RX FOR SURVIVAL
A GLOBAL HEALTH CHALLENGE

Disease Warriors

Vaccines are one of public health's greatest triumphs. Millions of people can be immunized to prevent or reduce the incidence and spread of infectious disease. Global immunization even opens the possibility of eradicating certain diseases. Yet, underlying their great potential to prevent or reduce disease is the challenge of getting vaccines to all who need them.

ACTIVITY AT A GLANCE

PURPOSE: To examine regional health concerns in order to gain insight into how vaccinations can protect populations as well as travelers

OVERVIEW: Students play and discuss two games to model how vaccines protect a population. They then research diseases found in a particular region and the vaccinations required to travel to that region. To highlight key vaccination topics, students complete a student sheet, and the class discusses the responses.

LEVEL: Grades 7–12

TIME: 1–2 class periods

CORE CONCEPTS

- Vaccines are important, powerful tools of public health.
- While a vaccine protects an individual, an infectious disease will only be eradicated if vaccines are used on a widespread, sustained, population-wide basis.
- The availability of vaccines varies around the world.
- In the United States, vaccines help limit the occurrence of many infectious diseases.
- Some people believe vaccines are harmful.

MATERIALS

- *Disease Warriors* student sheet for each student
- Box for the game, Zap, with slips of paper prepared for each student (see step 1)
- Access to health information (e.g., the Web and/or school library)

STANDARDS CONNECTION

Geography

- Standard 1: Use maps and other geographic representations, tools, and technologies to acquire, process, and report information.
- Standard 3: Analyze the spatial organization of people, places, and environments.
- Standard 16: Examine the meaning, use, distribution, and importance of resources.
- Standard 18: Apply geography to interpret the present and plan for the future.

Social Studies

- Standard VII a: Explain how the scarcity of productive resources requires the development of systems about how to produce and distribute goods and services.
- Standard VIII c: Analyze how science and technology influence core values, beliefs, and the attitudes of society.
- Standard IX d: Analyze the causes, consequences, and possible solutions to persistent global issues such as health.

Health

- Standard 1: Comprehend concepts related to health promotion and disease prevention.
- Standard 2: Access valid health information and health-promoting products and services.
- Standard 3: Practice health-enhancing behaviors and reduce health risks.
- Standard 7: Advocate for personal, family, and community health.

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PROGRAM CONNECTION

A vaccine protects a person against an infectious disease. It does this by stimulating the immune system to recognize and destroy the disease-causing microbe. Vaccines contain dead or severely weakened versions of the microbe. Once inside a person's bloodstream, these neutralized microbes trigger an immune response, and the person's immune system produces antibodies against that particular microbe. These antibodies stay in the bloodstream for many years. If a vaccinated person is then exposed to the fully virulent microbe, these antibodies destroy it before it can make the person ill. In essence, vaccines trick the body into thinking it has been infected and prepares it to resist a future attack. This ability to prepare the immune system has stopped the spread of infectious diseases, such as smallpox, and led to the near-eradication of polio. Unfortunately, a vaccine against HIV/AIDS has remained elusive. This is because the virus attacks cells of the immune system, compromising a person's ability to rid his or her body of the virus.

Before people understood what caused disease, public health workers could only fight epidemics through careful surveillance and quarantine. "Disease Warriors" chronicles the groundbreaking work of 19th century researchers, such as the famed scientist Louis Pasteur, who discovered that germs cause illness and developed some of the first vaccines—one of public health's greatest triumphs. Today, vaccines have made great strides against disease. While certain diseases are preventable or can be reduced with vaccines, "Disease Warriors" makes clear that the world still faces major challenges in getting vaccines to all who need them.

In this activity, students learn about the important role vaccines play in the health of a population and assess whether vaccines are a viable way to address the health situations in different regions.

BEFORE WATCHING

- Contrast infectious and chronic diseases.

  An infectious disease makes people sick through an infectious agent, such as a virus or bacterium. A chronic disease is an illness, such as heart disease, diabetes, cancer, or asthma, that is ongoing or recurring but is not caused by infection or transmitted by contact. Chronic diseases can be controlled, but not cured.

- Ask, "How are diseases spread?"

  Make sure students understand that infectious diseases can be transmitted directly from person to person, through a vector, such as mosquitoes or ticks that carry the microbe that infects people, or through consuming contaminated food or water.

- Make sure students understand the following terms:

  Antibiotic: a substance that inhibits the growth of bacteria.

  Antibody: a protein produced by the immune system that binds to foreign substances introduced into the bloodstream and destroys them.

  Bacteria: a single-celled, microscopic, prokaryotic organism capable of rapid reproduction.

  Disease: a change in the body that impairs its ability to function.

  Herd Immunity: resistance of a population to a pathogen due to the immunity of a large proportion of the group to that pathogen. For example, vaccinating a large percentage of a population prevents the spread of an infectious disease. Because the disease has little opportunity to spread within the community, even unvaccinated individuals and newborns gain some protection. Herd immunity is one way to eradicate an infectious disease.

continued

BEFORE WATCHING (continued)

Immunization: the use of vaccines to protect the body from a disease-causing microorganism. The term is often used interchangeably with vaccination or inoculation.

Infectious: describes an organism that lives in the body of another organism. Infectious agents often cause a disease in the host.

Pathogen: a microbe capable of causing disease.

Ring vaccination: administering vaccine only to people in close contact with an infected patient. Ring vaccinations prevent the spread of an infectious disease by surrounding the patient with a "ring" of immunized people.

Vaccine: a preparation made from a suspension of killed or weakened pathogens or an inactivated toxin that stimulates the production of antibodies, protecting individuals from infectious diseases.

Virus: a non-cellular biological entity consisting of nucleic acid covered by protein. Viruses cannot replicate without a host cell. Inside an infected cell, a virus uses the host's own cellular processes to replicate itself. Antibiotics do not affect viruses.

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FOR MORE INFORMATION

pbs.org/rxforsurvival

AFTER WATCHING

- Identify diseases for which vaccinations exist. On the board, write the Centers for Disease Control's list of recommended childhood vaccinations: hepatitis A and B, diphtheria, tetanus, pertussis (whooping cough), influenza (flu), polio, measles, mumps, rubella (German measles), varicella (chicken pox), and pneumonia. Ask if students recognize these diseases, what it is like to be sick with these illnesses, and if they have been vaccinated for any of them. In addition, ask about students' experience with vaccinations related to travel.
- Ask students to recall and review specific researchers and their work.
- List diseases that were once major challenges that have been controlled (or nearly so) and ones that have arisen or become widespread in the past 25 years, such as SARS, the avian flu, and the West Nile virus.
- Discuss the pros and cons of herd immunization versus ring vaccination. Which one is best suited to eradicating a disease, such as polio or measles?

  When an entire community is protected, an infectious disease is unable to establish itself. In some cases, vaccines can be used to provide herd immunization, such as with polio. In other cases, populations may have a natural immunity, such as the immunity European explorers had to smallpox. Herd immunization's benefits are great, but it is difficult to vaccinate every susceptible individual. Ring vaccination is useful in preventing a local outbreak of an infectious disease from tuning into an epidemic. Ring vaccination is an especially important tool when a disease is highly infectious or the outbreak occurs in a densely populated area.

PROCEDURE

1. Explore how vaccines protect individuals and populations by doing the following analogies.
   - In a small, defined area, organize a game of freeze tag with one or two students designated as "it." In the first round, play until all students have been frozen. In the second round, give half the students a card to hold as they move about in the game. The student(s) who are "it" cannot freeze anyone holding a card. Play until all the players without cards are frozen.
   - Play a game based on the popular party game, Killer. In this version, called Zap, players try to identify the secretly designated zapper. Place a slip of paper on which you have written the word *Zapper* into a box. Prepare other slips of paper with the word *Player* written on them. Make sure there is one slip of paper for every player. In round 1, have the class sit in a circle. Have each player draw a slip out of the box, keeping his or her identity secret. The zapper is the student who

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picks the slip that reads *Zapper*. He or she "zaps" others by winking at them. When zapped, players are out of the game and move back from the circle. All players watch carefully and try to catch the zapper at work. The play continues until either everyone is zapped or the zapper is revealed. For round 2, prepare and use a different set of slips: one zapper slip, half of the remaining slips with the word *player*, and half with the words *vaccinated—you cannot be zapped*. A vaccinated player is unaffected when zapped. To surprise the zapper, do not tell the group about this new kind of card. Rather, advise players to read their card carefully and do what it says. The group plays until they identify the zapper.

2. Process the activities by discussing the following questions:
   - What did the people who were designated as "it" or as the zapper represent?

     An infectious virus.
   - What did the other players represent?

     A population at risk of being exposed to the virus.
   - How did a vaccine protect an individual?

     It prevented an individual from getting tagged or zapped.
   - What happened when half the group was "vaccinated?"

     Only some people got tagged or zapped.
   - What would happen if the whole group were "vaccinated?"

     The person who is "it" could not tag anyone and the zapper could not zap anyone.
   - What is the parallel between the games and vaccinating a large number of people?

     Vaccination protects an individual from contracting an infectious disease. When everyone is vaccinated, no one becomes ill and the infectious disease stops.
   - What has to occur to eradicate an infectious disease?

     Everyone in the world with a chance of becoming infected needs to be vaccinated. Smallpox has been eradicated thanks to an aggressive vaccination program started in 1966 and ending in 1979.
   - What are some problems associated with an incomplete or partial vaccination program?

     Most diseases (e.g., SARS, West Nile, Avian flu, and anthrax) have reservoirs in nature. Thus, they remain present and can cause repeated outbreaks. In addition, disease agents can mutate, giving rise to new forms that can make even vaccinated people sick.
   - Why is vaccination considered a preventive measure rather than a treatment?

     A vaccine stimulates a person's natural immune response. Over time, a vaccinated person develops antibodies, which prevent infectious diseases from taking hold. Once an unvaccinated person has contracted an infectious disease, it is usually too late to begin to prepare the immune system—it is already fighting the full-strength infectious agent.

3. Assign student teams a region from the list of suggested regions and countries. (One way to form teams is to list regions on the board and let students select the ones they are interested in studying.) Have teams research the diseases prevalent in some or all of the countries within their region and prepare a map or chart showing the following:
   - Specific diseases of concern in this region
   - Vaccinations that the Centers for Disease Control recommends for particular countries or for the region as a whole

4. If suitable vaccinations are available to travelers, discuss why the diseases still persist around the world. Ask: "What issues hamper getting vaccines to those who need it?"

   Answers include: Lack of funding; difficulty delivering vaccines; war; governmental instability; lack of infrastructure (e.g., roads and refrigeration); lack of health education leading to unfounded fears about vaccines causing impotence, sterilization and AIDS; and lack of political will and leadership to vaccinate each new generation of children, year after year.

5. Point out that there are factors besides vaccination that can affect the spread of disease, including poverty, population density, geography, altitude, weather, topography, and politics. These factors are explored in greater depth in the "Delivering the Goods" activity. Ask how, in the game, Zap, one could represent these other factors.

   To represent moving to an uninfested area to avoid mosquito-transmitted diseases, a player could turn his or her chair around to elude the zapper. Players could represent income levels by designating high and low income roles. A low-income player could be zapped with one wink, while a high-income player would require two or three. To represent good health care, they could give people who were zapped a second chance. To show population density, students could change how closely they sit to one another. To represent winter—a form of vector control, the zapper could stop winking for a minute every four minutes.

6. Have students complete the questions on the student sheet and discuss their responses. See the Assessment section for answers to the questions and for key discussion points.

GOING FURTHER

- Conduct a school-wide (or family) health census, asking people what vaccinations they have had. Calculate the percentage of people that know their vaccination status. Find out whether people feel that knowing which vaccinations they have had is important.
- Research the controversy surrounding vaccinations. What risks are associated with vaccinations? What ethical reasons might deter people from being vaccinated? Why do certain people recommend that everyone should be vaccinated? What might happen to a child whose parents do not want their children vaccinated?
- Ask the school nurse what vaccines are mandatory for school attendance and which ones are suggested? What are the reasons? How critical a school-health issue is infectious disease?
- Play the following classroom games to explore health conditions around the world and how vaccines play an important role in improving them.

Download these free games at **pbs.org/wgbh/rxforsurvival/campaign/givetime/index.html**.

- *Investing Your Money Wisely:* If you were advising a government on how to spend its limited healthcare budget, how would you keep the largest possible number of people healthy? In this game, you decide which public health measures should be put in place first. (*Activity type: Debate. Duration: 30 minutes. Requires a table. Preparation time: 15 minutes.*)
- *Growing Up Healthy:* How easy is it for a child to grow up healthy without an adequate public health care system? Find out how challenging it can be! (*Activity type: Board game. Duration: 10 minutes. Requires tabletop. Preparation time: 15 minutes.*)
- *Unfair Race:* How much of an impact does where you live have on your health? Players assume the roles of different countries and examine the extent to which one's country can help or hinder one's health. (*Activity type: Group experience. Duration: 15 minutes. Requires a large room or outdoor space. Preparation time: 20 minutes.*)

REGIONS AND COUNTRIES INFORMATION SHEET

The countries below are sorted into unofficial groupings. Feel free to combine and rearrange the lists. North America and Western Europe have been omitted because the disease and vaccination issues for these regions are minimal.

Central America: Belize, Honduras, Guatemala, El Salvador, Nicaragua, Costa Rica, Panama

South America: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela

Eastern Europe: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic

Former Soviet Union: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine

North Africa: Morocco, Western Sahara, Mauritania, Algeria, Libya, Egypt

West Africa: Senegal, The Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Ivory Coast (Côte D'Ivoire), Ghana, Mali, Burkina Faso, Togo, Benin, Niger, Nigeria

Central Africa: Chad, Sudan, Cameroon, Central African Republic, Gabon, Congo (capital: Brazzaville), Democratic Republic of the Congo (capital: Kinshasa), Sao Tome, and Principe

East Africa: Ethiopia, Eritrea, Somalia, Kenya, Uganda, Rwanda, Burundi, Tanzania

Southern Africa: Angola, Zambia, Namibia, Botswana, Zimbabwe, Mozambique, South Africa, Lesotho, Swaziland, Madagascar

West Asia: Syria, Lebanon, Israel, Jordan, Iraq, Saudi Arabia, Yemen, Oman, Qatar, United Arab Emirates, Bahrain, Iran

South Asia: Afghanistan, Pakistan, India, Sri Lanka, Nepal, Bhutan, Bangladesh

East Asia: Myanmar (Burma), Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Brunei, Philippines, Taiwan, China, South Korea, North Korea, Japan

ASSESSMENT

Students' responses to the questions on the student sheet should incorporate the points discussed in the answers (included in this section). In addition, consider the following when assessing student work:

- Played the games in a cooperative manner.
- Supported the team by contributing to the discussion, listening to others' ideas, discussing a variety of views, and helping the team develop a consensus.
- Used several appropriate sources when researching countries and regions.
- Wrote thoughtful responses to student sheet questions and based conclusions on a variety of information.
- Demonstrated an understanding of how the activity's games, group work, research, and discussion relate to the important role vaccines play in improving global health.

ANSWERS TO *DISEASE WARRIORS* STUDENT SHEET

THE ELEMENT IN THE GAME	WHAT THAT GAME ELEMENT REPRESENTS
The person who is "it"	*The virus causing the infectious disease*
The freeze tag players	*The population at risk of being infected*
Getting tagged	*Becoming infected*
Holding a card	*Getting vaccinated*
The zapper	*The virus causing the infectious disease*
The Zap players	*The population at risk of being infected*
Getting zapped	*Becoming infected*
Getting a vaccination card	*Getting vaccinated*

2. What is the parallel between the games and vaccination?

Vaccination protects an individual from contracting an infectious disease. When everyone is vaccinated, no one becomes ill and the infectious disease stops.

4. In what ways are a disease-causing virus and a computer virus alike?

Computer viruses make computers "sick" or malfunction, similar to human viruses. They also pass from infected computers to unprotected ones through "contact," such as e-mail.

5. Some people do not protect their computers against computer viruses. How might the reasons for leaving their computers unprotected be similar to the reasons people give for not getting vaccinated?

Answers may include economic decisions (I can't afford it), availability (I don't know where to get it or I haven't been offered protection), motivation (I'm not sure I really need it), and mistrust (I'm better off without it).

6. What problems or issues prevent basic vaccines getting to those in need?

Answers include: lack of funding, difficulty delivering vaccines, governmental instability, lack of infrastructure (e.g., roads and refrigeration), war, and lack of political will and leadership to vaccinate each new generation of children. In addition, the community must understand the need. Lack of health education and misinformation (e.g., vaccinations cause impotence, AIDS, or make one sterile) can prejudice people against vaccinations.

7. How can vaccines be used to eradicate a disease?

While a vaccine protects an individual, an infectious disease can only be eradicated if vaccines are used on a widespread, sustained, population-wide basis.

8. In the United States, vaccinations protect most people from many serious diseases. How can living here affect how we think about the amount of disease around the world and its impact?

Thanks to widespread vaccination, people in the United States rarely witness many of the serious, often deadly diseases common in many parts of the world. This situation leads many people to take the low incidence of these diseases for granted and causes us to downplay the important role vaccination plays in the health of our nation.

9. Describe how the United States' need to vaccinate its population compares to the need of other countries to vaccinate their people.

All countries need to vaccinate their populations. Otherwise, infectious diseases persist and can be reintroduced in places where they are rare or nonexistent. Furthermore, vaccinations help free countries from the economic and societal burdens of disease. Economics and infrastructure often dictate the kind of vaccination program a country can offer its citizens.

RELATED *RX FOR SURVIVAL* WEB SITE FEATURES (see pbs.org/rxforsurvival)

Why Global Health Matters: Learn why we should all be involved in global health initiatives.

Deadly Diseases: Learn about some of the diseases that are humanity's most feared killers.

Global Health Atlas: Learn about the health profiles of nations.

Ask the Expert: Post a question about vaccines and vaccination programs.

Get Involved: Find meaningful ways to take action.

Dispatches from the Field: Hear first-person accounts from people on the frontlines of health care.

LINKS

Centers for Disease Control
cdc.gov
Learn more about techniques and strategies for tracking and containing infectious diseases. Also, find out about health and disease risks by region and country and read about the recommended childhood immunizations.

Making Vaccines
pbs.org/wgbh/nova/meningitis/vaccines.html
Create vaccines in your own virtual laboratory using this interactive NOVA Online feature.

Smithsonian Institution History of Polio and the Polio Vaccine exhibit
americanhistory.si.edu/polio
Learn about the history of polio and the polio vaccine and take a virtual tour of the exhibit.

UNICEF
unicef.org/immunization
Learn how UNICEF combats child mortality through vaccination programs that currently reach 40% of the world's children.

World Health Organization (WHO)
who.int
Learn how the WHO and its member states attempt to stem the spread of disease worldwide. Also, access the data doctors use to diagnose diseases brought to the United States by travelers.

Worldwatch Institute 2005 Report
worldwatch.org/features/security/tf/4
Find out about infectious disease around the world.

BOOKS

Cartographies of Disease. Tom Koch. Redlands, CA: ESRI Press, 2005.
Filled with beautiful maps, illustrations, charts and graphs, this highly visual book helps readers visualize the connection between geography and disease.

Exploring Health Care Careers: Real People Tell You What You Need to Know. David Hayes, ed. Chicago: Ferguson Publishing Company, 1998.
Over 100 health care professionals share their stories with a new generation of disease warriors.

Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, a Man Who Would Cure the World. Tracy Kidder. New York: Random House, 2004.
For 20 years, Dr. Paul Farmer has traveled the world, treating the desperately poor, comforting the seriously ill—and refusing to let any obstacle, large or small, stand in his way.

World Health Organization. Cath Senker. Chicago: Raintree, 2004.
Summarizes the history, mission, and modern-day role of the WHO in promoting public health around the globe.

The Secret Life of Germs: Observations and Lessons From a Microbe Hunter. Philip M. Tierno, Jr., Ph.D. New York: Simon and Schuster, 2001.
The author presents the pros and cons of co-existing with one of the most abundant—and potentially dangerous—forms of life on the planet.

World Health. Ronan Foley. Chicago: Raintree, 2004.
Learn how international issues impact health in the developing world and the difficult choices governments are often forced to make.

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RX FOR SURVIVAL
A GLOBAL HEALTH CHALLENGE

Disease Warriors

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1. Freeze tag and Zap model the role that viruses and vaccines play in infectious disease. Match an element in the games to a part of the vaccination process. Even if you played just one of the games, see if you can identify how each game represents the vaccination process.

THE ELEMENT IN THE GAME	WHAT THAT GAME ELEMENT REPRESENTS
The person who is "it"	
The freeze tag players	
Getting tagged	
Holding a card	
The zapper	
The Zap players	
Getting zapped	
Getting a vaccination card	

2. What is the parallel between the games and vaccination?

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DID YOU KNOW?

The word *vaccination* comes from the Latin word *vacca*, meaning "cow." This is because some of the first vaccinations against smallpox were made of fluid from cowpox sores.

3. Your team researched the health issues in a specific region. List the specific diseases of concern in this region and the vaccinations that the Centers for Disease Control recommends.

4. In what ways are a disease-causing virus and a computer virus alike?

DID YOU KNOW?

The 1974 meningitis epidemic in Brazil was stopped when public health workers vaccinated three million people in five days.

5. Some people do not protect their computers against computer viruses. How might the reasons for leaving their computers unprotected be similar to the reasons people give for not getting vaccinated?

6. What problems or issues prevent basic vaccines getting to those in need?

7. How can vaccines be used to eradicate a disease?

8. In the United States, vaccinations protect most people from many serious diseases. How can living here affect how we think about the amount of disease around the world and its impact?

9. Describe how the United States' need to vaccinate its population compares to the need of other countries to vaccinate their people.

DID YOU KNOW?

Every 30 years or so, a new strain of influenza (i.e., the flu) appears. Since nobody has immunity to the new strain, a worldwide flu epidemic often occurs.

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