

These notes explain the **why** behind every concept, not just the what. They include **analogies**, **real-life examples**, and explanations of **common mistakes**. Use these alongside your revision notes for full understanding.

Topic 2 Cells and Control — From Division to the Nervous System

The Cell Cycle — Controlled and Precise

Cell division is one of the most tightly controlled processes in biology. Dozens of genes monitor the process at multiple checkpoints — checking that DNA replication is complete, that DNA has not been damaged, and that conditions are right. Failure of these control mechanisms leads to cancer.

Stem Cells — Promise and Controversy

Embryonic stem cells can become any cell type. This gives them enormous medical potential — potentially growing new neurons for Parkinson's disease, new beta cells for Type 1 diabetes, or new heart muscle after a heart attack. However, obtaining embryonic stem cells requires destroying a human embryo, which raises profound ethical questions about when human life begins.

■ **Real-life example:** Scientists discovered that adult cells can be reprogrammed back to a stem-like state — induced pluripotent stem cells (iPSCs). This potentially bypasses the ethical problem, though iPSC-derived cells can sometimes develop into cancer cells and research is ongoing.

The Brain — The Most Complex Object in the Universe

The human brain contains approximately 86 billion neurones, each forming thousands of synaptic connections — around 100 trillion connections in total. The brain's electrical activity is so complex we still cannot fully explain consciousness, memory, or creativity. Brain scanning techniques like fMRI allow us to see which regions are active during specific tasks.

Cell cycle	The sequence of events by which a cell grows, replicates its DNA and divides
Stem cell	Undifferentiated cell capable of becoming many different cell types
Neurone	Specialised nerve cell that carries electrical impulses
Reflex	Rapid automatic response to a stimulus — does not require conscious thought
Cerebral cortex	Outer layer of brain — responsible for conscious thought, memory and language