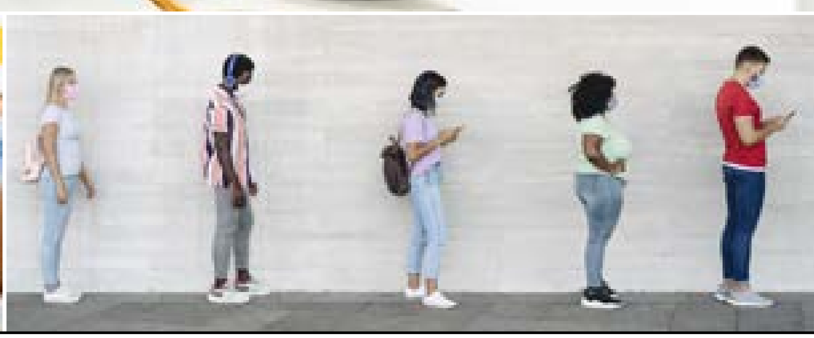
Smithsonian | SCIENCE *for Global Goals*

COVID-19!

HOW CAN I PROTECT MYSELF AND OTHERS?



NGSS-Aligned Teacher Companion Guide

developed by

Smithsonian
Science Education Center

in collaboration with

iap SCIENCE HEALTH POLICY
the interacademy partnership

nsta
National Science Teaching Association

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This NGSS Teacher Companion Guide is based upon, and intended to be used in conjunction with, the Smithsonian Science for Global Goals *COVID-19! How can I protect myself and others?* guide, © 2020 Smithsonian Institution.

For a list of Project Advisors, please see *COVID-19! How can I protect myself and others?*

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Thank You for Your Assistance

Thank You for Your Support

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Dear Educators,

In May 2020, the Smithsonian Science Education Center developed *COVID-19! How Can I Protect Myself and Others?,* a Community Response Guide dedicated to helping young people understand what COVID-19 is and how to take action in their own communities. This response guide was designed to be used either at home with siblings, parents, or caregivers or in schools with teachers. The guide is written for the student. While the scientific and medical communities' understanding of COVID-19 has changed since the guide was developed, the public health best practices included in the guide have not changed: thorough hand washing, social distancing, and mask wearing. And when they are followed, they can help reduce the spread of not only COVID-19, but also things like the flu and the common cold.

Now more than ever, we recognize the need for all students to have the tools and knowledge to protect themselves from the ongoing COVID-19 pandemic. To make this content more accessible and applicable for students, educators, school districts, and state education agencies who have adopted the *Next Generation Science Standards (NGSS)* or similar standards, we have collaborated with the National Science Teaching Association (NSTA) to create this *NGSS* Teacher Companion Guide to *COVID-19! How Can I Protect Myself and Others?*

This *NGSS* Teacher Companion Guide is intended to be used in tandem with the student-facing Community Response Guide of the *COVID-19!* guide. It provides additional conversations, activities, and support for educators to easily adapt the content for an *NGSS* classroom. In the Companion Guide, you will see that each lesson now centers around a phenomenon or problem, and includes a table outlining the Performance Expectations (PEs) and the *NGSS* elements reflective of three-dimensional learning.

We hope that this content will support you and your students as you engage with *COVID-19! How Can I Protect Myself and Others?*. We are all committed to a healthier world. And science education—and action—can help us accomplish this goal together.

Stay safe. Stay healthy. Stay informed.

Carol L. O'Donnell

Dr. Carol O'Donnell, Director
Smithsonian Science Education Center

NGSS Teacher Companion Guide

COVID-19!

HOW CAN I PROTECT MYSELF AND OTHERS?

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1 What is happening in the world right now?

Grade Level	Subject	Total Time
Middle School (target audience)	Life Science	45 minutes

Task-Level Performance Expectation (Task Objective). Ask questions that arise from careful observations to seek additional information about how people's interactions and behaviors changed after COVID-19 was declared a global pandemic in March 2020.

Phenomenon: People's interactions and behaviors have changed since COVID-19 was declared a global pandemic.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Asking Questions • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.		**Stability and Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
This Task does not build toward one specific performance expectation; however, students have opportunities to develop and use grade-appropriate elements of science and engineering practices and crosscutting concepts.		

Materials

- COVID-19! How can I protect myself and others? COVID-19 Community Response Guide
- Images from your school, community, or state showing interactions/behaviors of people before March 2020 and after March 2020 (The World Health Organization declared COVID-19 a global pandemic in March 2020). The images may be projected or copied and shared with student pairs/groups. Examples could include these:
  - People gathered in large spaces, tightly packed together;
  - People gathered in large spaces, distanced far apart and wearing masks, and/or empty public spaces;
  - People shaking hands; and
  - People greeting one another from a distance or behind a clear plastic screen. (Do not include images of elbow or foot "bumps," which were early behaviors later deemed to bring people too close together.)
- KLEWS chart (see KLEWS Chart Template listed in Additional Teaching Resources)

Task 1

Discover: How is life changing during COVID-19?

1. Ask students complete Task 1 “Discover” Steps 1–7, in the Community Response Guide.

Understand: How would I describe myself?

1. Share images of your school, local community, or state showing interactions/behaviors of people before March 2020 and after March 2020 (make sure to indicate which time period the images represent). Tell students this is a **phenomenon** (it has a cause and an effect) they are already familiar with. Some of the images may show interactions or behaviors they shared with their partner as they discussed ***How has life changed recently and how do I feel about it?***
2. Instruct students to create a table with three columns in their journal and label the columns **I see, I think,** and **I wonder.**
3. Ask students to independently study the images and identify observable changes in people’s interactions/behaviors after COVID-19 was declared a global pandemic in March 2020. Instruct them to record the changes they observed (I see) and possible explanations for why each (specific) change occurred (I think). Tell them to use the third column to record questions they would like to investigate (I wonder).
4. Next, task students to add to their table any changes to people’s interactions/behaviors they have observed at home or in the communities to which they belong and why they think these changes occurred. Encourage them to also record new questions that arise.
5. Move students into small groups of three or four students (either virtually or in person, observing social distancing guidelines as recommended by your local authorities).
6. Ask students to take turns sharing changes in behavior they observed (one share per turn) and their initial thinking about why the change in behavior occurred. Group members may have different ideas about the same interaction/behavior.
7. Bring students back together and direct their attention to the KLEWS chart. Tell students, “We will fill in some of the columns now, and the others as we progress through the module.”

Teacher Note:
Consider providing students with the sentence starter “One difference between my idea and yours is…” to respectfully offer a competing idea following a group member’s share.

8. Above the KLEWS chart, record the driving question: ***Why have people’s interactions and behaviors changed since COVID-19 was declared a global pandemic in March 2020?*** This question drives the learning in this and the next 4 tasks. All ideas the students develop can contribute toward answering this driving question.



Driving Question: *Why have people's interactions and behaviors changed since COVID-19 was declared a global pandemic in March 2020?*

K What we think we know about the phenomenon	L What we are learning	E Evidence (from our data)	W Wonderings	S Scientific Concepts and Words

Figure 1: KLEWS chart

9. Say to students, "Based on your conversations with your group members and your own experiences outside of school, what do we think we know about the phenomenon of people's interactions and behaviors changing after the sudden COVID-19 event was declared a global pandemic?"
10. Record students' shares in the **K** column. Responses might include these:
    - COVID-19 is caused by a virus (coronavirus).
    - COVID-19/viruses is/are really contagious.
    - Staying far apart (social distancing) keeps coronavirus from spreading.
    - Wearing a mask protects you from getting sick.
    - Washing your hands keeps you from getting sick.
    - People's interactions/behaviors can return to normal after everyone has the vaccine.
11. Let students know that their identity map is a graphic tool that can help people understand the things that are unique to them: what makes you—you.
12. Have students do Task 1, "Understand," Steps 1–9, in the Community Response Guide.
13. Have students reflect on their responses in the **K** column. Ask for volunteers to share how their identity may have influenced these responses.
14. Instruct students to return to their groups, and ask each group to choose three questions that have answers they think will help explain the phenomenon of people's interactions and behaviors changing after March 2020.
15. Bring students back together and ask groups to take turns sharing their three questions (one question per turn).

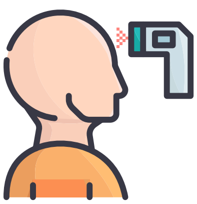
Check the Appendix

Have students expand their Identity Map using instructions in the Appendix: "Exploring STEM Identities." Expanding their Identity Map will launch students' exploration of STEM Careers aligned with this module.

16. Record students’ questions in the **W** column. If more than one group has the same question, consider adding check or tic marks next to the question. The questions students elevate to share with the class may include these:
    - How does staying far apart (social distancing)/wearing a mask/washing your hands keep you from getting sick?
    - Is using hand sanitizer better than soap?
    - How does COVID-19 make you sick?
    - What is contract tracing? *or* What does it mean when you get contact traced? (Many middle school students are likely to know someone in the school or community who was “contract traced.” It is acceptable if this question or a similar question is not asked.)
    - How does the vaccine work?
17. Let students know that they will be collecting evidence to answer some of these questions in the next few lessons.

Act: What are things we can do to feel safe?

1. Students complete Task 1, “Act,” Steps 1–6, in the [Community Response Guide].



Exploring STEM Identities

Have students read about Anne McDonough in the Appendix: “Exploring STEM Identities.” Anne McDonough, MD, MPH, is the Public Health Emergency Officer at the Smithsonian Occupational Health Services.

Additional Teaching Resources

KLEWS Chart Template. An Open Education Resource that can be used to create your own KLEWS chart.

2 How can keeping distance from others help?

Grade Level	Subject	Total Time
Middle School (target audience)	Physical Science	75 minutes

Task-Level Performance Expectation (Task Objective). Plan and carry out an investigation to determine if patterns in water droplets dispersed using the amount of force of a sneeze can be used to support the idea that social distancing can stop/slow the spread of COVID-19 through a community.

Phenomenon. People's interactions and behaviors have changed since COVID-19 was declared a global pandemic.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations • Plan an investigation individually and collaboratively, and in the design, identify independent and dependent variables and controls; what tools are needed to do the gathering; how measurements will be recorded; and how many data are needed to support a claim. **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. **Constructing Explanations** • Construct an explanation using models or representations.	**PS2.A: Forces and Motion** • The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.	**Patterns** • Graphs, charts, and images can be used to identify patterns in data.
This Task could be one in a series of tasks building toward the following performance expectation: **MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system; qualitative comparisons of forces, mass, and changes in motion (Newton's Second Law); frame of reference; and specification of units.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]		

Task 2

Materials

- COVID-19 Community Response Guide
- KLEWS Chart (from Task 1)
- Sneeze Animation
- Objects to use to flick water, such as
  - plastic spoon or "spork" (fork/spoon combination)
  - bottle brushes (test tube-sized)
  - vegetable brush
  - mall paintbrush (1/2-inch)
- bowls or other shallow, wide-mouthed containers (one per small group)
- water
- meter sticks or measuring tapes (one per small group)
- outdoor space with building or other constructed wall that students can flick water against
- Paper towels or cloth to clean up water on hands and surfaces
- butcher paper or poster paper (optional)
- chalk or markers (optional)
- cup
- tape (optional)
- camera (optional)
- Sneeze Video
- Timelapse Sneeze Video

Teacher Note:

1. You may choose to allow students to determine what object to use to flick water (part of investigation design) or provide all students with the same object.
2. Using butcher paper or poster paper on the wall and/or ground may support students in identifying patterns in the location and size of water droplets ("spray" patterns).
3. Student groups need to be able to easily view one another's data and claim. Consider providing whiteboards, posters, or a virtual space (e.g., Google Slides, Jamboard, or Padlet) for groups to publicly post their data.

Discover: Do you notice people keeping distance from others?

1. Review the Driving Question and KLEWS chart with students.
2. Say to students: "Many of us are wondering how staying far apart (social distancing) helps keep us safe. Does it make sense to investigate this first?"
3. Students complete Task 2, "Discover," Steps 1–2, in the Community Response Guide.

Understand: Why is distance so important?

1. Ask students to complete Task 2, "Understand," Steps 1–3, in the Community Response Guide.
2. Add any new scientific terms to the KLEWS chart. Tell students, "Using the specialized language **respiratory droplets** will help us more easily communicate the idea of very small drops of fluid that come from our lungs, nose, and mouth."
3. Bring students' attention back to the KLEWS chart. Point out statements in the **K** column about staying far apart from one another (social distancing) to stay safe.
4. Say to students, "We think we know we need to keep far apart from one another to stay safe (to protect ourselves from becoming infected with COVID-19 from a sneeze or cough). Does anyone know how far apart scientists recommend we stay from one another to keep the virus from spreading?" Students will likely say six feet (two meters). Ask students why they think that scientists recommend staying six feet apart.

Teacher Note:
Specialized language should, in most cases, be a product (or outcome) of learning along an instructional sequence, not a prerequisite of learning. We introduce the term *respiratory droplets* here because the term will make communicating patterns observed in data easier for students (patterns in data are what students are trying to make sense of, not the idea of respiratory droplets).

5. Tell students you have read that a sneeze can be **modeled** by "flicking" water with a sharp snap of the wrist. (Imagine holding a pencil in your hand and propelling it forward with a quick snap or flick of the wrist). Demonstrate flicking your wrist, then ask students to mimic the motion.
6. Tell students that they are going to be modeling a sneeze to explain why scientists recommend staying six feet apart. Show students the objects you have available to "flick" water forward.

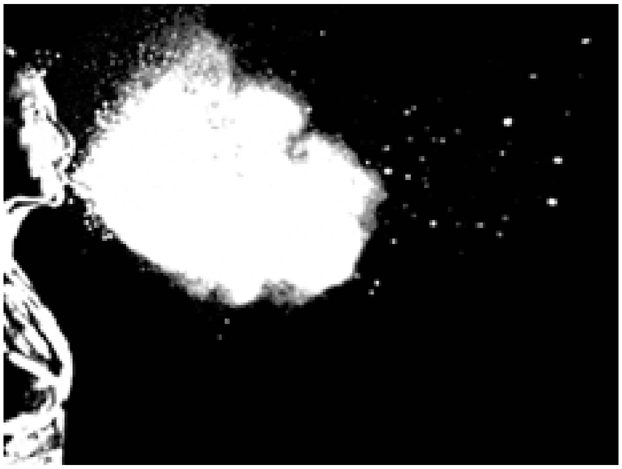


Figure 2: Sneeze Animation

Task 2

7. Share the Sneeze Animation with students.

8. Ask students which object they would use to model a sneeze. Instruct them to share their idea with a partner first before you ask them to share it with the class. Student ideas will likely vary, but may include these:
   - Plastic spoon or "spork." When you sneeze violently, a large amount of respiratory droplets/mucus/phlegm comes out of your nose or mouth in one blob/glob.
   - Brushes. When you sneeze, the respiratory droplets/mucus/phlegm spreads out or in all directions.

Teacher Note: You might choose to reach class consensus on which object to use to flick water forward, or assign students to small groups based on the object they believe best represents a sneeze.

9. Ask students the following questions about the distance the water will travel:
   - What is causing the water to move forward?
   - What will cause respiratory droplets to move a greater distance?

10. Assign students to small groups. Task each group to design an investigation that will provide data the class can use to make a claim about why scientists recommend that people stay six feet apart. Tell students they will use a wall—not another student—to represent a person standing in the path of the sneeze.

11. As you move around the room, support groups in designing their investigation by asking some or all of the following "back-pocket" questions:
    - How will you determine you are standing far enough away from the other person (wall) to keep them safe?
    - What distances from the wall will you test? How many trials will you conduct at each distance from the wall?
    - What variables will you keep constant at each distance? How will you keep them constant?
    - What data will you collect at each distance you test? How will you measure (quantify) your data?
    - How might you quantify your data besides counting the number of individual drops that strike the wall?
    - Besides the number or area of drops that reach the wall, what other data might you collect? Why? How will you measure (quantify) these data?

Teacher Note: Consider first providing students independent thinking time (two to four minutes) to help ensure everyone in the group has something to offer to the investigation design.

12. When you are confident groups' investigation plans will enable them to answer the question of why scientists recommend staying six feet apart, instruct students to create data tables. It is okay if students' **data tables** vary, even within a group, as long as they reflect the types of data students intend to collect and how they plan to quantify that data.

13. Take students outdoors (or to another appropriate space) to conduct their investigations.

Teacher Note: The types of data students identify they will collect and the method they describe for conducting their tests and quantifying data should be the focus, not writing step-by-step procedures.

14. Provide students time to work together in their groups to analyze their data and identify and record any patterns they observe. Instruct groups to use their data to make a claim that answers the question of why scientists recommend staying six feet apart. Inform groups they will present their claims and supporting evidence to the class.

Physical Safety Tip:

Follow your school's safety rules for working outdoors with students. See NSTA's Position Statement on Safety and School Science Instruction in the reference list at the end of this task.

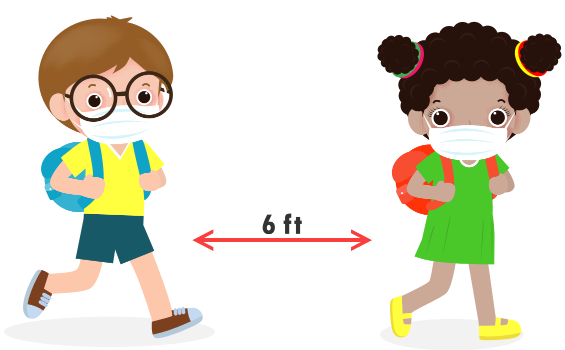
15. Invite each group to share their data and identify any patterns. Students are likely to identify the pattern of less or smaller droplets occurring with increasing distance from the sneeze. They may also identify a pattern of a smaller droplet area occurring with increasing distance from the sneeze.

16. Ask students, "Why do you think we all didn't record the same data?" Ask students to share their ideas with their group members, then with the class. Students should identify that although the force of the sneeze was held constant in their group's investigation, some groups may have used more force for their sneezes than other groups did.

17. Ask students to make a claim that answers the question of why scientists recommend staying six feet apart. Students may say that there is less chance of breathing in respiratory droplets from someone who has COVID-19 if you are at least six feet away from that person.

18. Redirect students' attention to the KLEWS chart, and ask, "What have we learned that will help us answer the Driving Question?" Before recording each idea in the L column, ask the class, "What's our evidence?" Record evidence in the E column. Additions to the L column may include "staying at least six feet apart reduces the risk of catching COVID-19 by direct contact." Additions to the E column may include "the number and size of droplets from a sneeze is far fewer at six feet than at three feet."

19. Ask students to compare the class's data with the CDC's social distance recommendation of 6 feet (2 meters).



Teacher Note

Students may question whether six feet apart is sufficient based on the class's data. At this point, you also may choose to show the Timelapse Sneeze Video, which measures the distance of the respiratory droplets. In addition, if students say that "flicking" water may not be a good model for a sneeze, share the Sneeze Video with students. Add any questions to the W column in the KLEWS chart.

Task 2

Act: What can you do or share about physical distancing?

1. Ask students complete Task 2, “Act,” Steps 1–5, in the Community Response Guide. Instruct students to skip Step 3b.

Additional Teaching Resources

NSTA’s Position Statement on Safety and School Science Instruction

NSTA provides the following guidelines for school leaders (including principals, assistant principals, school and district science supervisors, superintendents, board of education members, and others) to develop safety programs that include the effective management of chemicals, implement safety training for teachers and others, and create school environments that are as safe as possible.

3 How can covering our noses and mouths help?

Grade Level	Subject	Total Time
Middle School (target audience)	Physical Science	60 minutes

Task-Level Performance Expectation (Task Objective). Analyze data from models to determine the effect masks have on the distance that respiratory droplets from coughs and sneezes travel.

Phenomenon. People's interactions and behaviors have changed since COVID-19 was declared a global pandemic.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data • Analyze and interpret data to provide evidence for phenomena. **Obtaining, Evaluating, and Communicating Information** • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. **Developing and Using Models** • Develop and/or use a model to predict and/or describe phenomena.	**MS PS2.A: Forces and Motion** • All positions of objects and the direction of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	**Cause and Effect** • Cause-and-effect relationships are routinely identified, tested, and used to explain change. (Grades 3–5) **Patterns** • Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products. (Grades 3–5)
This Task could be one in a series of tasks building toward the following performance expectation: **MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system; qualitative comparisons of forces, mass, and changes in motion (Newton's Second Law); frame of reference; and specification of units.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]		

Task 3

Materials

- COVID-19 Community Response Guide
- KLEWS Chart begun in Task 2
- Engineering a Cough video (Note: The video contains graphics and tickers about COVID-19 infection numbers and death toll.)
- Testing Face Masks video
- Whiteboard or chart paper
- Which Mask Works Best article
- Computer or mobile device (for at least each pair of students)

Discover: Are the people in your home covering their noses and mouths?

1. Review the Driving Question and KLEWS chart with students.
2. Say to students: "Now that we have investigated respiratory droplets, does it make sense to investigate why we are covering our mouths and noses?"
3. Have students complete Task 3, "Discover," Steps 1–5, in the Community Response Guide. In step 4, show students the images from Task 1 again as prompts for the journal questions.

Understand: How does covering your nose and mouth help?

1. Say to students, "Many of us are wondering if wearing a mask shortens the distance we need to remain apart to stop/slow the spread of COVID-19 through direct contact with respiratory droplets from a sneeze or cough." Point out the question in the **W** column of the KLEWS chart.
2. Tell students you found data from two different sources that may help answer their question about wearing masks. Before sharing these data with students, ask them to retrieve their own data (or their group's data) collected in their investigation from Task 2 of how far respiratory droplets travel when we sneeze without a "mask" or cloth.
3. Prepare to share the Engineering a Cough video. Tell students the video originally aired on CNN on May 4, 2020. In the video, the CNN correspondent (on-the-scene reporter) is interviewing two engineering professors from Florida Atlantic University (FAU) who created a model to generate data to test ideas about how wearing a mask could help shorten the distance we need to remain apart to stop/slow the spread of COVID-19 through direct contact with respiratory droplets from a cough.
4. Ask students to make and record similarities and differences they observe between the FAU professors' model of a cough and their own model of a sneeze from the previous investigation (Task 2).
5. Play the video from 0:00 to 2:00. You may need to play the first two minutes of the video more than once.

Teacher Note:
The engineering professors engaged in an element of Developing and Using Models: Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales (6–8 grade band) to help answer their own question about whether masks reduce the distance that respiratory droplets from a cough travel.

Teacher Note: You might scaffold this task by asking students to create a t-chart, with one side labeled "similarities" and the other side labeled "differences."

6. Instruct students to return to their small group (from the previous investigation) and share the similarities and differences they observed. Ask each group to identify three similarities and/or differences that most people in the group observed and one similarity/difference only one (or two) group members noticed. Tell groups to be prepared to share these similarities and/or differences with the class.

7. Ask each group to share similarities and differences with the class. Depending on the number and type of observations students recorded in their group investigations, the similarities and differences between their group's model and the model observed in the video shared could include these:

Similarities	**Differences**
• We kept the amount of force we used to flick the water the same from trial to trial, and so did FAU. • Our sneeze made a cloud of droplets (some of us standing on the side got wet, and we saw drops on the ground and wall), and so did the FAU cough. • Our sneeze traveled about the same distance as the FAU cough. (This may fall into the "differences" column for your students.)	• Our model used water, while FAU's model used water and glycerin. • We observed where droplets landed (on wall/ground); they observed droplets in the air. • We modeled a sneeze, and they modeled coughs. • FAU timed how long it took the droplets to travel over a distance: 3 feet, immediately; 6 feet, 5 seconds); and 9 feet, 10 seconds. • FAU pumped water/glycerin, but we flicked the water.

Figure 3: Similarities and Differences

8. Ask students if they have any new questions. Add questions to the W column of the KLEWS chart. Questions could include these:
   - Why did FAU use water and glycerin?
   - Do respiratory droplets travel differently in a cough than in a sneeze?
   - Can you get out of the way of a cough or sneeze in time?

9. Point out to students that while the FAU professors used materials and equipment not available in our classroom, we engaged in the same science practice of developing and using models as the engineering professors did, and our investigation produced similar results.

10. Share with students that the materials and equipment available to the FAU engineering professors made it easy for them to test the effect wearing a mask has on the distance respiratory drops from a cough travel (easier than it would be for us to test the effect of wearing a mask). Tell students to make and record observations about the effect of wearing a mask on respiratory droplets as they watch the rest of the video.

11. Play the Engineering a Cough video from 2:00 to the end. Consider replaying the video from 2:11 to 2:20 two or three times.

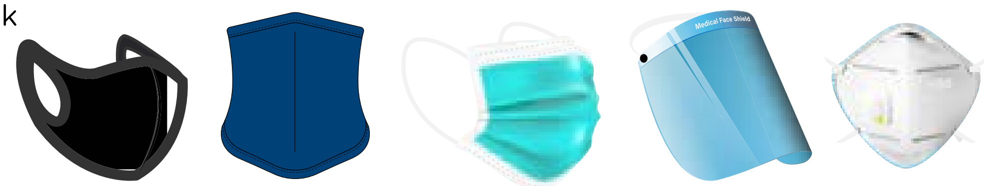
12. Ask students to share their observations with a partner, then invite them to share an observation (their own or a partner's observation) with the class. Students will likely share that the mask reduced the distance the respiratory droplets traveled.

13. Your KLEWS chart may contain questions about the effectiveness of different types of masks. If the chart doesn't, ask students what type of mask is most effective.

> **Teacher Note:**
> Use a talk move—for example, "Can you say more about that?" or "What's your evidence?"—to elicit information from students about how much the distance was reduced and how the mask changed the direction the respiratory droplets traveled.

14. Prepare to share the Testing Face Masks video. Share with students that this video was created by the same FAU engineering professors and shows the effectiveness of different types of masks on reducing the distance (and direction) respiratory drops from a cough travel. Encourage students to make and record observations as they watch the video. Play the video from 1:24 to the end.

15. In a place that all students can easily view list the types of face masks tested in a place that all students can easily view:
    - Ski mask ("gator")
    - Non-stitched fabric mask
    - Stitched fabric mask
    - Surgical cone mask
    - Surgical mask
    - Shield



16. Ask students to work with a partner or small group to rank the face masks from least effective to most effective in reducing the distance that respiratory drops from a cough travel.

17. Bring the students back together to reach class consensus on the effectiveness ranking of the different types of masks. Students will likely agree on some of the mask rankings more easily than others; masks that drastically change the direction respiratory drops travel may cause disagreement among students. This can lead to a productive discussion about the problem that becoming covered in respiratory droplets introduces: The person coughing/sneezing can be a source of contamination for others by **indirect contact,** (as defined on pg. 12 of the Community Response Guide).

18. Assign students to a computer or mobile device.

> **Teacher Note:**
> Because the distance traveled by the cough isn't measured in the video, only relative effectiveness can be determined. You might use this opportunity to support students in beginning to develop the middle school science idea PS2.A: Forces and Motion: All positions of objects and the direction of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen unit of size. To share information with other people, these choices must also be shared.

19. Ask students to read the Which Mask Works Best article.

20. As you move around the room and note students who are recording ideas about masks reducing the distance respiratory droplets from talking, coughing, and sneezing travel (from the video), ask how they might quantify their observations.

Teacher Note:
Consider using a reading strategy to provide a scaffold for students to summarize their ideas. One example is 3-2-1:

- What are three things you learned?
- What are two things you found interesting and that you'd like to learn more about?
- Record one question about the information provided in the article.

21. Ask students to share their summaries of the article with a partner or small group. Listen for students to share ideas about the similarities between the model coughs and real coughs and the effectiveness of different masks on reducing the distance respiratory droplets travel for the model coughs and real coughs. Also listen for students to share ideas about the differences in distance that respiratory droplets travel when speaking, sneezing, and coughing. Call on these students first when you bring the students back together.

22. Direct students' attention to the KLEWS chart, and ask, "What questions can we now answer?" If student response is low, ask them to turn and talk with a partner, then pose the question again. Students will likely say they learned that wearing a mask does shorten the distance we need to remain apart to stop/slow the spread of COVID-19 through direct contact with respiratory droplets from a sneeze or cough. Students will also share that some masks are more effective than others in reducing the distance respiratory droplets from a cough or sneeze travel. Before recording each idea in the **L** column, ask the class, "What's our evidence?" Use clarifying questions to help students quantify their evidence (data/patterns) when possible. Record evidence in the **E** column.

23. Ask students if they have any questions about masks. Add these questions to the W column of the KLEWS chart.

24. Have students do Step 12 in the Community Response Guide.

Exploring STEM Identities

Have students read about Shweta Bansal in the Appendix: Exploring STEM Identities. (Shweta Bansal is an Associate Professor of Biology at Georgetown University, USA.)

Task 3

Act: What can you do or share about covering our noses and mouths?

1. Students do Task 3, "Act," Steps 1–4, in the Community Response Guide. Ask students to omit Step 2a.

Additional Teaching Resources

Scientific article: Visualizing the Effectiveness of Face Masks in Obstructing Respiratory Jets"

Article: "Community Use of Face Masks and COVID-19: Evidence From a Natural Experiment of State Mandates in the US" (published June 16, 2020, and reflecting mask mandates that were current at the time). Article contains data tables and examples of statistical analysis.

4 How can washing our hands help?

Grade Level	Subject	Total Time
Middle School and High School (target audience)	Physical Science	75 minutes

Task-Level Performance Expectation (Task Objective). Use evidence from an investigation and scientific information from the media to explain how the structure of soap molecules allows them to interact with COVID-19 to effectively cleanse hands.

Phenomenon. People are asked to wash their hands for a specific length of time during the COVID-19 pandemic.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Conduct an investigation, and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meets the goal of the investigation. (Grades 6–8) **Obtaining, Evaluating, and Communicating Information** • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in the media and visual displays to clarify claims in findings. (Grades 6–8)	**PS1.A: Structure and Properties of Matter** • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (Grades 9–12)	**Patterns** • Patterns can be used to identify cause and effect relationships.

This Task could be one in a series of tasks building toward the following performance expectation:
HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipoles). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

Task 4

Materials

- A COVID-19 poster on handwashing that includes a suggested length of time for washing your hands (See CDC Handwashing Posters listed under Additional Teaching Resources.)
- Timers (at least one for each group)
- Cooking oil, butter, or ghee divided into small containers
- Pipettes or 1/8 tsp. measuring spoons
- Tub of clean water (one for each group)
- Tub of very soapy water (one for each group)
- Towels for hand drying
- Board or chart paper
- [Fighting Coronavirus with Soap video](#) (video of how soap helps protect against COVID-19)
- Camera (optional)

Physical Safety Tip:

Only use cooking oil. Do not use oil for machinery.

Notes on materials

The timers should display seconds. Mobile phones can be used if students are careful to avoid getting them wet.

If possible, ensure that each person has their own timer. If there is only one timer per group, all members of the group will need to start washing their hands at the same time.

Discover: Are the people in your home washing their hands?

1. Revisit the KLEWS chart from Task 1, and highlight any statements or questions on handwashing.
2. Ask students to do Task 4, "Discover," Steps 1–4, in the Community Response Guide.

Exploring STEM Identities

Have students continue learning more about Cassie Morgan's STEM career as the Kuunika Sustainability Coordinator, Cooper/Smith in Lilongwe, Malawi, in the Appendix: Exploring STEM Identities.

Understand: Why do we need to wash our hands with soap?

1. Share the handwashing poster with your students. Draw students' attention to the time in the poster.
2. Ask students how handwashing has changed since the start of the COVID-19 pandemic, using the following questions:
   - Have you noticed handwashing signs like this around the school or the community?
   - Do you remember seeing these signs before the COVID-19 pandemic?
   - How have we changed how we wash our hands since the start of the COVID-19 pandemic?
3. Invite students to share their experiences with the class, and summarize students' sharings.
4. Ask students if they have any questions about handwashing. If students don't mention handwashing time, ask them why they think the poster says that people should wash their hands for a specific length of time. Add any new questions to the **W** column of the KLEWS chart.
5. Remind students what they learned previously about respiratory droplets containing the virus being spread by indirect contact.
6. Tell students that in this investigation, they will place a small amount of oil/fat on their hands to model respiratory droplets containing COVID-19. Let students know that the fat/oil is similar to molecules found on the surface of the virus.
7. Divide students into small groups of four students and distribute materials/equipment to each group.
8. Assign each group member a specific handwashing time: 10 seconds, 20 seconds, 30 seconds, and 40 seconds. No group member should have the same assignment as another group member.
9. Share the following investigation procedure with the class:
   - Apply .5 ml (or 1/8 tsp.) of oil/fat to the back of one hand, and rub it in.
   - Make observations of the backs of both hands and record these observations in your journal. Consider taking pictures of the backs of both of your hands; ask a group member for help if needed.
   - Put the hand without oil into the soapy water and swish it around until your hand is completely wet and well-covered in soap bubbles.
   - Wash the hand with oil on it for the assigned handwashing time, then quickly rinse both hands in the clean water. Gently shake the water from your hands, but do not wipe them dry with a towel.
   - Make observations of the backs of both hands and record these observations in your journal. If you took pictures of your hands before washing them, take another picture now. Blot the palms of your hands dry, if necessary, to record observations or take pictures.
   - When everyone has finished washing their hands for their assigned time, work together to clean up your work space.

Teacher Note:
Consider reviewing class norms before distributing materials/equipment that include soapy water and cooking oil.

Teacher Note:
If groups have only three members, do not assign the 40-second handwashing time.

10. Ask students to share their observations with their group members and to identify patterns they notice in the group's data. Tell groups to be prepared to share which group members' hands were clean after handwashing for their assigned times, but do not invite them to share that with the class.

11. Temporarily reassign students to groups based on their assigned handwashing time (10-second group, 20-second group, etc.).

12. Ask students to share their observations with their "handwashing time" group members and identify any patterns they observe in their group's data. Invite each "handwashing time" group to share the patterns they identified. Record these patterns in a place that is easily viewable by all students in the classroom.

Physical Safety Tip:

Tell students not to touch one another's hands.

13. Ask students to return to their original groups.

14. Now ask groups to identify patterns across the handwashing groups (10-seconds, 20-seconds, etc.) and compare these patterns to the patterns they identified within their own (original) group. How are the patterns in the small groups' data similar to the patterns in the handwashing groups' data? How are they different?

15. Invite groups to share their observations. Students should notice some or all of the following similarities and differences:
    - No students' hands were clean after washing only for 10 seconds.
    - All (or almost all) students' hands were clean after washing for 40 seconds.
    - Some small groups had members with clean hands after washing for 20 seconds, but most groups did not or some small groups had members with clean hands after washing their hands for 30 seconds, but most groups did not.
    - Some students determined their hands were clean when the back of their hand no longer appeared "shiny"; other students used touch (back of hand was no longer slippery) to determine if their hands were clean.

16. Ask students, "Based on our class data, why do you think the poster tells us to wash our hands for a specific length of time?" Ask volunteers to make a claim.

17. Ask students, "How might we improve this investigation to produce data that may better support a claim for why there is a recommended length of time we should wash our hands?" Give students time to independently think and record their ideas. Then, ask students to share their ideas for improvement with a partner.

Teacher Note:
If time permits, consider providing students time to conduct the revised investigation. Alternatively, present the revised investigation plan to the next group of students (next class period, for example) and continue to revise the investigation plan throughout the day.

18. Bring students back together and ask students to share their partner's idea with the class. Follow each sharing by asking, "How will this addition/change to the investigation plan help produce data that may better support a claim?" You might ask students if they agree (thumbs up) or disagree (thumbs down) with each proposed addition/change.

19. Have students read Task 4, "Understand," Steps 15–17, in the Community Response Guide. This discusses COVID-19 and soap molecules (see figure below for your reference).

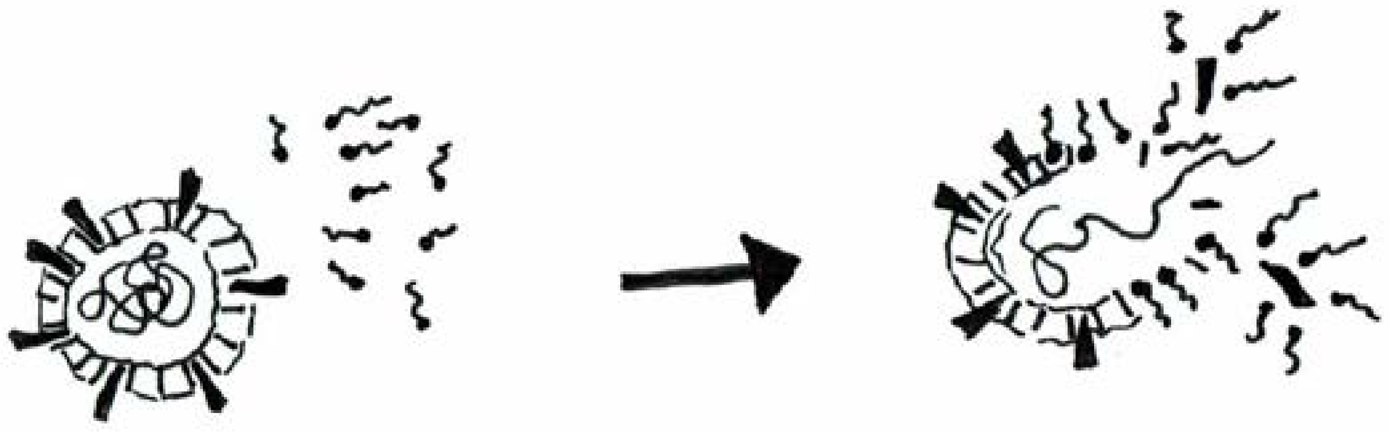


Figure 4: COVID-19 and Soap Molecules

20. Ask students to share ideas about the *interactions* among the components in the model and how to represent them using words, pictures, and symbols. You might introduce the idea of using "zoom-in bubbles" to show interactions among components in more detail. Poll students to find out if they agree (thumbs up) or disagree (thumbs down) with each addition/change to the model. You might use question marks to represent components/interactions on the model that students disagree about.

21. Add unresolved questions to the **W** column on the KLEWS chart.

22. Tell students that you have a video that might help answer some of these questions. Share the Fighting Coronavirus With Soap video. Instruct students to make and record observations that may help explain how soap works to remove COVID-19 from our skin. Tell students to focus on *how* soap works, and not on the specialized language used to describe different components of soap and viruses.

23. Ask students to turn and share a question about the information provided in the video with a partner; encourage the listening partner to share their understanding or partial understanding with the partner who asked the question. Make sure both partners have an opportunity to share questions.

Teacher Note:
Students may want to revise the investigation plan to include hand sanitizer. Ask students, "What question do you want to answer by including hand sanitizer in the revised investigation plan?" Students will likely say they are wondering if they can use hand sanitizer instead of soap, or they might ask if hand sanitizer works better than soap in removing infected respiratory droplets from their hands. Add new questions about hand sanitizer to the W column of the KLEWS chart.

24. Play the video again. Tell students to focus on obtaining information from the video that will help them answer their question.

25. Ask students to turn back to their partner and share their ideas about how soap works; remind them again to focus on *how* soap works to remove COVID-19 from our skin, not on the specialized language used to describe the specific components.

Teacher Note:
Give students independent thinking time to add to and/or change their explanations. Consider using this student artifact to formatively assess students' understanding of how handwashing helps keep us safe from becoming infected with COVID-19 and slows the spread of the virus through a community.

26. Ask students to return to their initial claim for why we need to wash our hands for a specific length of time.

27. Revisit the **KLEWS** chart with students. Ask students to identify which questions we can now answer.

Act: What can you do or share about washing your hands?

1. Students complete Task 4, "Act," Steps 1–4, in the Community Response Guide.

Additional Teaching Resources

CDC Handwashing Posters. This link contains posters about handwashing for different age groups.

Surfactants. This video explains what a surfactant is and how detergents can break down dirt and grease.

5 How is COVID-19 impacting families and communities?

Grade Level	Subject	Total Time
Middle School (target audience)	Life Science, Engineering Design	65 minutes

Task-Level Performance Expectation (Lesson Objective). Identify patterns in simulated data that can be used to predict how increasing isolation and quarantine rates slows the spread of COVID-19 through a community.

Problem. COVID-19 spreads rapidly among individuals, families, and local and global communities.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop and/or use a model to predict and/or describe phenomena. **Analyzing and Interpreting Data** • Use data to evaluate and refine design solutions.	**ETS1.B: Developing Possible Solutions** • Models of all kinds are important for testing solutions.	**Patterns** • Patterns can be used to identify cause-and-effect relationships. **Science Addresses Questions About the Natural and Material World** • Science knowledge can describe consequences of actions but is not responsible for society's decisions.

This Task could be one in a series of tasks building toward the following performance expectation:
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. [Contemporary research on how students learn science, reflected in the Next Generation Science Standards and other state standards based in A Framework for K-12 Science Education, requires that engineering lessons taught as part of the science curriculum provide students opportunities to "acquire and use elements of disciplinary core ideas from physical, life, or Earth and space sciences together with elements of disciplinary core ideas from engineering design to solve design problems." (NGSS Lesson Screener, www.nextgenscience.org/screener) The task provides an opportunity for students to build toward an engineering idea, but does not meet this requirement.]

Materials

- COVID-19 Community Response Guide
- KLEWS chart
- Transmission Chains Animation
- Whiteboard or chart paper
- Task 5 Contact Tracing Slide Presentation
- Video from Slide 6 of Contact Tracing Slide Presentation (optional) Quarantine and Isolation

Task 5

Discover: How are we protecting people in our community from COVID-19?

1. Revisit the KLEWS chart from Task 1, and highlight any statements or questions on contact tracing.

2. Have students complete Task 5, "Discover," Steps 1–2, in the Community Response Guide.

Understand: Who are you coming into contact with?

1. Share the Transmission Chains Animation with students (the image below is only for reference).

2. Invite students to share their ideas. Continue to call on students until these ideas have emerged: "Infected" means a disease-causing organism (COVID-19) has entered the person's body system; "infectious" means the virus can spread from the infected person to someone else even though the infected person doesn't look or feel sick; and "shows symptoms" means the infected person is observably sick.

Teacher Note:
Ask students what the differences are among the terms **infected**, **infectious**, and **shows symptoms.**

3. Project the Contact Tracing Slide Presentation, and have it open on Slide 1 (Figure 5). Ask students how they think they can stop Person C from becoming infected.

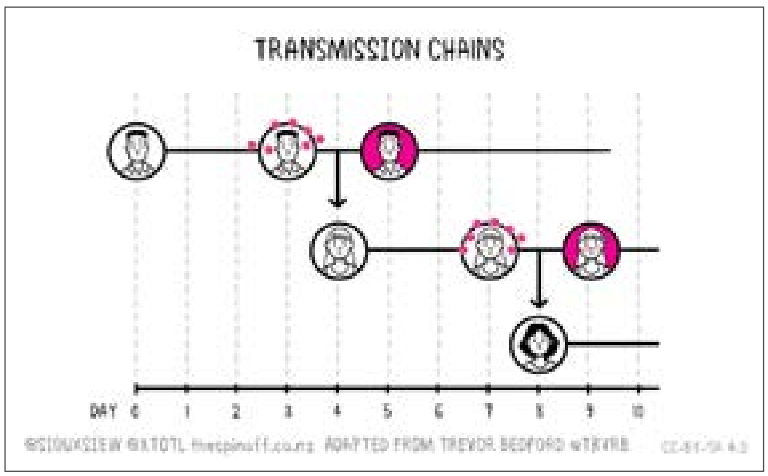


Figure 5: Transmission Chains

4. Give students time to independently think and record their ideas. Then ask students to share their ideas with a partner or small group. Listen for students to share ideas about warning Person B that they might be sick, telling Person B they should get tested, and/or asking Person B to quarantine themselves. Call on these groups first when you bring the class back together to make sure everyone hears these ideas.

5. Have students do Task 5, "Understand," Steps 1–5, in the Community Response Guide.

6. After students have completed these steps, ask students to identify who might be Person A, Person B, and Person C in their contact tree.

7. Ask students if creating their contact tree has given them any more ideas for how to solve the problem of preventing Person C from becoming infected.

Teacher Note:
You might ask students if they know the symptoms of COVID-19 using the COVID-19 Symptoms resource listed in Additional Teaching Resources. Explain clearly that not all infected people show symptoms.

8. Share Slides 2 and 3 from the Contact Tracing Slide Presentation. These describe the job of the contact tracer. Ask students how they think contact tracing would stop Person C from becoming infected.
9. Share Slide 4 of the Contact Tracing Slide Presentation. Ask students, "What information are the authors trying to communicate through this graph?"
10. Give students time to independently view the graph and record their ideas. Then ask students to turn to a partner and share their ideas. As you move around the room, you might ask students questions such as these:
11. How might reading the figure title and caption help you interpret this graph?
12. What do you think the x-axis and y-axis represent?
13. What information do the lines on the graph communicate?
14. Do you see any patterns in the data presented in this graph?
15. Bring students back together. Share Slide 5 of the Contact Tracing Slide Presentation (an annotated version of the previous slide).
16. The x-axis represents the percentage of people showing symptoms identified from the total number of people showing symptoms within a community; these are Person A's.
17. The y-axis represents the percentage of people who do not become infected from the total number of people predicted to become infected without contact tracing; these are Person C's.
18. Contacts successfully traced represents the percentage of people reached by contact tracers from the total number of people who were in close contact with the people identified as showing symptoms; these are Person B's.
19. Ask students to turn back to their partners and add to or revise the ideas they shared about the patterns they identified in the data represented in the graph. Then ask them to share the patterns they identified with the class. Record these patterns in a space where all students can easily view them. Students should identify the following patterns:
20. The greater the number of **Person A's** identified (and contact traced), the greater the reduction in the number of **Person C's** who become infected.
21. The greater the number of **Person B's** reached by contact tracers, the greater the reduction in the number of **Person C's** who become infected.
22. Point out the assumption (condition), "A," on Slide 5 of the Contact Tracing Slide Presentation. Ask students what they think this means.
23. Tell students you have information about isolation and quarantine that might help us interpret what "30% isolation and quarantine efficacy" means. Share Slide 6 of the Contact Tracing Slide Presentation, and play the video. (*Note: This video has no sound.*)
24. Return to Slide 5 in the Contact Tracing Slide Presentation. Ask again what students think the assumption means.

25. Give students independent thinking time before asking them to share their thinking with a partner. Invite students to share ideas with the class; continue questioning students until the idea emerges that the assumption is isolating or quarantining Person B's is only 30% as effective as it should be in stopping/slowing the spread of COVID-19 through the community.

26. Remind students that although this data was produced using a computer simulation, it's based on real-world observations. Ask students what may cause isolation and quarantine to be only 30% as effective as it should be in the real world.

Teacher Note:
You might quickly poll the class to reveal their thinking: Percentage reduction increases (thumbs up); percentage reduction remains the same (thumbs sideways); percentage reduction decreases (thumbs down). Invite one or two students holding each stance to share their thinking.

27. Ask students to predict how increasing the percentage of efficacy of isolation and quarantine of Person B's affects the percentage of reduction in the number of Person C's becoming infected with COVID-19. Instruct students to record their ideas in their journals.

28. Share Slides 7 and 8 in the Contact Tracing Slide Presentation with students. Ask students how increasing the percentage of efficacy of isolation and quarantine of Person B's affects the percentage of reduction in the number of Person C's becoming infected with COVID-19.

29. Ask students again how they would solve the problem of Person C becoming infected.

30. Refocus students' attention to the KLEWS chart. Write **contact tracing** in the **S** column and ask students to help create a brief definition to record with the term. Ask students what new or refined understanding we can add to the **L** column. For every idea shared, ask the class, "What's our evidence?" and add this to the **E** column.

Teacher Note:
Consider using the dramatic increase in the percentage Reduction in R_t caused by the 60% increase in isolation and quarantine efficacy to explicitly address social justice issues around people's ability to isolate and quarantine once reached by a contact tracer. Use the "Inequities in America" article listed in Additional Teaching Resources.

Act: How can you plan for COVID-19 in your home?

1. Students complete Task 5, "Act," Steps 1–4, in the Community Response Guide.

Exploring STEM Identities

To allow students to continue learning more about STEM careers, focus on the section of the Appendix titled Exploring the Diversity of STEM Careers. This section engages students to look for other STEM careers associated with the global response to the COVID-19 pandemic.

Additional Teaching Resources

COVID-19 Symptoms. The CDC's list of COVID-19 symptoms to watch for

Contact Tracing Principles. An article from the CDC outlining contact tracing that is titled "Case Investigation and Contact Tracing: Part of a Multipronged Approach to Fight the COVID-19 Pandemic"

Contact Tracing Strategies. *Journal of the American Medical Association* article titled "Modeling Contact Tracing Strategies for COVID-19 in the Context of Relaxed Physical Distancing Measures"

Inequities in America. An article from Vox titled "Every Aspect of the Coronavirus Pandemic Exposes America's Devastating Inequalities"

6 How can staying informed about the problem help?

Grade Level	Subject	Total Time
Middle School and High School (Target Audience)	Life Science	60 minutes

Task-Level Performance Expectation (Task Objective). Assess the credibility and accuracy of several resources to learn how vaccines can prevent the COVID-19 virus from causing serious illness.

Problem. How to find information on vaccines that is accurate		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information • Gather, read, and synthesize information from multiple appropriate sources, and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (Grades 6–8)		
This Task does not build toward one specific performance expectation; however, students have opportunities to develop and use a grade-appropriate element of a science and engineering practice.		

Materials

- COVID-19 Community Response Guide
- Set A: Transmission
  - COVID 19 Transmission and Symptoms
  - How does Coronavirus spread?
- Set B: Protection
  - Coronavirus disease (COVID-19) advice for the public
  - *How to protect yourself against COVID-19*

Discover: Where are people in your home getting their information about COVID-19?

1. Revisit the KLEWS chart from Task 1 and highlight any statements or questions about where to get information about COVID-19.
2. Ask students where they would go to find accurate information on COVID-19. Ask students to recall some of the other resources, articles, images, and videos from which we've obtained data and scientific information to answer our questions about COVID-19. Invite students to share examples. Then ask them, "How do we know if an article, image, or video is from a credible source? Do credible sources always provide accurate information?" Accept all responses.
3. Have students complete Task 6, "Discover," Step 1, in the Community Response Guide.

Task 6

Understand: How can I identify trustworthy information about COVID-19?

1. Ask students to share which sources members of their household get their information on COVID-19 from and what concerns they have about accuracy of this information.
2. Read aloud or have students read the quotes at the top of Task 6, "Understand," Step 1. Ask students what they understand about the term infodemic.
3. Let students know that they are going to review some resources on vaccines and decide whether they would share them or not.
4. Assign students to small groups of four students, then divide the groups into pairs.
5. Provide each pair of students one set of information resources (Set A or Set B) about COVID-19.
6. Have students identify the source of each piece of information.
7. Have students complete Task 6, "Understand," Steps 1–3, in the Community Response Guide.
8. Listener asks, "Can you summarize the text in just two or three sentences?" Reader asks, "What stood out for you? What made you choose that?"
9. Move students back into small groups. Ask each student pair to share information from the resources they read that they consider to be credible.
10. Move back to the KLEWS chart and address questions in the **W** column. Ask students, "What questions can we now answer about vaccines? What new questions do we have?" Add new learning **(L)** and scientific information **(S)** to the chart.

Teacher Note:
You might choose to use partner reading for text-based resources; the pairs of students will alternate reading the text aloud, then taking the role of the listener. Consider providing students the following prompts to support reading comprehension.

Act: What is my plan to stay informed during an "infodemic"?

1. Ask students complete Task 6, "Act," Steps 1–2, in the Community Response Guide.

Additional Teaching Resources

Vaccines! Smithsonian Science for Global Goals Community Response Guide on vaccines, developed in collaboration with the InterAcademy Partnership

7 What actions can I take right now?

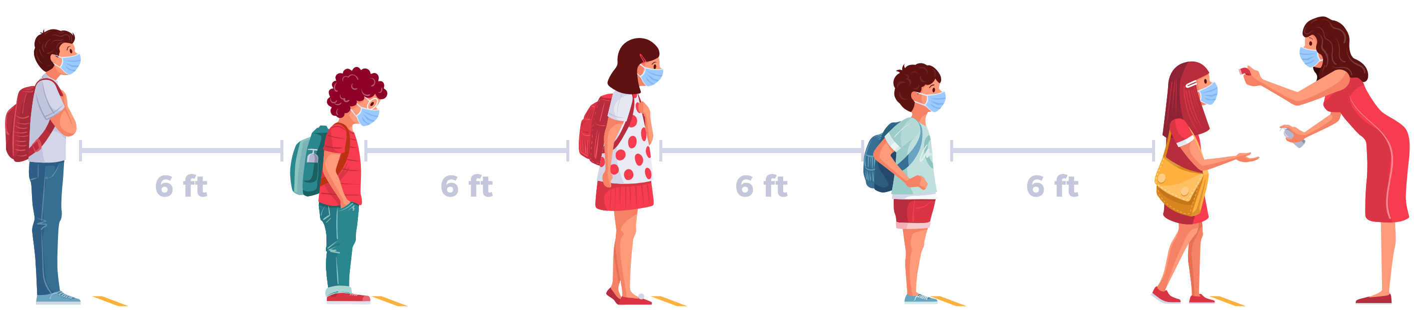
Grade Level	**Subject**	**Total Time**
Middle School (target audience)	Life Science, Engineering Design	60 minutes

Task-Level Performance Expectation (Task Objective). Combine different solutions to design an action plan to slow the spread of COVID-19 in students' own community.

Problem. COVID-19 spreads rapidly among individuals, families, and local and global communities.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information • Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.	**ETS1.B: Developing Possible Solutions** • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural and designed systems.
Contemporary research on how students learn science, reflected in the Next Generation Science Standards and other state standards based in A Framework for K-12 Science Education, requires that engineering lessons taught as part of the science curriculum provide students opportunities to "acquire and use elements of disciplinary core ideas from physical, life, or Earth and space sciences together with elements of disciplinary core ideas from engineering design to solve design problems." (NGSS Lesson Screener, www.nextgenscience.org/screener) The task provides an opportunity for students to build toward an engineering idea, but does not meet this requirement.		

Materials

- COVID-19 Community Response Guide



Discover: What should I include in my action plan?

1. Ask students the following:
   - In looking at our KLEWS chart, what have we learned that will help us, our families, and our community manage COVID-19?
   - How can we use our new knowledge to design a process to reduce the spread of COVID-19 in our community?
2. Have students complete Task 7, "Discover," Steps 2–6, in the Community Response Guide. Encourage students to use evidence from the KLEWS chart to support their integrated action plan.

Understand: Should I only do one thing?

1. Have students do Task 5, "Understand," Steps 1–3, in the Community Response Guide.
2. Have students write a few lines explaining why their integrated action plan is better than just doing one thing.

Act: How will I let my family, friends, and my community know about my plan?

1. Have students do Task 5, "Act," Steps 1–3, in the Community Response Guide.
2. Have students take action and complete their project.
3. Have students share their projects with their peers and community.

Exploring STEM Identities

To continue exploring STEM careers after Tasks 1–7 are done, students now focus on local STEM professionals in the health field and those who are solving issues in their own local community.

Appendix: Exploring STEM Identities

Introduction

Humanity's collective response to the COVID-19 pandemic changed how the world does science together. For the first time in a generation, many of the world's researchers and other science, technology, engineering, and math (STEM) professionals are focused on a single topic fueled by science and technology. The global response to combat the COVID-19 pandemic is just one more example of the importance of STEM. As the world becomes more and more digitally dependent, those in science and technology careers continue to drive innovation with bold ideas and methods as evidenced by the pandemic response. The STEM revolution is worldwide, and the next generation of thinkers will be leading it.

Solving some of the world's other biggest problems in areas such as climate change, access to affordable and clean energy, and medical help/global public health are becoming the top priorities for a growing number of industries, and with that grows the need for more engineers, scientists, medical workers, mathematicians, computer programmers, and others in STEM fields. As cited in this module, the United Nations has announced 18 Global Issues all world citizens should be aware of and has also set 17 goals to be achieved by 2030.

According to the 2021 *U.S. News & World Report* ranking of STEM jobs, five of the top 10 jobs are in the medical/health field. With STEM-focused careers on the front line, student exploration of STEM careers is critical not only in filling these important roles, but also for all students to develop some level of a STEM identity awareness to become informed global citizens. The goal is not to force every student to want a STEM career; it is to raise their exposure to the diverse array of STEM careers to support equal opportunity and access to these careers.

For students to truly gain the skills to enter careers of their choice as outlined in the *Next Generation Science Standards,* we must expose students to STEM careers and have them engage in the practices of real STEM professionals. As students work though the seven sensemaking tasks in this module, they are engaged in practices mirroring the work of STEM professionals. While it is always the hope to inspire student interest in a STEM career, the main goal of this Appendix is to help further develop an explorer mindset and nurture responsible community and world citizens who value problem solving.

Exploring STEM Identities

As we think about creating inclusive STEM experiences, one possible strategy is helping students build their STEM identity. We know that giving them the opportunity to gain confidence in their abilities, helping them see the value in the STEM fields, and connecting them to role models that look like them all help students build their STEM identities and create access for all students. By providing entry points to explore STEM careers within some of the Tasks in this guide, we automatically increase content relevance because further connection has been made to the real world. Applying a STEM career lens to the student Identity Maps started in Task 1 helps students consider their interests and abilities and connects them with career possibilities.

Integrated with Task 1:
What is happening in the world right now?

2. After students have finished Task 1, explain to them that they will continue building the Identity Maps they started in their journals to deepen their understanding of themselves and the ways the interests and skills they are developing might intersect with STEM careers.

3. Have students work in pairs to think about their responses to the following prompts, add their new thinking to their Identity Maps, then share their new thinking with their partner.

   Student Prompts

   My top three greatest strengths are:

   My favorite things to do in my spare time are: (choose activities you truly enjoy that really spark your interest!)

   I have talents such as:

   I have unlimited energy when I am:

   I am a rock star at:

   I like to solve problems when:

   I enjoy challenges when:
   The part of my identity map that's most important to my sense of self is: (Circle it!)

4. Invite students to first record their responses in their journals, then share their thinking in a whole-class discussion using questions similar to those introduced in the Understand section of Task 1: Step 8 in the Community Response Guide:
   - Are certain aspects of your identity more important to you than others? Why?
   - How do you think your identity map might change over time?
   - How might things on your identity map affect decisions you make in your life?

5. Ask students if they know what the acronym STEM stands for. If they don't know, share that STEM stands for Science, Technology, Engineering, and Math. Then share that there are hundreds of STEM careers and that almost all jobs today require STEM skills. Add that whatever they dream about doing in their future, chances are there's a STEM career to make it come true.

6. Invite students to create a personal chart in their journals for their exploration of STEM Careers and Skills. The chart should have three columns:

STEM Careers	Skills/Knowledge	Connections to My Identity Map

7. Ask students to share in a class discussion what they think they know about STEM careers/skills, then show them the following video:

   [What Is STEM? Career Pathways: An Exploration of STEM]

   Have students add any other thoughts to their personal charts, then tell them that as they work through the tasks in this module, they will be reading comments from and learning from STEM professionals whose jobs are connected with the pandemic. Students will have the opportunity to learn more about them, their work, and the skills they apply in their work. Students will look for connections to their Identity Maps after the STEM career explorations.

8. Set up a class chart to keep track of the STEM jobs, skills, and knowledge students are learning about that are associated with answering the Driving Question of this module: **Why have people's interactions and behaviors changed since COVID-19 was declared a global pandemic in March 2020?**

Appendix

Integrated with Task 3:
How can covering our noses and mouths help?

1. Re-read aloud the quote below that students read in the Understand section of Task 3 in the Community Response Guide.

   "This is a new virus, so our bodies don't have the natural immunity...and we don't have any protection as individuals...Over time, there might be more evidence that comes to light that tells us that certain people in our population may have been more protected...But at the moment we know of nothing that actually protects individuals. So everyone is at risk."

   —Dr. Shweta Bansal, PhD, Associate Professor of Biology, Georgetown University, Washington, D.C., USA

2. Tell students that they can learn more about Dr. Bansal's work by reading about her work and listening to a short video about a STEM career as a biology professor.

3. Have students work in pairs or small groups to explore Dr. Bansal's web page to learn more about her work. Shweta Bansal's web page

   Ask students to discuss and record the following in their journals:
   - What characteristics does Dr. Bansal possess?
   - What do you think are the most important aspects of Dr. Bansal's work, and why?
   - What skills and knowledge does Dr. Bansal apply to her work?
   - What things do you admire about Dr. Bansal, and why?

4. Have students repeat Step 2 after watching the following video to learn more about the career of a biology

Note:
For each STEM career students explore through this process, the information sources are varied to create a snapshot of the STEM career highlighted. Therefore, not all resources are focused on the STEM professional who is quoted in the Community Response Guide.

professor. This video features Martha Cyert from Stanford University discussing what drives her work with students. (If you do not have enough internet access for groups, then do this as a whole class).
The Work of a Biology Professor

5. Ask students to work independently to record in their personal charts in their journals which skills/knowledge are applied in the STEM career of a biology professor.
6. Invite students to share their thinking, and add the career name and the skills and knowledge applied to the class chart on STEM Careers. Have students add any new information to their personal charts in their journals.
7. Invite students to search independently for connections between the STEM career of a biology professor to their Identity Maps. (They should look for similarities in characteristics, skills, interests, etc.)

Integrated with Task 4: How can washing our hands help?

1. Re-read aloud the quote from the Task 4 Discover section, Step 2:

"We constantly touch our face, so it is easy to imagine how our hands become the virus's main way into our body through our nose, eyes, and mouth. Washing our hands with soap and water or hand sanitizer is a very powerful defense."

—Cassie Morgan, Kuunika Sustainability Coordinator, Master of Public Health focused in Epidemiology, Cooper/Smith, Lilongwe, Malawi

2. Repeat Steps 2–6 from the Task 3 career exploration above using the links below:
Cassie Morgan Biography

The two videos below are linked to COVID-19, as epidemiology was at the forefront. The World Health Organization (WHO) video has subtitles, as STEM professionals worldwide work for WHO.
Epidemiologists: At the Core of the Coronavirus Response
What WHO Epidemiologists Do

Integrated with Task 7:
What actions can I take right now?

1. Re-read the quote from the Task 1 Understand section, Step 2.

   "What is most interesting to me about pandemics, and public health emergencies in general, is that they are very complex, and many different specialties, people, communities, environments, and science all must quickly organize and work together to find an (integrated) solution. COVID-19 is a perfect example because it demands an integrated solution."

   —Dr. Anne McDonough, MD, MPH, Public Health Emergency Officer, Smithsonian Office of Safety, Health, and Environmental Management, Washington, D.C., USA

2. Repeat Steps 2–6 from the Task 3 career exploration above using the links below:

   Web page for Smithsonian Office of Safety, Health, and Environmental Management

   Field notes from Dr. McDonough

   Day in the Life of a Health and Safety Specialist

   Hear from Occupational and Health Safety Students

3. Now that students have learned about several STEM careers, have them use the class chart of STEM careers and skills/knowledge to look for connections to their Identity Maps. Explain to students that now they will explore their STEM identities to see if there are any connections to the career identities of the people/STEM careers they learned about. Try prompts such as these:

   What skills are similar to what makes you—you?

   What STEM career most excited you? Why?

   What STEM career sparked your interest? Why do you think it did?

   What talent, interest, or skill of yours may relate to the work of STEM professionals, and why?

   Do you like to solve problems? Do you enjoy challenges? Which STEM career does this relate to?

4. Invite students to revisit the questions below and then add any new thinking to their Identity Maps and any personal reflections in their journals:
   - Are certain aspects of your identity more important to you than others? Why?
   - How do you think your identity map might change over time?
   - How might things on your identity map affect decisions you make in your life? Or on what career you might pursue?

Appendix

After Tasks 1–7 are complete

A. Exploring the Diversity of STEM Careers

1. In this exploration, students do their own research about more STEM careers linked to Task 6 to discover the diversity of STEM careers related to the global response to the pandemic.

   The two STEM professionals/organizations quoted in Task 6 are
   - World Health Organization—Students can research this organization to uncover many careers in global health.
   - Lisa Cooper, MD, MPH, Physician, Public Health Researcher, Johns Hopkins University, USA and Ghana

   Explain to students that working in groups (or as a whole class if internet access doesn't allow for grouping) in this exploration, they will research the STEM career of Public Health Researcher and the diverse STEM careers available at the World Health Organization. Groups should record what they learn in their personal charts in their journals. (This website has great information on careers at WHO: *Careers at WHO*)

2. If time allows or as home learning, challenge students to read Tasks 1–6 in their Community Response Guide to uncover other STEM careers that may be related to the information in the Tasks. For example, biochemists are related to Task 4: How Can Washing Our Hands Help? Many STEM careers are hinted at but contributed to the global response to COVID-19. Broaden this challenge beyond this guide by inviting students to research the people whose work contributed to the global response to the pandemic.

   Note:
   If needed, have students share how they would do this research. This is a great opportunity to have students share their knowledge and skills in searching for information using technology, as digital literacy is a critical 21st-century skill. (See the Resources Section for helpful websites on growing "digital natives.")

3. As a class, add what the students find out to the class chart on STEM Careers. Have students revisit their Identity Map to look for more connections with the STEM careers they found.

B. Exploring STEM Careers in Your Local Community

1. Connecting your students to STEM careers in your local community allows for contextualization of their exploration into these fields. You can learn about local STEM professionals in many ways. Remind students that they are looking for people who use Science, Technology, Engineering, and/or Mathematics in their jobs. Below are some ideas:

   - Have students uncover the STEM careers in their community through research. Brainstorm with the class all the ways to find this information, then add any new careers to the class chart.

- As students visit zoos, museums, nature centers, and other informal science venues with their families/caregivers, challenge them to look for STEM professionals.
- Interview a local STEM professional either in class or virtually, and note the different STEM disciplines in their role and how they use them in their work.

  Below are some interview question ideas, but your students may come up with even more by using their Identity Maps!

  1. Please describe what your job involves. What is your favorite thing about your job?
  2. What do you identify as the key STEM disciplines in your day-to-day role? How do you use them? Why do you think your job is important?
  3. How did you discover your STEM identity? When did you know you wanted to pursue it?
  4. Were there challenges along the way, and if so, how did you navigate them? Who helped you, and how did they do that?
  5. What experiences or what people helped you develop your STEM identity?
  6. We know from research that many students who choose to study STEM subjects—especially engineering—and persist in the STEM field need strong support networks. Who was in your support systems in middle and high school, and how might teachers and volunteers play a role in providing support?
  7. Why did you choose your STEM field? Were you inspired by someone?
  8. What are some really cool things that people in your profession work on?
  9. What message would you give young girls to inspire them to pursue STEM careers?
  10. What is the best part of your job?
  11. What are the challenges of your job?
  12. Do you have any hobbies or other interests?
  13. What characteristics of a student might show an interest in or aptitude for your STEM field?
  14. What advice would you give to someone interested in pursuing a career similar to yours?

Note:
There are many STEM career websites for students to explore. The resource section lists just a few; you can encourage your students to find more!

Appendix

Resources

[Designating the MVP: Facilitating Classroom Discussion About Texts]

[When to Use Biographies in the Classroom]

[The need for digital literacy]

[Top-research-strategies-for-students-and-teachers]

[How to Teach Online Research Skills to Students in 5 Steps]

[5 Google Search Tools and Strategies to Cut Through the Clutter]

[Women in STEM Fields: Advice From the Lab]

https://www.nasa.gov/stem/nextgenstem/nasa-stem-stars/index.html

https://money.usnews.com/careers/slideshows/explore-top-stem-careers

https://stemstudy.com/stem-careers-glossary/

https://nmaahc.si.edu/learn/students/through-window-and-mirror-narratives-african-american-stem-professionals

https://www.careergirls.org/cluster/stem/

https://napequity.org/professional-development/counselor-training/stem-careers-students/

http://www.discovere.org/our-activities

Parents, Caregivers, and Educators

Action Plans can be shared with us by using hashtag #SSfGG!

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Smithsonian Science for Global Goals (SSfGG) is a freely available curriculum developed by the Smithsonian Science Education Center in collaboration with the InterAcademy Partnership. It uses the United Nations Sustainable Development Goals (SDGs) as a framework to focus on sustainable actions that are student-defined and implemented.

Attempting to empower the next generation of decision makers capable of making the right choices about the complex socio-scientific issues facing human society, SSfGG blends together previous practices in Inquiry-Based Science Education, Social Studies Education, Global Citizenship Education, Social Emotional Learning, and Education for Sustainable Development.

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