Welcome to A Level Biology at Heckmondwike Grammar School.

Below are resources, worksheets and practice questions to prepare you for the start of the course. Please use each resource to complete the worksheets and practice questions. You will be assessed on this material and aspects of your GCSE knowledge during the first week of the course.

We look forward to seeing you in September 2019.

Dr S. Hounsell
Head of Biology.
**Prokaryotes** are single celled organisms, including bacteria. They are simpler and smaller than Eukaryotic cells.

**Bacterial cells have:**
- no nucleus with circular DNA free in the cytoplasm
- cell wall made from peptidoglycan
- no membrane-bound organelles
- small ribosomes.

**Eukaryotic** cells include animal and plant cells. They are larger and more complex than prokaryotic cells.

**Animal cells have:**
- linear DNA contained inside a nucleus
- no cell wall
- larger ribosomes and many membrane-bound organelles including mitochondria where aerobic respiration occurs and endoplasmic reticulum and golgi which are involved in the processing of proteins.

**Plant cells** have the same organelles as animal cells but they also have:
- a cell wall
- a large vacuole containing cell sap
- chloroplasts for photosynthesis.
Mitosis results in the production of two genetically identical diploid body cells. It occurs during growth, repair and asexual reproduction.

Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

Mitosis is broken down into stages – prophase, metaphase, anaphase and telophase, followed by cytokinesis.

**Interphase:** before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.

**Prophase:** the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.

**Metaphase:** the nuclear membrane breaks down. Spindles made of microtubules have been formed by the centrioles. The chromatids line up on the equator.

**Anaphase:** the centromeres separate and each chromatid is pulled along a spindle tubule towards one of the poles centromere first.

**Early telophase:** the chromatids reach the poles of the cell where they are now known as chromosomes. The membrane begins to reform and the cytoplasm to divide.

**Late telophase:** the chromosomes begin to decondense. The nuclear membranes and nuclei are fully reformed and centrioles are present again. The division of the cytoplasm continues until two new identical cells are formed which once more enter interphase.
Magnification is how much bigger the image is than the specimen on the microscope slide. The size of the specimen can be calculated using the formula:

\[
\frac{\text{length of the image}}{\text{length of the specimen}} = \text{magnification}
\]

With a light microscope the magnification is the combination of the magnification of the objective lens and the eye piece lens. For example a 40× objective lens and a 10× eye piece lens produce a total magnification of 400×.

When you are doing magnification calculations you must have all the lengths in the same units.

| 1 cm       | 10 mm |
| 1 mm       | 1000 µm |
| 1 µm       | 1000 nm |

Calculation
Calculate the actual size of a cell with a diameter of 8 mm using 100× magnification.

\[
\text{Actual size} = \frac{8}{100} = 0.08 \text{ mm} = 80 \text{ µm}
\]

Resolution is a measure of how easy it is to distinguish between two points that are close together i.e. how much detail can be distinguished. Electron microscopes have a higher resolution than light microscopes so they can see more detail.
**Summary sheet 4: Diffusion, osmosis and active transport**

**Diffusion**
Liquid and gas particles are constantly moving which causes particles to move from an area of high concentration to an area of low concentration.

Small particles can diffuse across cell membranes and **no energy** is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own **specific carrier protein** that allows the molecule through the cell membrane without the need for energy. This is known as **facilitated diffusion**.

**Osmosis**
Osmosis is the diffusion of water molecules from an area of higher concentration of water molecules to an area of lower concentration of water molecules across a partially permeable membrane.

**Active transport**
Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration.
Worksheet 1: Cell structures 1

Use the summary sheets to complete the table.

<table>
<thead>
<tr>
<th>Features present in animal cells</th>
<th>Features present in plant cells</th>
<th>Features present in bacterial cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Extension activity – research a function for each feature listed.
1. The diagram shows a bacterial cell with some of the key features labelled.

a. Label cell features A, B, C and D.

b. Complete the table to identify three features present in animal cells and describe their function.

<table>
<thead>
<tr>
<th>Animal cell feature</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 The image shows root tip cells at different stages of the cell cycle.

Substances can be transported into cells through diffusion, osmosis and active transport.

3 Write a definition for diffusion, osmosis and active transport.

**Diffusion:**

**Osmosis:**

**Active transport:**
4 Cells were placed in a solution containing solute X and solute Y. The diagram below represents the concentration of the two solutes inside and outside one of the cells, when this cell was placed in the solution and then after 30 minutes.

Explain the movement of solute X and solute Y into the cell.

5 A red blood cell was placed in a solution of distilled water. Explain the effect on the red blood cell of being placed in a solution of distilled water.

6 Explain the key word ‘isotonic’.
A gene is a sequence of DNA which codes for a protein. Proteins are synthesised in a two-step process – transcription and translation.

Transcription takes place in the nucleus and translation takes place at the ribosome. A complementary mRNA strand is made using the DNA as a template. The mRNA leaves the nucleus and attaches to the ribosome in the cytoplasm. A triplet of bases on the mRNA (a codon) code for specific amino acids. The amino acids are delivered to the ribosome by tRNA. Peptide bonds are formed between the amino acids to make the polypeptide.

The DNA gene sequence is ACA CGG AAA CCT GAC.

The mRNA sequence is UGU GCC UUU GGA CUG.

This codes for the amino acid sequence is:

Cys-Ala-Lys-Gly-Leu

The protein folds into a specific structure. For enzymes this means that the active site forms a specific shape that binds specific substrates.
Enzymes are biological catalysts that speed up chemical reactions. Enzymes work by reducing the amount of activation energy needed for the reaction to occur.

The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

Different factors can affect how quickly the enzymes work. These include temperature, pH, enzyme concentration and substrate concentration.

As temperature increases there is more chance of a collision between the enzyme and substrates, as they have more kinetic energy. This continues until the optimum temperature where the rate of reaction is highest. As the temperature continues to rise the enzyme denatures, as the active site changes shape, when bonds holding the protein together break.

Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.

As the substrate concentration increases there is more chance of a collision between the substrate and the enzyme. The rate of reaction increases until all the actives sites are occupied.

The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

In practical situations you can sometimes measure the amount of product formed over time. The initial rate of the reaction for an enzyme can be calculated by measuring the gradient of the graph.

If the line is curved a tangent to the curve can be used: gradient = \( \frac{y}{x} \).
Worksheet 1: Data analysis

Processed data should be recorded to the same number of decimal places as the primary data

This table shows the same data recorded to different numbers of decimal places.

<table>
<thead>
<tr>
<th>Data set 1</th>
<th>Data set 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>2.37</td>
</tr>
<tr>
<td>3.6</td>
<td>3.55</td>
</tr>
<tr>
<td>4.1</td>
<td>4.05</td>
</tr>
<tr>
<td>2.8</td>
<td>2.76</td>
</tr>
<tr>
<td>3.5</td>
<td>3.51</td>
</tr>
</tbody>
</table>

1. Compare the mean values for data set 1 and data set 2.

2. Express data set 2 to 1 decimal place. What do you notice?

3. Explain why it is incorrect to record 3.28 as the mean for data set 1.

Being able to convert data, using standard form and different units, is an important skill

4. Convert the data in the table below.

<table>
<thead>
<tr>
<th>Data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 100 g</td>
<td>into standard form</td>
</tr>
<tr>
<td>45 100 g</td>
<td>into kilograms</td>
</tr>
<tr>
<td>34 ms</td>
<td>into seconds</td>
</tr>
<tr>
<td>780 µm</td>
<td>into millimetres</td>
</tr>
<tr>
<td>0.25 × 10⁻⁹s</td>
<td>into nanoseconds</td>
</tr>
</tbody>
</table>
Practice questions

1 Enzyme A catalyses the breakdown of molecule X into Y and Z.

Molecule X and enzyme A were mixed together at 30°C at pH 6.8.

This graph shows the mass of molecule Z formed over a 10 minute time period.

![Graph showing the mass of molecule Z formed over time.]

a Calculate the initial rate of reaction of enzyme A.

b What is the rate of reaction of enzyme A after 8 minutes?

c Suggest a reason for the rate of reaction calculated in b.
Mutations in DNA can impact on the activity of enzymes.

This DNA sequence is from the region of the gene which codes for the active site of an enzyme.

GAA GAG AGT GGA CTC ACA GCT CGG

The table shows the amino acid coded for by some codons.

<table>
<thead>
<tr>
<th>Amino acid/stop signal</th>
<th>DNA triplet codons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proline</td>
<td>GGT GGG GGA</td>
</tr>
<tr>
<td>Alanine</td>
<td>CGG CGA CGT CGC</td>
</tr>
<tr>
<td>Cysteine</td>
<td>ACA ACG</td>
</tr>
<tr>
<td>Serine</td>
<td>AGG AGA AGT AGC</td>
</tr>
<tr>
<td>Leucine</td>
<td>GAA GAG GAT GAC</td>
</tr>
<tr>
<td>Arginine</td>
<td>GCA GCG GCT GCC</td>
</tr>
<tr>
<td>Glutamine</td>
<td>CTT CTC</td>
</tr>
<tr>
<td>Gkycine</td>
<td>CCT CCG CCA CCC</td>
</tr>
<tr>
<td>Threonine</td>
<td>TGC TGA TGT TGG</td>
</tr>
<tr>
<td>Stop signal</td>
<td>ATT ATC ACT</td>
</tr>
</tbody>
</table>

**a** State the amino acid sequence coded for by the sequence above.

**b** Using the information above explain the effect on the protein produced for the following mutations.

GAA GA\text{T} AGT GGA CTC ACA GCT CGG

GAA GAG AGT GGA CTC C\text{CA} GCT CGG

GAA GAG AGT GGA CTC ACA A\text{CT} CGG
The left side of the heart pumps oxygenated blood from the lungs around the body. The blood enters the left atrium from the pulmonary vein. It flows through the atrioventricular or bicuspid valve to the left ventricle. The blood is then pumped into the aorta, through a semi-lunar valve, and around the body.

The right side of the heart pumps deoxygenated blood from the body back to the lungs. The blood returns from the body to the right atrium via the vena cava. It flows through the atrioventricular or tricuspid valve to the right ventricle. The blood is then pumped into the pulmonary artery, through a semi-lunar valve, and to the lungs.

The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

The semi-lunar valves in the aorta and pulmonary artery open to allow blood from the ventricles to flow into the arteries. They close to prevent backflow into the ventricles as the heart relaxes.

Oxygen enters the blood in the alveoli of the lungs. Oxygen in the alveolus is at a high concentration and it diffuses down the concentration gradient into the blood which has a low concentration of oxygen. This low concentration is maintained because the blood is moving and carries the oxygen away.

The walls of the alveolus and capillaries are only one cell thick. This creates a short diffusion distance between the alveolus and the blood allowing a high rate of diffusion.
Blood flows around the body via a network of arteries, veins and capillaries.

The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.

The pulmonary system pumps blood around the lungs and the systemic system pumps blood around the rest of the body.

Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.

Veins carry blood from capillary beds back to the heart. The blood is at low pressure and the walls of the vessels are relatively thin with less elastic fibre. The contraction of muscles help push the blood through veins and the vessels have valves to prevent backflow.

Capillaries are thin vessels that form capillary networks around tissues. They allow the exchange of substances such as oxygen, glucose and waste materials between cells and the blood.
1. Explain how oxygen enters the blood at the alveoli.

   **In the alveolus oxygen from the air moves into the blood vessels through the walls of the alveolus. The blood is moving so there is always a low concentration in the blood.**

2. Describe the route blood takes from the lungs to the body.

   **Blood from the lungs blood travels through a vein to the atrium. The blood is pumped from the atrium into the ventricle and then into the aorta.**
Practice questions

1 a Write a definition for each key word in the box. If possible give a structural feature for each key word.

| atria | ventricles | aorta | vena cava | pulmonary artery | pulmonary vein | atrioventricular valves | septum | semi-lunar valves | diastole | systole |

atria:

ventricles:

aorta:

vena cava:

pulmonary artery:

pulmonary vein:

atrioventricular valves:

septum:

semi-lunar valves:

diastole:

eysotole:
b  Label this diagram of the heart using as many of the key words from 1 a as possible.

Right side  Left side


c  Use the keywords from 1 a in your answers to the following questions.

i  Explain why the left ventricles has thicker chamber walls than the right ventricle and the atriums.

ii  Describe the role of the atrioventricular valves.
2. This flow diagram shows the part of the circulation system in a mammal.

![Flow Diagram]

a. Complete a table to show conditions of blood vessel A, B and C.

<table>
<thead>
<tr>
<th>Blood vessel</th>
<th>Type of vessel</th>
<th>Level of oxygen saturation</th>
<th>Relative pressure of the blood</th>
<th>Valves present in the vessel</th>
<th>Thickness of blood vessel walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
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</tbody>
</table>

b. Draw a line on the axis to show the blood pressure changes in the blood as it flows from the heart to the lungs before returning to the heart.

![Blood Pressure Graph]