The Game of Life: Stem Cell Edition

It takes some choices to go from 1 to 10 trillion.

Materials
Play-doh or clay
Dice
Small adornments – toothpicks, beads, pins, etc
Game board from this activity

To do and notice
Make an enlarged copy of the gameboard. Here are the steps to playing the game:

1. Make a pea-sized ball with play-doh, and place it in the oval labeled "zygote".

2. You are a fused egg and sperm. You have to generate every cell type in the body as well as some in the placenta around you, which makes you a **totipotent stem cell**. Fortunately, you can make identical copies of yourself to help you out.

Go ahead and make several identical copies of yourself so you can get all this work done.

3. Now that you have some friends, you can afford to specialize a little. Most of you will need to become cells in the body, so you don't have to worry about the placenta anymore. You still have the ability to become any cell type in the body, which makes you a **pluripotent stem cell**. You can still make identical copies of yourself. Yeah.

Since you've lost a feature, make a pea-sized ball with a new color. Then make some more copies of yourself to get ready for the big job ahead.

4. You now need to specialize into one of the 3 germ layers of the body. Roll a die to see which way to go. If you roll a 1 or 2, go left. 3 or 4, go center. 5 or 6, go right. Since you're specializing, pick a new color to represent yourself, and make a new ball.

5. Roll the die again. If you roll an odd number, go left. If you roll an even number, go right. Some cells with the ability to make copies of themselves and turn into other cells hang around until adulthood. These are called **adult stem cells**. As an adult stem cell, you're limited in the type of cell you can become, so make yourself a new shape. You can still make copies of yourself, so go ahead and make a new friend.

6. Sometimes a cell's fate is determined by its physical location in the body. Look around to find instructions on where to go next. (Teacher: place signs around the room that designate whether to go right or left. Try to place signs in a place where students will be limited in the one that they can see.)

Since you've specialized even further, add an adornment to make yourself unique.

7. A cell's fate can also be influenced by the signals of other cells around it. Have everyone at the table roll 2 dice. The person with the highest number gets to decide which way everyone at your table will go.

Change your appearance again. Do you look like any of the other cells?

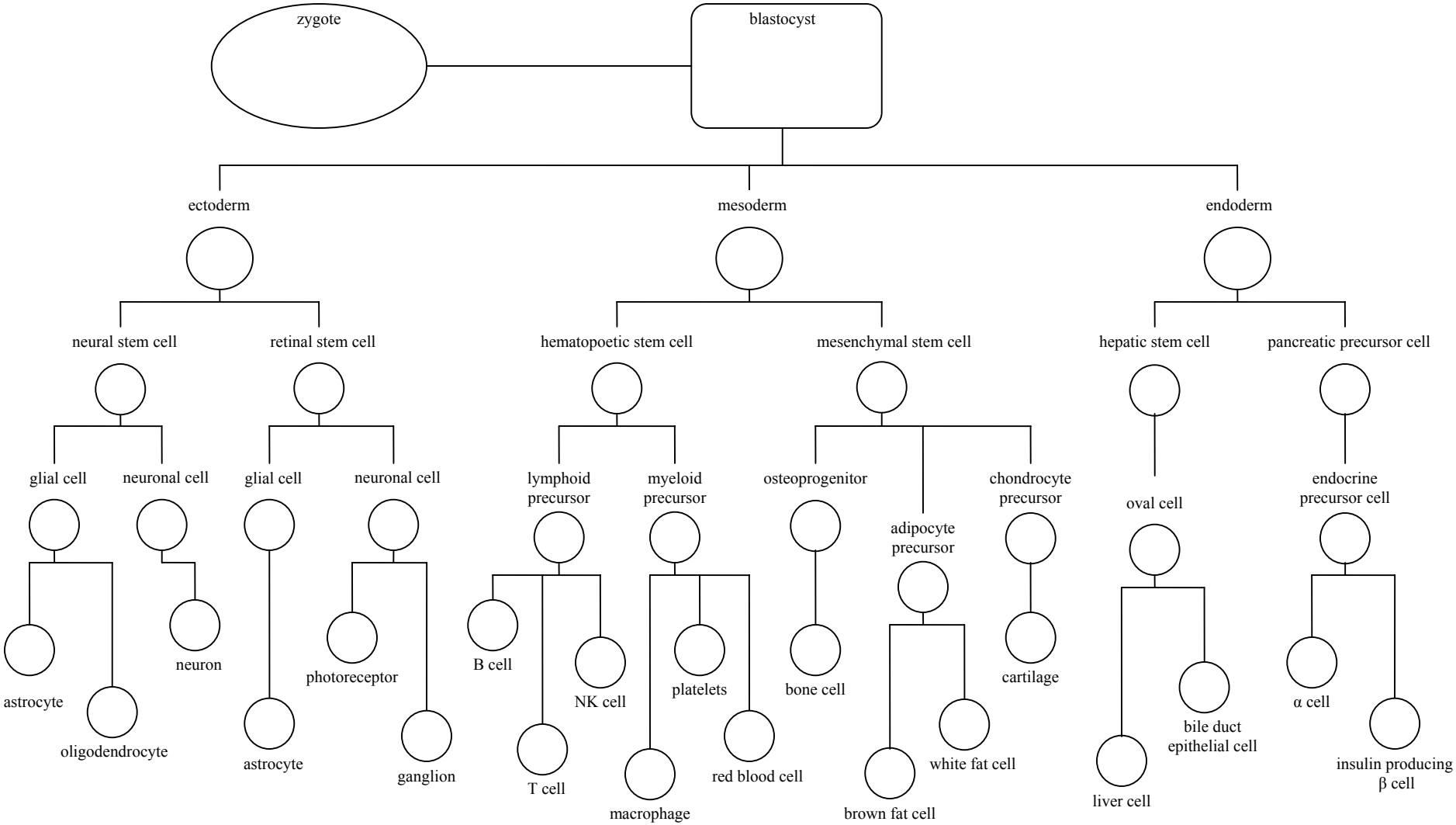
What's going on?

The human body is made up of over 10 trillion cells. There are over 200 different types of cells that make up this number. We all start out as a single cell, or zygote, which results from the fusion of an egg and a sperm. That first cell needs the ability to make more copies of itself and turn into different types of cells in order to get to 10 trillion. Stem cells are cells with the ability to make identical copies of themselves, or **proliferate**, AND the ability to specialize into another type of cell, or **differentiate**. Since there are so few cells in the early embryo, **embryonic stem cells**, which are present in the blastocyst stage, are able to differentiate into the most different types of cells. As these cells differentiate, their abilities are more specialized, and the types of cells they can differentiate into become more limited. After birth, the body has a pool of **adult stem cells**, which are restricted (we think) in the tissues that they can become, but are available to repopulate specific types of cells.

**Important disclaimer: this activity attempts to model what happens as stem cells differentiate into different cell types. It is not a complete or comprehensive model of all the possibilities. This is a very active area of research, and our understanding of the processes represented in the gameboard could be changing at this moment!

The activity should show that a wide variety of cells can arise as different choices, or **cell fate decisions**, are made along its developmental path. These decisions can seem somewhat random (such as the roll of a die), but are often influenced by a cell's physical position in the body and chemical signals sent from surrounding cells (such as when your neighbor told you what to do). Much of the current research with stem cells is focused on understanding the chemical signals that influence these decisions.

For more information, check out a free primer on stem cells from the National Institute of Health. There are basic and technical versions at: http://stemcells.nih.gov/info/basics/


zygote
blastocyst
ectoderm
mesoderm
endoderm
neural stem cell
retinal stem cell
hematopoetic stem cell
mesenchymal stem cell
hepatic stem cell
pancreatic precursor cell
glial cell
neuronal cell
glial cell
neuronal cell
lymphoid precursor
myeloid precursor
osteoprogenitor
adipocyte precursor
chondrocyte precursor
oval cell
endocrine precursor cell
astrocyte
oligodendrocyte
neuron
astrocyte
photoreceptor
ganglion
B cell
T cell
NK cell
macrophage
platelets
red blood cell
bone cell
brown fat cell
white fat cell
cartilage
liver cell
bile duct epithelial cell
α cell
insulin producing β cell