# LESSON 3:
## Science through the Centuries

### INTRODUCTION

In this lesson, students participate in an historical activity demonstrating how current research builds on prior understanding, and how scientific priorities are influenced by the social and health concerns of the time. This is a "jigsaw" activity in which students are first divided into four different time period groups (1700s, 1800s, 1900s, and 2000s) to discuss social concerns and medical technology of the time. Each time period is seen through the eyes of four individual characters: a ***citizen***, a ***medical practitioner***, a ***person with Type I Diabetes***, and a ***scientist***. The students then regroup by character roles to compare themes over time. Lastly, students are introduced to **translational research** and see that, in many cases, basic research and the resulting application to human health are many decades apart.

### CLASS TIME

Two class periods of 55 minutes each.

### KEY CONCEPTS

- Scientific and educational priorities are influenced by the social and health concerns of the time.
- The history of science shows that curiosity-driven basic research paves the way for heath treatments and medical advances, even though there may be decades between the basic research and its resulting application to human health.
- Translational research is the process of connecting **basic research** ("bench" science) to **applied research** ("bedside" science).
- **Serendipity**—making fortunate discoveries by accident—plays a part in the scientific process.

### LEARNING OBJECTIVES

***Students will know:***

- Social concerns influence scientific research.
- Scientific advancements build off prior knowledge gained over time.

***Students will be able to:***

- Explain how basic research leads to cures and treatments through translational research.
- Give examples of how serendipity plays a part in science.

### MATERIALS

| Materials | Quantity |
|---|---|
| Student Handout 3.1—*Science through the Centuries* | 1 per student |
| Possible Answers to Student Handout 3.1—*Science through the Centuries* | 1 |
| Student Handout 3.2—*Homework: Ask your Elders* | 1 per student |
| Teacher Resource 3.1—*Science through the Centuries Cards* (see *Teacher Preparation*)<br>1 copy is needed for a class with up to 16 students; 2 copies are needed for a class with up to 32 students | 1 or 2 copies |
| Computer with PowerPoint and overhead projection | 1 |
| *Science through the Centuries Slide Set* found at http://nwabr.org. | 1 |
| Optional: Ball of yarn | 1 |

LESSON 3

## SUGGESTED TIMING

| Day | Activities |
|---|---|
| Day One | Students meet in time period groups.<br>Students jigsaw into character groups and present. |
| Day Two | Continue presentations, if needed.<br>Class discussion on future trends.<br>Introduction of translational research.<br>Closure. |

The timing for this lesson is flexible. It is suggested that students complete the jigsaw portion on Day One, and discuss future trends on Day Two.

## NOTE TO THE TEACHER

A common student misconception is that medicines, cures, and treatments can be discovered and made available in a relatively short time frame.

Students may think that science is marching on towards "truth." Although this lesson shows a rather linear progression of scientific thought, make sure that students know that scientific knowledge, in any given era, can be changed and replaced in the following era.

## TEACHER PREPARATION

- Make copies of Student Handout 3.1—*Science through the Centuries* and Student Handout 3.2—*Homework: Ask your Elders*, one per student.
- To show the PowerPoint slide set, prepare the computer and projection unit. Download the *Science through the Centuries Slide Set*.
- Copy the cards found on Teacher Resource 3.1—*Science through the Centuries Cards*. It is helpful, but not necessary, to copy each century onto a different color paper. Make one copy for a class with up to 16 students or two copies for a class with up to 32 students. Cut up the cards.

## PROCEDURE – DAY ONE

### Part I: Time Period Groupings

1. Tell students that they will be participating in an activity that explores how social concerns have influenced scientific knowledge and research over the last few centuries. Students will also map connections between current scientific discoveries and scientific knowledge from years past.
2. Divide the class into four or eight groups. Each group will represent a different century: the 1700s, 1800s, 1900s, and 2000s. Assign a century to each group. For larger classes, two groups can represent the same time period.

   [**Note:** Divide the class into four groups for a class up with up to 16 students. For a class with up to 32 students, divide into eight groups.]
3. Tell students that they will be looking at four representative people, or characters, from each time period (a ***citizen***, a ***medical practitioner***, a ***scientist***, and a ***person with diabetes***). Through these people, four themes will be explored. These themes are:
   - *Who pays for education? Who is educated during this time period? How is scientific research funded?*
   - *Which diseases are prevalent during this time? How is science addressing those diseases?*
   - *How do scientific discoveries build off previous work?*
   - *How is the specific disease example of diabetes identified and treated during this time period?*
4. For each group, hand out the *Science through the Centuries* cards, found on Teacher Resource 3.1, corresponding to the correct century.
5. Make sure that students know that, though the cards may represent real people or historical figures and are historically accurate, the first person statements were fictionalized.
6. Allow time for students to read the information on their group's cards and discuss it with their group members.
7. The first batch of slides in the *Science through the Centuries Slide Set* contains select pictures from each time period. Share these slides with students.

   **Optional:** If time permits, have each time period group research everyday aspects of life from their time period. What does a typical house look like? What amenities are included (i.e., electricity or plumbing)? What do people wear?
8. Have each student in the group choose a character to represent (the ***citizen***, the ***medical practitioner***, the ***scientist***, or the ***person with diabetes***) for the next section.

### Part II: Character Groupings

9. Reorganize groups so that all of the ***citizens*** across all time periods are in one group, all the ***medical practitioners*** are in one group, all the ***scientists*** are in one group, and all the ***people with diabetes*** are in one group. For larger classes, teachers can have two groups for each character.

10. Pass out copies of Student Handout 3.1—*Science through the Centuries*, one per student.

11. Tell students that each character group will focus on a theme:

- **Citizens:** Who pays for ***education***? Who is educated during this time period? How is scientific research funded?
- **Medical Practitioners:** Which ***diseases*** are prevalent during this time? How is science addressing those diseases?
- **Scientists:** How do scientific ***discoveries*** build off previous work?
- **Person with Diabetes:** How is diabetes identified and ***treated*** during this time period?

12. Allow time for students to share each individual's biographical information within their character group. Students should share in chronological order. As each character shares, the other students in the group should fill out the row representing the character on Student Handout 3.1—*Science through the Centuries*.

13. After the characters have shared, have each group identify any ***trends over time*** they observe. These trends can be written down in the space provided on the handout.

### Part III: Class Sharing and Interconnections

14. Select one student representing the ***citizen*** from each time period to come to the front of the room and summarize the information on his or her card. Students should present in chronological order. The second batch of slides in the *Science through the Centuries Slide Set* contains the information from the cards.

15. Students not presenting should fill out the corresponding section of Student Handout 3.1—*Science through the Centuries* either individually or as a class. Suggested answers and discussion prompts can be found on Possible Answers to Student Handout 3.1—*Science through the Centuries*.

16. After the ***citizens*** have presented, invite the ***medical practitioners*** to present in the same way. Repeat the sequence with the ***scientists*** and then ***people with diabetes***.

17. **Optional:** When all sixteen characters have presented, have them stand in a circle facing each other. Hand a ball of yarn to the student representing Aubrey Mathwig and ask the question: "Who is Aubrey connected to?" or "Whose work has helped Aubrey?"

Aubrey should explain why/how she is connected to one other person in the circle and toss the yarn to that person while holding on to her end. (*She is connected to a number of people. For example, she is connected to all the people with diabetes who came before her and paved the way for research; she is connected to the medical practitioner of her time; she has benefitted from work done by Jonas Salk, Louis Pasteur, and others.*)

The person she tosses the yarn to (Jonas Salk, for example) should hold on to a piece of the yarn and then pass the ball of yarn on to someone else he is connected to, such as Louis Pasteur. With some creativity, all the people in the circle can eventually be linked by the yarn, creating an interconnected web. This web represents how citizens' needs can drive scientific research, how research can spur new medical practices, how medical practices can benefit citizens and patients, and how patients value new discoveries (such as insulin).

18. Students may return to their seats.

## PROCEDURE – DAY TWO

### Part IV: What Does the Future Hold?

**[Note:** Field test teachers report that this discussion may take a lot of time. Please dedicate as much (or as little) time to this section as you have available, leaving enough class time for instruction about translational research and for closure.]

19. Ask students, "What do you think the future holds?" or "What trends from the past may predict future directions?" If students have a difficult time envisioning the future, a corollary question is, "How do films and television shows portray the future? What are some of the social and scientific trends other people envision?"

Some possible future ***social/educational*** trends include:

- Life expectancy is predicted to increase for both men and women.
- Health care advances may become too expensive for much of the global population.
- Climate changes may stress national economies and cause more people to move from rural areas, increasing the size of cities.
- Education will likely be more technology based, though funding is always going to be a challenge. If not addressed, educational disparities may increase based on disparate access to resources globally.

Some possible ***scientific*** and ***health-related*** trends include:

- An aging population means an increase in chronic disease.
- Cancer cases are expected to double in most countries during the next 25 years, but earlier detection and treatment may allow people to live with cancer for long periods of time.
- As the genetic component of disease becomes known, health care will become more personalized and increasingly rely on genetic tests and genetic counseling.
- DNA microchips containing a person's full genome might become a common part of an individual's medical file. These chips can help assess individual risks for developing different cancers as well as heart disease, diabetes, and other diseases.
- Medical research may increasingly rely on large databases containing the genomes of different populations.
- Medical sensors located under the skin may continually monitor the health of an individual and communicate wirelessly with databases and health care professionals.
- Stem cells might be used to create genetically identical replacement organs for transplant patients, reducing the risk of rejection.
- And many more!

20. Explain that the path of scientific advancement is full of missteps, dead ends, and errors. Yet, over time, it has the capacity to correct itself. With this in mind, ask students what they think we believe today that future generations will consider misguided.

### Part V: Translational Research

21. Tell students that scientists conducting curiosity-driven research into the fundamental nature of science often set the foundation for discoveries that lead to actual cures or treatments for disease in later years. In many cases, the ***basic research and the application to human health were many decades apart***.

22. Tell students that scientific research is sometimes put into two categories:

- **Basic research** furthers general scientific understanding of how the natural world works. This is quite often academic research.
- **Applied research** relates to human health care applications in the form of treatments or cures of human diseases. This is often done by for-profit companies.

The process of connecting basic research to applied medicine or treatment is called **translational research**. This is sometimes described as "From Bench to Bedside"—from the scientist's laboratory bench to the physician's bedside care of a patient.

> "…the concerted effort to discover new drugs without supporting basic research is like 'trying to construct a skyscraper without fully understanding the properties of bricks and cement.'"
>
> ~A. Jogalekar, PhD

### Part VI: Serendipity and Collaboration

23. Define for students the word **serendipity**: making fortunate discoveries by accident, as when people discover valuable things they were not actually looking for. Ask students for examples of serendipity in science. (Two examples can be found in the *Note to Teacher* section at the end of this lesson.) One of the most famous examples of serendipity in science is Alexander Fleming's "accidental" discovery that penicillin mold kills bacteria.

24. **Collaboration and Revision**: Highlight the ways in which scientists have built upon and revised each other's work even if it is not explicitly described in the cards. Point out that health treatments and cures do not occur independently from other scientific research but may owe their success to years, if not decades, of prior work by other scientists. Science is a collaborative endeavor, even over time.

### Closure

25. Return with students to the 1700s and read for them this quote from a satirist of the time who described Robert Hooke as:

*"…a Sot, that has spent £2000 in Microscopes, to find out the nature of Eels in Vinegar, Mites in Cheese, and the Blue of Plums which he has subtly found out to be living creatures."*

Without an understanding that Hooke's early work would directly (and indirectly) contribute to Pasteur's germ theory, Fleming's discovery of antibiotics, and many other scientific advancements, basic research at the time may seem unconnected to subsequent important cures and treatments.

26. Share with students this quote attributed to Isaac Newton and ask how it pertains to today's lesson:

*"If I have seen further, it is by standing on the shoulders of giants."*

27. Have students retrieve their *Unit Graphic Organizer* handouts and look at the second column, titled "Role of Science and Society." Ask students, "What are the structures, systems, or ways in which society influences what science is done or how it is paid for?" Students should brainstorm and write down phrases such as:

- Social needs (i.e., diseases of the time) influence research directions.
- Society funds education and research it values.

28. Ask students if they have anything to add to other columns. Suggest that students add "serendipity" to the "Research Process" column. To the "Translational Research" column, they may add:

- Basic science may lead to new cures and treatments.

29. Lastly, look at the last column, "Being a Scientifically Literate Citizen." Ask students how their understanding of the role of science and society impacts them as members of society. Discuss their responsibility to be scientifically literate in their role as a ***members of society*** and add those words to the graphic organizer.

## HOMEWORK

Student Handout 3.2—*Homework: Ask Your Elders* can be assigned as homework. In this activity, students interview a person in their mid-fifties or older to learn about changes in medical care and/or treatments during that person's lifetime.

## EXTENSION

Students can explore an interactive, historical timeline of medical discoveries created by the New England Journal of Medicine.

**History of Medical Discoveries**
http://www.nejm.org/doi/full/10.1056/NEJMp1114819

## NOTE TO THE TEACHER

There are many examples of ***serendipity*** in science—here are two:

"At the Johns Hopkins Hospital in 1947, two allergists gave a new antihistamine, Dramamine, to a patient suffering from hives. Some weeks later, she was pleased to report to her doctors that the car sickness she had suffered from all her life had disappeared. Drs. Leslie Gay and Paul Carliner tested the drug on other patients who suffered from travel sickness, and all were completely freed of discomfort, provided the drug was taken just before beginning the potentially nauseating journey. A large-scale clinical trial involving a troopship with more than 1,300 soldiers crossing the rough North Atlantic for twelve days (Operation Seasickness) decidedly proved the drug's value in preventing and relieving motion sickness. Dramamine is still used today, available over the counter."

From: Meyers, M. A. (2007). *Happy accidents: Serendipity in modern medical breakthroughs*. New York, NY: Arcade Publishing.

"The long-awaited breakthrough [in learning how to freeze and thaw tissues] was a lucky accident. In 1947, a British scientist named Christopher Polge was searching for ways to freeze, store, and revive chicken sperm, a potential boon to farmers. Polge tried immersing the fowl gametes in a fructose solution, which didn't work very well—until one day, mysteriously, it did. Analysis of the curiously effective solution revealed that its label had somehow been switched. The bottle actually contained glycerol, not fructose. Glycerol seemed to be such an effective cryoprotectant that it's still employed in biobanks for preserving blood cells and fluids like saliva and urine. "

From: Silberman, S. (2010, May 24). Libraries of flesh: The sorry state of human tissue storage. *Wired Magazine*. Retrieved from http://www.wired.com/magazine/2010/05/ff_biobanks/all/

## GLOSSARY

**Applied research:** Research that relates to human health care in the form of treatments or cures of human diseases. Applied research is often conducted by for-profit companies.

**Basic research:** Research that furthers general scientific understanding of how the natural world works. This is often academic research.

**Serendipity:** The phenomenon of making fortunate discoveries by accident, or discovering valuable things while looking for something else.

**Translational research:** The process of connecting basic research to applied medicine or treatment; sometimes described as "From Bench to Bedside."

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# STUDENT HANDOUT 3.1

## Science through the Centuries

Name_____________________________________________ Date_____________ Period_____________

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **CITIZEN**<br><br>Who pays for education? Who is educated? | Mary Walker | Samuel Christian | Pearl McKinley | Andrew Hayes |
| **Summary**:<br><br>Trend over time | | | | |

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **MEDICAL PRACTITIONER**<br><br>Which diseases are prevalent?<br><br>What do doctors think causes them? | Isaac Dawson | Joseph Lister | Alexander Fleming | Douglas Lowy |
| **Summary:**<br><br>Trend over time | | | | |

HANDOUT

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **SCIENTIST**<br><br>How do scientists build on prior work? | Robert Hooke | Louis Pasteur | Jonas Salk | Nora Disis |
| **Summary:**<br><br>Trend over time | | | | |

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **PERSON with DIABETES**<br><br>How is diabetes identified and treated? | Elizabeth Snell | Mary Roberts | James Walker | Aubrey Mathwig |
| **Summary:**<br><br>Trend over time | | | | |

HANDOUT

# STUDENT HANDOUT 3.2

## Homework: Ask Your Elders

Name_______________________________________________________________ Date________________ Period________________

**Instructions:** Find a person in their mid-fifties or older to interview. This can be a relative, neighbor, friend, or acquaintance. Tell the person you are interviewing that you will be asking questions about changes she has seen in medical care or medical treatment in her lifetime.

1. Did you or a family member have a memorable illness when you were young? What was it, and how was it treated?

2. Where there any diseases that "everyone got" or seemed very prevalent? What were they, and how where they treated?

3. Describe a typical visit to the doctor's office. How often did you go? Did you see one doctor or many doctors? How "trusted" was your doctor?

4. Describe a typical visit to the doctor's office today. Do these visits differ from those in your youth?

5. What types of treatments or cures were common for different diseases in your youth?

6. Do you have any other thoughts on this subject? [**Students:** Please take notes on any discussion on a separate piece of paper and attach it to this handout.]

HANDOUT

# Science through the Centuries

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **CITIZEN** | Mary Walker | Samuel Christian | Pearl McKinley | Andrew Hayes |
| Who pays for education? Who is educated? | Most education is privately funded. Wealthy landowners and aristocracy pay for the education of their children. The average male, most often farmers, may have some basic reading and writing skills.<br><br>The church is the intellectual driver of the time and most schooling is religious in nature. Science may be the hobby of wealthy gentlemen who have time to dedicate to exploring their interests. | Education is still privately funded and the wealthy are the educated class. The idea of "public" education (freely available to the population and paid for through public tax money) is gaining ground as more people move to cities, but it is still not widely available.<br><br>Boys are better educated than girls, especially at higher levels of education. | By the end of the 1900s, tax-payer supported public school education through high school is provided in most developed countries. While private universities still exist and thrive, state universities and government loans allow most people, not just the wealthy, to afford higher education. Future scientists don't have to be from wealthy families to pursue a science education. Military service can also provide education and medical training. | Public education for boys and girls through high school is provided in most developed countries. Higher education may be accessible through public universities and government loan programs. Increasing numbers of women are highly educated and involved in research. |
| **Summary**:<br><br>Trend over time | Education becomes more and more accessible to the common person as public schools, funded by taxpayers, become available. Society supports an educated citizenry. | | | |

RESOURCE

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **MEDICAL PRACTITIONER**<br><br>Which diseases are prevalent?<br><br>What do doctors think causes them? | Isaac Dawson<br><br>Infectious diseases such as smallpox, cholera, scarlet fever, bubonic plague, and others.<br><br>Without a clear understanding of the root cause of disease (i.e., microbes are the cause of infection), actual cures are elusive. The well-established theory of the time that disease is caused by an imbalance of the four humors in the body leads to many treatments that may seem bizarre or ill-conceived to us now. | Joseph Lister<br><br>Infectious disease is a major cause of death during this time period, and scientists are responding to the need for cures and treatments. Major scientific discoveries (cell theory, germ theory, antiseptics, and vaccines) build on prior research to improve human health. | Alexander Fleming<br><br>Infectious diseases become less of a concern (thanks to new vaccines and treatments) and more attention is paid to chronic diseases such as heart and respiratory disease and cancer during this time.<br><br>As scientists better understand the role of DNA and genetics, the focus of research shifts to the chronic diseases that affect more and more people.<br><br>Infectious diseases are still a global problem, and emerging conditions like HIV/AIDS create a need for research in these areas. | Douglas Lowy<br><br>With cancer and other chronic diseases claiming so many lives during this time, scientific research focuses on these conditions. As the population ages, scientists also look at diseases common to older people (osteoporosis, heart disease, Alzheimer's, etc.).<br><br>Molecular biology and stem cell research are both important research fields.<br><br>Infectious diseases are still a global problem; many researchers work in that area. |
| **Summary:**<br><br>Trend over time | Fewer people die from infectious diseases and more people begin to die from to chronic diseases in developed countries. (This section also shows how the prevalent theories of the time influence diagnosis and treatment. For example, physicians who believe illness is caused by an imbalance in the four humors would not acknowledge the existence of germs as the cause of illness.)<br><br>Scientific research priorities shift to reflect needs. | | | |

RESOURCE

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **SCIENTIST**<br><br>How do scientists build on prior work? | Robert Hooke<br><br>Robert Hooke depended on the new technology of grinding lenses to view things with a microscope. Though not mentioned in the lesson, Hooke also reviewed the work of Leeuwenhoek, the Dutch microscope maker. | Louis Pasteur<br><br>Louis Pasteur relied on microscopes for his studies of germs and vaccines. He was building on the technological work of Robert Hooke and others. | Jonas Salk<br><br>Jonas Salk continued to build on the vaccine research done by Louis Pasteur. The microscope was indispensable. | Nora Disis<br><br>As she works on a vaccine for a chronic disease, Nora Disis is building on the findings of Pasteur, Salk and others. Microscopy is still an essential technology. |
| **Summary:**<br><br>Trend over time | Though a scientist may not know how his research will be applied in the future, new scientific knowledge and technological developments often propel the research process forward. | | | |

RESOURCE

| | 1700s | 1800s | 1900s | 2000s |
|---|---|---|---|---|
| **PERSON with DIABETES**<br><br>How is diabetes identified and treated? | Elizabeth Snell<br><br>The disease may or may not have been diagnosed as "diabetes," a disease for which there was a name but no meaningful treatment. In 1674, an English doctor named Thomas Willis observed patients with diabetes. He described their urine as "wonderfully sweet, as if it were imbued with honey or sugar."<br><br>It is unknown how much medical care a rural farmer in the 1700s might have received; without a name, cause, cure, or treatment, diabetes may have been one of the many causes of premature death at that time. | Mary Roberts<br><br>Diabetes could be diagnosed. In this case, the patient had access to medical care, but without knowing the underlying cause of the condition, treatment was generally unsuccessful. | James Walker<br><br>The link between insulin and diabetes is established, and treatments, though rudimentary, address the mechanisms of diabetes. Effects of the disease can be serious, but for the first time diabetes may not be deadly. | Aubrey Mathwig<br><br>With an understanding of diabetes and a known treatment, diabetes is no longer fatal, if treated. Blood glucose testing and insulin delivery mechanisms are improving over time. Researchers are still very active in this area, however, trying to find out why and how the pancreas stops producing enough insulin or the body can't use the insulin produced. Some diabetics now wear an insulin pump, rather than injecting themselves daily. Future treatments include stem cell transplants, pancreas transplants, or pancreatic cell transplantation. |
| **Summary:**<br><br>Trend over time | As the medical/research community learned more about the underlying cause of diabetes, targeted treatments could be developed. The life expectancy of people with diabetes has increased. | | | |

RESOURCE

# TEACHER RESOURCE 3.1

## Science through the Centuries Cards

### CITIZEN OF THE 1700s

My name is **Mary Walker** and I am a typical citizen of the 1700s. I am 16 years old. I have two older sisters, a younger brother, and two siblings who died as babies. Most people are farmers, and many boys go to school, at least for a few years. I was taught some at home, but many of my friends don't know how to read or write. If my brother wants more school, he'll have to go into the ministry because the church supports most education. This isn't likely, though, because somebody will have to take over the family farm.

### MEDICAL PRACTITIONER OF THE 1700s

My name is **Isaac Dawson** and I practice medicine. Many people in our community (about one in three) die as infants or toddlers. If you live to be a teenager, you have a good chance of living to be as old as 50 or 60. Most of my patients die of smallpox, cholera, bubonic plague, scarlet fever, or tuberculosis. I believe that illness is caused by bad air or an imbalance of blood, phlegm, yellow bile, and black bile in the body. I use treatments that have been around for thousands of years, such as herbs, suction cups, and "bleeding" to cure disease.

### SCIENTIST OF THE 1700s

My name is **Robert Hooke**. I was educated at home in England by my father, a churchman, and sent away to school at the age of 13. I am an old man now, but I've seen lots of scientific advancements. Our lens grinding techniques are now good enough to make two important research tools: telescopes and microscopes. Using a microscope, I was able to see very small things such as plant "cells." The public doesn't always understand my work, though, and I have been publicly ridiculed for spending so much money on microscopes just to see "mites in cheese." I think this is important work that may change science and medicine!

### PERSON WITH DIABETES IN THE 1700s

My name is **Elizabeth Snell** and I am 27 years old. My husband is a farmer. I've had eight children, though only four are living now – one boy and three girls. One baby died before he was a week old, and I lost two children to smallpox when it spread through our village this year. My second son, though, that was the strangest thing. William was always hungry and we could hardly get enough food to feed him, but he stayed so skinny. He complained all the time of being tired and one day couldn't get out of bed. Maybe his body had too much black bile, I don't know. One evening we couldn't wake him up and by morning he was gone.

## CITIZEN OF THE 1800s

My name is **Samuel Christian** and I am a typical citizen of the 1800s. I am an old man at the age of 52. I am a farmer, but our family's land was not big enough to support everybody, so my younger brothers and their families moved to the city years ago to work in a factory. They are making a living, but I hear that they all live crammed together in one small apartment. I can read and write some, but it's mostly the landowners and wealthy people who are truly "educated" since they are the only people who can afford it. I've heard that free public elementary education might be available for all American children soon—now that more people are moving to cities, some people think that free education will create good citizens, unite society, and prevent crime and poverty.

## MEDICAL PRACTITIONER OF THE 1800s

My name is **Joseph Lister**, and I am a well-educated surgeon. Most people of this time die from diseases such as smallpox, cholera, scarlet fever, or tuberculosis. As a surgeon, I see a lot of women and babies die from infections after childbirth. I have heard of Louis Pasteur's work with "germs" and think they could be the cause of infection, not chemical changes due to "bad air" as most people think. Right now, many of the surgeons I work with don't even wash their tools or hands between surgeries. I'm now working on an antiseptic to kill germs on surgical tools, which may reduce infections from operations. Thanks to microscopes, one of my colleagues has discovered that both tuberculosis and cholera are caused by small living things—bacteria.
[**Note:** The popular antiseptic mouthwash *Listerine* is named after Joseph Lister.]

## SCIENTIST OF THE 1800s

My name is **Louis Pasteur** and I am the son of a French tanner. My wife and I had five children, but three of them died of typhoid. After that heartache, I have dedicated my life to curing disease, and I would like to thank my university, which often gave me financial support for my studies. Many people still think that disease is caused by bad air, but I have proven that disease is caused by microscopic organisms. I'm calling them "germs." I think these germs are also responsible for spoiling milk and beer. I'm now working on a vaccination for rabies and for anthrax, which kill many domestic animals. Without microscopes and people like **Robert Hooke** who pioneered them, I wouldn't be able to do this work.
[**Note:** The process of pasteurizing milk is named after Louis Pasteur.]

RESOURCE

## PERSON WITH DIABETES IN THE 1800s

Hello, I am **Mary Roberts** and I am 14 years old. My father is a banker. My mother mostly entertains, but lately she hasn't even been doing that. That's because my eight year old sister got sick. The doctor came a couple of months ago and he said she has the diabetes. Since then, they have tried giving her opium and bleeding her with leeches. Now, the doctor won't let my mother feed her hardly anything – just some broth and black coffee. I'm not allowed to go in her room any more but I peeked in this morning. She doesn't look good! Her eyes are closed and she is real skinny.

## CITIZEN OF THE 1900s

My name is **Pearl McKinley** and I am a citizen of the 1900s. I'm 96 now and I've seen a lot of changes! I grew up on a small family farm, but now most people rely on manufacturing jobs. Think of all the things that have been invented in my lifetime: television, credit cards, cell phones, dishwashers, contact lenses, ball point pens, frozen pizza, cars, microwave ovens, CDs, computers, fast food…the list goes on and on. When I was born, only about six percent of the population graduated from high school. Now, about 85 percent do! More and more people go to college now, too. Every child in the U.S. can get a free education now, at least through high school, because public schools are supported by the government.

## MEDICAL PRACTITIONER OF THE 1900s

My name is **Alexander Fleming** and I am a medical doctor. It's not uncommon now for people to live until their mid-70s or later, at least in developed countries. During World War I, I saw how easily deep wounds became infected, even though we used sterilization techniques developed by **Joseph Lister** and others. After the war, I began looking for antibacterial agents that would lead to a treatment. After accidentally leaving bacteria cultures to mold, I noticed that the colonies closest to the mold had been destroyed. This led to the discovery of penicillin which has become an early antibiotic and eventually led to treatments for scarlet fever, cholera, tuberculosis, bubonic plague, and other diseases. I, Alexander Fleming, will die of a heart attack as will many others. Chronic diseases involving the heart and respiratory systems will take their toll as people live longer. Cancer will also affect people all over the world.

## SCIENTIST OF THE 1900s

My name is **Jonas Salk**. and I was born to immigrants who were determined that I would have a good education. I went to public schools and was the first in my family to go to college. I attended a college in New York for students from working class, immigrant families, then on to medical school. During work on a project funded by a foundation (known as the March of Dimes), my research team and I developed the first effective vaccine against polio. Other researchers developed vaccines for smallpox, measles, mumps, rubella, and many other diseases reducing deaths and disfigurement drastically during this time period. We are all building on the early vaccine work of **Louis Pasteur** and others.

## PERSON WITH DIABETES IN THE 1900s

My name is **James Walker**. I am 25 years old. I was diagnosed with diabetes when I was 16 years old, in 1948. Doctors now know that diabetes is caused by a lack of insulin, so I watch what I eat and use insulin to control my blood sugar, which is really difficult. I have to give myself insulin shots several times a day; then the needle and syringe need to be washed and sterilized in boiling water. It's a big needle, too! I even have to sharpen it regularly. The only way to really know my blood sugar levels is to go to the hospital. Once I got a sore on my foot that turned into an ulcer, and I didn't even know it! The doctor said if I had waited any longer to see him I might have lost my foot. At least I'm not allergic to the insulin I use; I've read about some people who are.

## CITIZEN OF THE 2000s

My name is **Andrew Hayes** and I am a typical citizen of the 2000s. In the U.S. now, most workers provide some sort of service like health care, education, business, or retail. In developing countries, many people farm, though other types of jobs are becoming more common as developed countries move industries overseas. In the U.S., most people graduate from government-supported public high school, and the majority go on to college or trade school, too, though they may have to pay for part or all of it. Online education is becoming more popular and people now get a lot of their information through technology.

## MEDICAL PRACTITIONER OF THE 2000s

My name is **Dr. Douglas Lowy**. Our global life expectancy is about 67 years, though it is not uncommon for people in developed countries to live into their nineties. After studying art history and French and getting my medical degree, I began a career in basic science research at the National Cancer Institute (NCI). My work eventually led to two vaccines for cervical cancer. I am familiar with the work of **Dr. Nora Disis**, who is also working with cancer vaccines. All my work is federally funded through the NCI. As people are living longer, chronic diseases are the source of many health issues. Worldwide, the top health-related causes of death are heart disease and stroke, respiratory infections, pulmonary disease, diarrheal disease, and HIV/AIDS. Diabetes is the ninth cause of death globally. More health concerns are related to diet and access to healthy foods and clean water.

## SCIENTIST OF THE 2000s

My name is **Dr. Nora Disis** and I am a medical doctor and researcher interested in women's health, specifically breast and ovarian cancer. I discovered a tumor antigen which led me to develop cancer vaccines. In the past, vaccines made by famous researchers like **Jonas Salk** (1900s) fought infectious diseases like smallpox and polio, so my work using vaccines against cancer is pretty new! I work with the Tumor Vaccine Group in Seattle and rely on research grants from the U.S. government along with many other funding sources.

RESOURCE

## PERSON WITH DIABETES IN THE 2000s

My name is **Aubrey Mathwig**. I am 25 years old and have Type I Diabetes. I was diagnosed a few years ago when I was drinking two gallons of water every day but was extremely thirsty at all hours. I also was losing weight rapidly and was exhausted all the time. Things in my life have changed since then. First, I have to monitor my blood sugar throughout the day, every day, which can get tedious. I also have to give myself a shot of insulin each time before I eat, and once before bed. I have to be prepared at all times by traveling with insulin, needles, etc., along with a fast-acting carbohydrate in case my blood sugar gets low. Even with this disease, my future is bright as long as I consistently keep on top of my blood sugar levels and take good care of myself.