

Lesson 1 – Understanding How Diseases Spread

LESSON QUESTIONS

- What are the different ways that diseases can spread?
- How can the way a disease spreads affect who is at risk?

LESSON OBJECTIVES

- Identify the different ways diseases can spread.
- Discuss how the way a disease spreads affects who is at risk.

OVERVIEW

Students research different infectious diseases to determine the ways they spread and who is most at risk. The lesson concludes with students developing resources to help educate an at-risk population about how to protect themselves from infection.

LENGTH

Up to three 45-minute sessions

GLOSSARY TERMS

common cold; congenital rubella syndrome; COVID-19; epidemic; hand, foot, and mouth disease; hepatitis B; human papillomavirus; malaria; measles; mucous membranes; pandemic; pathogen; polio; rabies; rubella; salmonella; tetanus; vector

STANDARDS

Next Generation Science Standards

- Disciplinary Core Ideas in Life Sciences
 - Social Interactions and Group Behavior
 - Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
 - Interdependent Relationships in Ecosystems
 - Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite.

This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

- Adaptation
 - Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.
- Science and Engineering Practices
 - Asking Questions and Defining Problems
 - Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
 - Constructing Explanations and Designing Solutions
 - Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
 - Obtaining, Evaluating, and Communicating Information
 - Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
 - Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
- Crosscutting Concepts
 - Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
 - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
 - Cause and Effect: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- Scale, Proportion, and Quantity: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
 - The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
- Connections to the Nature of Science
 - Scientific Investigations Use a Variety of Methods
 - Science Knowledge is Based on Empirical Evidence

Common Core State Standards

- CCRA.R.1
Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.11-12.2.B Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

MATERIALS

- Student worksheet
https://vaccinemakers.org/sites/default/files/lessons/HS.student%20worksheet.How%20Diseases%20Spread.lesson1.final_o.pdf
- Computer with internet access
- For Activity 1, each group or individual will need:
 - Activity 1 sheet
https://vaccinemakers.org/sites/default/files/lessons/HS.activity1.How%20Diseases%20Spread.lesson1.Final_o.pdf

BACKGROUND FOR TEACHER

Infectious diseases spread in a variety of ways. When we know how infections spread, we can better control them. Infectious agents can spread directly from one person to another or indirectly when one person comes into contact with an infectious agent introduced into the environment by an infected person, such as on a surface or an item. And, in some cases, infections are not spread by people, but rather by a vector, like infected animals or insects, or via contaminated water or soil.

Person-to-person spread typically occurs when someone is exposed to an infectious person or products from their bodies, such as through droplets in the air (for example, from coughing, sneezing or even talking), through blood or body fluids (such as urine, saliva, breastmilk, semen, or vaginal secretions), through contact with skin or mucous membranes (such as mouth, respiratory tract, eyes, broken skin or genitals), or through feces. In some cases, the infected person's bodily fluids or products remain viable on inanimate objects long enough to infect the next person who comes into contact with that object. We often think about toys or diapers in daycare settings, but this can include contaminated food that is consumed uncooked; blood on a towel, washcloth, or gym floor; desks or tables that have not been cleaned between occupants; or shared water bottles. Infections can also spread from a mother to her unborn child either while in utero or during the birth process. Some infections can spread in more than one way, which students will research in Activity 1. Also, some infections can be more serious depending on when infection occurs. Rubella is an example of a disease that is often mild unless a woman contracts it during the first trimester of pregnancy. Even if maternal symptoms are mild, if the infection happens in that timeframe, it can cause issues during fetal development and result in congenital rubella syndrome.

TEACHER NOTES

Students should have a general understanding that different pathogens such as bacteria, viruses, parasites, and fungi can spread from one person to another. Sometimes exposure does not result in symptoms, but some infections can cause disease or death.

LESSON RESOURCES

- Lesson glossary
https://vaccinemakers.org/sites/default/files/resources/HS.lesson%20glossary.How%20Diseases%20Spread.lesson1.Final_.pdf
- Additional resources that may be helpful:
 - Video, Sneezing and Coronavirus Disease 2019 (COVID-19), JAMA Network, <https://www.youtube.com/watch?v=piCWFgwysuo>
 - Webpage, Vaccines and Diseases, VEC, <https://www.chop.edu/vaccine-education-center/vaccine-details>
 - Webpage, Ways infectious diseases spread, Government of South Australia, <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/conditions/infectious+diseases/ways+infectious+diseases+spread>
 - Book chapter, “How Infection Works,” The National Academies, <https://www.nationalacademies.org/read/13006/chapter/3>
 - Book chapter, “Disease Threats,” The National Academies, <https://www.nationalacademies.org/read/13006/chapter/4>
 - Webpage, Infectious Diseases, Cleveland Clinic, <https://my.clevelandclinic.org/health/diseases/17724-infectious-diseases#symptoms-and-causes>
 - Webpage, Infectious Diseases 101: What They Are, How They Spread, and How to Stop Them, Families Fighting Flu, <https://familiesfightingflu.org/infectious-diseases-101-what-they-are-how-they-spread-and-how-to-stop-them/>
 - Webpage, Discussing Infectious Diseases in Vulnerable and High-Risk Populations, Infectious Disease Specialists, <https://idspecialists.sg/medical/general/discussing-infectious-diseases-in-vulnerable-and-high-risk-populations/>
 - Article, “Vulnerable Populations: Who Are They?” The American Journal of Managed Care, <https://www.ajmc.com/view/nov06-2390ps348-s352>
 - PDF, Infectious diseases and immune-compromised people, VEC, <https://www.chop.edu/sites/default/files/vaccine-education-center-infectious-diseases-immune-comp.pdf>
 - PDF, Infectious diseases and cancer patients, VEC, <https://www.chop.edu/sites/default/files/vaccine-education-center-infectious-diseases-cancer-patients-qa.pdf>
 - PDF, Infectious diseases and pregnancy, VEC, <https://www.chop.edu/sites/default/files/2024-11/infectious-diseases-pregnancy-qa.pdf>

ENGAGE

1. Use a spray bottle containing water and have one of the students release a single spray in the direction of the class. Ask the class to indicate who felt the water land on them. Repeat this from several distances and angles of spray in the room.
Alternatively, have students stand at various distances and angles from the board or from a series of flip chart sheets and spray the bottle in the direction of the surface.
2. Discuss what students observed related to the variations of the spray at distances and angles. If needed, direct the discussion to the focus on how wide the spray angle was (# of people who felt a spray or diameter on the spray charts), where they found wet spots that they wouldn't expect (desks, the floor, the wall, etc.).
3. Ask students to think about how this activity relates to the spread of a contagious disease. If necessary, prompt students to consider the different numbers of people affected at various distances, wet surfaces that were later touched and how these factors could relate to the transmission of a pathogen.
4. Finish by brainstorming a class list of the ways that diseases spread. Students should be able to come up with a variety of examples, such as coughing; sneezing; from objects/surfaces to mouth, eyes or nose; kissing; foods; sex; bodily fluids, such as blood, saliva, or urine; mother to unborn child; or in the air.

EXPLORE

1. Have students complete the vocabulary table in the student worksheet.
2. Using activity 1 sheet, have students break into small groups and research one of the following diseases to determine how the disease is spread. Have groups also identify 1 to 3 additional examples of diseases that spread in a similar manner:

Common cold**COVID-19****Hand, foot, and mouth disease****Hepatitis B****Human papillomavirus****Malaria****Measles****Polio****Rabies****Rubella** (congenital rubella syndrome)**Salmonella****Tetanus****EXPLAIN**

1. Have each group share their findings with the class in a brief presentation.
2. During presentations, students should complete the table on the activity 1 sheet.
3. Following each presentation have a 1-to-2-minute class discussion to ensure that all students accurately interpreted the presentation by asking non-group members what they wrote for the corresponding blocks on the table. If any students express confusion, further discuss the findings with the class to clarify the information.

ELABORATE

1. Have each group determine who (which groups of people) is most likely to get the infection they researched and discuss among group members whether the method by which the infection spreads relates to who is most at risk of getting it.
2. Have groups prepare a resource that educates one of the high-risk groups about how to avoid being infected. Resource can be a flyer, poster, brochure, PSA, blog post or other type of media you deem appropriate.

EVALUATE

Evaluate student understanding based on presentations, educational resource, small group interactions, and class discussions

RUBRIC: STUDENT WORKSHEET

Vocabulary table

- Refer to the lesson glossary for correct definitions.

RUBRIC - Activity 1: How Diseases Spread

Disease	How it spreads	Other examples
Common cold	Droplets in air	Influenza, meningococcal disease (bacteria), COVID-19, rubella*
COVID-19	Droplets in air	Influenza, common cold
Hand, foot, and mouth disease (HFMD)	Skin; mucous membranes	Chickenpox (varicella)*, herpes simplex virus, head lice, ringworm, warts
Hepatitis B	Blood; body fluids	Hepatitis C, HIV*, Cytomegalovirus (CMV)
Human papillomavirus	Sexual; skin-to-skin	HIV*, gonorrhea, chlamydia, hepatitis B*
Malaria	Insect vector (mosquitoes)	Yellow Fever, dengue fever, Zika
Measles	Airborne	Chickenpox (varicella)*; tuberculosis
Polio	Fecal-oral	Giardia, hepatitis A, rotavirus, salmonella*
Rabies	Bite of infected animal	Cat-scratch disease, Q Fever, toxoplasmosis

Disease	How it spreads	Other examples
Rubella (specifically with congenital rubella syndrome)	Mother to child	Chickenpox (varicella)*, hepatitis B*
Salmonella	Contaminated food or water	Hepatitis A*, cholera, typhoid, Listeria
Tetanus	Soil	Amoebic meningitis, Legionella infection

*Indicates a disease that can be transmitted in more than one way and, therefore, may come up in more than one presentation.