

## 7.013 Recitation 14 - 2013

### Concepts from Lecture 23

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). 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, diabetes, 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:

- Cells that can differentiate into many cell types.
- A zygote that is about to start cleavage.
- Cells isolated from developing brain cortex that produce motor neurons or interneurons when provided with specific growth factors.
- Intestinal stem cells that replenish the differentiated intestinal crypt cells.
- A neuron.

2. Using intestinal cells, you do a pulse chase experiment by first putting the cells in a culture medium containing radioactive dTTP for a short time and then allowing them to grow and divide in medium containing a lot of non-radioactive dTTP.

a) What is the rationale for performing this pulse chase experiment?

b) What is the relationship of the rapid turnover of a cell with cell division?

3. 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?

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