Name: Jon Benskin  
Lesson Title: Plant vs Animal  
SSI Topic: Stem Cells  

Lesson Length (class periods): 3 (staggered days)  
Grade Level(s): 10-12

Appropriateness for Middle/High School Students
This lesson uses debate and kinesthetic strategies to better understand what stem cells are, how they are used, and differences between types. It is designed for implementation in college level biology courses (AP/AICE/IB).

Background
The use of stem cells in research has been in the forefront of ethical debate for the last two decades. Many students have heard of them and probably already have an unsubstantiated viewpoint on their medical use. However, it could be suggested that almost all students (grades 10-12) do not actually understand the different types of stem cells and how each can be used. Additionally, students only think of animals having stem cells and are unaware that plants also contain them.

These lessons focus on differentiating between the different types of stem cells, how each can be used in medical science, and how scientists can direct specific tissue development from them. Part of this lesson will feature collaborative work with Dr. Folta from the University of Florida (UF) in order to actually differentiate plant stem cells into different tissues. This real-life example will allow students to see the impact of stem cell research with plants and then make valuable correlations to animal stem cell research.

Florida State Standards (NGSSS)

SC.912.L.16.10 Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

SC.912.N.4.1 Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making.

Performance Objectives

1. Students will be able to understand what stem cells are (both plant and animal), understand how they are used, and then use this knowledge to hypothesize how different growth factors can affect plant cell differentiation.

2. Students have a better understanding of the ethical debate behind the use of stem cell in order to be able to make more informed decisions when they reach the voting age.

Materials List and Student Handouts

- “Ethical Choices” handout. One per student.
- Plant stem cell locker (not yet designed)
- Stem Cell Science Take Out Kit
### 5E Lesson Template

#### ENGAGE

**Overview**
Students will discuss the ethical use of stem cells in human health.

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#### Activities (Teacher or Student Actions)

“Ethical Choices” worksheet completed by each student. They will then work in groups to come to a consensus on their list of survivors.
Should the stem cells be tested with these cells?
EXPLORE

Overview
Students will explore stem cell usage in a laboratory scenario by completing the stem cell “Science Take Out Kit.”

Activities (Teacher or Student Actions)
The stem cell “Science Take Out Kit” will be completed in small groups.
**Overview**
The teacher will briefly recap the differences between pluripotent and totipotent stem cells in animals versus plants.

**Activities (Teacher or Student Actions)**
Short summary (and list) is created on the front board to categorize the differences between cells.
Overview
Students will investigate how plant stem cells are pluripotent by actually using stem cells and different...
growth factors (provided by Dr. Folta, UF) to cause differing plant cell differentiation. This part of the lesson is still under development with help from Dr. Folta.

<table>
<thead>
<tr>
<th>Activities (Teacher or Student Actions)</th>
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<tr>
<td>Students will hypothesize what the impact of certain growth factors will have on plant stem cell differentiation.</td>
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ors impact the differentiation of plant cells?
### Overview
The main student evaluation will be the product of the laboratory activity along with a flow chart connecting the concepts of animals vs plant stem cells.

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<tr>
<th>Activities (Teacher or Student Actions)</th>
<th>Probing Questions</th>
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<td>Students complete a cell differentiation analysis for all growth factors along with hypothesize what a mixture of different growth factors will do.</td>
<td>How will certain growth factors...</td>
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<tr>
<td>Students complete a concept flow chart.</td>
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Grading Rubric:

Student Score:

90-100% = Students successfully produced all plant tissue types in the laboratory activity and effectively demonstrate that they understand connections between different stem cells found in animals and plants (via flow chart).

70-89.9% = Students successfully produced all plant tissue types in the laboratory activity but only demonstrate that they partially understand connections between different stem cells found in animals and plants (via flow chart).
60-69.9% = Students could not produce all plant tissue types in the laboratory activity and only demonstrate that they partially understand connections between different stem cells found in animals and plants (via flow chart).

0-59.9% = Students could not produce all plant tissue types in the laboratory activity and cannot demonstrate that they understand connections between different stem cells found in animals and plants (via flow chart).