Name _____ Period _____ Date _____

Topic 1.1 Introduction to Cells

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

1. State the three core ideas of cell theory.
2. What evidence supports the idea that living organisms are composed of cells?
   a. Living organisms are... b. Organelles... c. Cells multiply...

1.1.A1 Questioning the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae. AND Nature of Science: Looking for trends and discrepancies - although most organisms conform to cell theory, there are exceptions. (3.1)

3. For each atypical example outline how it challenges conventional cell theory
   a. Striated muscle (done for you)
      Challenges the idea that a cell has one nucleus
      Muscle cells have more than one nucleus per cell
      Muscle Cells called fibers can be very long (300mm)
      They are surrounded by a single plasma membrane but they are multi-nucleated (many nuclei). This does not conform to the standard view of a small single nucleus within a cell
   b. Giant algae
   c. Aseptate fungal hyphae

1.1.U2 Organisms consisting of only one cell carry out all functions of life in that cell.

4. State the functions of life, as demonstrated by all living organisms.
   M - Metabolism
   R -
   H -
   G -
   R -
   E -
   N -

1.1.U3 Surface area to volume ratio is important in the limitation of cell size.

5. Describe three reasons why small cells are more efficient than big cells.
6. As a cell grows in size eventually the metabolic rate increases beyond it's ability to exchange materials and waste causing the cell to die. To prevent this increase in cell size is used as a trigger for cell division. The smaller cells restore a viable surface area to volume ratio (SA:vol)
   a. What mechanisms other than cell division to cells use to maintain viable, efficient SA:vol ratios?
   b. What mechanisms other than cell division to multicellular organisms use to maintain viable, efficient SA:vol ratios?
7. Extension: Describe how the invasive Caulerpa algae genus break the rules of SA:Vol (you will have to research this).

1.1.U4 Multicellular organisms have properties that emerge from the interaction of their cellular components.

8. Unicellular organisms carry out all the functions of life, multi-cellular organisms differentiate and show emergent properties.
   a. Describe what is meant by the term emergent properties.
   b. Outline the advantages of cells differentiating to carry out specific functions.

1.1.U6 Differentiation involves the expression of some genes and not others in a cell's genome.

9. All cells in an organism share the same, identical, genome (i.e. they all possess the same genetic information).
   a. In which type of cells is the entire genome active?
   b. Describe how newly formed cells become specialized. (Extension: Include packaging of genes in your answer).

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

10. Collections of similar cells are called tissues. How many different distinct highly specialized cell types have been recognized in humans?

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.

11. Describe what is meant by the term stem cell.
12. Define the following types of stem cells and give an example of each:
    a. Totipotent b. Pluripotent c. Multipotent d. Unipotent

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

13. Complete the table to detail the use of stem cells in the treatment of specific conditions.

Condition	Stargardt's Macular Dystrophy	Leukemia
Outline the condition and the problems it causes	• Affects around one in 10,000 children • Recessive genetic (inherited) condition • The mutation causes an active transport protein on photoreceptor cells to malfunction • The photoreceptor cells degenerate the production of a dysfunctional protein that cannot perform energy transport that causes progressive, and eventually total, loss of central vision	
Describe treatment of the condition using stem cells		
The benefit of using stems cells	• Stem cells are currently the only viable treatment for this condition.	

1.1.A4 Ethics of the therapeutic use of stem cells from specially created embryos, from the umbilical cord blood of a newborn baby and from an adult's own tissues. AND Nature of Science: Ethical implications of research—research involving stem cells is growing in importance and raises ethical issues. (4.5)

14. Complete the table to compare the different sources of stem cells available:

	Comparison of stem cell sources		
	Embryo	**Cord blood**	**Adult**
Differentiation ability	Can differentiate into any cell type	Limited capacity to differentiate (without inducement only naturally divide into blood cells)	
Genetic damage			Due to accumulation of mutations through the life of the adult genetic damage can occur
Compatibility			

15. Therapeutic cloning remains a controversial area of medicine.
    a. Outline the main arguments for therapeutic cloning
    b. Outline the main arguments against therapeutic cloning