**Topic 8.2: Cell Respiration**

**Essential Idea: Energy is converted to a usable form in cell respiration.**

**Statements & Objectives:**

**8.2.U1 Cell respiration involves the oxidation and reduction of electron carriers.**

Outline oxidation and reduction reactions in terms of movement of electrons, hydrogen or oxygen atoms.

(**Outline** Give a brief account or summary.)

Define “electron carrier.”

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

State the name of the electron carrier molecule used in cellular respiration.​​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U2 Phosphorylation of molecules makes them less stable.**

Define phosphorylation.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

State the consequence of a molecule being phosphorylated.​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U3 In glycolysis, glucose is converted to pyruvate in the cytoplasm.**

Outline the glycolysis reaction, including phosphorylation, lysis and energy harvest.​

(**Outline** Give a brief account or summary.)

**8.2.U4 Glycolysis gives a small net gain of ATP without the use of oxygen.**

State the formula for the glycolysis reaction.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that glycolysis occurs in both anaerobic and aerobic respiration.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that glycolysis is an example of a metabolic pathway.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U5 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.**

Define decarboxylation and oxidation.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

​Summarize the reactant and products of the link reaction.

(**Summarize** Abstract a general theme or major point(s).)

**8.2.U6 In the Krebs cycle, the oxidation of acetyl groups is coupled to the reduction of hydrogen carriers, liberating carbon dioxide.**

State that NADH and FADH2 are electron carriers formed during the Krebs cycle.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

Outline the events of the Krebs cycle, referencing the formation of NADH and

FADH2, formation of ATP and decarboxylation of acetyl groups.

(**Outline** Give a brief account or summary.)

**8.2.U7 Energy released by oxidation reactions is carried to the cristae of the mitochondria by reduced NAD and FAD.**

State that NAD+ is reduced to become NADH in the link reaction and Krebs cycle.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that FAD is reduced to become FADH2 in the Krebs cycle.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that NADH and FADH2 carry electrons to the electron transport chain on the mitochondrial inner membrane. ​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U8 Transfer of the electrons between carriers in the electron transport chain in the membrane of the cristae is coupled to proton pumping.**

State that at the electron transport chain, FADH2 and NADH given electrons to electron carrier proteins.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that the movement of electrons through electron carrier proteins in the electron transport chain is used to pump protons (H+) across the inner mitochondrial membrane into the intermembrane space.​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U9 In chemiosmosis protons diffuse through ATP synthase to generate ATP.**

Define oxidative phosphorylation and chemiosmosis.​

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

**8.2.U10 Oxygen is needed to bind with the free protons to maintain the hydrogen gradient, resulting in the formation of water.**

​State that oxygen is the final electron acceptor in aerobic cellular respiration.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

State that that formation of water in the matrix at the end of the electron transport chain helps to maintain the hydrogen gradient between the intermembrane space and the matrix.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.U11 The structure of the mitochondrion is adapted to the function it performs.**

Outline how mitochondria structure could evolve through natural selection.

(**Outline** Give a brief account or summary.)

State evidence that suggests mitochondria were once free-living prokaryotes.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.A1 Electron tomography used to produce images of active mitochondria.**

State that electron tomography enables scientists to view the dynamic nature of mitochondrial membranes. ​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.S1 Analysis of diagrams of the pathways of aerobic respiration to decide where decarboxylation and oxidation reactions occur.**

State that decarboxylation of glucose occurs in the linking reaction and Krebs cycle of aerobic respiration.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**8.2.S2 Annotations of a diagram of mitochondrion to indicate the adaptations to its function.**

​Draw and label a diagram of the mitochondria.

(**Draw**: Represent by means of a labeled, accurate diagram or graph, using a pencil. A ruler(straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted(if appropriate) and joined in a smooth curve. )

State the function of the following mitochondrial structures: outer membrane, inner membrane, cristae, intermembrane space, matrix, ribosome and mtDNA.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

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

State that Peter Mitchell’s proposal of the chemiosmotic hypothesis in 1961 lead to a major shift in our understanding of cellular processes. ​

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**Key Terms**

​ Oxidation

​NADH

​decarboxylated

​acetyl groups

protons

​lysis

decarboxylated

​hydrogen carriers

​hydrogen gradient

reduction

​glucose

​link reaction

​citric acid

​chemiosmosis

energy harvest

​coenzyme A

proton pump

bioenergetics

phosphorylation

​ATP

​acetyl coenzyme A

​FAD

​electron transport chain

​anaerobic

​acetyl coenzyme A

​electron transport chain

 ​electron tomography

electron carriers

​glycolysis

​FADH

aerobic

​Krebs cycle

​cristae

​mtDNA

NAD

​Pyruvate

​mitochondria

​oxidative phosphorylation

​ATP synthase

​pyruvate

​link reaction

NADPH

Peter Mitchell