Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Stem Cells: What are they? A Great Overview!

**Learn Genetics link:** <http://learn.genetics.utah.edu> Click on **“Stem Cells”** on the Home page

1. Click on : The Nature of Stem Cells: (use the arrow to progress along the module)   
   Click on the “cc” in the bottom left corner so that you can read along with the narrator.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells are specialized cells with specific functions.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells can give rise to multiple cell types including more stem cells.

1. When does development begin?
2. This first cell is a special type of stem cell which has the potential to grow into a

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( which nourishes the embryo as it grows).

1. As development continues, the cells divide and differentiate. How would you define “differentiate”, in your own words?
2. Sketch a diagram of the **blastocyst** in the space below. A blastocyst is an embryo a how many

days after fertilization? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. In your sketch above, **label** the following:
2. What will become the placenta
3. Inner cell mass which becomes the embryo/all cells of the body
4. After two weeks, **cells organize into** **3 layers**. Please describe what these layers will develop into:

|  |  |
| --- | --- |
| **Cell Layers** | **What will they become** |
| Ectoderm |  |
| Mesoderm |  |
| Endoderm |  |

1. How many different cell types are there in the body? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. As we grow, pockets of stem cells remain. These somatic (adult) stem cells have which important roles in the body?
3. Some stem cells sit quietly waiting for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ others are constantly at work

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which are lost by daily wear and tear.

1. Explain how somatic stem (adult) cells differ from embryonic stem cells, using bone as an example.
2. List some tissues in which you can find somatic stem cells, other than bone marrow.
3. How do somatic stem cells continue to play an important role in our lives?
4. Click on “Go Go stem cells!” Feel free to use the “Show Text” button.
5. What is a stem cell niche?
6. What is the **job** of a stem cell niche?
7. Choose 2 stem cell niches to investigate. Write your notes here:

|  |  |  |
| --- | --- | --- |
| Stem Cell Niche | What happens when you activate the stem cells in the niche? | Jobs of cells made/ Notes from this niche….. |
|  |  |  |
|  |  |  |

1. **Click on: “ Reversing Cell Differentiation” & learn thes Story of iPS Cells**

**iPS stands for: “induced pluripotent stem cell”**

1. Using the internet: look up the word **“pluripotent”.** What does this mean?
2. Using the internet: look up the word “**induce”.** What does this mean?
3. Now, go to the *Reversing Cell Differentiation* page. What does the term “**terminally differentiated”** mean?
4. In 2006, what significant achievement did scientists report?
5. Look at the pictures on the right of the page. Explain the visual difference between a stem cells DNA and the DNA in a differentiated cell. Read the caption under the picture to help you out.
6. Genes that are used in a specialized cell – do they remain open or do they shut down?
7. In 2012, a Nobel Prize was awarded to the scientists that created “induced pluripotent stem cells”. How did they make iPS cells? ( check out this picture!)  
   <http://www.nobelprize.org/nobel_prizes/medicine/laureates/2012/med_image_press_eng.pdf>
8. After observing how an iPS cell was created, why does the name “induced pluripotent stem cell” make sense?
9. Click on : Stem Cell Quick Reference

**There are 4 major kinds of stem cells and stem cell terminology**. It is important to understand the differences. Please go through the quick reference and fill in the chart to organize these concepts. ***MAKE SURE YOU STUDY THE DIAGRAMS AS YOU LOOK AT EACH CELL TYPE.***

1. **Somatic (adult) Stem Cells:**

Where do these cells come from?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Potential as therapy | Special considerations | Ethical considerations |
|  |  |  |

1. **Embryonic Stem Cells:**

Where do these cells come from?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Potential as therapy | Special considerations | Ethical considerations |
|  |  |  |

1. **iPS Cells “ induced pluripotent stem cells”:**

Where do these cells come from?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Potential as therapy | Special considerations | Ethical considerations |
|  |  |  |

1. **Embryonic Stem Cells from Therapeutic Cloning (SCNT-somatic cell nuclear transfer):**

Where do these cells come from? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Potential as therapy | Special considerations | Ethical considerations |
|  |  |  |

1. Click on “ Unlocking Stem cell potential”. AGAIN, click on the “cc” in the bottom left corner!
2. What is regeneration? What types of cells does regeneration rely on?
3. How and where does regeneration occur in humans?
4. What does the study of “regenerative medicine” aim to accomplish?
5. How are scientists trying to activate stem cells while still in the body?
6. Scientists are also growing stem cells in a lab and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ them into patients.
7. ESC cells and iPS have the ability to give rise to \_\_\_\_\_\_\_\_\_\_type of cell in the body. They can also live \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in culture where they can be grown by the millions.
8. What types of cells can these cells be differentiated into? Give some examples. *Someday these differentiated cells will be transferred into patients.*
9. How are tissue engineers using stem cells?
10. How do stem cells show promise for spinal cord injury? What experiment was done?
11. How are stem cells used in gene therapy? ( sickle cell anemia )
12. How are stem cells used in cancer research?
13. Click on “stem cells in use” – Be sure to read fully!!!

Read this page and summarize on how each of these adult/somatic stems cells have been put to use!

1. Bone Marrow Stem Cells (Transplant to treat Leukemia):
2. Peripheral Blood Stem Cells:
3. Umbilical Cord Stem Cells: