Stem Cell Differentiation

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The Science Education for Public Understanding Program

• Science curriculum design and professional development
• Based at the Lawrence Hall of Science, University of California at Berkeley
• Designing science curriculum, working with teachers, and supporting quality science instruction since 1983
• Major funding for curriculum work from the National Science Foundation

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Lab-Aids, Inc.

- Publishes and supports the use of SEPUP materials in classrooms across the United States
- Publishing quality science curricular materials, providing curricular support since 1963
- Based in Ronkonkoma, New York

**Science & Global Issues (SGI) Project Overview**

- National Science Foundation Curriculum Development Project
- Uses sustainability as the unifying context for studying important biological concepts
- Inquiry-based, issue-oriented science...
  - students talk, think, and discuss science content as it relates to personal, societal, and global issues
  - students learn to use evidence in the decision-making process
- Embedded assessments & literacy strategies
- Research-based & extensively field-tested

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Sustainability

- Sustainability in the context of human development can be defined as:
  *Meeting the needs of the present without compromising the ability of future generations to meet their own needs.*
- Sustainability can be examined through three perspectives - environmental, economic, and social.
- Sustainability can also be considered on three levels - personal, community, and global.
Cell Biology: World Health

A unit that focuses on sustainability from a health perspective.

Students:
• Study life at the cellular level.
• Examine health issues across the world and over time.
• Decide how to allocate limited funding to address problems of world health.

Stem Cell Differentiation

• Activity occurs late in the unit (Activity 14)
• Students investigate and discuss how stem cells become specialized cells.
• Students have learned about cell structure and function, processes of cells, and the cell cycle.
Stem Cell Differentiation: Getting Started

Transparency 14.1

• Students name some organs in the human body or other organism.
• Students express their ideas about how all of the specialized cells develop.

Activity: Stem Cell Differentiation

• Read the introduction and Challenge.
Stem Cell Differentiation

• Work with your partner to complete Procedure Steps 1-7.
• Read the Analysis Questions

Activity 15: Stem Cell Research

Students read about:
• current scientific research on use of embryonic stem cells
• the social controversy over embryonic stem cells
Stem Cell Research

• Compete the “Know” and “Want to Know” columns of the KWL.
• Complete the Reading. As you read, complete the “Learned” part of the KWL.
• Review the Analysis questions.

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Stem Cell Research

• Much of current scientific research on stem cells revolves around different types of stem cells and their potential to differentiate into specific types of cells.
• Scientists think embryonic stem cells provide a faster route to inventing therapies for diseases.
• People’s qualms about stem cell research are related to destroying a human embryo to obtain its stem cells.

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Cell Biology Topics

- Cell structure and function
- Cell principle
- Stem cell differentiation
- Cell cycle
- Homeostasis
- Structure and function of cellular organelles
- Movement of materials across a membrane
- Fluid mosaic model
- Photosynthesis and cellular respiration
- Roles of proteins
- Abnormal behavior of cells
- Viruses

SEPUP: Instructional Model for Issue-oriented Science

COLLECT SCIENTIFIC EVIDENCE
Gather scientific evidence through inquiry activities and readings.

MOTIVATE
Create a context with an issue or problem.

CHALLENGE
Focus on a specific question. What do we need to know?

ANALYZE THE EVIDENCE
Interpret and/or evaluate the nature of scientific evidence.

USE EVIDENCE
Apply the evidence to address the original issue or problem.

BUILD KNOWLEDGE AND MAKE CONNECTIONS
Build conceptual understanding of important scientific ideas. Connect new learning to previous ideas.
Why Use Issue-Oriented Science?

- Integrates sciences & science with other subjects
- Realistic view of how science contributes to solving problems and the role of science in careers
- Real-world connections
- Use of science in daily life
- More authentic science, for ALL students
- Helps students learn science
- Improves student attitudes toward science

SEPUP Development Process

- Iterative process of development, testing, expert review, evaluation, and revision developed and refined over 22 years of NSF funding
- Develop learning outcomes, assessments, and rough activities; pilot locally
- Refine activities and field-test nationwide; teachers receive PD; 1-2 cycles per unit
- Evaluate
  - Internal evaluation of usability for T and S
  - External evaluation of learning outcomes and pedagogy
  - External evaluation of scientific content
SGI: Biology Pre-Post Effect Sizes

Small effect size Cliffs $d = 0.147$; medium effect size Cliffs $d = 0.330$; large effect size Cliffs $d = 0.474$ (Cliff, 1993; Romano et al, 2006).

SGI Field Test

Effect sizes for SGI field test units
SGI Addresses 21st Century Skills

- Digital-age Literacy
  - Scientific and informational literacy
- Inventive Thinking
  - Higher-order thinking, sound reasoning
- Effective Communication
  - Team work and collaboration
  - Personal, social, and civic responsibility
- High Productivity
  - Effective use of real-world tools
  - Ability to produce

Literacy in the Science Classroom

- Supports students reading comprehension while they are engaged in content-rich and relevant reading.
- Supports inquiry hands-on experiences.
- Facilitates group discussion.
- Helps students synthesize concepts and vocabulary by teaching through experience, talk, and text.
- Enhances student writing.
Supporting Vocabulary Development

- Vocabulary words can be written on a class word wall.
- Students can keep a glossary in their science notebook of terms from the word wall that they do not know.
- Students can write the definition in their own words, draw a diagram, give examples of the word.

Contact Information

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