Poison Pump

Using a series of clues, students solve a mystery to discover the source of a deadly illness in 19th Century London.

Level(s): 6-8

Subject(s): History; Life Science; Health

Virginia SOLs: 6.5 f, g; 6.7 f, g; 6.9 a, c

Objectives:
1. Students will be understand the importance to public health of a clean water supply.

2. Students will understand the danger of waterborne pathogens such as bacteria.

3. Students will understand some of the principles used to track the spread of an epidemic, and locate its source.

Materials: Each Group:
- *Broad Street Area Map* (a fictionalized representation of London streets in 1854).
- copies of *Victim Cards*
- copies of *Clue Cards*
- colored marking pens

Estimated Time: 50 minutes

Background Information:
Poison Pump Background Information, p.125.
Table 1: Summary of selected waterborne disease outbreaks, p.127.

Preparation:
Have copies of the Materials ready for student groups.

Activity Procedure:

1. Tell students that in 1854 a cholera epidemic broke out in the slums of London. Without mentioning water, describe the symptoms of cholera. Tell the class that throughout history this disease killed millions of people, and that hundreds died in the 1854 epidemic. One man, Dr. John Snow, discovered the source and stopped the epidemic.

2. Inform the class that they will be given the same information that Dr. Snow possessed and will try to solve the mysterious epidemic.

3. Divide the students into groups and give each group a *Broad Street Area Map*, a set of *Victim Cards*, and a marking pen. If after five minutes any group has not yet begun to mark the location of victims on the map, suggest this as a logical strategy.

4. Allow the class 20 minutes to fill out the map, study the *Victim Cards* and write down all common characteristics.

5. Ask any group if they have located the source of the epidemic. Without telling the groups whether they are right or wrong, ask how they arrived at their conclusions.

6. One at a time, have different students read the Clue Cards aloud. The cards reveal additional information uncovered by Dr. Snow. As more information is given, students will either confirm or revise their conclusions.

7. Tell students that the disease broke out in India prior to the London epidemic. Have students discuss how the disease might have traveled to the Broad Street pump.

8. Discuss with students how water treatment can prevent outbreaks of waterborne diseases such as cholera. Some students who have traveled abroad may have received a cholera vaccination. Why was this necessary?

Assessment Opportunities:

Quiz students on what they learned during the exercise:

1. How did cholera get into the water used by the people who lived on Broad Street?

2. Why are we unlikely to contract cholera living in North America?

3. What are the symptoms of cholera?

Extensions:

1. Do the activity *Mini Water Treatment Simulation.*

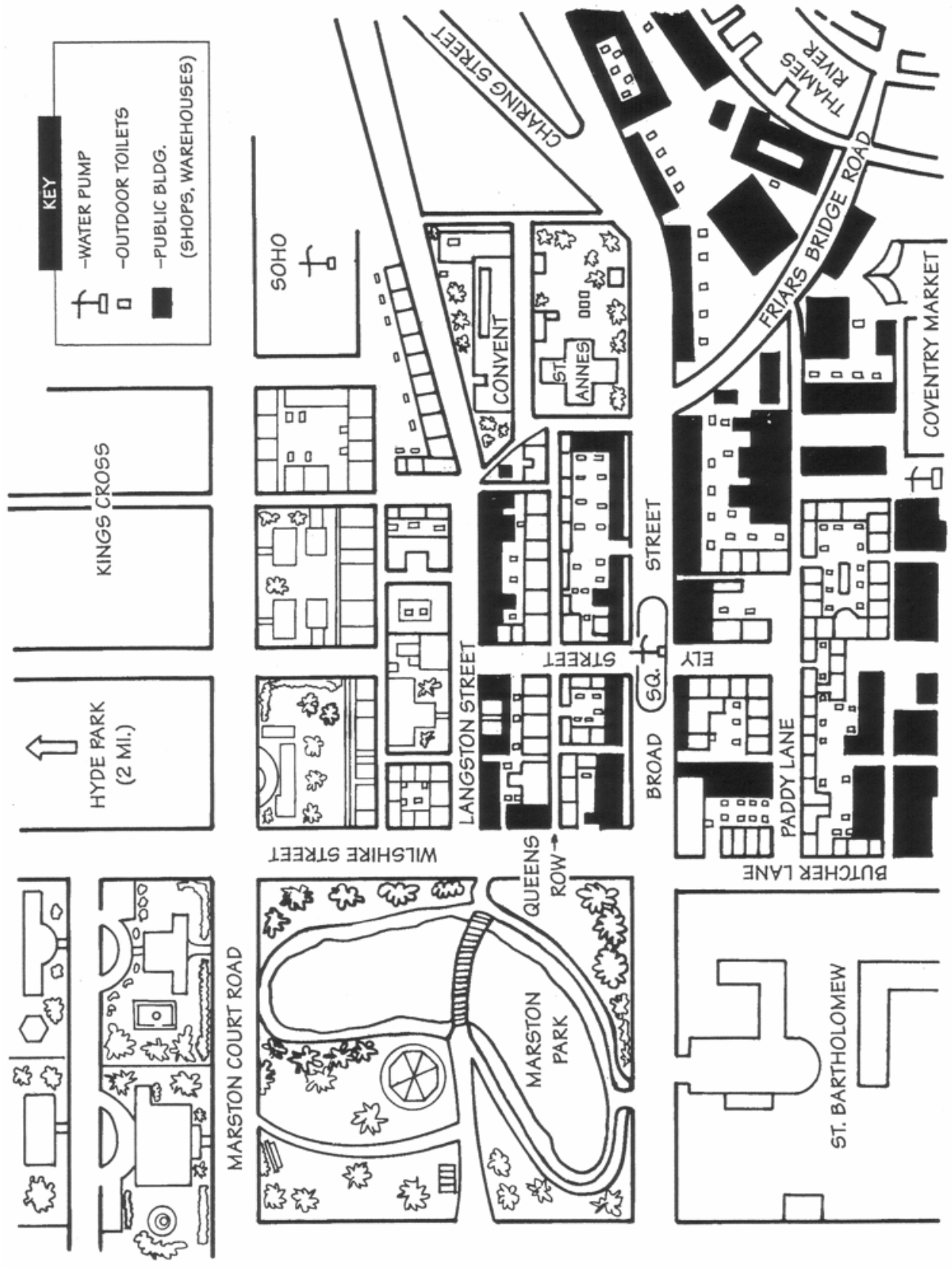
2. Research recent outbreaks of waterborne epidemics (e.g. Milwaukee, 1993)

Additional Reference Material:

EPA Publication, *Preventing Waterborne Disease*: http://www.epa.gov/nerlcwww/h2odis.pdf

From **Project WET Curriculum Guide**, pp.93-98

Broad Street Area Map



CLUE CARDS

#1

The people living around Broad Street are poor. Large families are crowded into on- and two-room apartments. None has indoor plumbing; residents use outdoor toilets and haul their water from the nearest public pump.

#2

Thomas Sutterfield fell ill two hours after stopping off to visit his great-aunt "Tilda". He had tea, biscuits and sausages with his great aunt. It was a hot day and he took a drink of cool water before leaving.

#3

Following his fight with another boy, Tolkly Martin washed the blood off his mouth at the Broad Street pump and ran off with a sausage stolen from the butcher shop.

#4

Matilda Wright refused to drink water from the faucets in her home. She would only drink the sweet-tasting water that her gardener hauled from the Broad Street pump.

#5

Ausley and Marthy Brown and their two children are the only people on Ely Street who didn't get cholera. Marthy's family lives in Soho. The Browns haul their water from the Soho pump, which allows them to visit their relatives

VICTIM CARDS

Thomas Sutterfield, Esquire, lawyer:

- Lives in Hyde Park with wife and two children
- Only member of his immediate family to contract cholera
- Won most recent case, defending a Broad Street butcher accused of selling spoiled meat.
- Recovering.

Matilda Wright, wealthy 90-year-old spinster:

- Lived alone (with her three servants) in the family mansion on Marston Court.
- Great-aunt of Thomas Sutterfield.
- Only member of the household to contract cholera.
- Died in a matter of hours.

Tolly Martin, 10 years old, professional pickpocket:

- Homeless orphan who slept in doorways around Soho Square.
- Occasionally roamed quite far from Soho looking for wealthier citizens to rob.
- Died of cholera two days after a fist fight in Broad Street Square.

Owen and Obedience Turner, and three children

- Lived on Paddy Lane behind butcher shop on Broad Street.
- Owen Turner, who was lame, earned small change cleaning up the day's slops at the butcher shop.
- Entire family died of cholera.

9 Families on Butcher Lane:

37 individuals dead; 8 recovering

12 families on Ely Street:

60 individuals dead; 10 recovering

Slye Children, ages 7, 8 and 10:

- Three of the eight fchildren of Gideon and Lucy Slye
- Gideon Slye is a Broad Street Butcher accused of selling spoiled meat.
- Sly family recently moved to Kings Cross from Broad Street and now have indoor plumbing.
- When not in school, three of the Slye children ofetn accoompanied their father to work and played on Broad Street Square.
- These three children are the only family members to contract cholera
- 2 died; 1 recovering.

Mucky Johnson, 18, delivery boy from Coventry Circle:

- Delivered seafood from Coventry Market to wealthy homes in Marston Street.
- Often stopped to eat lunch and talk to people on Broad Street Square; said the water from the Broad Street pump was the best in the city.
- Died.

John and Mary Canty, tinkers from Soho

- Pulled their cart through wealthy neighborhoods, mending pots and pans for the well-to-do.
- Often stopped to visit John's ailing mother who lived on Butcher Lane.
- Both died of cholera.

Twenty-five families on Queens Row:

89 individuals dead; 31 recovering.

18 Families on Paddy Lane:

83 individuals dead; 7 recovering

Poison Pump Background Information

From **Project WET Curriculum Guide**, pp. 93-94

Cholera is a disease caused by the *Vibrio cholerae* bacterium. The bacterium travels through untreated water contaminated by human or animal feces. Cholera is spread by sharing contaminated water or by eating contaminated food. Since the body does not produce a lasting immunity against the bacterium, the disease can be contracted more than once.

Cholera is characterized by rapid dehydration resulting from simultaneous vomiting, diarrhea and profuse perspiration. As victims dehydrate, their skin darkens, shrivels and loses its elasticity. Depending on general health, body mass, age, and amount of ingested bacteria, cholera victims may only suffer mild symptoms or can die in less than an hour.

In 1854, hundreds of people living in London died during a cholera epidemic. The disease spread from India to London on ships that carried contaminated drinking water. If a ship was known to carry the disease, the London port authorities refused to grant docking privileges. Rather than lose money on their cargo, some ship captains deceived the authorities by dumping contaminated water overboard into the Thames River, London's water source.

London was served by competing water companies in 1854. At least one, in an effort to cut costs, failed to adequately filter the river water being pumped into the city. While upper- and most middle-class citizens had indoor plumbing, the poor of London relied on public pumps for their water needs.

Dr. John Snow, considered the father of epidemiology, is credited with tracking and identifying the source and transmission agent of the 1854 cholera epidemic. The agent of the spread of the disease was found to be a Broad Street public pump.

Today, most people understand that unclean water carries organisms that cause disease, In the mid-nineteenth century, the idea of waterborne disease was an unpopular and frightening theory. Many people believed that the poor suffered as a result of their laziness and sinful living, and deserved punishment in the form of catastrophic disease.

Even though many people doubted and disapproved of Snow's contaminated water theory, Dr. Snow persuaded the authorities to remove the Broad Street pump handle. This simple act saved the lives of many people, and marked the beginning of the end of a tragic situation.

We now know that people can avoid cholera infection by making sure their water supplies are clean. Unfortunately, in developing countries where only 35% of the population has access to clean water, cholera epidemics continue.

Modern medicine has produced a vaccine against cholera, but it must be repeated every six to twelve months because the antibodies are short lived. Too often though, citizens in impoverished nations do not have the funds to procure the vaccine. Used for centuries in India, the most effective treatment is to provide the victim with large amounts of liquids and rehydration salts.

This method replaces lost body fluids and electrolytes, and flushes out the bacteria. After the pathogen has been purged from the body, antibiotics can promote the victim's recovery.

Cholera has been absent from the Western Hemisphere for most of the 20th Century. Nonetheless, health officials warn that the United States could experience outbreaks of cholera and other waterborne diseases. As population increases, more waste products are generated, a situation that can strain the abilities of municipalities to maintain plentiful and clean water supplies.

Table 1 Summary of selected waterborne disease outbreaks[1]

[1]from: *A fatal waterborne disease epidemic in Walkerton, Ontario: comparison with other waterborne outbreaks in the developed world***, Water Science and Technology** Vol 4 No. 3 pp 7-14, IWA Publishing 2003

Location and Dates	Characteristics	Reference
Richmond Height, FL, USA January–March 1974	1,200 cases of gastroenteritis, likely *shigellosis* served by chlorinated shallow (6–15 m) groundwater	Weissman *et al*., 1976
Bradford, PA, USA Sept–Dec 1979	3,500 cases of gastroenteritis of unidentified aetiology in a chlorinated groundwater supply	Akin & Jakubowski, 1986
Bramham, England July 1980	3,000 cases of gastroenteritis of unidentified aetiology in a direct filtered and chlorinated supply	Short, 1988
Eagle-Vail, CO, USA March 1981	80 cases of gastroenteritis likely rotavirus in a direct filtered and chlorinated supply	Hopkins *et al*., 1986
Orangeville, ON, Canada April 1985	241 cases of *campylobacteriosis* in an unchlorinated groundwater supply	Millson *et al*., 1991
Pittsfield MA, USA Nov 1985–Jan 1986	3,800 cases of giardiasis in a chlorinated but unfiltered water supply	Kent *et al*., 1988
Disraeli, PQ, Canada August 1986	50 cases of gastroenteritis associated with three cases of *campylobacteriosis* in an unchlorinated, unfiltered surface supply	Tessier *et al*., 1987
Penticton, BC, Canada June 1986	3,000 cases of *giardiasis* in a chlorinated, unfiltered, surface/groundwater supply	Moorehead *et al*., 1990
Oakcreek Canyon, AZ, USA April 1989	11/240 guests surveyed had gastroenteritis likely caused by a Norwalk-like virus in an unchlorinated private well	Lawson *et al*., 1991
Cabool, MO, USA Dec 1989–Jan 1990 2	243 cases of gastroenteritis including 86 cases of bloody diarrhea, 2 cases of HUS and 4 deaths caused by *E. coli* 0157:H7 in an unchlorinated community water supply	Swerdlow *et al*., 199
Uggelose, Denmark Nov 1992–Feb 1993	1,400 cases of gastroenteritis of suspected viral aetiology in filtered, unchlorinated municipal supply	Laursen *et al*., 1994
Warrington, England Nov 1992–Feb1993	47 confirmed cases of *cryptosporidiosis* in a water supply zone serving 38,000 consumers by groundwater with chlorination only	Bridgman *et al*., 1995
Milwaukee, WI, USA March–April 1993	Possibly 400,000 cases of *cryptosporidiosis* in a filtered, chlorinated surface supply	MacKenzie *et al*., 1996
Gideon, MO, USA December 1993 -	600 cases of salmonellosis, 15 hospitalisations and 7 deaths in an undisinfected groundwater supply	Clark *et al*., 1996
North Battleford, SK, Canada April 2001 1	1,900 cases of cryptosporidiosis in a chlorinated, filtered surface supply	Stirling *et al*., 200