3.1 – ENZYMES

C1.1.1	Enzymes as catalysts
C1.1.2	Role of enzymes in metabolism
C1.1.3	Anabolic and catabolic reactions
C1.1.4	Enzymes as globular proteins with an active site for catalysis
C1.1.5	Interactions between substrate and active site to allow induced-fit binding
C1.1.6	Role of molecular motion and substrate-active site collisions in enzyme catalysis
C1.1.7	Relationships between structure of active site, enzyme-substrate specificity and denaturation
C1.1.8	Effects of temperature, pH and substrate concentration on the rate of enzyme activity
C1.1.9	Measurements in enzyme-catalysed reactions
C1.1.10	Effect of enzymes on activation energy

METABOLISM

Define metabolism

_____

_____

Differentiate between anabolism and catabolism (using specific examples)

Anabolism	Catabolism

ENZYMES

Define enzyme

_____

_____

Describe the relationship between the active site and the substrate

_____

_____

ENZYME-SUBSTRATE INTERACTION

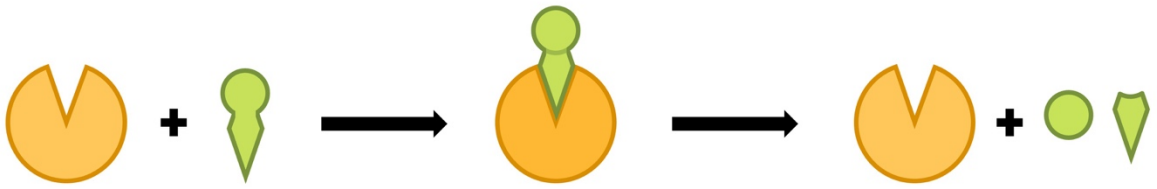
Outline enzyme-substrate specificity

_____

_____

_____

_____



Outline how the 'induced fit' model explains the effect of an enzyme on activation energy

_____

_____

_____

Note: The 'induced fit' model also explains how certain enzymes may demonstrate broad specificity

ENZYME ACTIVITY

Identify two factors that will improve the frequency of enzyme-substrate collisions

1. _____

2. _____

Describe the role of both protein structure and denaturation in determining the activity of an enzyme

_____

_____

_____

_____

_____

_____

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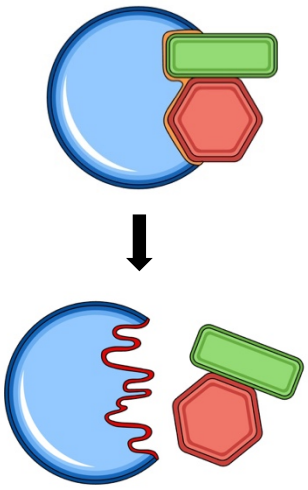


FACTORS AFFECTING ENZYME ACTIVITY

Explain how temperature, pH and substrate concentration affect enzyme activity

Temperature:

_____

_____

_____

_____

_____

pH:

_____

_____

_____

_____

_____

Substrate Concentration:

_____

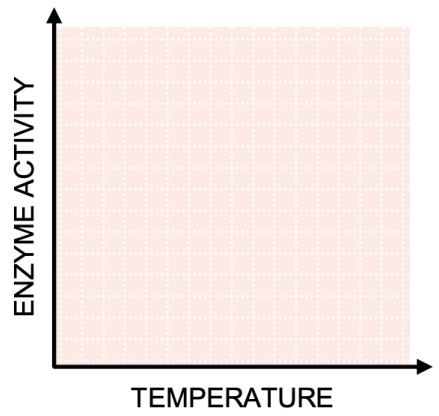
_____

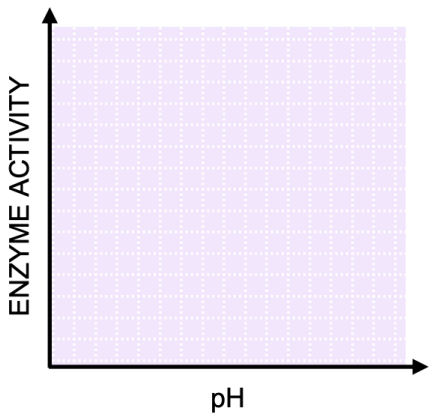
_____

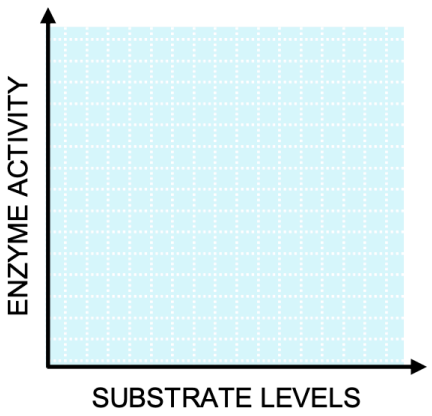
_____

_____

Draw graphs demonstrating the effect of the different factors on enzyme activity





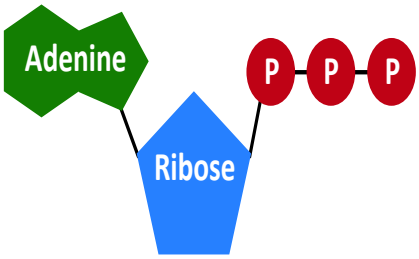


3.2 – CELL RESPIRATION

C1.2.1	ATP as the molecule that distributes energy within cells
C1.2.2	Life processes within cells that ATP supplies with energy
C1.2.3	Energy transfers during interconversions between ATP and ADP
C1.2.4	Cell respiration as a system for producing ATP in cells using energy from carbon compounds
C1.2.5	Differences between anaerobic and aerobic cell respiration in humans
C1.2.6	Variables affecting the rate of cell respiration

ADENOSINE TRIPHOSPHATE

Describe how ATP (and ADP) acts as the energy currency within a cell



_____

_____

_____

Outline living processes that rely upon ATP for energy

Biosynthesis: _____

Active Transport: _____

Movement: _____

CELL RESPIRATION

Define cell respiration

_____

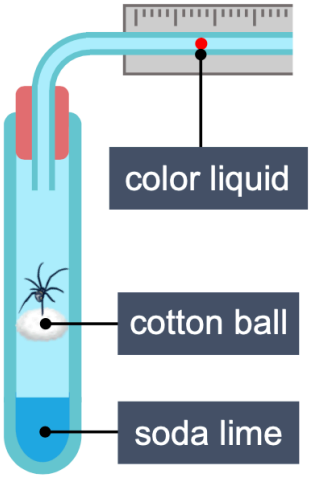
_____

Compare anaerobic and aerobic respiration

	Anaerobic	Aerobic
Oxygen Use		
Energy Yield		
Products		
Location		

MEASURING RESPIRATION

Describe how a respirometer may be used to measure the rate of cellular respiration in a living organism



FACTORS AFFECTING ENZYME ACTIVITY

Explain how glucose concentration, oxygen levels, temperature and pH may affect the rate of respiration

Glucose Concentration:

Oxygen Levels:

Temperature:

pH:

3.3 – PHOTOSYNTHESIS

C1.3.1	Transformation of light energy to chemical energy when carbon compounds are produced in photosynthesis
C1.3.2	Conversion of carbon dioxide to glucose in photosynthesis using hydrogen obtained by splitting water
C1.3.3	Oxygen as a by-product of photosynthesis in plants, algae and cyanobacteria
C1.3.4	Separation and identification of photosynthetic pigments by chromatography
C1.3.5	Absorption of specific wavelengths of light by photosynthetic pigments
C1.3.6	Similarities and differences of absorption and action spectra
C1.3.7	Techniques for varying levels of carbon dioxide, light intensity or temperature experimentally to investigate the effects of limiting factors on the rate of photosynthesis
C1.3.8	Carbon dioxide enrichment experiments as a means for predicting future rates of plant growth

LIGHT ENERGY

Identify the wavelengths of light present in the visible spectrum (both colours and range in nanometres)

_____

State the main photosynthetic pigment used by living organisms to absorb light

_____

Draw a generalised absorption spectrum for photosynthetic pigments and an associated action spectrum

Absorption Spectrum

Action Spectrum

Compare and contrast the absorption spectrum and action spectrum

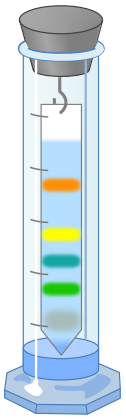
_____

_____

_____

CHROMATOGRAPHY

Describe how pigments can be separated by chromatography (including Rf value calculation)

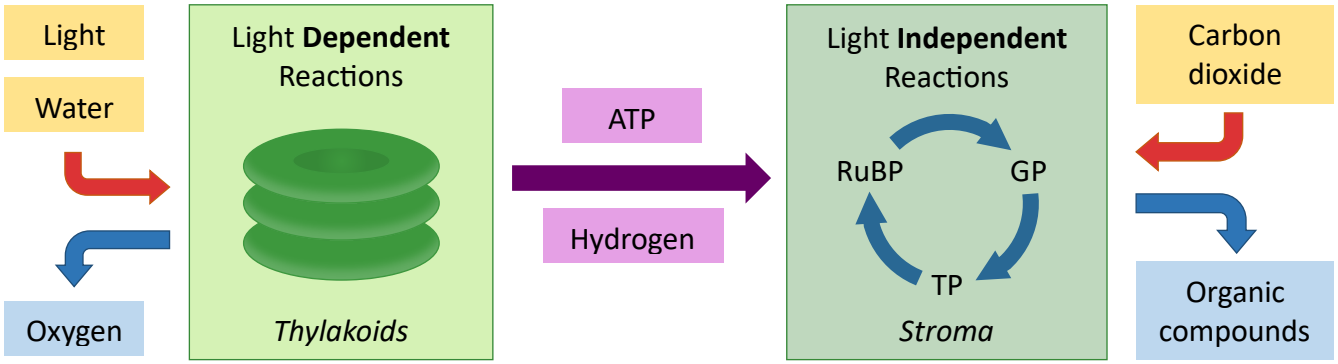


STAGES OF PHOTOSYNTHESIS

Define photosynthesis

Outline the inputs and outputs of the light-dependent stage of photosynthesis

Outline the inputs and outputs of the light-independent stage of photosynthesis



PHOTOSYNTHESIS EXPERIMENTS

Define limiting factors

_____

_____

Outline the effect of the following factors on the rate of photosynthesis

Light Intensity: _____

CO_2 Concentration: _____

Temperature: _____

pH: _____

Describe a method by which photosynthesis could be measured using the following dependent variables

Carbon Dioxide Uptake:

_____

_____

Oxygen Production:

_____

_____

Biomass (Indirect):

_____

_____

Compare and contrast the different methodologies for predicting future rates of photosynthesis

Include: Enclosed greenhouse experiments versus Free Air CO_2 Enrichment experiments (FACE)

_____

_____

_____

_____

_____

3.4 – ENZYMES (AHL)

C1.1.11 Intracellular and extracellular enzyme-catalysed reactions

C1.1.12 Generation of heat energy by the reactions of metabolism

C1.1.13 Cyclical and linear pathways in metabolism

C1.1.14 Allosteric sites and non-competitive inhibition

C1.1.15 Competitive inhibition as a consequence of an inhibitor binding reversibly to an active site

C1.1.16 Regulation of metabolic pathways by feedback inhibition

C1.1.17 Mechanism-based inhibition as a consequence of chemical changes to the active site caused by the irreversible binding of an inhibitor

METABOLIC REACTIONS

State an example of the following types of metabolic reactions

Intracellular Reaction	
Extracellular Reaction	
Linear Pathway	
Cyclical Pathway	

Explain why heat is produced as a by-product of metabolic reactions

_____

_____

_____

Describe how homeotherms may use the production of heat to maintain a constant body temperature

_____

_____

_____

_____

_____

ENZYME INHIBITION

Distinguish between competitive and non-competitive inhibition

	Competitive Inhibition	Non-Competitive Inhibition
Inhibitor Structure		
Inhibitor Binding		
Active Site Effect		
Substrate Effect		

Describe the use of statins as an example of competitive inhibition

_____

_____

Outline feedback inhibition, using isoleucine as an example of an end-product inhibitor

_____

_____

_____

_____

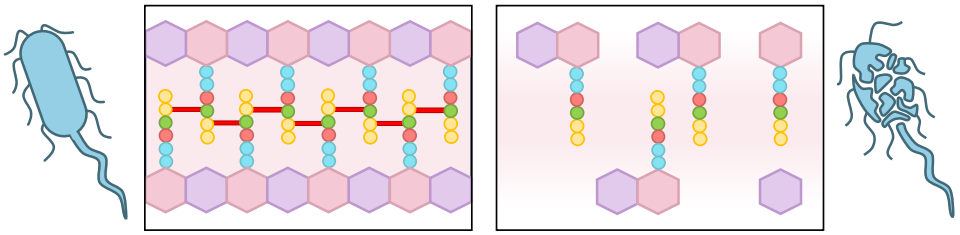
Describe mechanism-based inhibition, using penicillin as an example

_____

_____

_____

_____



Transpeptidases act to maintain the structure of the bacterial cell wall by catalysing cross-links between peptidoglycans

3.5 – CELL RESPIRATION (AHL)

C1.2.7	Role of NAD as a carrier of hydrogen and oxidation by removal of hydrogen during respiration
C1.2.8	Conversion of glucose to pyruvate by glycolysis with a net yield of ATP and reduced NAD
C1.2.9	Conversion of pyruvate to lactate as a means of regenerating NAD in anaerobic cell respiration
C1.2.10	Anaerobic cell respiration in yeast and its use in brewing and baking
C1.2.11	Oxidation and decarboxylation of pyruvate as a link reaction in aerobic cell respiration
C1.2.12	Oxidation and decarboxylation of acetyl groups in the Krebs cycle with a yield of ATP and reduced NAD
C1.2.13	Transfer of energy by reduced NAD to the electron transport chain in the mitochondrion
C1.2.14	Generation of a proton gradient by flow of electrons along the electron transport chain
C1.2.15	Chemiosmosis and the synthesis of ATP in the mitochondrion
C1.2.16	Role of oxygen as terminal electron acceptor in aerobic cell respiration
C1.2.17	Differences between lipids and carbohydrates as respiratory substrates
B2.2.4	Adaptations of the mitochondrion for production of ATP by aerobic cell respiration

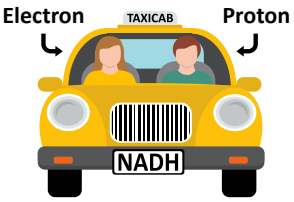
COENZYMES

Outline the role of ATP and hydrogen carriers as coenzymes

_____

_____

_____



NADH (H^+/e^- carrier)

Describe the transfer of protons and electrons via redox reactions

	Electron	Hydrogen	Oxygen
Oxidation			
Reduction			

Oxidation **I**s **L**oss (e^-)
Reduction **I**s **G**ain (e^-)

Differentiate between ATP production via substrate-level phosphorylation and oxidative phosphorylation

_____

_____

_____

_____

TYPES OF RESPIRATION

Differentiate between anaerobic respiration and aerobic respiration (including location and ATP yield)

_____

_____

_____

Complete the following table for aerobic respiration

	Location	Decarboxylation	Oxidation / Reduction	ATP Production
Glycolysis				
Link Reaction				
Krebs Cycle				
ETC				

Outline the role of fermentation in anaerobic respiration

_____

_____

_____

Compare the products of fermentation in different organisms

_____

_____

Describe the use of alcoholic fermentation in brewing and baking

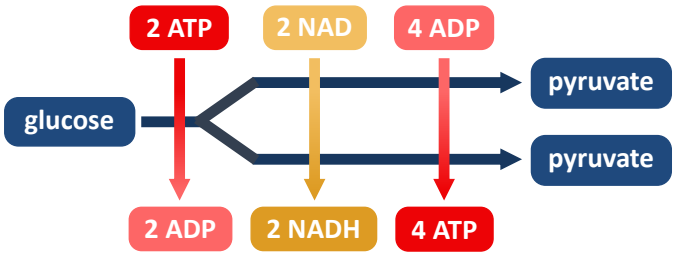
Brewing: _____

Baking: _____

GLYCOLYSIS

Outline the process of glycolysis

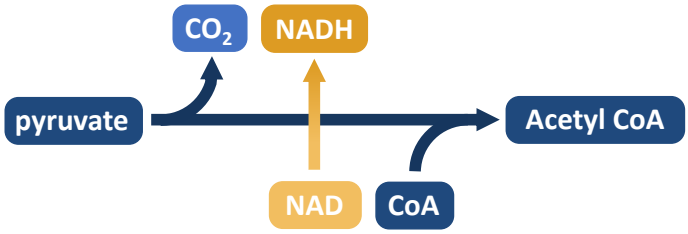
Inputs	
Outputs	



LINK REACTION

Outline the process of the link reaction

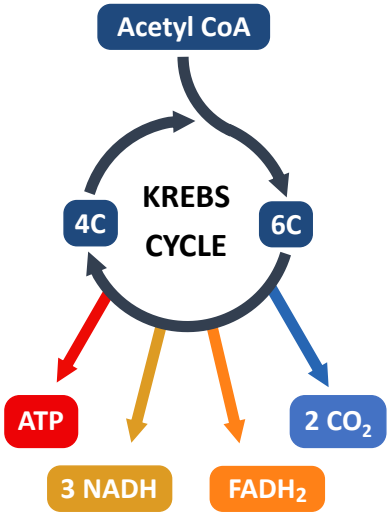
Inputs	
Outputs	



KREBS CYCLE

Outline the process of the Krebs cycle

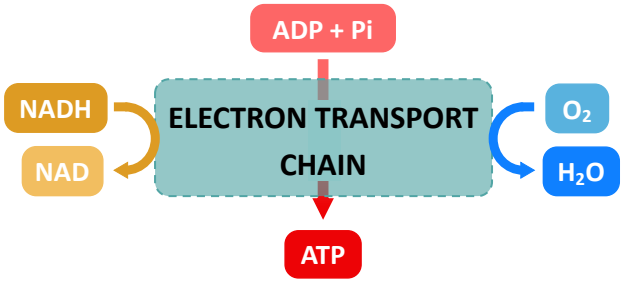
Inputs	
Outputs	



ELECTRON TRANSPORT CHAIN

Outline the steps in the electron transport chain (including chemiosmosis and oxidative phosphorylation)

Inputs	
Outputs	



MITOCHONDRIA

Draw a labelled diagram of a mitochondrion, annotating the location of the stages of aerobic respiration

Describe the relationship between the structure of the mitochondrion and its function

RESPIRATORY SUBSTRATES

Compare the use of carbohydrates (glucose) and lipids (triglycerides) as respiratory substrates

3.6 – PHOTOSYNTHESIS (AHL)

C1.3.9	Photosystems as arrays of pigment molecules that can generate and emit excited electrons
C1.3.10	Advantages of the structured array of different types of pigment molecules in a photosystem
C1.3.11	Generation of oxygen by the photolysis of water in photosystem II
C1.3.12	ATP production by chemiosmosis in thylakoids
C1.3.13	Reduction of NADP by photosystem I
C1.3.14	Thylakoids as systems for performing the light-dependent reactions of photosynthesis
C1.3.15	Carbon fixation by Rubisco
C1.3.16	Synthesis of triose phosphate using reduced NADP and ATP
C1.3.17	Regeneration of RuBP in the Calvin cycle using ATP
C1.3.18	Synthesis of carbohydrates, amino acids and other carbon compounds using the products of the Calvin cycle and mineral nutrients
C1.3.19	Interdependence of the light-dependent and light-independent reactions
B2.2.5	Adaptations of the chloroplast for photosynthesis

PHOTOSYNTHESIS

Write an equation for the process of photosynthesis

_____

Identify the mineral nutrients needed to synthesise the following carbon compounds after photosynthesis

Proteins: _____

Lipids: _____

Nucleic Acids: _____

PHOTOSYSTEMS

Discuss the advantages of organising photosynthetic pigments into photosystems

_____

_____

Differentiate between photosystem I and photosystem II

_____

_____

CHLOROPLAST

Draw a labelled diagram of a chloroplast, annotating the location of the stages of photosynthesis

Describe the relationship between the structure of the chloroplast and its function

_____

_____

LIGHT DEPENDENT REACTIONS

Describe the role of the electron transport chain in the light dependent reactions (photophosphorylation)

_____

_____

_____

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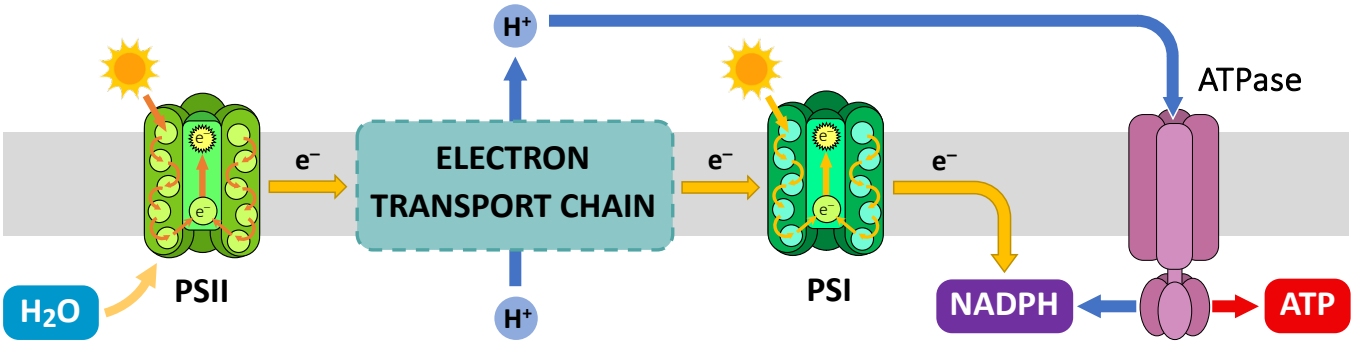
_____



LIGHT INDEPENDENT REACTIONS

Outline the three main steps involved in the light independent reactions (Calvin cycle)

1. Carbon Fixation

_____

_____

_____

2. Synthesis of Triose Phosphate

_____

_____

_____

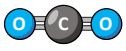
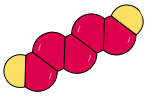
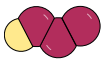
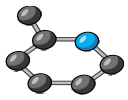
3. Regeneration of RuBP

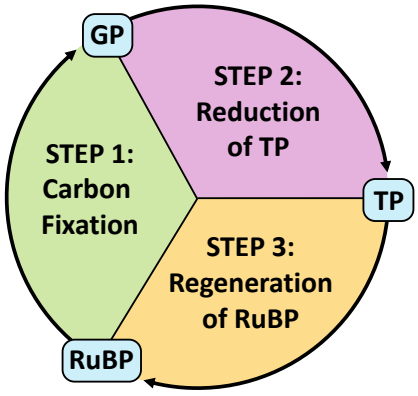
_____

_____

_____

Overview of the Calvin Cycle:

	CO_2	RuBP	TP	Glucose
Molecule				
Number				
Total Carbons				



Explain how the light dependent reactions and light independent reactions are interdependent

_____

_____

_____

_____

_____