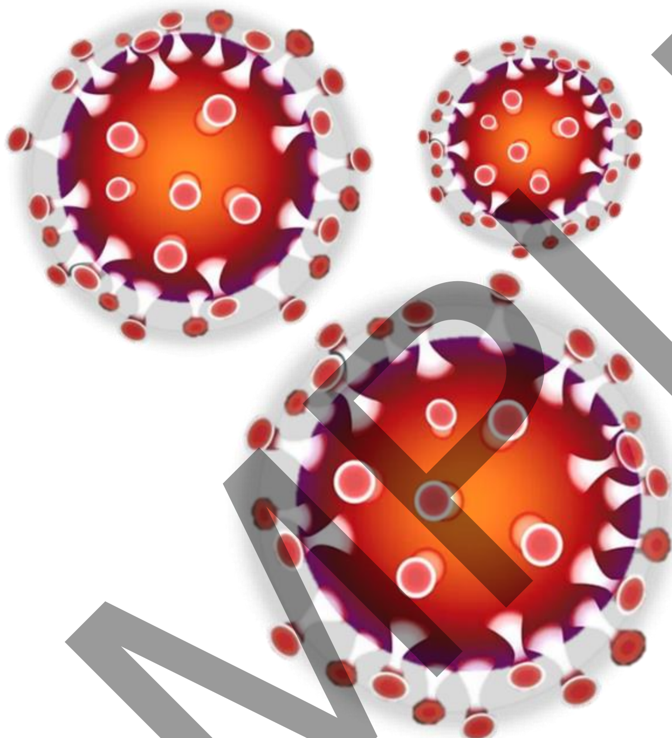

Coronavirus Education Kit

Understanding Transmission and Response

TEACHER'S GUIDE

Note: This manual contains information related to an ongoing disease outbreak. The facts related to this situation may change rapidly and this manual may not reflect the most up to date information. If you have questions or concerns, consult your doctor or local health officials for more information.

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MATERIALS

The materials in this kit can be used with an individual or a group of up to 5 students. **Copies of the Student Worksheet and Lab Manual are required for use in groups**. For larger groups, additional “add-on” materials are available at www.homesciencetools.com (Product ID: KT-PANCLA).

Item	Quantity Required (per group)
Glo Germ Powder (4 oz)	The included 4 oz bottle is enough for numerous students and/or repetitions of the lab.
UV Light (with Batteries)	1
Small Scoop	1
Balloons	4
Bottle & Spray Nozzle	1
Tissues	2 (not included)
Liquid Soap	(not included)
Ruler or Tape Measure	1 (optional; not included)
Sink (for washing hands)	(not included)

Using This Lab Kit

Along with the detailed instructions in this Guide, this kit contains hands-on materials, a Student Lab Manual, and a Student Worksheet. Prior to starting the lab, review this Guide to understand expected outcomes, preparation, additional materials required, and recommended areas for action.

Lab Overview

The Coronavirus Education Kit is a valuable hands-on activity that helps students understand disease outbreaks, discover the modes of disease transmission, and apply their learning to design solutions for preventing a pandemic. In **Part 1**, students will discover practical hygiene techniques that help prevent disease spread through four "virus transmission" experiments. In **Part 2**, they'll apply what they've learned from the hands-on activities and background reading, and will decide on a pandemic response in a fictitious scenario. Students will work to identify the source of a new virus passing through a community, and will then propose solutions to limiting further spread.

Preparation	Time Required	Target Grade Range
Review Background* (10 - 15 min.) **Prepare Materials** (5 – 10 min.)	**Part 1**: 40 – 60 min. **Part 2**: 40 – 60 min.	**8th – 12th Grade**

*Detailed review of the background material may be assigned as homework.

Throughout the lab, look for the following icons to make the most of your teaching and/or learning experience:

Use these **THINK ABOUT IT** sections to maximize the outcomes of this lab. These sections include questions to ask and steps to take to encourage discussion, debate, and more.

SAFETY is the highest priority. Look for this symbol for important safety tips and reminders.

Learning Outcomes

In this lab, students will learn to:

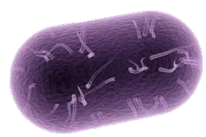
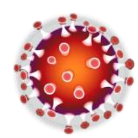
- **Qualitatively assess modes of disease transmission and methods for reducing the spread of viruses**
- **Investigate the source of a spreading disease and consider the impact on individuals and communities**
- **Describe a problem and use relevant scientific information to develop a solution that meets specified criteria and constraints**

Note: Alignment to NGSS Standards provided on Page 22.

Background

"Germs"

"Germs" is a common term used to refer to **bacteria, viruses, fungi** and **protozoa**, all of which can cause illness and disease. However, "germs" generalizes several very different types of things. Here, the focus is on bacteria and viruses. Bacteria are living organisms that are typically between 0.5 – 5 microns in size (as comparison, a human hair is 15 – 200 microns in diameter). Viruses, on the other hand, are often not even considered "living" things – as they can only replicate inside the cells of other living organisms (e.g., human cells). In addition, viruses are much smaller and less organizationally complex compared to bacteria. In terms of size, viruses are typically between 0.05 – 0.5 microns – several *hundred* times smaller than a human red blood cell. While size clearly demonstrates some of the differences between bacteria and viruses, there are a multitude of other factors that set them apart, including:

Bacteria	Viruses
	
Self-replicate, do not require a host cell	Require a host cell to replicate
Contain cell walls	Have a protein coat instead of cell wall
Unicellular	Do not have cells
Have a circular DNA chromosome	Contain DNA or RNA strands
Treated by antibiotics	NOT treated by antibiotics

In the study of infectious disease, it is important to differentiate bacteria and viruses, rather than simply using the generic term "germs" to refer to either. This distinction allows for a better understanding of the risks, treatment, and impact of an infection.

Are Antibiotics the Solution?

When suffering from a severe illness, patients or their caretakers may ask about antibiotics. It is true that antibiotics are life-saving medicines, but they are only effective against bacteria – **not** viruses. Why? Antibiotics prevent very specific functions that occur in bacteria, such as DNA replication, transcription, and cell wall synthesis. In many cases, antibiotics target and inhibit the particular proteins (**enzymes**) found in bacteria that carry out these functions. Thus, the bacteria can no longer grow or survive!

How Contagious is a Virus?

Viruses need hosts to infect and continue their cycle of propagation, transmission and infection. Without new hosts, the virus will no longer spread amongst a community or population, and it will thus eventually die off. Many infectious diseases are present at a roughly constant level within a population and geography – known as the **endemic** level. For this to occur, infected people must infect exactly one other person during the lifecycle of the virus. The dynamics of an endemic disease are described by a simple equation:

$$R_0 S = 1$$

Where R_0 is the **basic reproduction number** (average number of infections generated by one case, when all the population is **susceptible**) and S is the actual susceptibility of the population. If an infected person typically infects more than one other, the proportion of the population which has the disease will grow exponentially. If the infected person, on average, infects less than one person the virus will eventually be eradicated. In a completely susceptible population (a population with no **immunity**), $S = 1$ and the R_0 can be used to understand the likelihood of spread in a population. See transmission models below for the different R_0 scenarios.

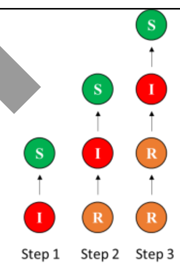
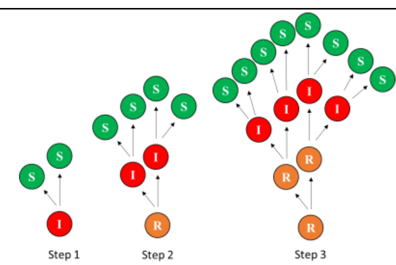
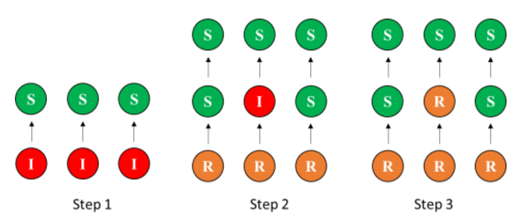
R_0	Outcome	Model
=1	Endemic disease, constant level within population/geography	
>1	Epidemic disease, exponential growth within population/geography (model shows R_0=2)	
<1	Declining disease, eventually dying out completely (model shows R_0=0.33)	

Table 1. "S" represents a susceptible individual, "I" is an infected individual, and "R" is a recovered or removed individual. Notice that for an endemic disease, the number of infected individuals remains constant, while the number rapidly expands for an epidemic.

time frame to allow for transmission. The virus may then be eradicated or exist at an endemic level. The proportion of the population that must be immune is a key determination made by the health agencies and pharmaceutical companies who develop vaccines.

In a situation like COVID-19 outbreak, when a vaccine is not yet available, other measures must be taken to ensure limited contact between susceptible and infected individuals.

Hands-on Exploration

Concept 1: Preventing Transmission

Person-to-Person

According to the CDC, the prevailing knowledge regarding COVID-19 indicates that the disease is transmitted primarily from person-to-person via:

- Close contact and/or touching
- Respiratory droplets generated by coughs or sneezes

Transmission from Surfaces

According to the CDC, it is thought that it is possible to transmit the SARS-CoV-2 virus from an infected surface (or object-to-person), though this is not believed to be a primary means of virus spread. In order to transmit the virus, a person would have to contact an infected surface then touch their own eyes, nose, or mouth.

In this activity, you'll discover that viruses can be rapidly transmitted from person-to-person (or from infected surfaces to people), and that they can potentially cause infection and disease. Therefore, it is critical to practice proper hygiene.

This includes:

- Proper handwashing technique
- Sanitizing contaminated surfaces
- Coughing or sneezing into a tissue or sleeve, not your hand

Activity 1: Testing Proper Hand Hygiene

Materials

Item	Quantity Required (per group)
Glo Germ Powder	½ Scoop
UV Light (with Batteries)	1
Small Scoop	1
Liquid Soap	(not included)
Running Water	(not included)
Sink & Soap (to clean up)	(not included)

WARNING!

Never look directly at UV lights, including the UV flashlight included in this kit. UV radiation exposure can damage the cornea - the outer protection of the eye. For extended usage, wear UV-filtering sunglasses or goggles (not included).

Procedure

Create a representation of hands that have been contaminated:

1. Apply ½ scoop of Glo Germ Powder to your hands and liberally smear it across your palm, between your fingers, and on top of your hands.
2. Turn off the lights, and use your UV light to examine all of the simulated virus “germs” on your hands!

Test handwashing techniques: Attempt the following techniques individually, or break up the techniques between group members.

1. Cold Water Rinse, No Soap
    - Without using soap, rinse your hands in cold water for 30 seconds (but do not rub your hands together).
2. Hot Water Rinse, No Soap
    - Without using soap, rinse your hands in hot (not scalding) water for 30 seconds (but do not rub your hands together).
3. Cold Water Rinse, With Soap
    - Rinse your hands in cold water for 30 seconds (but do not rub your hands together).
    - Add a typical amount of liquid soap to your palm and scrub your hands together for 30 seconds
    - Rinse your hands under cold water to remove the soap.
4. Hot Water Rinse, With Soap
    - Rinse your hands in hot (not scalding) water for 30 seconds (but do not rub your hands together).
    - Add a typical amount of liquid soap to your palm and scrub your hands together for 30 seconds.
    - Rinse your hands under hot (not scalding) water to remove the soap.

Compare the results of techniques 1 – 4 (either individually or as a group). Using the UV light, assess the amount of remaining Glo Germ Powder on your hands. Which technique removed the most simulated “germs”?

Record your observations on the Student Worksheet, Page 1.

Practice proper handwashing:

1. Apply ½ scoop of Glo Germ Powder to your hands and liberally smear it across your palm, between your fingers, and on top of your hands.

Activity 4: Transmission via Droplets

Materials

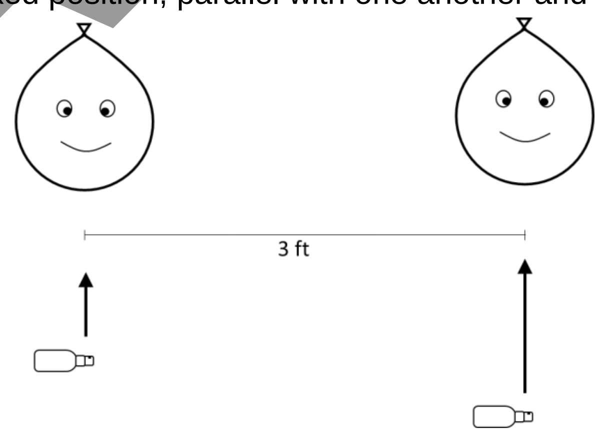
Item	Quantity Required (per group)
Glo Germ Powder	2 Scoops
UV Light	1
Spray Bottle	1
Balloons	4
Small Scoop	1
Ruler or Tape Measure	(optional)
Water (~ 50 mL)	(not included)
Sink & Soap (to clean up)	(not included)

Procedure

As noted above, a common form of transmission of COVID-19 and other viruses is through droplets of fluid released during coughing or sneezing (**aerosols**). A powerful sneeze can eject material at 100 miles per hour over distances of several feet; it can be the perfect mode of virus transmission.

Let's Explore Sneezing!

1. To simulate contaminated saliva, mix 2 scoops of Glo Germ Powder with water in the provided spray bottle.
2. Shake well to mix (note: powder will not dissolve, but attempt to break up clumps).
3. Test spray the bottle (into a sink or tissue) to ensure that a complete and full spray is achieved. If not, repeat the test spray several times until proper spray is achieved.
4. Blow up 2 balloons and draw a face on each.
5. Label one balloon with "1 ft" and the other with "3 ft" to represent a sneeze at 1 and 3 foot distances, respectively.
6. Place balloons at a fixed position, parallel with one another and about 3 feet apart.



7. Turn off/down the lights and use the UV flashlight to inspect the balloons – there should be very little fluorescence.
8. Measure (or estimate) 1 foot from one of the balloons.

3. Point the nozzle directly at the balloon., hold the tissue in front of the nozzle and press down rapidly and completely 2 times.
4. Repeat for the "3 ft" balloon, again using a new tissue and 2 sprays.
5. Turn down/off the lights and use the UV light to assess the amount of contaminated saliva that reached each face and the tissues. Record your observations on Page 3 of the Student Worksheet (in the "With Tissue" section).
6. Based on your observations, think about how sneezing in a tissue impacts the likelihood of transmission versus sneezing into the air or your hand.

THINK ABOUT IT

You will observe that a simple tissue or sleeve is a great way to prevent mass contamination of the air and nearby surfaces during a sneeze – the UV light will show the majority of the Glo Germ solution is on the tissue surface, not on the balloon. However, when a tissue is not used, even a sneeze from 3 feet away can contaminate another person through small droplets. The balloon when sprayed at 3 feet should have some small droplets present under the UV light, while the balloon at 1 foot will be completely contaminated.

1. What does this mean about how you can help prevent virus transmission?
2. How does this relate to recommendations that you should keep your distance, primarily staying several feet away from sick individuals?
3. How can you implement improved coughing/sneezing sanitary practices?

Concept 2: Protecting Communities

During the 2020 COVID-19 outbreak, many communities, states/provinces, and even entire countries put measures in place to protect citizens and prevent further spread of the virus. This included encouraging people to stay at home and away from public gatherings. Many businesses and corporate events were canceled across the globe, and some businesses even instructed employees to work from home. Flights across the globe were impacted: travelers from certain locations have been quarantined upon arrival and travel restrictions to certain countries were put in place. Early in an outbreak, it is crucial to prevent transmission using the techniques of Activity 1 – 4 and to focus on these types of activities in order to contain the virus.

Isolation

Viruses need hosts to infect and continue their cycle of propagation, transmission, and infection. Without new hosts, the virus will no longer spread amongst a community or population. As noted previously, large contributors to viral transmission are person-to-person contact and droplets released during coughing or sneezing.

During the COVID-19 Outbreak, the Chinese government instituted restrictions on people leaving the home. In addition, officials monitored the temperature (as an indicator of infection)

Alignment to NGSS Metrics

This lab can be used alongside instruction based on the Next Generation Science Standards*.

Key Performance Expectations

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constrains on materials, time or cost.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Asking Questions and Defining Problems Engagement in Argument from Evidence	ETS1.A Defining and Delimiting Engineering Problems ETS1.B Developing Possible Solutions	Influence of Science, Engineering, and Technology on Society in the Natural World Systems and System Models

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