Disease and the GeoHistoGram

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Lesson Overview: Students explore the geographical and historical development and diffusion of four diseases and discuss their significance to human civilizations

Essential Questions:
- How and why do diseases spread?
- What is the significance of diffusion of disease?

Objectives: Students will be able to:
- Map the locations of four disease areas.
- Describe the patterns of diffusion of four diseases.
- Explain the causes for the diffusion of the four diseases, including vectors (animals that carry disease) and methods of human transmission.
- Plot diseases on GeoHistoGram from the first recorded incident to the present

Subject/Grade Level: 7th Grade Social Studies/High School World History

Duration: 1-2 class periods

Student Materials: Blank world political map; GeoHistoGram; disease timelines, Student worksheets; colored pencils

Teacher Materials: Background Information; Answer Keys

References:
http://www.cbc.ca/health/story/2008/05/09/f-cholera-outbreaks.html
http://rarediseases.about.com/cs/bubonicplague/a/111602.htm
http://www.malariasite.com/MALARIA/History.htm
http://www.cdc.gov/malaria/history/index.htm
http://nobelprize.org/educational_games/medicine/malaria/readmore/history.html
http://encarta.msn.com/media_701508643/smallpox_through_history.html
http://dermatology.about.com/cs/smallpox/a/smallpoxhx.htm
http://www.nature.com/nri/journal/v2/n7/fig_tab/nri845_12.html

Grade Level Content Expectations

7-G1.3.3: Explain the different ways in which places are connected and those connections demonstrate interdependence and accessibility.

HS 4.2.3: The Plague – Using historical and modern maps and other evidence explain the causes and political consequences of this pandemic.

HS 5.2.1: European Exploration/Conquest and Columbian Exchange – Analyze the demographic, environmental and political consequences of European oceanic travel and conquest and of the Columbian Exchange in the late 15th and 16th centuries by describing the geographic routes used in the exchange of plants, animals, and pathogens among the continents in the late 15th and the 16th centuries

HS 7.1.4: Global Technology – Describe significant technological innovations and scientific breakthroughs in transportation, communication, medicine, and warfare and analyze how they both benefited and imperiled humanity.

National Geography Standards:
Standard 11: The patterns and
Procedure:

1. **Introduction:** Have students discuss effects of diseases on humans and concept of transmission.

2. **Vocabulary Development:**
   a) Disease - a change in the living body that interferes with its normal functioning
   b) Vector - a creature that carries disease germs
   c) Bacteria - any of many single-celled organisms that are important to humans because of their chemical activities and as causes of disease
   d) Virus - ultramicroscopic infectious agent that replicates itself only within cells of living hosts; many are pathogenic
   e) Antibiotic - a chemical substance derivable from a mold or bacterium that can kill microorganisms and cure bacterial infections
   f) Diffusion—the spread of ideas, organisms
   g) Hierarchical—from the top down as dictated by the government as through war or colonialism
   h) Contagious—by coming into contact with another as through trade or missionary work

3. **Mapping Activity:** Hand out 4 blank world maps, mapping activity worksheet and colored pencils. Have students fill in 4 maps (according to directions) while teacher tells the story of the occurrence/diffusion of the malaria, Bubonic Plague, smallpox, and cholera. Students answer the questions for each map. Show completed map and discuss questions.

4. **GeoHistoGram Activity:** Hand out blank GeoHistoGrams, timelines and GeoHistoGram activity worksheet. Have students work in pairs to complete directions. Show completed GeoHistoGram and discuss questions.

**NOTE:** If students have not had experience with this resource, show GeoHistoGram Explanation PPT and discuss how it shows time and place concurrently

Assessment:

- Students will need another blank GeoHistoGram for this activity. Have students choose one of the diseases mapped/charted. Students should recreate the GeoHistoGram as if air travel had been introduced in 1000 CE. Students should describe the changes in the GeoHistoGram. Did the current state of the disease change? Why or why not? How might this have impacted human populations?

Extensions:

- Have students research the dates for HIV/AIDS and complete the GeoHistoGram. What affects the spread of HIV/AIDS?
- Have students research the spread of the H1N1 virus. Chart the spread on a GeoHistoGram. Project the GeoHistoGram 50 years into the future - what happens to the spread of H1N1?
- Using Google Earth, map/plot the spread of diseases
MAP ACTIVITY:

Materials: four blank outline world map and four different colored pencils for each student.

It might be helpful for students to have an atlas for this activity

DIRECTIONS FOR ACTIVITY: (see appendix for key)

- While discussing the history of smallpox (see teacher notes), have students mark each country/region discussed with the letter “S” in one color for each country/region associated with smallpox

- On the second world map have students mark “M” in a different color for each country mentioned in the malaria discussion

- On the third world map have students mark “B” in a different color for each country mentioned in the Bubonic Plague discussion

- On the fourth world map have students mark “C” in the last color for each country mentioned in the Cholera discussion

- Students should shade in each map with appropriate colors

- Student then mark the map with an appropriate key and title

Discussion questions:

- What patterns do you see with the occurrence/diffusion of each of the different diseases?

- What might account for the differences?
Geohistogram Activity

Materials:
1. Maps from disease map activity
2. Four copies of GeoHistoGram
3. Timeline for malaria, cholera, smallpox, bubonic plague.
4. Four colored pencils (same as used for map activity)

Directions for Activity—work in pairs
1. Get out the timeline and map for smallpox.
2. Draw a point at the first evidence of smallpox at the approximate time and region of the world (use same colored pencil as in the map activity).
3. Continue the dates toward present, shading in the GeoHistoGram.
4. As more regions show evidence of smallpox, the width of the geohistogram line should thicken, likewise, as regions show a decrease in the incidence of smallpox, the line should decrease in width.
5. Continue shading to present.
6. Repeat the procedure for each of the other diseases on a new GeoHistoGram.
7. Title your GeoHistoGram.

Answer the following questions after finishing your geohistograms.

- How did the patterns of disease change after time was introduced as a factor?

- What historical events might explain the differences in diffusion of the diseases?

- What technological innovations might explain the differences of the diffusion of the diseases?

- What else might explain the differences in the diffusion/occurrences of a particular disease?

- How might these diseases have affected the human populations based on their diffusion across area and time?
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Michigan Geographic Alliance
Disease
2014
MAP ACTIVITY:

Discussion questions:

· What patterns do you see with the occurrence/diffusion of each of the different diseases?

  Malaria - Malaria seemed to start in Africa and spread throughout Europe, Asia, Africa moving to North America after 1500 CE

  Smallpox - First recorded in Nile River Valley, spreads into Asia and then the rest of Africa and Europe. Smallpox moves into the Americas with colonization and soon encompasses both North and South America. Lastly, smallpox moves into Australia.

  Bubonic Plague - Bubonic Plague is first recorded in Africa (Ethiopia). The plague moves north into Central Asia, and from there moves both east and west into the rest of Asia and Europe. While there are limited cases in the Americas, they do not cover the country, but rather focus in western and southwestern United States.

  Cholera - Cholera is first found in southern Asia. From there it travels throughout Asia, Europe, Africa, North and South America

· What might account for the differences?

  All of the diseases seem to move between Africa, Asia, and Europe fairly easily. However, Bubonic Plague did not make the jump to the Americas successfully. Something in the transmission or vectors of the diseases must not have made the diffusion easy. Also, Australia and the Americas did seem to be the origin of any of the diseases.
Teacher answer keys

GeoHistoGram Activity

Answer the following questions after finishing your GeoHistoGrams.

· How did the patterns of disease change after time was introduced as a factor?

When time was introduced, you can see the differences in the time of diffusion of the diseases. You can see the affect of colonization and actually attribute the diffusion to a particular event. You can also the eradication of a disease in a given area, like cholera not moving into Britain and the United States during the fifth pandemic. You can also the complete eradication of a disease like smallpox, using only a thin dotted line to represent the existence of the virus in two labs.

· What historical events might explain the differences in diffusion of the diseases?

Trade, military movements, COLONIZATION

· What technological innovations might explain the differences in the diffusion of the diseases?

Movement within the realm of Asia, Africa, Europe seems to occur throughout time. Movement into North/South America had to wait for the technology of Europeans to cross the oceans. The same could be said for movement into Australia. With discoveries in the medical field, some diseases saw a great decrease in areas/people affected, with smallpox being eradicated from the natural world.

· What else might explain the differences in the diffusion/occurrences of a particular disease?

One of the most glaring differences between the diseases is the fact that Bubonic Plague did not sweep through the Americas like the other diseases. One could hypothesize that something about the transmission of the disease was different, a different vector. In fact, the rats that the fleas depended on did not find a firm foothold in the Americas. The malaria (anopheles) mosquito seemed to survive just fine in the Americas, and smallpox and cholera also seemed to travel well.

· How might these diseases have affected the human populations based on their diffusion across area and time?

All of these diseases affected huge numbers of humans. North and South America seem to have been spared early affects of the diseases, but as soon as colonization occurred, three of the four diseases made their way across the oceans with serious consequences. Some diseases that severely affected human populations in earlier times, like Bubonic Plague or smallpox have decreased in importance in modern times. Smallpox, a disease that killed millions, is now confined to two labs. Bubonic Plague can be cured with a fairly simple dose of antibiotics. Even though Plague cases continue to occur, they do not affect the numbers of people that it did during the Middle Ages. Malaria continues to cause significant illness and death in tropical areas (the disease is considered to be endemic). Modern preventive measures are working to decrease the number of people affected.
Smallpox Dates

1. Smallpox outbreaks in Nile River Valley and Mesopotamia, 10,000 BCE
2. Smallpox epidemics in China and India, 3,000 BCE
3. Smallpox documented in Athens, Greece, 490 BCE
4. Smallpox documented in Korea, 583 CE
5. Smallpox documented in Japan, 585 CE
6. Smallpox spreads throughout Africa and Europe, 700-1000 CE
7. First recorded smallpox outbreak in New World, Hispaniola, brought by ill Spanish sailor, half indigenous population dies, 1518 CE
8. Cortes conquers Aztecs in Mexico, one of his soldiers passes smallpox to Aztec population, one third die, 1520 CE
9. Inca emperor Huayna Capac dies of smallpox, 1525 CE
10. King of Siam dies of smallpox, 1534 CE
11. 400,000 Europeans die yearly from smallpox, 1700’s CE
12. British troops distribute smallpox infected blankets to Native Americans in an attempt a biological warfare during the French and Indian War, 1763 CE
13. Smallpox introduced to Australia killing over half the indigenous Aborigine population, 1789 CE
14. British physician, Edward Jenner, tries first vaccination on boy using cowpox, 1796 CE
15. Vaccination begins to overcome resistance in Europe, Asia although epidemics still occur world wide, 1800’s CE
16. Last naturally occurring case of smallpox in United States, 1949 CE
17. WHO launches worldwide campaign to vaccinate against smallpox, two million die this year from the disease, 1967 CE
18. Last naturally occurring case of smallpox, worldwide, occurs in Somalia, 1977 CE
19. Laboratory case of smallpox resulted in death in United Kingdom, 1978 CE
20. WHO declare smallpox eradicated, only left in two labs in U.S. and Russian (USSR), 1979 CE

http://encarta.msn.com/media_701508643/smallpox_through_history.html
Malaria Dates

1. Malaria in Africa, 8,000 BCE
2. Malaria in Mesopotamia, Indian peninsula, southeast Asia, 3,000-8,000 BCE
3. Malaria in China, 3,000 BCE
4. Malaria reaches the shores of the Mediterranean, 500 BCE - 1CE
5. Malaria reaches northern Europe, 1000-1500 CE
6. 1100 CE, Valencia - farmers sentenced to death if they planted rice too close to villages and cities
7. Malaria reaches New World, end 1500 CE
8. Malaria spreads throughout North America, mid1700’s CE
9. Malaria reaches peak around globe, mid 1800’s CE
10. Malaria almost disappears from Europe, North America, 1950’s
11. Malaria continues to be endemic in tropical tropics with most deaths occurring in Africa, present time

http://www.malariasite.com/MALARIA/History.htm
Student Resource

Bubonic Plague Dates

1. Believed outbreak of Bubonic Plague beginning in Ethiopia, traveling to Egypt, Libya, and Greece, killing 1/3 the population of Athens (some believe this might have been smallpox), 430 BCE
2. Plague spreads from Egypt to Constantinople, 540’s CE
3. Plague again breaks out in Constantinople and spreads towards Europe, 1334 CE
4. Plague outbreak occurs in Constantinople and moves into Alexandria, Cyprus, Sicily, Italy, France, Germany, England, Norway, Eastern Europe, Scotland, Wales, Ireland, Russia, 1347-1351 CE
5. The Great Plague of London, 1665 CE
6. Plague outbreak in central Europe, small outbreak in London, 1679 CE
7. Austria has outbreak of plague, 1711 CE
8. Balkans have plague outbreak lasting two years, 1770’s
9. Third Plague Pandemic - worldwide although China, India hardest hit, 1855-1889 CE
10. Working independently, bacteriologists Alexandre Yersin and Shibasaburo Kitasato isolated the bacterium that causes bubonic Plague. Yersin discovers that rodents are the mode of infection. The bacterium is named Yersinia pestis after Yersin, 1894 CE
11. Outbreak of plague in Australia and Portugal, 1900 CE
12. Outbreak of plague in Manchuria, 1910 and 1920 CE
13. Outbreak of plague in Surat, India, 1994
14. Three mice infected with plague disappear from a lab in New Jersey, 2005 CE
15. According to the World Health Organization, there are 1,000 to 3,000 cases of bubonic plague worldwide each year. There are no known cases in Australia or Europe. Areas where cases occur are in Russia, the Middle East, China, Southwest and Southeast Asia, Madagascar, southern and eastern Africa, the Andes mountains and Brazil, western United States, present day

1. 1817 - 1823: first known pandemic of Cholera; Ganges River delta in India. By the early 1820s, colonization and trade had carried the disease to Southeast Asia, central Asia, the Middle East, eastern Africa, and the Mediterranean coast.

2. 1829 - 1849: The second pandemic started in India and reached Russia by 1830 before continuing into Finland and Poland. A two-year outbreak began in England in October 183. Irish immigrants carried the disease from Europe to North America. The disease then entered the U.S. through Detroit and New York, and reached Latin America by 1833. Another outbreak across England and Wales began in 1848.

3. 1852 - 1859: The third pandemic; generally considered the most deadly, originated in India. It devastated large swaths of Asia, Europe, North America and Africa. In 1854, British physician John Snow succeeded in identifying contaminated water as the transmitter of the disease, a breakthrough in eventually bringing it under control. Snow carefully mapped the cases of cholera in the Soho area in London and traced the source to a water pump. After convincing officials to remove the pump handle, the number of cholera cases in the area immediately declined.

4. 1863 - 1879: The fourth pandemic began in the Bengal region from which Indian Muslim pilgrims visiting Mecca spread the disease to the Middle East. From there it migrated to Europe, Africa and North America.

5. 1881 - 1896: The fifth pandemic originated in the Bengal region of India and swept through Asia, Africa, South America and parts of France and Germany. Cholera swept into Russia between 1893 and 1894; and Japan between 1887 and 1889. Quarantine measures based on the findings of John Snow kept cholera out of Britain and the United States. In 1892, Waldemar Haffkine, a Ukrainian bacteriologist who worked mostly in India, developed a human vaccine for cholera.

6. 1899 - 1923: the sixth pandemic killed more than 800,000 in India before moving into the Middle East, northern Africa, Russia and parts of Europe. By 1923, cholera had receded from most of the world, although many cases were still present in India.

7. 1961 - Present: the seventh pandemic originated in Indonesia. It spread across Asia and the Middle East, eventually reaching Africa by 1971. In 1991, 100 years after being vanquished from South America, cholera appeared in Peru. An outbreak among Rwandan refugee camps in the Democratic Republic of Congo occurred in 1994. The World Health Organization reported that nearly 500 people had died in an outbreak in Zimbabwe in the last few months of 2008. The outbreak is blamed on deteriorating infrastructure as the country's political crisis continues. The discovery of a new species of the cholera bacteria (O139) in Bangladesh in 1992, which has since been detected in 11 countries, has raised the possibility and fear of an eighth pandemic.

http://www.cbc.ca/health/story/2008/05/09/f-cholera-outbreaks.html
Notes on diseases

Smallpox
Smallpox is a serious, contagious, and sometimes fatal infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination. The *pox* part of *smallpox* is derived from the Latin word for “spotted” and refers to the raised bumps that appear on the face and body of an infected person.

Where Smallpox Comes From
Smallpox is caused by the variola virus that emerged in human populations thousands of years ago. Except for laboratory stockpiles, the variola virus has been eliminated. However, in the aftermath of the events of September and October, 2001, there is heightened concern that the variola virus might be used as an agent of bioterrorism. For this reason, the U.S. government is taking precautions for dealing with a smallpox outbreak.

Transmission
Generally, direct and fairly prolonged face-to-face contact is required to spread smallpox from one person to another. Smallpox also can be spread through direct contact with infected bodily fluids or objects such as bedding or clothing. Rarely, smallpox has been spread by virus carried in the air in enclosed settings such as buildings, buses, and trains. Humans are the only natural hosts of variola. Smallpox is not known to be transmitted by insects or animals.

A person with smallpox is sometimes contagious with onset of fever (prodrome phase), but the person becomes most contagious with the onset of rash. At this stage the infected person is usually very sick and not able to move around in the community. The infected person is contagious until the last smallpox scab falls off.

Bubonic Plague
Plague is an infectious disease of animals and humans caused by a bacterium named *Yersinia pestis*. People usually get plague from being bitten by a rodent flea that is carrying the plague bacterium or by handling an infected animal. Millions of people in Europe died from plague in the Middle Ages, when human homes and places of work were inhabited by flea-infested rats. Today, modern antibiotics are effective against plague, but if an infected person is not treated promptly, the disease is likely to cause illness or death.

Cholera
Cholera is an acute, diarrheal illness caused by infection of the intestine with the bacterium *Vibrio cholerae*. The infection is often mild or without symptoms, but sometimes it can be severe. Approximately one in 20 infected persons has severe disease characterized by profuse watery diarrhea, vomiting, and leg cramps. In these persons, rapid loss of body fluids leads to dehydration and shock. Without treatment, death can occur within hours.
A person may get cholera by drinking water or eating food contaminated with the cholera bacterium. In an epidemic, the source of the contamination is usually the feces of an infected person. The disease can spread rapidly in areas with inadequate treatment of sewage and drinking water. Cholera can be simply and successfully treated by immediate replacement of the fluid and salts lost through diarrhea. Patients can be treated with oral rehydration solution, a prepackaged mixture of sugar and salts to be mixed with water and drunk in large amounts. This solution is used throughout the world to treat diarrhea. Severe cases also require intravenous fluid replacement. With prompt rehydration, fewer than 1% of cholera patients die.

Antibiotics shorten the course and diminish the severity of the illness, but they are not as important as rehydration. Persons who develop severe diarrhea and vomiting in countries where cholera occurs should seek medical attention promptly.

**Malaria**

Malaria is a mosquito-borne disease caused by a parasite. People with malaria often experience fever, chills, and flu-like illness. Left untreated, they may develop severe complications and die. Each year 350-500 million cases of malaria occur worldwide, and over one million people die, most of them young children in Africa south of the Sahara.

This sometimes fatal disease can be prevented and cured. Bednets, insecticides, and antimalarial drugs are effective tools to fight malaria in areas where it is transmitted. Travelers to a malaria-risk area should avoid mosquito bites and take a preventive antimalarial drug.

*(All information from the Center for Disease Control)*