Worksheet 1  Cells: the Basics
Fill in the blank spaces & diag.labels.

The “Cell Theory” states that all (a).............................. are composed of cells, and that all cells are produced from (b)..............................

Our knowledge of cells is due mainly to the technology of (c)..............................

The (d).............................. of a microscope refers to its ability to distinguish fine details. The (e).............................. microscope is far superior in both (d) and (f)..............................

The man credited with being the first to see cells was (g)..............................

Label the parts of this plant cell (below) seen with a simple light microscope.

(h)..............................

(i)..............................

(j)..............................

(k)..............................

Which TWO parts of this plant cell would definitely never be seen in an animal cell?

(n).............................. and (o)..............................

List 5 additional organelles normally only visible with an electron microscope.

(p)..............................

(q)..............................

(r)..............................

(s)..............................

(t)..............................

Complete these lists to describe the functions of cell organelles.

<table>
<thead>
<tr>
<th>Organelle</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell membrane</td>
<td>(u) Divides cell into channels &amp; compartments</td>
</tr>
<tr>
<td>Golgi apparatus</td>
<td>(w) Cellular respiration.</td>
</tr>
<tr>
<td></td>
<td>(x) Photosynthesis</td>
</tr>
<tr>
<td>Cell wall</td>
<td>(z)</td>
</tr>
</tbody>
</table>
Worksheet 2  Cell Types & Technologies

Guided Notes. (Make your own summary)

1. Cell Size
   What is the (approx.) size, in micrometres, of a typical:
   a) plant cell?
   b) bacterial cell?
   c) animal cell?
   d) For comparison, this dot is 3mm in diameter. How far is this in micrometres?

2. Cell Types
   a) Outline the major differences between eukaryotic & prokaryotic cells, including cell structures and relative cell sizes.
   b) Which type of cells are found in:
      • bacteria?
      • fungi?
      • plants?
      • animals?

3. Prokaryotic cells can be further sub-divided into 2 types called ...?

4. Compare Optical & Electron microscopes in terms of:
   a) how the image is created.
   b) how the image may be viewed.
   c) magnification.
   d) resolution.

5. Electron Microscope Types
   Compared images formed by TEMs & SEMs in terms of:
   a) how the electrons interact with the specimen being viewed.
   b) general style & appearance of the image.

6. Other Technologies
   a) Outline what x-ray crystallography can tell us about cell chemicals.
   b) Outline, in general terms, what the “isosotopic tracer” technique is, and what it can tell us about a cell.

List below your questions to ask (or research) to understand everything in section 1 of this topic.
**Worksheet 3**

**Eukaryotic Cell Organelles**

**Student Name:.........................**

The nucleus can be considered the **a)**........................ centre of a cell. It contains the cell’s **b)**....................... information in the form of the chemical **c)**........................ arranged in structures called **d)**.................................

A nucleus often contains a structure called the **e)**................................. This is responsible for making **f)**............... (chemical) which is sent out as a messenger to other parts of the cell. The nuclear membrane has **g)**............................... to allow RNA molecules to exit.

The **h)**................................. are the sites of cellular respiration which uses **i)**............................... and ................................ (chemicals) to make ATP. ATP is a high- **j)**....................... chemical which can be used to power any & all cellular processes. The inner membrane is highly folded to give greater **k)**.............................. for attachment of the respiration **l)**............................... which control the chemical process.

Chloroplasts are the site of **m)**............................... in **n)**............... cells. Inside are “stacks” of membrane structures containing the chemical **o)**............................... which absorbs **p)**............................... energy. These “grana” carry out parts of the chemical process known as the “light reaction”. The process is completed in the “**q)**..........................” zone in a series of steps called the “dark reaction”, because light is not needed.

E.R. is the abbreviation for the **r)**............................... ........................................ This is a network of **s)**............................... throughout the cytoplasm which provides channels & compartments for chemicals to move & processes to occur. ER is often dotted with tiny **t)**............................... which are the sites for production of **u)**............................... The “**v)**.......................... Apparatus” is a (usually) curved membrane structure. Its function is concerned with “packaging” chemicals into small “vesicles” for storage or **w)**...............................
Multiple Choice

1. The man credited with the discovery of the cell nucleus was:
   A. Robert Hooke.
   B. Anton van Leeuwenhoek.
   C. Robert Brown.
   D. Louis Pasteur.

2. The organelle least likely to be seen with a light microscope is:
   A. Mitochondrion.
   B. Vacuole.
   C. Nucleus.
   D. Chloroplast.

3. The cell structure never found in an animal cell is:
   A. cell membrane.
   B. cell wall.
   C. endoplasmic reticulum.
   D. golgi body.

4. The function of the ribosomes can be described as:
   A. storage of genetic information.
   B. production of ATP.
   C. packaging of substances for secretion.
   D. manufacture of proteins.

5. Starch, glycogen and cellulose are all:
   A. proteins, composed of amino acids.
   B. nucleic acids, related to DNA & RNA.
   C. sugars, of the carbohydrate group.
   D. polymers of glucose.

Longer Response Questions

Suggested mark values are a guide to how detailed an answer is appropriate.

7. (2 marks)
Using either the nucleus or mitochondrion as your example, discuss the way that the structure of the organelle relates to its function.

8. (4 marks)
Using examples, discuss the difference between the “organic” & “inorganic” chemicals found in living cells.

9. (3 marks)
Using a specific historical example, briefly discuss how x-ray crystallography can contribute to our understanding of cell structures & functions.

10. (4 marks)
Outline the basic structure of a cell membrane, including the nature of the basic building-block chemicals.
Guided Notes. (Make your own summary)

1. The cell membrane is “semi-...............................”. This means...

2. The difference between “active transport” & “passive transport” is...

3. 
   a) 3 chemicals which commonly move passively through membranes are...
   b) 3 substances which require active transport to cross a membrane are...

4. 
   a) Diffusion refers to...
   b) Osmosis involves...

5. An outline of the functioning & purpose of the “sodium-potassium pump” is:

6. a) In general terms, “endocytosis” means...
   b) 3 variations of endocytosis are...

7. For secretion or excretion of substances from a cell the process is...
   In simple terms this is the ................................ of endocytosis.

8. As any shape gets larger:
   • the surface area a)............................
   • the volume b) ..............................
   • the ratio of SA to Vol. c)......................
   
   This is the reason why all cells have to be d)..............................
   
   A large cell is impossible because it would NOT be able to feed its e)............................. by transporting all its needs (and wastes) in/out through the f).............................. of its membrane.

   Prokaryotes are even worse off in this regard: they have no g).........................., which means they are less h)..........................
   
   To thrive, they must have a very i)........................ SA/Vol ratio. They achieve this by being ..................
Worksheet 7

Review Questions Section 3b

Student Name........................................

(on reverse, if insufficient room)

1. Outline the difference between autotrophs & heterotrophs, with an example of each.

2. a) Write a simple word equation to summarise the process of photosynthesis.

b) Briefly outline how the structure of the chloroplast is linked to the fact that photosynthesis occurs in 2 distinct phases.

3. a) Write a simple word equation to summarise the process of cellular respiration.

   b) Where in a cell does this occur?

   c) What is the most important product of this process? Explain why.

4. a) What does “ATP” stand for?

   b) How can ATP transfer energy to power a cellular process?

   c) How can the molecule be “re-charged”?

Worksheet 8

Enzymes

Student Name........................................

Fill in the blanks

The total of all the chemical reactions in an organism’s body is called a)........................................
Each reaction requires a catalyst, which is a chemical which b)................................. the reaction, without being c)........................................ itself.

Biological catalysts are called d)................................. These have the following properties:
They are molecules of e)................................., which are polymers of f).................................
Each one has its own unique g)................................., which perfectly fits the molecule(s) of the reaction.
These molecules are referred to as the h)................................. Since each enzyme only fits its own particular h)................................., they are said to be i).................................

Enzymes will only work effectively in a narrow range of j)................................. and k)................................. This is because their l)................................. changes so that they no longer fit their substrate.

The pH scale is a numerical measurement of m)................................. and n)................................. Things that are neutral have a pH= o)................................. Acids have pH values p)................................. 7, while alkalis (bases) have pH q).................................

The pH inside living cells, and in most parts of an organism’s body is about r)................................., but an exception is the s)................................. which is quite strongly t).................................
Worksheet 9

Enzyme Activity Graphs

Answer in the spaces provided.

1. Sketch the shape of a graph of Enzyme Activity against Temperature.

2. Explain the shape of the graph;
   a) at temperatures below the “optimum”
   b) at temperatures above the optimum.

3. Sketch a graph of Enzyme activity against pH.

4. a) Explain why the graph shows a “peak” of optimum activity at a certain pH.
   b) Why does activity decline at pH values higher or lower than the optimum?

Worksheet 10

Review Questions - Enzymes

Answer in the spaces provided.

1. Discuss the importance of shape to the characteristics of an enzyme, with specific reference to:
   a) why each enzyme will usually only catalyse only one reaction.
   b) why enzymes only work within fairly narrow ranges of temperature and pH.

2. The following data was collected in an experiment in which the time taken for a chemical reaction catalysed by an enzyme, was measured at different temperatures.

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>Time taken for reaction (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.0</td>
</tr>
<tr>
<td>10</td>
<td>2.0</td>
</tr>
<tr>
<td>15</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>0.2</td>
</tr>
<tr>
<td>25</td>
<td>2.5</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>

c) Is it likely that this is a human enzyme? Explain.
### Answer Section

**Worksheet 1**

a) all living things.... b) ...pre-existing cells  
c) microscopes d) resolution  
e) electron f) magnification  
g) Robert Hooke h) cytoplasm  
i) nucleus j) chloroplast  
k) cell wall l) cell membrane  
m) vacuole

n) cell wall & (o) chloroplast  
p)-(t) (any order) golgi body, endoplasmic reticulum, mitochondria, ribosomes, lysosomes  
u) controls substances going in/out of cell  
w) packaging substances for storage or secretion

**Worksheet 2**

1.  
a) 20-100  
b) 0.1 - 5  
c) 5-20  
d) 3,000

2.  
a) Eukaryotic cells contain many membrane-based organelles for specialised functions within the cell. Relatively large cells.  
b) bacteria = Pro... fungi, plants, animals = Eu...

**Worksheet 3**

a) control b) genetic  
c) DNA d) chromosomes  
e) nucleolus f) RNA  
g) pores / holes h) mitochondria  
i) glucose & oxygen j) energy  
k) surface area l) enzymes  
m) photosynthesis n) plant  
o) chlorophyll p) light  
q) stroma r) endoplasmic reticulum  
s) membranes t) ribosomes  
u) proteins v) Golgi

**Worksheet 4**

1.  
Inorganic cell chemicals = simple, small molecules (eg H₂O) or ions such as phosphate, chloride, magnesium, etc.  
Organic cell chemicals = generally more complex molecules based on carbon. Often (but not always) huge polymers of repeating units joined together.

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Function(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Sugars &amp; starches. Energy chemicals. Some structural uses eg cellulose cell walls</td>
</tr>
<tr>
<td>Protein</td>
<td>Main structural chemicals for cells, hair, skin, etc.</td>
</tr>
<tr>
<td>Nucleic Acids</td>
<td>DNA, RNA. Genetic material</td>
</tr>
<tr>
<td>Lipids</td>
<td>Fats &amp; oils. Energy storage. Main component of cell membranes</td>
</tr>
</tbody>
</table>

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**Optical Image created by** focused light  
**View by** eye or photo  
**Magnification** 500-2000 X  
**Resolution** 0.2μm

**Electron Image created by** electron beams  
**View by** screen or photo  
**Magnification** millions X  
**Resolution** 0.0002μm
Worksheet 4 (cont.)

3. a) phospholipid molecules
b) hydrophilic = “water loving”. Attracted to water, water soluble part of a molecule.
hydrophobic = “water hating” = Part of a molecule repelled by water, generally fat-soluble.

Each phospholipid molecule has a hydrophilic “head” and a long hydrophobic “tail”.
A membrane is formed from 2 layers of molecules with their tails clinging together in the middle, and hydrophilic heads outwards.

MEMBRANE STRUCTURE

Outside of cell

Inside of cell

Double layer of phospholipid molecules

c) Other molecules are embedded in the membrane. Most are proteins, often with carbohydrates attached. Some are receptors for messenger chemicals; some are “markers” to identify cells as “self”; some are concerned with helping substances get across the membrane.

Worksheet 5 (cont.)

8. Inorganic cell chemicals = simple, small molecules (eg H₂O) or ions such as phosphate, chloride, magnesium, etc.

Organic cell chemicals = generally more complex molecules based on carbon. Often (but not always) huge polymers of repeating units joined together. eg DNA, proteins, starch, etc.

9. By 1950, DNA was known to be the genetic chemical, but no-one could figure out its structure or how it functioned.

X-ray crystallography was used to determine the molecule’s shape. This led to a theory (later confirmed) as to how it could replicate itself and be a gene to produce cell chemicals.

With many biological chemicals, shape is critically important for functioning and x-ray crystallisation is how we can find out shapes.

10. A membrane is a double layer of phospholipid molecules clinging together. Each phospholipid molecule has a hydrophilic “head” and a long hydrophobic “tail”.
A membrane if formed from 2 layers of molecules with their tails clinging together in the middle, and hydrophilic heads outwards.

Worksheet 6

1. semi-permeable. This means that some chemical can pass through it easily, others cannot.

2. Active transport requires the cell to use energy to “pump” the chemical across the membrane. Passive transport requires no energy expenditure by the cell.

3. a) water, oxygen, carbon dioxide.
b) ions such as potassium, sodium and all larger molecules such as proteins, sugars, etc.

4. a) Diffusion refers to the movement of dissolved substances which will equalise a concentration gradient by the random “jigging” all gases & liquids undergo.
Worksheet 6 (cont.)

4.
   b) Osmosis is the diffusion of water across a membrane in response to a concentration gradient of a dissolved substance which cannot cross the membrane itself. Water flows towards the higher concentration of solute as if to equalise concentrations by diluting the solution.

5.
   The Na-K pump is an active transport mechanism in animal cells which constantly pumps Na ions out of a cell & K ions in. Without this pump, an animal cell would be in danger of rupture due to osmotic absorption of water.

   The pump is like a “double-door” system with only one door open at a time. Opening one way ejects Na ions & grabs K ions, then the reverse occurs when the other door opens.

6.
   a) Endocytosis refers to the way a cell can absorb large molecules & particles by growing its membrane around the particle & taking inside, encapsulated in a membrane sac.

   b) 3 variations are
      phagocytosis = eating particles.
      pinocytosis = drinking a parcel of liquid.
      receptor-mediated endocyt. = taking in specific large molecules which have been recognised by “receptor molecules” on the membrane.

7.
   For secretion or excretion of substances from a cell the process is... exocytosis.

   In simple terms this is the opposite / reverse of endocytosis.

Worksheet 7

1. An autotroph is an organism that makes its own food from simple inorganic chemicals, plus an energy source. All plants are autotrophic, making their own food by photosynthesis. A heterotroph cannot make its own food & must eat complex, high-energy compounds made by other living things. eg animals.

2.
   a) carbon + water $\rightarrow$ glucose + oxygen + dioxide
   b) Each chloroplast contains 2 regions:
      • the “grana” are stacked membrane-disks containing chlorophyll, which absorbs light energy. The energy is used to break up water molecules... oxygen is released, hydrogen is captured for the next stage.
      • the surrounding region (the “stroma”) carries out the so-called “dark reaction”. This is a cycle of reactions which, step by step, add hydrogen to carbon dioxide to build glucose molecules.

   These 2 stages must be kept separate so they do not interfere with each other. The structure of the chloroplast (grana & stroma) facilitates this.

   3.
   a) glucose + oxygen $\rightarrow$ carbon + water + ATP + dioxide
   b) mitochondria
   c) ATP, because it is able to power all cellular processes which require energy.

4.
   a) Adenosine triphosphate
   b) With help from special enzymes, ATP can detach one of its 3 phosphate groups. This releases energy which can power the cellular process it is coupled with (such as making a protein). The molecule becomes ADP... adenosine diphosphate.

   c) The ADP can be moved back to a mitochondrion where the energy of cellular respiration is used to add a 3rd phosphate group back on. This converts it back to ATP, with energy stored in the chemical bond.

Worksheet 8

a) metabolism
b) speeds up

c) changed / used up
d) enzymes

e) protein
f) amino acids
g) 3-D shape
h) substrate(s)
i) specific
j) temperature
k) pH (acidity)
l) shape
m) acidity
n) alkalinity
o) 7
p) below
q) above 7
r) 7 (neutral)
s) stomach
t) acidic
**Worksheet 9**

1. graph

2. a) reaction rate (=activity) increases as temp. goes up because molecules are more likely to collide and react with each other.

   b) Above the optimum the shape of the enzyme protein begins to change and be distorted. The substrate(s) no longer fit the enzyme perfectly, and activity declines rapidly.

3. graph

4. At the optimum pH the shape of the enzyme is a perfect “lock & key” shape to fit the substrate, so activity is at a maximum.

5. At pH’s either side of optimum the shape of the enzyme changes so that the “fit” with the substrate is no longer perfect, so activity declines.

**Worksheet 10**

1. a) Enzymes are protein molecules and each has a particular 3-dimensional shape which fits its substrate like a key fits a lock. Usually each enzyme will only “fit” one particular substrate, so it will only catalyse one reaction.

   b) Any change in temperature or pH can change the shape of an enzyme, by causing the protein chain to alter the way it is folded and twisted. As its shape changes, its ability to “fit” the substrate will change too. Thus each enzyme only works fully within relatively narrow ranges of temperature and pH.

2. a) The values in the 3rd column should be:

   - Reaction Rate (min⁻¹)
     - 0.25
     - 0.5
     - 1.0
     - 5.0
     - 0.4
     - 0.1

   (These values are calculated as 1/time taken)

   b) graph

   c) No. The graph shows that at human body temp. (37°C) the enzyme’s activity is close to zero. This enzyme would NOT function in a human body.