KESTEVEN AND SLEAFORD HIGH SCHOOL

Biology Scheme of Learning

Year 10 – Term 3/Unit 8 and 9 Photosynthesis and Respiration

Intent – Rationale

Students will study photosynthesis in both plants and algae. They should be familiar with the word equation for photosynthesis, and also the symbol equation in the case of higher-tier students. They should be aware that photosynthesis is an endothermic reaction.

Students will study the adaptations of leaves to achieve maximum efficiency in photosynthesis. They should link this work with B1.2 *Animal and plant cells*, B1.5 *Specialisation in plant cells*, and B4.6 *Tissues and organs in plants*. Students will study factors that affect the rate of photosynthesis. They should understand the concept of limiting factors. They should have carried out data interpretation exercises and be able to explain the results. Higher-tier students should understand that that any one factor could become limiting as the factors interact. These students should be confident in analysing two or three factors displayed on a graph and deciding which factor is limiting. They should be confident describing the inverse square law as applied to light intensity.

All students should be aware of the fate of glucose – its use in respiration, and also how it can be assimilated into starch and cellulose. They should link this with B1.2 *Animal and plant cells*, B1.7 *Osmosis*, and B9 *Respiration*. Students should also consider the need for nitrate ions as well as glucose to make proteins, and how glucose can be used to make lipids. They should link this with B3.3 *The chemistry of food* where they carried out food tests.

Students will consider the use of greenhouses and study how the conditions can be monitored and manipulated to achieve the highest rate of photosynthesis. Higher-tier students should have an appreciation of the economics of increasing the rate of photosynthesis – they should be aware that using a greenhouse is expensive, and weigh it up against the profit gained in increased biomass.

Students will study respiration, and should be able to recall that this is one of the most important processes in living cells. They should be able to describe the process of respiration and write the word equation, and higher-tier students should also be able to write the balanced symbol equation.

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Students will look at mitochondria as the site of respiration, linking this with B1.2 *Animal and plant cells* and cell specialisation in B1.4 and B1.5. Students should be able to list examples of living processes that need the energy released from respiration. They should link this with work in B1.9 *Active transport*, in particular the transport of mineral ions into the root hair cell.

Students will study the response of humans to exercise, including changes in heart rate, breathing rate, and breakdown of glycogen, all to increase the rate of respiration in muscle cells. They should link this with work on the heart and blood vessels in B4 *Organising animals and plants*.

In studying anaerobic respiration, students should be aware of this process in mammalian muscles, and be able to write the word equation. Students should be aware that anaerobic respiration occurs in yeast cells and some plant cells. They should know that fermentation is an economically important reaction and be able to write the word equation, with higher-tier students knowing the balanced symbol equation for fermentation. Higher-tier students should also be able to link aerobic respiration in mammalian muscles to the oxygen debt.

Students will study metabolism, and should be able to list common metabolic reactions. They should link these with B8.1 *Photosynthesis* and B8.3 *How plants use glucose*. Finally higher-tier students should recall the roles of lactic acid, urea formation, and the liver.

KESTEVEN AND SLEAFORD HIGH SCHOOL

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
Topic B7.1 Cells and Tissues **GCSE B1 Cells and their specialisation, diffusion, osmosis and active transport.** B1.2 Animal and plant cells, B1.5 Specialisation in plant cells, **B4 Organising animals and plants** B4.6 Tissues and organs in plants.	• GCSE Ecology units B16 B17 B18 • A level Biology Unit 1 Biological molecules Unit 5 Energy transfer between organisms
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
• Mathematics graph skills • Geography Water cycle/environment	• GB4 egh during practical work and analysing computer simulations of experiments
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	**What are the opportunities for developing mathematical skills?**
FROM THE LIBRARY *The Body*-612 *Breathing*-612 *Evolve or Die*-500 *Lungs*-612	• Graph drawing skills and calculating rates

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Year 10 – Term 3/Unit 8 and 9 Photosynthesis and Respiration

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?

Know

Describe how the leaf is adapted for photosynthesis. Write the balanced symbol equation for photosynthesis. Describe an experiment to prove that plants carry out photosynthesis when exposed to light. Describe why low temperature, shortage of carbon dioxide, shortage of light and shortage of chlorophyll limit the rate of photosynthesis. Describe all the ways in which plants use glucose, including how they make proteins. Describe why greenhouses increase plant growth.
Write the balanced symbol equation for respiration. Describe respiration as an exothermic reaction. Explain why heart rate, breathing rate, and breath volume change with exercise. Write the balanced symbol equation for anaerobic respiration in plants and microorganisms. Compare and contrast aerobic and anaerobic respiration. Explain why muscles get tired during exercise. Describe the role of the liver in repaying the oxygen debt.

Apply

Suggest which factor limits the rate of photosynthesis in a given situation. Interpret and explain graphs of photosynthesis rate involving one limiting factor. Evaluate risks involved in the starch test. Comment on the cost-effectiveness of adding heat, light, or carbon dioxide to greenhouses. Discuss the benefits of using greenhouses and hydroponics. Apply knowledge of enzymes to explain why a high temperature affects the rate of photosynthesis
Plan an investigation to include a control. Choose the best way to display data and calculate percentage changes. Justify the choice of chart/graph used to display data.
Apply understanding of respiration in new contexts.
Discuss whether it is possible to increase metabolism. Evaluate information to assess credibility.

Extend

Explain how adaptations of the leaf make photosynthesis efficient. Explain why photosynthesis is an endothermic reaction. Explain why chlorophyll is needed for photosynthesis. Predict how the rate of photosynthesis will be affected with more than one limiting factor. Understand and use the inverse square law and light intensity in the context of photosynthesis. Explain how carnivorous plants are adapted to their environment. Explain how and why plants convert glucose to starch for storage. Explain in detail how using greenhouses can help control limiting factors and increase the rate of photosynthesis. Use data to comment on the cost-effectiveness of greenhouses. Evaluate the use of greenhouses and hydroponics in terms of economics. Explain why respiration is an exothermic reaction. Explain why a control is necessary in some scientific investigations. Explain why stores of glycogen change with exercise. Compare and contrast anaerobic respiration in animals, plants, and microorganisms. Explain in detail why heart and breathing rate continue to be high for a period of time after exercise.
Write a prediction based on scientific knowledge. Explain the link between protein consumption and concentration of urea in urine.

What subject specific language will be used and developed in this topic?

Aerobic respiration	An exothermic reaction in which glucose is broken down using oxygen to produce carbon dioxide and water and release energy for cells.
Anaerobic respiration	an exothermic reaction in which glucose is broken down in the absence of oxygen to produce lactic acid in animals and ethanol and carbon dioxide in plants and yeast. A small amount of energy is transferred to the cells.
Biogas	Methane gas produced by the anaerobic digestion of organic material, such as farm animal manure.
Endothermic reaction	A reaction that requires a transfer of energy **from** the environment.
Chloroplast	An organelle found in some plant cells where photosynthesis takes place.
Ethanol	Waste product from anaerobic respiration in plants and yeast.
Exothermic reaction	A reaction that transfers energy **to** the environment.

What opportunities are available for assessing the progress of students?

- B8 LAQ 1 after B8 L4
- B8 LAQ 2 after B8 L5
- B9 LAQ after B9 L3
- B8 and 9 Test

Glucose	A simple sugar produced during photosynthesis
Glycogen	a carbohydrate store in animals. It is made up of many glucose units bonded together.
Hepatic artery	brings oxygenated blood to the liver
Hepatic portal vein	carries blood containing digested food from the intestines to the liver.
Hepatic vein	carries blood from the liver on to the heart
Hydroponic crop	
Lactic acid	the end product of anaerobic respiration in animal cells.
Limiting factors	limit the rate of a reaction, for example photosynthesis.
Metabolism	is the sum of all the reactions in the body. Metabolism includes the conversion of glucose to starch, glycogen and glucose as well as the breakdown of excess proteins to urea.
Mitochondria	are organelles within a cell. This is where many of the reactions of aerobic respiration take place.
Oxygen debt	the extra oxygen that must be taken into the body after exercise has stopped to complete the aerobic respiration of lactic acid.
Photosynthesis	The process in green plants that uses energy from sunlight to convert carbon dioxide and water into the sugar glucose.
Rate of photosynthesis	Rate at which green plants convert carbon dioxide and water to glucose in the presence of light.
Starch	A type of carbohydrate found in bread, potatoes and rice. Plants produce starch to store the energy food they make by photosynthesis. Starch molecules are a long chain of glucose molecules.
Starch grains	Microscopic granules of starch forming an energy store in plant cells.
Yield	The crop yield is the amount of crop that can be grown per area of land.

KESTEVEN AND SLEAFORD HIGH SCHOOL

Intent – Concepts

Lesson title	Learning challenge I can	Higher level challenge I can	Suggested activities and resources
B8 L1 **Photosynthesis** **(may take 2 lessons for starch test results)**	a) State that photosynthesis is an endothermic reaction. b) The equations that summarise photosynthesis.	Explain how adaptations of the leaf make photosynthesis efficient. Explain why photosynthesis is an endothermic reaction. Explain why chlorophyll is needed for photosynthesis.	
B8 L2 **Testing for starch**	a) Describe and carry out a test for starch in leaves. b) Describe how to test oxygen produced from a water plant during photosynthesis.	Plan how to measure the rate of photosynthesis. Done in advance of required practical.	
B8 L3 **The Rate of Photosynthesis**	a) List the factors that limit the rate of photosynthesis in plants. b) Interpret graphs showing changes in rate of photosynthesis.	Apply knowledge of enzymes to explain why a high temperature affects the rate of photosynthesis. Understand and use the inverse square law and light intensity in the context of photosynthesis.	
B8 L4 **Required Practical**	Investigate how light intensity affects the rate of photosynthesis	Predict how the rate of photosynthesis will be affected with more than one limiting factor.	
B8 L5 **How Plants use Glucose Making the most of Photosynthesis**	Describe how factors can be controlled when plants are grown in a greenhouse.	Explain how carnivorous plants are adapted to their environment. Explain how and why plants convert glucose to starch for storage. Explain in detail how using greenhouses can help control limiting factors and increase the rate of photosynthesis. Use data to comment on the cost-effectiveness of greenhouses. Evaluate the use of greenhouses and hydroponics in terms of economics.	
B9 L1 **Aerobic Respiration**	a) The word and balanced symbol equation for respiration b) That organisms need energy for: • Chemical reactions to build larger molecules • Movement • Keeping warm	Apply understanding of respiration in new contexts. Explain why respiration is an exothermic reaction. Explain why a control is necessary in some scientific investigations.	
B9 L2 **The Responses to exercise**	That during exercise the human body reacts to the increased demand for energy. Heart rate, breathing rate and breath volume all increase during exercise to supply the muscles with more oxygenated blood. This is needed to increase the rate of respiration and transfer more energy to meet the demands of the cells.	Explain why stores of glycogen change with exercise. Justify the choice of chart/graph used to display data.	

KESTEVEN AND SLEAFORD HIGH SCHOOL

B9 L3 **Anaerobic Respiration**	a) Why less energy is transferred by anaerobic respiration than by aerobic respiration b) What is meant by oxygen debt c) That anaerobic respiration takes place in lots of different organisms, including plants, bacteria and fungi	Compare and contrast anaerobic respiration in animals, plants, and microorganisms. Explain in detail why heart and breathing rate continue to be high for a period of time after exercise.	
B9 L4 **Metabolism and the Liver**	a) That metabolism is the sum of all the reactions in a cell or a body of an organism and can give examples b) The role of the liver in repaying the oxygen debt	Explain the link between protein consumption and concentration of urea in urine. Evaluate information to assess credibility.	
Revision lesson			
B8 and 9 Test			