Zig Zag Education

Biology AS / A Level | Edexcel B | 8BIO/9BIO

Starters and Plenaries

for AS / A Level Year 1 Edexcel B Biology

Update v1.2, September 2021

zigzageducation.co.uk

POD 8081

Contents

Teacher's Introduction

This resource follows the new Edexcel specification B, covering units 2–4 of the AS / A Level specification. While most activities cover ideas from one topic only, occasionally two or three related topics may be grouped into one activity. Each activity is designed to be used as either a starter or plenary, but many are suitable to be used for either. Additional notes and guidance often provide suggestions on how to use the activity differently as a starter or plenary, and may also provide extension ideas and/or suggestions for homework activities.

On the next page you will find an overview table with the names and contents of each activity. This table also provides a syllabus reference for each activity and highlights how the activities are distributed over the three sections of the A Level specification.

For each activity you will find both a photocopiable worksheet or activity and an accompanying page of teacher's notes. Teacher's notes provide instructions and answers for each activity, as well as additional notes, timings and other information.

February 2018

Update v1.1, August 2019
p. 5 – Two of the carbohydrate diagrams have been corrected.
p. 28 – The number labelling on the TEM images has been corrected.

Update v1.2, September 2021
p. 5 – The sixteenth carbohydrate diagram has been corrected.

#	Topic	Activity Title
1	Carbohydrates	Carbohydrates: Card Sort
2	Lipids	Lipid Structure
3	Proteins	Hexagon Connections
4	DNA	Nucleic Acid and ATP Structure
5	Genes and Chromosomes	Genes and Chromosomes
6	Protein Synthesis	Triangular Dominoes
7	Mutation	Types of Mutation
8	Enzymes	Dominoes: Enzymes Quiz
9	Inorganic Ions	Importance of Inorganic Ions
10	Water	Water!
11	Prokaryotic Cells	Prokaryotes
12	Eukaryotic Cells	Cell Structure and Function
13	Microscopy	Silent Sentences
14	Viruses	Viruses
15	Mitosis	Back-to-back: The Cell Cycle
16	Meiosis and Genetic Variation	Generating Diversity
17	Sexual Reproduction	Sexual Reproduction in Animals and Plant
18	Classification	Classifying Species
19	Classification – Five Kingdoms	Grouping Organisms
20	Adaptations	Sickle-cell Anaemia

#	Topic	Activity Title
21	Biodiversity and Communities	Calculating Biodiversity
22	Genetic Diversity	Investigating Diversity
23	Surface Area	Surface Area
24	Membranes and Transport	Passive Transport
25	Active Transport and Exocytosis	With a Little Energy – Transport Requirin
26	Gas Exchange	Adaptations for Gas Exchange
27	Circulatory System	The Heart
28	Haemoglobin	Transporting Oxygen
29	Transpiration	Transporting Water
30	Translocation	Transporting Sugar

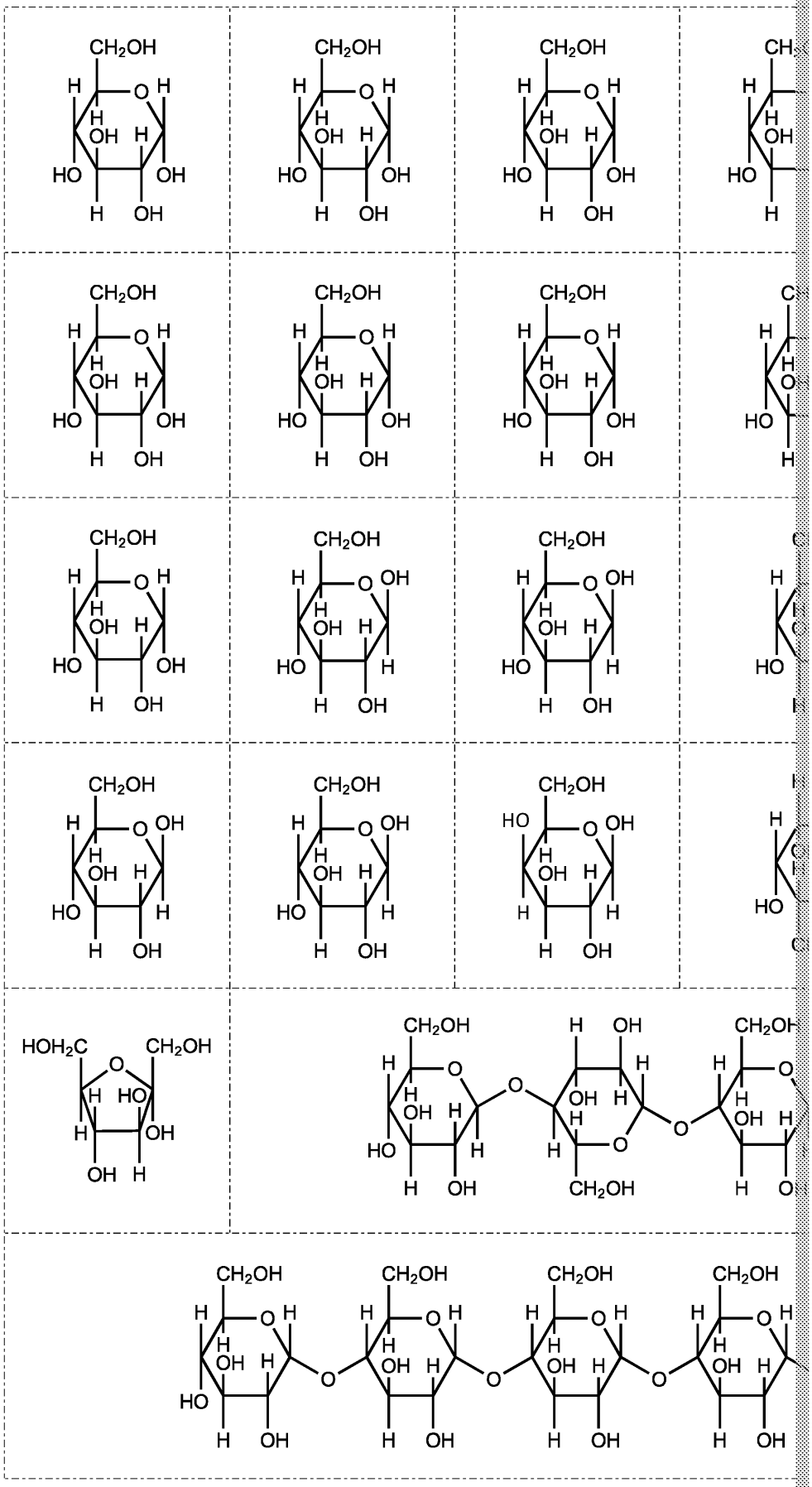
Notes:
S/P = intended for use as either a starter or plenary
S (P) = intended for use as a starter but possible to adapt for use as a plenary with a suggestion provic

Activity 1: Carbohydrates

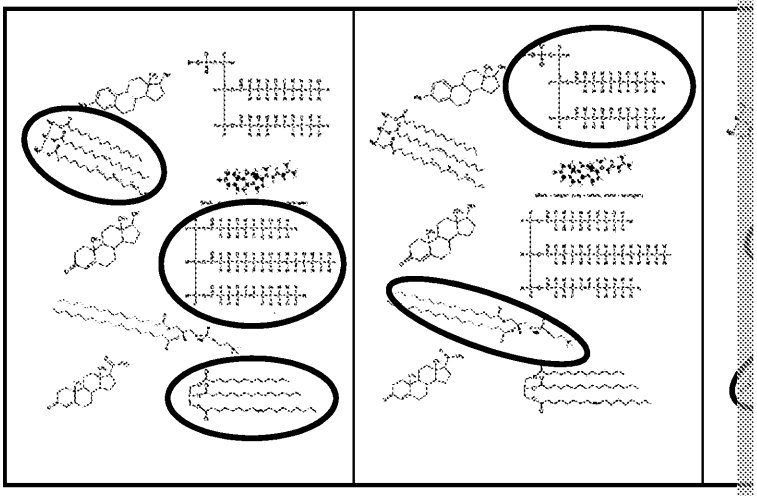
Activity name	Carbohydrates: card sort
Aim	To introduce the terms 'monosaccharide', 'disaccharide' and 'polysa formation of glycosidic bonds between monosaccharides
Instructions	**There are two main parts to this activity:** 1. Pupils are asked to separate the molecules into three groups (n polysaccharides). • Pupils are told that the molecules fall into one of three ca them into monosaccharides, disaccharides and polysaccha • If pupils have low English ability, are unlikely to recognise are unsure where to start after a minute has passed, they beginning with these prefixes or asked to think of words b can then be led to the conclusion that mono = one, di = tw with the task. 2. Pupils 'match' the molecules, finding the monosaccharides whi the disaccharides and polysaccharides. • Pupils are told that disaccharides and polysaccharides are together. • They are then asked to find the monosaccharides which jo molecules. **Extension / Lead into the main lesson:** • Pupils could be asked to identify which molecule must be 'lost' monosaccharides together – thus leading into an explanation o formation of a glycosidic bond.
Timings	Grouping monosaccharides, disaccharides and polysaccharides: **2–5** Matching disaccharides/polysaccharides with constituent monosacc **minutes** (ideas about formation of a glycosidic bond)
Required prior knowledge	Sufficient level of English to recognise prefixes mono-, di-, and poly- Basic chemistry knowledge – ability to recognise H, O, C, and lines be Knowledge of common molecules or compounds made from these e would also be useful.
Intended use	The activity is designed to be used as a starter, but may also be used learning.
Specification reference	Edexcel 1.1 **Note:** the names of different saccharides, relationships between structu and the biochemical tests for sugars and starch are not covered in this a
Additional notes and guidance	If used as a plenary, pupils will already know how a glycosidic bond f card sort activity to consolidate understanding. Additionally, they m molecules, as they will have learnt the names of these molecules in t **Note:** At some point during the lesson the teacher should ensure tha polysaccharide molecules will be much longer than the molecules use α-glucose molecules are found in both amylose (starch) and glycogen be asked 'What is wrong with this activity?' or 'How is this activity ina this point by themselves, as well as other points such as an inability t monosaccharides to create the larger molecules.
Answers	α-glucose M / α-glucose M / α-glucose M / α α-glucose M / α-glucose M / α-glucose M / α-glucose M / β-glucose M / β-glucose M / β-glucose M / β-glucose M / galactose M / Fructose M / cellulose (β-glucos starch/amylose/glycogen (α-glucose > (note M=monosaccharide, D=disaccharide, P=polysaccharide)

Activity 1: Carbohydrates: card

1. Cut out the molecules below and group them into what you think are 'mono
   and 'polysaccharide'.
2. Can you work out which monosaccharides go together to make each disacch



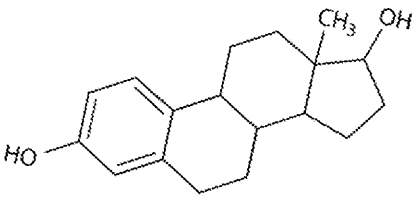
Activity 2: Lipids

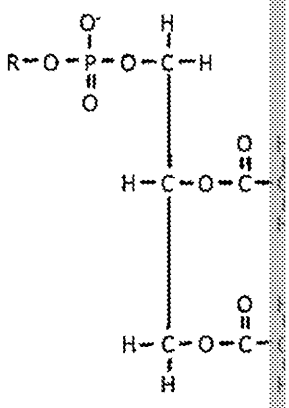
Activity name	Lipid structure
Aim	Pupils learn to distinguish between triglycerides and phospholipids More-able pupils will identify parts of the structure which affect the phospholipids.
Instructions	• The pupil sheet shows a number of lipid molecules. Pupils are fir into three groups based on similarities between the molecules. P which group of molecules they think are 'triglycerides', 'phospho • Pupils, especially those who are more able, or those also takin to focus on the structure of the triglycerides and phospholipids structures, features or functional groups which may affect the these groups. • Pupils may also be asked to consider the presence of double b how these may affect the physical properties of these molecul
Timings	**5 minutes** for the initial grouping activity **+ 5–10 minutes** for class/g
Required prior knowledge	Sufficient level of English to recognise the prefix tri- Basic chemistry knowledge – ability to recognise H, O, C, P, and sing atoms as single and double bonds.
Intended use	Starter
Specification reference	Edexcel 1.2 **Notes**: 1. The condensation reaction and formation of ester bonds as we not covered in this activity. 2. Steroid molecules are included in this activity to make pupils a lipid, but they are not required to remember any details about specification.
Answers	The molecules should be grouped as shown in the table below:  **Structure and properties of triglycerides:** • Non-polar molecule / made of non-polar bonds → hydrophobi **Structure and properties of phospholipids:** • Phosphate group is hydrophilic • Fatty acid tails are hydrophobic **Double bonds and physical properties:** • More double bonds → increased fluidity and lower melting po • Double bond causes a 'kink' → molecules cannot pack closely t

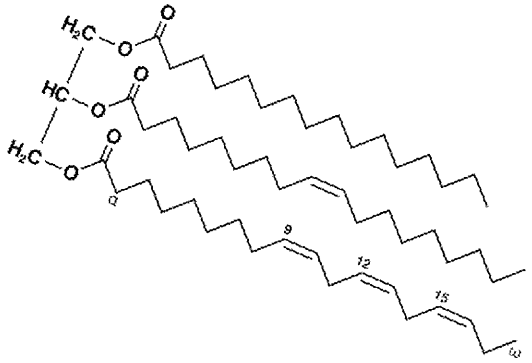
Activity 2: Lipid structure

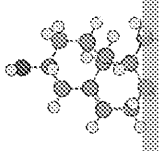
Look at the molecules below. Do you see similarities between some of them? D
molecule, using three different colours to group the molecules into three groups
you can see.

The molecules are either **triglycerides**, **phospholipids** or **steroids**. Also, circle th
to match each group to a name.

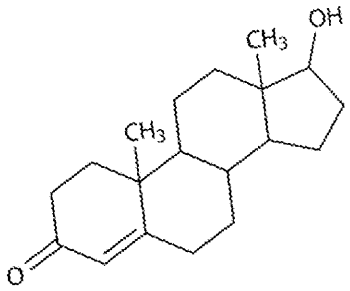


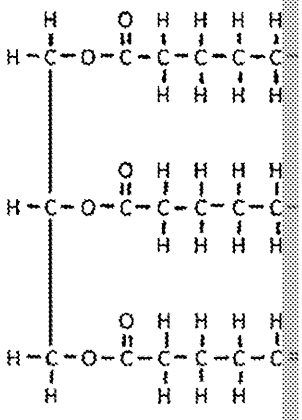


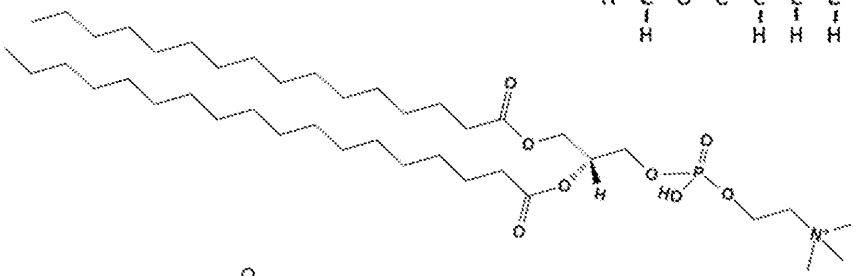


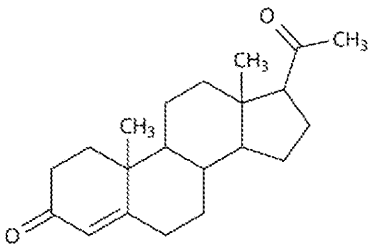


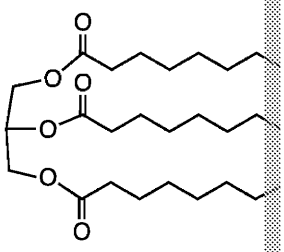
(Black = oxygen, grey





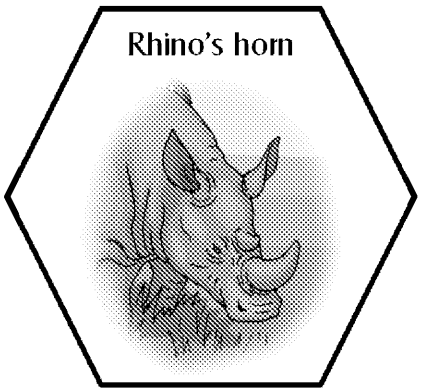


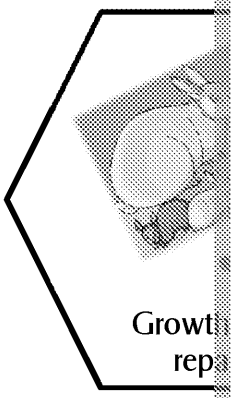


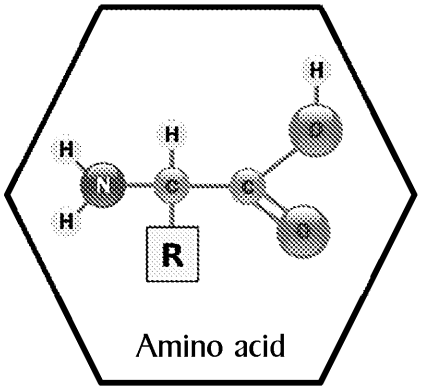


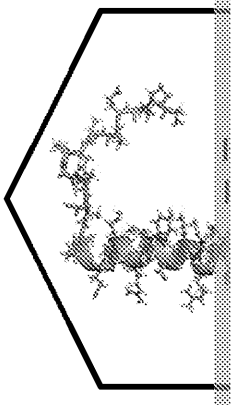
Activity 3: Proteins

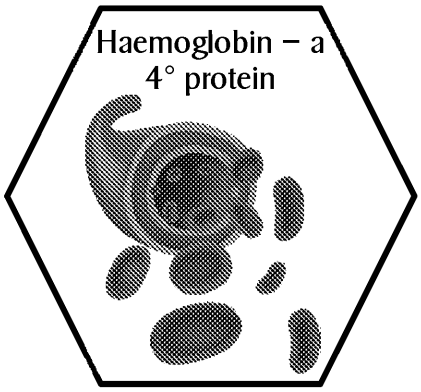
Activity name	Hexagon connections
Aim	Consolidate understanding of proteins
Instructions	• The hexagon pictures on p. 9 should be photocopied and cut • Pupils are first asked to arrange the hexagons by making links encouraged to make links on as many sides as possible. Any as pupils can justify their choice. They can then come up wit • Some words have been provided in the hexagons in order to However, teachers may wish to remove these words to provi able pupils. This will also leave the activity more open-endec • The hexagons can be stuck onto the blank pupil worksheet. • A few pupils could be asked to share their ideas with the clas lesson.
Timings	**5–10 minutes** (**+ 10–30 minutes** for homework/extension)
Required prior knowledge	Pupils do need knowledge of proteins in order to make the necess Other basic (GCSE level) biology would be useful for making conne
Intended use	Plenary
Specification reference	Edexcel 1.3 **Note**: This is quite an open-ended activity – how much of the spec depend on the connections which pupils make between the hexag not be covered.
Additional notes and guidance	As an extension or homework activity, pupils can be asked to draw hexagons on their worksheet. A discussion of their picture choices used as a starter to a following lesson or during a later revision les
Answers	There is no one set of correct answers for this activity. Any **justifie** Some expected connections include: Rhino's horn *is made from keratin*, a fibrous protein Amino acids *are used in the body for* growth and repair Amino acids *are the monomers of proteins/polypeptides; other bio* and nucleotides Blood *contains haemoglobin,* a quaternary protein Blood *carries* glucose and other simple nutrient molecules

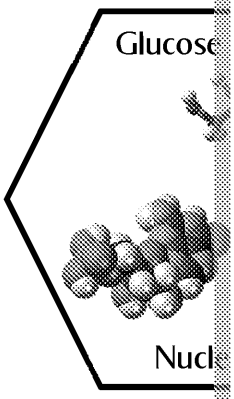








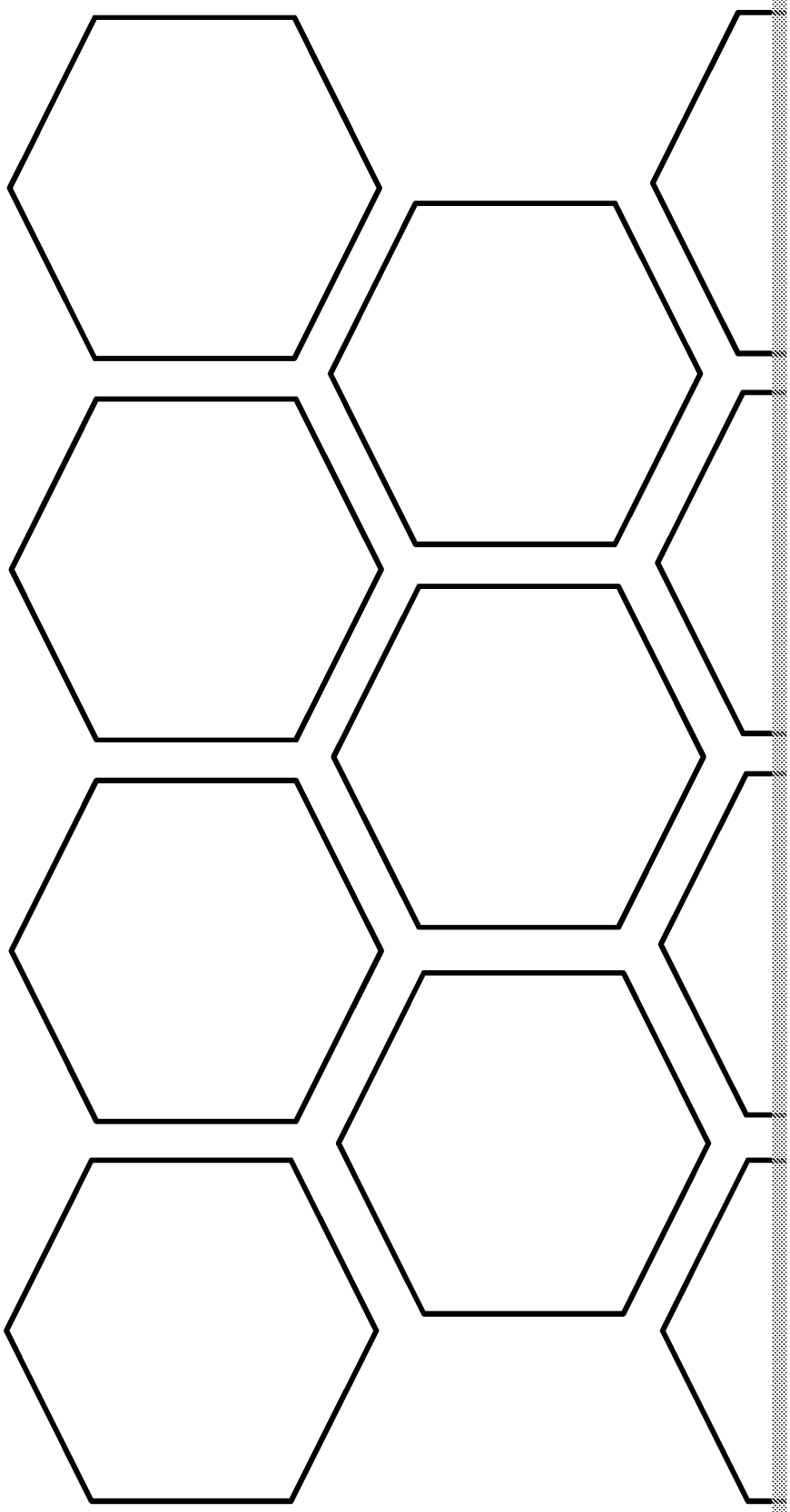




Activity 3: Hexagon connecti

What connections can you make between the pictures?

Place your hexagons into the grid below by making connections between the sid
as many connections as possible. Can you make suggestions for things to go in t
able to **justify** where you place your hexagons.

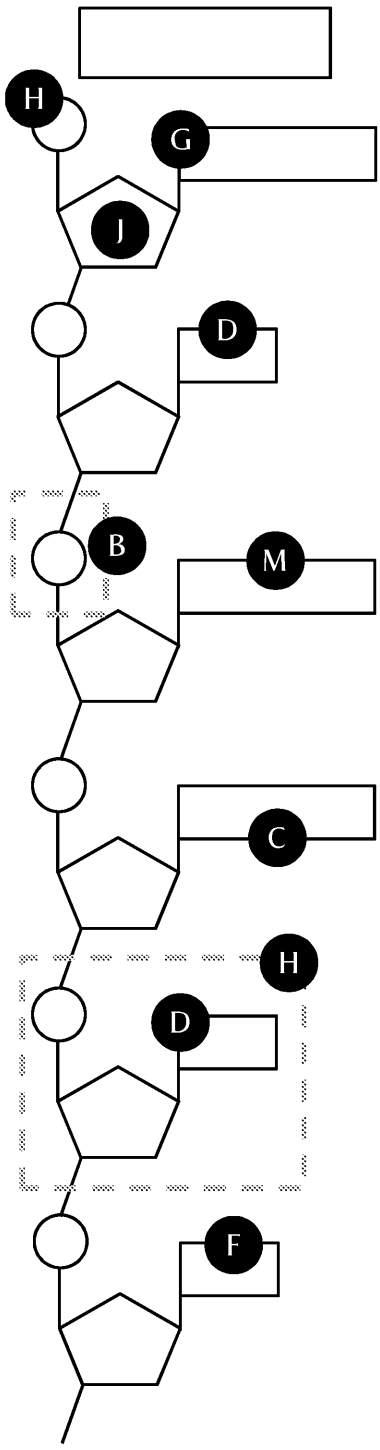


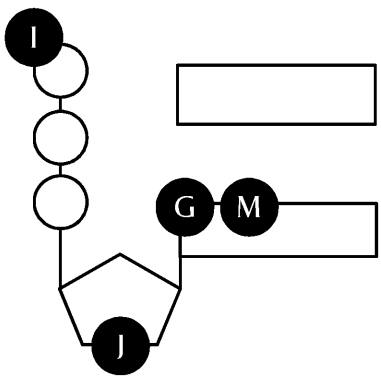
Activity 4: DNA

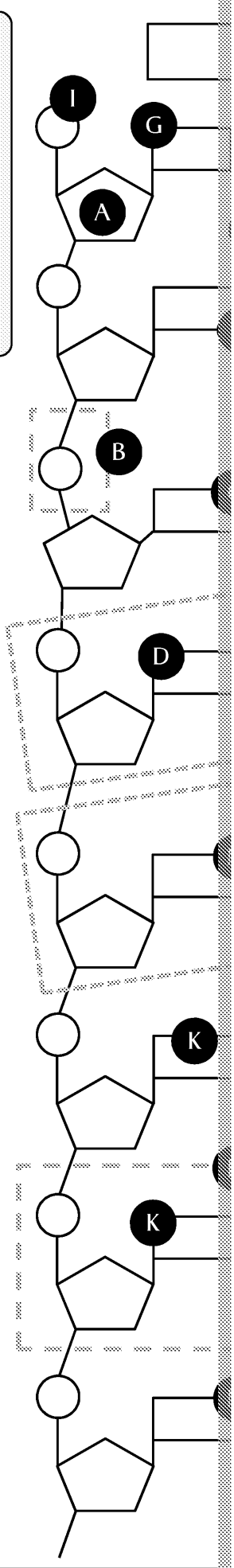
Activity name	Nucleic acid and ATP structure
Aim	To identify the structural features of nucleic acids and ATP
Instructions	In this activity, pupils need to identify three molecules as either DN the structures within the molecules. There is a grey box above each molecule in which pupils should wr the molecule. Key terms associated with the structure of these molecules are wri page. Pupils are expected to match these words or phrases to the letter (A-M) beside each.
Timings	This activity is expected to take around **5 minutes** to complete.
Required prior knowledge	Pupils will need to have been introduced to the key terminology fo nucleotide, base, ribose, deoxyribose, adenine, cytosine, guanine, t phosphodiester bond, hydrogen bond.
Intended use	Plenary
Specification reference	Edexcel 1.4i, iv-v **Note**: This activity looks mainly at the structure of nucleic acids. Th (3.1.5.2) that is covered is complementary base pairing through rec hydrogen bonds between complementary bases.
Additional notes and guidance	This activity is intended to be used as a plenary at the end of a lesso and ATP. However, it may also be used as a starter, perhaps after le teaching a lesson on ATP. In this way, it can help to link the two top The activity may also be a useful component to a revision lesson.
Answers	**Diagram titles:** Top-left = RNA Bottom-left = ATP Right = DNA **Diagram labels:** A = Deoxyribose B = Phosphodiester bond C = Guanine D = Cytosine E = Complementary base pairs F = Uracil G = Nitrogen-containing base H = Nucleotide I = Phosphate group J = Ribose K = Thymine L = Hydrogen bond M = Adenine

Activity 4: Nucleic acid and ATP s

1. Identify which of the molecules is DNA, which is RNA, and which is ATP.
2. Match the words below to the structures in the molecules by writing the matching letter by each word.







Deoxyribose

Ribose

Phosphate group

Nitrogen-containing base

Adenine

Cytosine

Guanine

Thymine

Uracil

Phosphodiester bond

Complementary base pairs

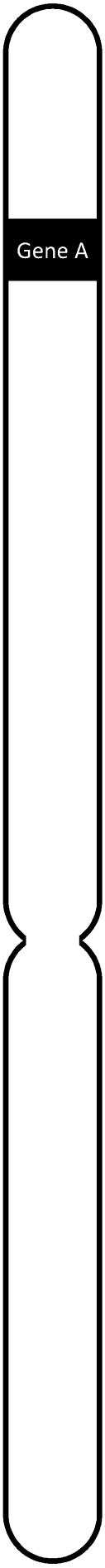
Nucleotide

Hydrogen bond

Activity 5: Genes and chromosomes

Activity name	Genes and chromosomes
Aim	Solidify understanding of the link between DNA, genes and protein topic.
Instructions	Pupils must use the keywords provided to complete paragraphs re
Timings	**5–15 minutes** depending on language ability. (EAL pupils may take
Required prior knowledge	Knowledge of key terms would be useful but not essential, especia
Intended use	Plenary
Specification reference	Edexcel 1.4 iii, vii
Additional notes and guidance	This activity is probably best used as a plenary, to solidify and chec relevant terms. However, it may also work as a starter, forcing pu between different terms and molecules, especially with more-able syllabus was covered by pupils at GCSE level, this activity could als recall and understanding of prior learning.
Answers	A ***gene*** is a base sequence of ***DNA*** which codes for a functional RN ***tRNA*** molecules. ***mRNA*** molecules coded by DNA are used with ril ***sequence*** of amino acids in a ***polypeptide*** molecule. Each amino acid in the polypeptide molecule is coded for by a sequ is, in turn, coded for by a sequence of three DNA bases, called a ***tri*** amino acid is coded for by the DNA sequence ACC which is transcri In eukaryotes, most of the DNA is non-coding. This non-coding DN sequences, can be found between the genes in a chromosome. Th called ***introns*** within the genes. The coding regions of a gene are c

Activity 5: Genes and chromos



DNA code	mRNA	Amino acid sequence of Protein A
T	A	
A	U	Start
C	G	
T	A	
T	A	Lysine
C	G	
G	C	
G	C	Proline
C	G	
T	A	
C	G	Serine
G	C	
T	A	
A	U	Methionine
C	G	
G	C	
T	A	Histidine
A	U	
A	U	
T	A	Tyrosine
G	C	
C	G	
G	C	Alanine
G	C	
C	G	
G	C	Alanine
C	G	
T	A	
A	U	Isoleucine
T	A	
G	C	
A	U	Leucine
C	G	
T	A	
C	G	Arginine
T	A	
A	U	
C	G	Tryptophan
C	G	
C	G	
G	C	Alanine
T	A	
A	U	
A	U	Phenylalanine
G	C	
A	U	
T	A	Stop
C	G	

The paragraphs below describe and function of DNA, genes and at the bottom of the box to con the paragraphs.

A _____ is a base sequ codes for a functional RNA mole _____ and _____ _____ molecules cod ribosomes to generate a particu acids in a _____ m

Each amino acid in the polypept sequence of three _____ coded for by a sequence of thre _____. For examp acid is coded for by the DNA seq to the mRNA sequence ___ ___

In eukaryotes, most of the DNA DNA, such as multiple _____ can be found between the gene also non-_____ reg within the genes. The coding re _____.

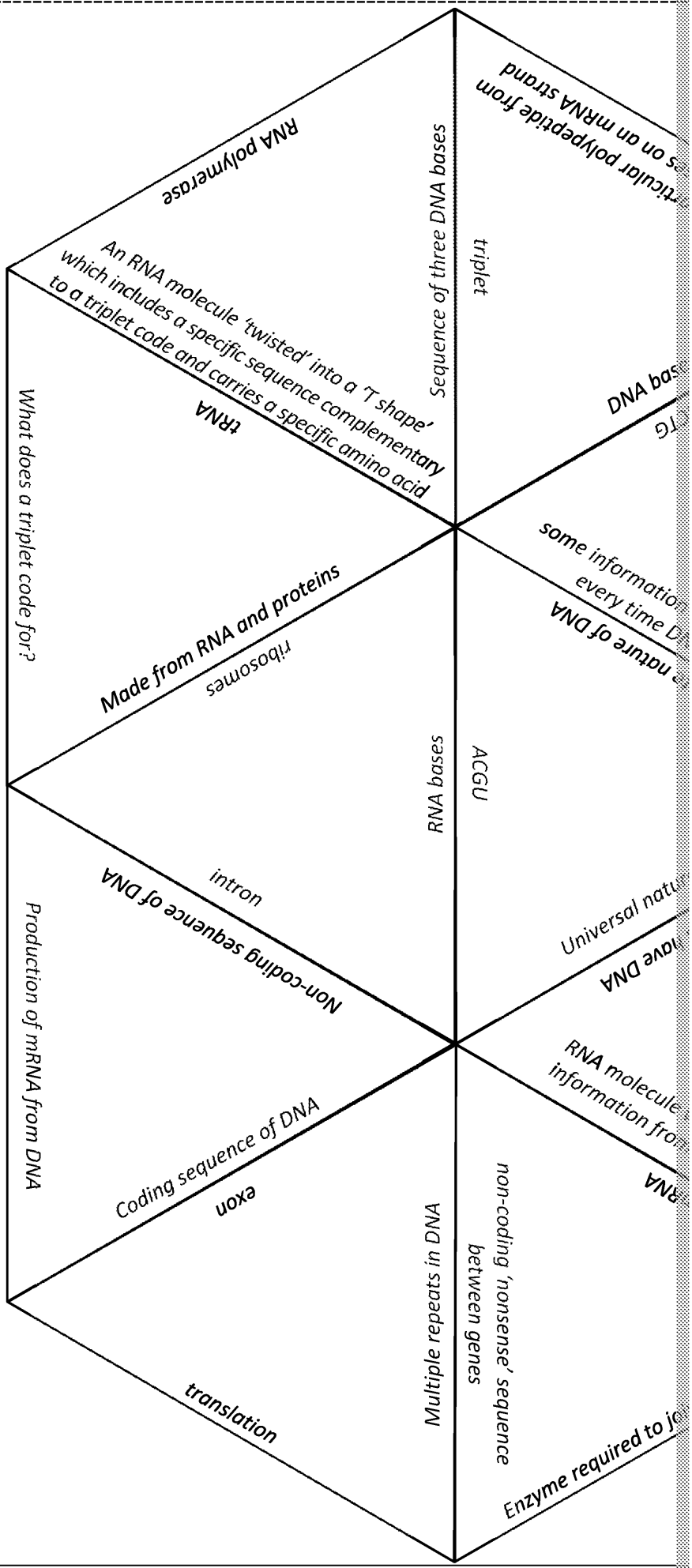
Use some of these words to cor

triplet, DNA, gene, coding, sequence, mRNA, tRNA, rRNA, serine, alanine

Activity 6: Protein synthesis: transcription and translatio

Activity name	Triangular dominoes
Aim	To reinforce understanding of key terms and the processes of tran
Instructions	The triangles should be cut out to make the triangular dominoes b individually or in groups and should try to arrange the dominoes b on the dominoes' sides. There are multiple possible combinations The teacher should monitor pupils during the activity to pick up or If pupils are working in groups, monitoring their discussions can al identify areas of the topic which pupils may be struggling with.
Timings	**5–15 minutes**: Pupils who finish early can be asked to find a differ
Required prior knowledge	Knowledge of transcription and translation, as well as the structur
Intended use	Plenary
Specification reference	Edexcel 1.4v-vii
Additional notes and guidance	
Answers	As these dominoes are triangular, there are multiple possibilities f triangles. However, the sides should always be paired correctly as *Sequence of three DNA bases: triplet* *All organisms have DNA: DNA is universal* *Some information may be lost every time DNA is transcribed:* *ACGU: RNA bases* *ACGT: DNA bases* *Made from RNA and proteins: ribosome* *An RNA molecule 'twisted' into a 'T shape' which includes a sp* *a triplet code and carries a specific amino acid: tRNA* *What does a triplet code for?: an amino acid* *Non-coding sequence of DNA: intron* *Coding sequence of DNA: exon* *Multiple repeats in DNA: non-coding 'nonsense' sequence bet* *RNA molecule which carries genetic information from DNA to* *Enzyme required to join mRNA nucleotides: RNA polymerase* *Production of a particular polypeptide from a sequence of ba* *Production of mRNA from DNA: transcription*

Activity 6: Triangular domino



Activity 7: Mutation

Activity name	Types of mutation
Aim	To consider the types of mutation which may occur (base deletion, substitution) and the effect that these may have on the subsequen therefore protein produced.
Instructions	Pupils should use the diagrams to identify each of type of mutation amino acid sequence produced during subsequent translation. The transcription and translation practice. An amino acid coding wheel this, which can be photocopied and shared between students.
Timings	**10–15 minutes**
Required prior knowledge	This will depend on how the activity is going to be used (see additi will certainly need to recognise the DNA and mRNA base sequence translation will also certainly help.
Intended use	Starter/Plenary
Specification reference	Edexcel B (9BI0) 1.4: DNA and protein synthesis (viii-ix)
Additional notes and guidance	If used as a starter: Pupils should be given the names of the differe insertion and substitution), and asked to figure out which one is wh as long as they know the meaning of these words in everyday Engli diagrams to see the kind of effect each of these types of mutations sequence/primary structure of a protein.
Answers	Boxes left → right **Box 1:** Base Insertion One base is added to the sequence, resulting in a change of many s **Box 2:** Base Substitution One base is changed, this may or may not result in the change of o the given example nothing changes. **Box 3:** Base Deletion One base is removed from the sequence, resulting in a change of m **Box 4 (bottom):** What type of mutation causes this disease? *Base substitution* What change is made to the amino acid sequence? *A single amino to valine / the amino acid associated with codon 6 is changed from*

Normal sequence:

Codon	1	2	3	4	5	6	7	8	9
DNA	CAC	GTG	GAC	TGA	GGA	CTC	CTC	TTC	AGA
mRNA codon	GUG	CAC	CUG	ACU	CCU	GAG	GAG	AAG	UCU
tRNA anticodon	CAC	GUG	GAC	UGA	GGA	CUC	CUC	UUC	AGA
Amino acid	Val	His	Leu	Thr	Pro	Glu	Glu	Lys	Ser

Mutated sequence:

Codon	1	2	3	4	5	6	7	8	9
DNA	CAC	GTG	GAC	TGA	GGA	CAC	CTC	TTC	AGA
mRNA codon	GUG	CAC	CUG	ACU	CCU	GUG	GAG	AAG	UCU
tRNA anticodon	CAC	GUG	GAC	UGA	GGA	CAC	CUC	UUC	AGA
Amino acid	Val	His	Leu	Thr	Pro	Val	Glu	Lys	Ser

Activity 7: Types of mutatio

Each of the diagrams below shows a particular form of genetic mutation. For eac
type of mutation depicted, and describe the effect that it has on the amino acid
translation of the subsequent mRNA strand?

TACCGATGCTAGCCGTATCGTAGC AUGGCUACGAUCGGCAUAGCAUCG Met-Ala-Thr-Ile-Gly-Ile-Ala-Ser **TACCCGATGCTAGCCGTATCGTAGC** AUGGGCUACGAUCGGCAUAGCAUCG Met-Gly-Tyr-Asp-Arg-His-Ser-Ile-	**TACCGATGCTAGCCGTATCGTAGC** AUGGCUACGAUCGGCAUAGCAUCG Met-Ala-Thr-Ile-Gly-Ile-Ala-Ser **TACAGTTGCTAGCCGTATCGTAGC** AUGGCAACGAUCGGCAUAGCAUCG Met-Ala-Thr-Ile-Gly-Ile-Ala-Ser	**TA** AU Me **TA** AU Me
Type of mutation: ..... How is the amino acid sequence affected?	Type of mutation: ..... How is the amino acid sequence affected?	Ty ... Ho aff ... ...

One disease caused by a genetic mutation is sickle-cell anaemia. Look at the DNA
abnormal alleles, below.

What type of mutation causes this disease? .....

Complete the mRNA sequence, and use this to determine the tRNA anticodons a
produced.

What change is made to the amino acid sequence?.....

First 15 codons of the normal haemoglobin allele:

Codon	1	2	3	4	5	6	7	8	9	10
DNA	CAC	GTG	GAC	TGA	GGA	CTC	CTC	TTC	AGA	CGG
mRNA codon										
tRNA anticodon										
Amino acid										

First 15 codons of the abnormal sickle-cell haemoglobin allele:

Codon	1	2	3	4	5	6	7	8	9	10
DNA	CAC	GTG	GAC	TGA	GGA	CAC	CTC	TTC	AGA	CGG
mRNA codon										
tRNA anticodon										
Amino acid										

Activity 8: Enzymes

Activity name	Dominoes: enzymes quiz
Aim	Pupils will use knowledge from the lesson to identify the correct a
Instructions	• The activity provides 20 domino cards which should be printed a • Each pupil is given one card. All of the cards need to be used • If you have fewer than 20 pupils, you could give an extra card spare cards yourself, answering questions from the pupils at t • If you have more than 20 pupils, the pupils could be paired u competition – see 'additional notes' below). • Either the teacher or a designated pupil can start by asking the • The pupil who thinks they have the correct answer to the que the teacher agrees that this is correct, the pupil can then rea • The answer to the last question is on the first card, bringing y pupil/teacher and concluding the activity.
Timings	**5–10 minutes**
Required prior knowledge	Basic knowledge of enzymes and enzyme action
Intended use	Plenary
Specification reference	Edexcel 1.5 **Note**: This activity does not allow pupils to become familiar with g catalysed reactions or to develop ideas regarding investigating fac
Additional notes and guidance	This activity is best done at the end of a lesson on enzyme activity, the following lesson to recap / check understanding before doing a activity. Using the activity as a competition: 1. Divide the class into two equal teams. The pupils are then pa team. Each pair is given one card. The first pupil to answer s 2. The class is divided into groups (size dependent on the teach of cards, except the first card. The cards are divided among t cannot be allowed to see each other's cards as this would giv string of answers. The game continues as normal, but as eve must answer quickly to score a point for their team.
Answers	The cards are printed in the order they should be spoken, with the second card, etc. The left column comes first, from top to bottom column. The answer to the last card is on the first card.

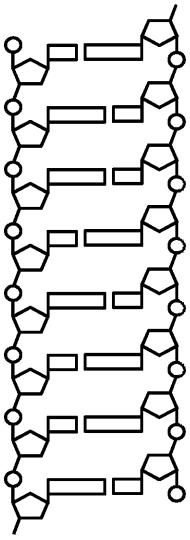
Activity 8: Dominoes: enzyme

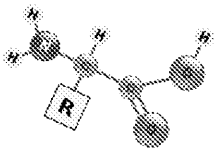
Denature at higher temperatures	Enzymes are examples of which type of biological molecule?
Competitive inhibitor	
Protein	Name a variable that increases the rate of an enzyme-controlled reaction.
Enzyme–substrate complex	
Substrate concentration	Which type of enzyme inhibitor changes the shape of the active site?
Only sucrose can fit t active site of sucrase	
Non-competitive inhibitor	Where are enzymes found in the human body?
It does not bind to th active site	
Almost everywhere	Name two variables which have an optimum value for the highest rate of enzyme activity.
Inhibitors	
Temperature and pH	Which model states that the shape of the active site changes as a substrate binds to it?
It depends on the optimum value for th enzyme	
Induced-fit model	How do enzymes increase the rate of biological reactions?
Arctic cod	
They lower the activation energy required	Why can't an enzyme usually function at high temperatures?
In the stomach	
Hydrogen bonds holding the enzyme's 2° and 3° structures are broken	What is the name given to this process?
The shape of the acti site is changed	
Denaturation	Which type of enzyme inhibitor can attach to the active site?
The rate increases an then suddenly drops	

Activity 9: Inorganic ions

Activity name	Importance of inorganic ions
Aim	Pupils should develop an understanding of the wide-reaching impo identifying the role of specific ions in a range of biological situatio
Instructions	The worksheet shows four varied situations in which a specific ion Pupils must first identify the important ion – this could be done by Pupils must then describe the role of this ion in the given situation
Timings	**5–10 minutes**
Required prior knowledge	Pupils will need to know what an 'inorganic ion' is. Some knowled would also be desirable: • pH • role of haemoglobin in carrying oxygen • transport of substances across cell membranes • structure of DNA and ATP
Intended use	Starter
Specification reference	Edexcel B (9BI0) 1.6: Inorganic ions Note: Not all key inorganic ions mentioned in the specification are
Additional notes and guidance	This activity is designed to be used as a starter, to introduce the co components in many biological situations. The situations shown in in more detail. Plenary/extension/homework ideas: 1. Ask the pupils to think of other situations in which ions are in the importance of magnesium in the chlorophyll molecule, th bone, or the importance of nitrates for protein building in pla 2. Ask pupils to research the importance or main uses of the otl the specification: Ca^{2+}, K^{+}, NH_4^{+}, NO_3^{-}, HCO_3^{-}, Cl^{-}, OH^{-}.
Answers	**DNA and amino acids are essential molecules for all known life in bacteria.** NO_3^{-} is the important ion Plants are able to absorb nitrogen in the form of nitrate ions. This plant to produce DNA, RNA and amino acids. Animals in turn get n animals. **Chlorophyll is a complex molecule required by plants for photosy** Mg^{2+} is the important ion This ion is an essential component of the chlorophyll molecule. Wi functional and photosynthesis cannot occur. **Calcium pectate is an important component of the pectin layer in cell walls of adjacent cells.** Ca^{2+} is the important ion Pectin includes –COOH or $–COO^{-}$ groups which are negatively char provide a powerful attractive force between adjacent pectin mole *Note: If used as a starter, pupils will probably not be familiar with (though they may have briefly looked at pectin when studying euk may therefore be more challenging than the others. However, they negative charge shown in the pectin molecule, and the positive ch **Hydrolysis of ATP to ADP and Pi provides the energy required for** PO_4^{3-} is the important ion. Phosphate ions allow the transfer of electrons during reactions wi energy for chemical reactions in the body. *Note: If following the specification in order, pupils will not yet have may not be able to give the full explanation above. They should be an important component of ATP and ADP. The teacher may then w during feedback at the end of the activity.*

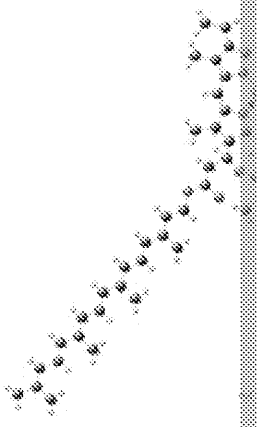
Activity 9: Importance of inorgan





DNA and amino acids are essential molecules for all known life including plants, animals and bacteria.

Chl
mo
for

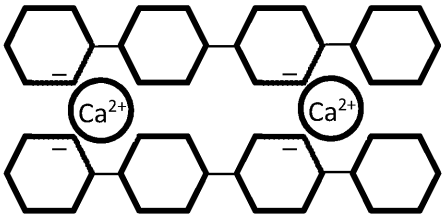


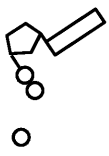
What is the importance of inorganic ions?

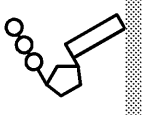
For each diagram:

- identify the important ion
- describe the role of this ion in the given situation

Calcium pectate is an important component of the pectin layer in plants, helping to 'cement' the cell walls of adjacent cells.







Hydrolysis of A
energy require

Activity 10: Water

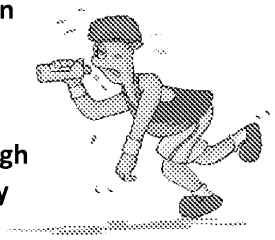
Activity name	Water!
Aim	Pupils will think about some of the chemical and physical properti importance in a range of biological situations.
Instructions	There are four situations shown in pictures on the worksheet. Pup For each situation they must first determine what the picture is sh the box provided below the picture. They should then determine important in this situation, identifying the important properties by
Timings	**10 minutes**
Required prior knowledge	It would be helpful if pupils are already familiar with the propertie vaporisation, heat capacity, cohesion, metabolite, solvent.
Intended use	Starter or plenary
Specification reference	Edexcel 1.7
Additional notes and guidance	Extension idea: Ask pupils to put the five properties in order of imp with 1 as the most important and explaining their reasoning.
Answers	**Picture 1:** A person running (pupils may note high rate of respirati Important properties: *metabolite* (for respiration) *high latent heat of vaporisation* (to cool the runner as his sweat ev *solvent* (nutrients carried in the blood to the runner's cells for resp *high heat capacity* (the runner's body contains a lot of water; the l maintain his body temperature, i.e. it will not heat up easily) **Picture 2:** An insect 'skating' on a pond surface Important properties: *cohesion* (the surface tension of the water allows the insect to star *high heat capacity* (the insect's environment stays at a relatively c **Picture 3:** Small (single-celled) organism living in (pond) water Important properties: *high heat capacity* (the organism's environment stays at a relative *solvent* (food for the organism is dissolved in the water – nutrients organism's cell membrane) **Picture 4:** Transpiration from a leaf Important properties: *high latent heat of vaporisation* (the plant is cooled as water evap leaves) *cohesion* (cohesion between water molecules allows the plant to t the leaves – transpiration pull) *solvent* (minerals are brought from the roots to the leaves dissolve

Activity 10: Water!

Some of the main chemical and physical properties of water are written in a clou
below. Each diagram shows a common biological situation. You must first deter
showing – write your description in the box provided. Then, identify which of th
important for this situation. Your teacher may ask you to think about the level o
numbering them in order 1–5 with 1 as the most important.

Water has a **high latent heat of vaporisation**

Metabolite in reactions such as condensation and hydrolysis



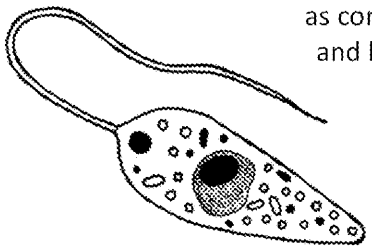
Water has a **high heat capacity**

Strong cohesion between water molecules

Important **solvent**

Water has a **high latent heat of vaporisation**

Metabolite in reactions such as condensation and hydrolysis

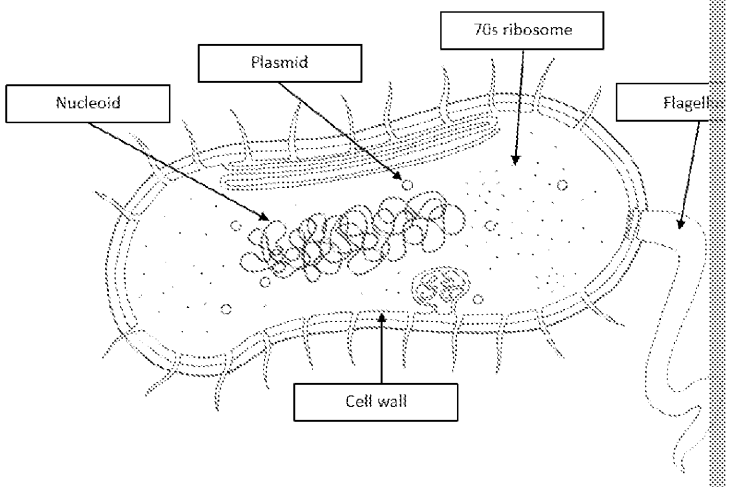


Water has a **high heat capacity**

Strong cohesion between water molecules

Important **solvent**

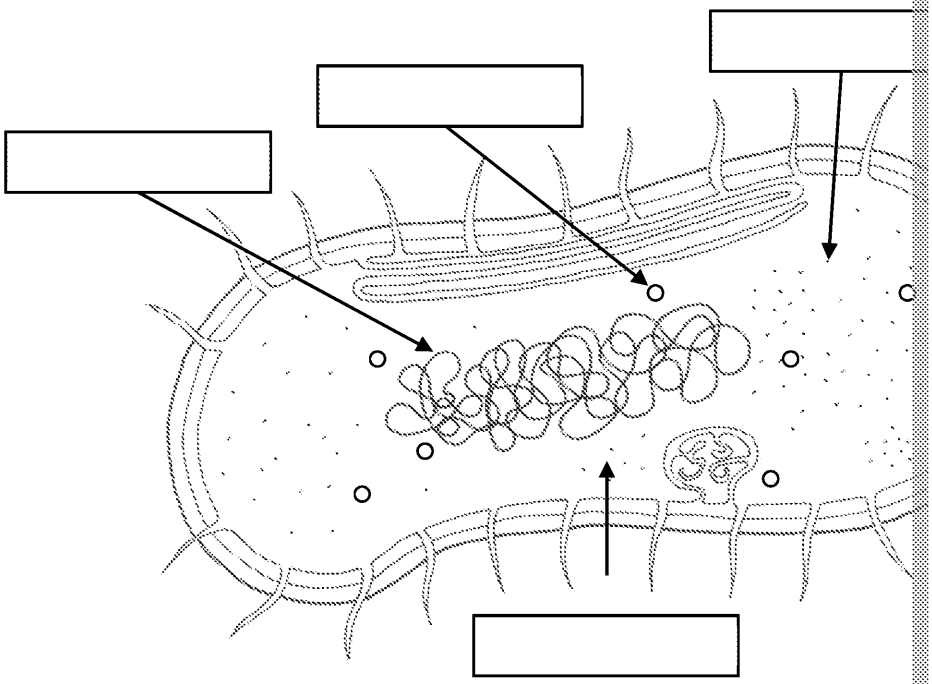
Activity 11: Prokaryotic cells

Activity name	Prokaryotes
Aim	To explore the similarities and differences between Gram-positive bacteria.
Instructions	Pupils should first label the diagram, identifying: nucleoid, plasmid cell wall. Pupils should then use the table provided to summarise the differe bacteria and Gram-negative bacteria.
Timings	**10 minutes**
Required prior knowledge	
Intended use	Starter/plenary
Specification reference	Edexcel B (9BI0) 2.1: Eukaryotic and prokaryotic cell structure and
Additional notes and guidance	If used as a starter, pupils will need to be given a reference source Gram-positive cell walls and Gram-negative cell walls as well as Gr negative bacteria.
Answers	 Differences to a eukaryotic cell: • No membrane-bound organelles • DNA is not contained within a nucleus • Single loop of DNA (not in chromosomes) • Flagellum (different to some eukaryotic cells) • Cell wall made of peptidoglycan • Smaller

	Gram-positive bacteria	
Peptidoglycan	Thick layer	
Cell membrane	Cytoplasmic membrane only	
Crystal violet dye	Retained by peptidoglycan layer	
Appearance after gram staining	Purple	
Susceptibility to antibiotics	High	
Reason for antibiotic susceptibility	Lack of outer membrane	e

Activity 11: Prokaryotes

Label the diagram below to identify some of the key features of prokaryotic cells
describe three differences between a prokaryotic cell and a eukaryotic cell.



Three differences:

1. .....

2. .....

3. .....

Complete the table below, describing the differences between Gram-positive bac

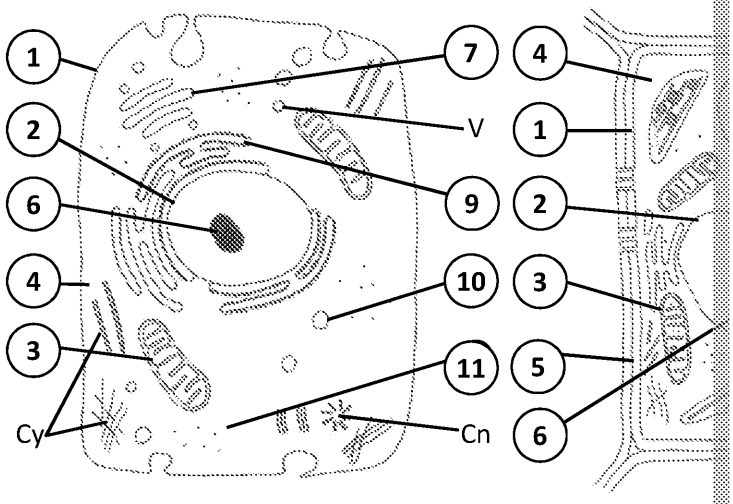
Extension: Can you think of any other differences between these two major grou
the table.

	Gram-positive bacteria	G
Peptidoglycan layer		
Cell membrane		
Crystal violet dye		
Appearance after gram staining		
Susceptibility to antibiotics		
Reason for antibiotic susceptibility		

Activity 12: Eukaryotic cells

Activity name	Cell structure and function
Aim	To identify cellular structures in diagrams and electron micrograph
Instructions	Pupils must match the names and functions of the cellular structur They must then also identify these structures on the cell diagrams can do this by labelling the structures 1–12 or by drawing label line
Timings	**10–15 minutes** It is expected that matching the names and functions will take aro electron micrographs is likely to vary between pupils.
Required prior knowledge	Basic knowledge of cellular structure form GCSE
Intended use	Starter or plenary
Specification reference	Edexcel 2.1 **Note:** The worksheet focuses only on eukaryotic cell structure.
Additional notes and guidance	**Extension ideas:** 1. Identify other organelles/structures, e.g. plasmodesmata, cer 2. Ask pupils to identify which of the structures are also found i the same in prokaryotes and eukaryotes? Are there any stru in eukaryotes?

Answers



Extension idea 1: Some extra organelles are identified above:
Cy = cytoskeleton (larger microtubules, smaller microfilaments)
Cn = centriole
V = vesicle
P = plasmodesmata

Extension idea 2:

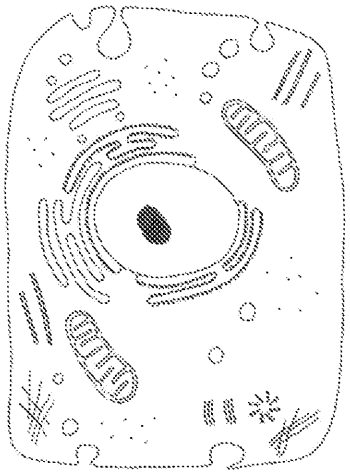
- Structures also found in prokaryotes include: cell surface m
  ribosomes
- The cytoplasm of prokaryotes lacks membrane-bound org
- The cell wall of a bacterium consists of glycoprotein (mure
- The ribosomes of prokaryotes are smaller than those in eu
- Prokaryotic cells often include:
  - Flagella (some eukaryotic cells also have these)
  - DNA plasmids and circular DNA

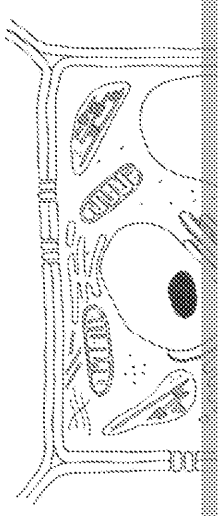
1.	Cell surface membrane	To maintain shape and organism structure in plants and fungi
2.	Nucleus	Modification and packaging of proteins before export out of the cell
3.	Mitochondrion	Storage of water in plants – helps to maintain the cell's water potential
4.	Cytoplasm	Provides energy through generation of ATP in respiration
5.	Cell wall	Everything within the cell membrane excluding the nucleus
6.	Nucleolus	A region of the nucleus in which ribosomes are assembled
7.	Golgi body	Where genetic information is stored. Controls cell activities.
8.	Vacuole	Releases lysozymes to digest unwanted items inside the cell
9.	Rough endoplasmic reticulum (RER)	Controls movement of molecules in or out of the cell
10.	Lysosome	Production and packaging of proteins to be used outside of the cell
11.	Ribosome	Photosynthesis
12.	Chloroplast	Production of proteins

5
7
8
3
4
6
2
1
9
5
1
1

Activity 12: Cell structure and fu

Label the diagrams with the cellular structures listed below.





Match the name, function and an EM image for each cellular structure.
Note: It may not be possible to identify the cell surface membrane or ribosomes on the EM images.

1. Cell surface membrane	To maintain shape and organism structure in plants and fungi
2. Nucleus	Modification and packaging of proteins before export out of the cell
3. Mitochondrion	Storage of water in plants – helps to maintain the cell's water potential
4. Cytoplasm	Provides energy through generation of ATP in respiration
5. Cell wall	Everything within the cell membrane excluding the nucleus
6. Nucleolus	A region of the nucleus in which ribosomes are assembled
7. Golgi body	Where genetic information is stored. Controls cell activities.
8. Vacuole	Releases lysozymes to digest unwanted items inside the cell
9. Rough endoplasmic reticulum (RER)	Controls movement of molecules in or out of the cell
10. Lysosome	Production and packaging of proteins to be used outside of the cell
11. Ribosome	Photosynthesis
12. Chloroplast	Production of proteins

Activity 13: Microscopy

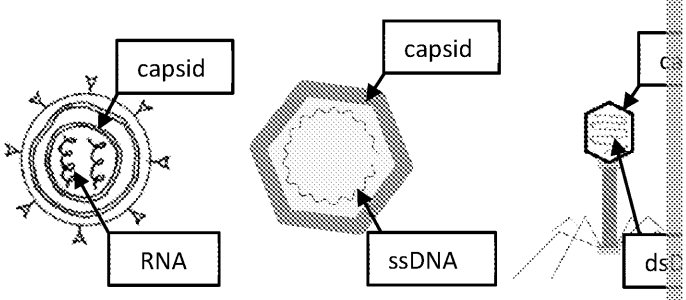
Activity name	Silent sentences
Aim	To develop pupils' appreciation of the uses and limitations of diffe
Instructions	The cards in the worksheet provide eight sentences on the use of printed and cut out before the lesson, with one set per group of p Pupils should be divided into groups of four. Each person in the gr one column on the sheet. If you need to have three or five pupils divided randomly, but equally, between the group members. Each pupil should place their cards on the table and try to make th look at the cards of their other group members, and they may give group, but they are not allowed to take cards or ask for them in ar talk and they should not use body language to ask for cards either This activity may take a little explaining and could take some time helps to develop team work and self-discipline. EAL pupils could b help the activity go quicker, while also developing verbal English sl A more straightforward alternative is to give a complete set of car a full set of sentences. ***Note**: To make preparation for the lesson easier, and to keep track good idea to print each set on a different colour of paper. This ma after cutting and to prevent cards from different sets getting mixe*
Timings	**5–15 minutes**
Required prior knowledge	Understanding of the terms 'resolution' and 'specimen' and nm as
Intended use	Starter or plenary
Specification reference	Edexcel 2.1vi **Note:** This activity focuses on the uses and limitations of different cover calculation involving magnification, cell fractionation or ultra
Additional notes and guidance	This activity can be used either as a plenary, solidifying pupils' und limitations of microscopes, or as a starter, to get pupils thinking ar a starter or if pupils finish the activity quickly, a possible plenary o give pupils a series of scenarios, asking them to choose the best ty scenario. Some possible scenarios to use in this activity include: • To view the 3D structure of a virus (SEM – gives high-resoluti • To view the mouthparts of a flea/mosquito/hairs on an ant (S outer surface) • To view movement of daphnia in water (light microscope – sp • To view internal cell structure (TEM – high-resolution image
Answers	1. Electron microscopes have much higher resolution than optic 2. The resolution of an electron microscope is around 5 nm. 3. The optical light microscope cannot be used to view specime 4. Scanning electron microscopes can be used to view specimen 5. Scanning electron microscopes produce 3D images of an obje 6. Transmission electron microscopes can be used to make deta a cell. 7. Only the optical light microscope can be used to observe livin 8. Electron microscopes require specimens to be placed inside a staining; therefore, specimens must be dead.

Activity 13: Silent sentence

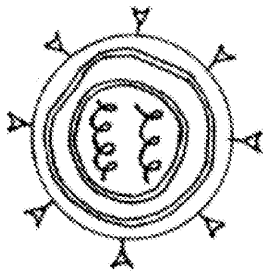
Electron	microscopes	have much
resolution	than optical	light
The resolution	of an electron	microscope
The optical light	microscope	cannot be use
specimens	as small as a virus.	Scanning electr
be used to view	specimens	as large as
Scanning	electron	microscopes
3D images	of an object's	surface.
electron	microscopes	can be used t
images of	structures	inside a cell.
optical light	microscope	can be used t
living specimens.	Electron	microscopes
specimens	to be placed	inside a vacuu
metal staining;	Therefore,	specimens mu

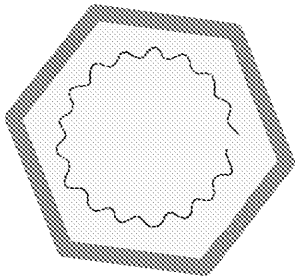
Activity 14: Viruses

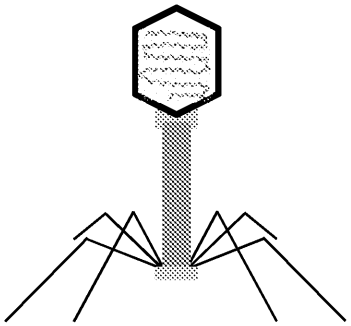
Activity name	Viruses
Aim	To introduce the topic of viruses and develop an awareness of the how they are classified based on genetic material.
Instructions	Pupils are given some basic information regarding viruses. They sh features of genetic material and capsid, in the four examples given which virus is from each of the named groups. This may be a bit tr starter. However, it is quite possible that pupils have seen images After labelling the diagrams, pupils are asked to use their prior kno killing viruses and treating viral infections. This provides an opport knowledge and also provides a lead in to the main lesson, by expa have brought up.
Timings	**5 minutes** for labelling diagrams **+ 10 minutes** for brainstorm activ
Required prior knowledge	Pupils are expected to have prior knowledge of proteins, distinguis (i.e. very small, non-living particles) and also a basic understanding the benefits of breast milk (from KS3/GCSE).
Intended use	Starter
Specification reference	Edexcel B (9BI0) 2.2: Viruses (i, iii, iv)
Additional notes and guidance	

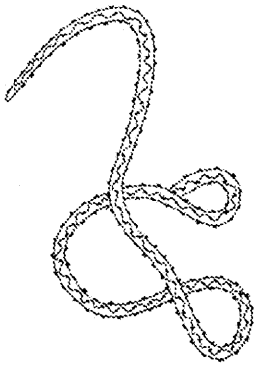
Answers	Boxes on left (top to bottom):
	1. RNA retrovirus = HIV
	2. ssDNA virus = Parvovirus
	3. dsDNA virus = Lambda phage (bacteriophage)
	4. RNA virus = Ebola
	 
	
	Mind map: Due to the open-ended nature of this activity, a wide r
	expected. However, the following ideas should be present at least
	- Killing viruses:
	  - High temperature
	  - Denatures the protein of the protein coat and kills
	  - Damages/destroys viral DNA/RNA thus killing it or
	  - Some strong chemicals could destroy the protein c
	- Treating viral infections:
	  - More problematic
	  - Most methods used to kill viruses could also kill/in
	  - Prevention better than cure
	  - Vaccination
	  - Antibodies to support body's own immune system (fron

Activity 14: Viruses









Viruses

The structure of a virus usually consis
- nuclear material
- a capsid (protein coat) surroundi
- other protein parts
- (sometimes) a membrane envelo

Viruses are classified according to the
contain and their method of reproduc
- single-stranded DNA virus (ssDNA
- double-stranded DNA virus (dsDN
- RNA virus, e.g. Ebola
- RNA retrovirus, e.g. HIV

The diagrams on the left show examp
virus listed above.

Can you identify which virus is which t

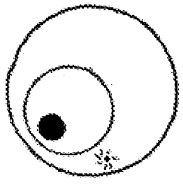
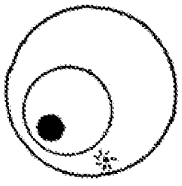
Write the virus classification in the bo

Try to label each diagram, identifying
material.

Using your prior knowledge of biologi
and function, and health and disease,
killing viruses and treating viral infecti

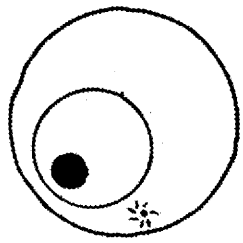
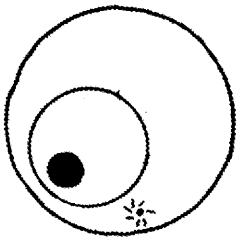
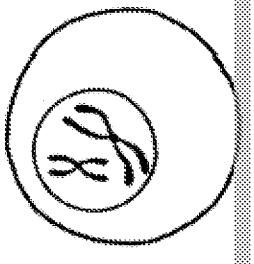
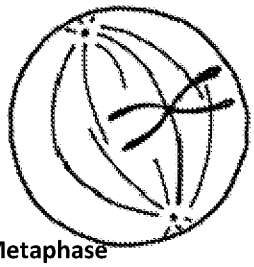
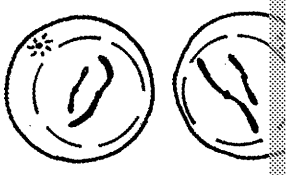
Activity 15: Mitosis

Activity name	Back-to-back: the cell cycle
Aim	To develop understanding of the phases of the cell cycle.
Instructions	Pupils must be put into pairs. Between them, each pair will have a c worksheet has six missing parts in the phase diagrams or informatio to each other to complete their diagrams and information. This sho communication only, with pupils sitting back-to-back so that they ca Once they are finished they should compare their worksheets to see
Timings	**10–15 minutes**
Required prior knowledge	Names of cellular structures such as chromosomes, chromatids, spir membrane would be useful but not essential, as pupils can describe
Intended use	Starter or plenary
Specification reference	Edexcel 2.3i-ii **Note:** This activity focuses on the cell cycle, including interphase and Uncontrolled cell division leading to tumours and cancer is not cove replication in viruses are covered in the next activity.
Answers	The complete information should be as in the table below. The written information will be easier to complete, as the pupils onl missing and ask their partner for the relevant missing information. There is likely to be some variation in the students' drawings. This i representative of the cell cycle. For person 1, ensure that: • two centrosomes are shown in G2 • spindle fibres are attached to centromeres of chromosomes in • the smaller chromosome is lined up alongside the other at the For person 2, ensure that: • a centrosome is drawn in the S-phase cell • the left-hand side of the cell is a mirror image of the right-hand • there is one copy of each chromosome in each daughter cell

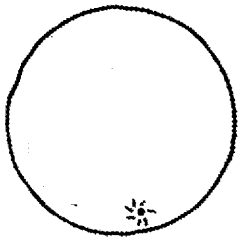
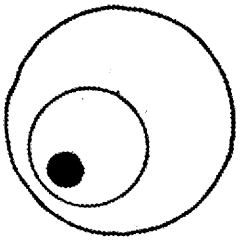
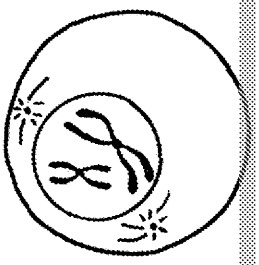
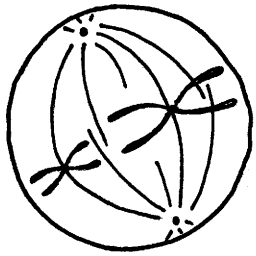
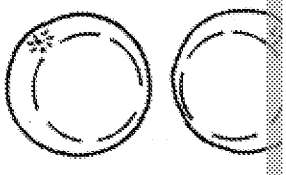
The main growth phase of the cell.	DNA replicates	Cell prepares for n Spindle begins to
		
Interphase G1	**Interphase S-phase**	**Interphase G**
Spindle fibres pull chromosomes to line up at the centre of the cell.	Chromatids separate and move to opposite ends of the cell.	Nuclear envel reforms. Cytoki divides the cell in
		
Metaphase	**Anaphase**	**Telophase**

Activity 15: Back-to-back: the ce

The cell cycle and mitosis: Person 1

The main growth phase of the cell.  ……	…… replicates  **Interphase S-phase**	Cell prepares for mitosis Spindle begins to form.  **Interphase G2**
Spindle fibres pull chromosomes to line up ……  **Metaphase**	Chromatids separate and move to opposite ends of the cell.  **Anaphase**	…… Cytokinesis divides the c in half.  **Telophase**

The cell cycle and mitosis: Person 2

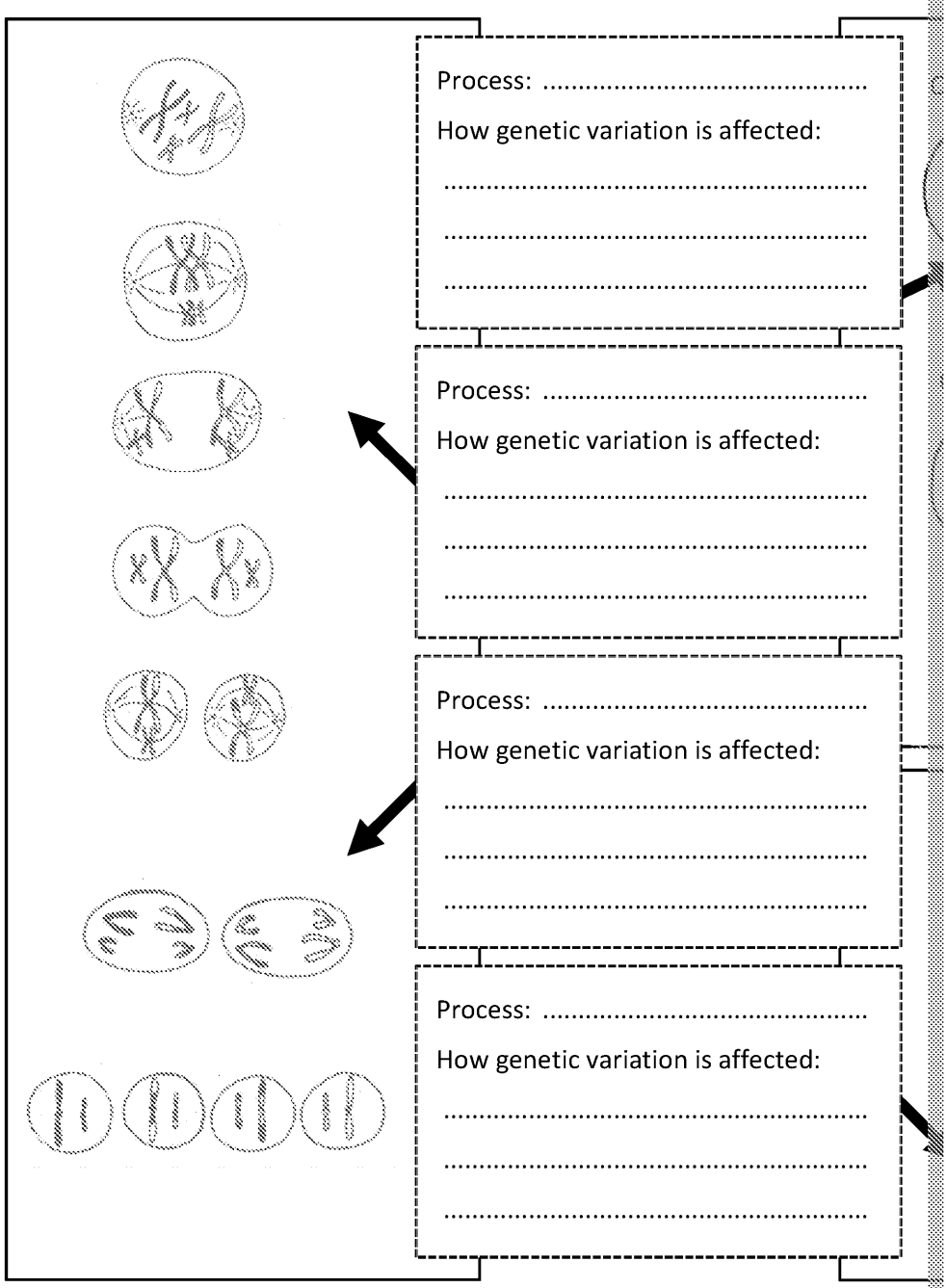
The main growth phase of the cell.  **Interphase G1**	DNA ……  **Interphase S-phase**	……  **Interphase G2**
…… to line up at the centre of the cell.  **Metaphase**	Chromatids separate and move to opposite ends of the cell.  **Anaphase**	Nuclear envelope reform ……  **Telophase**

Activity 16: Meiosis and genetic variation

Activity name	Generating diversity
Aim	To develop understanding of the stages of meiosis and its importa reproducing organisms.
Instructions	There are two sections to this activity.
Timings	**10–15 minutes** As this activity requires some writing, EAL pupils may take significa
Required prior knowledge	An ability to identify the cell structures involved in cell division wil essential.
Intended use	Starter/plenary
Specification reference	Edexcel B (9BI0) 2.3: Eukaryotic cell cycle and division (iv–vii)
Additional notes and guidance	
Answers	Boxes: top → bottom Note: Pupils are not expected to include information in brackets. H additional information for the teacher, and in case gifted students **Box 1:** Translocation Changes the karyotype of the cell. Caused when all or part of a chr or part of a non-homologous chromosome. (The diagram shows b where two non-homologous chromosomes which have a centrom and a reciprocal translocation where two non-homologous chrom **Box 2:** Crossing-over Crossing-over during prophase generates great variation among g **Box 3:** Independent assortment Independent assortment of chromosomes results in a high numbe combinations in the gametes even without crossing-over (this is e **Box 4:** Non-disjunction Non-disjunction results in an abnormal number of chromosomes – and too few in other daughter cells. This will have large impacts o **Box 5:** Random fertilisation Random selection of a sperm and an egg (or other gametes) also i members of a species.

Activity 16: Generating diver

Each of the diagrams on this page depicts something which generates or increas members of the same species. For each diagram, identify the process depicted a variation.



Process: .....

How genetic variation is affected:

.....

.....

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Process: .....

How genetic variation is affected:

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Process: .....

How genetic variation is affected:

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Process: .....

How genetic variation is affected:

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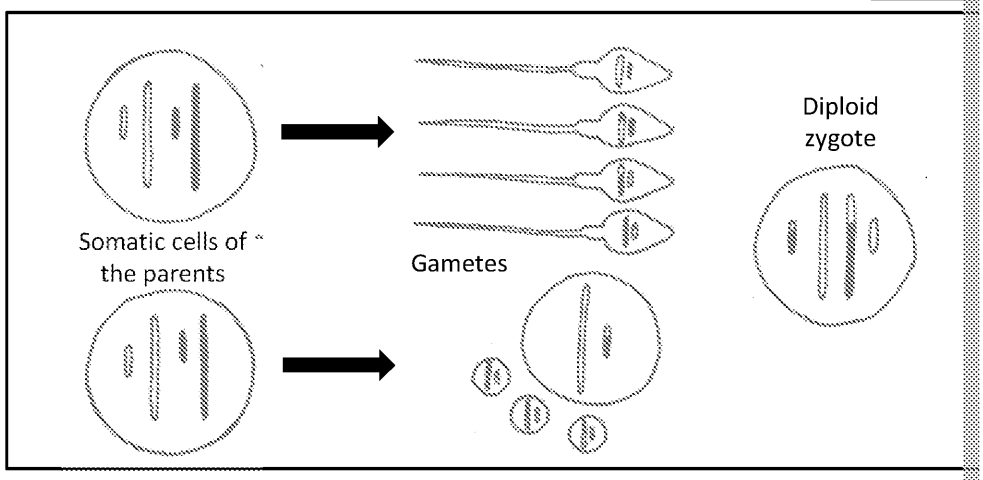


Activity 17: Sexual reproduction

Activity name	Sexual reproduction in animals and plants
Aim	Develop understanding of various steps in the process of sexual re flowering plants.
Instructions	Pupils are given a description of specific parts of the process of sex flowering plants. They are asked to identify the function of this fea
Timings	**10–15 minutes**
Required prior knowledge	Dependent on how the activity is used. See below.
Intended use	Plenary (but see notes on how to use as a starter)
Specification reference	Edexcel B (9BI0) 2.4: Sexual reproduction in mammals, and 2.5: Se
Additional notes and guidance	For the majority of pupils, this activity may be more suitable as a p learning from the lesson. However, it could be used as a starter to fill in what they know at the start of the lesson in one colour, and to fill in their additional learning in another colour.
Answers	

Group	Process	
Animals	Oogenesis generates only one viable egg and three polar bodies	The egg must carry a organelles for the firs other three cells are large and nutrient-ric
	Spermatogenesis generates four motile sperm	Maximise the numbe the egg. Most will be
	In species which use external fertilisation, sometimes billions of sperm are released by each male	Maximises the chanc Most sperm will be 'l is also likely to be hig of different males.
Plants	Pollen grains form in the anther, while the embryo sac forms in the ovule	This separation of ma ensure cross-pollinat
	The pollen grain contains two important cells – a generative cell and a tube cell	The generative cell w The tube cell 'grows'
	Double fertilisation occurs in the embryo sac	One sperm fertilises t other sperm combine cell, forming the end

Activity 17: Sexual reproduction in anim

More complex organisms, including the majority of plants and animals, use sexu
to generate gametes, and these gametes fuse together during fertilisation to ge
develop into a new organism.

Although all sexually reproducing organisms use meiosis to generate gametes, th
varies between major groups, and is also different for the generation of male ga
table below highlights some of the key features of gamete formation and fertilis
plants. For each one, can you explain the function of this part of the process?

Group	Process	
Animals	Oogenesis generates only one viable egg and three polar bodies	
	Spermatogenesis generates four motile sperm	
	In species which use external fertilisation, sometimes billions of sperm are released by each male	
Plants	Pollen grains form in the anther, while the embryo sac forms in the ovule	
	The pollen grain contains two important cells – a generative cell and a tube cell	
	Double fertilisation occurs in the embryo sac	

Activity 18: Classification — Classifying Species

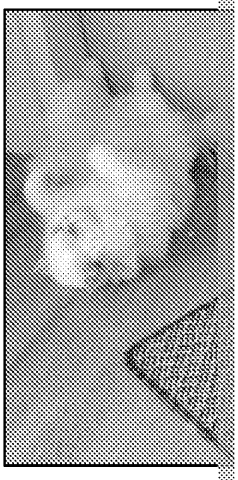
Activity name	Classifying species
Aim	To solidify understanding of the meaning of species and also check hierarchy.
Instructions	This is a simple fill-in-the-gaps exercise which will help to solidify p makes a species a species. Pupils are also required to identify the groupings of three organisms.
Timings	**5–10 minutes** EAL learners may take longer due to developing language skills.
Required prior knowledge	Prior GCSE level understanding of species and genus would be use
Intended use	Starter/plenary
Specification reference	Edexcel 3.1i-v
Additional notes and guidance	The words required to fill in the blanks are not provided to mainta force pupils to read the text carefully. The words to complete the table rows could be removed to provic second section of the worksheet.
Answers	Words to fill-in the blanks should appear in the following order: reproduction, similar, selectively, created/made/produced, geneti Table: Domain: *Eukaryotes* (*Chlamydymonas,* Blue shark, Domestic cat – Order: *Carnivora* (Hyena, Seal, Domestic cat – Persian) Family: *Felidae* (Caracal, Lion, Domestic cat – Persian) Species: *Felus catus* (Domestic cat – Manx, Munchkin, Persian) NB Pupils are not expected to know the species. Each species is id information.

Activity 18: Classifying speci

Introduction to species

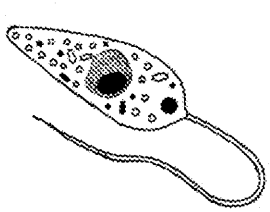
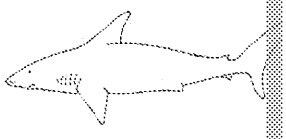
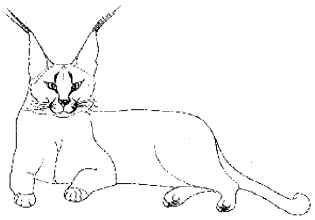
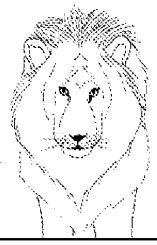
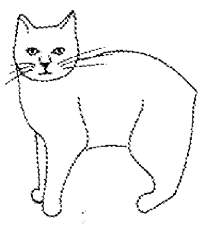
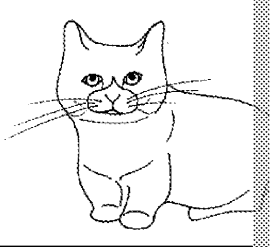
Fill in the gaps:

Members of the same species are able to mate and produce fertile offspring. A fertile organism is one which is capable of ..... . Usually members of the same species look quite ..... while members of different species look different. However, this is not always the case. Dogs and cats have been ..... bred by humans for hundreds of years. In doing so we have ..... hundreds of breeds which can look quite different. Despite these different appearances, their ..... are still similar enough that they are able to breed ..... – they can mate and produce fertile offspring. This tells us they are the same species.



For each row of the table, use the words below to identify the lowest level of cla describe all three species, and name the group to which the three species belon

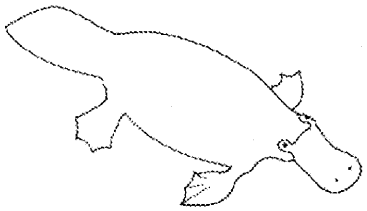
Kingdom *Felidae* Class *Felus catus* Domain *Carnivora Animal* Order *Mammalia* Genus Family *Eukaryotes Chordata*

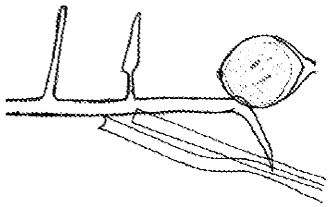
Activity 19: Classification — five kingdoms

Activity name	Grouping organisms
Aim	For pupils to develop an appreciation of the difficulties faced by ta species or updating existing classifications of organisms, and the in technologies to clarify relationships.
Instructions	Pupils should first be introduced to the task. Pupils should be reminded of the concept of phylogenic classificat based on evolutionary relationships. Traditionally, classification is observable characteristics. Teachers may want to recap earlier (KS the five kingdoms. Working in pairs, or groups of three or four, pu organisms on the cards. They should try to show evolutionary rela must be able to explain why they have placed organisms in the sar Pupils can be asked either to group the cards into any groups they their groupings, or to group the cards using the five kingdoms syst short discussion on which cards were difficult to group. This can al using the three-domain system.
Timings	**10–15 minutes**
Required prior knowledge	
Intended use	Starter
Specification reference	Edexcel B (9BI0) 3.1: Classification (v–vii) Note: This is meant to be a thought-provoking exercise and, as suc However, it should be used to develop students' understanding of be used to highlight some of the difficulties with traditional metho pupils to appreciate that advances in genetic techniques have led that they help to clarify evolutionary relationships.
Additional notes and guidance	Pupils should be quite familiar with the five-kingdom system of cla organisms may not fit easily into the groupings they are familiar w Points to note include: • Archaea and bacteria are morphologically similar and are sep molecular (genetic) data. Some DNA of archaea is shared wit • Oomycetes are 'fungus-like' protists that often reproduce sex infectious, others are saprophytic. • Euglena are autotrophic and mixotrophic protists, capable of green algae as secondary endosymbionts. • The parasites that cause malaria and African sleeping sickne They are single-celled organisms that reproduce asexually. H nucleus can usually be easily seen under the microscope) and Other points for discussion or a possible plenary activity could rev classification of oomycetes (in the SAR clade – chromista) and slim related to both animals and fungi).
Answers	If using the five-kingdom classification system, the cards should be Animals: Platypus (1), Planarian (flatworm) (4) Plants: Liverwort (5), Banana palm (9) Fungi: Yeast (8), Chytrid fungus (15) Protoctista: *Phytophthora infestans* (oomycete responsible for pot (6), Euglena (7), *Trypanosoma brucei* (sleeping sickness parasite) (1 Monera (bacteria): *Borrelia spp.* (3), *Mycobacterium tuberculosis* (*acidarmanius* (12), Cyanobacterium (13), Methanogen (14) If using the three-domain system: Archaea: 12, 14 (Eu)bacteria: 3, 11, 13 Eukaryotes: 1, 2, 4, 5, 6, 7, 8, 9, 10, 15

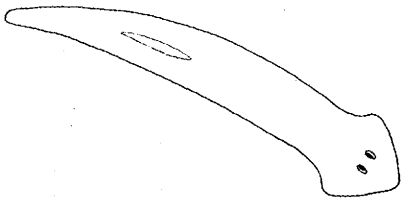
Activity 19: Grouping organis



Lays eggs
- Venomous
- Large organism

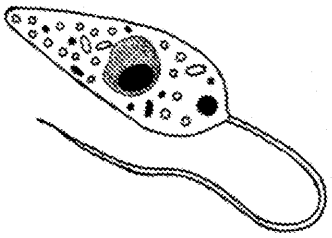


- Causes potato late blight
- Reproduces using spores
- Microscopic

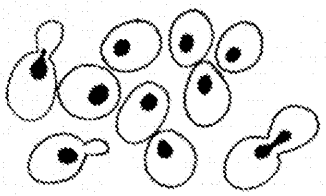


- Microscopic
- Reproduces asexually
- Lives in a range of environments

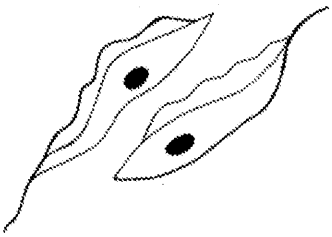
- Photosynthetic autotroph
- Produces sperm, eggs and spores during life cycle



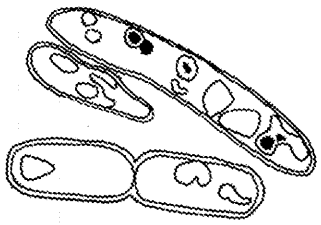
- Photosynthetic autotroph
- Motile
- Microscopic



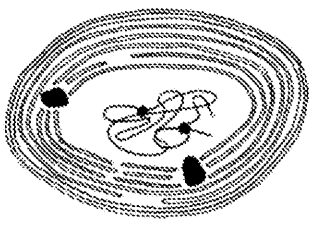
- Reproduces asexually through budding
- Single-celled



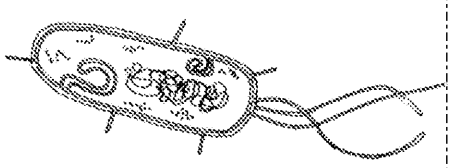
- Causes African sleeping sickness
- Microscopic



- Causes TB
- Microscopic
- Reproduces asexually



- Photosynthetic autotroph
- Mostly marine
- Microscopic



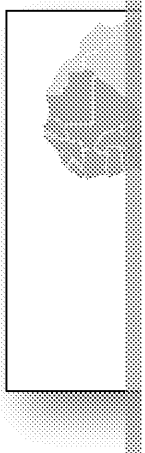
- Produces methane
- Survives in anoxic conditions
- Common symbiont

Activity 20: Adaptations

Activity name	Sickle-cell anaemia
Aim	Provide pupils with practice in putting the principles of natural sel situations, and to highlight the idea that whether an allele is advan disadvantageous is dependent on the environment in which the po
Instructions	Pupils are provided with an introduction to sickle-cell anaemia and including the ability to provide resistance to malaria. They are also how natural selection has acted upon this allele in the Northern Eu Pupils must describe how the process of natural selection with res the population of Sub-Saharan Africa.
Timings	**10 minutes** **Note:** EAL pupils may require more time due to reading speed, rea ability.
Required prior knowledge	Understanding of the process of natural selection
Intended use	Plenary
Specification reference	Edexcel 3.2i **Note:** Generation of new alleles through random mutation, selecti stabilising) and types of adaptation (anatomical, physiological or b activity.
Additional notes and guidance	
Answers	1. The population shows variation in the haemoglobin protein. haemoglobin; a few have sickle-cell haemoglobin. 2. Those individuals who possess the sickle-cell allele are resista 3. Those individuals with sickle-cell live longer and produce mor 4. The sickle-cell allele is passed on to the next generation more 5. Over time and several generations the frequency of the sickle increases.

Activity 20: Sickle-cell anaem

Sickle-cell disease is caused by a mutation in the gene which is used to produce ha
red blood cells which are more rigid and not as effective at carrying oxygen. Sickle
problems for people who carry the sickle-cell allele and can result in a shortened li
though this has become less common as our medical care has developed. There is
sickle-cell trait. People who have sickle-cell haemoglobin are resistant to malaria –
disease common in sub-Saharan Africa. The table below shows how natural select
people in Northern Europe who carry the sickle-cell allele. Your task is to complete
population of Sub-Saharan Africa. How would natural selection have acted differe

Northern European population	Sub-
	
The population shows variation in the haemoglobin protein. Most individuals have normal haemoglobin; a few have sickle-cell haemoglobin.	
There are no benefits to having sickle-cell haemoglobin.	
Those individuals with sickle-cell die younger and have fewer children.	
The allele for sickle-cell is not passed on to the next generation as often as the allele for normal haemoglobin.	
Over time and several generations the frequency of the sickle-cell allele in the population decreases.	

Activity 21: Biodiversity and communities

Activity name	Calculating biodiversity
Aim	Provide practice in calculating an index of diversity.
Instructions	Pupils are given the formula for calculating an index of diversity biodiversity index for two communities. Data on the community which pupils must complete in order to calculate the biodiversity
Timings	**10–15 minutes** depending on mathematical literacy of pupils
Required prior knowledge	Understanding of key terms: habitat, species, diversity
Intended use	Starter/plenary
Specification ref.	Edexcel 3.3i–ii
Additional notes and guidance	If this is used as a starter, the students will first need to be introduce using the given formula (Simpson's index). The results of the activit discussion on the effects of farming practices on biodiversity. If this is used as a plenary, pupils will already be aware of how we ca expecting the diversity of the plantation to be less than that of the r provides pupils with an opportunity to practice calculating an index *Extension idea*: Discussion on sampling communities – pupils can seem realistic. Are there enough species? Is it possible to sample Are 'n' numbers representative of the whole population? Why? guided to the idea that usually only one taxonomic group is samp dependent partly on the sample methods used. This is part of the taxonomic group. Differences in the population size between diff the index due to lowering species evenness.
Answers	

Species	n	n/N	(n/N
Tree shrew	17	0.283	0.08
Common kestrel	1	0.017	0.00
Spider hunter (small bird)	2	0.033	0.00
Red-wattled lapwing	5	0.083	0.00
Tree sparrow	5	0.083	0.00
Mynah bird	30	0.500	0.25
Sum	N=***60***	$\Sigma(n/N)^2$ = ***0.345***	
D = 1 – 0.345 = 0.655			

Species	n	n/N	(n/N
Variable squirrel	9	0.100	0.01
Giant squirrel	3	0.033	0.00
Macaque	7	0.078	0.00
Tree shrew	10	0.111	0.01
Palm civet	3	0.033	0.00
Binturong	1	0.011	0.00
Yellow-throated marten	3	0.033	0.00
Great hornbill	5	0.055	0.00
Oriental pied hornbill	4	0.044	0.00
Red-whiskered bulbul	8	0.088	0.00
Spider hunter (small bird)	5	0.055	0.00
Thick-billed green pigeon	5	0.055	0.00
Four-lined tree frog	10	0.111	0.01
Asian painted frog	15	0.167	0.02
Oriental whip snake	2	0.022	0.00
Sum	N=***90***	$\Sigma(n/N)^2$ = ***0.090***	
D = 1 – 0.090 = 0.910			

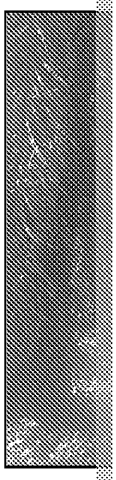
Which habitat has the greatest biodiversity? Rainforest
Is this what you expect? Yes. Farming practices reduce biodiver sources and often increasing the amount of toxins in the environ

Activity 21: Calculating biodiv

This worksheet provides information about the number of vertebrate animal spe
plantation and the estimated number of species found in an equal area of rainfo
Simpson's Index of Diversity (D) to calculate the species biodiversity in each habi
formula $D = 1 - \sum(n/N)^2$, where N is the total number of individuals in the sample
individuals within a species.

Palm oil plantation

Species	n	n/N	$(n/N)^2$
Tree shrew	17		
Common kestrel	1		
Spider hunter (small bird)	2		
Red-wattled lapwing	5		
Tree sparrow	5		
Mynah bird	30		
Sum	**N =**	**$\Sigma(n/N)^2$ =**	
$D = 1 - \Sigma(n/N)^2$			



Rainforest of equal area

Species	n	n/N	$(n/N)^2$
Variable squirrel	9		
Giant squirrel	3		
Macaque	7		
Tree shrew	10		
Palm civet	3		
Binturong	1		
Yellow-throated marten	3		
Great hornbill	5		
Oriental pied hornbill	4		
Red-whiskered bulbul	8		
Spider hunter (small bird)	5		
Thick-billed green pigeon	5		
Four-lined tree frog	10		
Asian painted frog	15		
Oriental whip snake	2		
Sum	**N=**	**$\Sigma(n/N)^2$ =**	
$D = 1 - \Sigma(n/N)^2$			

Which habitat has the greatest biodiversity? .....

Is this what you expect? Why? .....

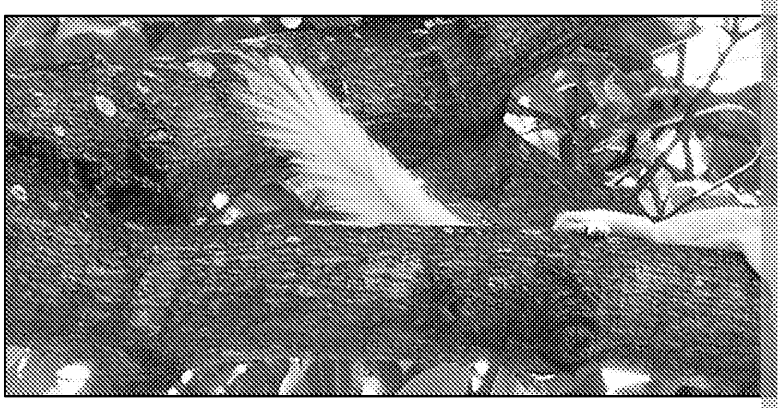
.....

Activity 22: Genetic diversity

Activity name	Investigating diversity
Aim	Practise interpreting data relating to genetic diversity.
Instructions	Pupils should read the introduction and work through the questio data relating to the genetic diversity in four populations of variabl consider reasons for the observations.
Timings	**10 minutes**
Required prior knowledge	Pupils will not be able to complete the worksheet until they have l diversity. The questions in the worksheet also link to previous wo diversity among a population.
Intended use	Plenary
Specification reference	Edexcel 3.3ii-iii
Additional notes and guidance	The point of this exercise is to get pupils to interpret data regardin some of the causes of variation. The longer answers below show p Pupils may have other ideas.
Answers	**Which data from the table can be used to determine genetic dive** 'Number of different fur colours' <u>and</u> 'percentage of polymorphic **Which of these data would be the most reliable? Why?** Percentage of polymorphic gene loci – the measurement covers m one characteristic so it is probably affected by only one gene or a s of gene loci is also an analysis of the actual DNA which is likely to b phenotypes – where heterozygotes cannot be identified. (Not all a **Which population shows:** **the greatest diversity?** <u>Mae Wong National Park</u> **the least diversity?** <u>Koh Chang Island</u> **Can you explain the pattern of diversity shown in the data?** ***Note:*** *Pupils are not expected to include all of the following ideas c their own which are feasible.* Mae Wong National Park and Khao Yai National Park have high lev range area and expected large population. Lumpini Park has a slightly smaller diversity, due to small populatio Lumpini Park population has probably only been isolated for a sho would have been isolated by the urbanisation of Bangkok, i.e. < 50 well fed, meaning that the population may still be quite large. Koh Chang is an island and, therefore, the squirrel population is lik time; there may have been significant inbreeding leading to a low

Activity 22: Investigating dive

The variable squirrel *Callosciurus finlavsonii* is a small squirrel species found in th habitats of South East Asia. It can be found in a wide variety of colours including brown or red-brown, and also often shows two colours, with a darker colour on colour on the underside. Other patterns are also known.



Fifteen individuals were captured at random in four different populations aroun data collected is shown in the table below.

Population	Mean body mass (g)	Mean age (months)	Number of different fur colours	po
Khao Yai National Park	243 ± 23	66 ± 12	8	
Koh Chang Island	259 ± 18	62 ± 14	4	
Lumpini Park (Central Bangkok)	297 ± 35	73 ± 18	1	
Mae Wong National Park	252 ± 28	64 ± 10	8	

Which data from the table can be used to determine genetic diversity?

.....

Which of these data would be the most reliable? Why?

.....

.....

Which population shows:

the greatest diversity? .....

the least diversity? .....

Can you explain the pattern of diversity shown in the data?

.....

.....

.....

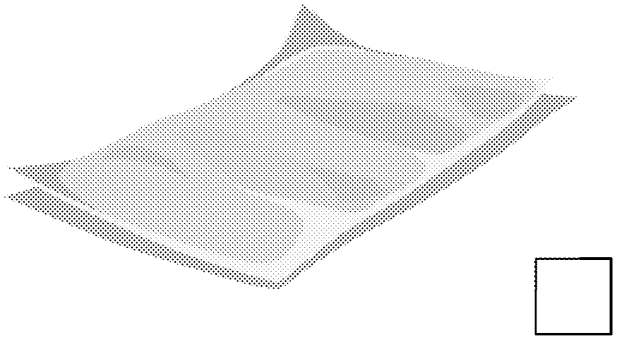
.....

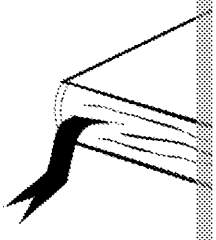
Activity 23: Surface area

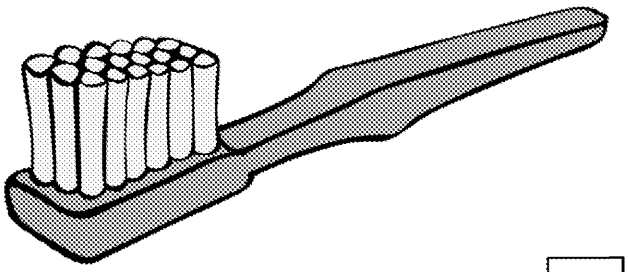
Activity name	Surface area
Aim	To consider and identify structural features which can provide an in ratio.
Instructions	Pupils are given diagrams of four everyday objects and four biologic diagrams, pupils must order from largest to smallest SA:V ratio, by r Once pupils have finished they could be asked to discuss in small gro choose a different order? Were there any pairs which you were uns
Timings	**<5 minutes** (**5–10 minutes** if including group discussion)
Required prior knowledge	If teaching EAL learners, ensure understanding of the terms surface,
Intended use	Starter
Specification reference	Edexcel 4.1
Additional notes and guidance	You may wish to follow the activity with a short discussion. Try to e common features which lead to increased surface area (to volume r • a flat or long, thin shape • size (smaller objects have larger SA : V ratios) • column or 'finger-like' projections (as in the toothbrush and mi You could follow the activity with calculation of the SA : V ratio of a 12 mm × 2 mm × 0.5 mm), *Chlamydomonas* (roughly spherical, appr diameter), root hair cell (using round numbers within the normal ra 'cylinder' 1000 µm, diameter of 'cylinder' 10 µm, main cell body dia depth 20 µm) and micro-villi/epithelial cell of the ileum (each micro epithelial cell of the ileum may have up to 1,000 microvilli).
Answers	Everyday objects: Clockwise from top left: 2–4–3–1 1 = toothbrush head 2 = sheet of paper 3 = coffee mug 4 = book Biological structures: Clockwise from top left: 4–3–1–2 1 = microvilli 2 = root hair cell 3 = single-celled organism 4 = planaria (very small / microscopic multicellular organisms)

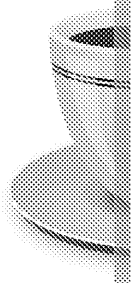
Activity 23: Surface area

Which of the following everyday objects has the largest surface area to volume r
largest to smallest surface area by numbering the boxes 1–4.

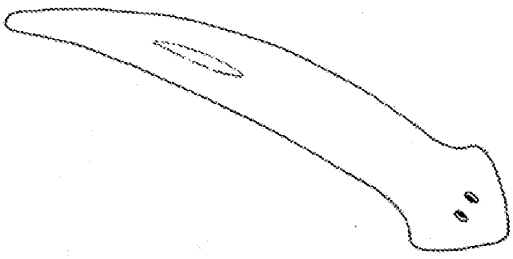




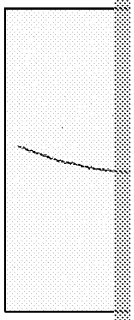




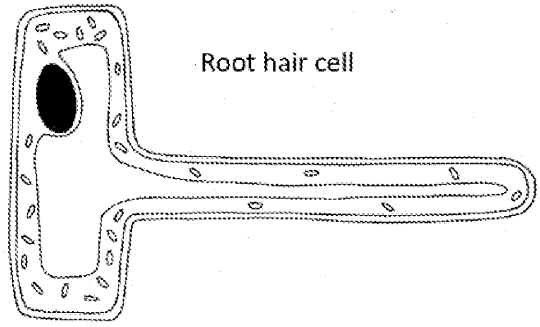
Which of the following biological structures has the largest surface area to volum
from largest to smallest surface area by numbering the boxes 1–4.



Planarian: A multicellular but microscopic organism

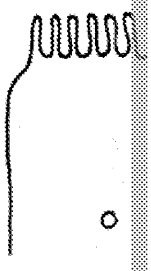


Chlamydomonas: A s



Root hair cell

Microvilli

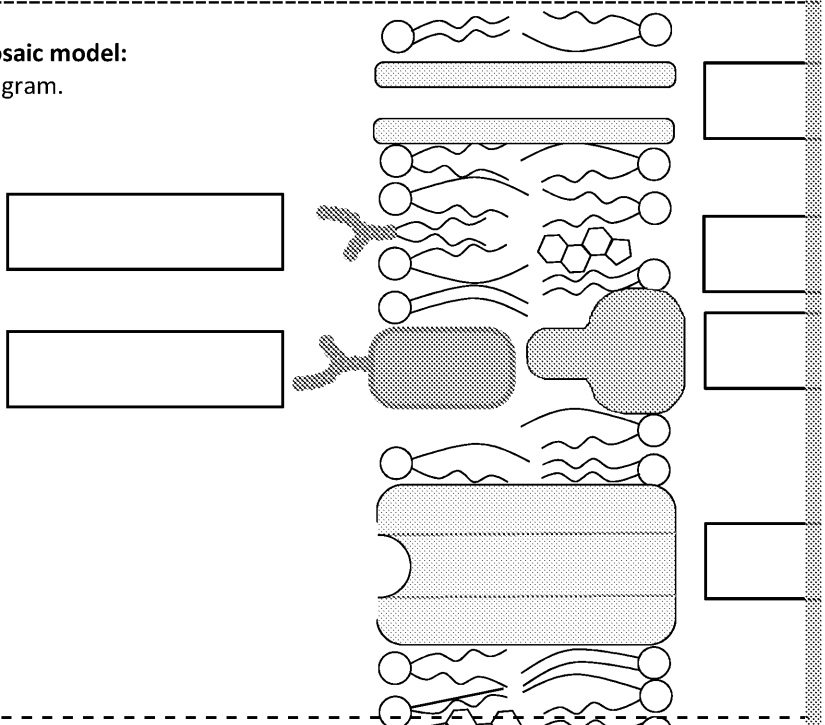


Activity 24: Membranes and transport

Activity name	Passive transport
Aim	To identify features of the fluid mosaic model of membrane struct of the differences between different methods of passive transport
Instructions	Instructions for the pupils are given on the worksheet. Pupils shou 1. Label the cell membrane diagram 2. Annotate the sections of the diagram for 'simple diffusion', 'f identifying the features of the diagram and explaining their s transport.
Timings	**10–15 minutes**
Required prior knowledge	Knowledge of the properties of phospholipids
Intended use	Plenary
Specification reference	Edexcel 4.2i-iii **Note:** Active transport, co-transport and adaptation of cells specia in this activity but are covered in the following pages.
Additional notes and guidance	This activity is designed to be used as a plenary to recap and solidi three types of passive transport across membranes. If pupils have mosaic model of membrane structure in a previous lesson, labellin a starter to recap that knowledge before moving on to diffusion. T them be used as a plenary, or pupils could use it as an aid to note
Answers	**Fluid mosaic model** – clockwise from top right: 1. Protein-lined pore 2. Cholesterol 3. Peripheral protein / extrinsic protein 4. Integral protein / intrinsic protein / (allow) transport protein 5. Glycoprotein 6. Glycolipid **Simple diffusion** – clockwise from top right: 1. Allows simple diffusion of polar molecules, e.g. water, ions 2. Sometimes very small polar molecules, such as water, can mo 3. Prevents movement of polar and charged molecules **Facilitated diffusion** – top to bottom: 1. Channel protein: Allows free movement of molecules down t open. 2. Carrier protein: Allows movement of a specific molecule dow **Osmosis** – left to right: 1. High water potential. Many free water molecules. 2. Low water potential. Few free water molecules. Water will move to this side of the membrane.

Activity 24: Passive transpo

The fluid mosaic model:
Label the diagram.



Simple diffusion:
Explain the significance of each item for simple diffusion.

Hydrophobic phospholipid bilayer

Protein-

Small ga

Facilitated diffusion:
Explain the significance of each item for facilitated diffusion.

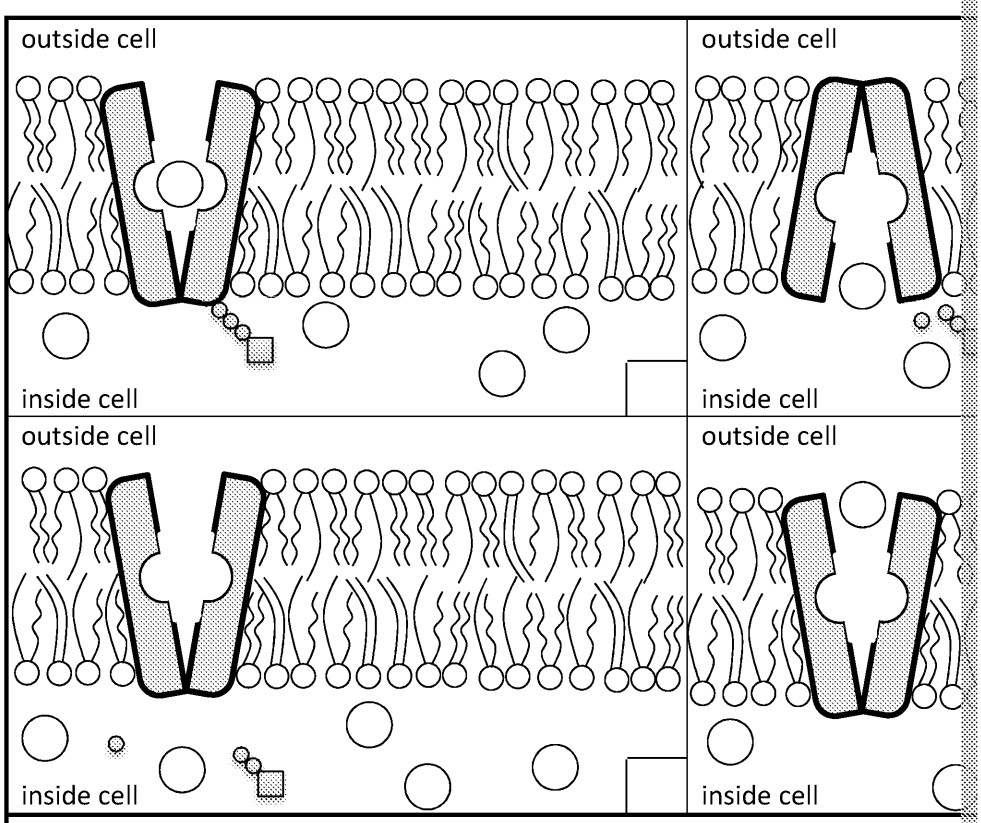
Osmosis:
Describe the conditions on each side of the membrane and how these affect movement of water.

Activity 25: Active transport and exocytosis

Activity name	With a little energy – transport requiring ATP
Aim	Develop understanding of how molecules can be moved against th higher rate using ATP as a source of energy.
Instructions	Pupils must order the diagrams into a sequence of events by writi box at the bottom right of each diagram. Pupils can also be asked to try to describe what is happening in the useful if the activity is used as a plenary.
Timings	Less than **5 minutes** to order the diagrams. **10–15 minutes** if pupils are also asked to describe what is shown i
Required prior knowledge	Pupils should be able to recognise the phospholipid bilayer and int Knowledge of ATP structure and function will also be useful, in orc its ability to provide energy for the movement of a substance agai
Intended use	Starter/plenary
Specification reference	Edexcel 4.2i-iii
Additional notes and guidance	**Using the activity as a starter:** The activity can be used to introduc thinking about the processes of active transport and exocytosis. P diagrams and then discuss in groups or as a class why they chose t feature of the diagram made them choose a particular position in **Using the activity as a plenary:** The activity can be used to summa understanding from the lesson. It can also be used to help improv the ability to give accurate descriptions. To achieve this, pupils co happening in each diagram. This activity could be followed by pup their descriptions with each other. How are their descriptions diff keywords? Which description for each diagram is better? Why? C combined to create a better description?
Answers	Active transport: Clockwise from top left = 2–3–1–4 1. Molecule has a higher concentration on the inside of the cell molecule is able to enter a specific transport protein. 2. ATP activates the specific transport protein. 3. Change in the shape of the transport protein (due to activati the inside of the cell. 4. ADP and P^+ are released from the transport protein, returnin Exocytosis: Clockwise from top left = 3–1–2–4 1. Substance to be transported is packaged into a vesicle inside cell membrane. 2. On reaching the cell surface membrane, the vesicle's outer la the phospholipid bilayer of the cell surface membrane. 3. When the inner layer of phospholipids reaches the outer laye two layers merge, causing the vesicle to 'open up' and releas the space outside of the cell. 4. The cell surface membrane returns to normal. (The vesicle h membrane and the vesicle contents have been released.)

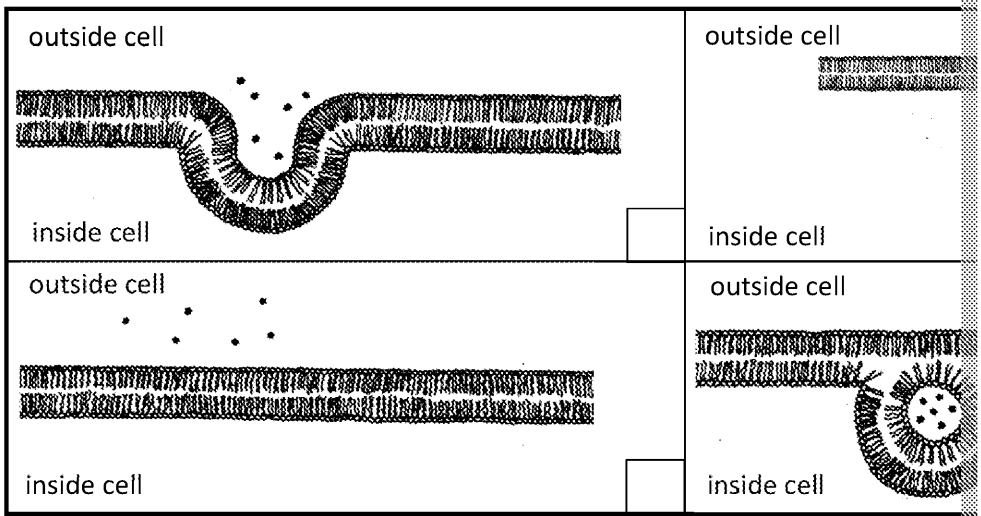
Activity 25: With a little energy – transpo

Active Transport: Order the sequence of events by numbering the boxes from 1 suggest what is happening in each diagram.



What might be happening:
1.
2.
3.
4.

Exocytosis: Order the sequence of events by numbering the boxes from 1 to 4. I suggest what is happening in each diagram.



What might be happening:
1.
2.
3.
4.

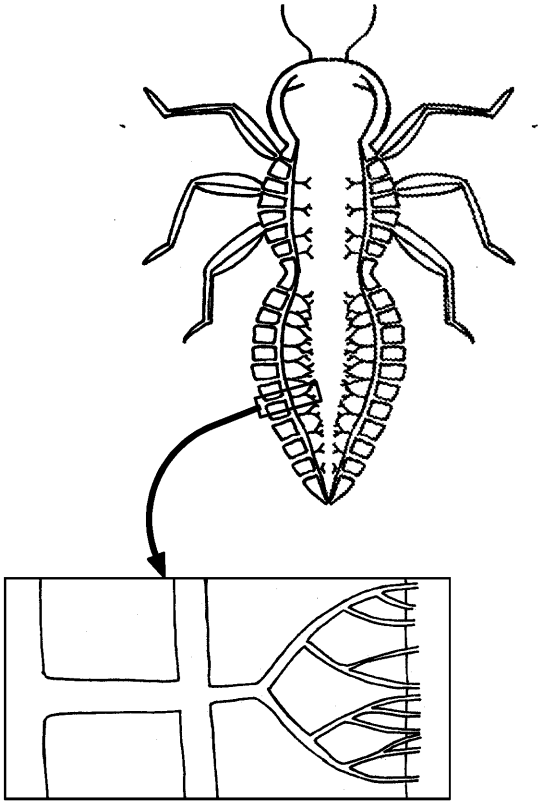
Activity 26: Gas exchange

Activity name	Adaptations for gas exchange
Aim	To highlight the universal nature of many adaptations of gas excha
Instructions	Pupils are presented with diagrams of gas exchange surfaces in fou mammals (humans), plants). Their task is to identify the features o function of gas exchange.
Timings	**10 minutes**
Required prior knowledge	Pupils will need to have some knowledge of circulation from GCSE area to volume ratio if the activity is to be used as a starter.
Intended use	Starter or plenary
Specification reference	Edexcel 4.3 **Note:** Ventilation and the mechanism of breathing, and the gross s exchange system, are not covered in this activity.
Additional notes and guidance	**Using the activity as a starter:** Assuming pupils have already cover to volume ratio in biology, the activity can be used as a starter, int the adaptations of gas exchange surfaces. Knowledge of circulatio also be useful to pupils if the activity is used as a starter. **Using the activity as a plenary:** The activity could be used at the e humans, to show how many adaptations of gas exchange surfaces Single-celled organisms are not shown in this worksheet, but teach post-activity discussion.
Answers	**Adaptations to increase surface area:** Insect trachea: highly branched into smaller and smaller tubes Gills: gill lamellae and filaments Alveoli: highly branched network of capillaries and shape of alveol Leaf: substomatal air space and interconnecting air spaces throug of mesophyll exposed to the atmosphere **Maintenance of a concentration gradient:** Insect trachea: walls of smallest trachioles made from single cells Gills: countercurrent Alveoli: continuous circulation of blood to remove oxygen and brin Leaf: CO_2 constantly used up in photosynthesis **Thin membrane/barrier – reduces distance for diffusion / gas exc** Insect trachea: single layer of cells Gills: capillaries of gill lamella, single-cell thick Alveoli: single layer of epithelial cells Leaf: diffusion occurs across the cell wall and cell membrane of th through open stomata

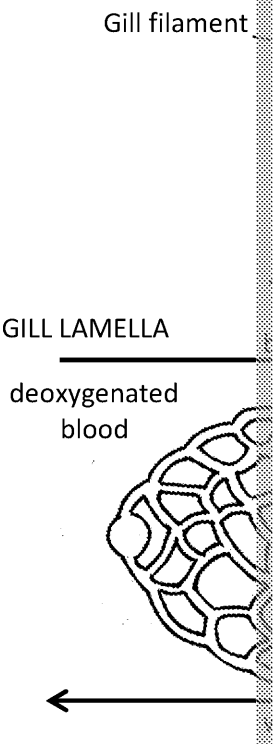
Activity 26: Adaptations for gas e

In the boxes below, try to identify the features of each organ which help it to perfo

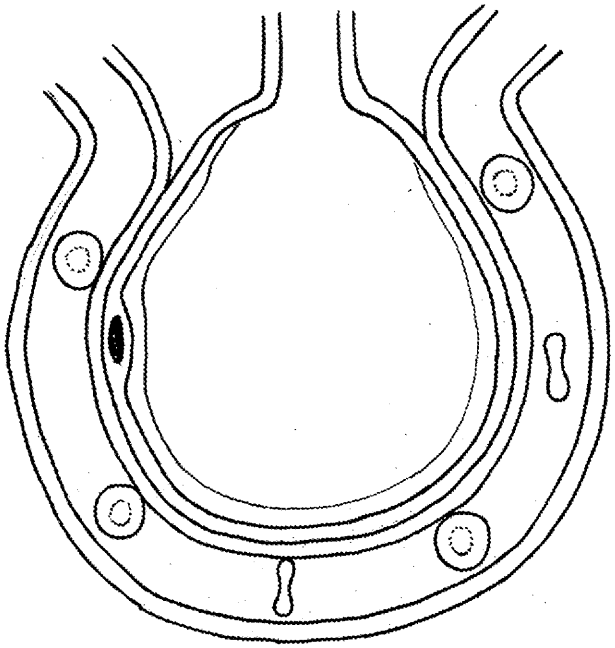
The tracheal system of an insect



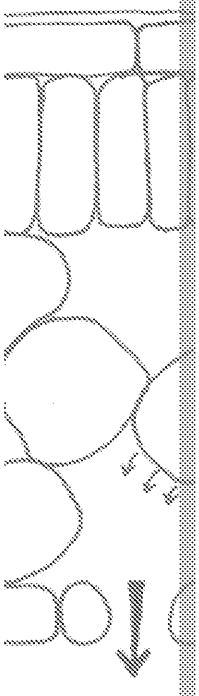
The gills of a fish



Alveoli in the human lungs



The leaves of dicotyledo



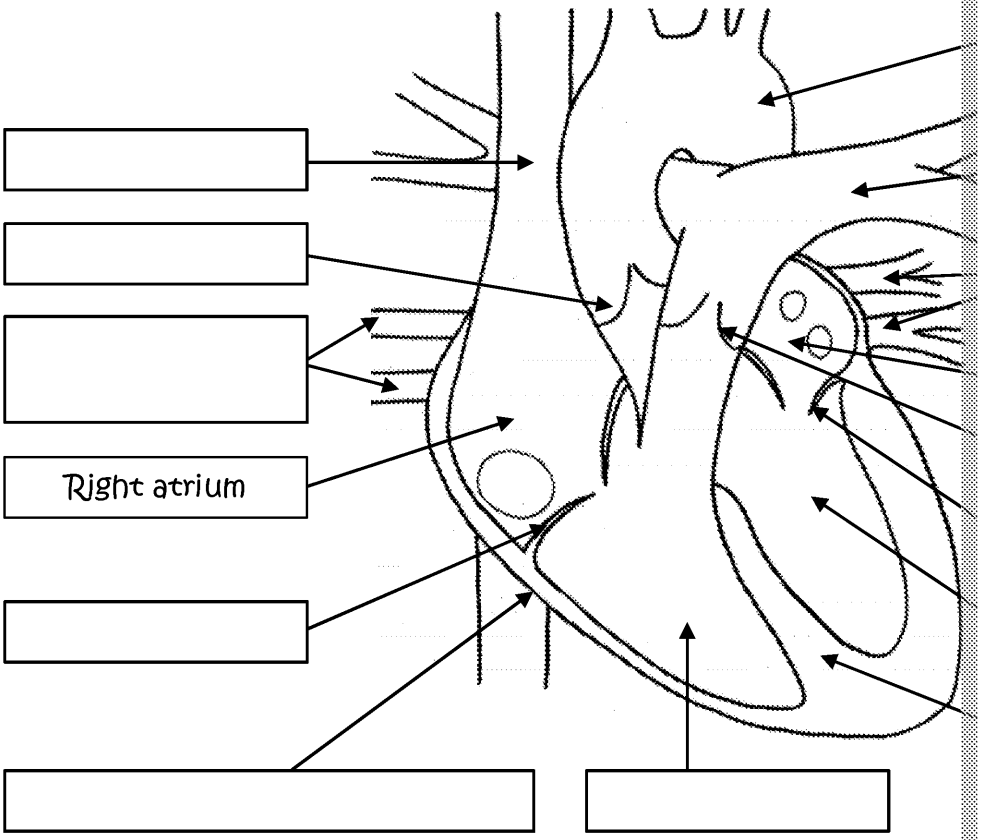
Activity 27: Circulatory system

Activity name	The heart
Aim	Recap and check understanding of GCSE level content of the hea teaching in more depth.
Instructions	This worksheet provides an unlabelled diagram of the human he blood vessel. Pupils are expected to label the heart diagram and compare the the table provided.
Timings	**10 minutes**
Required prior knowledge	Pupils will be required to recall GCSE level content of the circulat
Intended use	Starter/plenary
Specification reference	Edexcel 4.4i–v
Additional notes and guidance	Note: The bicuspid valve is also known as the mitral valve.
Answers	Heart diagram: Labels clockwise from top right: aorta, pulmonary artery, *left pulr* valve, *bicuspid valve*, left ventricle, septum, right ventricle, (inferi *atrium*, right pulmonary veins, pulmonary valve, (superior) vena c Comparison table:

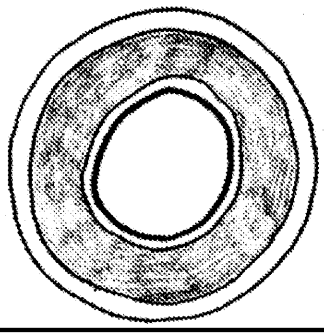
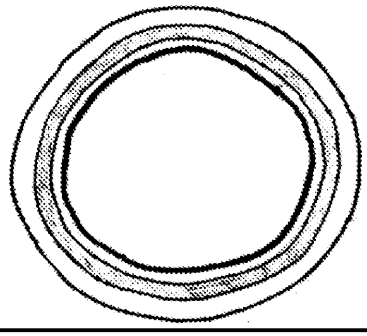
	Artery	**Vein**	**Capill**
Muscular tissue	Thick	Thin	Nor
Elastic tissue	Yes	No	
Lumen	Small	Large	
Valves	No		No
Blood pressure		Low	

Activity 27: The heart

Label the diagram to include the names of the heart chambers, the valves and th
into and out of the heart.



Complete the missing information in the table below.

Vessel type		
Structural feature		
Muscular tissue		
Elastic tissue		
Lumen		
Valves		Yes
Blood pressure	High	

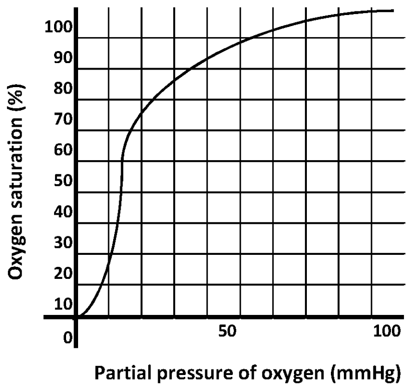
Activity 28: Haemoglobin

Activity name	Transporting oxygen
Aim	Develop understanding of oxygen dissociation from oxyhaemoglob conditions.
Instructions	Pupils are given four graphs showing the oxygen dissociation curve and in different conditions. Two of these are actually the same (fo haemoglobin). Pupils must match the haemoglobin type and conc and also give a reason for their choice.
Timings	**10 minutes**
Required prior knowledge	Pupils will need to be familiar with oxygen dissociation curves.
Intended use	Starter/plenary
Specification reference	Edexcel 4.5i-iii **Note:** The structure of the circulatory system, including the heart a this activity.
Additional notes and guidance	**If used as a starter:** (**5 mins** should be spent introducing the conce 'normal' curve for adult haemoglobin in humans. Some pupils ma Biology and this could also serve as a recap of GCSE work. The tea understand what the dissociation curve shows, including the axes make pupils aware of normal arterial pressure (75–100 mm Hg) ar to help them understand the dissociation of oxygen in the body's t Pupils can then be given the worksheet to think about how differe dissociation curve. **(5–10 minutes)** **If used as a plenary:** The worksheet could be used at the end of a circulatory system. During such a lesson, pupils may have conside between foetal and maternal blood pressure and so be more read
Answers	**Graph 1: Avian haemoglobin (interchangeable with graph 3)** Birds are adapted to flight, often at high altitudes where the air pr haemoglobin of birds must have a higher affinity for oxygen to allo altitude. **Graph 2: Haemoglobin – normal curve** Curve is 'in the middle'. It should be further right than foetal and b than the graph showing haemoglobin in the presence of CO_2. **Graph 3: Foetal haemoglobin (interchangeable with graph 1)** Foetal blood has a lower pressure. Foetal haemoglobin has a high carry oxygen at lower pressure. **Graph 4: Haemoglobin in the presence of CO_2** Curve is shifted to the right; this shows the Bohr effect / effect of l allows oxygen to dissociate more easily in tissues where there is a

Activity 28: Transporting oxy

The graphs below show oxygen dissociation curves for four different circumstanc
graph shows the dissociation curve for each situation and give a reason for your

- Haemoglobin under normal conditions (normal temperature, normal pressu
- Foetal haemoglobin under normal conditions
- Haemoglobin with elevated levels of CO_2 in the blood, which lowers blood p
- Bird haemoglobin, under normal conditions



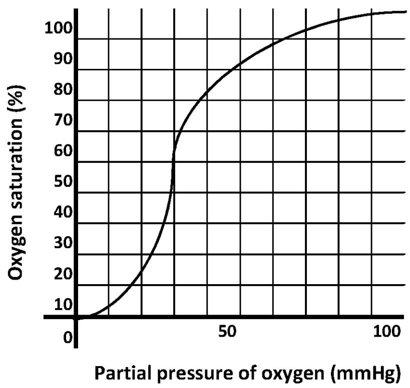
Situation: ....

Reason for your choice:

....

....

....



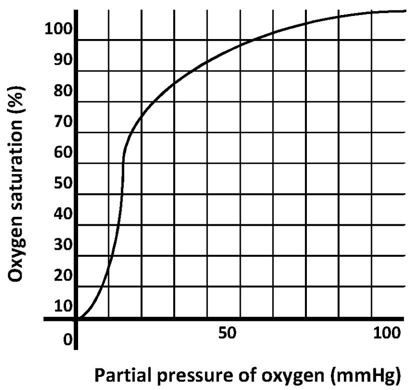
Situation: ....

Reason for your choice:

....

....

....



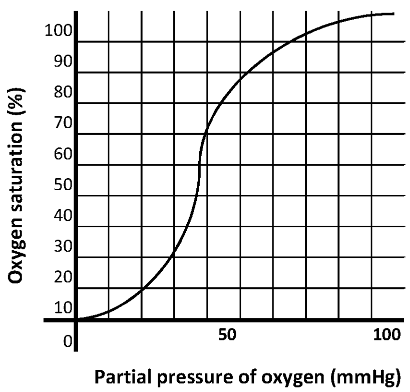
Situation: ....

Reason for your choice:

....

....

....



Situation: ....

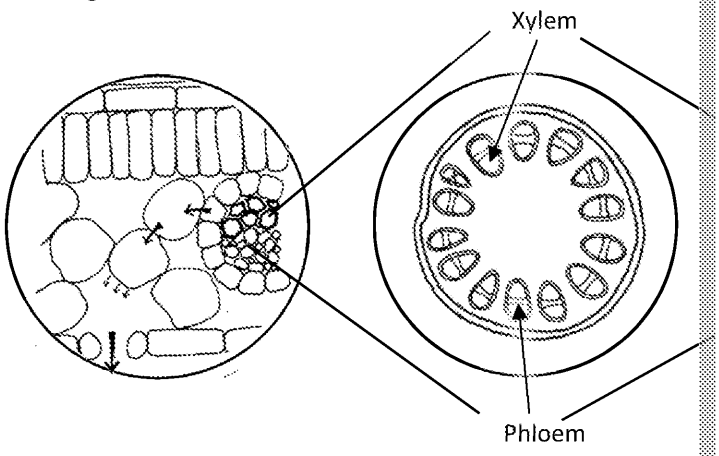
Reason for your choice:

....

....

....

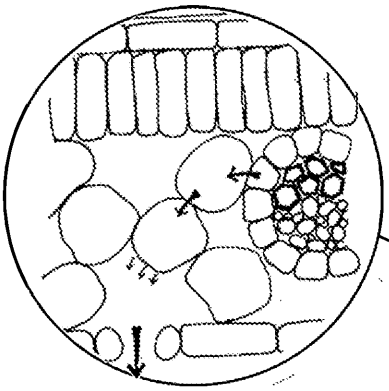
Activity 29: Transpiration

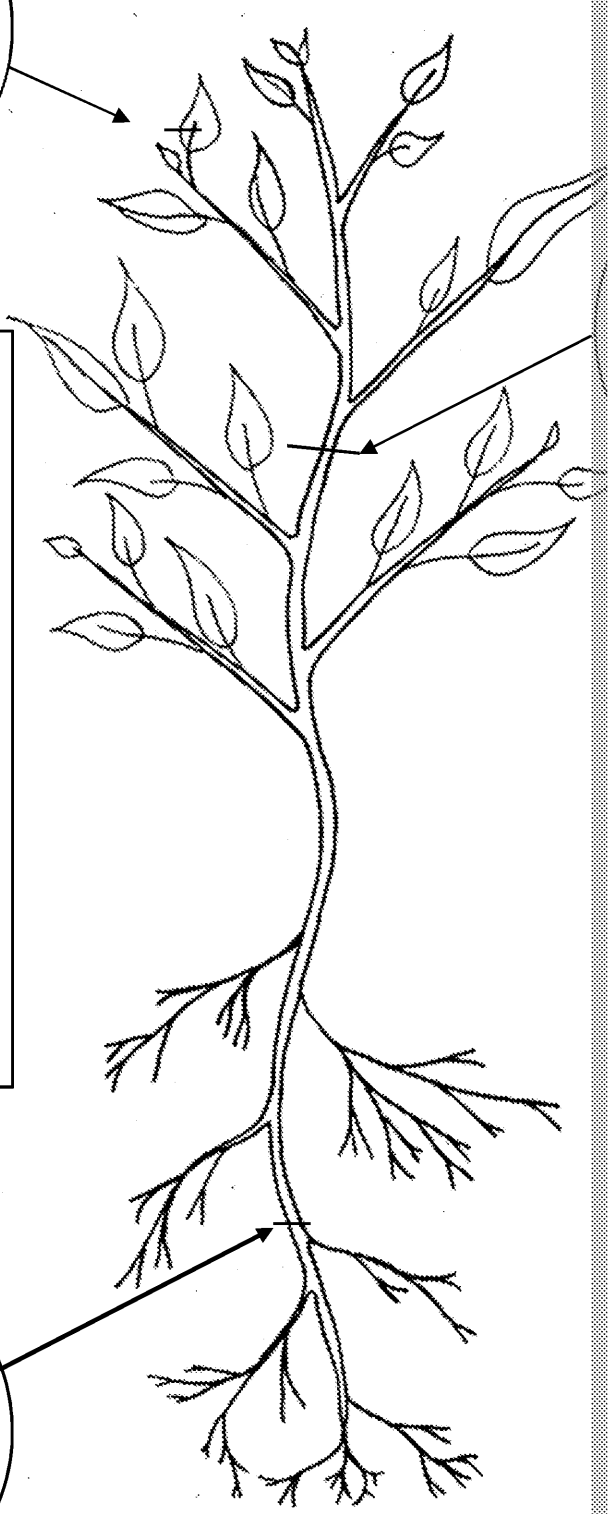
Activity name	Transporting water
Aim	Provide a basic introduction and overview of transport in plants.
Instructions	Pupils are asked to identify the xylem and phloem vessels in eac and leaf) and also to identify factors affecting the rate of transpi pupils on the worksheet also include an extension whereby pupils between "normal" plant cells and these specialised cells.
Timings	**10 minutes**
Required prior knowledge	This activity is designed as a plenary to summarise and check rec lesson. It may also be suitable as a starter to recap previous wor (e.g. from GCSE) or as part of a revision lesson on plant transpor
Intended use	Starter/plenary
Specification reference	Edexcel 4.7iii-iv Note: The scale of the cross sections in this activity is not sufficie between sieve tube elements and companion cells. Pupils shoul these under the light microscope and/or in micrographs. It is als drawing scientific sketches of their observations under the light
Additional notes and guidance	
Answers	Labelling of cross sections:  Factors which increase transpiration rate: - High/Increasing temperature (but not too high) - Low/Decreasing humidity - High/Increasing concentration of CO_2 - Optimum light intensity Extension: Xylem vessels - No nucleus - Often lignified for strength - Cells have no end walls Factors which - Low/Decre - High/Incre - Low/Decre - Too low or Extension: Phlo - No nucleu - Require co many mito - End walls movement sieve plate

Activity 29: Transporting wa

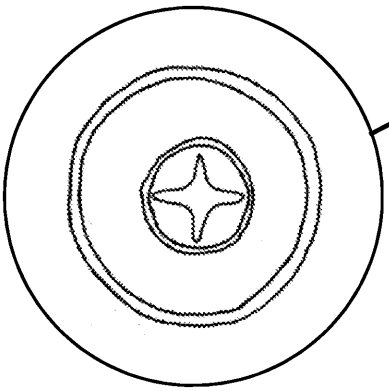
1. Identify the xylem and phloem vessels in each of the cross sections.
2. Describe the environmental factors which increase or decrease transpiratio

Extension: Identify how xylem vessels and p
different to other plant cells.





Factors which increase transpiration rate:

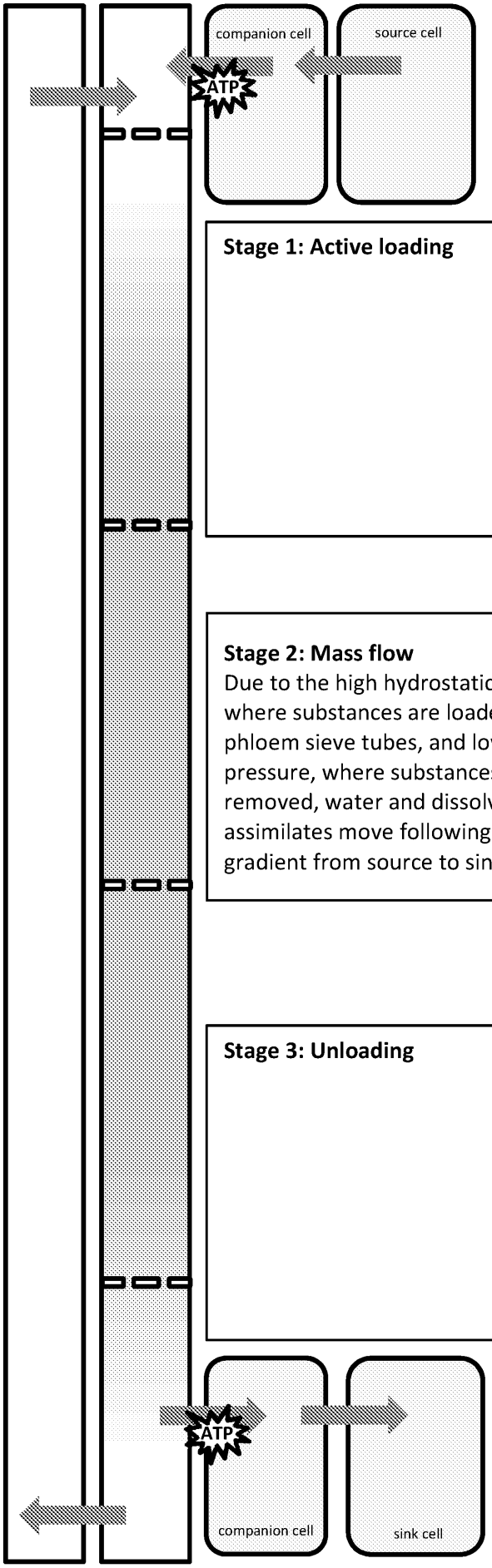


Activity 30: Translocation

Activity name	Transporting sugar
Aim	To summarise the mechanism of translocation and identify a comm
Instructions	The worksheet provides a partially labelled diagram showing the n incomplete descriptions of sources and sinks, as well as describing mechanism. Pupils must complete the missing information. This includes: • A description of active loading • A description of unloading • Fill in the blanks in the descriptions of sources and sinks As an extension, pupils are asked to think about how the evidence hypothesis, and to specify which part of the hypothesis the eviden
Timings	**10 minutes**
Required prior knowledge	Knowledge of intercellular transport (active transport and osmosis how the mechanism of translocation works.
Intended use	Plenary
Specification reference	Edexcel 4.7
Additional notes and guidance	An extension idea is included on the worksheet and in the main in The specification states that pupils should cover the 'details of act removal at the sink'. It does not specify a direction of transport or and so it is important pupils are aware that movement can occur i on where substances are needed most. The evidence using radioac and could be highlighted in a post-activity feedback or discussion.
Answers	Active loading: The companion cell provides ATP for the active transp tube. This greatly lowers the water potential of the sieve tube eleme tube via osmosis. This raises the hydrostatic pressure in the sieve tul Unloading: The companion cells provide ATP to actively transport allows the movement of sucrose to happen more quickly as the co companion cell might become quite high. As the water potential c to leave the sieve tube, lowering the hydrostatic pressure. Fill-in-the-blanks expected answers: Sources: sucrose, leaf/leaves Sinks: sucrose, roots Aphid experiments: Shows that there is a higher pressure inside th supports the idea that it is a pressure gradient causing the flow of Bark ringing experiments: Shows that assimilates are carried in the the ringing but does not help the lower tissues to survive) and tha parts of the tree die without access to these substances). Radioactive carbon experiments: Prove that substances cannot be gradients (as movement is too quick). Also supports the pressure f different directions of movement based on use of substances. e.g. they will be a sink (and sucrose will move down), if a root tuber is will become a source (and sucrose will move up to the new growin

Activity 30: Transporting su

Complete the missing information to explain what is shown in the diagram.



Stage 1: Active loading

Stage 2: Mass flow
Due to the high hydrostatic pressure, where substances are loaded into the phloem sieve tubes, and low hydrostatic pressure, where substances are removed, water and dissolved assimilates move following the pressure gradient from source to sink.

Stage 3: Unloading

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