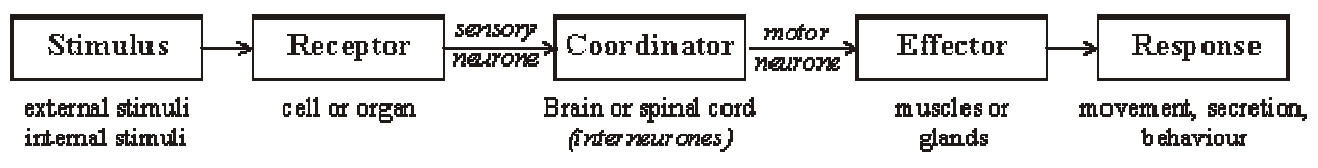


The 3 types of neurones are arranged in circuits and networks, the simplest of which is the reflex arc.



In a simple reflex arc, such as the knee jerk, a stimulus is detected by a receptor cell, which synapses with a sensory neurone. The sensory neurone carries the impulse from site of the stimulus to the central nervous system (the brain or spinal cord), where it synapses with an interneurone. The interneurone synapses with a motor neurone, which carries the nerve impulse out to an effector, such as a muscle, which responds by contracting.

**A reflex arc can also be represented by a simple flow diagram:**



**Examples of Reflex Actions**

<b>Reflex</b>	<b>Stimulus</b>	<b>Receptor</b>	<b>Response by effector</b>	<b>Purpose</b>
Knee jerk	Pressure on tendon below kneecap stretches thigh muscle	Stretch receptor in muscle	Upper thigh muscle contracts, so straightening knee	Helps keep the balance when walking
Blinking	Object approaching eye	Retina	Eyelid muscles contract	Protects eye
Salivation	Sight or smell of food	Retina or olfactory cells in nose	Salivary glands produce saliva	Preparation for digestion
Pupil	Increased brightness of light	Retina	Circular muscle in iris contracts to narrow pupil	Improves eye vision
Withdrawal of hand	Damage to skin of finger e.g. when burnt	Pain and heat receptors in skin	Arm muscles contract to remove hand	Protects against further damage

**HW 1 – Co-ordination and the nervous system – A4 notebook**

- a. How is the nervous system divided? Explain in a short paragraph.
  - b. Define the following:
    - i. Receptors
    - ii. Sensory impulses
    - iii. Effectors
    - iv. Motor impulses
    - v. Nerve
  - c. Draw a large labelled diagram of:
    - i. A sensory neurone
    - ii. A motor neurone
    - iii. A relay neurone
  - d. What is the nature of electrical impulses?
- 

**HW 2 – Co-ordination and the nervous system – A4 notebook**

Work out GCSE Biology pg. 167 numbers 1- 4



## **Voluntary Actions**

You can decide to close a door or to sit down so we say that such actions are under our **conscious** or **voluntary control**. They start in the brain, then motor impulses travel from the brain to the spinal cord, through the spinal nerves to the appropriate effectors.

## **Reflex and voluntary Actions**

<b>Reflex action</b>	<b>Voluntary action</b>
1. Involves spinal cord only	Always controlled by the brain
2. The same stimulus always produces the same response	Response varies according to circumstances
3. Very fast; may involve as few as 3 neurones	Slower; may involve thousands of neurones
4. Memory not involved	Memory essential in deciding nature of response
5. Automatic and unconscious	Deliberate and always requires conscious thought

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## **HW 3 – Co-ordination and the nervous system – A4 notebook**

- Draw a large labelled diagram of a transverse section through the spinal cord. On your diagram show the reflex arc taken by a named action. (e.g. withdrawal of the hand)
- What is a synapse?
- What is a reflex action?
- In table form distinguish between reflex action and voluntary action.

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## **The Central Nervous System (CNS)**

The brain and spinal chord form the central nervous system. The brain is enclosed in the cranium, which is part of the skull, for protection.

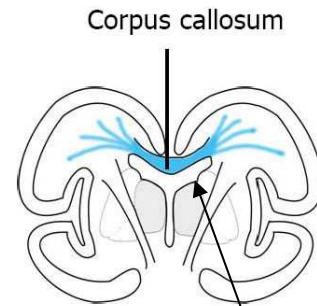
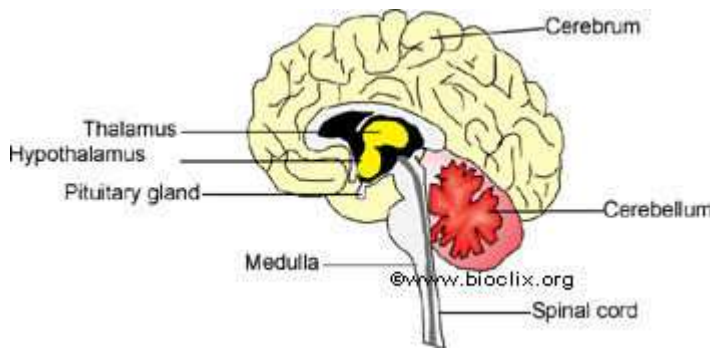
Electric impulses are carried from the central nervous system to the rest of the body.

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## **The Brain**

The **brain** is the most important organ in the whole body. It is made up of millions of nerve cells. Different areas of the brain are responsible for different parts of its work, though the neurones (nerve cells) of the areas are in constant communication with one another. The largest part of the brain is called the **cerebrum**.





### Cerebrum – cerebral hemispheres

- This consists of two sides, the right and left cerebral hemispheres joined by the **corpus callosum**.
- The left side sends and receives information to/from the right side of the body, and vice versa.
- The hemispheres are covered by a thin layer of **grey matter** known as the **cerebral cortex**, which is made of numerous nerve cells and cell bodies that form the grey matter. This part is greatly folded to increase the surface area.

#### Functions: -

- Receives various impulses from different sense organs, sorts them out and sets off an appropriate response
- Enables us to learn as the cerebrum can store information.
- Involved with intelligence, which includes the ability to apply past experiences to new situations.

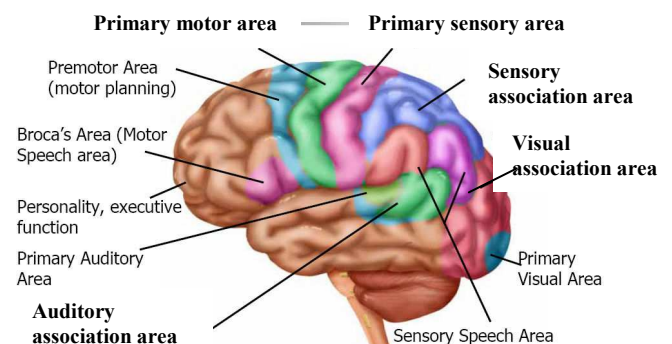
### Function of the motor, sensory and association areas in the brain

#### Cerebrum sections:

**Motor areas** - send motor impulses to different parts of the body  
 - each section is concerned with a particular body part

**Sensory area** - receives impulses from the sense organs or receptors  
 - each section is concerned with a particular body part

**Association area** - receives impulses from various parts of the brain  
 - recognizes information, associates it with past information and sets out appropriate responses to the motor areas. It is the area which stores information.





### Medulla

This is the part that attaches to the spinal chord. It controls automatic actions like our heartbeat, breathing and blood pressure. These happen without us thinking about them (**reflex actions**)

### Cerebellum

The Cerebellum controls our sense of balance and muscular actions. It allows us to make precise movements such as walking running or riding a bike. It receives impulses from various organs, sorts them out and then sets off an appropriate response.

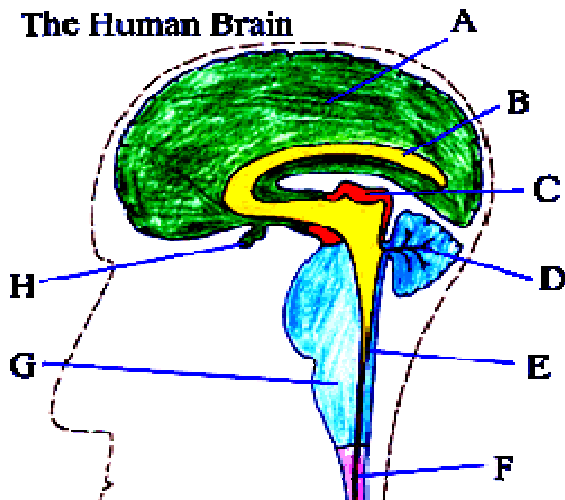
### Hypothalamus

The hypothalamus contains control centers, which help to keep the body temperature and the concentration of blood constant.

(adapated from [www.bioclix.org](http://www.bioclix.org))

### HW 4 – Co-ordination and the nervous system – A4 notebook

a. Name parts A to G



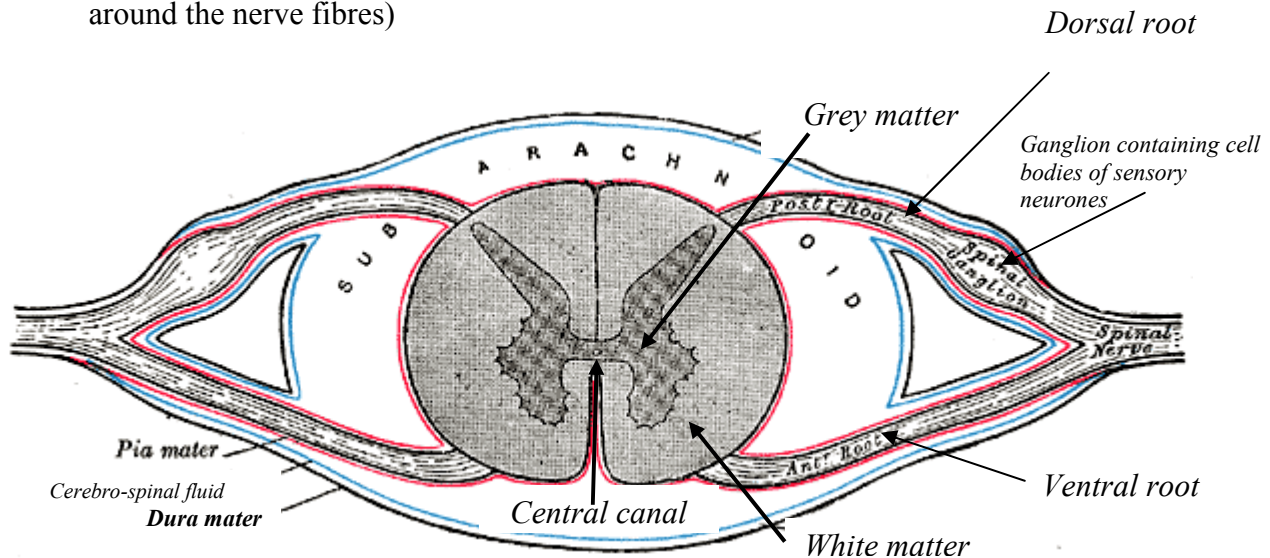
b. Explain why the grey matter is grey and the white matter is white.

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## The Spinal Cord

This consists of thousands of nervous cells and is protected by the vertebral column. There are two important sections that can be readily observed in cross (transverse) section:

- The inner grey matter – made of a group of nerve cell bodies except those of the sensory neurones, which gather in the dorsal root ganglion.
- The outer white matter - consists of nerve fibres (white due to the fatty insulating sheath around the nerve fibres)



The spinal cord is protected by **2 membranes**:

- the **pia mater** – this closely surrounds the spinal cord
- the **dura mater** – the tough layer outside it.

**Cerebrospinal fluid** can be found between them. This is secreted by the brain, and serves to:

- supply the brain and spinal tissue with nutrients e.g. glucose,
- removes wastes
- acts as a shock absorber

The **spinal cord** is mainly concerned with:

- reflex actions below the neck
- conducting sensory impulses from the body parts to the brain
- conducting motor impulses from the brain to the body parts



## Co-ordination and The Endocrine System (make sure you can draw fig. 19.14 pg. 170 GCSE)

The endocrine system is a collection of glands that secrete chemical messages we call HORMONES. These signals are passed through the blood to arrive at a target organ, which has cells possessing the appropriate receptor.

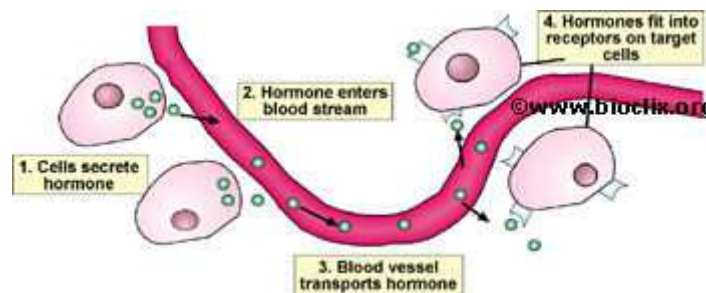
### Hormones

A hormone is a specific messenger molecule synthesized (built) and secreted by a group of specialized cells called an endocrine gland.

There are 2 types of glands in the body:

- a. Exocrine glands - glands that secrete their products through ducts e.g. sweat glands or salivary glands
- b. Endocrine glands - glands that secrete hormones not into ducts but directly into the bloodstream. As a result these are called ductless glands.

Hormones then travel elsewhere in the body transferring information and instructions to target organs, upon which they act. Each hormone's shape is specific and can be recognized by the corresponding target cells. The binding sites on the target cells are called hormone receptors.



Most hormones produce their effects rather slowly, which bring about long-term effects in the body, e.g. growth and sexual development. One exception is adrenaline.

When a hormone has produced the desired effect, further secretion of the hormone is switched off by negative feedback. This usually happens by the secretion of another hormone usually having an antagonistic effect. Much hormonal regulation thus depends on feedback loops to maintain balance and homeostasis.

Although many different hormones circulate throughout the bloodstream, each one affects only the cells that are genetically programmed to receive and respond to its message. When they have carried out their function, they are broken in the *liver* and later excreted.

(see the Table - *HORMONES AND THEIR EFFECTS* - on the following page)

## Feedback control in Hormone Secretion (see GCSE Biology pg. 172 – Homeostasis and feedback)

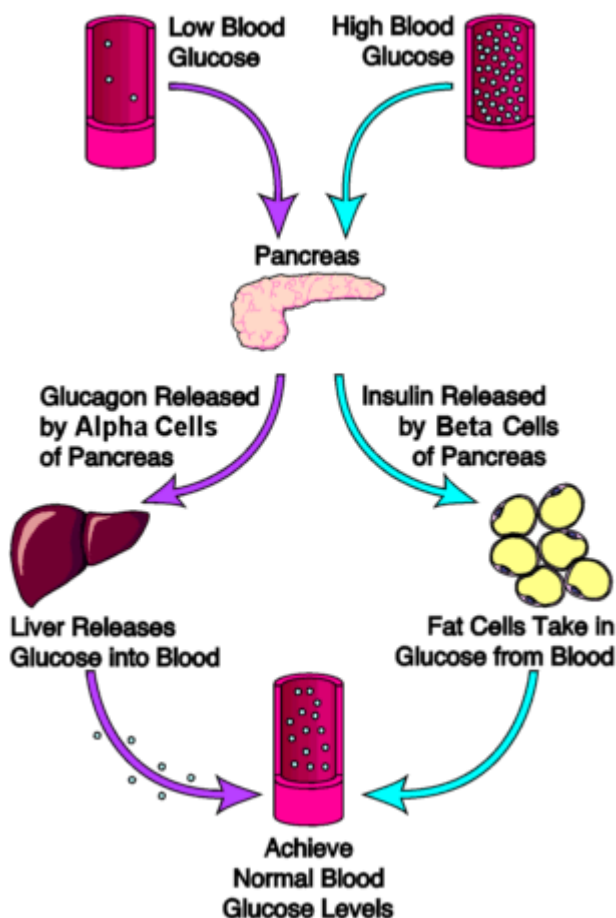
**REMEMBER:** Homeostasis is the maintenance of a constant internal body environment.

- Control of blood glucose level
- Regulation of body temperature
- Control of blood concentration

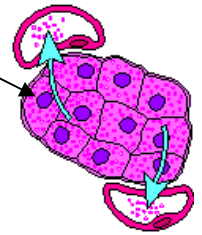
### The role of INSULIN and GLUCAGON in blood-glucose level control - *negative feedback*

**Negative feedback** – increase in the level of the factor under control triggers off a response which causes that factor to decrease.

*The heating system in your home is a simple negative feedback circuit. When the furnace produces enough heat to elevate temperature above the set point of the thermostat, the thermostat is triggered and shuts off the furnace (heat is feeding back negatively on the source of heat). When temperature drops back below the set point, negative feedback is gone, and the furnace comes back on.*



- Insulin and glucagon are hormones secreted by **islet cells** within the pancreas. They are both secreted in response to blood sugar levels, but in opposite fashion!
- If glucose levels rise above normal, the islet cells respond by secreting insulin. This reduces the level of glucose in the blood.
- If glucose levels fall, the islet cells in the pancreas stop secreting insulin and secrete glucagon. This raises the level of glucose in the blood.



**Comparing Nervous and hormonal control**

	<b>Nervous</b>	<b>Hormonal</b>
<i>Form of transmission</i>	Electrical	By means of chemicals, called hormones
<i>Route (path) of transmission</i>	Along nerve fibres	In the bloodstream
<i>Relative speed of transmission</i>	Very fast	Slow
<i>Termination (end) of transmission</i>	When impulse reaches effector	When hormone molecules are destroyed in the liver

**HW 1 – Co-ordination and the endocrine system – A4 notebook**

- Draw a labelled diagram to show the position of the endocrine system.
- Distinguish between endocrine and exocrine glands.
- What are hormones?
- In table form give three (3) differences between nervous and hormonal control.
- Define homeostasis
- With the aid of a flow diagram explain how blood sugar level is controlled in the body.
- What is negative feedback?

**HW 2 – Co-ordination and the endocrine system – A4 notebook**

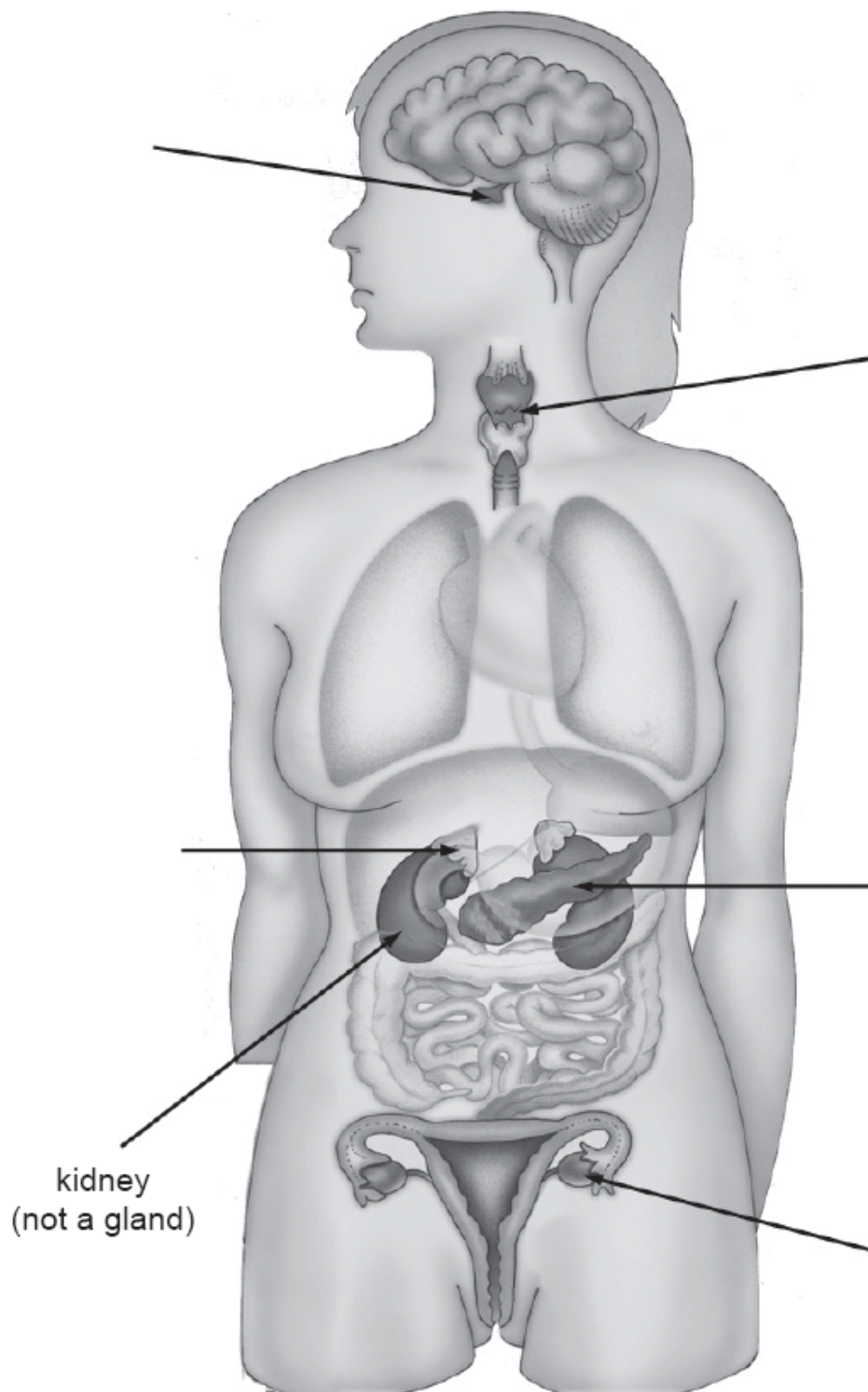
- Copy and complete the following table

Hormone	Where is it produced	Effects on the body
Insulin		
Testosterone		
Progesterone		
Oestrogen		
Adrenaline		
Antidiuretic hormone		
Adrenaline		
Growth hormone		
Thyroxin		





**b. Copy and label the diagram below:** (make a same size drawing, you only need to include the hormone secreting glands in the drawing)





**HW 3 – Co-ordination and the endocrine system – A4 notebook****Junior Lyceum Annual 2001**

1. Read the following paragraph and answer the questions below:

In order to survive in the world in which we live, we must be able to react to changes that occur in it. Behaviour is a mixture of **reflexes**, some that you are born with and others learned throughout life. Your response to a sharp, unexpected pin prick on the hand is an example of a simple **reflex action**.

The **nervous system and the endocrine system** control the responses we make to changes in the internal and external environment.

Reflexes are vital to our survival. Shivering when cold, increasing the rate of breathing when we are exercising and need oxygen, the contractions of the bladder and rectum when they are full to expel urine and faeces are inborn reflexes and vitally important to our survival.

- a. Explain the difference between a reflex action and a reflex arc.(2)
- b. Describe, with the help of a well-labelled diagram, the path taken by the impulse initiated by the unexpected pin prick on the hand. (7)
- c. State **three** structural or functional differences between the nervous and the endocrine systems. (3)
- d. The **brain** is a major part of the nervous system in humans. State **one** function of:
  - (i) cerebrum (1)
  - (ii) cerebellum (1)
  - (iii) medulla oblongata (1)

**(total 15 mark)**