Meden School Curriculum Planning							
Subject	Biology	**Year Group**	10	**Sequence No.**	4	**Topic**	Bioenergetics

Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
Year 9 Cardiovascular System and Respiration L8: Respiration is not breathing. The word equation for respiration is: **glucose + oxygen → carbon dioxide + water** and the balanced symbol equation is: **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$.** Energy is not created or destroyed, it is **transferred**. Respiration occurs in **animals** and **plant cells.** **Year 9 Cardiovascular System and Respiration L9:** Anaerobic respiration starts when all the oxygen available is used up. The word equation for anaerobic respiration is: **glucose → energy and lactic** acid. Only half the energy is transferred compared to aerobic respiration. **Lactic acid** causes **muscle fatigue. Oxygen debt** is the amount of extra oxygen the body needs to react with the build-up of lactic acid and remove it from cells. Pulse and breathing rate remains high whilst there are high levels of lactic acid and carbon dioxide.	**L1: Photosynthesis** uses energy to change **carbon dioxide** and **water** into **glucose** and **oxygen**. It takes place in **chloroplasts** in green plant cells, they contain pigments like **chlorophyll** that absorb light. Energy is **transferred** to the chloroplasts from the environment by light. Photosynthesis is **endothermic** so energy is **transferred** from the environment. The word equation for respiration is: **glucose + oxygen → carbon dioxide + water** and the balanced symbol equation is: **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$.** Transfer energy from some of the **glucose** to convert the rest of the glucose into other, useful, substances. **Glucose** is converted into **cellulose** to make strong **plant cell walls. Glucose** is combined with **nitrates** to make **amino acids. Nitrate ions** are absorbed from the soil. **Amino acids** make **proteins. Glucose** is converted into **lipids** (fats and oils) for storing in seeds. **Glucose** is converted into **starch** and stored in the **roots, stems** and **leaves.** Plants use the **starch** when it is not photosynthesising. **Starch** is **insoluble** (cannot dissolve) so it is a better storage molecule as it doesn't cause water to enter and swell the plant cell. **L2:** The rate of **photosynthesis** is affected by the **intensity of light, carbon dioxide concentration** and **temperature**. This means that it is stopping photosynthesis from going any faster. They can depend upon **environmental conditions** such as night (light) and winter (temperature). **Chlorophyll** can also be a limiting factor as it can be affected by a **disease** or **environmental stress**, such as lack of **nutrients. Chloroplasts** become damaged and do not make enough **chlorophyll** so they cannot absorb as much light. As **light** level increases the rate of photosynthesis increases steadily, but only up to a certain point, after that it won't make a difference. **Temperature** or **carbon dioxide** will now be the limiting factors. This is also true for **carbon dioxide** (but the limiting factor may be temperature of light now). **Light intensity** can be measured with a **light meter**. If **temperature** is too low, the **enzymes** needed for photosynthesis will be working slowly. Too high and they will be **denatured** which happens at about **45 degrees Celcius.**	**L4:** What is the effect on the environment of growing plants **artificially** (commercially)? What are the alternatives? Will they or won't they solve **world hunger?** What causes **world hunger?** **L7: W**hat do **performance enhancing** drugs do to athletes? Why do athlete's take **performance enhancing** drugs? Should an athlete be banned from all competitions if they are caught taking **performance enhancing** drugs?

Year 9 Enzyme Activity L1: Metabolism is the sum of all the chemical reactions in the body or a single cell. **Glucose** is joined together to form **starch, glycogen and cellulose.** Lipids are made from one **glycerol** and three **fatty acids**. Glucose is combined with **nitrate ions** to make **amino acids** for **proteins.** **Year 9 Plant Structure & Photosynthesis 4: Photosynthesis** takes place in the **chloroplasts** of cells. The word equation is: **carbon dioxide + water → glucose + oxygen.** The balanced word equation is: **$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$**, it is the opposite of the equations for respiration. **Year 9 Plant Structure & Photosynthesis 7:** Plants use glucose in five different ways: **respiration**, making **cell walls**, making **amino acids**, stored as **fats** or **oils** and stored as **starch.**	**L3:** Pondweed can be used to measure the effect of **light intensity** on the rate of **photosynthesis.** The rate at which the pondweed produces oxygen corresponds to the rate at which it is photosynthesising. A source of **white light** is placed at a **specific distance** from the pondweed. It is let to photosynthesise for a **set amount** of **time**, the oxygen released will be collected in a **capillary tube**. A **syringe** is used at the end of the experiment to draw the gas bubble in the tube alongside a ruler and length of the gas bubble is **measured**. This is **proportional** to the **volume** of oxygen produced. The temperature and time left to photosynthesis are **control variables**. The test tube the pond weed is in can be put in a **water bath** at a set temperature or a measured amount of **sodium hydrogencarbonate** can be dissolved in the water, it releases carbon dioxide. The experiment can be **repeated** at different water temperatures or concentration of sodium hydrogen carbonate. Light intensity decreases in proportion to the **square of the distance**. This is the **inverse square law: light intensity $\propto$ 1 / d^2**. So, if the distance is halved, the light intensity will be four times greater. **L4:** Artificially creating the ideal conditions for plants includes growing them in a **greenhouse. Greenhouses** trap the Sun's heat and ensures **temperature** is not a **limiting factor**. **Shades** and **ventilation** is used in the Summer to cool the greenhouse down. **Artificial light** is used at night. **Carbon dioxide** levels are increased by using a **paraffin heater**. Plants in a greenhouse are also protected from **pests** and **diseases, fertilizers** can be added to provide **minerals** needed for healthy growth. If conditions are kept right plants will grow much **faster** and a **decent crop** will be **harvested** much more **often** and so sold. This needs to be balanced with **cost.** **L5:** Energy transferred (from the breakdown of **glucose**) from **respiration** is used for all living processes. Respiration is **not breathing**. It goes on in **every cell** continuously, **animal** and **plant cells**. It is an **exothermic** process as energy is transferred to the environment. Energy from respiration is used to build **larger molecules** from **smaller ones**. In animals it is used to allow **muscles** to **contract.** In mammals and birds it is used to keep **body temperature constant**. **Aerobic respiration** uses **oxygen** and is the most efficient way to transfer energy from glucose, it takes place in **mitochondria.** The word equation for respiration is: **glucose + oxygen → carbon dioxide + water** and the balanced symbol equation is: **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$.** When vigorous exercise is being done the body cannot supply enough oxygen to the muscles so **anaerobic respiration** (as well as aerobic respiration) begins. **Anaerobic** means **without oxygen** and is the incomplete breakdown of glucose which makes **lactic acid**. The word equation is **glucose → lactic acid.** Glucose is not fully **oxidised** which is why not as much energy is transferred in comparison to aerobic respiration. Therefore, it is only useful in **emergencies**. **Plant** and **yeast cells** can respire without oxygen, but produce **ethanol (alcohol)** and **carbon dioxide** instead of lactic acid. The word equation for anaerobic respiration in plant and yeast cells is: **glucose → ethanol + carbon dioxide**.	

	In yeast cells this is called **fermentation** and is used in the **food** and **drinks industry** to make bread and alcoholic drinks. The carbon dioxide causes bread to rise. **L6: Metabolism** is happening **all of the time** and is the **sum of all the reactions** that happen in a cell or the body. Chemical reactions happen all the time in cells, and they are controlled by **enzyme**s. Many of these reactions are linked together to form bigger reactions. In some of these reactions larger molecules are made from smaller ones. Lots of **glucose** molecules are joined together in reactions to form **starch** (a storage molecule in plant cells), **glycogen** (a storage molecule in animal cells) and **cellulose** (a component of plant cell walls). **Lipid** molecules are made from one molecule of **glycerol** and three **fatty acids. Glucose** is combined with **nitrate ions** to make **amino acids** which are then made into **proteins.** In other reactions, larger molecules are broken down into smaller ones. **Glucose** is broken down in **respiration** to transfer energy to power all reactions. Excess **protein** is broken down in a reaction to produce **urea** which is then **excreted** as **urine.** **L7: Muscles** need energy from **respiration** to **contract.** When exercising some muscles contract more **frequently** than others so more energy than normal is needed so **respiration increases**. In turn more **oxygen** is also needed so **breathing rate** and **breath volume increase** to get more oxygen into the blood. **Heart rate** then **increases** to get this **oxygenated blood** around the body faster, so **carbon dioxide** is removed more quickly. When really **vigorous** exercise is done, the body cannot supply oxygen quick enough to muscles so **anaerobic respiration** occurs which is not the best way to transfer energy from glucose as **lactic acid** builds up in the muscles and gets **painfu**l. Long periods of exercise can also cause **muscle fatigue,** the muscles get tired and stop contracting efficiently. Once exercise has stopped there is an **oxygen debt.** This is the amount of **extra oxygen** needed to react with the **build-up** of **lactic** acid and remove it from cells in the form of **carbon dioxide** and **water.** The **lungs, heart** and **blood** couldn't keep up with the demand for oxygen. This means breathing is still hard after exercising has stopped to get more oxygen into the blood which is then transported to muscle cells. **Pulse** and **breathing rate** stay high whilst there are high levels of lactic acid and carbon dioxide. Blood that enters muscles transport lactic acid to the **liver** where it is **converted** back into **glucose.** Breathing rate can be measured by counting breaths and heart rate by taking a **pulse**. Two fingers are placed inside the **wrist** or **neck** and pulses are counted for **one minute**. Pulse rate will increase the more intense exercise is as the body needs more oxygen to the muscles and needs to take more caron dioxide away. To reduce the effect of **random errors** results can be done as a group with the **average** pulse rate plotted.	