**Transforming Organ Transplantation**

***Document Overview:***

This activity is designed to give students a background on how the process of organ transplantation has changed and how new technologies will impact the transplantation process. This will correlate with Jennifer West’s presentation at the Nobel Conference.

***Minnesota State Academic Science Standards:***

9.1.1.1.6 Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge.

9.1.3.3.3 Describe how scientific investigations and engineering processes require multi-disciplinary contributions and effort.

9.1.3.4.1 Describe how technological problems and advances often create a demand for new scientific knowledge, improved mathematics and new technologies.

***Objectives:***

I will be able to describe how organ transplantation has evolved and is evolving.

I will be able to discuss new technologies and the impacts they may have on organ transplantation and the possibility of solving problems associated with current transplant procedures.

***Type of Activity:*** Pre-conference video research and jigsaw activity to prepare students for Jennifer West’s presentation.

***Duration:*** Two 50 minute class periods, with optional summary homework assignment.

***Connection to Nobel speakers:***Biomedical engineer **Jennifer L. West**, PhD – Fitzpatrick Family University Professor of Engineering and professor, Departments of Mechanical Engineering and Materials Science, Biomedical Engineering, Cell Biology, and Chemistry, Duke University, Durham, N.C.; member of the Pratt School of Engineering’s Fitzpatrick Institute for Photonics.

***Teacher Tips:***

Assign students to one of three groups. On day 1, students gather in expert groups to research their topics. Each group will complete the videos and/or reading assignments for a section, (an option could include students conducting research, the evening before the class meets), in order to become knowledgeable about that topic. Instructor should ensure that all members are knowledgeable about their topic.

On day 2, rearrange the class into groups of three, so each group has an "expert" from each of the three topics. In these new groups, students will take turns sharing information regarding their area while the other two students listen and then complete the questions for each section on the student page.

Finally, use the Summary Activity from the student page to engage the class in discussion of the concepts. This can be used as a formative assessment by using the questions in an exit slip format or journal exercise.

***Concepts and Keywords:***

Organ Transplantation, Tissue matching, Stem cells, 3D printing, Biomimetic hydrogels, Bioengineering

***Materials:***

Section 1

US Department of Health and Human Services video discussing how standard organ donation and transplantation works:

<https://www.youtube.com/watch?v=HuKx2a5HkIM> (5 minutes)

Articles:

<http://donatelife.net/statistics/>

<http://www.webmd.com/a-to-z-guides/organ-transplant-after-the-transplant>

Section 2

Nova video discussing how to re-engineer a human organ to be used for transplantation:

 <http://www.pbs.org/wgbh/nova/body/replacing-body-parts.html> (13:35 minutes)

CBS news article on using stems cells to grow organs:

<http://www.cbsnews.com/news/ears-noses-grown-from-stem-cells-in-petri-dishes/>

Section 3

Video on Jennifer West’s 2008 O’Donnell award:

<https://www.youtube.com/watch?v=K0L5QdTZOeY> (3:46 minutes)

Public radio broadcast of 3D printers and their applications for creating human organs:

<http://hereandnow.wbur.org/2014/06/16/organs-3d-printing> (7:33 minutes)

Provide each student with a copy of the **Transforming Organ Transplantation Student Worksheet**

***Extension and Follow-up Activity Possibilities:***

Create a timeline of events regarding organ transplantation.

Research specific scientists who played major roles in advances in transplantation.

Watch the Video “No Greater Love” <https://www.youtube.com/watch?v=rpVNhUeVuls> (58 minutes)

Watch [Jennifer West’s Nobel Conference 42 lecture](https://www.youtube.com/watch?v=oDQ_4A6A-BA&list=PLHuAoPzfQhGHBt69m-K8Isl_zoCQpfB3J&index=12) to further understand her work in creating materials to assist in preventing scar tissue from forming after coronary bypass surgeries. (first 36 minutes) <https://www.youtube.com/watch?v=oDQ_4A6A-BA&list=PLHuAoPzfQhGHBt69m-K8Isl_zoCQpfB3J&index=12>

**Basics of Organ Transplantation Student Worksheet** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Watch the videos and read the article(s) for your assigned section and be ready to share with your classmates tomorrow.

**Section 1**

US Department of Health and Human Services video discussing how standard organ donation and transplantation works:

<https://www.youtube.com/watch?v=HuKx2a5HkIM> (5 minutes)

Articles:

<http://donatelife.net/statistics/>

<http://www.webmd.com/a-to-z-guides/organ-transplant-after-the-transplant>

Questions

1. What factors are considered when matching donors and recipients?

2. What are the major drawbacks/complications with standard organ transplantation?

3. Scientists are looking for new ways to “create” organs to be transplanted-why?

**Section 2**

Nova video discussing how to re-engineer a human organ to be used for transplantation:

 <http://www.pbs.org/wgbh/nova/body/replacing-body-parts.html> (13:35 minutes)

CBS news article on using stems cells to grow organs:

<http://www.cbsnews.com/news/ears-noses-grown-from-stem-cells-in-petri-dishes/>

Questions

1. What are the benefits of “replaceable” body parts?

2. What major obstacles need to be overcome in order to replace larger organs?

3. How have scientists overcome those obstacles? Discuss the general process.

**Section 3**

Video on Jennifer West’s 2008 O’Donnell award:

<https://www.youtube.com/watch?v=K0L5QdTZOeY> (3:46 minutes)

Public radio broadcast of 3D printers and their applications for creating human organs:

<http://hereandnow.wbur.org/2014/06/16/organs-3d-printing> (7:33 minutes)

Questions

1. What are biomimetic hydrogels?

2. What are the benefits of using biomimetic hydrogels?

3. How do you imagine the future of transplantation changing in the next 30 years?

**Summary Activity:**

a) How have the advances in transplantation over the past 70 years occurred in incremental steps?

b) How have the advances in transplantation required knowledge from a variety of different fields?

c) How can a technological advance lead to a new hurdle that pushes scientists to expand and create another new technology?