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EXAMPLE LEARNING MATERIA

Course: Access to Higher Education D

Subject: Biology

Unit: Introduction to Cell Biology

If there's an essential text for a unit or topic it'll be listed here. Further resources (such as videos, podcasts, websites) will be found throughout every unit. They should be used to deepen understanding, as well as to stretch and challenge you.

Essential reading:

Tortora, G.J., and Grabowski, S.R., 2002. *Principles of Anatomy and Physiology*. 10th ed. London: John Wiley & Sons. ISBN: 9780471224723

Recommended reading:

Recommended reading for this topic is listed in the back pages of these learning materials.

Further resources:

Further resources to deepen your learning on specific aspects of this topic are listed throughout these learning materials.

Read and make notes:

- ✓ **Making notes turns reading into studying.**
- ✓ **Notes should be brief, clear and helpful.**

To help your understanding:

- **rewrite or summarise** what you have learned (avoid copying);
- **note down any questions** your studying has raised, either to ask your tutor, or to develop into further research.

To help you to remember:

- **summarise** to improve long term memory;
- **write things down** to aid motor memory;
- **use colour, images or patterns** to help visual memory.

To help you in your assessments:

- **record** where you will find information (e.g. page numbers);
- keep your notes **organised** and easy to navigate;
- **highlight** where further reading and research are needed, including any recommended or further reading;
- **use your notes** to help you to get started when answering a question.

You're given study skill tips and advice during your course in both the materials and your tutorials.

Course: **Access to Higher Education Diploma**
Subject: **Biology**
Unit: **Introduction to Cell Biology**
Topic 1: **Cell Biology**

EXAMPLE LEARNING MATERIALS

Contents

Press **CTRL / ⌘ + Click** in the contents list t

Learning materials are broken into sections so they are manageable to study, simple to make notes on, and easily referred back to during an assessment.

These sample materials will show you the middle of this unit (Section 3), which focuses on cell membrane structure and function.

Course: **Access to Higher Education Diploma**
Subject: **Biology**
Unit: **Introduction to Cell Biology**
Topic 1: **Cell Biology**

EXAMPLE LEARNING MATERIALS

Every topic starts with a summary of what you will study.

Introduction

In this topic:

We are going to focus on the 'building blocks of life' – cells. The specification for this unit can be accessed here.

One of the characteristics of living things is that they are all made up of cells. Because of this, cells are often called the 'building blocks of the body'. The cell is the smallest unit of matter we can say is alive. They use food, respire, produce waste, and reproduce, much like organisms.

First, we will look at microscopes, and how they enable us to study the cell. Then we will discuss the structure of both prokaryotic cells (bacteria) and eukaryotic cells (animals and plants) and how their structures suit their unique functions, especially in the case of specialised cells.

We will explore the structure of cell membranes and the different ways in which substances can enter and exit the cell through this membrane. We will focus on passive transport (diffusion and osmosis), active transport and bulk transport.

We will discuss the two types of cell division (mitosis and meiosis) and the importance of these processes for cell repair and growth and gamete synthesis.

Finally, we will look at the processes behind ce

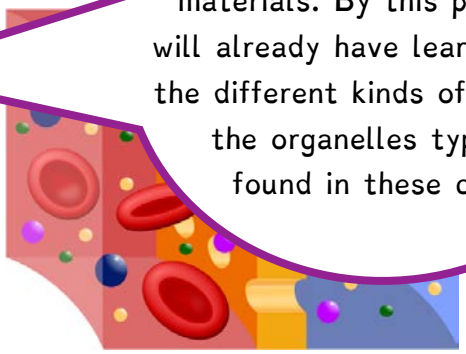
The learning materials are written to prepare you for the unit's assessment, so they teach you what you need to know to meet the learning outcomes and assessment criteria.

Keywords:

Prokaryotic cell:	Single-celled organism w
Eukaryotic cell:	Cell with a membrane-boun
Diffusion:	Movement of a substance from a concentration to lower concentration
Osmosis:	Diffusion involving water molecules
Endocytosis:	The process of cells absorbing molecules
	The process of cells releasing substances
	Cell division resulting in two diploid daughter cells
sis:	Cell division resulting in four haploid daughter cells
	Symbol for nanometre, a metric unit of length equal to one billionth of a metre

Key words, terminology or theories are highlighted at relevant points in the learning materials to aid your studying, note taking and understanding.

This section is from the middle of the learning materials. By this point you will already have learned about the different kinds of cells and the organelles typically found in these cells.



3. Membrane structure and function

There's always a summary of what you'll study at the beginning of each section.

Ready, steady, go!

In this section we will consider the different kinds of transport across the cell membrane (passive, active and bulk) and the importance of each of these transport types.

3.1 Fluid mosaic model

The membrane of a cell has a very unique structure. The majority of the membrane is made up of masses of **phospholipids** with some protein molecules floating in them. The model of the membrane is referred to as 'fluid mosaic' because the different components (such as the phospholipids and the proteins) are able to move fluidly around the membrane. The main components necessary to produce this fluid mosaic model are:

- ✓ **The phospholipid bilayer**
- ✓ **Proteins**
- ✓ **Carbohydrates**
- ✓ **Cholesterol**

Clear introductions put what you're studying into context.

3.1.1 The phospholipid bilayer

As you can see in **Figure 6** opposite, the phospholipids are arranged in two layers (bilayer).

A single phospholipid is comprised of a hydrophilic phosphate head that is attracted to water, and two hydrophobic fatty acid tails that repel water.

When exposed to water, these phospholipids move in such a way as to get the hydrophobic end away from the water. This leads to them bunching up and forming the bilayer, as can be seen in the figure.

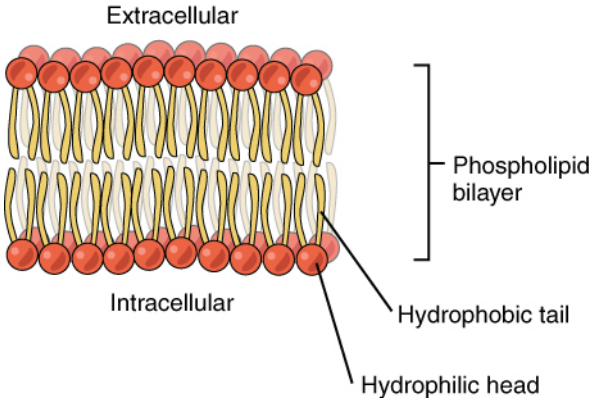
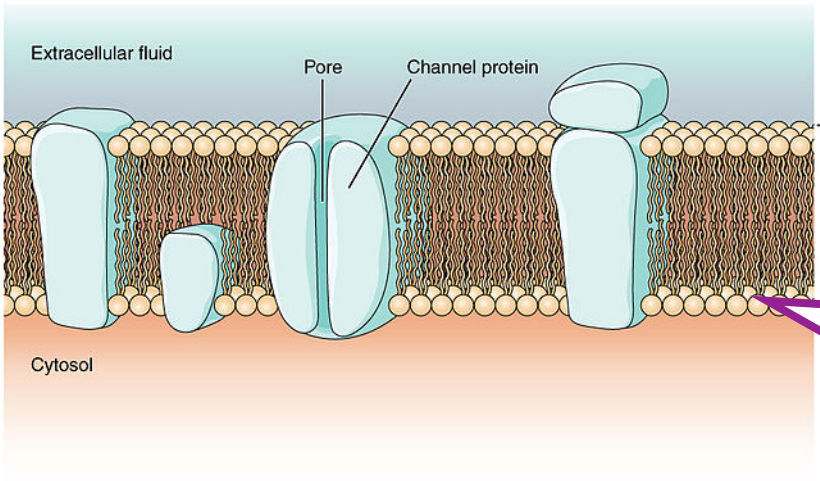


Figure 1: Diagram of the phospholipid bilayer

3.1.2 Proteins

The pale blue blocks in **Figure 7** are examples of how proteins can sit within (or on top of) the phospholipid bilayer. Because of the hydrophobic tail of the phospholipid, any substance that is not soluble in lipid cannot pass through the phospholipid bilayer.



Diagrams or images are always used to support your learning.

Figure 2: Diagram of proteins in a cell membrane

The proteins provide safe passage for these substances into and out of the cell. This function makes proteins vital to the cell, which depends on transfers such as these to remove waste substances from the cell and to gain nutrients from the extracellular fluid.

3.1.3 Carbohydrates

There are also short carbohydrate chains attached to the outer surface of the membrane. Most of these carbohydrates are attached to proteins and are called **glycoproteins**. They are involved in cell-to-cell interactions and may also play a part in recognition of hormones and foreign molecules.

3.1.4 Cholesterol

Molecules of cholesterol are also present in the cell membrane. These make up nearly 20% of the mass of the membrane. Cholesterol stabilises the membrane, slowing or limiting the movement of the phospholipid molecules whilst maintaining fluidity.

Accessible further resources are given to deepen, develop and stretch your understanding.

Further resources:

- Khan Academy: Cell membrane introduction
- Khan Academy: Cell membrane overview and fluid mosaic model

3.2 Passive transport

One of the most important features of the cell membrane is that it can allow for passage of molecules across the membrane. Without receiving nutrients and removing waste, the cells would be unable to function. Simple molecules (such as oxygen, water and carbon dioxide) can travel across the membrane by passive transport.

Passive transport is the movement of molecules **without** using chemical energy sources (e.g. ATP – the energy transferring molecule that we looked at earlier on). A **semi-permeable** membrane is necessary for passive transport to occur as it allows some substances to pass through it. Here we will discuss three different types of passive transport:

- ✓ **Simple diffusion**
- ✓ **Osmosis**
- ✓ **Facilitated diffusion**

Challenging concepts are broken down into bitesize chunks.

3.2.1 Simple diffusion

Diffusion is the movement of molecules through a membrane from an area of high concentration to an area of low concentration. We refer to this as **diffusing down a concentration gradient**. This is how oxygen molecules move into a cell and how carbon dioxide molecules move out.

As this movement is down a concentration gradient it requires no energy: the molecules just pass through the phospholipid bilayer. Rates of diffusion can be affected by the following factors:

Steepness of concentration gradient – the steeper the gradient, the faster the diffusion

Temperature – molecules move faster at higher temperatures and so will diffuse faster

Permeability – more permeable substances diffuse faster through the membrane

3.2.2 Osmosis

Osmosis is a special type of diffusion that explains the movement of water molecules across a membrane. Cells can be thought of as two solutions on either side of a semi-permeable membrane. The solution on the outside of the cell has a higher concentration of solute molecules than the solution on the inside of the cell.

Usually the solute molecules would move across the membrane to balance the concentration, but some of the molecules can be too large or too charged to pass through the phospholipid bilayer. To balance the concentration of the two sides, water moves from the side with a **low** concentration of solute molecules to the side with a **high** concentration to dilute that solution, lowering the concentration. It will do this until the two sides have the same concentration (**equilibrium**).

Further resources:

Blausen Medical: Osmosis

3.2.3 Facilitated diffusion

Facilitated diffusion (see **Figure 8**) is a form of passive transport that allows substances to cross cell membranes by using **transfer proteins**.

As we have mentioned, some molecules (such as large or charged molecules) cannot pass through the phospholipid bilayer because they are unable to dissolve in lipids. These molecules are **polar**. Glucose is an example of a polar molecule that is incapable of entering the cell by simple diffusion. But because we need glucose in our cells for energy, we produce it from the proteins that are floating in the membrane. Some transfer proteins are capable of letting molecules move through them from one side of the membrane to the other without having to pass directly through the phospholipid bilayer.

Channel proteins allow a water-filled pore to occur in the membrane. Water-soluble molecules can then travel easily through this protein.

Carrier proteins are another type of transfer protein. A molecule, such as glucose, can combine with a carrier protein that will then undergo a **conformational change** (change of shape), moving it through the protein and allowing the molecule to be released into the cell.

Facilitated diffusion still happens down a concentration gradient, so requires no chemical energy.

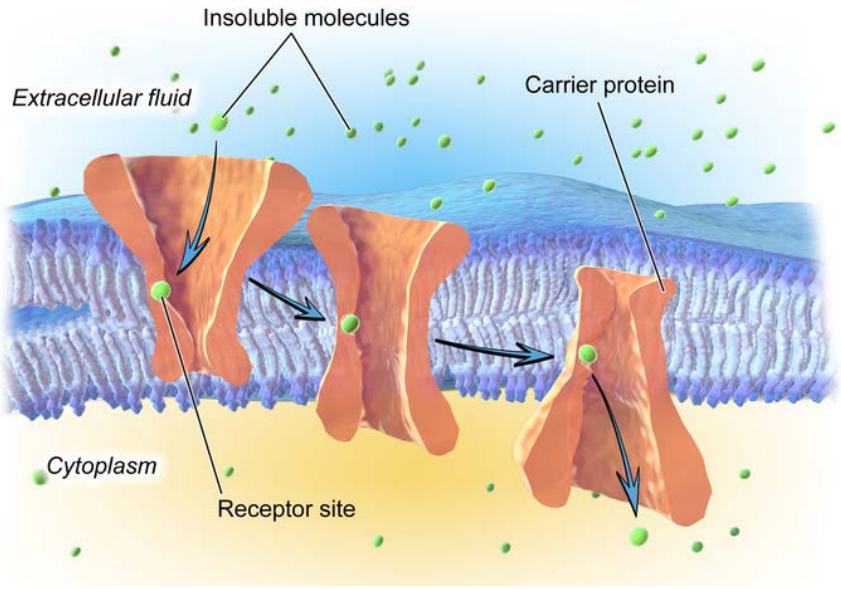


Figure 3: Diagram of facilitated diffusion

Further resources:

The learning materials teach you what you need to know to Pass the unit's assessment. As you progress onto graded units you are expected to develop your independent research skills during your Diploma to achieve Merits and Distinctions. You will be signposted to appropriate sources to help you with this.

3.3 Active transport

Active transport is the movement of molecules **against** a concentration gradient, from a low concentration to a high concentration. Unlike passive transport, this process requires chemical energy (ATP). This process allows essential molecules to enter cells even if they are of low concentration in the environment. Charged ions, such as hydrogen, use active transport to travel across the cell membrane.

The mechanism for the transport of ions is similar to that of facilitated diffusion. For example:

→ Ions enter a transfer protein;

→ ATP then provides the transfer protein with the energy requir

→ The ions can then be pushed across the membrane agai gradient.

These are self assessment questions, and you'll find them at relevant points in all learning materials. They are there to ensure that you fully understand what you've studied, and what you need to know to succeed on the unit's assessment.

Further resources:

Bozeman Science: The Cell Memb

Wiley.com - Animations: Membra

SAQ 5:

1. **How is active transport different from passive transport?**

3.4 Bulk transport

When large molecules (**macromolecules**) need to travel through a cell membrane, they do so using **vesicles** (bubble-like membranes).

These processes of entering or exiting the cell are called **endocytosis** and **exocytosis**, respectively. These processes are particularly useful when a substance is too large to pass through a transfer protein or to go through the phospholipid bilayer. Both of these processes require chemical energy (ATP).

3.4.1 Endocytosis

Endocytosis (**en**docytosis = taking **in**) is the process by which materials enter the cell.

Macromolecules travel to the cell membrane and the cell's plasma membrane surrounds them. It then seals to form a vesicle and moves into the cell.

After it has been transported into the cell, the macromolecule can then be broken down by digestive enzymes, and any solutes produced can be used by the cell.

3.4.2 Exocytosis

Exocytosis (**ex**ocytosis = **exiting** out) is the process by which large molecules or groups of molecules leave a cell.

A membrane develops around the material, forming a vesicle. This vesicle then fuses to the cell membrane and the contents leave.

Remember we looked at this process briefly when discussing the **Golgi apparatus**? Exocytosis is important for the removal of waste products from the cell and for the secretion of materials such as hormones.

Further resources:

WWW **Yakima Valley Community College: Membrane transport**

SAQ 6

1. **What different kinds of transport occur across membrane?**

At the end of each section there's a summary (plenary) of what you have just studied.

In a nutshell:

In this section, we examined the fluid mosaic model of the cell membrane and looked at how different substances pass through this membrane in different ways.

Let's recap this topic:

In this topic, we have discussed the general structure of the cell and its organelles. We have examined how the cell receives nutrients and excretes waste through the membrane via different types of transport. We have explored the cell's ability to reproduce to replace old cells and to form sex cells. Finally, we looked at the process of cell death.

At the end of every topic (so this would come after section 5 in the non-sample learning materials) there's a recap of what you've studied, so you can check you've covered and understood everything.

Here are the SAQ answers so you can check your understanding of the questions in this sample unit.

Answers to SAQs

SAQ 5:

1. **How is active transport different from passive transport?**

Answer:

1. **Active transport needs energy from ATP to pump substances against a concentration gradient. Passive transport does not require energy, and works down a concentration gradient.**

SAQ 6:

1. **What different kinds of transport occur across a cell membrane?**

Answer:

1. **Active transport, passive transport, osmosis, simple diffusion, facilitated diffusion, endocytosis and exocytosis are all methods of transport across the cell membrane.**

Any extra recommended reading will be found here

Recommended reading

DLC resources

DLC Library: Log in to your Learner Account and click on 'Library' to view various resources to help you with your learning.

DLC Forum: http://www.distancelearningcentre.com/phpBB3/index.php

Sources and credits

Image credits

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Figure 7: Diagram of proteins in a cell membrane	OpenStax College / Wikimedia Commons / CC-BY-SA-3.0
Figure 8: Diagram of facilitated diffusion	BruceBlaus, Blausen Medical Communications / Wikimedia Commons / CC-BY-SA-3.0