

History of Medicine Innovations in Elder Care

Teacher's Guide

Grade Level: 9–12

Curriculum Focus: Life Science

Lesson Duration: Three class periods

Program Description

Explore innovations in elder care, including the story of the first successful heart transplant, the development of the pacemaker and major strides in tumor reduction and the treatment of cancer. Delve into treatments for late-in-life blindness, the first successful cataract operation and the latest findings in the fight against Alzheimer's disease. Then learn about one of the most revolutionary discoveries in medical history to date: the discovery of DNA.

Lesson Summary

Students select either Alzheimer's disease or cancer to study, learning the symptoms, suspected causes, and the history of the research being conducted. Students prepare a report and then reconvene as a class to share their findings. Students will observe that both diseases are now being studied on the molecular level, with the hope of reactivating or correcting a mechanism that has caused the disease. Students will think about the ramifications of this development and discuss what scientific breakthroughs are possible.

Onscreen Questions

Part 1, "The Heart: Fixing the Pump," and "The Fight Against Cancer"

- How do doctors use synthetic parts to treat cardiovascular disease?
- What treatment options are available for cancer, and what are their side effects?

Part 2, "Vision in Medicine," "Alzheimer's Disease: Losing the Past," and "Lords of the Flies"

- Why was the first cornea transplant significant for all medical fields?
- How will genetics shape the future of medicine?

Lesson Plan

Student Objectives

- Describe the symptoms and suspected causes of Alzheimer's disease or cancer.

- Detail the history of research into one of these diseases.
- Describe current research projects seeking to learn more about or find treatments for either Alzheimer's disease or cancer.
- Compare the research history of Alzheimer's disease with that of cancer.

Materials

- *History of Medicine: Innovations in Elder Care* program
- Computer with Internet access
- Newsprint and markers
- 3 x 5 cards

Procedures

At the start of the lesson, write the following diseases on the board: cancer, Alzheimer's disease. Leave room below each one to write some information about it.

1. Begin by passing out the 3 x 5 cards.
 - Give students five minutes to write these words on their cards and ask them to write three things they think they know about each disease under its name.
 - After the five minutes, have students break into small groups and share what they know about each disease.
 - Ask each group to share what they already know and add those items to the board.
2. Now ask students to watch the program, paying close attention to the following segments:
 - The Fight Against Cancer
 - Alzheimer's Disease: Losing the Past
 - Lord of the Flies
3. Tell students that the segments present a brief history of the research of two dreaded diseases — Alzheimer's disease and cancer. The segments highlight the progress being made in diagnosing and treating them. Although they are different, the similar directions research is taking for both diseases reflect growing knowledge of how the body works as well as the increased sophistication of medical and scientific tools. During this lesson, students will have an opportunity to trace the progress of research into one of these diseases.
4. Ask students to pick one disease and develop a report explaining the following points:
 - Its symptoms and suspected causes
 - The history of research into the disease, including a discussion of tools used during each phase of research
 - Current research projects leading to either more knowledge or additional treatments

5. Give students time in class to work on their reports. In addition to the information in the program, students can learn more about these diseases at the following Web sites:

Alzheimer's disease

- <http://www.sciencedaily.com/releases/2003/02/030219080659.htm>
- <http://www.sciencedaily.com/releases/2001/05/010524061819.htm>
- http://www.nih.gov/news/NIH-Record/10_03_2000/story05.htm
- <http://www.hno.harvard.edu/gazette/2004/02.19/12-diabetes.html>
- <http://www.hno.harvard.edu/gazette/1999/04.08/alzheimer.html>
- <http://www.alzheimers.org/pubs/conv12n3-4.htm>
- <http://www.psych.org/pnews/00-09-01/head.html>

Cancer

- <http://www.rare-cancer.org/history-of-cancer.html>
- http://www.cancer.org/docroot/CRI/content/CRI_2_6x_the_history_of_cancer_72.asp?sitearea=CRI
- <http://www.bizjournals.com/sanjose/stories/1998/10/19/focus4.html>
- <http://www.cancersupportivecare.com/immunotherapy.html>

6. For your information, here are milestones in the history of the research of each of these diseases.

- *Alzheimer's disease.* This disease was first observed by Alois Alzheimer in 1901 in Germany. A middle-aged woman came to see him complaining of memory loss and disorientation. Using a simple questionnaire as his research tool, Dr. Alzheimer kept a record of her declining memory. Over a three-year period, the patient went from being able to give her name, the day of the week, and what she had for lunch to just being able to remember her name. Dr. Alzheimer hypothesized that something he called senile plaque had killed the brain. Autopsy studies from the brains of individuals suffering from this disease confirmed that plaque had destroyed the brain. Magnetic resonance imaging (MRI) sometimes shows how the brain has shrunk and atrophied from the disease.

In a new wave of research, scientists are working with fruit flies to learn how memories form and which genes are responsible for enabling organisms to learn new information and retain it. One such gene, called the CREB gene, works like an on-off switch. If the gene is turned off, then long-term memories cannot form. Scientists hope that they will be able to apply this knowledge to human beings and develop more effective therapies for people suffering from Alzheimer's disease.

- *Cancer.* Cancer has been documented since the time of the Egyptians. Hippocrates was the first to identify the difference between benign and malignant tumors. The first kind

of treatment was surgery, followed in the 19th century by the use of x-rays to destroy tumor cells. Chemotherapy, the use of chemical agents to kill cancer cells, began in the 1940s, but it wasn't until the 1960s that researchers began using combination therapies, which were much more effective than single agents. While all these therapies continue to be used, sometimes together, researchers are now starting to look at cancer at the genetic level. By understanding what genes may be responsible for certain kinds of cancer, scientists hope to develop more precise treatments. Therapies designed to stimulate the body's immune system to fight the cancer cells also are being used, and many more are being studied.

7. During the next class period, ask volunteers to share their essays. Make sure students have included the main points and have an understanding of how the research has progressed.
8. Conclude the lesson by comparing how research has progressed for the diseases. Point out an important similarity: Scientists studying both diseases are now focusing on how they can treat them at the molecular level. Ask students why this is an important change. (*Because it means that scientists have a better chance of getting to the cause of the disease, not just developing ways to eliminate it or arrest its development.*) What breakthroughs do students think are now possible? (*An understanding of what "turns on" the gene that causes either disease; a way to diagnose either disease before symptoms appear; how to target therapies so that the cause of the problem is removed, making the possibility of regression smaller.*) How do students think our growing knowledge of genes will benefit research into these two diseases? (*Treatments will become more effective, with the possibility of identifying people likely to get a disease before symptoms appear, enabling therapy to begin at the earliest possible time.*)

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Students researched the topic thoroughly, included all requested elements in their reports, and compared how research has progressed for the two diseases.
- 2 points: Students researched the topic adequately, included most of the requested elements in their reports, and compared how research has progressed for the two diseases.
- 1 point: Students did not complete their research of the topic, did not include the requested elements in their reports, and did not compare how research has progressed for the two diseases.

Vocabulary

Alzheimer's disease

Definition: A brain disorder that has as its symptoms disorientation and memory loss; the condition is thought to be caused by plaque made of protein that builds up in the brain, eventually destroying it

Context: Researchers estimate that 4.5 million people suffer from Alzheimer's disease, a number that is expected to rise as the population ages.

cancer

Definition: A disease characterized by uncontrolled growth of cells that take over and destroy healthy parts of the body

Context: In recent years, tremendous strides have been made in treating cancer, prolonging life for many people.

chemotherapy

Definition: Chemical agents used to treat cancer; these medicines work by destroying the cancer cells and slowing their growth in the body

Context: Although chemotherapy is an effective way to treat cancer, the treatments are harsh and have numerous side effects, such as nausea and hair loss.

CREB gene

Definition: The gene in fruit flies that scientists think is responsible for causing long-term memories to form. When this gene is not working properly, the fruit flies cannot retain new information.

Context: Scientists hope that they will be able to apply what they have learned about the CREB gene to people, resulting in treatments that can reactivate people's ability to learn and retain new information.

dementia

Definition: The deterioration of brain function that occurs as a result of Alzheimer's disease

Context: Although dementia can be caused by other conditions, Alzheimer's disease is by far the biggest culprit.

imaging techniques

Definition: noninvasive ways that the inside of the body can be observed, such as x-rays, computer tomography (CAT) scans, magnetic resonance imaging (MRI), and positron emission tomography (PET)

Context: PET scans, one of the newer imaging techniques, opened the door to extensive study of the brain because the images could show how the brain behaved while working, at rest, or under stress.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/>.

This lesson plan addresses the following national standards:

- Scientific Knowledge: Understands the nature of scientific knowledge
- Historical Understanding: Understands the historical perspective
- Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following national standards:

- History and Nature of Science: Science as a human endeavor
- History and Nature of Science: History of science

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>

DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into sections indicated by video thumbnail icons; brief descriptions are noted for each one. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to

highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units – These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. The Heart: Fixing the Pump

Learn about advances in heart surgery and see how doctors are able to diagnose and treat millions of cardiac patients with the help of cardiac catheters and pacemakers.

II. The Fight Against Cancer

Thanks to advances in modern medicine, many types of cancer can now be treated with great success. Examine developments in treatment therapies and diagnostic tools associated with cancer.

III. Vision in Medicine

Explore the history of cataract surgery and corneal transplants, and learn about a 19th century optical device that revolutionized the way we see inside the eye.

IV. Alzheimer's Disease: Losing the Past

Alzheimer's disease causes memory loss. Examine the medical technology used to explore the human brain, and learn about the search for a cure for Alzheimer's.

V. Lords of the Flies

Investigate the genetic similarities between flies and humans, and see how scientists are using what they have learned from fruit flies to explore new possibilities in the fight against Alzheimer's.

Curriculum Units

1. Cardiac X-Rays

Pre-viewing question

Q: What cardiovascular diseases or ailments do you know of?

A: Answers will vary.



Post-viewing question

Q: How is a cardiac catheter examination performed?

A: A cardiac catheter examination is a special x-ray in which a tiny, flexible tube about one meter long is inserted through the blood vessels and into the heart. A dye is injected to make the coronary arteries visible. Doctors can see if the heart is pumping properly or if arteries have become clogged.

2. Major Advances in Heart Surgery

Pre-viewing question

Q: Why was heart surgery one of the last frontiers for medical pioneers?

A: Answers will vary but could include that doctors feared any attempt to operate on a beating heart would be fatal, and until the introduction of the heart-lung bypass machine, they didn't have the ability to stop the heart, operate on it, and then restart it while keeping other body functions going.

Post-viewing question

Q: What do you think was the most important advancement in heart surgery and why?

A: Answers will vary.

3. The Use of Artificial Hearts and Cardiac Pacemakers

Pre-viewing question

Q: What do you know about the functions of the human heart?

A: Answers will vary.

Post-viewing question

Q: How does a pacemaker work?

A: Using a battery, a frequency modulator, and wires connected to the heart muscle, a pacemaker is an electrical device that helps keep the hear beating at the right pace. Every year approximately 500,000 patients around the world receive a cardiac pacemaker.

4. Cancer and the Study of Cellular Pathology

Pre-viewing question

Q: What do you know about human cells and cellular growth?

A: Answers will vary.

Post-viewing question

Q: How did Rudolf Virchow explain the relationship between cells and disease?

A: Rudolf Virchow believed that it is not the whole body that becomes diseased but individual cells or groups of cells. Because of this he believed that cells were not only the source of all life but also the source of all disease. With his knowledge of cells, Virchow recommended that cancer not be seen as an independent creature but rather as part of an organism and subject to the same cellular laws.

5. Diagnosing Cancer and Detecting Tumors

Pre-viewing question

Q: What are some techniques that doctors use to diagnose diseases, illnesses, and physical problems?

A: Answers will vary.

Post-viewing question

Q: Why was the use of ultrasonic technology preferable to the use of radiation in detecting tumors?

A: Ultrasounds use sound waves to distinguish between healthy and malignant tissue, eliminates exposure to radiation from an x-ray.

6. Cancer Treatments

Pre-viewing question

Q: How is cancer treated?

A: Answers will vary.

Post-viewing question

Q: Do you think we will ever have a cure for cancer?

A: Answers will vary.

7. Diagnosing Ailments of the Inner Eye

Pre-viewing question

Q: What sights would you miss the most if you lost your ability to see?

A: Answers will vary.

Post-viewing question

Q: How did Hermann von Helmholtz' device help doctors diagnose ailments of the inner eye?

A: In 1851 Hermann von Helmholtz constructed an optical mirror to investigate the retina of the human eye. He found that in a darkened room with a single light source, a mirror makes it possible to illuminate the interior of the eye through the pupil. With his optical device he could see delicate blood vessels on the optic nerve as it entered the eye. For the first time doctors could see some of the causes of blindness: constricted arteries, detached retinas, and untreated cataracts.

8. Giving Sight to the Blind

Pre-viewing question

Q: Why do you think many people are reluctant to have eye surgery?

A: Answers will vary.

Post-viewing question

Q: How does the modern treatment of cataracts differ from that of medieval times?

A: Cataract surgery became a routine procedure during medieval times. Surgeons and barbers would prick the eye with a needle and push the murky lens out of the way. Vision would be restored, but it would be blurry because the lens used to focus the eye was gone. Infection was common. Today the clouded lens is removed and replaced with a new one, and there is little to no susceptibility to infection due to sterile surgical procedures.

9. Examining the Brain

Pre-viewing question

Q: What are some functions performed by the human brain?

A: Answers may include memory; sense of touch, sight, and smell; language; coordination of physical movements; control of breathing and heart rate; and control of motor skills.

Post-viewing question

Q: What can positron emission tomography tell us?

A: Positron emission tomography, or PET, measures the activity in a brain. This type of technology makes it possible to watch how the brain thinks and determine if it is functioning properly.

10. Battling Alzheimer's Disease

Pre-viewing question

Q: What ailments are commonly associated with old age?

A: Answers will vary.

Post-viewing question

Q: How does Alzheimer's disease affect its victims' brains?

A: Alzheimer's disease creates protein deposits that destroy the brain. Researchers believe that these deposits slowly cause areas of the brain to die. The disease may cause the brain to shrink by about 20 percent.

11. Researching Genetic Mutations in Flies

Pre-viewing question

Q: What is a mutation?

A: A mutation is a permanent change in the DNA that makes up a gene. The change may or may not be noticeable to someone looking at the organism.

Post-viewing question

Q: How do homeotic genes affect the development of body parts?

A: A small number of genes determine where different body parts will form. Known as homeotic genes, they act as switches; they turn other genes on and off. The homeotic switch turned one way will have a cascading effect on other genes and eventually make a particular body part. The same homeotic gene turned the other way will also have a cascading effect on genes, but it will cause them to respond in a different manner, eventually leading to the creation of a different body.

12. Using Fruit Flies to Understand Behavior and Memory

Pre-viewing question

Q: What are some smells that remind you of a particular place or person?

A: Answers will vary.

Post-viewing question

Q: How did the behavior of the genetically modified flies differ from that of normal fruit flies?

A: The flies that had been modified to produce only the CREB on switch, which increases gene activity, had enhanced long-term memory. They formed a long-term memory after only one practice session while non-modified flies required 10 practice sessions. The flies that had been produced with only the CREB off switch, which suppresses gene activity, were unable to form a long-term memory at all. They could still respond to the scents and the shock but were unable to be trained to avoid the shock in future practice sessions.