Understandings:

1. Explain cell theory.
- The cell theory builds on three premises.

1. All living organisms are composed of cells.

2. A cell is the smallest living unit.

3. Cells come from pre-existing cells by cell division. Thus everything alive we see today may be rooted back into one single cell.

Then there are some characteristics a cell always has (since we need to define what a cell is we also need to know their characteristics). They have a membrane, a genetic blueprint (DNA), a chemical metabolism and some kind of energy processor.

2. Explain unicellular organisms.
- Uni means one and cellular means small unit so a unicellular organism is one cell that can carry out all the functions of life all alone.

The functions of life every organism needs to execute are:

Movement, Reproduction, Sensibility, Growth, Respiration, Excretion and nutrition (in short it is MRS GREN).

3. Explain the importance of surface area to volume ratio.
- The ratio between SA:V grows significantly as the measurement increases in a 3D object. Thus if it grows too much, its rate of metabolism will expand faster than the amount of molecules going through the membrane. Volume corresponds to metabolism, and surface area the absorption but also the secretion through membrane. So the cell will be overheated and should undergo cell division when the cell is too big.

The cell cannot be too small though because the organelles have to fit.

4. Explain multicellular organism and explain emergent property.
- Humans are multicellular organism because we are made up of more than one cell. But what makes it different from a colony of unicellular organism and a multicellular organism? Well, multicellular organism is bounded with an external membrane like the skin to make "one organism".

An important concept is the emergent property. "The whole is greater than the sum of the parts". Essentially, it is saying that individual cells may be important, but it is the interactions between them that make the organism.

Extra notes

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	Eukaryote (Protista kingdom)	**Prokaryote (Prokaryote kingdom)**
Unicellular	Amoeba, paramecium	Bacteria
Multicellular	Human beings, animals	Does not exist (as far as I know) but may exist in colonies, such as *Volvox aureus*.

5. Explain specialized tissues that have developed by cell differentiation.

- We know this stuff. This is just like in economics. People become specialized in one job to be more efficient at it. Likewise, cells become specialized by expressing different genes to become more efficient of what they do. Erythrocytes (RBCs) do not have a nucleus to fit more hemoglobin.

6. Explain that differentiation involves the expression of some genes and not others in a cell's genome.

- As we said above, specialization requires gene expression. All cells in our body have the same genetic sequence because they fundamentally came from one zygote. But it is what is getting expressed that determines the role of the cell.

7. Explain stem cells.

- Stem cells are cells that are not fully differentiated. Now, obviously there are many types of stem cells because some may be pluripotent and some may be totipotent (yes there is a difference. I made an explanation of all the different types of potent in chapter 9).

But right now, it is important to distinguish between embryonic stem cell and somatic stem cell. Simply said, embryonic (baby) stem cells have a broader possibility of different cells it can become than somatic (adult) stem cells.

In either case, stem cell research is one of the areas in biology that has an enormous prospect. Understanding stem cells have potential to solve many problems such as food (differentiating into muscles for meat) and spinal cord recovery and other injuries.

Applications and skills:

1. Be able to question the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae.

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Striated muscles have more than one nucleus.

Aseptate hypha also has more than one nucleus.

Giant algae are up to 100mm but are unicellular.

All seems to defy the characteristics of a cell.

2. Explain the functions of life in *Paramecium* and one named photosynthetic unicellular organism.

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Paramecium	**Chlamydomonas**
Nucleus – reproduction	Nucleus – reproduction
Cytoplasm – metabolism	Cytoplasm – metabolism
Food vacuole – food storage	Water vacuole – water storage, turgidity
Cell membrane – entrance of materials	Cell wall – entrance of materials, structure
Cilia – movement	Flagella – movement

3. Explain the use of stem cells to treat Stargardt's disease and one other named condition.

- Stem cells have a wide register of potentially curing diseases.

Stargardt's disease is a genetic disorder from a recessive gene, usually developed before 20. This impairs the active transport of cells on retina so basically, the eye cannot receive the light properly. It may ultimately lead to blindness. So how should we do this? Well, we use embryonic stem cells to become cells on retina! It seems like the results were promising with no side effects (which are quite rare in biology).

Leukemia is a cancer of white blood cells (leucocytes are WBC, so it makes sense). But a lot of white blood cells must mean better immune system…right? No! The truth is that these rapidly multiplying WBC are immature WBCs (known as lymphoblasts). These result in lack of platelets (get bruises easier). The affected is also prone to get ill from simple infections. So what should we do? Well, the source is in the bone marrow, so one would extract stem cells, kill the stem cells in bone marrow and insert the healthy ones back in. It works!

4. Discuss the 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.
- When it comes to stem cells, ethical issues are inevitable. Why? Well, stem cells are found in young organisms and extremely fragile. So, the more the potent stem cells, the higher risk we have of killing it (if not we must kill it to obtain them which is even worse).

Embryonic stem cells are fragile but extremely plastic.

Cord blood stem cells (from umbilical cord) are less fragile, easily obtained but are not as plastic as embryonic stem cells.

Somatic stem cells are not fragile but they are difficult to obtain and not so plastic. But hey, it does not kill the adult.

So, should we create human life to get stem cells or should we do that and potentially save millions of lives? How do we even define life anyways?

Perhaps there are areas in biology where human interference is simply not meant to touch?

5. Be able to use a light microscope to investigate the structure of cells and tissues, with drawing of cells. Be able to calculate the magnification of drawings and the actual size of structures and ultrastructures shown in drawings or micrographs.
- Yeah, basic math and things your teacher with do with you.

TOK:

1. There is a difference between the living and the non-living environment. How are we able to know the difference?