**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?