

**Sara Josephine Baker**  
**Physician & Public Health Worker**  
**1873–1945**



*Unit developed by  
Marsha Lakes Matyas  
The American Physiological Society*

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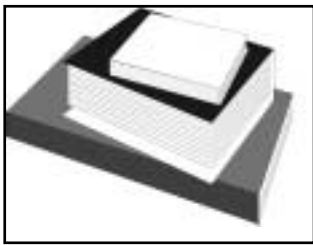


## History of the times

In the late 1800s and early 1900s, infectious diseases were a major concern of both physicians and researchers. In larger cities such as New York and Boston, sanitation was poor. The rotting bodies of dead horses lay in the streets and unpasteurized milk was sold from rusty, open cans (O'Hern, 1985). Dysentery, smallpox, and typhoid were major health problems. Although we are often unfamiliar with these diseases today, they caused horrible suffering. Dysentery caused severe diarrhea and loss of fluids. The bodies of smallpox victims were covered in painful sores. Typhoid was often transmitted by body lice and resulted in high fever, delirium, and intense headaches. These diseases were especially common and deadly among young children. In New York City, one-third of all deaths were among infants less than one year old. In New York's Hell's Kitchen, 1,500 infants died each week during the summer of 1902, primarily due to dysentery.

During the same period, preventative medicine was almost unknown. It was only when a person became ill that medical treatment was sought. There were no public health nurses and few large-scale public health programs or policies. It was also a time of social change. Women were marching in the streets to gain the right to vote. Certainly, female physicians were a rarity at this time; they accounted for less than 1% of all physicians. Few medical schools were open to women; it was very different from today when nearly 38% of graduating physicians are women (AAMC, 1994).

## Josephine Baker's personal background



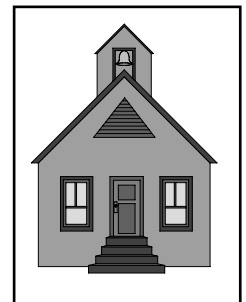
Josephine Baker did not intend to become a physician. At the age of 16, she was preparing for studies at Vassar by attending Misses Thomas' School for Young Ladies in Poughkeepsie, New York, when her father died of typhoid fever. In order to support her mother and family, she decided to study medicine instead. She knew of only one school that would accept women: the Women's Medical College of the New York Infirmary for Women and Children, founded by Drs. Elizabeth and Emily Blackwell. She was the next to the last class at the college;

Emily Blackwell closed the school the following year because Cornell University had opened its medical college to women the same year.

After finishing medical school, Josephine Baker interned at the New England Hospital for Women and Children in Boston and also worked at an out-clinic in one of Boston's worst slums. There, she learned how poorly medical science was serving the crowded city populations.

## Working at the Department of Health in New York

At the turn of the century, Dr. Baker began her life's work with the New York Department of Health as a medical inspector. Her first job was to examine children in a public school; she was allotted one hour for every three schools and could send home any child who was sick. Unfortunately, the truant officers were just as likely to send the sick child straight back to school. Her work in the schools led to the establishment of a city-wide school nurse program. The program worked so well that cases of head lice and the eye infection trachoma — once extremely prevalent in the schools — dropped to nearly zero.



Josephine Baker helped to establish some of the first programs in preventative medicine and public health. In order to curb the enormous death rates among infants in the city, Dr. Baker used school nurses in the summer of 1908 to visit the homes of newborns to teach mothers how to take care of their babies. There were 1,200 fewer deaths that summer than the previous one (O'Hern, 1985). Soon after, the Division of Child Hygiene (later the Bureau of Child Health) was established and Josephine Baker was appointed its chief. Her other accomplishments include:

- a long and successful battle to allow midwives to be licensed by the city;
- the development of a foolproof dispenser for administering silver nitrate to newborns' eyes to prevent gonococcal infections and subsequent blindness;
- the development of a newborn formula by adding water, calcium carbonate, and lactose to cow's milk; and
- the controversial development of the Little Mothers Leagues where eight- to nine-year old girls were taught how to take care of younger children while their mothers were working to earn a living to support the children. Many protested that the Leagues were "enslaving the young girls so their mothers could be irresponsible, go to the movies, or get drunk" (O'Hern, 1985, p. 27).



It is difficult to realize today how innovative and radical these programs were. In testimony before a Congressional committee, one physician opposed Baker's Little Mothers Leagues, stating, "If we're going to save the lives of all the women and children at public expense, what incentive will there be for a young man to go into medicine?" (O'Hern, 1985, p. 27). When the Bureau of Child Hygiene was formed, a petition was signed by more than 30 Brooklyn physicians and sent to the mayor demanding that the bureau be abolished because "it was ruining medical practice by its results in keeping babies well" (p. 27). Dr. Baker told the mayor that the letter was a compliment to the Bureau. There was no doubt that some social norms were about to change!

### Tracking down "Typhoid Mary"

One of Josephine Baker's most famous professional tasks was tracking down Mary Mallon ("Typhoid Mary") in 1907. The way Ms. Mallon's case was handled raises some interesting questions even today about conflicts between personal rights and public health:

*George Soper at the Department of Health Laboratories had investigated seven family epidemics of typhoid going back to 1900. He found that they were all linked to the cook [Mary Mallon] in each family. Baker was sent to collect specimens for culture. On her first visit, Baker had the door slammed in her face. The next day, when she returned with several policemen, Mary answered the door and again tried to slam it shut, but a policeman's foot was in the door. Mary ran into the house and could not be found in a search of the house. But looking out the rear window, Dr. Baker noticed a chair against the fence and footprints in the snow. Mary was found next door hiding in a closet. She was most uncooperative and fought against having blood taken so she was forcibly transported in an ambulance to a hospital where specimens were obtained. The blood and urine culture were negative but the stool culture was teeming with typhoid bacilli. Captured on March 20, 1907, Mary Mallon was confined to Willard Parker Hospital for two years and 11 months during which every available remedy was tried to rid her of the typhoid organisms. All efforts failed. On the promise that she would return every three months to the laboratory and take up some occupation other than cooking, Mary was released. She promptly disappeared and it was more than five*

*years later when her trail was picked up, once more through epidemiology. She made no struggle against the second capture. This time she was sent to North Brother Island where she remained for 23 years, to the end of her life in 1938, a special guest of New York City (O'Hern, 1985, p. 24).*

### **Facing discrimination**

Josephine Baker's success in reducing infant sickness and mortality obviously created some enemies for her. Not surprisingly, some resented the fact that a female physician was in charge of a city bureau, and, in 1919, there was considerable pressure to remove her from her position. However, she received great public support from the local press and from mothers who marched to the mayor's office to protest her possible dismissal. When she was first appointed director of the division, the six physicians who had been her peers as medical inspectors "all resigned because of the disgrace of working for a woman. She persuaded them to try it for a month" (O'Hern, 1985, p. 28). All six stayed permanently.

Perhaps the most discouraging discrimination she faced was from the students she taught at the New York University who were studying for the Doctor of Public Health degree:

*I stood down in a well with tiers of seats rising all around me...and the seats were filled with unruly, impatient, hardboiled young men. I looked them over and opened my mouth to begin the lecture. Instantly, before a syllable could be heard, they began to clap — thunderously, deafeningly, grinning, and pounding their palms together (O'Hern, 1985, p. 28).*

Dr. Baker roared with laughter to save face but, at the end of the lecture, the clapping began again. She endured this clapping for each of her lectures for fifteen years!

Interestingly, she was also a suffragette, that is, a person who wanted women to have the right to vote in elections. She was one of 500 who marched in the first suffrage parade on Fifth Avenue and met with President Woodrow Wilson at the White House along with a group supporting women's suffrage. Finally, she served as an officer, consultant, or board member for a number of professional associations, most notably as president of the American Child Hygiene Association and president of the American Medical Women's Association. She published five books and over 200 articles during her professional career. In 1939, her autobiography, *Fighting for Life*, was published.



## SUGGESTIONS FOR TEACHERS

### ACTIVITY #1: What Is a Carrier?

#### Purpose

To illustrate how bacteria and viruses can be transmitted from person to person, including via a “carrier.”

#### Objectives

- 1) To learn how viruses and bacteria can be carried via various body fluids.
- 2) To learn how viruses and bacteria appear in these fluids at different times during the course of an infection.
- 3) To learn patterns of infection for a carrier.
- 4) To learn how the pattern of infection varies for different diseases.
- 5) To provide practice in generating and reading graphic data.

#### Materials

- graph paper
- reference materials

#### Before You Begin

- 1) Gather information on various infectious diseases. In addition to checking your microbiology texts, write to pharmaceutical companies that make antibiotic or antiviral agents; they often produce mini-texts on particular diseases. Also check with local physicians and public health officials, water treatment plant officials, and the county medical association.
- 2) Ask students to read the Resource Sheet, “Typhoid and Dysentery: Still With Us...Still Deadly” on pages 89-90.

#### Safety Considerations

None.

#### Questions to Ask

- Why is it important to know what the *incubation period* (the time between exposure and the exhibition of symptoms) is for a disease?
- What happens to the levels of typhoid bacteria in the blood as the amount of typhoid-specific antibodies in the blood increase?
- When do you think a person with typhoid is most contagious to others (that is, how many weeks after initial infection)? Why do

you think so?

- Which of the following problems have we made progress in for people who live in suburban and urban areas: sewage, garbage, raw milk, food preservation, overcrowding, clean water, clean air, pests carrying disease (rats, mice, lice), and prenatal and young child care?
- Although physicians tried every method at their disposal to cure Mary Mallon of the typhoid bacteria that she carried (short of removing her gall bladder, which she would not allow them to do), they were unable to rid her of the disease. She did not cooperate with public health officials by avoiding work as a cook; instead she returned to work as a cook in a private home and infected another family with typhoid. Rather than risk continued outbreaks of typhoid fever, the City of New York kept her a virtual prisoner in the hospital for the rest of her life. She worked in the hospital as a volunteer, but was not allowed to move away for fear that she would start another epidemic. What would you have done with Mary’s case if you had been the health officials involved?
- Typhoid was a serious and frightening disease in the 1700s and 1800s. Today, we face another frightening and deadly disease, AIDS, which is also spread by carriers who often are unaware of the disease they carry. What if a person who knew that he or she tested positive for HIV, and worked in a profession where infection of others was possible (such as a dentist or dental assistant), indicated that he or she would continue to work and would not feel any need to inform patients about his or her disease? Could the HIV-positive person’s physician do anything or not? What could a public health official do, if anything? What do you think? Is this different from Mary Mallon’s situation? If so, how?

#### Where to Go From Here

- Hold a debate (as described in the “Ideas for Assessments” section).
- Try *Activity #1*, “AIDS? Who Me? — A

Disease Transmission Simulation,” in the Linda Laubenstein module.

### Ideas for Assessment

- Use *Part 2 of Activity #1*, “What is a Carrier?” as an assessment tool for either individuals or small groups. Be sure to provide adequate information on where appropriate information may be found. Students may want to include interviews with physicians or public health officials or may have specific questions they can address to the Centers for Disease Control in Atlanta.
- Ask small groups to present a debate on one of the following questions: “Was Mary Mallon’s case handled ethically, according to present day medical practice — yes or no?”; “Should the remaining smallpox virus be destroyed — yes or no?” Arguments should be fact centered, not based on emotional appeals. For a good example, see the debate presented in the November 1993 *Science* cited below on whether the remaining smallpox virus should be eradicated.

### References and Resources

#### ✓ *About Sara Josephine Baker and other women physicians of her time:*

Abram, R. J. (1985). *Send Us a Lady Physician: Women Doctors in America, 1835–1920*. New York: W. W. Norton.

American Association of Medical Colleges (AAMC). (1994). *Student Database for 1992–93*. Washington, DC: AAMC.

Baker, S. J. (1939). *Fighting for Life*. New York: Macmillan.

Herzenberg, C. L. (1986). *Women Scientists from Antiquity to the Present: An Index*. West Cornwall, CT: Locust Hill Press.

O’Hern, E. M. (1985). *Profiles of Pioneer Women Scientists*. Washington, DC: Acropolis Books.

#### ✓ *About typhoid fever, smallpox, and dysentery:*

Caldwell, M. (March 1992). Vigil for a doomed virus. *Discover*. p. 50–56.

Carey, C. (June 1989). Mary Mallon’s trail of typhoid. *FDA Consumer*, 23 (5), p. 18.

Davis, B. D., Dulbecco, R., Eisen, H. N., Ginsberg, H. S., Wood, W. B., & McCarty, M. (1973). *Microbiology* (2nd ed.). Hagerstown, MD:

Harper & Rowe.

The effect of the Gulf crisis on the children of Iraq. (September 26, 1991). *New England Journal of Medicine*, 325 (13), p. 977.

Gill, P. G., Jr. (June 1991). Battling the bare-bottom blues: You won’t get cholera in the American wilderness, but the bacteria that cause typhoid, dysentery, and diarrhea are still out there. *Outdoor Life*, 187 (6), p. 52.

Magner, L. N. (1992). *A History of Medicine*. New York: Marcel Dekker.

Nikiforvk, A. (1991). *The Fourth Horseman*. New York: M. Evans & Co.

The remaining stocks of smallpox virus should be destroyed. (November 19, 1993) *Science*, 262, p. 1223–24.

Roberts, L. (December 8, 1989). Disease and death in the New World. *Science*, 246, p. 1245.

Service, R. F. (July 22, 1994). *E. coli* scare spawns therapy search. *Science*, 265, p. 475.

Small, P. A., Jr., & Small, N. S. (May, 1996). Mankind’s magnificent milestone: Smallpox eradication. *The American Biology Teacher*, 58 (5), p. 264–271.

Why the smallpox virus stocks should not be destroyed. (November 19, 1993) *Science*, 262, p. 1225–26.

Woodruff, B. A., Pavia, A. T., & Blake, P. A. (February 13, 1991). A new look at the typhoid vaccination. *Journal of the American Medical Association*, 256 (6), p. 756.

#### ✓ *Related novels and stories:*

Bess, C. (1982). *Story for a Black Night*. Oakland, CA: Parnassas Press. (An African boy hears the tale of his family’s brave struggle with smallpox).

Hudson, J. (1989). *Sweetgrass*. New York: Philomel Books. (A 19th century, 15-year-old Blackfoot Indian girl saves her family from a smallpox epidemic).

Marshall, C. (1967). *Christy*. New York: Avon. (A young woman volunteers as a teacher in Appalachia during a typhoid epidemic).

#### ✓ *Other resources:*

Write for a free subscription to *Chemecology*, a newsletter published by the Chemical Manufacturers Association. The newsletter describes how chemical manufacturers and users are working to assure that chemical use (in a wide range of applications) does not negatively impact

the environment. A good source for “success” stories. Write to: Chemical Manufacturers Association, 2501 M Street, N.W., Washington, DC 20037 or call (202) 887-1236.

See the Centers for Disease Control (CDC) home page at <http://www.cdc.gov>.

The Howard Hughes Medical Institute, 4000 Jones Bridge Road, Chevy Chase, MD 20815-6789, (301) 215-8855, offers a free report, *The Race Against Lethal Microbes*, about bacteria, viruses, and parasites that cause infectious diseases.

✓ *Photo credit:*

Photos on pages 81 and 85 courtesy of the National Library of Medicine, Bethesda, MD.

## Resource Sheet #1

### ***Typhoid and Dysentery: Still With Us...Still Deadly***

Typhoid fever is caused by the bacterium *Salmonella typhi*. This bacterium infects only humans and is transmitted primarily through contamination of food, water, or milk by human feces. It causes headaches, abdominal tenderness, and fever, sometimes to the point of delirium. It can also cause internal bleeding and peritonitis via breaks in the wall of the bowel. An infected person sheds the bacterium through stools and urine, thus spreading the disease whenever the stool or urine contaminates food or water sources. Even after they recover, one-third of those infected remain carriers, shedding bacteria for weeks or months (Carey, 1989). About 5% of infected persons become long-term carriers like Mary Mallon ("Typhoid Mary"). The bacteria live and multiply in their gall bladders and bile ducts and, therefore, constantly contaminate their stools. It is critical that these persons not be involved in food preparation, since it is easy to contaminate food via contact with poorly washed hands.

Although typhoid fever is rare in the U.S. today, the typhoid bacterium is still in our soil and water (Gill, 1991). Typhoid is especially problematic for backpackers and hikers or in situations where access to clean water and food is limited. During Operation Desert Storm, 13 of the 20 major power plants in Iraq were shut down. Both typhoid and cholera became epidemic because the water treatment plants were unable to run without electricity and people drank water from sources contaminated with the microorganisms that cause these diseases (Effect..., 1991). This was also a concern during the aftermath of Hurricane Andrew in Florida and following the 1993 floods in the Midwest; water was brought from considerable distances into these areas until the water treatment facilities could be cleaned and put in working order. In Des Moines, Iowa, 850 miles of city water pipe had to be disinfected along with every single surface at the water treatment plant before water could be provided to residents again (What Do..., 1993).

A new oral vaccine has been developed for typhoid, but it is not totally effective (Woodruff et al., 1991). Currently, only persons traveling to countries where typhoid is common (such as Peru, India, Pakistan, and Chile) are typically vaccinated. The key to preventing the spread of typhoid fever is to stop person-to-person transmission by proper sewage disposal, pasteurization of milk, maintenance of unpolluted water supplies, and careful exclusion of chronic carriers as food handlers (Davis, 1973).

Carriers receive long-term treatment with antibiotics. If this is not effective in eliminating the bacteria, the gall bladder and bile ducts can be surgically removed, thus eliminating the source of the bacteria. In fact, Mary Mallon was given this option but refused surgery; she believed that the physicians wanted to kill her. Instead, she remained at the hospital, working as a volunteer for the rest of her life (Carey, 1989).

Dysentery is also an ancient disease; descriptions of it were written as early as the fourth century, B.C. Like typhoid, it is caused by a bacterium (*Shigella dysenteriae*) and spreads rapidly under conditions of overcrowding and poor sanitation, as in disaster areas (Davis, 1973). In fact, dysentery has often been a military consideration because it can quickly change a prepared army to a crowd of very ill people, unable to fight.

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Dysentery is characterized by abdominal cramps, diarrhea, and fever. It causes dehydration and electrolyte imbalance due to the loss of water and salts through diarrhea. This is especially dangerous for young children; in the late 1960s, a dysentery epidemic in Central America had a 20% fatality rate for children (Davis, 1973). More recently, the Minnesota Vikings football team, along with 240 other passengers, contracted dysentery from eating contaminated food on an airliner in 1988. Unlike with typhoid fever, there are no long-term *Shigella* carriers. The prevention is the same as for typhoid — prevention of contamination of food and water.

#### References

Carey, C. (June 1989). Mary Mallon's trail of typhoid. *FDA Consumer*, 23 (5), p. 18.

Davis, B. D., Dulbecco, R., Eisen, H. N., Ginsberg, H. S., Wood, W. B., & McCarty, M. (1973).

*Microbiology* (2nd ed.). Hagerstown, MD: Harper & Rowe, p. 775.

The effect of the Gulf crisis on the children of Iraq. (September 26, 1991). *New England Journal of Medicine*, 325 (13), p. 977.

Gill, P. G., Jr. (June 1991). Battling the bare-bottom blues: You won't get cholera in the American wilderness, but the bacteria that cause typhoid, dysentery, and diarrhea are still out there. *Outdoor Life*, 187 (6), p. 52.

What do you do when the water runs rampant? (November 1993). *Chemecology*, 22 (9), p. 2.

Woodruff, B. A., Pavia, A. T., & Blake, P. A. (February 13, 1991). A new look at the typhoid vaccination. *Journal of the American Medical Association*, 256 (6), p. 756.

**ACTIVITY #1: What Is a Carrier?**

**Part 1**

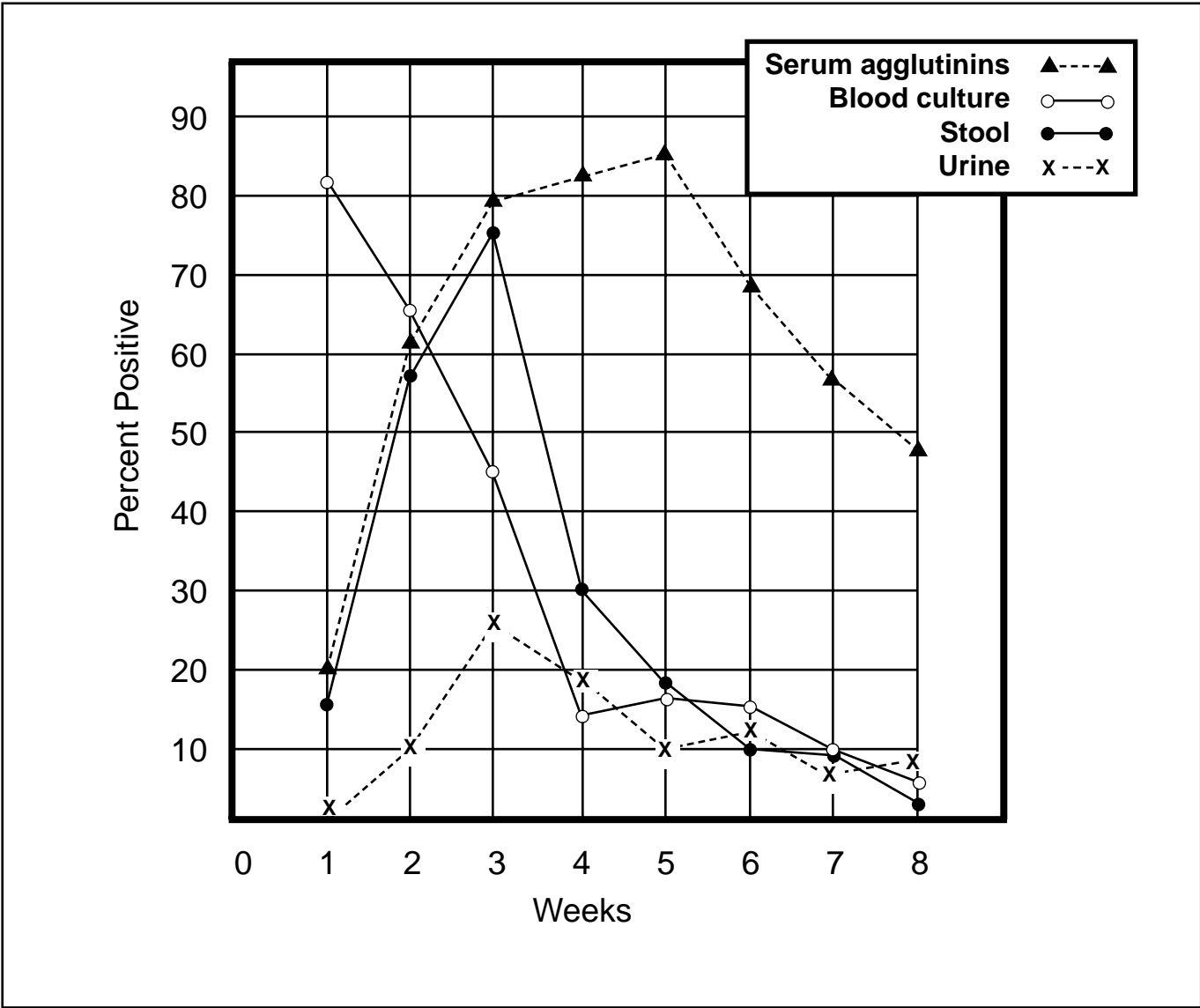
The graph on page 92, "Graph A," shows how the presence of typhoid bacteria (*Salmonella typhi*) in different body fluids changes over the course of a typhoid infection. The X-axis (horizontal) shows the number of weeks since initial infection with the bacteria.

1. According to the information in Graph A, when do the bacteria reach their highest concentration in the blood, that is, how many weeks after initial infection? In the urine? In the stool? Complete the data chart below.
2. According to the information in Graph A, what happens to the amount of antibody (*serum agglutinins*) to the bacteria in the blood during the course of the infection? Write your answer on the data chart on the following page.
3. Mary Mallon (Typhoid Mary) did not have large amounts of bacteria in her blood or urine. The bacteria were present in her bile and stool. How might the graphs for blood, stool, and urine look for someone who had the infection and then became a carrier? Draw them on "Graph B" (see page 93) and describe why you think they would look this way.

**Data Chart:**

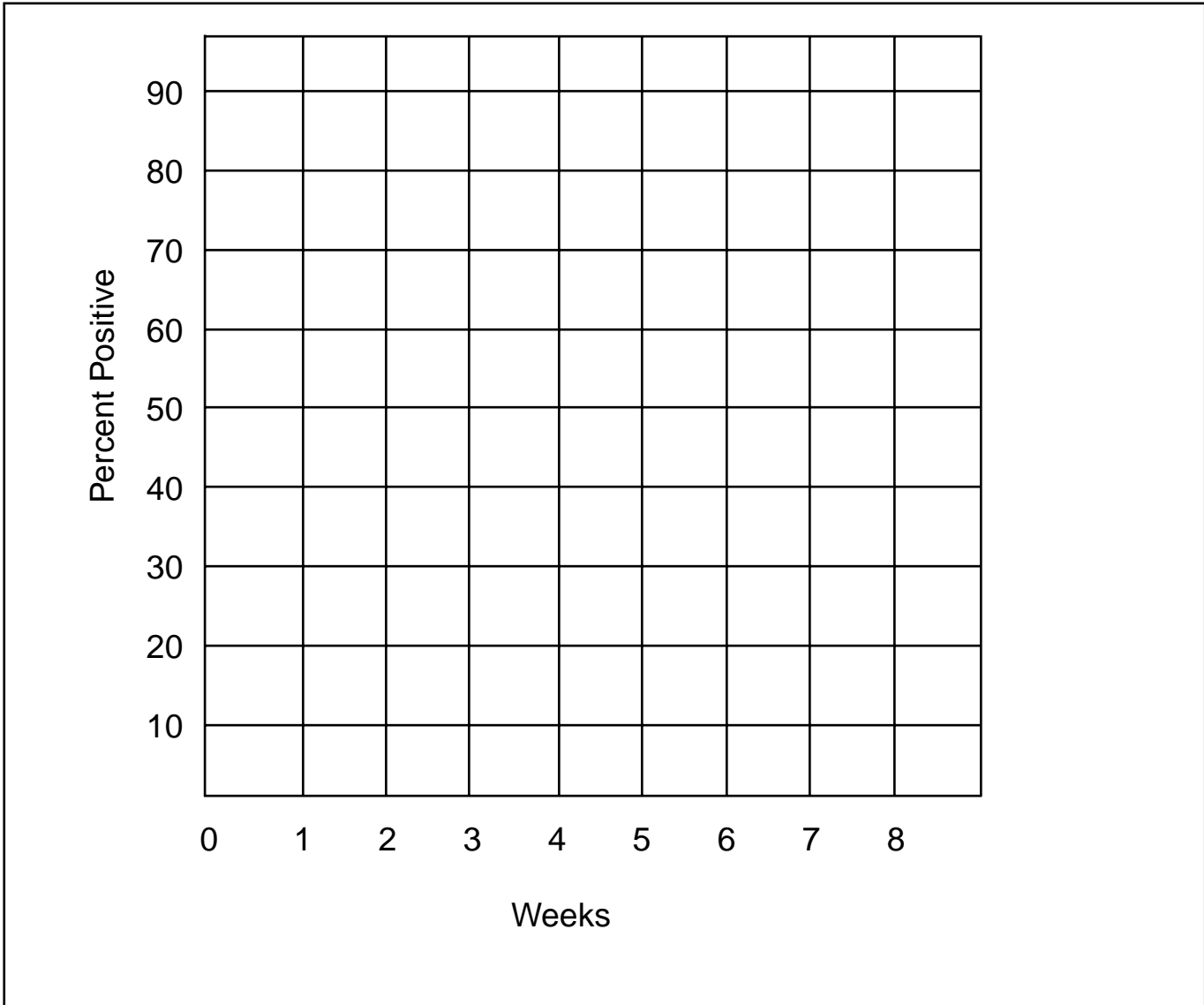
| Body Fluid  | How many weeks after initial infection are the highest numbers of bacteria found? | What is the highest concentration (approximate)? |
|---|---|--|
| Blood   |   |  |
| Urine   |   |  |
| Stool   |   |  |
| Describe what happens to the amount of typhoid bacteria antibody in the blood during the course of the infection: |   |  |
|   |   |  |

**Graph A**



(Adapted from Davis et al., (1973).  
*Microbiology* (2nd ed.). Hagerstown, MD: Harper & Rowe.)

**Graph B**



**Part 2**

Your mission is to find out about the course of infection for another contagious disease (such as chicken pox, AIDS, smallpox, dysentery, tetanus, rabies, malaria, etc.). What can you find out about the following topics?

**Transmission**

- How does the human body become infected?
- Can other animals become ill from this disease?
- Are there animals that act as a carrier or “vector” for the disease?
- When is the infected person contagious?
- How does the infected person cause another person to be exposed to the disease (for example, respiratory, hand-to-hand contact, specific body fluids)?

**Immunity**

- Does the disease victim develop immunity to the disease?

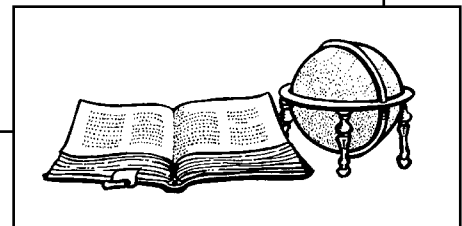
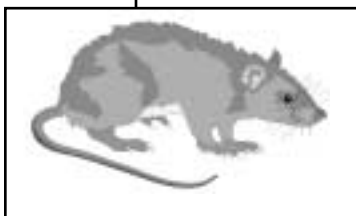
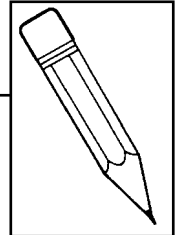
**Treatment**

- What is the current treatment for this disease?
- Are there recent developments in treatment methods?

**Frequency**

- How common is this disease in the U.S. today?
- Are there specific areas of the world where this disease is most common? Why?

There are many sources for this type of information: microbiology textbooks, local public health officials, physicians, pharmaceutical companies, medical encyclopedias and handbooks, the State Department offices for international travelers, etc. Be sure to check the magazine and newspaper guides in your public or school library to learn whether new developments have been taking place related to the disease you are investigating.



## SUGGESTIONS FOR TEACHERS

### ACTIVITY #2: Where in Kansas Is Typhoid Terri?

#### Purpose

This simulation will illustrate how epidemiologists and public health workers track down the sources of disease organisms to prevent disease epidemics. Also, it can illustrate the importance of maintaining facilities that provide clean water and food.

#### Objectives

- 1) To learn how many disease organisms, such as typhoid, exist in our natural environment.
- 2) To learn that the way water is processed and food is grown and handled can prevent these bacteria from infecting humans.
- 3) To learn how public health officials and epidemiologists are involved in preventing disease and tracking down its source.
- 4) To develop decision-making skills concerning the most effective use of limited resources (e.g., time).
- 5) To develop cooperative group work skills.

#### Materials

*For each group of two to three students*

- a set of source and action cards  
 Note: Source cards include 8 pink cards, 5 blue cards, and 9 green cards. Action cards include 10 white cards; use 3x5 index cards cut in half for extras. For each color, there are at least two blank cards for students to develop their own action cards.

#### Before You Begin

- 1) Photocopy cards (on pages 97-100) onto appropriate colored paper and cut apart.
- 2) Ask students to read Resource Sheet #2, "Smallpox: Minister of Death," on page 101-102, to provide them with some perspective on the effects of epidemics on human populations and history.
- 3) Prepare a set of cards for each group (see above). Be sure to include a few blank cards of each color to allow students to generate their own "food sources," "water sources," and "persons." If you want to use the cards for future years without

duplicating, you can laminate several sets.

- 4) Assign roles for each team. Each team should have a Team Leader, a Timekeeper (to determine how much time each "action" should require), and a Planner (to keep track of the overall plan of action and total time used).
- 5) Select one or two of the food, water, and/or person sources of contamination. Write your selections on a piece of paper and put it into an envelope. Seal the envelope and show it to the class when you begin the activity. When each group has developed its plan, they can use the information in the envelope to determine whether they would have found the typhoid source in time to prevent an epidemic. Each team should develop a flow chart using the format shown on the following page.
- 6) Draw the "Sample Flow Chart" on page 96 on the chalkboard, use it as an overhead, or give a copy to each group.
- 7) Emphasize that there is more than one right answer to this problem.
- 8) To simplify the simulation for your students, tell them that the water supply has been checked and is not a source of contamination.
- 9) To make the simulation more interesting, add more options for teams such as having two public health workers; calling in a state department of health assistance team which would result in more staff to work on the problem, but would delay the start-up; or selecting a "hidden source" of contamination so that teams must use the blank cards to try to think of other possible sources.

#### Safety Considerations

None.

#### Questions to Ask

- With whom would you talk first? Make a map of the key points to check in your epidemiological search.

- How would you find out whether these persons were involved in the typhoid outbreak? Describe what tests you would want to do.
- Draw a pathway where you think the source of the contamination might be and what public health measures you might use to combat future spread of the disease. Measures you might use include testing of food handlers, pasteurization, water testing, and waste water processing. Can you think of others?
- Once you have tested your plan of action, what could you have done to make it more effective?

**Where to Go From Here**

- Take a field trip to the local water treatment plant or invite one of the professional staff to come to visit the classroom.
- Invite a public health official to discuss his/her work in disease prevention and how they would deal with an outbreak of a contagious disease.

**Ideas for Assessment**

- The results of this exercise can be used as an assessment measure.
- In addition, you could develop a similar scenario and ask groups or individuals to come up with a plan of action for a different disease. A good example would be the *Staphylococcus A* bacteria, which has recently caused problems in undercooked ground beef and unpasteurized fruit juices (such as apple cider). Check your library's guide to periodical literature for recent articles.

**References and Resources**

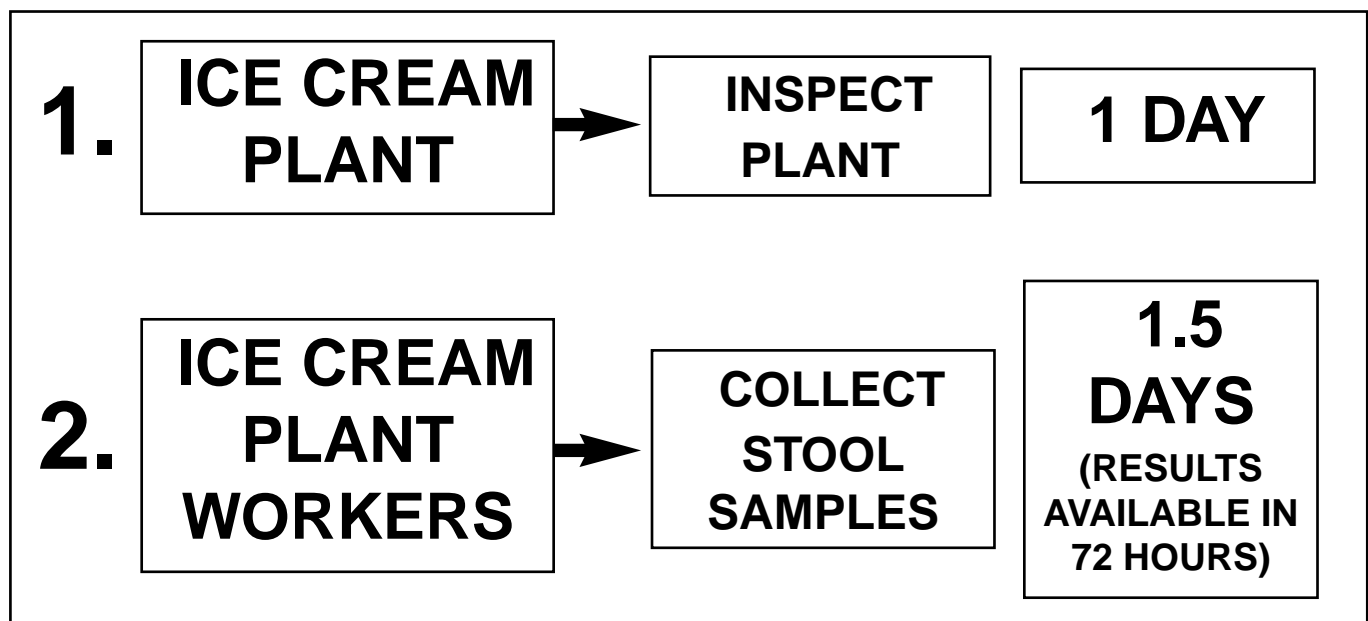
Davis, B. D., Dulbecco, R., Eisen, H. N., Ginsberg, H. S., Wood, W. B., & McCarty, M. (1973). *Microbiology* (2nd ed.). Hagerstown, MD: Harper & Rowe.

Lemonick, M. D. (1994, September 12). The killers all around. *Time*, p. 60-69.

See listing at end of *Activity #1*, "Suggestions for Teachers."

See also recent movies (e.g., *Outbreak*).

**Sample Flow Chart**



Food Sources (pink paper)

|                             |  |
|-----------------------------|--|
| <b>ICE CREAM<br/>PLANT</b>  | <b>DAIRY</b>                             |
| <b>5 LOCAL<br/>FARMS</b>    | <b>2 ROADSIDE<br/>PRODUCE<br/>STANDS</b> |
| <b>3<br/>RESTAURANTS</b>    |  |
| <b>2 GROCERY<br/>STORES</b> |  |

Water Sources (blue paper)

|                                      |              |
|--------------------------------------|--------------|
| <b>WATER WELLS</b>                   | <b>RIVER</b> |
| <b>WATER<br/>TREATMENT<br/>PLANT</b> |              |
|                                      |              |

Direct Human Sources (green paper)

|   |  |
|---|--|
| <b>20 UNTESTED<br/>RESTAURANT<br/>WORKERS</b>   | <b>15 ICE CREAM<br/>PLANT WORKERS</b>              |
| <b>20 WATER<br/>TREATMENT<br/>PLANT WORKERS</b> | <b>20 DAIRY<br/>WORKERS</b>                        |
| <b>5 FARMERS</b>                                | <b>SOMEONE WHO<br/>VISITED FOREIGN<br/>COUNTRY</b> |
| <b>15 GROCERY<br/>STORE WORKERS</b>             |  |

Possible Actions (white paper)

|   |   |
|---|---|
| <p><b>COLLECT STOOL SPECIMENS</b><br/>_____ DAYS</p>                    | <p><b>VISIT ONE FARM</b><br/>_____ DAYS</p>                                   |
| <p><b>WAIT FOR STOOL OR WATER TEST RESULTS</b><br/>_____ DAYS</p>       | <p><b>GET COURT ORDER AND CLOSE DAIRY</b><br/>_____ DAYS</p>                  |
| <p><b>GET COURT ORDER AND CLOSE GROCERY STORE</b><br/>_____ DAYS</p>    | <p><b>GET COURT ORDER AND CLOSE ROADSIDE PRODUCE STAND</b><br/>_____ DAYS</p> |
| <p><b>INSPECT DAIRY, GROCERY STORE OR RESTAURANT</b><br/>_____ DAYS</p> | <p><b>COLLECT WATER SAMPLE AND TEST</b><br/>_____ DAYS</p>                    |

## Resource Sheet #2

### ***Smallpox: Minister of Death***

Smallpox is a disease caused by a virus related to cowpox and monkeypox. It is believed that smallpox became a human parasite thousands of years ago when Middle Eastern civilizations began to domesticate animals. A strain of cowpox or monkeypox began to infect humans but was not a deadly disease. In the 16th and 17th centuries, however, more *virulent* (infectious and damaging) strains of the virus began to appear (Nikiforvk, 1991). By the end of the 17th century, smallpox accounted for nearly one-third of children's deaths in Europe and four of five adults had been infected with it.

Smallpox was known as "the most terrible of all the ministers of death" (Magner, 1992). It was usually contracted through the upper respiratory tract, but it also could be transmitted by clothing, blankets, and other items that came in contact with the infected person. The disease caused high fever, chills, damage to internal organs, and often caused permanent blindness as well. The entire body became covered with pustules (sores). If the person survived, he or she was left with permanent ugly pock marks wherever the pustules had been. The smallpox survivor often was disfigured for life.

One of the most tragic epidemics of smallpox occurred when European explorers came to the New World. Before the arrival of Europeans (and the smallpox they carried with them), there were an estimated 90-112 million native persons in North and South America...without immunity to smallpox, tuberculosis, chicken pox, or influenza (Roberts, 1989). Estimates of the epidemic differ but all of the estimates express dramatic numbers: Central Mexico's population dropped from 25 million in 1490 to less than 2 million in 1568 (Nikiforvk, 1991). North American natives were similarly devastated by European explorers. The guns and swords carried by European explorers were insignificant compared to the biological weapons they unconsciously brought to bear on the native American populations.

The end of smallpox's reign of terror began in the 1790s when a physician, Edward Jenner, learned that those who milked cows often came down with cowpox and were immune to smallpox. He began inoculating people with cowpox (a relatively mild disease) and, because the cowpox and smallpox virus are similar, those persons became immune to smallpox as well. Further research led to the development of a vaccine specifically for smallpox. Systematic vaccination of populations began. The U.S. was somewhat slow in vaccinating its population. In 1910, the U.S. was the least vaccinated civilized country in the world. Between 1928 and 1931, less than 40% of U.S. residents had been vaccinated (Magner, 1992). Vaccinations increased after World War II and, by 1960, smallpox had been eliminated from England, the U.S., and China. In 1977, the World Health Organization recorded the last naturally occurring case of smallpox.

Has smallpox been eradicated from the world? Not yet. Although it no longer exists in nature, stores of frozen virus are still stored at the Centers for Disease Control (CDC) in Atlanta, Georgia, and at the Research Institute of Viral Preparations in Moscow. There has been considerable debate about whether to destroy the remaining virus. On one hand, smallpox remains a deadly and dangerous virus, especially since so few persons are now vaccinated against it. In fact, a laboratory

*(continued)*

(continued)

photographer died of smallpox in 1978 when some of the virus escaped from a research lab, probably through a ventilation duct. There is even some speculation that it could be used for biological warfare, although there are much more effective bacteria and viruses that could be selected for this purpose. On the other hand, there is concern about completely eradicating a species, even one as deadly as smallpox. What if we later encounter a similar virus, equally deadly, and need the smallpox virus to use as a research tool to find a vaccine or a cure? The smallpox virus is unique in that it is a very large virus and can replicate in the cytoplasm of the cell; it does not need to reach the nucleus, as do most viruses.

The World Health Organization (WHO), the CDC, and the Research Institute in Moscow initially agreed to destroy the remaining smallpox virus stores in December 1993 (Caldwell, 1992). They have delayed this in order to map the genome (that is, the DNA sequence) from several strains of smallpox virus so that this information will be available to researchers in the future. If the virus is destroyed, all that will remain will be a record of its genetic code and the tremendous impact of that genetic sequence on human history.

#### **References**

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- Nikiforvk, A. (1991). *The Fourth Horseman*. New York: M. Evans & Co.
- Roberts, L. (December 8, 1989). Disease and death in the New World. *Science*, 246, p. 1245.

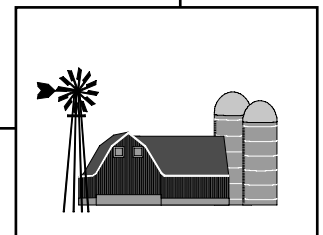
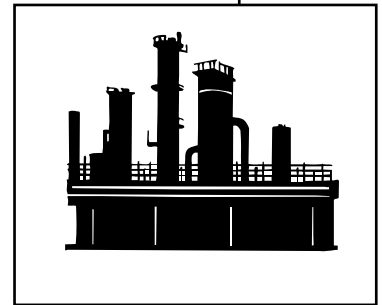
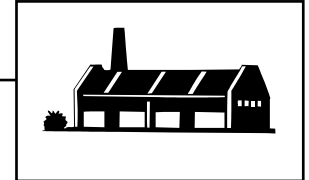
## ACTIVITY #2: Where in Kansas Is Typhoid Terri?

### Your Mission

Several cases of typhoid fever have developed in a small midwestern community. You are a public health official trying to track down the source of the infection. You know that typhoid is caused when food or water is contaminated by the stool of persons who actively have typhoid or are carriers of the disease. Typhoid bacteria can also be found in the soil. Interviews with the infected persons reveal that they all used water from the local water treatment plant (despite public warnings to use bottled water; see #1 below), ate at three popular restaurants, bought locally grown produce from the same roadside stand, and ate the same brand of local ice cream. You think that three possible contamination sources are most likely:

1. A recent flurry of spring storms has caused flooding in low-lying areas, especially near the river. The local water treatment plant is concerned that the flood may either have contaminated wells used for local water or caused cracks in the pipes that take fresh water to housing areas and take waste water away from housing areas. Local farmers are trying to harvest produce from fields that have been affected by the floods.
2. Local restaurants have sometimes hired personnel who are recent immigrants from countries where typhoid is more common. Some are illegal aliens who have not gone through the health tests required to obtain a work permit.
3. A new ice cream plant has opened recently. With the problems created by the storms and the typhoid outbreak, you haven't been able personally to check out the new facility, although the company's permits are in order.

You are the only public health official in your town. If you don't have the source of the infection isolated within seven days, you may have an epidemic on your hands. WHERE DO YOU START? You must come up with a plan of action to track down the source (or sources!) of typhoid contamination within 7 days.

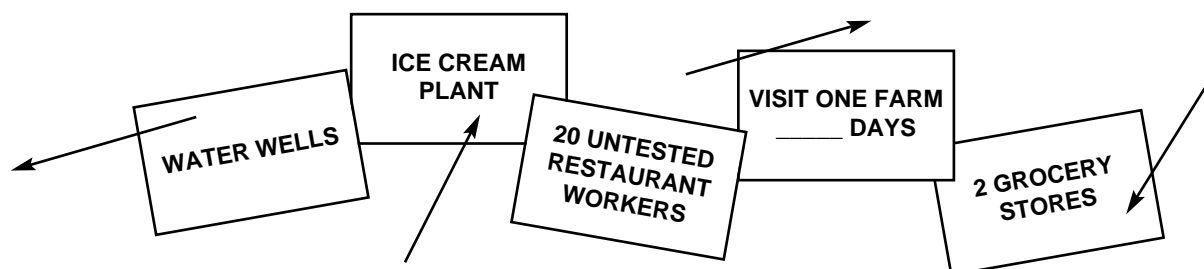


### The Rules

- You are working with two consultants via conference call. One of you acts as the **Team Leader**, one as the **Timekeeper**, and the third as the **Planner**. Your roles are described below.
- You may assume that you have isolated the people with active cases of typhoid and that they are no longer a threat.
- You have a set of cards to assist you in developing your plan of action. The **green cards** represent people who may be carriers of the typhoid bacteria. The **pink cards** are food sources that might be the source of typhoid contamination. The **blue cards** are water sources that might be the source of typhoid contamination. The **white cards** represent “actions” that you decide to take as part of your plan.
- Use these cards as you develop your plan of action to locate the source of the typhoid contamination. Your teacher will tell you how many sources of contamination there are.

### Develop a Plan of Action

- Lay out the cards on your table/desk to create your plan of action. This way you can easily make changes to the plan as you discuss it with your team. The plan should allow you to determine the source(s) of the contamination (food, water, or person) as quickly as possible.
- The white cards are your actions. USE ONE CARD FOR EACH ACTION. For example, you can decide to test all workers at the three local restaurants for typhoid. That is one action. The **Timekeeper** will decide how much time this will take (see below); write the amount of time on the card. Use the information on the “Time Table Guide” on the next page to help you.
- Feel free to move cards around, change your mind about what actions to take, and in what order. If you think there are sources of contamination that are not on the cards, use the blank cards to write down these “hidden sources.” When you think you have a good plan, draw it up as a flow chart with total time needed written at the bottom (see example provided by your teacher). Be sure to include a description of why you selected each of your actions, that is, your rationale.



**Your Public Health Team**

- **Team Leader.** Leads the team members in proposing sources of contamination and actions that can help uncover them. Makes the final decision, in conjunction with the team, on when the plan is complete.
- **Timekeeper.** Decides how much time a given action will require, using the “Time Table Guide” below. Time for actions should be given in half days (for example, 0.5 day, 1.0 day, 1.5 days, etc.). Be reasonable — getting stool samples from 30 people should take more time than from 10 people! Once you have decided about the time needed for an action, it should not change; be consistent throughout the plan of action.
- **Planner.** Keeps track of the overall plan and the total time used.

**When You Have a Plan...**

- Your teacher has the source of the contamination in a sealed envelope. When you learn what it is, apply your plan of action to learn whether you would have discovered the source(s) of typhoid contamination in time to prevent an epidemic!

**Time Table Guide**

| ACTION  | DAYS NEEDED |
|---|-------------|
| Collect stool specimens from 10 workers                 | 0.5         |
| Wait for typhoid stool test or water test results       | 3.0         |
| Obtain court order and close down a grocery, farm, etc. | 1.0         |
| Inspect a dairy, grocery, or restaurant                 | 1.0         |
| Visit three farms to talk to farmers                    | 1.0         |



