**Topic 1.1: Introduction to Cells Review Guide**

**Essential Idea: The evolution of multicellular organisms allowed for cell specialization and cell replacement.**

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**1.1.U1 ​According to the cell theory, living organisms are composed of cells.**

State the three parts of the cell theory.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Outline evidence that supports the cell theory.

**(Outline**: Give a brief account or summary)

**Compare the use of the word theory in daily language and scientific language.**

**1.1.U2 Unicellular organisms carry out all functions of life.**

Outline eight functions of life.

**(Outline**: Give a brief account or summary)

**1.1.U3 ​Cell Surface to volume is an important limitation to cell size.**

**​**Outline the activities occurring in the volume and at the surface of the cell.

**(Outline**: Give a brief account or summary)

Calculate the surface area, volume and SA:V ratio of a cube.

**(Calculate**: Obtain a numerical answer showing the relevant stages in the working(unless-instructed not to do so).

Explain the benefits and limitations of using cubes to model the surface area and volume of a cell.

(**Explain**: Give a detailed account including reasons or causes)

Describe the relationship between cell size and the SA:V ratio of the cell.

**(Describe**: Give a detailed account)

Explain why cells are often limited in size by the SA:V ratio.

(**Explain**: Give a detailed account including reasons or causes)

List three adaptations of cells that maximize the SA: volume ratio.

**(List**: Give a sequence of brief answers with no explanation.)

**1.1.U4 ​Multicellular organisms have properties that emerge due to the interaction of their cellular components.**

Define and provide an example of unicellular and multicellular organism.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

List characteristics of cells in a multicellular organism.

**(List**: Give a sequence of brief answers with no explanation.)

Define and give examples of emergent properties.​ ​

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

**1.1.U5 ​Specialized tissues can develop by cell differentiation in multicellular organisms.**

Define tissue.​

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

Outline the benefits of cell specialization in a multicellular organism.

**(Outline**: Give a brief account or summary)

Define differentiation.​

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

**1.1.U6 ​Differentiation involves the expressions of some genes and not others in a cell’s genome.**

Describe the relationship between cell differentiation and gene expression.

**(Describe**: Give a detailed account)

**1.1.U7 ​The capacity of stem cells to divide and differentiate along different pathways is necessary in embryonic development and also makes stem cells suitable for therapeutic uses.**

Define zygote and embryo.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

List 2 key properties of stem cells that have made them on the active areas of research in biology and medicine today.

**(List**: Give a sequence of brief answers with no explanation.)

Explain why stem cells are most prevalent in the early embryonic development of a multicellular organism.

(**Explain**: Give a detailed account including reasons or causes)

Contrast the characteristics of embryonic, umbilical cord and adult somatic

stem cells.

**(Compare and Contrast:** Give an account of similarities and differences between two(or more) items or situations, referring to both(all) of them throughout.)

Define totipotent, multipotent and pluripotent.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

**​1.1.A1 ​Questioning the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae.**

Describe features of striated muscle fibers that make them an atypical example cell.

**(Describe**: Give a detailed account)

Describe features of aseptate fungal hyphae that make them an atypical example cell.​

**(Describe**: Give a detailed account)

Describe features of giant algae that make them an atypical example cell.

**(Describe**: Give a detailed account)

**​​1.1.A2 ​Investigation of functions of life in Paramecium and one named photosynthetic unicellular organism.**

Describe characteristics of Paramecium that enable it to perform the functions of life.

**(Describe**: Give a detailed account)

Describe characteristics of Chlamydomonas that enable it to perform the functions of life.

**(Describe**: Give a detailed account)

**1.1.A3 ​Use of stem cells to treat Stargardt’s disease and one other named condition.**

Outline the cause and symptoms of Stargardt’s disease.

**(Outline**: Give a brief account or summary)

Explain how stem cells are used in the treatment of Stargardt’s disease.

(**Explain**: Give a detailed account including reasons or causes)

Outline the cause and symptoms of leukemia.

**(Outline**: Give a brief account or summary)

Explain how stem cells are used in the treatment of leukemia.​

(**Explain**: Give a detailed account including reasons or causes)

**1.1.A4 ​Ethics of the therapeutic use of stem cells from specially created embryos, from the umbilical cord blood of a new-born baby and from an adult’s own tissues.**

**​**List the source and mechanism of obtaining stem cells.

**(List**: Give a sequence of brief answers with no explanation.)

Outline the benefits and drawbacks in using embryonic, cord blood and adult stem cells. **​​​​​**

**(Outline**: Give a brief account or summary)

**1.1.S1 ​Use of a light microscope to investigate the structure of cells and tissues. Practical 1**

Label the names of parts of the microscope.

**(Label** : Add labels to a diagram)

Given the magnification of the ocular and objective lenses, calculate the total microscope magnification.

**(Calculate**: Obtain a numerical answer showing the relevant stages in the working(unless-instructed not to do so).

Measure the field of view diameter of a microscope under low power.

**(Measure**: Obtain a value for a quantity )

Calculate the field of view diameter of a microscope under medium or high power.

**(Calculate**: Obtain a numerical answer showing the relevant stages in the working(unless-instructed not to do so).

Estimate the size of a sample in the microscope field of view.

**(Estimate**: Obtain an approximate value)

Demonstrate how to focus the microscope on a sample.

Demonstrate how to make a temporary “wet mount” on a microscope slide.​

**1.1.S2 ​Drawing of cell structures as seen with the light microscope.**

Demonstrate how to draw cell structures seen with a microscope using sharp, carefully joined lines and straight edge lines for labels.​

**(Draw** :Represent by means of a labeled, accurate diagram or graph, using a pencil. A ruler(straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted(if appropriate) and joined in a smooth curve. )

**1.1.S3 ​Calculation of the magnification of drawings and the actual size of structures and ultrastructures shown in drawings or micrographs.**

Define micrograph.

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

State why the magnification of a drawing or micrograph is not the same as the magnification of the microscope.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Use a formula to calculate the magnification of a micrograph or drawing.

**(Calculate**: Obtain a numerical answer showing the relevant stages in the working(unless-instructed not to do so).

If given the magnification of a micrograph or drawing, use a formula to calculate the actual size of a specimen.​

**(Calculate**: Obtain a numerical answer showing the relevant stages in the working(unless-instructed not to do so).

**1.1.NOS1 ​Looking for trends and discrepancies- although most organisms conform to cell theory, there are exceptions.**

Define “trend” and “discrepancy.”

**(Define**: Give the precise meaning of a word, phrase, or physical quantity.)

Explain why “trends and discrepancies” are useful in scientific study.

(**Explain**: Give a detailed account including reasons or causes)

List features of cells that would be considered a “trend”.

**(List**: Give a sequence of brief answers with no explanation.)

List examples of cell types or organisms that are “discrepancies” to the cell theory.​

**(List**: Give a sequence of brief answers with no explanation.)

**1.1.NOS2 ​Ethical implications of research- research involving stem cells is growing in importance and raises ethical issues.**

Explain why biological research must take ethical issues into consideration.

(**Explain**: Give a detailed account including reasons or causes)

**Key facts**

1. The cell theory states that living organisms are composed of cells, that cells are the smallest unit of life, and that cells come from pre-existing cells.
2. Even unicellular organisms carry out the functions of life which include: metabolism, response, homeostasis, growth, reproduction, excretion and nutrition.
3. A size hierarchy exists involving cells going from largest to smallest: cells (100 microns) – organelles (10 microns) – bacteria (1 micron) – viruses (100 nanometers) – membrane thickness (10 nanometers) – molecules (1 nanometer).
4. Scale bars or stated magnifications allow one to determine the actual size of specimens.
5. It is essential that there be a high surface area to volume ratio if a cell is going to successfully exist. As a cell increases in size, the volume increases much faster than the surface area thus decreasing the surface area to volume ratio. This decrease the chances for the successful existence of the cell.
6. It is essential to note that cells show emergent properties. This means that the interaction of the parts of the cell results in the fact that the whole is greater than the sum of its parts.
7. In multicellular organisms, cells differentiate to carry out specialized functions. This specialization occurs as a result of differential expression of genes in multicellular organism’s genes.
8. Differentiation involves the expression of some genes and not others in a cell’s genome.
9. Stem cells have yet to go through the differentiation process. Thus, they maintain the ability to differentiate along different pathways. There appear to be stem cells in most major types of tissues.
10. The capacity of stem cells to divide and differentiate along different pathways is necessary in embryonic development. It also makes stem cells suitable for therapeutic uses.
11. Stem cells have many therapeutic uses including the replacement of damaged bone marrow cells in leukemia patients. In the future it may be possible to treat conditions such as Alzheimer’s disease and Parkinson’s disease with stem cells. There is even hope that some forms of diabetes may be treated with these undifferentiated cells. Plants show large numbers of stem cells in meristematic (growth) areas.

**KEY TERMS**

centimetre

electron microscope

eye piece

light microscope

magnification

meter

micrograph

micrometer

microscope

millimeter

nanometer

objective lens

resolution

life

emergent

multicellular

linear

unicellular

stem cell

therapeutic

differentiation

specialized cell

paramecium