- Re-create a famous experiment that once caused biologists to believe in the theory that life spontaneously arose from non-living matter. Have the students gather a handful of grass or other plant clippings, and place the clippings in a container of tap water. Use a sealed container of plain tap water as a control. Wait a week, and then use a microscope to search for microorganisms in both water samples. As the students observe the microorganisms in the water, ask them to discuss their origin. Did the microorganisms spontaneously arise?
- Have students re-create the debate over antiseptic hospital conditions. Assign students to research the career of Dr. Joseph Lister, who became famous by advocating antiseptic practices based on the work of Pasteur. Ask students to pair off and have one play the part of Lister and another an opposing surgeon. Ask the pairs of students to debate the merits of antiseptic surgery. To help with student research on why so many doctors opposed Pasteur's ideas, ask them to visit the following Web page: www.accessexcellence.org/AE/AEC/CC/hand_background.html.
- Ask students to imagine a colony of 10 microbes that doubles every 20 minutes. Have students calculate how many microbes will be in the colony after two hours. Based on this information, have each student guess how long it would take for the colony to surpass one million organisms. Then ask the students to do the computation and compare their guesses with the calculated time.
- Have students view prepared slides of various substances under a microscope. Ask students to write down their observations and compare what they see under the microscope to what they see with the naked eye. Ask students to discuss the new world that the microscope enables us to see.

Suggested Internet Resources

Periodically, Internet Resources are updated on our Web site at www.LibraryVideo.com

- **www.kidshealth.org/kid/health_problems/infection/rabies.html**
  This KidsHealth site provides a Rabies Reference page for young people.
- **www.amnh.org/nationalcenter/infection/index.html**
  "Infection Detection Protection" is a Web site hosted by the American Museum of Natural History containing a great deal of information about microbes and their effect on our lives. Several interactive games that teach about bacteria are also included.
- **www.labexplorer.com/louis_pasteur.htm**
  This LabExplorer page contains an excellent explanation of the history of the scientific work of Louis Pasteur.

TEACHER'S GUIDE

Suggested Print Resources

- Landau, Elaine. *Rabies.* Lodestar Books, New York, NY; 1993.
- McTavish, Douglas. *Joseph Lister.* Bookwright Press, New York, NY; 1992.
- Smith, Linda Wasmer. *Louis Pasteur: Disease Fighter.* Enslow Publishers, Berkeley Heights, NJ; 1997.

TEACHER'S GUIDE CONSULTANT

Jim Quinn
Writer-in-Residence, National Inventors Hall of Fame

COMPLETE LIST OF TITLES

- **ALEXANDER GRAHAM BELL**
- **GEORGE WASHINGTON CARVER**
- **LEONARDO DA VINCI**
- **THOMAS EDISON**
- **HENRY FORD**
- **BENJAMIN FRANKLIN**
- **A HISTORY OF INVENTION**
- **INVENTING IN TODAY'S WORLD**
- **LOUIS PASTEUR**
- **JAMES WATT**
- **ELI WHITNEY**
- **THE WRIGHT BROTHERS**

Teacher's Guides Included and Available Online at:

libraryvideo.com

800-843-3620

SCHLESSINGER MEDIA — A DIVISION OF LIBRARY VIDEO COMPANY

TEACHER'S GUIDE

Inventors of the World

LOUIS PASTEUR

This guide is a supplement designed for teachers to use when presenting programs in the video series *Inventors of the World.*

This series focuses on famous inventors who have helped change the course of history with their groundbreaking ideas. Programs in this series stress that the process of inventing is much more than a quick "eureka" moment and is more likely the culmination of a great deal of hard work and experimentation. These programs also dispel the notion that advancements in science occur only due to the work of a lone, isolated genius and illustrate how the great inventors of history often "stood on the shoulders of giants" and improved upon the work of others. In addition to documenting the inventors and their process of invention, this series also highlights how new technologies influenced society at the time of their inception and how they continue to shape our modern world.

SCHLESSINGER MEDIA — A DIVISION OF LIBRARY VIDEO COMPANY

Historical Overview

The 19th century saw profound, dramatic advancements made in medicine and biological science, and many of these improvements can be credited to the French scientist, Louis Pasteur. When Pasteur began his research, physicians operated more as craftspeople than as scientists. They practiced medicine with a wide range of therapeutic techniques developed over the years, but they made little effort to determine which techniques were valid and which ones were not. Pasteur demonstrated forcefully with several groundbreaking discoveries that rigorous scientific standards could be applied to medical practice. These developments include his theory about the role of germs in causing disease, pasteurization, the rabies vaccine and antiseptic medical practices that revolutionized hospital care.

Pasteur's influences outside the field of medicine were just as dramatic. When he began his career, biologists had only a rudimentary awareness of the presence of microscopic organisms in the natural world and did not realize the significance that these microbes had in human affairs. By developing techniques that revealed the action of microbes in processes like fermentation, disease and the spoilage of food, Pasteur profoundly advanced our understanding of the natural world and gave birth to the new science of microbiology.

Time Line

1822 — Louis Pasteur is born in Dole, France.

1857 — Pasteur begins writing about the role of microbes in fermentation.

1862 — Pasteur begins experiments that lead to the germ theory of disease.

1864 — Pasteur invents the process of pasteurization.

1865 — Pasteur begins investigating a disease that kills silkworms.

1877 — Pasteur develops his theory about the role of germs in causing disease.

1879 — During his work with chicken cholera, Pasteur discovers that weakened bacteria can provide immunity against disease.

1885 — The first successful use of the rabies vaccine by Pasteur.

1888 — The Pasteur Institute is established in Paris.

1895 — Louis Pasteur dies at age 73.

Vocabulary

germs — Microorganisms that cause disease.

rabies — A serious disease caused by a virus that attacks the nervous system.

microbes — Small living things that cannot be seen without a microscope.

crystals — Solids that have molecules arranged in repeating patterns, forming particular geometric shapes. ***(Continued)***

fermentation — The process that occurs when yeast converts sugar into alcohol.

yeast — A type of fungus used primarily in the making of alcoholic beverages and in baking.

microbiology — The science of studying microbes.

pasteurization — A process that uses heat to destroy microorganisms which cause spoilage in food.

antiseptic — Substances that kill harmful germs.

sterilize — To make a substance free from living microorganisms.

cholera — A type of disease that occurs in people and animals that is characterized by severe stomach problems.

smallpox — A diseases caused by a virus that is characterized by fever and a severe skin rash.

vaccine — An injection of material that causes the body to develop immunity against a disease.

central nervous system — The nerve cells that make up the brain and spinal cord, which receive messages from our senses and send decisions or messages in the form of electrical impulses to muscles to make them move.

Pre-viewing Discussion

- Ask students to imagine that they have been transported back to the middle of the 19th century to a time when people lived in crowded cities with inadequate sewer and water systems. Inform students that people were almost powerless to prevent the spread of disease until Pasteur and the age of vaccination and the public health movement. Ask students to brainstorm and discuss a plan to improve the health of people living in a typical large urban center of this time period. Students can also compare opportunities and problems of 19th-century families in large cities to those who live in urban America today.
- The fact that microorganisms are impossible to see without microscopes explains why it took so long for Pasteur and others to recognize the role that they play in the natural world. Ask students to relate different ways by which they know microorganisms are present in their world, e.g., the spoilage of food, the conversion of milk into cheese and the decomposition of leaves and other plant material. Take a poll: are all microorganisms bad?
- Ask students what they know about vaccines. Ask students to speculate on what is happening in their bodies when they receive a shot for the measles, mumps, chicken pox or some other childhood disease.

Focus Questions

1. Why was Joseph Meister brought to Louis Pasteur's laboratory?
2. What did many people in the past believe was the origin of bugs, maggots and beetles? ***(Continued)***

3. What role did the microscope play in Pasteur's work?
4. What did Pasteur discover about yeast and fermentation?
5. What is pasteurization? How does it work?
6. What did Pasteur discover about how healthy silkworms were getting sick?
7. Who was Joseph Lister? What did he discover?
8. What was the significance of Pasteur's work with chicken cholera?
9. Who was Edward Jenner? What did he contribute to our knowledge of medicine?
10. What does the Institut Pasteur do?

Follow-up Discussion

- The development of the germ theory provided us with solid evidence on the role of microorganisms in causing disease. What steps could students take in their lives to minimize their chances of getting sick or getting an infection?
- A famous quote by Pasteur is the phrase, "Chance favors only the prepared mind." Ask students to interpret Pasteur's remark and discuss what he meant. How would students relate this statement to Pasteur's work with chicken cholera and his discovery of the idea of using weakened microbes in the process of vaccination.
- Many important 19th-century medical advancements are credited to Europeans like Pasteur, Joseph Lister and Robert Koch. One of Koch's pupils, American Joseph Kinyoun, studied at the Institut Pasteur and in Germany before returning to America to start the first public health research center. Ask students to discuss the importance of different cultures sharing and communicating scientific developments and how other scientific ideas have changed the way people perceive their world.

Follow-up Activities

- Challenge pairs of students to investigate the history of an invention that helps them when they are sick or helps keep them healthy. Some examples are toothpaste, eyeglasses, antibiotics, microscopes and plastic bandage strips. Instruct them to work together and construct a time line of inventions to display in the classroom.
- Demonstrate the activity of yeast by baking bread. Obtain the ingredients for making bread and prepare a batch in the morning. Prepare a batch without yeast as a control. Set the two types of dough aside and have the students monitor them. Ask students to reflect on what they know about Pasteur and his work with fermentation, and to hypothesize what is happening to the dough with the yeast in comparison to the dough without the yeast. The teacher may point out that the distinctive aroma of baking bread is caused, in part, by the smell of alcohol produced by the yeast. The heat of the oven forces the alcohol to evaporate, contributing to the smell of baking. ***(Continued)***