

Activity Guide



River of Death:

The Lowell Typhoid

Epidemic of 1890- 1891



University of Massachusetts Lowell
Graduate School of Education

Lowell National Historical Park

**Connections to
National
Standards and
State
Curriculum
Frameworks**

National Science Standards (appropriate grades listed):

Science as Inquiry

- Identify questions that can be answered through scientific investigations (5 – 8)
- Design and conduct a scientific investigation (5 – 8, 9 – 12)
- Think critically and logically to make the relationships between evidence and explanations (5 – 8)
- Understandings about scientific inquiry (9 – 12)

Life Science

- Structure and function in living systems (5 – 8)
- The interdependence of organisms (9 – 12)

Science in Personal and Social Perspective (5 – 8)

- Personal Health (5 – 8)
- Personal and community Health (9 – 12)
- Populations, Resources, and Environments (5 – 8)
- Environmental Quality (9 – 12)
- Natural and Human-Induced Hazards (9 – 12)
- Risks and benefits (5 – 8)

History and Nature of Science (grades 5 – 8)

- Science as a Human Endeavor (5 – 8, 9 – 12)
- Nature of Science (5 – 8)
- History of Science (5 – 8)
- Nature of Scientific Knowledge (9 – 12)
- Historical Perspectives (9 – 12)

Massachusetts Curriculum Standards:

Grades 6-8:

Life Science (Biology) Standard #2

Life Science (Biology) Standard #6

Comprehensive Health Standard #8.5

Comprehensive Health Standard #8.9

Comprehensive Health Standard #13.3

Comprehensive Health Standard #13.2

Comprehensive Health Standard #14.6

Comprehensive Health Standard #14.a (Interdisciplinary Learning Objectives: Community and Public Health).

Mathematics Standard # 6.D.2 and #8.D.2

English/Language Arts: Composition Strands 20.4, 23.8, 23.10, and 24.3

Grade 9:

Biology #2.8

Biology #6.2

U.S. History II: #USII.2, parts A, B, and C

Comprehensive Health Standard #8.14

Comprehensive Health Standard #8.19

Comprehensive Health Standard #8.c (Interdisciplinary Learning Objectives: Disease Prevention and Control)

Comprehensive Health Standard #14.10

Comprehensive Health Standards #14.b – 14.e (Interdisciplinary Learning Objectives: Disease Prevention and Control)



River of Death

Program Description

The *River of Death* is a Tsongas Industrial History Center outreach education program. It is designed for grades 6 – 9 and is presented in your classroom by a Tsongas Center Museum Teacher. The program is flexible in time frame; it can be abbreviated for a 45 minute class or expanded for a 60 minute class. Although science-based, it is an interdisciplinary (science, history, health) program that combines descriptive pieces, a safe and simple hands-on lab activity, use of primary source material, and class discussion. While a lab classroom is helpful, it is not essential. Students need only minimal background in bacteria and disease. The program has numerous connections to educational standards which are listed after the post-visit activities.

Program Themes

All that we consider “modern” was shaped significantly by the Industrial Revolution, whether it be in technology, politics, art, culture, or the nature of work itself.

The *River of Death* program focuses on the typhoid epidemic that occurred in the city of Lowell, Massachusetts, during late 1890 and early 1891. The epidemic struck hundreds before its mysterious origins and mode of spread were finally uncovered. Using the epidemic as a case study, the program blends the themes of 19th century industrialization, urbanization, use and misuse of natural resources, and developments in medical knowledge to illustrate the emergence of the important field of public health. It emphasizes both the historical context of the epidemic and the scientific methodology that was used to “crack the case.” It concludes with a class discussion of what was learned from the unfortunate episode and the significance of that knowledge for us today.

Program Objectives

After participating in the Ranger/Museum Teacher led *River of Death* program and using the activities in this guide, students will be able to

- Explain what typhoid fever is and how it can be transmitted.
- Explain how the growth of the Industrial Revolution resulted in conditions in 1890s Lowell that enabled the disease to thrive and spread.
- State and explain Dr Sedgwick’s recommendation to the Lowell City Council.
- Define Public Health and describe some things that public health workers do.
- Summarize the importance of Public Health for the individual as well as the group.



Pre-Visit Activities

1. The Basics.

To prepare students for the *River of Death* program, review basic concepts of bacterial and viral pathogens using the questions below as a guide:

- What is a bacterium? What is a virus? What are the differences between them?
- What are some ways bacteria or viruses enter the body?
- What kinds of effects can bacteria or viruses have on humans? Name some illnesses that are known to be caused by each.
- Discuss ways the body fights disease.

Some vocabulary to review (definitions are given at the end of this unit):

Antibiotic	Pandemic
Contaminated	Pathogen
Epidemic	Population density
Epidemiology	Proximity
Endemic	Rural
Immune system	Septic
Industrialization	Urban
Infectious Disease	Urbanization
Mitosis	Vaccination
Noninfectious Disease	Vaccine

2. Going the Distance: the effect of population density on the spread of disease.

Before the Industrial Revolution, most people lived with their families on their own farm in rural settings. For the most part they had daily contact only with other family members. Contact with those outside the farm occurred much less frequently, limited by the distances between farms and nearby towns and the slowness and difficulty of travel. As a result, the density of population tended to be very low. This simple activity demonstrates how the density of a population can affect the rate at which disease germs spread and thus determine whether an outbreak of illness will become an epidemic, a rapidly growing outbreak that results in much higher than expected incidence of a particular disease.

Setting up the activity: Explain to students that population density, the number of people living in a particular sized area (such as a square mile), is a factor in the rate at which a disease can spread and, thus, in the size of an epidemic. The more people come into contact with each other, the more likely they are to pass on disease and the quicker the disease will reach epidemic proportions. In this activity we will see how, when people began to move away from their farms and into the cities during the 19th century, the rates of disease spread changed.

Step 1: Students divide into four groups and each group stands in a different corner of the classroom. Each group represents a farm family living on its farm, separated by about 5 miles of distance to the group on each side. Students may turn in place but not move their feet; this symbolizes the slowness of travel and the rarity of contact between different farms.

Step 2: One student is selected to be the first person in one of the farm families to get sick. This person must stand in place and shake hands with the family member closest to her. The shaking of hands indicates that the disease has been transferred. That family member in turn shakes hands with the closest person to him. What happens to that family? Soon they have all become sick. But because the distance between the “sick” farm and the other farms is so great, the people in the other farms do not get sick.

Step 3: Reset the scenario so that all students are now well. But their farms are not doing so well economically. So they all move into the city, located in the center of the room, to get jobs and places to live. Have all students move to the center of the room and stand very close together. Now they are packed into the city and they have more contact not just with their own family members but with all the other families, as well.

Step 4: Select a new student to become sick, and have that person begin shaking hands again. But now, so many more people are close by...what happens to the number of people he can contact and pass the disease on to? It increases rapidly. Not only that, but everyone that he shakes hands with can turn and shake hands with someone else. It will not be long before everyone in the “city” is “sick”! YOU HAVE AN EPIDEMIC!!

Questions for class discussion:

- What were the factors that prevented the spread of the disease in the first scenario?
- What changed when all the people began moving to the city, increasing the proximity of more possible victims?
- What is the relationship between the number of people who get sick and the population density?
- Urban is the adjective used to mean associated with the city. Rural is the adjective that refers to the countryside where farms would be found. Which of these two environments would tend to be more vulnerable to an epidemic, and why?
- Urbanization is the general term used to indicate the growth of a city. In addition to increased possibility of disease, what other changes do you think urbanization brings to an area and the people who live there?



Post-Visit Activities

1. Sedgwick's Report to the Water Board of Lowell.

This activity incorporates the material presented to students during the *River of Death* program with practice in language arts. Students exercise their writing skills by synthesizing the information they have learned and creating their own version of Sedgwick's "Report to the Water Board of Lowell," a branch of the Lowell City Council that oversaw water-related issues. This activity can be done either individually or in the groups in which the students worked when they did the program. If the reports are done in groups, they can be shared with the class upon completion. As each report is read, the rest of the class can act as the Board, deciding if the report is persuasive enough to move the Board to action.

Emphasize to students that their task in writing this report is to present their investigation and then make their recommendation to the Board as to what specific actions they think should be taken. Their arguments must be clear, logical and persuasive. They should be based not upon conjecture or assumption but upon the results they obtained in a scientific investigation and what, in their expert opinion, those results mean.

Their report should include:

- A brief description of the problem in Lowell
- The task you were asked by the Board to take on
- Your approach/steps to solving the mystery
- Your results, summarized
- Your recommendation to the Board, based upon your results.

You may want to limit them to one page in length, which will encourage them to be precise.

2. Primary source document: Report of the Water Board.

In late 1891, after the epidemic, the Water Board published its “Annual Report to the Lowell City Council,” which became part of the public record. Based on Sedgwick’s findings, the Board wrote this paragraph as part of its report:

Danger is as present with us in the daily routine of our peaceful lives as on the battlefield, only that the embodiment of danger is an invisible and intangible germ instead of a fast-flying bullet. It flows beside us in the river, in our mains, from the taps in our houses; the germ of disease may not be in this pitcherful or in that, but it will find us some day if we continue to use the water which contains it. About one victim in Lowell is taken daily, and as the average duration of this fever is about a month, there are always 30 persons in this city whose lives are trembling in the balance...

Class Discussion:

- From the language that the Board uses, how would you characterize this paragraph, and what does the Board hope to achieve by including it in its Report?
- How does the Board use metaphor effectively in its writing?
- What do you think the effect upon the citizens of Lowell was when they read the paragraph?

3. What the data show...

The Student Activity Sheet on page 7 contains a table of data compiled by Sedgwick and published in his 1892 Report to the State Board of Health: “On Recent Epidemics of Typhoid Fever in the Cities of Lowell and Lawrence due to Infected Water Supply.” The data show the death rate from typhoid fever in three cities along the Merrimack River during the period July, 1890 through March 1891. Use the table and the questions that follow to give your students practice in data management and analysis.

Note: An Answer Key for part B is provided on page 8.

Death Rate per 100,000 Population for Three Merrimack Cities

City	July 1890	Aug 1890	Sept 1890	Oct 1890	Nov 1890	Dec 1890	Jan 1891	Feb 1891	Mar 1891
Nashua, NH	0	0	0	0	0	0	0	5.3	0
Lowell, MA	7.8	7.8	12.9	12.9	36.6	32.3	24.6	18.1	12.9
Lawrence, MA	2.2	2.2	4.5	11.2	15.6	42.6	47	26.9	13.4

A. Explain what is meant by “Death Rate per 100,000 Population.” Why would Sedgwick use a death rate rather than just the number of deaths?

B. The actual populations of the three cities during the period in question were:

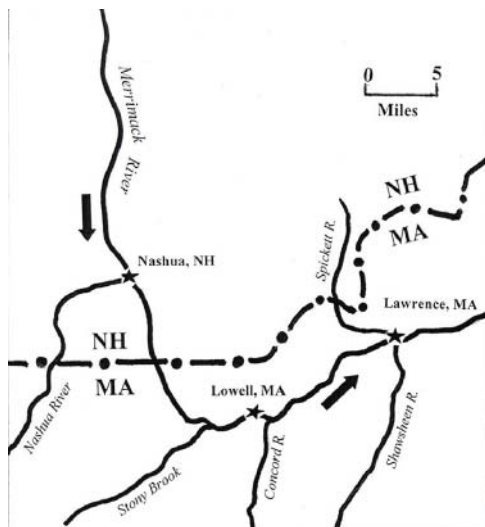
- Nashua, NH: 19,311
- Lowell, MA: 77,696
- Lawrence, MA: 44,654

Calculate the actual number of deaths that occurred in each city during each month. How will you set up the equation?

C. Graph the data in Sedgwick’s table using two different graphical representations (e.g., scatter plot, bar graph, etc.) to show:

- The development of the disease over time in each city
- A comparison of that development amongst the three cities

D. Now look at the map below, showing the portion of the Merrimack River that flows by the three cities:



Write a short paragraph about how the data in your graphs support Sedgwick’s findings about where the disease originated.

Answers to part B of Activity 2:

Number of Deaths from Typhoid Fever for Three Merrimack Cities

City	July 1890	Aug 1890	Sept 1890	Oct 1890	Nov 1890	Dec 1890	Jan 1891	Feb 1891	Mar 1891
Nashua, NH	0	0	0	0	0	0	0	1	0
Lowell, MA	6	6	10	10	28	25	19	14	10
Lawrence, MA	1	1	2	5	7	19	21	12	6

3. What is Public Health all about?

For Teachers: Students, especially at the middle school level, are frequently intrigued by stories of diseases, what they do to people, how they spread and how they are fought. Teachers and students sometimes question how diseases are studied and managed, which belongs to the broader field of public health. Students often think they must become medical doctors in order to participate in the public health community, but this is not the case. There are many ways in which people become engaged in public health work, requiring a broad range of skills, abilities, and backgrounds. This activity is designed to encourage students to investigate these ways, following their own interests and imagining themselves in various roles as public health workers.

The Student Information Sheet below can be printed and passed out to your class to help them in their research. Note: the internet sources listed at the end of the sheet can also be used for Post-Visit Activity #4.

As students work on their job descriptions, a suggestion (especially for older students) is to have them structure their job descriptions as job listings, for example using the heading “Exciting Employment Opportunity!” They can then list all the information about the job, even including possible salary, based on their research of what the job might pay. The “Want Ads” can then be posted on a bulletin board for all students to peruse.

Student Information Sheet: What is Public Health?

The field of public health is a very diverse and important one. It can also be a very exciting field to work in! What is the field of public health all about and what might your job be like as a worker in that field? Using resources approved by your teacher (some suggestions are given below), investigate the field of public health and try to find out what makes it so complex and why it is so important. Here are some questions to help get your thinking started:

- What kinds of things do workers in the public health field do?
- Who is the “patient” in public health: individuals or groups of people?
- What kind of education would I need in order to be a public health worker?
- What would I like to do as a public health worker? (More than one answer ENCOURAGED!)
- Why is public health important to me, even if I do not work in the field?

Now, make up your own questions about public health and investigate the answers. Then, using the information you have collected, choose a public health career you would like to pursue and write a “job description,” a paragraph that explains what your career choice is all about: what you will do, what skills and education you will need, and what you hope to accomplish.

Below are some suggested internet sources of information on both public health and various diseases.

<http://www.amnh.org/exhibitions/epidemic/> This is the American Museum of Natural History’s exhibit, “Epidemic! The world of infectious disease.”

<http://www.cdc.gov> This is the Centers for Disease Control and Prevention website. It has a great deal of information, but students may find it complex.

<http://www.whatispublichealth.org/resources/index.html> This is a public information website associated with the American Public Health Association

<http://www.healthypeople.gov/> This is a public information website from the U.S. Department of Health and Human Services.

<http://www.asph.org/document.cfm?page=200> This is a public information website of the Association of Schools of Public Health.

<http://phpartners.org/> This is a public information website of the Partners in Information Access for the Public Workforce, a “collaboration of U.S. government agencies, public health organizations, and health sciences libraries which provides timely, convenient access to selected public health resources on the Internet” (quoted material taken from www.whatispublichealth.org/resources).

www.pbs.org/wgbh/nova/sciencenow/ Click on a fascinating profile of the pandemic flu of 1918, and how researchers are using information from that tragedy to help them understand and prevent pandemics of the future.

Glossary of Terms:

Antibiotic: a chemical substance that is used as a medicine to fight bacteria infection.

Contaminated: having harmful substances that do not belong.

Epidemic: a higher-than-expected rate of occurrence of a disease in a population.

Epidemiology: the study of the spread and behavior of diseases in a population.

Endemic: the typical or expected rate of occurrence of a particular disease in a population, often high, but so frequent that it is not considered out of the ordinary.

Immune system: a system within the body that acts to fight disease and infection, and protect the body against their harmful effects.

Industrialization: The processes of technological development that bring about extensive social and economic changes in a society.

Infectious disease: a disease resulting from the infiltration into the body of some microbial pathogen (bacteria, viruses, etc.) that causes infection and harm. Note: a contagious disease is an infectious disease that can spread readily from person to person.

Mitosis: the process by which a single cell replicates its DNA and divides into two new cells that are genetically identical to the original cell.

Noninfectious disease: diseases that do not result from infection by a pathogen, for example, cancer.

Pandemic: the rapid spread of an infectious disease through a large human population such as a nation or the world.

Pathogen: a biological agent such as a harmful bacterium or virus that can invade and do damage to a living thing, plant or animal.

Population density: the number of people inhabiting a given area (such as a square mile or an acre) of land.

Proximity: the degree of closeness between people and/or objects.

Rural: having to do with the environment of the country, as opposed to the city. Rural areas are characterized by sparse housing, small towns or villages and low population densities. Frequently associated with farming areas.

Septic: having to do with infection, dirtiness, decay, or putrefaction. A septic system is the waste water disposal system for an individual home.

Urban: having to do with the environment of the city, as opposed to the country. Urban areas are characterized by dense living and working areas, large towns and cities and high population densities.

Urbanization: the collection of social, economic and demographic changes that occur as cities grow and become population centers.

Vaccination: the receiving of a medical preparation designed to prevent the onset of a particular disease(s), usually of the infectious type.

Vaccine: a medical preparation designed to prevent the onset of a particular disease, usually of the infectious type.



The Tsongas Industrial History Center is a joint educational enterprise sponsored by the University of Massachusetts Lowell and Lowell National Historical Park. Established in 1987, its goal is to encourage the teaching of industrial history in elementary and secondary schools.

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