Assessment of your knowledge

a) Answer the following questions to assess your command on terminology, facts, concepts, and theories learned in this chapter.

1. In the early embryo, what are the three layers of cells from which other cells and tissues are derived?
2. What abilities define a stem cell?
3. Stem cell division may be _____ or _____.
4. A billion cells are the result of 1 cell undergoing _____ cell divisions. (number)
5. In developing a cellular product, the tissue engineer will need to develop an assay of _____, while the doctor or company involved in developing the product will need to develop a _____ _____ assay.
6. Many tissues in the adult may have reserve stem cells that are in a nondividing state called _____.
7. Cell death is a normal occurrence and occurs by what four processes:
8. Many cells require attachment to a substrate or an extracellular matrix. Otherwise, cell death occurs by the process termed _____.
9. Analyzing the surface molecules on cells is most often done by using fluorescent antibodies and flow cytometry, also known as _____. (abbreviation)
10. A stem cell colony derived from a single cell may exhibit heterogeneity of gene expression within those cells over time. This is called _____ _____ differentiation and will be followed by stepwise _____ differentiation.
11. DNA sequencing methods have been adapted to analyze the RNA complexity of a cell by first isolating the RNA, and then converting it to its complementary DNA using reverse transcriptase. Then the many cDNAs for study undergo automated sequencing. This method is known as _____.
12. Epigenetic modifications of DNA can regulate gene expression by restricting the access of transcription factors to their DNA binding sites. This type of chromatin remodeling usually involves the common epigenetic modifications 1) _____ and 2) _____.
13. Canonical intercellular signaling by Wnt utilizes _____as its intracellular second messenger to alter gene expression.
14. Hematopoietic stem cells can produce all blood-derived cell types but are (easy/difficult) to produce with current in vitro conditions. They are the (most/least) utilized stem cell in clinical therapies.
15. Mesenchymal stem cells, also called mesenchymal stromal cells, or simply MSCs are most commonly isolated from _____ _____ and _____ _____.
16. MSCs can be readily differentiated in vitro into specific lineages with >95% of the MSCs becoming either _____, _____, or _____, depending on the specific conditions.
17. The MSCs produce multiple _____ and _____ that enhance tissue repair and _____ the immune response.
18. The skin has different stem cells in the _____ layer and in the _____.
19. The intestinal epithelium has one of the most rapid turnovers of all tissues. Its stem cells are found in the _____ _____ and may be identified by expression of _____ or _____.
20. The reprogramming of somatic fibroblasts to induced pluripotent stem (iPS) cells was first accomplished with viral vectors overexpressing the four genes _____, _____, _____, and _____.
21. To produce iPS cells without integrating viruses, three strategies are being tested: 1) _____, 2) _____, and 3) _____.
22. The central nervous system has three sites known to produce more neural cells. These sites are known as the _____ zone, _____ _____ and _____ bulb.

23. Pluripotent stem cells from mice have proven very useful. In a _____-__mouse, the gene product is not produced, and the biological function of the gene can be inferred. Similarly, a _____-__ mouse can be genetically engineered to over produce a gene of interest, or a _____ _____-___/__ mutant can be created in which the gene product can be turned on or off.

b) Answer the following questions to assess your ability to apply the concepts and theories learned in this chapter in real life, clinical, and scientific situations.

1. What conditions can influence whether stem cells undergo symmetric of asymmetric division?
2. Draw the cell cycle and label important stages.
3. Why would apoptosis be a necessary biological process?
4. How would you analyze the molecules on the surface of stem cells?
5. How would you analyze the differentiation potential of isolated stem cells?
6. How would you determine that your stem cells in a dish are not a collection of somatic cells with different differentiation potential?
7. Making the first IPS cells required using constitutive overexpression of four gene products. What limitations does this impose? (Hint: Why are these original IPS cells not used in clinical trials?)
8. What do you think are the properties of cancer stem cells that differentiate them from other stem cells?
9. How would you isolate a new stem cell?