Stem Cell Research

This curriculum is available on the NWABR website,
http://www.nwabr.org/education/stemcellrequest.html

The Science and Ethics of Stem Cell Research

Overview

This unit explores the scientific and ethical issues involved in stem cell research. Students are introduced to fundamental stem cell concepts by using planaria as a model organism in a laboratory investigation. Students then identify stages in the development of human embryos by modeling early growth with play-dough. Using their models, they are then able to compare the types and potency of human stem cells. A variety of techniques for obtaining stem cells are introduced to students though written descriptions, diagrams and news articles. Students learn the type of stem cells produced by each technique as well as some history of stem cell research. By introducing students to the major principles of biomedical ethics, students are able to develop an awareness of the many shades of gray that exist among positions of stakeholders in the debate about the use of stem cells in research. Students are also provided an opportunity to become familiar with the history of federal policy and regulation in regard to embryonic stem cell research, the ethical debate which has shaped this policy, and the implications for treatment of disease and advancement of scientific knowledge. The unit culminates with students developing a position on embryonic stem cell research through the use of a Decision-Making Framework. Two culminating assessments are offered: In the individual assessment, students write a letter to the President or the President's Council on Bioethics describing his or her position and recommendations; In the group assessment, students develop a proposal for NIH funding to research treatment for a chosen disease using either embryonic or adult stem cells.

Instructional Components

Length:

A Planaria lab, 5 lessons, and a selection of culminating assessments span approximately 2 weeks, depending on the number of activities and/or extensions used.

Target Audience: Grades 7-12

Washington State Standards Targeted

Systems	1.1.6 Characteristics of Living Matter
	1.2.6 Structure and Organization of Living System
	1.2.7 Molecular Basis of Heredity
	1.2.8 Human Biology
Inquiry	2.1.1 Questioning
	2.2.2 Limitations of Science and Technology
Design	3.1.1 Identifying Problems
	3.1.2 Designing and Testing Solutions
	3.1.3 Evaluating Potential Solutions
	3.2.1 All Peoples Contribute to Science and Technology
	3.2.2 Relationship of Science and Technology

Correlation to National Science Standards: Grades 5-12

Unifying Concepts and Processes	Planaria Lab	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Assessment
Systems, order, and organization	•	•					•
Evidence, models, and explanation	•	•	•	•	•	•	•
Constancy, change, and measurement	•	•	•		•	•	•
Evolution and equilibrium	•						•
Form and Function	•	•					•

Correlation to the National Science Standards: Grades 9-12

	Planaria Lab	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Assessment
Science as Inquiry							
Abilities necessary to do scientific inquiry	•						•
Understandings about scientific inquiry	•		•			•	•
Physical Science							
Structure and properties of matter			•				
Chemical Reactions							
Life Science							
The cell	•	•	•	•	•	•	•
Molecular basis of heredity	•	•	•				•
Biological Evolution		•					
Interdependence of organisms							
Matter, energy, and organizations in living systems		•	•				•
Behavior of organisms	•						
Science and Technology							
Abilities of technological design				•			•
Understandings about science and technology				•	•	•	•
Science in Personal and Social Perspectives							
Personal health and community health		•	•	•	•	•	•
Science and technology in local, national, and global challenges		•	•	•	•	•	•
History and Nature of Science							
Science as human endeavor	•	•	•	•	•	•	•
Nature of scientific knowledge	•	•	•	•	•	•	•
Historical Perspectives			•		•	•	•

Essential Questions:

1. What are the defining characteristics of different types of stem cells and how can each type be used in research?
2. Who should be allowed to make decisions regarding research related to moral and ethical issues that affect our quality of life?
3. How do we decide what to do, individually and collectively, when there are so many valid and conflicting viewpoints about stem cell research?
4. What are the various ethical perspectives concerning research on embryonic stem cells?
5. Will embryonic stem cells live up to their promise of providing life-saving health benefits?

Unit Objectives:

The student will be able to:

1. Explain what stem cells are, where they are located, how they develop, and how they function.
2. Explain the different methods of obtaining stem cells, the potential use of the types obtained, and how the source relates to the controversy over stem cell research.
3. Analyze the economic, social, legal, and ethical factors influencing stem cell research.
4. Describe the range of positions taken by individuals/organization/countries with respect to stem cells, and identify how a particular position relates to an ethical theory.
5. Evaluate policy options identified by the scientific community and the U.S. government, and become familiar with the ethical debate which has shaped this policy.
6. Integrate and apply understandings about stem cells, disease, and policy issues to develop an informed, personal position expressed either by writing a letter to a policy maker/advisory committee, or creating a research proposal for funding.

Enduring Understandings:

1. Because stem cells are undifferentiated cells with the ability to develop into a variety of cell types, they have many potential medical uses to regenerate tissues and act as a model for exploring cell processes, disease mechanisms, and treatment.
2. Research has given scientists tools and techniques for investigating the potential uses and limitations of stem cells from various sources (embryonic, adult, umbilical, fetal) and with different potencies.
3. Stem cell research (and scientific research in general) is determined by many factors, including public policy and laws, economic and funding issues, analysis of potential risks and benefits, and advocacy by groups and individuals.
4. Policy, advancement of research, and decision-making regarding stem cells varies between states and between countries, due to ethical considerations, economic concerns, cultural concerns, religious beliefs, and personal values of their citizens.
5. Stem cell research is controversial because there are many different and sometimes contradictory viewpoints that need to be considered when making decisions about which stem cells should be used and the ways in which experiments should be ethically conducted.

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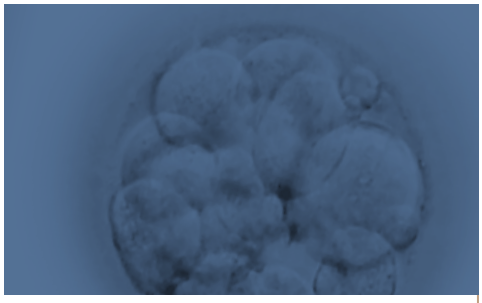

Lesson Overview

The lessons support students in writing and presenting a proposal for NIH funding to research treatment for a chosen disease using stem cells based upon knowledge of regeneration, types and potencies of stem cells, stakeholder positions on stem cell research, and current policies and regulations on stem cell research.

Laboratory Investigation — *Plenty of Planaria*

Students engage in a laboratory investigation designed to introduce fundamental stem cell concepts using Planaria as a model organism. This model works well for demonstrating stem cell function and complexity of tissue regeneration. The investigation functions as a starting point for students to begin thinking about the concept of regeneration and stem cells in other organisms. It also introduces the concept of stem cell potency.

Lesson One — *Stem Cell Development*

This lesson focuses on identifying stages in the development of human embryos and comparing the types and potency of stem cells. Using student-made play dough models, students visualize where stem cells come from, and learn that stem cells are totipotent, pluripotent, or multipotent at different stages of development.

Lesson Two — *Techniques for Obtaining Stem Cells*

Students gain an understanding of the variety of techniques used for obtaining stem cells, and learn if a given technique produces embryonic or adult stem cells. Students read articles from the news in which these different techniques are used and engage in small group discussions.

Lesson Three — *Case Study: One Family's Dilemma*

In this lesson, students are introduced to some major principles of biomedical ethics; respect for persons, beneficence / nonmaleficence, and justice. Next, they examine a case study in which the parents of two children born with the help of *in vitro* fertilization techniques are asked to decide the fate of their remaining frozen embryos. In small groups, students evaluate the options available to the parents in light of the bioethical principles, applying their understanding of ethical concepts to the case.

Lesson Four – *Shades of Gray*

Students develop an awareness of the many shades of gray that exist in the stakeholders of the stem cell research debate. In this lesson students participate in an activity where they take the role of a stakeholder and make inferences about that stakeholder's beliefs with respect to embryonic stem cell research. Later, an actual biographical example of such a stakeholder is provided to them. In several cases, the stakeholders do not fit the 'stereotype' of the particular group they belong to, reinforcing the idea that there are many 'shades of gray' in considering the perspectives on stem cell research.

Lesson Five – *Ethics and Policy*

This lesson provides students with the opportunity to consider how underlying ethical considerations influence the direction of public policy and advancement of scientific knowledge. Using a Socratic Seminar format, students consider fundamental ethical considerations underlying the use of embryos in research.

Culminating Project

Students complete a Decision-Making Framework to consider the larger moral and ethical issues behind the use of *in vitro* fertilized embryos in developing stem cell lines. The framework document serves as a basis for the final assessment.

For the culminating project, teachers may choose a group assessment, an individual assessment, or both;

As an individual assessment, each student expresses his or her personal view on the stem cell debate by writing a letter to the President or President's Bioethics Commission recommending future regulations and funding criteria.

The group culminating assessment allows students to simulate the real-life process of writing and presenting proposals for obtaining NIH funding to research treatment for a chosen disease using stem cells. In addition, the students participate on a review panel to evaluate proposal presentations in order to determine which proposals should be funded.