

Using Data to Understand and Improve Health Outcomes

Unit Overview

- [Using Data to Understand and Improve Health Outcomes Storyline Outline](#)
- [Using Data to Understand and Improve Health Outcomes Model Tracker](#)

This Unit is part of the [Health DataWell](#) collection of instructional materials. This project uses real-world data and case studies to develop students' understanding of the varied roles of citizens and health professionals in protecting and promoting the health and wellness of their communities.

Storylines and Phenomena

Storylines start with an anchoring phenomenon that raises questions or introduces a problem. Each step in a storyline unit is then driven by students' questions that arise from the phenomenon.

In this case, the anchoring phenomenon is disparities in health outcomes from respiratory diseases. Students analyze data about the Top 10 Causes of Death Globally by Income Group between 2000 and 2019 and note that respiratory diseases are in the top five causes of death across income categories. However, the order and specific type of disease differ by income group and geography. To begin to explain these differences, students decide to look at data on a smaller scale – states and counties in the United States. This data introduces additional disparities in both case numbers and health outcomes.

The first day of the unit provides opportunities for students to consider what they do and don't know about feedback mechanisms in the body, the respiratory and immune systems, respiratory diseases, air pollution, and public health. In doing so, they will begin to make sense of Disciplinary Core Ideas related to the structure and function of body systems, variation of traits, and how environmental factors affect the expression of traits.

Standards

The Using Data to Understand and Improve Health Outcomes unit provides opportunities for students to apply science ideas related to **LS1.A [Structure and Function](#)**, **LS3.B [Variation of Traits](#)**, and **ETS1.C [Optimizing the Design Solution](#)**.

The Using Data to Understand and Improve Health Outcomes unit could be part of a series of lessons building toward the following Performance Expectations (PEs):

- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]
- HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]
- HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]
- HS-ETS1-2.
<https://www.nextgenscience.org/pe/hs-ls1-3-molecules-organisms-structures-and-processes>

The science and engineering practices (SEPs) and crosscutting concepts (CCCs) in each lesson were selected to best support students in using the targeted DCIs and may or may not be reflected in the PEs above.

Crosscutting Concepts: Scale

The crosscutting concept of scale will be used throughout the unit. In each lesson, prompts are included to ensure students are considering scale while constructing explanations. For additional support, refer to STEM Teaching Tool Practice Brief 41: [Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction](#)

Required Prior Knowledge

This unit assumes students have already had an opportunity to figure out the following science ideas.

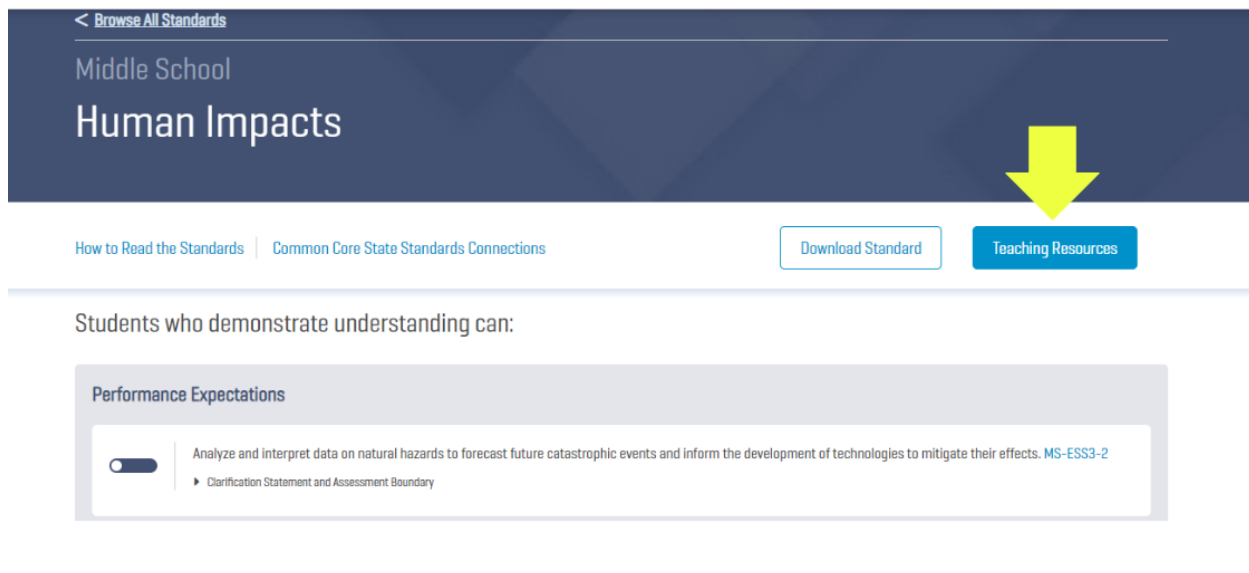
- HS LS1.A [Structure and Function](#)

- HS LS1. B [Growth and Development of Organisms](#)
- HS LS3.A [Inheritance of Traits](#)
- HS LS 3.B [Variation of Traits](#)
- MS ESS3.C [Human Impact on Earth's Systems](#)

To find instructional materials that address these DCIs,

1. Go to the [NSTA Standards page](#).
2. Select a Grade band and a Topic.
3. Click on the Teaching Resources Button.

Resources are being added regularly, so set a reminder to return to the page if there are currently no resources for a specific DCI.



< [Browse All Standards](#)

Middle School

Human Impacts

[How to Read the Standards](#) | [Common Core State Standards Connections](#) [Download Standard](#) [Teaching Resources](#)

Students who demonstrate understanding can:

Performance Expectations

☒ Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [MS-ESS3-2](#)

► [Clarification Statement and Assessment Boundary](#)

Advanced Planning

Once students develop an explanation of the complex set of factors that led to the disparities identified at the beginning of the unit, they work on a mitigation plan to address a respiratory health issue of their choice. In Lesson 8, there is an optional step where students consult with public health professionals, air quality researchers, policymakers, community activists, or other experts to refine their ideas. We recommend you begin researching and reaching out to these experts several weeks before beginning the unit to ensure there is ample time to accommodate busy schedules.

Options for interactions could include:

- The class visits to the expert's office or place of work
- The expert comes to the school
- Video call
- Asynchronous feedback through shareable documents

The following experts have offered to share their expertise with students. The authors will continue to add to the list. Consider finding experts, activists, and policymakers in your community.

- Jennifer Ramos-Chavez: Civil and Environmental Engineer
jcchavez10@utep.edu
Dr. Jennifer Ramos-Chavez is a postdoctoral researcher at the University of Texas at El Paso. Her research interests include community-based participatory environmental research and community-centered outreach.
- Madelyn Percy: Researcher, Educator, and Advocate
madelyn.percy@state.co.us
Dr. Madelyn Percy is an employee of the Air Pollution Control Division of the Colorado Department of Public Health & Environment. Her work supports the development and deployment of air quality networks and the creation of air quality and public health-focused curricular materials, aligned to the Next Generation Science Standards.

Another part of lessons 7 and 8 that will require pre-planning is considering where students will give their presentations. Consider public events or forums that would provide students access to policymakers and the general public. Or if students will not be doing oral presentations, consider where their ideas could be posted or shared with policymakers and the general public.

Community Engagement in Public Health

In this unit, students analyze data from communities within the United States and globally. When discussing populations, be careful not to essentialize them or their culture. As outlined in [Appendix D of the NGSS](#), it is crucial for science teaching to make meaningful connections to the cultural knowledge, experiences, and ways of knowing of students and their communities. However, it is complex work. For additional information, consider reading STEM Teaching Tool Practice Brief 53: [How to avoid possible pitfalls associated with culturally responsive instruction](#).

Caution students from making assumptions about a community, what work is being done, or solutions that are needed. We recommend highlighting mitigation strategies that the community is already working on. When designing and implementing true mitigation, it is mandatory to connect with the community to find out: Do they indeed

have this need? What kind of support would they like? How can you amplify or support work already being done by community members?

Additional information about empowering and amplifying voices within communities can be found at:

- WHO: [Community engagement: a health promotion guide for universal health coverage in the hands of the people](#)
- Public Health Institute: [Strategies for Strengthening Community Engagement](#)
- STEM Teaching Tool Practice Brief 97: [What is climate justice learning?](#)

Social-Emotional Strategies for Discussing Public Health Issues

A unit addressing air pollution, respiratory diseases, and disparities in health outcomes could possibly elicit emotional stress from some students, whether from their empathy for those affected or from experiencing respiratory diseases directly or through the experiences of family and friends.

Emotional stress from air pollution can often be great in students who feel they do not understand the situation or have no control over it. Although air pollution and the other factors investigated often bring impacts that students cannot control, the aim of this unit is to empower students to use what they learn about air pollution, respiratory diseases, and access to resources to develop a mitigation plan that involves students taking action within their spheres of influence.

For guidance on using social–emotional learning strategies when discussing personal health and public health problems, consult the following CDC resource.

[Promoting Mental Health and Well-Being in Schools: An Action Guide for School and District Leaders](#)

Optional Data Literacy Resources for Teachers and Students

[Tableau Data Literacy for All](#)

Learn data skill fundamentals with this free online training program. This self-paced course will teach you how to explore, understand, and communicate with data. Training covers key topics, including statistics, understanding data types, and storytelling with data. You will need to be logged into your Tableau account (or create a free account) to access the free training.

Optional Genetics Resources for Teachers

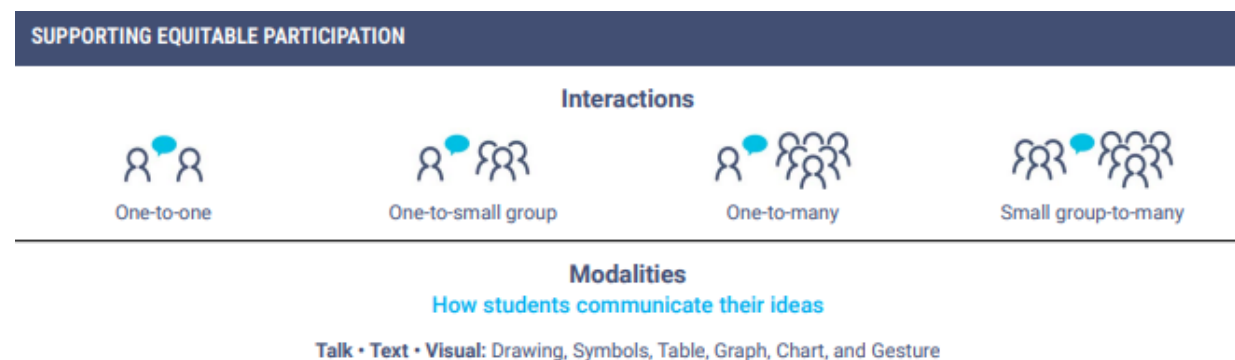
This unit builds on the ideas and concepts of genetics and natural selection from middle school. Students will engage with complex data sets, simulations, and scientific studies to make sense of and build on these science ideas. To help prepare to teach this unit, teachers can use the resources below to “brush up” on genetics and evolution. These resources are intended for teacher preparation only and are not meant to be given to students or frontloaded to them before teaching the unit.

- [Evolutionary Genetics | Learn Science at Scitable](#)
- [Population and Quantitative Genetics | Learn Science at Scitable](#)
- [DNA Damage & Repair: Mechanisms for Maintaining DNA Integrity](#)

Building Science Ideas as a Community of Learners

Intentional Progression of Interactions to Build Community

- Alone zone (Individual)
- Partner share
- Small group
- Class



Recording Student Ideas Publicly

Making students’ thinking public is an important step in the process of building science ideas as a community of learners. As students share, be sure to capture these ideas using student language. It is important that these initial ideas are recorded authentically using students’ exact wording. For more information about the purpose of capturing students’ ideas, consult the *Attempt to Make Sense* section on page 15 of the [inquiryHub Curriculum Front Matter](#).

Connect - Extend - Question

Thinking routines allow students to engage in a structured exploration of materials. The most important aspect of any thinking routine is that it allows students to make their thinking visible so they can go public with their ideas. The Connect, Extend, Question routine asks students to engage with the following questions:

- Connect. How are the ideas and information presented connected to what you already know? (Did it answer any prior questions?)
- Extend. What new ideas did you get that extended or broadened your thinking in new directions?
- Question. What new questions arise after reading the new material?

Identify and Interpret (I²)

This strategy is used to understand a visual representation, graph, data set or other image (which may also include some text).

Step 1: Identify (record “What I see” comments) Identify any changes, trends, or differences you see in the graph or figure. Draw arrows and write a “What I see” comment for each arrow. Be concise in your comments. These should be just what you can observe. Do not try to explain the meaning at this point.

Step 2: Interpret (record “What it means” comments) Interpret the meaning of each “What I see” comment by writing a “What it means” comment. Do not try to interpret the whole graph, data set or figure.

Step 3: Caption (Write a caption for the graph or figure.) Start with a topic sentence that describes what the graph or figure shows. Then join each “What I see” comment with its “What it means” comment to make a sentence. Build a coherent paragraph out of your sentences.

Developing an Initial Model

Focusing on what is known allows for a starting point in developing a model. Once students have some components, encourage them to think about interactions. Explain that it is acceptable to use question marks when we don’t know what exactly is going on, but we know there is some kind of relationship among the components.

Explain that they are creating these initial models just to help them get their thinking on paper, and they will only have 5 minutes. Tell students you want to see their ideas about what they think is happening in these populations to explain how the phenotypic frequency has changed.

Stick to a time limit and set expectations.

- It is expected that all students develop a model within the time limit.
- Assure students that they do not have to worry about the artistic quality of their model, and they are not expected to have a complete explanation in the first lesson. They will return to and revise their models throughout the unit.

Initial models should never be graded. Students need to feel safe in knowing we really want to know their thinking and that we are NOT judging them (nor will it affect their grade) for what they do and do not know. However, it is valuable to you as a teacher to look at these initial models and even assess them formatively - giving feedback only on how students are using the modeling practice. This will allow you to see over time (when looking at initial models for different phenomena), students become more adept at using modeling to make their thinking visible (even if the science ideas are not there yet).

Note that the [Model Tracker](#) provides sample models and/or explanations that students might develop in each lesson. This is a teacher-facing resource that should not be used as an answer key or considered the one correct model. Students should be allowed to choose how to represent the science ideas explained in their model.

Driving Question Board

The driving question board (DQB) is a strategy that allows students to make their questions public in a low-stakes situation, as students are only asked to share a single question based on their observations. This task does not require students to have background knowledge or prior experience with the science ideas of the phenomena. Having students share a question they want to learn about also helps them build confidence in sharing publicly and promotes agency in their learning.

There are several different ways to facilitate the construction of a DQB, and construction can be done using adhesive notes or digitally using a tool like Jamboard or Padlet.

- Walk-n-talk
- Snowball
- Bundling

Regardless of how the DQB is developed, it is important that each student shares a question and all questions are represented on the DQB, as this promotes equity and access to the science ideas being figured out during the lesson. Also, note that students are only engaged in asking questions based on observations. They are not yet trying to answer these questions.

Talking Sticks Protocol

The talking stick protocol is used to ensure equitable floor time for all students in the discussion in the first couple of rounds. The later round of discussion encourages students to build off each other's ideas.

Let students know they will have a set amount of time (15-30 seconds) to share their thinking with their group. The person that has their pencil in their hand is the only person talking. All questions and comments that come up must be saved, the other group members are not allowed to speak.

Decide who will be the first to share. Tell students when you call "time" the person sharing has to put down their pencil and quit speaking (even if they are mid-sentence) The person to the right will share their ideas or their model as soon as time is called. If the person sharing stops talking before time is up, tell students not to talk among themselves and not to move to the next person. Instead they should sit quietly until time is called (often the student sharing will think of more to say). Ask all students except the person going first to put their pen or pencil down and begin timing. Continue calling "time" at the end of each time interval until all group members have shared their ideas.

For the final round (which may be a longer interval of time) open the discussion up for students to ask questions of each other or make comments about connections they made with ideas they shared.

Gallery Walks

1 stay—3 stray

This strategy gives students an opportunity to see one another as sources of knowledge in the classroom. It also helps students deepen their thinking about disciplinary core ideas. In this gallery walk, one person from each group stays to answer questions while the other group members visit and learn from other groups. At the end of the gallery walk, students reconvene with their original groups, share what they learned, and consider new questions they have.

Types of Discussions

Allowing students time to share initial ideas helps to surface their prior knowledge and provides opportunities for them to notice the thinking of their classmates to recognize similarities and differences. This type of discussion is called an Initial Ideas Discussion. At this point, students should only be discussing and sharing ideas, and not trying to figure out the answers to their questions.

During an Initial Ideas Discussion, it is important for the teacher to acknowledge all student ideas and not try to correct any misconceptions or incomplete science ideas at this time. Use this discussion as a formative assessment opportunity and to guide instruction. Throughout the storyline, students will use science and engineering practices, which gives them opportunities to change their thinking based on new evidence.

Additional types of discussions include **Building Understanding Discussions** and **Consensus Discussions**. For information about each type of discussion, consult the OpenSciEd resource [3 Discussion Types](#).

Protocol to Support Close Reading

Reading Strategy Teacher Steps:

1. Establish the purpose for reading the article.

Students will use this article as additional evidence to support the science ideas that will be used to explain the phenomenon. Build or tap into schema: What do we know about the phenomenon already?

2. First Read: Tell students that in a moment, they will read the article independently.

Have students annotate the text as they read.

Consider giving students a format for annotation. For example:

- Encourage students to underline confusing parts.
- Have students circle any unfamiliar science or academic language
- Students should write questions in the margins.

Observe students' silent reading closely to watch for signs of difficulty. As they read, target students who may need more assistance making meaning of the text.

3. Partner talk: Ask students to turn to a partner to discuss their initial interpretations of the text.

Provide the following sentence starters/frames if students have trouble getting started:

- A word or phrase I [did not know/found confusing/interesting] is _____ because _____.
- One pattern I noticed was _____.
- I think the author wants me to know_____.

As partners discuss the article, ask students to write their observations or questions either

directly on the article as annotations or in their Science Notebook. Monitor students' conversations and notes during this time to check for understanding.

4. Class discussion 1: Invite students to share their ideas and those of their partners.

Listen carefully to what students share—their ideas will provide you with initial insight into what portions of the text they understand. Ask students if any words or phrases were unfamiliar or unclear. How did students attempt to determine the meaning? Note students' responses, as they will guide you regarding what should be modeled.

5. Second reading: Students read for understanding.

Tell students to read the article again in order to find the answers to the questions they still have and to identify any additional questions.

6. Class discussion 2: Students share new understandings.

Lead a class discussion using the text-dependent and close-reading questions you have developed for the article.

Optional: Teacher-Led Shared Reading and Think-Aloud

Think-alouds are beneficial at the beginning of the year or when the text you are asking students to read is complex. The steps are provided below.

- Before reading to the class, identify either a close-reading question or language you want to focus on in the article based on what you learned during the class discussions. In addition, identify the part of the article you will read to model your selected focus.
- Read the article to the class once through without interruption.
- Explain the think-aloud process.
- Reread the passage that you selected as your focus. As you read, model your metacognition—thinking about thinking—using
 - Either your own or the provided close-reading questions.
 - Context clues to determine word meaning; emphasize the “keep reading” strategy (i.e., continuing to read even if confused and attempting to make meaning based on contextual

clues).

Note that this process can be used with any reading assigned to students throughout the year. As you completely release the responsibility for reading to students, and as they repeat this process, it will not be necessary for you to model it.