Herd Immunity and Positive Externalities

Lesson Authors

John Tibbetts, Worth County High School, Sylvester, Georgia

Jennifer Tontodonati, Social Circle High School, Social Circle, Georgia

Standards and Benchmarks (see page 17)

Lesson Description

In this lesson, students participate in a simulation using the idea of herd immunization to investigate the concept of positive externalities related to market failure and the role of government. The lesson also introduces the concept of negative externalities.

Grade Level

9-12

Concepts

Externality

Negative externality

Positive externality

Objectives

Students will be able to

- explain externality, positive externality, and negative externality;
- explain why an externality is an example of market failure;
- explain ways a government corrects for externalities; and
- identify and describe examples of positive externalities and negative externalities.

Essential Question

How do governments correct for externalities?

Time Required

60 minutes

Materials

- *Visual 1: Herd Immunity and Positive Externality*, PowerPoint Slides 1-6
- *Handout 1: Disease Information*, one copy for the teacher
- *Handout 2: Assessment*, one copy for each student
- Yellow, red, and green sticky dots or notes in various amounts, depending on the size of the class; the breakdown is as follows:

	Round								
	1	**2**	**3**	**1**	**2**	**3****	**1***	**2**	**3**
Classroom size	**Red dots**			**Yellow dots**			**Green dots**		
10-19	4	12	4	4	No new dots	7-16	32-68	No new dots	2
20-29	8	24	8	8	No new dots	15-24	64-100	No new dots	3
30+	12	36	12	12	No new dots	23-35	96-120	No new dots	4

*See Step 1: In Round 1, all other students need additional green dots.

**See Step 24: In Round 3, all other students need additional yellow dots.

Procedure

1. As students enter the classroom, distribute dots randomly based on the following table for Round 1 of the simulation. Do not reveal to the students what the colors of the dots mean until Step 9. Tell the students that the dots are important for a simulation in which they will participate and that they should place the sticky dot or note on their shirts.

Classroom size	Infected (Red)	Vaccinated (Yellow)	Susceptible (Green)
10-19	1	1	All others
20-29	2	2	All others
30+	3	3	All others

2. Display Slide 1. As you read through the diseases listed on the slide, discuss the following:
   - Have you heard of any of the diseases? (*Answers will vary.*)
   - How have you heard about the disease(s)? (*Answers will vary.*)
   - What do you know about the disease(s)? (*Answers will vary based on students' experiences and background.*)

3. Review the content from *Handout 1: Disease Information* with the students. Discuss the following:
   - Why do you think that you have not heard of some or all of these diseases? (*Answers will vary.*)
   - Explain that vaccination programs have been successful enough to greatly lower the incidence of some diseases and that in other cases, diseases have been eradicated. This is somewhat problematic because some diseases are so rare that many newer doctors may never have seen a case, so some doctors may have trouble identifying rare cases of the disease.
   - Why might economists care about disease? What role might the government play? (*Give students two minutes to write down their thoughts.*)

4. Tell the students they will now participate in a simulation. Without explaining what the dots represent, give each student three additional dots of the same color that they will give away.

5. Explain to the students that during the simulation they must keep the dots they are given even if the dots are the same color as the dot they already have. They may only give away the dots they received at the start of the round.

6. Display the following chart on the board or display Slide 2. Record the number of students in each category of the Start row—see example below:

	Red	**Yellow**	**Green**
Start	2	2	18
Round 1			
Round 2			
Round 3 – Start			
Round 3 – End			

7. **Round 1:** Tell the students that for Round 1 they will have 30 seconds to move around the room and interact with three students. Instruct them to shake the hand of each person they meet and to give a dot to each person with whom they shake hands, even if that person has already received the same color dot from another person.

8. Allow 30 seconds for students to interact. At the end of the 30 seconds, make sure each student has interacted with three other students.

9. Separate the students into color groups according to the dots they received at the start of class. Tell the students what each color dot means: Red dot means infected with a disease, yellow dot means vaccinated, and green dot means susceptible to a disease. Explain the following:
   - Those who are vaccinated (yellow dot) and received an infected dot (red) from an infected person remain healthy.
   - Those who were susceptible (green dot) and received an infected dot (red) from an infected person are now infected, too.
   - Those who were susceptible and met only susceptible people (green dots) or received a vaccine dot (yellow dot) remain susceptible. Unlike a disease, a person cannot transmit his or her vaccine to others through contact.
   - Those who were infected (red) and met an infected or vaccinated person (yellow dot) remain infected.

10. Record the number of students in each category in the chart on the board or on Slide 2 for Round 1. Explain that any student who was susceptible (green) and met an infected student (red) will change to infected for Round 2. Have these students move to the red-dot group.

11. Ask the students if they have any predictions for what will happen in Round 2. (*Students should deduce that any remaining susceptible students who come into contact with an infected student would be infected.*)

12. **Round 2:** Divide the class in half and have the students form two circles, one inside the other. Students in the outer circle should face inward; students in the inner circle should face outward. Each student should be paired with the student he or she is facing. If there is an odd number of students, one student should pair with another student in the same circle regardless of category and interact with other people as the partner does. Hand out three additional red dots to each infected student—both the originally infected and those infected in Round 1. Remind the students infected in Round 1 to wear the red dot they were given.

13. Instruct the students to move in the following way: Those in the outer circle will move clockwise and those in the inner circle will stand still. After a short period of time (5-10 seconds), tell the outer circle to stop. Have students shake hands with the student in front of them. Infected

students will give dots to those whose hands they shake. Repeat this movement and exchange dots two more times.

NOTE: This round is more controlled so that students cannot avoid other students they know to be infected.

14. When Round 2 is complete, explain the following:
    - Those who were susceptible (green) and received a red dot from an infected person are now infected, too.
    - Those who were vaccinated were not infected.
    - Record the number of students in each category in the chart on the board or on Slide 2 for Round 2.

15. Have the students return to their seats. Discuss the following:
    - Is what happened in Round 2 what you predicted at the end of the first round? (*If students predicted there would be more infected students, they should conclude their prediction was true.*)
    - Who should be responsible for the prevention of the spread of disease? (*Student answers will vary. They may say prevention is an individual responsibility, either of the infected student or of the uninfected student. Some may say doctors who know about an infection should inform their patients about how to prevent the spread. Some may say the government has a responsibility to protect the public.*)
    - If you were in charge, what solution would you offer to prevent the spread of a new disease? (*Answers will vary. Some may say there should be a quarantine. Some may suggest creating a vaccine. Others may say there should be research to find a cure [which is different from a vaccine].*)
    - Would the spread of disease in any way affect the economy? (*Answers will vary but may include the following: Businesses will be affected if employees miss work or there is a loss of customers; there could be an increase in mortality; businesses could see an opportunity to make money through a cure or vaccine; parents may have to miss work to take care of children; and adult children may miss work to take care of elderly parents.*)

16. Explain to the students that scientists have learned that if enough people are immune or vaccinated, unvaccinated individuals are less likely to be infected because of a statistically decreased likelihood of coming into contact with the disease. This is a concept known as herd immunity. Herd immunity is "the resistance to the spread of a contagious disease within a population that results if a sufficiently high proportion of individuals are immune to the disease, especially through vaccination." (https://en.oxforddictionaries.com/definition/herd-immunity)

17. Display Slide 3 and explain that scientists have determined that diseases have different levels of transmission, known as the reproduction number (R_0). As a result, for herd immunity to

occur, percentages of the population must be incapable of contracting a disease, either through natural immunity or vaccination. This percentage required for herd immunity to be effective is the "herd immunity threshold" or the HIT.

18. Explain to the students that when markets are well-functioning, all of the costs and benefits of a transaction for a good or service are paid by the buyer and seller. Continue with the following:
    - When someone buys a sandwich at a shop, it is reasonable to assume that all of the costs and benefits of the transaction are contained between the seller and the buyer.
    - However, sometimes the production or consumption of a good or service results in costs or benefits that spill over to a third party not directly involved in the transaction.
    - These spillover costs and benefits are called **externalities**.
    - A **negative externality** occurs when a cost spills over.

19. Display Slide 4 and review the examples of negative externalities. Have students identify and explain the benefits and costs in each transaction. (*Cigarette smoking: The company selling the cigarettes and the person buying benefit directly; others who don't smoke and don't sell cigarettes are hurt—they breath polluted air; Loud concert in the park: Those who buy tickets and the band selling the tickets benefit; others who live near the park and have to listen to the loud music bear a cost, and those caught on congested streets where others have parked bear a cost.*) NOTE: Students may argue that others who live near the park could enjoy the music, which would be a positive externality.

20. Explain that a **positive externality** occurs when a benefit spills over. Display Slide 5 and review the examples of positive externalities. Have students identify and explain who benefits and who loses with each example. (*Homeowner improves house and sells it for a higher price: The home seller and home buyer benefit, and neighbors benefit because their property values rise, even though they weren't involved in improving the home or selling it; State builds a reservoir: Tax payers and those who sold the land for the reservoir benefit from the transaction. People from outside the area who did not pay the taxes to build the reservoir benefit from the recreation provided; Company provides first aid classes: Both the health care vendor that provides the classes and the company whose employees become trained in first aid benefit from their transaction. Others who are not part of the transaction may benefit if they are in need of first aid and one of the company's trained employees is nearby.*)

21. Point out that externalities occur when some of the costs or benefits of a transaction fall on someone other than the producer or consumer. A cost to a third party is a negative externality, and a benefit to a third party is a positive externality. In both cases, externalities exemplify a market failure. A market failure is a condition where the market fails to allocate goods, services, or resources efficiently. When there are positive externalities to a transaction, more of the good or service should be produced. When there are negative externalities to a transaction, less of the good or service should be produced. Explain that a government can correct market failures.

In the case of a negative externality, the government can force producers to pay the full cost of production so that less of the good or service is produced. For example, a plant that is generating electricity causes air pollution. The company pays for the costs of producing electricity, such as labor and equipment. It also pays for the waste it produces, such as trash hauling for solid waste and sewer service for liquid waste. But who does it pay to take its gaseous waste? There is no one to haul off this waste—it simply goes into the air. So, disposing of gaseous waste is free for the company. If the government taxes the company an amount to represent the cost of the gaseous waste, the company pays the full cost of its production.

22. Explain that in the case of positive externalities, not enough of the good or service is being produced. In this case, the government can subsidize the production of the good or service so that more is produced. Discuss the following:

    - Could herd immunity represent an externality? (*Yes*) Which type of externality does it represent? (*Positive externality*) Why? (*Because the benefits of immunity spill over to others who may or may not be vaccinated*)
    - Because herd immunity is an example of a spillover benefit or a positive externality, what could the government do to increase the percentage of immunity in society? (*Subsidize vaccinations, which would raise the percentage of people with an immunity; quarantine the sick to prevent the spread of the disease, which would reduce the percentage of the population that is infected; or impose regulations that require children entering kindergarten to be vaccinated*)
    - Does the government have the authority to require people to be vaccinated or to legally quarantine people? (*Yes*) For example, some states require children to be vaccinated before entering school, and some countries require people to be vaccinated before entering. During the flu epidemic of 1918, some states and cities implemented a quarantine. Schools may close if too many students are sick.
    - Might there be an economic reason for this type of regulation? (*Referring to the answers at the end of Round 2 [Step 15], there is a definitive economic need for the government to improve public health due to the cost of containment and cures/vaccines, especially in the face of recent debilitating epidemics/pandemics such as HIV/AIDS [1960-present], influenza pandemics [1918, 1957, 1968, 2009], cholera [2008-09], SARS [2002], and ebola [2013-16].*) Refer to Handout 1.
    - Is it possible for someone who is susceptible but not immune or vaccinated to not be infected by a disease? How might that occur? (*Students may recognize that if someone "survived" the first two rounds of the simulation without being infected, they were actually either vaccinated or had a natural immunity, or they simply did not come into contact with an infected student.*)

23. Confirm to the students that the government has the authority to subsidize vaccination programs, require vaccinations, or quarantine. Tell the students that there will be a third round of the simulation.

24. **Round 3:** Explain that in this round the government has intervened in the market to provide some amount of vaccines. For Round 3, distribute dots based on the following table:

Classroom size	Infected (Red)	Vaccinated (Yellow)	Susceptible (Green)
10-19	1	All others	2
20-29	2	All others	3
30+	3	All others	4

25. Record the number of students in each category in the chart on the board or on Slide 2 in the row labeled "Round 3 - Start." Discuss the following:
    - What do you predict will happen in this round? (*Answers will vary. Some students may believe the results will be similar to Round 1.*)
    - Do you think more or fewer people will likely become infected? (*Answers will vary. Fewer students should be infected than in Round 1.*)

26. Divide the class in half and have the students form two circles as in Round 2 (refer to Step 12). For class sizes of 20 or greater, there should be an infected student in both circles. Hand three red dots to those students who are infected for them to pass out to those they meet. NOTE: If the students are in the same groups as in Round 2, consider flipping the circles such that the inner circle students are now in the outer circle, and the outer circle becomes the inner circle.

27. As in Round 2, have the students in the outer circle move clockwise and those in the inner circle stand still. After a short period of time (5-10 seconds), tell the outer circle to stop. Tell the students to shake hands with the student in front of them and exchange dots as in Round 1. Repeat this movement and exchange dots two more times. Record the number of students in each category in the chart on the board or on Slide 2 in the row labeled "Round 3 - End." Discuss the following:
    - Based on the results of Round 3, were there more or fewer healthy people at the end of Round 2? (*More healthy people*)

28. Instruct the students in the inner circle to explain to the person in front of them the definition of a positive externality. After giving students an opportunity to speak to their partner, ask for a volunteer in the outer circle to explain what a positive externality is. Explain to the students that vaccinations are not the only type of positive externality. Discuss the following:
    - If a person decides to become a beekeeper, what benefits are there to that person? (*Honey production and sales*) What benefits might spill over to others who don't buy or sell honey? (*Crop pollination*)

- If society wants more crop pollination, what could we do? (*Subsidize beekeepers*)
- Who benefits from public education? (*Those who attend school and obtain an education; the teachers and administrators who are paid to educate*) Do others benefit from public education even if they do not have children? (*Yes*) How do they benefit? (*Society as a whole benefits from having educated citizens who are generally more productive than those who aren't well educated.*)
- Because we recognize that education produces positive externalities—that is, benefits spill over to those who aren't producers and consumers of education—what do we often do? (*We subsidize education through taxes.*)
- How does planting trees in your backyard benefit you? (*Provides shade, beauty, a place to hang a hammock*)
- When you plant trees in your backyard, do people who don't live in your house or visit your yard benefit? (*Yes*) How? (*Answers will vary but may include that neighbors could see into your yard and enjoy the beauty of the trees and that trees pull carbon dioxide from the air and provide oxygen.*) So, planting trees results in a positive externality.

29. Instruct the students in the outer circle to explain to the person in front of them the definition of a negative externality. After giving students an opportunity to speak to their partners, ask for a volunteer in the inner circle to explain what a negative externality is. Discuss the following:
    - Are there spillover costs from building a new airport; that is, are there costs paid by people who don't provide air transportation or buy air transportation? (Yes) What are those spillover costs? (*Answers will vary but may include that an airport could lead to noise pollution, air pollution, and increased traffic congestion.*)
    - How might we correct for this negative externality? (*Pay those near the airport to compensate them for the noise pollution, air pollution, and traffic congestion; purchase the properties of those who live around the airport*)
    - What are the spillover costs that result from someone smoking cigarettes? (*Answers will vary but may include that people would be affected by secondhand smoke or that people with asthma could have breathing problems.*)
    - When people drive, they pollute the air. This means they are consuming transportation/a car without paying the full cost of driving—in other words, they are producing a negative externality. What could governments do to reduce air pollution from cars? (*Require that cars have catalytic converters or special air filters; require cars to use special gasoline; impose gas taxes requiring those who pollute through driving to pay the cost of polluting; impose regulations on how far or how much someone can drive*)

30. Have the students review the predictions they wrote down before Round 1 of the simulation. They should reflect on whether their predictions were correct. Discuss the following:

- Why might economists care about disease? (*People can spread disease, and those who are sick can't work. People who are ill drain government health care resources and generally aren't able to participate as consumers as readily as they would when well.*)
- What role might the government play? (*Governments can subsidize research for curing diseases, subsidize vaccinations for preventing the spread of disease, and impose regulations requiring people to be vaccinated.*)

31. Remind students that vaccinations are a type of positive externality because there are spillover benefits. That is, those who are vaccinated are protected, and if enough people are vaccinated then others are less likely to contract the disease—so they benefit from vaccinations even if they themselves aren't vaccinated.

Closure

32. Display Slide 6 and review the vocabulary. Discuss the following:
    - What is a negative externality? (*A cost for people not involved in producing or consuming a good or service*) Provide an example. (*Air or water pollution, cigarette smoke*)
    - What is a positive externality? (*A benefit to people not involved in producing or consuming a good or service*) Provide an example. (*Vaccinations, medical research, beekeeping, yard landscaping*)
    - How can governments correct for externalities? (*Positive externalities: Governments can impose regulations and provide subsidies that reduce the costs and increase the amount of production. Negative externalities: They can tax production to reduce the amount produced, regulate production, and impose fines.*)
    - How do vaccines benefit the individual? (*Answers will vary but may include that vaccines protect the individual from getting sick, save the individual money on healthcare, and prevent the individual from missing work.*)
    - How do vaccines help society? (*Answers will vary but may include the following: They help prevent children from getting sick and missing school; parents/guardians would not have to miss work to take care of sick children; families would save money that would have been spent on healthcare; vaccines increase life span because if enough people are vaccinated, it helps prevent others who are unable to be vaccinated from becoming sick; and vaccinations may result in increased productivity because people have fewer sick days.*)
    - If there isn't enough production of a vaccine, what could governments do? (*Subsidize production*)

Assessment

33. Distribute a copy of *Handout 2: Assessment* to each student. Allow time for students to work. Use *Handout 2: Assessment—Answer Key* to review student answers.

Handout 2: Assessment—Answer Key

Short Answer

1. Why might the government need to have a role in a market economy if the problem was pollution? What could the government do to correct for this negative externality?

   Pollution results when producers and consumers are not paying all of the costs of production associated with a product. For example, if the production of a product results in air pollution, the producer is not paying to use/pollute the air. The government can force the producer to pay the full costs of production by taxing production, selling pollution rights, and so on.

Multiple Choice

2. You decide to hire a company to improve the landscaping around your house. For your neighbors, this could be a
   a. positive externality.
   b. market failure.
   c. public good.
   d. negative externality.

3. If the government expands an airport in a city, which of the following is a positive externality?
   a. Growth in high-tech jobs
   b. Traffic congestion around the airport
   c. Noise pollution
   d. Increased hotel tax to pay for the airport

4. What is the most likely solution when society wants to increase herd immunity?
   a. Higher prices for vaccinations
   b. Reduced spending on research
   c. A private sector solution
   d. Government subsidy

Handout 1: Disease Information (page 1 of 4)

Ebola

"Ebola (Ebola Virus Disease)" from the CDC website;
https://www.cdc.gov/vhf/ebola/pdf/ebola-factsheet.pdf.

- Ebola was previously known as Ebola hemorrhagic fever.
- It is a rare and deadly disease caused by infection with one of the Ebola virus species.
- It can cause disease in humans and nonhuman primates (monkeys, gorillas, and chimpanzees).
- There are five identified Ebola virus species. Four have caused disease in humans:
    - Ebola virus (*Zaire ebolavirus*);
    - Sudan virus (*Sudan ebolavirus*);
    - Taï Forest virus (*Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus*); and
    - Bundibugyo virus (*Bundibugyo ebolavirus*).
- The Reston virus (*Reston ebolavirus*) has caused disease in nonhuman primates but not in humans.
- Ebola was first discovered in 1976 near the Ebola River in what is now the Democratic Republic of the Congo.
- Outbreaks have appeared sporadically in Africa.
- Researchers believe that the virus is animal-borne and that bats are the most likely reservoir. Four of the five subtypes occur in an animal host native to Africa.

Signs and Symptoms

- A person infected with Ebola virus is not contagious until symptoms appear. Signs and symptoms of Ebola include:
    - fever,
    - severe headache,
    - fatigue,
    - muscle pain,
    - weakness,
    - diarrhea,
    - vomiting,
    - stomach pain, and
    - unexplained bleeding or bruising.
- Symptoms may appear anywhere from 2 to 21 days after exposure to the virus, but the average is 8 to 10 days.
- Ebola viruses are found in several African countries. Past Ebola outbreaks have occurred in the following countries:
    - Democratic Republic of the Congo (DRC),
    - Gabon,
    - South Sudan,
    - Ivory Coast,

Handout 1: Disease Information (page 2 of 4)

- Uganda,
- Republic of the Congo (ROC), and
- South Africa (imported).

Treatment

- There is no FDA-approved treatment (e.g., antiviral drug) for Ebola.
- Symptoms and complications are treated as they appear.

Prevention

- There is no FDA-approved vaccine available for Ebola.

Measles

"Top 4 Things Parents Need to Know about Measles" from the CDC website; https://www.cdc.gov/measles/about/parents-top4.pdf.

- Measles was declared eliminated from the U.S. in 2000 thanks to a highly effective vaccination program.
- Though no longer constantly present in this country, measles is still common in many parts of the world, including some countries in Europe, Asia, the Pacific, and Africa.
- Every year, measles is brought into the U.S. by unvaccinated travelers.
- Worldwide, an estimated 20 million people get measles and 146,000 people, mostly children, die from the disease each year.

Measles Can Be Serious

- Some people think of measles as just a little rash and fever that clears up in a few days.
- Measles can cause serious health complications, especially in children younger than 5 years of age.
- About 1 in 4 people in the U.S. who get measles will be hospitalized.
- One out of every 1,000 people with measles will develop brain swelling, which could lead to brain damage.
- One or 2 out of 1,000 people with measles will die, even with the best care.

Measles Is Very Contagious

- It is spread through the air when an infected person coughs or sneezes.
- It is so contagious that if 1 person has it, 9 out of 10 people around him or her will also become infected if they are not protected.
- Children can get measles just by being in a room where a person with measles has been, even up to 2 hours after that person has left.
- An infected person can spread measles to others even before knowing he or she has the disease—from 4 days before developing the measles rash through 4 days afterward.

Measles-Mumps-Rubella (MMR) Vaccine

- It provides long-lasting protection against all strains of measles.
- A child needs two doses of MMR vaccine for best protection.

Handout 1: Disease Information (page 3 of 4)

Mumps

"Mumps and the Vaccine (Shot) to Prevent It" from the CDC website; https://www.cdc.gov/vaccines/parents/diseases/child/mumps-basics-color.pdf.

- Mumps is a contagious disease caused by a virus.
- It spreads easily through coughing and sneezing.
- There is no treatment for mumps, and it can cause long-term health problems.

Symptoms of Mumps

- Mumps usually causes the following symptoms for about 7 to 10 days:
  - fever,
  - headache,
  - muscle aches,
  - tiredness,
  - loss of appetite (not wanting to eat), and
  - swollen glands under the ears or jaw.
- Some people do not have symptoms.
- It can spread before swollen glands appear and up to 5 days afterward.
- Some may feel sick but will not have swollen glands.
- Generally mumps is pretty mild, but it can cause serious, lasting problems, including
  - meningitis (swelling of the tissue covering the brain and spinal cord);
  - deafness (temporary or permanent);
  - encephalitis (swelling of the brain);
  - orchitis (swelling of the testicles) in males who have reached puberty; and
  - oophoritis (swelling of the ovaries) and/or mastitis (swelling of the breasts) in females who have reached puberty.
- In rare cases it can be deadly.

Polio

"Polio and the Vaccine (Shot) to Prevent It" from the CDC Website; https://www.cdc.gov/vaccines/parents/diseases/child/polio-basics-color.pdf.

- Polio (or poliomyelitis) is a disease caused by poliovirus.
- It can cause lifelong paralysis (inability to move parts of the body).
- It can be deadly.

Symptoms of Poliovirus Infection

- Most people who get infected with poliovirus do not have any symptoms.
- Some people (25 people out of 100) have flu-like symptoms usually lasting 2 to 5 days.
- About 1 out of 200 people have weakness or paralysis in their arms, legs, or both.
  - Paralysis or weakness can last a lifetime.

Handout 1: Disease Information (page 4 of 4)

- Even children who seem to fully recover can develop new muscle pain, weakness, or paralysis as adults, 15 to 40 years later.
- About 2 to 10 children out of 100 with paralysis from polio die if the virus affects breathing muscles.

Polio Vaccine, also Called IPV (or Inactivated Poliovirus Vaccine)

- Doctors recommend all children get the vaccine.
- It protects a child from polio, a potentially serious disease.
- It prevents a child from developing lifelong paralysis from polio.
- It is very safe and effective at preventing polio.

Rubella

"Rubella (German Measles, Three-Day Measles)" from the CDC website; https://www.cdc.gov/rubella/about/in-the-us.html.

- Rubella is a contagious disease caused by a virus.
- It is also called "German measles," but it is caused by a different virus than measles.
- It was eliminated from the U.S. in 2004.
- Rubella remains a problem in other parts of the world and can be brought into the U.S.
- Before 1969, rubella was a common and widespread infection in the U.S. The last major rubella epidemic in the U.S. was from 1964 to 1965:
  - 12.5 million people (estimated) got rubella;
  - 11,000 pregnant women lost their babies;
  - 2,100 newborns died; and
  - 20,000 babies were born with congenital rubella syndrome (CRS).
- The number of people infected with rubella in the U.S. dropped dramatically once the vaccine became widely used.
  - Less than 10 people in the U.S. are reported as having rubella each year.
  - Since 2012, all rubella cases had evidence that they were infected when they were living or traveling outside the U.S.

Handout 2: Assessment

Short Answer

1. Why might the government need to have a role in a market economy if the problem was pollution? What could the government do to correct for this negative externality?

Multiple Choice

2. You decide to hire a company to improve the landscaping around your house. For your neighbors, this could be a
   a. positive externality.
   b. market failure.
   c. public good.
   d. negative externality.

3. If the government expands an airport in a city, which of the following is a positive externality?
   a. Growth in high-tech jobs
   b. Traffic congestion around the airport
   c. Noise pollution
   d. Increased hotel tax to pay for the airport

4. What is the most likely solution when society wants to increase herd immunity?
   a. Higher prices for vaccinations
   b. Reduced spending on research
   c. A private sector solution
   d. Government subsidy

Standards and Benchmarks

Voluntary National Content Standards in Economics

Standard 16: Role of Government and Market Failure

There is an economic role for government in a market economy whenever the benefits of a government policy outweigh its costs. Governments often provide for national defense, address environmental concerns, define and protect property rights, and attempt to make markets more competitive. Most government policies also have direct or indirect effects on people's incomes.

- **Benchmark 1, Grade 12:** Markets do not allocate resources efficiently if: (1) property rights are not clearly defined or enforced; (2) externalities (spillover effects) affecting large numbers of people are associated with the production or consumption of a product; or (3) markets are not competitive.
- **Benchmark 4, Grade 12:** Externalities exist when some of the costs or benefits associated with production and consumption fall on someone other than the producers or consumers of the product.
- **Benchmark 5, Grade 12:** When a price fails to reflect all the benefits of a product, too little of the product is produced and consumed. When a price fails to reflect all the costs of a product, too much of it is produced and consumed. Government can use subsidies to help correct for insufficient output; it can use taxes to help correct for excessive output; or it can regulate output directly to correct for over—or under—production or consumption of a product.