Summary

Unit 8 - Metabolism, cell respiration and photosynthesis Current

Subject	Year	Start date	Duration
Biology	IB1	Week 1, May	4 weeks 14 hours

Course Part

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop experimental and investigative scientific skills including the use of current technologies

Develop and apply 21st century communication skills in the study of science

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

Objectives

Demonstrate knowledge and understanding of

- facts, concepts, and terminology
- methodologies and techniques
- communicating scientific information

Apply

- facts, concepts, and terminology
- methodologies and techniques
- methods of communicating scientific information

Syllabus Content

Additional higher level

8. Metabolism, cell respiration and photosynthesis

8.1 Metabolism

Nature of science:

Developments in scientific research follow improvements in computing - developments in bioinformatics, such as the interrogation of databases, have facilitated research into metabolic pathways.

Understandings:

Metabolic pathways consist of chains and cycles of enzyme-catalysed reactions.

Enzymes lower the activation energy of the chemical reactions that they catalyse.

Enzyme inhibitors can be competitive or non-competitive.

Metabolic pathways can be controlled by end-product inhibition.

Applications and skills:

Application: End-product inhibition of the pathway that converts threonine to isoleucine.

Application: Use of databases to identify potential new anti-malarial drugs.

Skill: Calculating and plotting rates of reaction from raw experimental results.

Skill: Distinguishing different types of inhibition from graphs at specified substrate concentration.

8.2 Cell respiration

Nature of science:

Paradigm shift - the chemiosmotic theory led to a paradigm shift in the field of bioenergetics.

Understandings:

Cell respiration involves the oxidation and reduction of electron carriers.

Phosphorylation of molecules makes them less stable.

In glycolysis, glucose is converted to pyruvate in the cytoplasm.

Glycolysis gives a small net gain of ATP without the use of oxygen.

In aerobic cell respiration pyruvate is decarboxylated and oxidized, and converted into acetyl compound and attached to coenzyme A to form acetyl coenzyme A in the link reaction.

In the Krebs cycle, the oxidation of acetyl groups is coupled to the reduction of hydrogen carriers, liberating carbon dioxide.

Energy released by oxidation reactions is carried to the cristae of the mitochondria by reduced NAD and FAD.

Transfer of electrons between carriers in the electron transport chain in the membrane of the cristae is coupled to proton pumping.

Oxygen is the final electron acceptor.

In chemiosmosis protons diffuse through ATP synthase to generate ATP.

Oxygen is needed to bind with the free protons to maintain the hydrogen gradient, resulting in the formation of water.

The structure of the mitochondrion is adapted to the function it performs.

Applications and skills:

Application: Electron tomography used to produce images of active mitochondria.

Skill: Analysis of diagrams of the pathways of aerobic respiration to deduce where decarboxylation and oxidation reactions occur.

Skill: Annotation of a diagram of a mitochondrion to indicate the adaptations to its function.

8.3 Photosynthesis

Nature of science:

Developments in scientific research follow improvements in apparatus - sources of 14C and autoradiography enabled Calvin to elucidate the pathways of carbon fixation.

Understandings:

Light-dependent reactions take place in the thylakoid membranes and the space inside them.

Light-independent reactions take place in the stroma.

Reduced NADP and ATP are produced in the light-dependent reactions.

Absorption of light by photosystems generates excited electrons.

Photolysis of water generates electrons for use in the light-dependent reactions.

Transfer of excited electrons occurs between carriers in thylakoid membranes.

Excited electrons from Photosystem II are used to contribute to generate a proton gradient.

ATP synthase in thylakoids generates ATP using the proton gradient.

Excited electrons from Photosystem I are used to reduce NADP.

In the light-independent reactions a carboxylase catalyses the carboxylation of ribulose bisphosphate.

Glycerate 3-phosphate is reduced to triose phosphate using reduced NADP and ATP.

Triose phosphate is used to regenerate RuBP and produce carbohydrates.

Ribulose bisphosphate is reformed using ATP.

The structure of the chloroplast is adapted to its function in photosynthesis.

Applications and skills:

Application: Calvin’s experiment to elucidate the carboxylation of RuBP.

Skill: Annotation of a diagram to indicate the adaptations of a chloroplast to its function.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will
  - ask students to formulate a reasoned argument to support their opinion or conclusion
  - give students time to think through their answers before asking them for a response
  - reward a new personal understanding, solution or approach to an issue
  - ask open questions
  - set students a task which required higher-order thinking skills (such as analysis or evaluation)
  - build on a specific prior task
  - help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)
  - require students to take an unfamiliar viewpoint into account when formulating arguments
  - ask questions that required the use of knowledge from a different subject from the one you are teaching
  - include a reflection activity
  - make a link to TOK

Social

- In this unit, we will
  - have students work in small groups
  - allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity
  - have students peer assess their group performance or process
  - support students in resolving a conflict in a team
  - give a group assessment task
  - give students feedback on how they worked as a group
  - have students discuss their understanding of a text or idea among themselves and come up with a shared understanding
  - provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance
  - encourage students to consider alternative points of view or to take the perspective of others
  - provide opportunities for students to make decisions

Developing IB Learners

Learner Profile

- Inquirers
- Knowledgeable
- Thinkers
- Balanced
- Reflective