Cells (C)

| Key IdeasStudents should know and understand the following: | Intended Student LearningStudents should be able to do the following: |
| --- | --- |
| Organisation |  |
| C1. The cell is the unit of structure and function of most organisms. | C1.1 Understand that the cell is the smallest independent unit of life.C1.2 Explain the significance of the surface area-to-volume ratio. |
| C2. There are two main types of cell organisation. | C2.1 Compare the size and structural organisation of prokaryotic and eukaryotic cells. C2.2 Describe the structure and function of the following organelles: nucleus, mitochondrion, chloroplast, vacuole, Golgi body, and endoplasmic reticulum.C2.3 Understand why even the simplest cell has several hundred genes. |
| C3. All cells have a lipoprotein cell membrane. In eukaryotic cells it is attached to the cytoskeleton. | C3.1 Describe the structure and function of the cell membrane in terms of the fluid mosaic model.C3.2 Describe the role of the membrane in endocytosis and exocytosis.C3.3 State three functions of the cytoskeleton. |
| Selectivity |  |
| C4. The intracellular environment of cells differs in composition from the extracellular environment of cells. | C4.1 Know that the proportions of chemicals in the intracellular environment of cells are different from those in the extracellular environment of cells.C4.2 Understand why the internal composition of the cell is regulated.C4.3 Explain how selective exchange occurs at the cell membrane. |
| C5. Movement of substances across membranes may be passive or require the expenditure of energy. | C5.1 Understand that the movement of substances by diffusion and osmosis is passive.C5.2 Understand that the active transport of substances against the concentration gradient requires energy. This energy is supplied by ATP. |
| Energy Flow |  |
| C6. All cells require energy. | C6.1 Know that all living cells use energy for movement, synthesis, and the maintenance of a stable intracellular environment. |
| C7. Energy is obtained in physical or chemical form from the cell’s environment, and energy transformations occur within the cell. | C7.1 Know that the sun is the main source of energy for life.C7.2 Understand that light energy can be used by some cells in photosynthesis.C7.3 Know that some molecules contain energy that can be released when chemical bonds are broken and new bonds are formed.C7.4 Explain how the ATP/ADP conversion provides energy for use in cells.C7.5 Explain why energy pathways involve many small, regulated steps.C7.6 Describe how a metabolic pathway is controlled by a specific enzyme at each step.C7.7 Understand that each step produces intermediate compounds and loses some energy as heat. |
| Perpetuation |  |
| C8. Cells arise from pre-existing cells, and cell division leads to an increase in cell number. | C8.1 Explain why the amount of DNA in a cell doubles before division.C8.2 Describe how prokaryotic cells divide by binary fission.C8.3 Illustrate the process of mitosis in eukaryotic cells.C8.4 Know that the products of mitotic division or binary fission have the same number and type of chromosomes as the parent. |
| C9. Division may be regulated by internal and external factors. | C9.1 Know that the cell produces gene products that regulate the cell cycle.C9.2 Understand that hormones may regulate cell division.C9.3 Understand that carcinogens upset the normal controls of cell division by causing mutations. |
| Evolution |  |
| C10. Existing cells are the products of evolution. | C10.1 Understand that there is evidence that prokaryotic cells existed before eukaryotic cells.C10.2 Explain how the ancestry of most existing eukaryotic cells probably involved endosymbiotic events. |
| Human Awareness |  |
| C11. Human beings culture cells for a variety of purposes. | C11.1 Understand techniques of cell culture, and discuss some contemporary examples of their use. |
| C12. Chemicals can interfere with cell metabolism. | C12.1 Discuss possible benefits and/or harmful effects of chemicals that human beings use. |

**C1.1: Understand that the cell is the smallest independent unit of life.**

1. Rank these cells from smallest to largest:

Bacterium, mesophyll cell, human red blood call, human liver cell.

2. An old mate says to you “cells cannot be considered as alive”. Do you agree or disagree with them? Why? Why not?

3. How do you think the size of a cell would affect the function of a cell?

4. What measurement do scientists generally use to measure cells? How does it relate to a millimetre?

**C1.2: Explain the significance of the surface area-to-volume ratio.**

1. Calculate the SA:V of a 5cm cube.

2. Calculate the SA:V of a 1cm cube.

3. Which cell would be more energy efficient? Write two processes that this cell could undertake easier.

**C2.1: Compare the size and structural organisation of prokaryotic and eukaryotic cells.**

1. Draw and label a prokaryotic cell.

2. How is it different to a Eukaryotic cell?

3. Give an example of a prokaryotic cell.

**C2.2: Describe the structure and function of the following organelles: nucleus, mitochondrion, chloroplast, vacuole, Golgi body, and endoplasmic reticulum.**

|  |  |  |
| --- | --- | --- |
| **Organelle** | **Sketch** | **Function** |
| Nucleus |  |  |
| Mitochondrion |  |  |
| Chloroplast |  |  |
| Vacuole |  |  |
| Golgi Body |  |  |
| Endoplasmic Reticulum |  |  |

**C2.3: Understand why even the simplest cell has several hundred genes.**

1. Why do you think a human would need more genes than a bacterium?

2. What is a gene and where is it found in a cell? Why are they important for all organisms?

**C3.1: Describe the structure and function of the cell membrane in terms of the fluid mosaic model.**

1. What does the membrane consist of? What is the function of the membrane and why is important for a cell?

2. What does the phospholipid bilayer consist of?

3. What are the different functions of the proteins?

4. Draw and label a cell membrane. Make sure to include all parts.

5. What is meant by the term “fluid mosaic model”?

**C3.2: Describe the role of the membrane in endocytosis and exocytosis.**

1. Draw and compare the two processes.

2. What is pinocytosis and phagocytosis? Do these processes require cell energy?

**C3.3: State three functions of the cytoskeleton.**

**1.** What are the three main functions of the cytoskeleton?

**C4.1: Know that the proportions of chemicals in the intracellular environment of cells are different from those in the extracellular environment of cells.**

1. What is the definition of an organic molecule?

2. What are the three most common elements found in organisms?

**C4.2: Understand why the internal composition of the cell is regulated.**

1. What is homeostasis? What factors do bodies try to maintain constant? Why?

2. What is the optimum temperature for cells? Why?

3. Why is the control of water in and out of cells important?

4. What is pH?

5. Name one waste product and suggest how a cell may remove this product.

**C4.3: Explain how selective exchange occurs at the cell membrane.**

1. What is meant by the term selective exchange?

2. Outline three properties of the cell membrane that make it selectively permeable.

3. Describe three instances where the cell membrane uses energy for selective exchange of materials between the internal and external environment.

**C5.1: Understand that the movement of substances by diffusion and osmosis is passive.**

1. Explain how osmosis occurs. Why does it not require cell energy?

2. Is osmosis easier for a small or large cell? Why?

3. What is the concentration gradient?

4. What is meant by the term “semi-permeable”?

5. Old red blood cells tend to swell up because water moves into them from osmosis. Explain why this happens?

6. How does a cell become: (a) turgid, (b) flaccid

7. What is the difference between a hypertonic, hypotonic and isotonic solution?

**C5.2: Understand that the active transport of substances against the concentration gradient requires energy. This energy is supplied by ATP.**

1. Does osmosis require energy? Why / why not?

2. What is the ATP / ADP cycle? Why is it used in the membrane?

**C6.1: Know that all living cells use energy for movement, synthesis, and the maintenance of a stable intracellular environment.**

1. Give an example of how the cell uses energy for movement within the cell AND an example of how the cell uses energy for movement of the whole cell.

2. It is said that cells require energy for “synthesis”, describe this process and explain why this would require energy.

3. How do cells regulate temperature? Does this require energy?

**C7.1: Know that the sun is the main source of energy for life.**

1. Write the word equation and symbol equation for photosynthesis. What is the main source of energy? What is the organelle involved? What is the chemical involved?

2. Old mate says that “Humans get their energy from the sun too”. Do you agree with old mate? Why / why not?

**C7.2: Understand that light energy can be used by some cells in photosynthesis.**

1. Why is Oxygen known as a by-product of photosynthesis?

2. Plants are autotrophs. What does this term mean?

3. How is the energy released in photosynthesis?

**C7.3: Know that some molecules contain energy that can be released when chemical bonds are broken and new bonds are formed.**

1. What ‘molecules’ do you think C7.3 are talking about? How is the energy released from these molecules. What organelle is involved in this process?

**C7.4: Explain how the ATP/ADP conversion provides energy for use in cells.**

1. What is ATP? How is it different to ADP?

2. Where is ATP stored and how does it ‘create’ energy?

**C7.5: Explain why energy pathways involve many small, regulated steps.**

1. Briefly describe the steps of aerobic respiration.

2. Explain how each step is controlled. Why does this process involve small steps?

**C7.6: Describe how a metabolic pathway is controlled by a specific enzyme at each step.**

1. Approximately how many enzymes are in a “production line” in the production of cell energy? Where does this occur? Why are enzymes needed? What is their purpose? What are the enzymes creating?

**C7.7: Understand that each step produces intermediate compounds and loses some energy as heat.**

**1**. Enzymes involved in energy create heat, where does this heat go? Why is heat created?

**C8.1: Explain why the amount of DNA in a cell doubles before division.**

1. How many chromosomes are in a parent cell? How many chromosomes are in daughter cells after mitosis?

2. Why does the DNA double in interphase?

3. Interphase is commonly known as a rest phase. Why is this term technically incorrect?

**C8.2: Describe how prokaryotic cells divide by binary fission.**

1. Describe the process of binary fission. What type of cells does this occur in? In your opinion do you think this process is simple or complex? Explain your answer.

**C8.3: Illustrate the process of mitosis in eukaryotic cells.**

1. Draw, describe and label the process of mitosis.

2. Describe each step in mitosis.

3. Why does this process occur in animal cells?

4. What is the role of the cytoskeleton in this process?

**C8.4: Know that the products of mitotic division or binary fission have the same number and type of chromosomes as the parent.**

1. How do the daughter cells in mitosis and binary fission differ from the parent cells? Why is this important?

2. What does the term diploid mean? Are human cells diploid or haploid?

**C9.1: Know that the cell produces gene products that regulate the cell cycle.**

1. Describe the cell cycle. How is this different to mitosis?

2. How is the cell cycle controlled? What external factors affect the cell cycle?

3. What is an MPF and what is its purpose?

4. What would happen if these proteins were not present?

**C9.2: Understand that hormones may regulate cell division.**

1. What are growth hormones and how do they assist cell division? Are these similar to, or different from MPF’s. Explain your answer.

**C9.3: Understand that carcinogens upset the normal controls of cell division by causing mutations.**

1. How do mutations occur in chromosomes? What are some environmental factors that cause mutations?

2. What is a carcinogen?

3. How do these carcinogens disturb the process of cell division?

4. What is a cancer? How do they form? How are they controlled?

5. How do cancers disrupt the process of mitosis?

**C10.1: Understand that there is evidence that prokaryotic cells existed before eukaryotic cells.**

1. Old mate says that “Eukaryotic cells existed before prokaryotic cells”, provide evidence to prove old mate wrong!

2. What evidence would support the theory that life has gradually developed rather than the sudden appearance of large animals and plants?

**C10.2: Explain how the ancestry of most existing eukaryotic cells probably involved endosymbiotic events.**

1. What is endosymbiosis?

2. What is Eubacteria and what role did it play in the evolution of organelles?

3. Why were cells different 4 billion years ago?

**C11.1: Understand techniques of cell culture, and discuss some contemporary examples of their use.**

1. Why would the process of cell culturing need to be undertaken? How is this process utilised in modern science? Give specific examples.

2. Describe the general technique for cell culturing?

3. What are the benefits for creating cell cultures?

**C12.1: Discuss possible benefits and/or harmful effects of chemicals that human beings use.**

1. Describe these main groups of chemicals that humans use. How do humans use these chemicals?

Medical drugs:

Non-medical drugs:

Fossil fuels:

Inorganic fertilisers:

Industrial chemicals:

Insecticides:

CFC’s:

Nuclear Fission:

2. How do they benefit humans? Use three specific examples.

3. What are the harmful effects of these chemicals? How do they harm human cells?