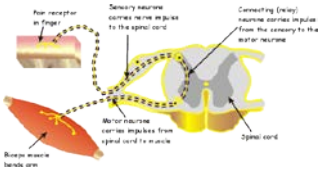
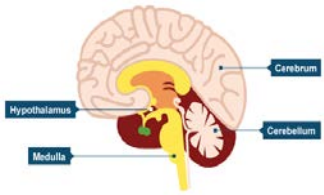
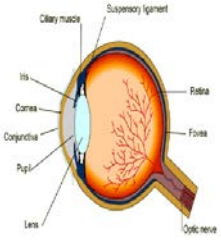
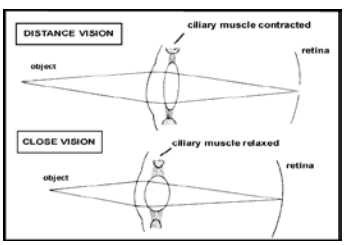
4.5 Homeostasis and response - knowledge organiser

4.5.1	Homeostasis
4.5.1 **Homeostasis**	Maintains **optimal (best) conditions for enzyme action**. Include control of **blood glucose** concentration; **body temperature**; **water levels** Control systems include cells called **receptors**, which **detect stimuli**, **coordination centres** (brain, spinal cord, pancreas) which **process** information, **effectors**, muscles or glands which bring about **responses**.
4.5.2	**Human nervous system**
4.5.2.1 Structure and function 	Information from receptors passes along cells (neurones) as **electrical impulses** to the **central nervous system** (CNS). The CNS is the brain and spinal cord. The **CNS coordinates** the response of effectors which may be muscles contracting or glands secreting hormones. **Stimulus → receptor→ coordinator → effector → response** **Synapses** join different neurones. **Chemicals** are released and **diffuse** across the gap. This **slows** the impulse down **Reflexes** are **automatic and rapid**. They do not involve the conscious part of the brain. Remember the **reaction time practical**.
4.5.2.2 The brain (biology only) 	The brain **controls complex behaviour**. It is made of billions of interconnected neurones and has different regions that carry out different functions. The **cerebrum** which controls memory, personality and conscious thought, the **cerebellum** which controls balance and co-ordination of movement, the **medulla** which controls heart rate and breathing rate, the **hypothalamus** which is the regulating centre for temperature and water balance Neuroscientists have been able to map the regions of the brain to particular functions by studying patients with brain damage, electrically stimulating different parts of the brain and using MRI scanning techniques. The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult.
4.5.2.3 The Eye (biology only)  	The eye is a sense organ containing receptors sensitive to light intensity and colour. **Retina** – light sensitive lining containing photoreceptor cells **optic nerve** – bundle of sensory neurones **Sclera** – the white of the eye, protective **Cornea** – front part of the eye, tough outer coat **Iris** – pigmented part of the eye, muscle alter the size of the pupil **ciliary muscles** – control the thickness of the lens for focussing **suspensory ligaments** – hold the lens in place **Accommodation** is the process of changing the shape of the lens to focus **on near or distant objects.** **To focus on a near object**: • the **ciliary muscles contract** • the **suspensory ligaments loosen** • the **lens** is then **thicker** and refracts light rays strongly. To focus on a dist**ant object**: • the **ciliary muscles relax** • the **suspensory ligaments are pulled tight** • the **lens** is then pulled **thin** and only slightly refracts light rays.

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	Two common defects of the eyes are **myopia (short sightedness)** and **hyperopia (long sightedness)** in which rays of light do not focus on the retina. • These defects are treated with spectacle lenses which refract the light rays so that they do focus on the retina. • New technologies now include hard and soft contact lenses, laser surgery to change the shape of the cornea and a replacement lens in the eye.
4.5.2.4 Control of body temperature (biology only)	**Body temperature** is **monitored** and **controlled** by the **thermoregulatory centre** in the brain. The thermoregulatory centre contains receptors **sensitive** to the **temperature of the blood**. The **skin contains temperature receptors** and sends nervous impulses to the thermoregulatory centre. If the **body temperature is too high**, **blood vessels dilate** (vasodilation) and **sweat is produced** from the sweat glands. Both these mechanisms cause a **transfer of energy from the skin to the environment.** If the **body temperature is too low**, **blood vessels constrict** (vasoconstriction), sweating stops and skeletal **muscles contract (shiver).**
4.5.3.1 **Human endocrine system**	The **endocrine system** is composed of **glands** which secrete chemicals called **hormones** into the **blood**stream. **Pituitary gland** is the '**master' gland**
4.5.3.2 **Control of blood glucose concentration**	Blood **glucose too high**, **pancreas** releases **insulin**. Glucose is moved into cells. Liver and muscle cells convert **glucose→ glycogen** for storage **Type 1 diabetes** – the **pancreas fails to produce enough insulin**. Treat with insulin injections **Type 2 diabetes** – body cells **no longer respond to insulin**. Commonly treat with a carbohydrate controlled diet and exercise. Obesity is a risk factor. If blood **glucose is too low**, the **pancreas releases glucagon**, which converts **glycogen into glucose** which is released into the blood
4.5.3.3. **Maintaining water and nitrogen balance in the body (biology only)**	**Water leaves the body** via the **lungs** during exhalation. Water, ions and urea are lost from the **skin in sweat.** There is no control over water, ion or urea loss by the lungs or skin. **Excess water, ions and urea** are removed via the **kidneys** in the **urine**. If body cells lose or gain too much water by osmosis they do not function efficiently. (HT only) The digestion of proteins from the diet results in **excess amino acids** which need to be **excreted** safely. In the liver these amino acids are **deaminated** to form **ammonia**. Ammonia is **toxic** and so it is immediately converted to **urea** for **safe excretion**. The kidneys produce urine by filtration of the blood and **selective reabsorption** of **useful substances** such as **glucose**, **some ions** and **water.** (HT only) The **water level** in the body is controlled by the **hormone ADH** which acts on the **kidney tubules.** ADH is **released by the pituitary** gland **when the blood is too concentrated** and it causes **more water to be reabsorbed** back into the blood from the kidney tubules. This is controlled by **negative feedback.** People who suffer from kidney failure may be treated by organ transplant or by using kidney dialysis.

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4.5.3.4 **Hormones in human reproduction**	**Oestrogen** is the main female reproductive hormone. **Testosterone** is the main male reproductive hormone. **Follicle stimulating hormone** (FSH) causes **maturation of the egg** **Luteinising hormone** (LH) stimulates **release of the egg.** **Oestrogen** and **progesterone** are involved in **maintaining the lining** of the **uterus**
4.5.3.5 **contraception**	**Oral contraceptives** contain hormones to **inhibit FSH,** so **no eggs mature**. **Injection, implant or skin patch of slow release progesterone inhibits maturation and release of eggs** for months or years. **Barrier methods** e.g. condoms and diaphragms **prevent sperm reaching the egg**. **Intrauterine devices (IUD) prevent implantation** of the embryo in the womb, or release a hormone. **Spermicides** kill sperm
4.5.3.6 **Using hormones to treat infertility (HT)**	**FSH and LH** are contained in 'fertility' drugs. In vitro fertilisation (IVF) involves giving a mother FSH and LH to **stimulate maturation of several eggs**, the eggs are collected and **fertilised** by sperm in the laboratory. The fertilised eggs develop into **embryos**. These tiny balls of cells are **inserted into the mother's uterus**. IT is emotionally and physically very stressful, has a low success rate, can lead to multiple births
4.5.3.6 **Negative feedback (HT)**	**Adrenaline** produced by the adrenal glands in times of fear or stress. It **increases heart rate** and **boosts delivery of oxygen** and glucose to the brain and muscles, preparing the body for '**fight or flight'**. **Thyroxine** from the thyroid gland **stimulates the basal metabolic rate**, playing an important role in growth and development. Thyroxine levels are **controlled by negative feedback**