

**7.013 Recitation 15 – Spring 2018**

*(Note: The recitation summary should NOT be regarded as the substitute for lectures)*

**Summary of Lecture 26 (4/20)**

**Stem cells:** In the adult, the cells of most organs and tissues are differentiated and do not divide, but have a finite lifespan. Examples of such cells are the skin cells, blood cells and the cells of the intestinal lining. Cell replacement is accomplished by specialized stem cells, which are able to self-renew throughout the life of the organism. Stem cells are partly determined, while progenitors are more determined. Stem cells reside in a specific cellular environment, called a niche. Cell-cell signaling between the niche and stem cell regulates when the stem cell will divide and whether it will divide symmetrically, to create two stem cells, or asymmetrically, to create a new stem cell and a progenitor cell. The progenitor goes on to divide further to create more progenitors which later differentiate into cells needed for replacement in a specific organ. Progenitors have limited division capability. Each stem cell type has specific potency. The zygote is the only naturally totipotent cell (that can form all cell types including the placenta).

The stem cells can be isolated using Fluorescence activated cell sorter. Embryonic cells are multi-potent (pluripotent, many fates), while adult stem cells can be pluripotent, bipotent or unipotent. A set of cell types that arise from the same stem cell (or progenitor) is a lineage. Progenitors or transit amplify cells may have less potency than the stem cell from which they arise. Stem cells may be able to repair or replace the damaged tissues in diseases i.e. stroke, Parkinson's disease, muscular dystrophy and heart disorders. However, stem cells are rare, and difficult to isolate. Recent work has shown that stem cells can be generated from adult cells by expression of a small set of genes.

**Questions**

1. Classify the following as totipotent, pluripotent, bipotent, unipotent or differentiated:

a) Cells that can differentiate into many cell types.

b) A cell that is about to start cleavage.

2. A patient has a rare recessive genetic disorder due to the loss of a specific gene function. This disease causes a decrease in immune function. The patient receives a bone marrow transplant which is successful in alleviating the symptoms of the disease, such that patient can lead a normal life.

a) Why does the bone marrow transplant relieve the patient's symptoms?

b) Your patient marries a man who happens to be carrier for the same genetic disorder. What is the probability that their offspring will inherit the disease if the couple had a child a) before and b) after any bone marrow transplant?

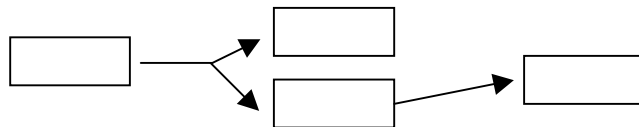
3. Stem cells are found in all multi-cellular organisms. They can undergo mitotic cell division to form cell types that can differentiate into diverse specialized cells. Stem cells are believed to have immense therapeutic potential.

a) A stem cell is known to divide asymmetrically. When a stem cell divides asymmetrically, what are the two possible fates of its daughter cells?

b) A major goal of stem cell research is to repair diseased brain tissue using neural stem cell lines. Four human embryonic cell lines, originally prepared from the **SAME embryo**, were tested for their potency in vitro. Based on the data below, complete the table by ranking the potency of these cell lines.

Cell types	Cell types differentiated in vitro	Potency from 1-4 (1=most potent and 4= least potent).
A	motor	
B	motor, sensory, lateral, hippocampal	
C	sensory, lateral, hippocampal	
D	motor, sensory	

c) Draw a lineage tree for the cell types A-D using the information in the table above.



d) Does each of the above cell types have the same DNA (Yes/ No)? **Explain.**

MIT OpenCourseWare  
<https://ocw.mit.edu/>

7.013 Introductory Biology  
Spring 2018

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.