# *History of Medicine*
# *Innovations in Adult Care*
# Teacher's Guide

**Grade Level:** 9–12 | **Curriculum Focus:** Life Science | **Lesson Duration:** Three class periods

## Program Description

Middle age brings with it its own host of health problems, including heart disease. See how the historical understanding of the circulatory system and the heart has influenced the diagnosis and treatment of cardiovascular problems throughout the years, including bloodletting procedures, the development of blood pressure devices, blood transfusions, and the invention of the EKG. Innovations in organ transplantation, as well as research into the cause and treatment of diabetes are discussed. Witness the discovery of penicillin.

## Lesson Summary

Working in groups, students research the work of a Nobel Prize–winning scientist to learn about the experiments he conducted in his research, how the research built on work that came before, and how the work paved the way for future discoveries.

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## Lesson Plan

### *Student Objectives*

- Identify the important dates in a Nobel Prize–winning scientist's life and explain why these dates are important.
- Describe the scientist's prize-winning discovery and the experiments he conducted in his research.
- Explain how the scientist's work built on the work of scientists who came before him.
- Cite specifically how the findings from this work led to future discoveries in the same field of science or in other fields.

### *Materials*

- *History of Medicine: Innovations in Adult Care* program
- Computer with Internet access
- Poster board (optional)
- Transparencies (optional)

## *Procedures*

1. Begin the lesson by dividing students into small groups. Ask the groups to think about the following question: What are the greatest medical discoveries of the 20th century? Encourage students to think of as many as they can. After five minutes, bring the class together and discuss their ideas. Make a list on the chalkboard.
2. Tell students that during today's lesson, they are going to learn about some of the 20th century's major accomplishments in medicine. Then ask students to watch the program *History of Medicine: Innovations in Adult Care*, paying close attention to the following segments:
    - The Heart: Circulating Ideas
    - Machines and Medicine
    - Insulin: Shots of Hope
    - Noninvasive Measures
3. Tell students that these segments highlight the work of five scientists or teams who won the Nobel Prize for Medicine or Physiology. Ask students to focus on the information in the video about these scientists and their work. For your information, these scientists are listed below, along with their major accomplishments.
    - Karl Landsteiner, who won the Nobel Prize in 1930 for his discovery of human blood groups. This work made it possible for scientists to know when blood transfusions were safe. It also paved the way for organ transplantations; organs cannot be transplanted unless blood types are compatible.
    - William Einthoven, who won the Nobel Prize in 1924 for his discovery of the mechanism of the electrocardiogram. He also invented a device called a string galvanometer, which has enabled scientists worldwide to study the functions of the heart.
    - Joseph E. Murray, who won the Nobel Prize in 1990 for pioneering kidney transplantation. As a pioneer in the field of transplantation, Murray led the way for transplants of other organs in the body.
    - Sir Frederick Grant Banting and John James Richard Macleod, who won the Nobel Prize in 1923 for discovering insulin and developing it as a treatment for diabetes. Not only did this discovery save countless lives, it also led to additional studies about how carbohydrates are metabolized in the body.
    - Sir Alexander Fleming, Sir Ernst Boris Chain, and Lord Howard Walter Florey, who won the Nobel Prize in 1945 for discovering penicillin and developing it as a treatment for bacterial infections. Many other antibiotics have since been developed from both natural and synthetic materials.
4. After students have finished watching the program, point out that these scientists made some of the most important scientific discoveries of the 20th century. These discoveries, however, built upon previous work that had paved the way for new scientific breakthroughs.

5. Tell students that they are going to work in small groups to focus on the work of one of these scientists or teams. Then divide the class into five groups and assign each group one scientist. Explain to students that they are going to develop presentations highlighting the work of these scientists. Their presentations could be a poster, a series of transparencies, or a PowerPoint show. Each presentation must include the following elements:
    - A chronology of important dates in the life of the scientist
    - A description of the Nobel Prize–winning discovery and the experiments done as part of the research
    - An explanation of how the scientist's work built on the work of scientists who came before him
    - A discussion of how this work led to future discoveries in the same field or in other fields
6. Give students time in class to work on the projects. To help students get started, suggest that they check out the following Web sites for more information about each scientist. Encourage students to locate additional Web sites on their own.
    - Karl Landsteiner: 1930 Nobel Prize Winner
      http://nobelprize.org/medicine/laureates/1930/landsteiner-bio.html
      http://www.pbs.org/wnet/redgold/innovators/bio_landsteiner.html
    - Willem Einthoven: 1924 Nobel Prize Winner
      http://nobelprize.org/medicine/laureates/1924/einthoven-bio.html
      http://chem.ch.huji.ac.il/~eugeniik/history/einthoven.html
    - Joseph E. Murray: 1990 Nobel Prize Winner
      http: //nobelprize.org/medicine/laureates/1990/
      http://www.britannica.com/eb/article-9054368
    - Sir Frederick Grant Banting and John James Richard Macleod: 1923 Nobel Prize Winners
      http://nobelprize.org/medicine/laureates/1923/banting-bio.html
      http://www.discoveryofinsulin.com/Banting.htm
      http://nobelprize.org/medicine/laureates/1923/macleod-bio.html
    - Sir Alexander Fleming, Sir Ernst Boris Chain, and Lord Howard Walter Florey: 1945 Nobel Prize Winners
      http://nobelprize.org/medicine/laureates/1945/fleming-bio.html
      http://www.bbc.co.uk/history/historic_figures/fleming_alexander.shtml
7. During the next class period, ask volunteers to share their presentations. Then discuss common threads among the work of these scientists. How did their work build on the work of those that came before them? How did this work lead to additional discoveries? What conclusions can the class draw about how progress in science is made?

## *Extension*

In 1983, Barbara McClintock won the Nobel Prize for Physiology or Medicine. She is the only woman ever to have won this award. Ask students to research her discovery and explain its significance to our understanding of science. Information about Ms. McClintock can be found at http://nobelprize.org/medicine/laureates/1983/index.html.

## *Assessment*

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

3 points: Students provided complete information regarding their assigned scientists, including all the requested elements in their presentations, and demonstrated an understanding of common threads among the scientists' lives and accomplishments.

2 points: Students provided adequate information regarding their assigned scientists, including all but one of the requested elements in their presentations, or demonstrated an incomplete understanding of common threads among the scientists' lives and accomplishments.

1 point: Students provided inadequate information regarding their assigned scientists; presentations were missing several elements; students were not able to demonstrate an understanding of common threads among the scientists.

## *Vocabulary*

**blood groups**

*Definition:* The organization of blood into four main groups (A, B, AB, and O) as a way to identify which molecules, or antigens, are found in the blood

*Context:* With the discovery of blood groups, physicians came to understand that transfusions must take place between compatible blood types; if not, the antigens of one type would react negatively with the antibodies of another type, resulting in potentially fatal complications.

**electrocardiogram**

*Definition:* A device that records the electrical waves produced by the heart as a way to detect heart disease

*Context:* Willem Einthoven studied and refined the electrocardiogram, work that earned him the Nobel Prize for Physiology or Medicine in 1924.

**insulin**

*Definition:* A hormone secreted by islet cells in the pancreas in response to an increase of glucose in the body; receptors in the body's cells bind the insulin to their surface, activating other receptors to absorb the glucose necessary for life

*Context:* Before scientists understood the role that insulin plays in the body, people died from a deficiency of this hormone; this deficiency is a disease called Type 1 diabetes.

**kidney transplantation**

*Definition:* The process of replacing a diseased kidney with a healthy one; for a transplantation to work, blood types must be compatible

*Context:* The biggest problem with kidney transplantation is organ rejection, which happens when the body produces antibodies against the new organ, making it impossible for it to function.

**penicillin**

*Definition:* The first antibiotic, discovered by Alexander Fleming in 1928; Fleming observed that the mold penicillium could destroy the bacteria *Staphylococcus aureus*

*Context:* Although Alexander Fleming discovered penicillin in 1928, penicillin was not used widely until the 1940s, when Howard Florey and Ernst Chain figured out how to convert penicillin to a powder that could be made into a medicine.

## *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

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## 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: Circulating Ideas
The heart is the largest muscle in the human body. Learn about major discoveries and medical inventions that changed how doctors look at the heart and circulatory system.

II. Women's Heart Disease
Follow 36-year-old Colleen Kayes from the time of her diagnosis with blocked coronary arteries through her recovery from a cardiac bypass, and learn more about heart disease and how it affects women.

III. Machines and Medicine
Artificial kidneys and kidney transplant operations save thousands of lives a year in the United States alone. See how dialysis machines work and learn more about transplant operations.

IV. Insulin: Shots of Hope
Millions of diabetics around the world are now able to live healthy, normal lives thanks to insulin injections. See how the discovery of insulin revolutionized the treatment of diabetes.

V. Noninvasive Measures
Many medical problems that historically could only be diagnosed through surgery can now be detected through much less invasive measures. Investigate the discovery of penicillin and the modern techniques for detecting and curing stomach ulcers.

## *Curriculum Units*

**1. William Harvey's Theory**
*Pre-viewing question*
Q: What do you know about the human heart?
A: Answers will vary.

*Post-viewing question*
Q: Why do you think William Harvey was so reluctant to publish his findings on the circulatory system?
A: Answers will vary but may include that Harvey thought his discovery would not be believed.

**2. Blood Pressure and Blood Transfusions**
*Pre-viewing question*
Q: Have you ever had your blood pressure taken?
A: Answers will vary.

*Post-viewing question*
Q: What do the numbers in blood pressure readings indicate?
A: Two readings are taken: systolic and diastolic. Systolic blood pressure is the force of the blood pushing against the walls of the arteries every time the heart beats. A systolic pressure of around 120 is considered normal. Diastolic blood pressure is measured when the heart is at rest, between beats. A reading of around 80 is considered normal. Consistent readings above 140/90 (systolic/diastolic) indicate high blood pressure and an increased risk of hearth attack and stroke. As a general rule, children tend to have lower blood pressure than adults.

**3. Blood**
*Pre-viewing question*
Q: Why were early attempts at blood transfusions often fatal?
A: Doctors didn't know about different blood types. Mixing blood of different types can cause the blood to clot and kill the patient.

*Post-viewing question*
Q: How are human blood types categorized?
A: A+, A-, B+, B-, AB+, AB-, O+, or O-.

**4. The Electrocardiogram**
*Pre-viewing question*
Q: What is an example of the relationship between electricity and the human body?
A: One example would be that nerves pass information to the brain via electric impulses.

*Post-viewing question*
Q: What did Willem Einthoven find out about electrical activity in the heart?
A: While conducting his experiments, Willem Einthoven discovered that different heart problems often create unique patterns of electrical activity. Being able to read these patterns helps doctors diagnose cardiac arrhythmia, coronary illness, and heart attacks using Einthoven's curves.

**5. Detecting Heart Disease in Young Women**
*Pre-viewing question*
Q: What are some forms of heart disease that you know of?
A: Answers will vary but could include coronary artery disease (blockage of the arteries), heart failure, and arrhythmias (abnormal heartbeat).

*Post-viewing question*
Q: How does a stent work?
A: A stent is a wire-mesh tube placed inside an artery to open arterial blockage. This tube prevents artery walls from collapsing, which allows blood to keep flowing.

**6. Colleen Kayes' Robotic Bypass Surgery**
*Pre-viewing question*
Q: What are some uses of robotic technology that you know of?
A: Answers will vary.

*Post-viewing question*
Q: How do you think Colleen Kayes' story could help other women?
A: Answers will vary.

**7. Kidney Dialysis**
*Pre-viewing question*
Q: What do you know about kidneys and how they function?
A: Answers will vary but should include that kidneys help remove wastes from the body.

*Post-viewing question*
Q: How do dialysis machines work?
A: Dialysis machines are like artificial kidneys. They work by removing toxins and other wastes from a patient's blood over the course of several hours and then circulating the blood back into the body.

**8. Kidney Transplants**
*Pre-viewing question*
Q: What do you think it takes to be an organ donor?
A: Answers will vary.

*Post-viewing question*
Q: Why is it difficult to find organ donors?
A: Transplantation requires that the tissue of the donor and receiver be compatible. In cases such as kidney transplants, where the organ comes from a living donor, major surgery is required.

**9. Producing Insulin**
*Pre-viewing question*
Q: What are some historically fatal diseases and illnesses that people are now able to live with?
A: Answers will vary.

*Post-viewing question*
Q: What do insulin injections do for diabetics?
A: Diabetics have difficulty processing sugars because their bodies either don't produce insulin or can't properly use the insulin it does produce. Insulin injections help diabetics keep their blood glucose levels under control and protect them from such complications as blindness and nerve damage.

**10. The Digestive System**
*Pre-viewing question*
Q: How has computer technology revolutionized exploratory medicine?
A: Answers will vary but should include that it has reduced the need for surgery.

*Post-viewing question*
Q: Why were early gastroscopy procedures unpleasant?
A: The natural curve in a human esophagus was a problem for the straight pipe used in gastroscopy procedures. To overcome this, patients would have to tilt their heads back to keep the esophagus straight. Still, there was a great risk of injury while a doctor tried to get a picture of what was going on inside the stomach. Patients had to lie still and straight because the pipe was rigid, a half-inch in diameter, and 26 inches long.

**11. A Cure for Stomach Ulcers**
*Pre-viewing question*
Q: What does the phrase "nature is the best medicine" mean to you?
A: Answers will vary.

*Post-viewing question*
Q: How can stomach ulcers be cured?
A: Ulcers used to be treated with an invasive surgery. However, we now know that the bacterium *Helicobacter pylori* causes about 90 percent of all stomach ulcers. A two-week course of antibiotics is all it takes to kill the bacteria and completely heal this type of ulcer.

**12. The Discovery and Production of Penicillin**
*Pre-viewing question*
Q: What are some things penicillin is used for?
A: Treatment of bacterial infections.

*Post-viewing question*
Q: How does penicillin work?
A: Penicillin prevents bacteria from forming new cell walls as they divide. In this way, the deadly pathogens are decimated.