Medical Research and Advancement

Course

Anatomy & Physiology

Unit III

Cellular Biology

Essential Question

What are the emerging technologies in health care?

TEKS

130.206 3D,5B,10C,12,B

Prior Student Learning

Understanding of cellular function and reproduction

Estimated time

2-7 hours

Rationale

As a health care professional it is important to keep up with emerging technology and advances being made in the field of health care and how the advances are being perceived by the public.

Objectives

Upon completion of this lesson, the student will be able to:

- Understand advances in stem cell research
- Recognize advances in bioengineering
- Analyze the ethical issues surrounding stem cell research •

Engage

Consider many of the major diseases that plague society today. We have diseases such as Parkinson's, Diabetes Type I and Heart Disease where cells are killed or damaged within organs, claiming lives or impairing a person's ability to live a normal life. But what if these dead cells could be replaced with fresh, new, revitalized cells? Could these patients be treated and live normal lives? Scientists are researching the use of stem cells as a possible answer.

Key Points

- I. Stem cells are the basic building block of the human body, capable of dividing for lengthy periods of time. Stem cells are unspecialized cells that develop into specialized cells needed by the body. Normal body cells are only capable of reproducing themselves, where as stem cells are pluripotent. Pluripotent cells divide and become any one of the 220 different cells found in the human body or they may just divide and make additional stems cells ready to divide and specialize.
- II. Types of stem cells
 - A. Embryonic stem cells -- include stem cells found inside an embryo, inside a fetus or from umbilical cord blood. Harvested embryonic stem cells can give rise to just about any cell in the human body.
 - B. Adult stem cells (also known as somatic stem cells) -- found in infants, children and adults. They exist in already developed tissues and organs such as the kidney, heart and brain. They are thought to live in a specific area of each tissue, where they may remain dormant for years, dividing and creating new cells only when they are activated by tissue injury, disease or anything else that makes the body need more cells. They range from cells that are able to form many different kinds

of tissues to specialized cells that form just some of the cells of a particular organ. Basic subgroups include:

- 1. Mesenchymal stem cells -- form fat cells, cartilage, bone, tendon, ligaments, muscle, skin and even nerve cells
- 2. Hematopoietic stem cells -- give rise to blood cells only (red, white and platelets cells)
- 3. Neural stem cells -- form only cells in the nervous system
- C. Induced pluripotent stem cells (iPSC) -- Adult cells that have been genetically reprogrammed into a stem cell-like state.
- III. Isolating and harvesting of stem cells -- There are several ways adult stem cells can be isolated, most of which are being actively explored by our researchers.
 - A. From the body itself
 - 1. Adult stem cells can be isolated from the body and vary, depending on the tissue. Blood stem cells, for example, can be taken from a donor's bone marrow, from the umbilical cord of a new born, or from a person's circulating blood. Mesenchymal stem cells, which can make varies types of connective tissue can be isolated from bone marrow. Neural stem cells (which form the brain's three major cell types) have been isolated from the brain and spinal cord.
 - 2. After isolating the adult stem cells, they need to be grown to large enough numbers to be utilized for treatment.
 - B. From amniotic fluid -- Amniotic fluid, which surrounds the fetus in the womb, contains fetal cells including mesenchymal stem cells. Many pregnant women elect to have amniotic fluid drawn to test for chromosome defects, the procedure known as amniocentesis. Researchers are working on the idea of isolating mesenchymal stem cells and using them to grow new tissues for babies who have birth defects detected while they are still in the womb. Since the tissue would be a perfect match to the child's it would not be rejected by the child's immune system and could be implanted either in utero or after the baby is born.
 - C. From embryonic stem cells -- Because embryonic stem cells are able to create all types of cells and tissues, scientists hope to use them to generate many different kinds of adult stem cells.
 - D. Induced pluripotent cells (iPS cells) -- Scientists have discovered ways to take an ordinary cell, such as a skin cell, and "reprogram" it by introducing several genes that convert it into a pluripotent cell. This cell is called induced pluripotent cell. Scientist are very excited about iPS cells because they come from a patient's own cells, they are genetically matched to that patient, eliminating tissue matching and rejection problems that currently hinder successful cell and tissue

transplantation. Scientist also see the iPS cells as a valuable research tool to understand how different diseases develop.

- IV. Ethics vs. Science
 - A. Laboratories around the world are busy testing different chemical and mechanical factors that might stimulate embryonic stem cells or iPS cells into forming a particular kind of adult stem cell. Adult stem cells made in this fashion would potentially match the patient genetically, eliminating both the problem of tissue rejection and the need for toxic therapies to suppress the immune system. Because iPS cells are derived from skin or other body cells, some people feel that genetic reprogramming is more ethical than harvesting embryonic stem cells which are taken from embryos or eggs. However, this process must be carefully controlled and tested for safety before it's used to create treatments. In animal studies, some of the genes and the viruses used to introduce them have been observed to cause cancer. More research is also needed to make the process of creating iPS cells more efficient.
 - B. Opponents of stem cell research consider the use of any embryo to be totally unacceptable and many disagree with the growing of human tissue as very risky business that could lead man kind down a very narrow road of selectivity.
 - C. Proponents of stem cell research argue that it may be they very answer to many chronic and debilitating diseases that currently plague man kind and researchers should have the ability to see where the discoveries take us.

Resources:

Boston Children's Hospital website- "Stem Cell Research" - http://www.childrenshospital.org/

"Essentials of Human Anatomy & Physiology" by Elaine N. Marieb ISBN: 9780321513427

Activity

- Create an educational brochure about stem cell research. Search the internet for information that should be included in a brochure supporting or opposing stem cell research for one of the following diseases: Parkinson's, Diabetes, spinal cord injury, Alzheimer's, Stroke, or Breast Cancer.
- II. Debate *Embryonic Stem Cell Research* using the HOSA guidelines for "Biomedical Debate"
- III. Write a persuasive speech on the topic, *The government should fund* and support stem cell research or *The government should ban stem cell* research using the HOSA guidelines for "Research Persuasive Speaking"

Assessment

Complete stem cell research disease brochure using brochure rubric. Use the HOSA guidelines to score "Biomedical Debate" Use the HOSA guidelines to score the "Research Persuasive Speaking" activity.

Materials

Brochure rubric and computers with internet access HOSA guidelines for "Biomedical Debate" and computers with internet access -- <u>http://hosa.org/</u> HOSA guidelines for "Research Persuasive Speaking" and computers with internet access -- <u>http://hosa.org/</u>

Accommodations for Learning Differences

For reinforcement, the student will define new vocabulary and make flashcards either using note cards or using an electronic version.

For enrichment, the student will research the topic of "Cord Blood Storage" and report their findings to the class.

National and State Education Standards

National Health Science Cluster Standards

Foundation Standard 1: Academic Foundation

Healthcare professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in a health science program of study.

Accountability Criteria

1.2 Diseases and Disorders

1.21 Describe common diseases and disorders of each body system (prevention, pathology, diagnosis, and treatment).

1.22 Recognize emerging diseases and disorders.

1.23 Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease

Foundation Standard 3: Systems

Healthcare professionals will understand how their role fits into their department, their organization and the overall healthcare environment. They will identify how key systems affect services they perform and quality of care. Accountability Criteria

3.1 Healthcare Delivery Systems

3.14 Explain the impact of emerging issues such as technology,

epidemiology, bioethics, and socioeconomics on healthcare delivery systems.

Foundation Standard 6: Ethics

Healthcare professionals will understand accepted ethical practices with respect to cultural, social, and ethnic differences within the healthcare environment. They will perform quality healthcare delivery.

Accountability Criteria

6.1 Ethical Boundaries

6.11 Differentiate between ethical and legal issues impacting healthcare.

6.12 Recognize ethical issues and their implications related to healthcare.6.2 Ethical Practice

6.21 Apply procedures for reporting activities and behaviors that affect the health, safety, and welfare of others.

6.3 Cultural, Social, and Ethnic Diversity

6.31 Understand religious and cultural values as they impact healthcare.

Foundation Standard 10: Technical Skills

Healthcare professionals will apply technical skills required for all career specialties. They will demonstrate skills and knowledge as appropriate. Accountability Criteria

10.1 Technical Skills

10.11 Apply procedures for measuring and recording vital signs including the normal ranges.

10.12 Apply skills to obtain training or certification in cardiopulmonary resuscitation (CPR), automated external defibrillator

(AED), foreign body airway obstruction (FBAO) and first aid.

*Additional technical skills may be included in a program of study based on career specialties

Foundation Standard 11: Information Technology Applications Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.

Accountability Criteria

11.3 Basic Computer Literacy Skills

11.31 Apply basic computer concepts and terminology in order to use computers and other mobile devices.

11.32 Demonstrate basic computer operating procedures.

11.34 Use basic word processing, spreadsheet, and database applications.

11.35 Evaluate the validity of web-based resources.

<u>TEKS</u>

130.206(c)(3)(D) evaluate the impact of scientific research on society and the environment;

130.206(c) (5)(B) investigate and report the uses of various diagnostic and

therapeutic technologies;

130.206(c) (9)(A) identify the effects of environmental factors such as climate, pollution, radioactivity, chemicals, electromagnetic fields, pathogens, carcinogens, and drugs on body systems;

130.206(c) (10)(C) research technological advances and limitations in the treatment of system disorders;

130.206(c) (12)(A) recognize advances in stem cell research such as cord blood utilization; and

130.206(c) (12)(B) recognize advances in bioengineering and transplant technology.

Texas College and Career Readiness Standards

English/LA standards

V. Research

- A. Formulate topic and question
- B. Select information from a variety of sources
- C. Produce and design a document

Science Standards

III. Foundation skills:

- C. Presentation of scientific/technical information
- D. Research skills/information literacy
- IV. Science, Technology, and Society
- B. Social Ethics
- C. History of science

VI. Biology

- A. Structure and functions of cells
- D. Molecular genetics and heredity

Brochure Rubric

CATEGORY	4	3	2	1
Writing - Organization	Each section in the brochure has a clear beginning, middle, and end.	Almost all sections of the brochure have a clear beginning, middle and end.	Most sections of the brochure have a clear beginning, middle and end.	Less than half of the sections of the brochure have a clear beginning, middle and end.
Content - Accuracy	All facts in the brochure are accurate.	99-90% of the facts in the brochure are accurate.	89-80% of the facts in the brochure are accurate.	Fewer than 80% of the facts in the brochure are accurate.
Graphics/Pictures	Graphics go well with the text and there is a good mix of text and graphics.	Graphics go well with the text, but there are so many that they distract from the text.	Graphics go well with the text, but there are too few and the brochure seems "text- heavy".	Graphics do not go with the accompanying text or appear to be randomly chosen.
Spelling & Proofreading	No spelling errors remain after one person other than the typist reads and corrects the brochure.	No more than 1 spelling error remains after one person other than the typist reads and corrects the brochure.	No more than 3 spelling errors remain after one person other than the typist reads and corrects the brochure.	Several spelling errors in the brochure.
Attractiveness & Organization	The brochure has exceptionally attractive formatting and well- organized information.	The brochure has attractive formatting and well-organized information.	The brochure has well- organized information.	The brochure's formatting and organization of material are confusing to the reader.