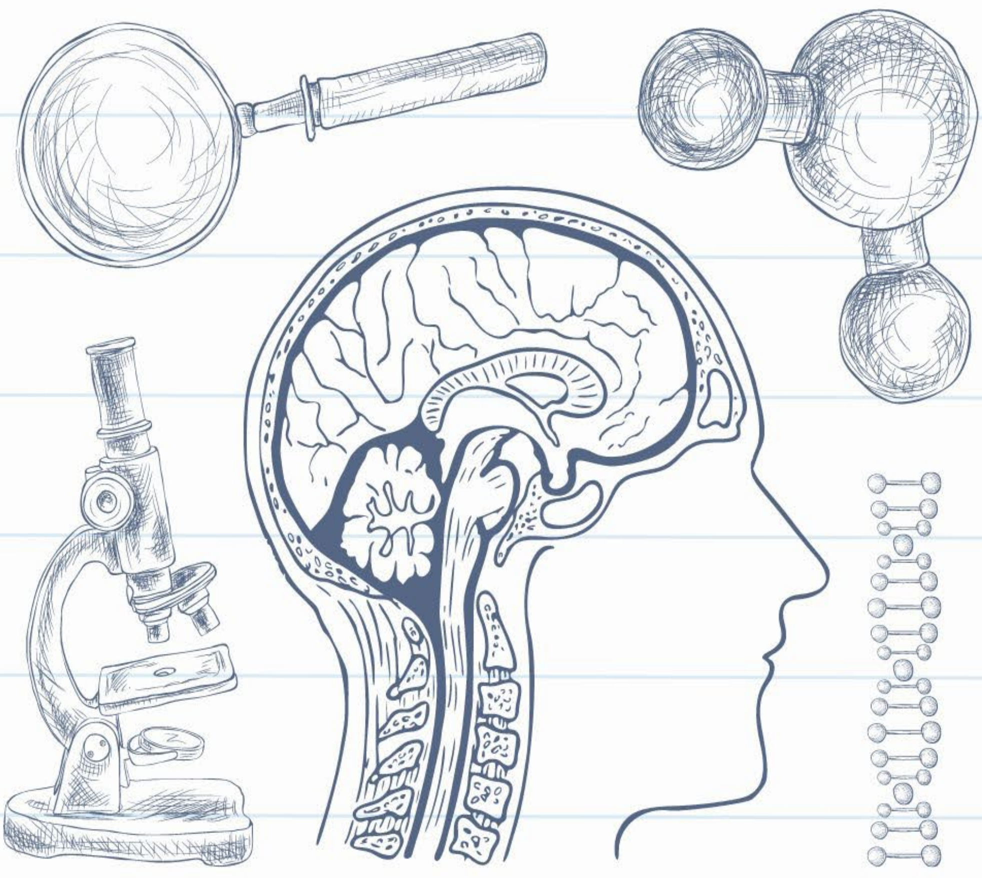
A Blueprint
OF LIFE

Exploring Cells and Human Anatomy



SCIENCE YEAR 8

A Blueprint of Life: Exploring Cells and Human Anatomy

By Michelle Morrow

All enquiries to [My Homeschool].

Contents

To Parents and Students

At My Homeschool, we study a variety of scientific disciplines, such as biology, Earth science, space science, physics, and chemistry. We use the scope and sequence laid out in the Australian Curriculum and the NSW syllabus. We also use Charlotte Mason's ideas when preparing the framework for our courses.

This resource covers cell structures and the systems of the human body. There are two science lessons per week over the semester. These lessons begin with a short narrative about the topic you will study. Some lessons also have an additional **Anatomy Links** which include videos and weblinks to discover more. Read through the narrative and then watch the additional complementary links when provided. After you have completed your reading then write a summary of what you have learnt.

Notebooking

You will need a science notebook to complete your lessons, I suggest using a book that includes space for illustrations (Botany Book). When studying anatomy you will have many opportunities to include diagrams within your narration and this is encouraged as you will learn the anatomical names and understand their structure much more if you draw them.

Microscope Activities

We also encourage you to get access to a microscope during the semester. Knowing how to use a microscope is considered an important skill for high school students to have. We have not given a specific lesson on this but here are 10 engaging and educational activities that you can do with a microscope at home:

1. Observing Onion Cells: Peel a thin layer from an onion, place it on a slide, and add a drop of iodine for better visibility. This is a classic experiment to view plant cells and their structures, like the cell wall and nucleus.

2. Exploring Pond Water: Collect a sample of pond or rainwater and observe it under the microscope. Students can discover a variety of microorganisms, algae, and possibly even small crustaceans.

3. Examining Salt and Sugar Crystals: Look at different types of salt and sugar crystals. Compare their shapes and structures. This helps understand crystalline structures and differences in molecular composition.

4. Studying Blood Cells: If possible, observe a drop of blood under the microscope (this should be done with adult supervision and safe handling practices). It's an opportunity to learn about red and white blood cells and blood cell morphology.

5. Observing Yeast Fermentation: Mix active dry yeast with a sugar solution, place a drop on a slide, and watch the yeast cells ferment the sugar. This demonstrates cellular respiration and fermentation.

6. Inspecting Insect Parts: Examine parts of insects like a fly's wing or a bee's leg. This can give insights into the anatomy of insects and how their body parts are adapted to their lifestyle.

7. Exploring Plant Transpiration: Look at a thin slice of a plant stem under a microscope after it's been in coloured water. This can show how water moves through plant tissues.

8. Studying Mould Growth: Place a piece of bread in a sealed bag and let it grow mould. Observe the mould under the microscope to see the fungal structure and spores.

9. Cheek Cell Examination: Swab the inside of your cheek, smear it on a slide, and add a drop of methylene blue. This is a safe and easy way to observe human cells.

10. Soil Examination: Collect a soil sample and mix it with water. Place a drop of this mixture on a slide to observe the various components of soil, including possible microorganisms, sand, clay, and organic matter.

Remember, safety is important while handling any biological specimens or chemicals. Adult supervision is recommended for certain activities.

Living Books

Our science resources combine the ideas of Charlotte Mason and modern teaching methods. The melding of these two approaches gives children the delight of learning about science through a range of literary and digital mediums. It also utilises a core idea in the Charlotte Mason method where children make connections between all the knowledge they are acquiring across all subjects – she calls this the science of relations.

Melding these two methods allows you to give your child a modern Charlotte Mason science curriculum that will consolidate and reinforce their science understanding and the science of relations.

There are two books we recommend you read this semester:

- Gifted Hands by Ben Carson
- Fearfully and Wonderfully: The Marvel of Bearing God's Image by Dr Paul Brand and Philip Yancey. (This is best as a read aloud as there are some adult concepts covered and good opportunities for thoughtful discussion).

Enjoy!

Michelle Morrow

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Lesson 1: The Story of the Microscope

The story of the microscope begins over 400 years ago. It's a tale of curiosity, innovation, and an insatiable desire to explore the unseen world. This journey has not only revolutionised science but also unravelled the mysteries of life at the most fundamental level - the cell.

In the late 16th century, a Dutch spectacle maker named Zacharias Janssen, along with his father, Hans Janssen, experimented with lenses. They discovered that if they placed two lenses in a tube and aligned them correctly, they could magnify small objects. This was the birth of the compound microscope, although it was very rudimentary compared to what we have today.

The real breakthrough came in the 17th century with Antonie van Leeuwenhoek, a Dutch draper and scientist. Leeuwenhoek, with no formal training in science, ground lenses to create microscopes with magnifications up to 300 times. This was far beyond what Janssen had achieved. What set Leeuwenhoek's microscopes apart was their incredible clarity and magnification power, allowing him to be the first person to observe single-celled organisms, which he named "animalcules."

Leeuwenhoek's discoveries marked a major leap in biological science. He observed bacteria, yeast, blood cells, and many tiny creatures in a drop of water. His work laid the foundation for microbiology, the study of microscopic organisms.

As time went on, the microscope continued to evolve. In the 19th century, significant improvements were made, particularly by Joseph Jackson Lister, who solved the problem of chromatic aberration (colour distortion) in lenses. This advancement significantly enhanced the quality of images produced by microscopes.

The 20th century brought further innovations. The invention of the electron microscope in the 1930s, by Ernst Ruska and Max Knoll, was a game-changer. This type of microscope uses a beam of electrons instead of light to create an image. It has a much higher resolving power than a light microscope, allowing scientists to see much smaller objects in finer detail, such as the structures within cells and even viruses.

The development of the microscope transformed our understanding of biology, particularly cell theory. Before microscopes, the concept of cells was unknown. The discovery of cells can be credited to Robert Hooke. In 1665, using a compound microscope, Hooke examined a thin slice of cork and observed tiny, pore-like structures, which he called "cells" as they reminded him of monastery cells.

Building on Hooke's work, two German scientists, Matthias Schleiden and Theodor Schwann, formulated the cell theory in the 1830s. This theory states that all living things are composed of cells and that the cell is the basic unit of life. This was a revolutionary idea at the time and fundamentally altered our understanding of living organisms.

The microscope also played a crucial role in medical advancements. By allowing scientists to observe pathogens and understand their role in disease, it paved the way for the field of bacteriology. Scientists like Louis Pasteur and Robert Koch, armed with powerful microscopes, identified bacteria responsible for various diseases, leading to the development of vaccinations and antibiotics.

Today, microscopes continue to be essential tools in science and medicine. Fluorescence microscopy, confocal microscopy, and other advanced techniques allow scientists to observe cells and their internal processes in extraordinary detail and in real time. These technologies are crucial for understanding diseases, developing new treatments, and even in the emerging field of cellular engineering.

Microscopes, from their humble beginnings in the hands of Janssen and Leeuwenhoek to the sophisticated instruments used today, have profoundly impacted our world. They have not only revealed the hidden mysteries of the microscopic world but have also provided us with a deeper understanding of life itself, from the smallest bacterium to the complexity of the human body.

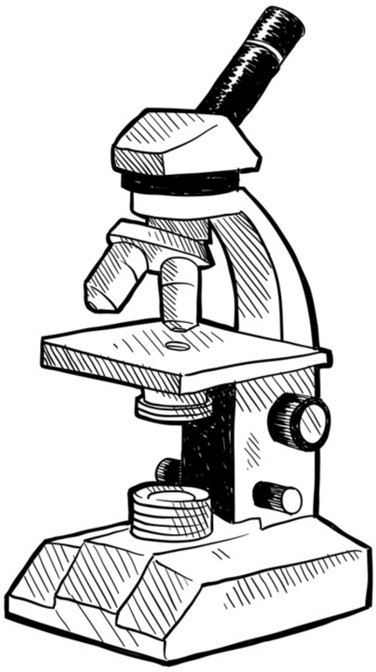
In essence, the history of the microscope is a testament to human curiosity and the pursuit of knowledge. It's a story of how a simple tool, designed to make small things appear larger, opened up an entirely new world for us to explore, understand, and appreciate the intricate details of life at the cellular level. For students and scientists alike, the microscope remains a symbol of exploration and discovery, continually driving our quest to understand the secrets of life.

RESEARCH & RECORD

1. Watch the ***Anatomy Links*** to view microscopic links.

   Curriculum Note: Whilst looking at images filmed through a microscope will help you see many things you would not have access to view, it is recommended that whilst studying this unit you get access **to an actual microscope to view various objects however there is no specific lesson on this.**

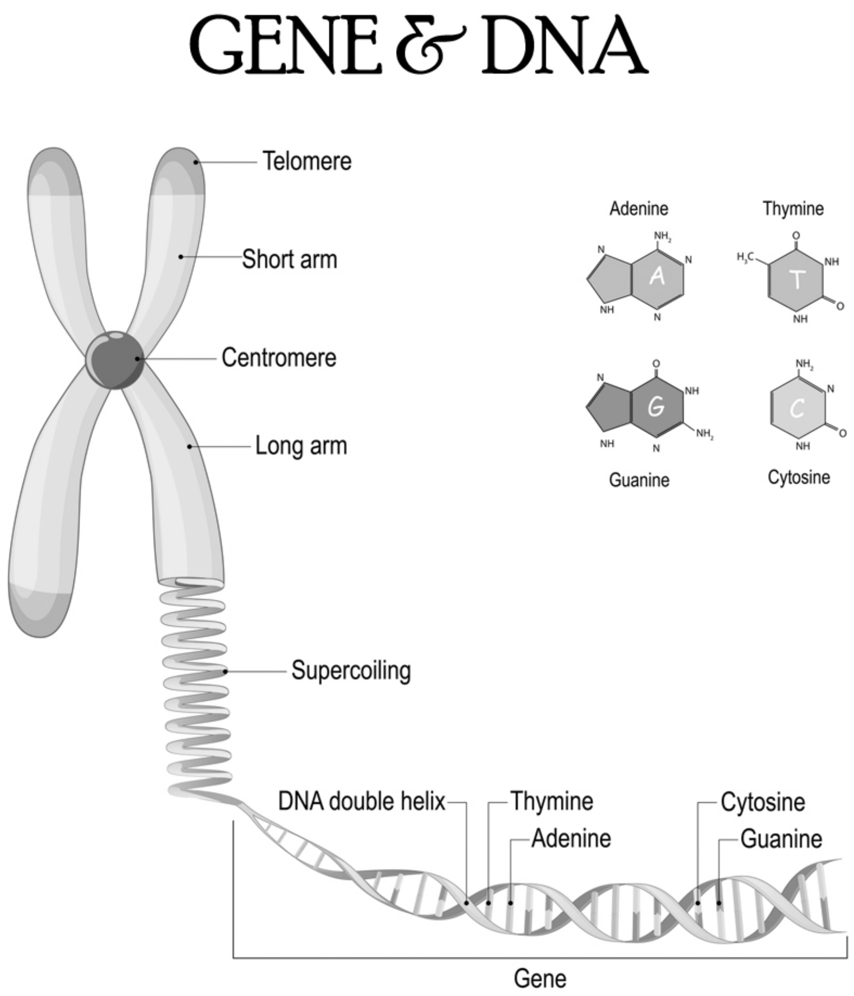
2. Make an entry into your notebook sharing what you have learnt in this lesson.



Lesson 2: What is DNA?

DNA, or deoxyribonucleic acid, is an incredible molecule that's at the heart of every living thing on Earth, from the smallest bacteria to the tallest trees and, of course, us - humans. It's like an extremely detailed instruction manual that tells each part of a living organism how to grow, develop, and function. Imagine building a huge LEGO structure, but instead of a regular instruction booklet, you have DNA guiding you on how and where to place each piece.

DNA is made up of four basic building blocks, or 'bases,' which are like the letters of a special alphabet. These are adenine (A), thymine (T), cytosine (C), and guanine (G). Just like how different combinations of letters form words and sentences, these bases pair up in specific ways (A with T, C with G) to create the 'words' and 'sentences' that instruct our cells. These sequences of bases are organised into units called genes. A gene is like a sentence or a paragraph in the instruction manual, carrying the instructions for making a specific protein, which in turn performs a particular function in the body. Think of genes as specific instructions for building different parts of your LEGO model – some genes instruct for the creation of an eye colour, while others for height or even aspects of your personality.



Mapping the Human Genome

Now, let's dive into a bit of history to understand how we discovered DNA. In the 1950s, two scientists, James Watson and Francis Crick, made a groundbreaking discovery. They figured out the structure of DNA, which is a double helix, kind of like a twisted ladder. This discovery was like finding the key to understanding life's blueprint! But they couldn't have done it without the work of Rosalind Franklin, a brilliant scientist whose X-ray images of DNA were crucial for understanding its structure.

Now, fast forward to the late 20th century, where another massive scientific project began – mapping the human genome. The Human Genome Project, started in 1990, it was the most challenging puzzle ever attempted. Scientists from around the world worked together to 'read' the entire DNA sequence in human cells. This project was a bit like trying to understand the entire instruction manual for building a human, from head to toe.

Mapping the human genome was no small feat. The human DNA is made up of about 3 billion of these bases. If you think of them like letters, the human genome is a book with about 3 billion letters! This book is divided into chapters, known as chromosomes. Humans typically have 23 pairs of chromosomes, making up the entire human genome.

The Human Genome Project was completed in 2003, and it was a huge milestone in science and medicine. It opened up new ways to explore how humans develop and how we can tackle diseases. For instance, by understanding the parts of the genome that are linked to certain diseases, scientists can work on better treatments and even ways to prevent these diseases in the future.

As you learn more about DNA and genetics, you'll discover how this knowledge is not just important for scientists and doctors but for everyone. It can help us make healthier choices, understand our family's health history, and even solve mysteries from the past through genetic archaeology.

In the future, as technology advances, we might see even more amazing discoveries and applications of our knowledge about DNA. Maybe one day, you'll be part of those new discoveries, whether it's finding new treatments for diseases, understanding more about our evolution as a species, or even exploring the genetics of other forms of life on Earth or perhaps beyond!

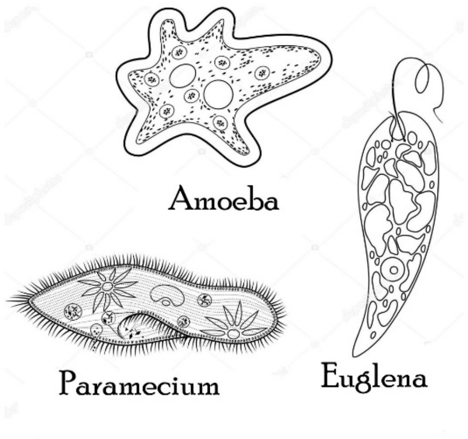
DNA is not just a molecule; it's the storybook of life, and mapping the human genome is like finally getting the chance to read and understand this book in its entirety. As you continue your journey through science, keep an eye on genetics - it's a field that's always evolving and might just hold the answers to many of the questions we have about life itself.

RESEARCH & RECORD

1. Watch the ***Anatomy Links*** to view microscopic links.
2. Make an entry into your notebook sharing what you have learnt in this lesson.

Lesson 3: Looking at a Single Celled Organism

Procaryotic and eucaryotic cells are the two main types of cells that make up all living organisms on Earth. Procaryotic cells, found in bacteria and archaea, are simpler and smaller. They don't have a nucleus, which is a special compartment that holds the cell's DNA. Instead, their DNA floats freely inside the cell. Eucaryotic cells, on the other hand, are more complex and are found in plants, animals, fungi, and protists. These cells have a nucleus that houses their DNA, and they also contain other specialised structures called organelles, which perform different functions to keep the cell alive and healthy. Understanding these two types of cells is important because they form the basic building blocks of all life, showing how diverse life can be even at the smallest level.



Single-celled organisms, also known as unicellular organisms, are fascinating. Unlike humans, plants, or animals, which are made up of trillions of cells, these organisms consist of just one cell that performs all the functions necessary for life. You might be looking at an amoeba, paramecium, or euglena; each has its unique way of living, but they all share some common features.

Single-celled organisms like amoebas are eucaryotic. Despite being just one cell, amoebas have a complex cell structure that includes a nucleus, where their DNA is stored, and other organelles, each performing specific functions necessary for the cell's survival. This complexity distinguishes them from procaryotic cells, which lack a nucleus and are generally simpler in their internal structure.

First up, let's talk about Amoeba. Imagine a tiny blob of jelly moving around by changing its shape. That's an amoeba for you. It doesn't have a fixed shape. Instead, it stretches out parts of its body to form temporary 'feet' called pseudopodia (which means 'false feet'). It uses these pseudopodia to move around and to capture food and when it finds something to eat, like a smaller organism or tiny food particles, it wraps its pseudopodia around it and takes it in. This process is called phagocytosis. Amoebas live in water bodies, damp environments, and even inside humans, and they play a role in breaking down organic material.

Next, meet Paramecium. This little organism looks a bit like a slipper with a lot of tiny hairs. These hairs, called cilia, are all over its body. Paramecium use these cilia to move through water – it's like rowing with lots of tiny oars! The cilia also help it to gather food, sweeping particles into a mouth-like opening. Paramecium is like a tiny, bustling city. Inside, you'll find different parts that handle various tasks, like digestion and getting rid of waste. Paramecium live in a freshwater environment and they plays a part in the ecosystem by eating bacteria and helping to recycle nutrients.

Last but not least, there's Euglena. Euglena is really special because it's like a plant and an animal mixed into one. During the day, it uses chloroplasts (which contain chlorophyll) to make its own food through photosynthesis, just like plants. But when there's no light, it can switch to a more animal-like mode, taking in food from its environment. Euglena has a long whip-like structure called a flagellum, which it uses like a propeller to move through water. One interesting thing about Euglena is that it has an eyespot, which is sensitive to light. This eyespot helps it to locate well-lit environments suitable for the process of photosynthesis.

Looking Through A Microscope

Under the microscope, you see the cell's structures working harmoniously. The cell might be processing food, which it gathered from its surroundings. Digestion happens inside parts called vacuoles, where food is broken down and nutrients are extracted. These nutrients then fuel various processes within the cell, like growth and repair.

Now, you might wonder, is this single-celled organism bigger than a multicellular organism? Well, it's tricky. While the single cell itself can be quite large compared to the individual cells in a multicellular organism, overall, multicellular organisms are much larger. Think of it this way: a single-celled organism is like one brick, while a multicellular organism is like a whole building made of similar bricks. Some single-celled organisms are visible to the naked eye, but they're still tiny compared to even the smallest multicellular organisms.

As you continue observing, you might see the cell divide, a process called binary fission in bacteria or mitosis in other single-celled eukaryotes. It's a moment of awe, watching the cell split into two, each with its own complete set of life-supporting tools. This is how single-celled organisms reproduce, ensuring their survival and continuation.

Looking at this single-celled organism, you realise how complex and self-sufficient it is. In its microscopic world, it carries out all the necessary functions of life. It's a reminder of the diversity and adaptability of life on Earth. From the tiniest single-celled bacteria to the largest multicellular whale, each organism plays a role in the tapestry of life, each one fascinating and intricate in its own way. This tiny glimpse into the world of a single-celled organism not only expands your understanding of biology but also deepens your appreciation for the complexity and wonder of life in all its forms.

RESEARCH & RECORD

3. Watch the ***Anatomy Links*** to view microscopic links.
4. Make an entry into your notebook sharing what you have learnt in this lesson.

Lesson 4: Plants and Animal Cells

Imagine you're in a science lab, looking through a light microscope at two different slides. On one slide, there's a plant cell, and on the other, an animal cell. At first glance, they might seem quite similar – after all, they're both cells. But as you look closer, you start to notice some key differences, as well as some similarities, between these building blocks of life.

Let's start with what's the same. Both plant and animal cells are **eukaryotic**, which means they have a nucleus and other organelles that are enclosed within membranes. Under the microscope, you can see the nucleus in both types of cells – it's like a small, dark spot, and it's where the DNA is stored. This DNA contains all the instructions for the cell's activities. Both types of cells also have mitochondria, tiny structures often described as the cell's powerhouses. They convert energy from food into a form that the cell can use. Another similarity is the presence of a cell membrane in both plant and animal cells. This membrane holds everything inside the cell and decides what gets in and out.

As you enter a plant cell, the first thing you notice is a sturdy outer layer called the **cell wall.** This wall is like the bricks and mortar of a building, providing structure and support. It's what keeps the plant upright and gives leaves and stems their shape. The cell wall is like a strong suit of armour made mostly of a substance called cellulose. It keeps the plant cell sturdy and helps the whole plant – from the tiniest blades of grass to the tallest trees – stay upright and not wilt. Without the cell wall, plants would be floppy and unable to stand against the wind or grow towards the sun. This isn't something you'd find in your own cells.

Just inside the cell wall, you find the **cell membrane** (or **plasmalemma).** Think of this as the cell's security gate. It's a flexible layer that controls what comes in and out of the cell. Water, nutrients, and other essentials pass through the cell membrane, while it keeps out harmful substances. This selective entrance is vital for the cell's health.