HEALTH DATAWELL

Utilizing real-world data and case studies
to understand public and environmental health challenges

Syril D. Pettit, DrPH MEM
Executive Director
Health and Environmental Sciences Institute
www.hesiglobal.org
501c3 Global non-profit scientific institution based in Washington, DC, USA since 1989

Mission: Developing science via collaboration for a safer, more sustainable world

Covid engaged us ALL in public health: Highlighted need to expand multi-disciplinary training and thinking to next generation
ABOUT: HEALTH DATAWELL

A Health and Environmental Sciences Institute (HESI) and National Science Teaching Association (NSTA) Collaboration

Background

Bridging gap in resources to teach students about public health, data science, and health equity.

Materials for use with high-school level science students and can be freely accessed and implemented

Main Takeaway

Students will build skills and knowledge in three primary focus areas:
- Data analysis and visualization
- Social and environmental determinants of health
- Awareness of varied careers/civic roles in societal health protection.
INSTRUCTIONAL MATERIALS

April 2023

3 Daily Do’s
1. How does where you live affect your risk of heat-wave-related death?
2. How can where you live affect your risk of experiencing asthma?
3. How does where you live and work affect your risk of mesothelioma?

April 2024

One Unit
Using Data to Understand and Improve Health Outcomes (8 lessons)

2024/2025

More to Come!
1. Additional Daily Do’s
2. Currently only available in English - future iterations may be translated to other languages

hesi@hesiglobal.org
Collection of Resources

HDW Web Seminar: Using Data to Understand and Improve Health Outcomes, June 4, 2024 Collection

PUBLIC
3 items
This is a collection of resources for the program titled: Health DataWell Web Seminar: Using Data to Understand and Improve Health Outcomes Storyline. This program aired on June 4, 2024.

Resources in “HDW Web Seminar: Using Data to Understand and Improve Health Outcomes, June 4, 2024” Collection

<table>
<thead>
<tr>
<th>Title</th>
<th>Resource Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Framework for K-12 Science Education (pdf)</td>
<td>Web Page</td>
</tr>
<tr>
<td>Anchoring Phenomenon Routine Tracker</td>
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https://my.nsta.org/collection/Q7_sxTSq1w9Y_E
Our Community Norms

- We come prepared to work toward a common goal.
- We share our own thinking to help us all learn.
- We listen carefully and ask questions to help us understand everyone’s ideas.

From OpenSciEd Classroom Norms
Participating in Small Group Discussions (Breakout Room)

- Camera on and microphone on, or
- Microphone on, or
- Chat window
Science Instructional Shifts

Shift 1. Explain phenomena and design solutions to problems

Shift 2. Doing science (three-dimensional learning)

Shift 3. Coherent learning progressions over time

https://my.nsta.org/collection/Q7_sxTSq1w9Y_E
Continuum of Science Instruction

Information Frame

• Teacher is focused on disseminating information.
• Students are focused on knowing information.
• Science is portrayed as a body of established facts.
• Assessments are focused on “right” answers.

Knowing about...

Sensemaking Frame

• Teacher is focused on developing conceptual understanding.
• Students are focused on understanding something.
• Science is portrayed as a way to make sense of something.
• Assessments are focused on use of evidence to support conclusions/generalizations.

Figuring out…

From: Cynthia Passmore, NSTA Virtual PD, Nov. 15, 2014
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Figuring out...

From: Cynthia Passmore, NSTA Virtual PD, Nov. 15, 2014
Sensemaking

Students-as-scientists actively trying to make sense of the world.
How Students Experience Sensemaking

- Students experience a **phenomenon**;
- engage in **science and engineering practices** and
- **share ideas** (and build on others’ ideas) to develop or apply the
- **science ideas** and **crosscutting concepts** needed to explain how or why the phenomenon occurs.
Unit Overview
Where can I access the Instructional Materials?

https://my.nsta.org/collection/Q7_sxTSq1w9Y_E
This storyline builds towards:

**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:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
### Storyline Outline

**Using Data to Understand and Improve Health Outcomes:** Storyline Outline

**Lesson 3**
- **Scenario 3:** The Top 10 Causes of Death Globally by Income Group: Respiratory diseases are in the top 5 causes of death globally and in the low-income countries, but the most specific type of disease offered by smoking.

**Lesson 4**
- **What makes a disease healthy or unhealthy?**
  - Disease and lifestyle factors in the health outcomes of respiratory diseases: We analyze the factors that impact differences in health outcomes between communities.

**Lesson 5**
- **What makes a disease healthy or unhealthy?**
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**Lesson 6**
- **What makes a disease healthy or unhealthy?**
  - Disease and lifestyle factors in the health outcomes of respiratory diseases: We analyze the factors that impact differences in health outcomes between communities.

**Lesson 7**
- **How can we stop the spread of disease?**
  - Disease and lifestyle factors in the health outcomes of respiratory diseases: We analyze the factors that impact differences in health outcomes between communities.

### Navigation

**After analyzing the data, we have concluded that some differences in health outcomes can be fully explained by exposure to PM2.5. What site is different from these sites?**

**Lesson 3**
- **The Top 10 Causes of Death Globally by Income Group:** Respiratory diseases are in the top 5 causes of death globally and in the low-income countries, but the most specific type of disease offered by smoking.

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**Resource 3**

https://my.nsta.org/collection/Q7_sxTSq1w9Y_E
Lesson Front Matter

Why are there differences in case numbers and health outcomes of respiratory diseases at the country, regional, and local levels?

Lesson Level Performance Expectation

- Ask questions and consider patterns in data that could explain the differences in case numbers and health outcomes of respiratory diseases at the country, regional, and county levels.

What Students Will Figure Out

- Air pollution poses risks to human health.
- There are differences in case numbers and health outcomes of respiratory diseases at the country, state, and county levels.
- One of the outcomes of air pollution is PM2.5, very small particles that can become trapped in the air sacs of the lungs and pass from there into the bloodstream. PM2.5 can be made up of a variety of substances, including inorganic ions, metallic compounds, elemental carbon, organic compounds, and compounds from the earth's crust.

Lesson Snapshot

High school students, as scientists, ask questions and identify patterns in data to answer the following driving question: Why are there differences in case numbers and health outcomes of respiratory diseases at the country, state, and county levels? Students watch a Public Service Announcement about the health risks posed by exposure to air pollution. To begin investigating air pollution's potential health effects, students evaluate information about different categories of respiratory diseases. From there, 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, but 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 at a smaller scale—states and counties in the United States. This data introduces additional disparities in both case numbers and health outcomes. Next, students investigate their initial questions about the health effects of air pollution. Finally, students will create an individual model to explain the differences in respiratory disease case numbers and health outcomes observed in the data. Students will share their initial models to look for similarities and differences, and to help them answer questions they need to answer to explain the phenomena.

Phenomena

In 2019, Chronic Respiratory Diseases (CRDs) were responsible for an estimated 4.0 million deaths and 454.6 million cases globally. [source: WHO, 2019 Chronic Respiratory Disease Collaborators, Global burden of chronic respiratory diseases and air pollution, 2018-2019, an update from the Global Burden of Disease Study 2016, (https://www.thelancet.com/pdfs/10.1016/S0140-6736(19)30314-0.pdf).]


The 2019 Top 10 Causes of Death Globally by Income Group: Respiratory diseases are in the top five causes of death across income categories, but the order and specific type of disease differ by income group. [source:WHO]

Case and health outcomes differences in Respiratory Disease Data for Several US Communities.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking Questions and Defining Problems</td>
<td>Students will apply and develop ideas related to structure and function.</td>
<td>Patterns of different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td>
</tr>
<tr>
<td>Identifying and Investigating Patterns</td>
<td>Students will apply and develop ideas related to structure and function.</td>
<td>Patterns of different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td>
</tr>
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</table>

Performance Expectations:
For information about Performance Expectations, refer to the Standards section of the Front Matter document.

Materials

<table>
<thead>
<tr>
<th>Per Student</th>
<th>Student Materials</th>
<th>Teacher Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHW Unit 1.1: The Front Guide</td>
<td>CHW Unit 1.1: Respiratory Disease Data for Several US Communities</td>
<td></td>
</tr>
</tbody>
</table>

Lesson Preparation

Advanced Planning
Before beginning this unit, visit the Advanced Planning section of the Using Data to Understand and Improve Health Outcomes: Front Matter.

Required Prior Knowledge
See the Front Matter Required Prior Knowledge section for information about the Disciplinary Core Ideas students are expected to have developed in previous lessons and units. The section also includes a list of instructional materials that address the D.1.
**Experience the Phenomenon**

**What Students Are Doing**

In this section, students watch a Public Service Announcement about the health risks posed by exposure to air pollution. Students ask questions and reflect on how air pollution has affected them. To begin investigating air pollution’s health effects, students evaluate information about different categories of respiratory diseases. From there, 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, but the order and specific type of disease differ by income group. To begin to explain these differences, students decide to look at data at a smaller scale – states and counties in the United States. This data introduces additional differences in both case numbers and health outcomes.

**Teacher Guidance**

1. **Access students’ background knowledge about air pollution and public service announcements.**

   Pass out a copy of the Student Guide to each student and ask them to use the Notice and Wonder chart on page 1 to record any observations, including connections to their previous experiences and questions that come to mind as they watch the video. Play WHO Breathe Life – Clean Air, Healthy Future.

   Ask for a few students to share their observations and connections if they are open to it. For guidance on using social-emotional strategies when discussing environmental health issues, consult Social-Emotional Strategies for Discussing Environmental Health Issues in the Front Matter document.

2. **Tell students they will watch a public service announcement (PSA) about an environmental challenge.**

   Suggested Prompts
   - Have you seen a video similar to this before? What do you think is the purpose of a PSA?
   - What did you notice about the video?
   - What connections did you make to your life? Have you had experiences with air pollution?
   - We learned about feedback mechanisms in an earlier unit. How can we use our understanding to consider how the body responds to air pollution? Do you think the relationship between air pollution and health is as simple as the PSA makes it seem?

Sample Student Observations and Connections

- I have seen videos like this before. I think they are trying to teach people about a problem and potential solutions.
- Air pollution causes 7 in 9 deaths worldwide.
- Air pollution affects 80% of people living in cities.
- There are solutions to air pollution. For example, using different types of transportation.
- In the summer, when there were a lot of fires, sometimes I coughed more, and it was harder to breathe.
- Where I live, there are sometimes Spare the Air days when people are asked not to drive. On those days, experts also tell people with certain health problems to stay inside.
- I’m not sure what feedback mechanisms the body would use to address air pollution. Does the body treat it like it would a germ, and activate the immune system? Or does something else happen?
- It probably is more complicated than the PSA makes it seem. We learned in the last unit that lots of factors affect feedback mechanisms in our bodies.

Sample Student Responses

- We wondered why income level would affect rates of certain diseases.
- We’re not sure. Maybe there are differences in access to healthcare based on income. Maybe there are differences in the environmental hazards, like pollution, people are exposed to based on income.
- No, probably not.
- No, they will experience different things based on exactly where they live in that county. Pollution levels could be different in different parts of the country. And there are different things to track.

**8. Introduce the Phenomenon (Part 2)**

Facilitate a discussion that motivates students to identify the need to analyze respiratory disease data at a smaller scale.

<table>
<thead>
<tr>
<th>Suggested Prompts</th>
<th>Sample Student Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>I noticed some of you discussing how the data was sorted based on the income level of countries, did that bring up any questions for you?</td>
<td>We wondered why income level would affect rates of certain diseases.</td>
</tr>
<tr>
<td>What are some factors that could be related to income that might contribute to deaths from respiratory diseases?</td>
<td>We’re not sure. Maybe there are differences in access to healthcare based on income. Maybe there are differences in the environmental hazards, like pollution, people are exposed to based on income.</td>
</tr>
<tr>
<td>Do you think that everyone in each of those countries has the same income?</td>
<td>No, probably not.</td>
</tr>
<tr>
<td>If they are not all living at the same income level—or even if they are—do you think they all experience the same conditions?</td>
<td>No, they will experience different things based on exactly where they live in that country. Pollution levels could be different in different parts of the country. And there are different things to track.</td>
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</table>

**Additional Guidance:**

**Prompt and Response Tables**

This lesson contains prompt and response example tables to help students move toward the key ideas that need to be addressed in the discussion. These examples are meant to be used when students are stuck, if the discussion is moving in an unproductive direction, or if the discussion stalls. However, the goal is to facilitate discussions in a way that encourages students to consider and respond to each other’s ideas. Use talk moves to ask students to build on the thinking of others, agree or disagree with each others’ ideas, mistake others’ ideas, and clarify their own ideas.

For more information about: [Additional Guidance: Prompt and Response Tables](#)

**Additional Guidance: Culturally Responsive Instruction**

Be careful when introducing countries or communities not to essentialize them or their culture, or reduce them to their World Bank income group classification or other data. For the purposes of equity, it is crucial for science teaching to make sense of diversity and connect students to their local and regional contexts and communities. Culturally responsive teaching should include an understanding of cultural paradigms and norms, the role of culture in shaping the ways we think about other cultures, and the importance of considering cultural variation within cultural contexts.

**Additional Guidance: Discussing the Effects of the COVID-19 Pandemic on the Data**

Ensure that students are aware that the time period the data covers includes the onset of the COVID-19 pandemic. This affects the data in many ways due to stay-at-home ordinances and the high transmissibility of COVID-19 variants. Encourage students to focus less on how big the numbers are overall as there are more cases of respiratory diseases during this period due to COVID-19, but on the differences between states and counties within states. The focus of the unit is on differences in health outcomes in different countries, regions, and neighborhoods.

For more information about COVID-19, respiratory infections, and lower respiratory infections, consult the studies below.

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1052076/
Anchoring Phenomenon Routine

This routine positions students to make sense of a phenomenon, grounding all students in a common experience and raising student questions.

Element #1: Explore the phenomenon
Element #2: Attempt to make sense
Element #3: Identify related phenomena
Element #4: Questions and next steps
## Anchoring Phenomena Routine Tracker

<table>
<thead>
<tr>
<th>Element 1: Explore the Phenomenon</th>
<th>Element 2: Attempt to Make Sense of the Phenomenon</th>
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<tr>
<td>What do we notice?</td>
<td>How can we explain this? Do our explanations agree?</td>
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- Notes about what you or the students did.
- How does this support **figuring out**?
- How does this support a classroom culture where all students have access?

[https://my.nsta.org/collection/Q7_sxTSq1w9Y_E](https://my.nsta.org/collection/Q7_sxTSq1w9Y_E)
Student Hat/Teacher “Hat”

Student Hat: Think like a student.

Student/Teacher Hat: Think like a student, but note teacher guidance.

Teacher “Hat”: Reflect on student experience and educator moves.
Using Data to Understand and Improve Health Outcomes

Lesson 1
Why are there differences in case numbers and health outcomes of respiratory diseases at the country, regional, and local levels?
Create a Notice and Wonder chart in your science notebook.

<table>
<thead>
<tr>
<th>Notice</th>
<th>Wonder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Experience the Phenomenon

WHO: Breathe Life – Clean Air, Healthy Future

Air pollution causes 1 in 9 deaths worldwide and is the largest single environmental health crisis we face.

Launched by the World Health Organization and the Climate Clean Air Coalition, Breathe Life is a global campaign to build a network of citizens, urban and national leaders, and health professionals to leverage change in our communities.
Add ideas to the chat: What body system should we focus on to investigate how air pollution can affect our health?
Experience the Phenomenon

Alone Zone: Read pg 1-2 of the student handout to evaluate the information about two categories of respiratory system diseases and add any new information and questions to the notice and wonder table.

Be prepared to share your ideas and questions.

Experience the Phenomenon

In the chat: Share at least 1 new idea or question you recorded while reading

- What do all Chronic Lower Respiratory Diseases (CLRDs) have in common?
- What do all Respiratory Infections have in common? What about Lower Respiratory Infections (LRIs)?
- How can we use scale to discuss the differences between the two categories of respiratory diseases?
- How can we use cause and effect to discuss the differences between the two categories of respiratory diseases?
- How do you think this information connects to the PSA on air pollution?
- What other questions do you have about the categories of respiratory diseases?
With your Group: Analyze the data on pages 3-6 of the student guide and consider the patterns you notice in the data.

Be prepared to share what your group discussed in the chat when you return.

Experience the Phenomenon

The Top 10 Causes of Death Globally by Income Group
Experience the Phenomenon

<table>
<thead>
<tr>
<th>Breakout Room #</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 6, 11, 16</td>
<td>Illinois</td>
</tr>
<tr>
<td>2, 7, 12, 17</td>
<td>South Dakota</td>
</tr>
<tr>
<td>3, 8, 13, 18</td>
<td>Arizona</td>
</tr>
<tr>
<td>4, 9, 14, 19</td>
<td>New York</td>
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<td>5, 10, 15, 20</td>
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Be prepared to share what your group discussed in the chat when you return.
Experience the Phenomenon

In the chat: Share any important patterns you noticed, as well as any new questions this data brought up.
**Alone Zone:** Think about how we could investigate the new questions we have. What kind of data might we need?

Write your ideas in the chat, but don’t hit enter until we give you the cue.

<table>
<thead>
<tr>
<th>Ideas for Investigation</th>
<th>Data we need to collect/analyze</th>
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Air pollution is a complex mixture of gas and solid particulate matter. Particulate Matter (PM) is a mixture of solid particles and liquid droplets found in the air. Two sizes: PM2.5 and PM10.

In addition to the outdoor sources listed above, certain cooking practices and cigarettes are indoor air sources of air pollution.

Our bodies’ natural defenses help us to keep coarse particles (PM10) we inhale out of the deepest parts of our lungs.

Smaller fine or ultrafine particles (PM2.5) can penetrate all the way into the air sacs of the lungs. Many of these particles get trapped in the air sacs, while the smallest are so tiny that they can pass from the air sacs into the bloodstream and disperse to other organs of the body.
With your Group

Using the model template, Discuss and work together using the drawing tools on the toolbar to create an initial model to explain the patterns we saw for respiratory diseases in different countries, states in the United States, and counties within the same state.
In the chat: Share how your group model compared to other group models. How are they similar and different?

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Differences</th>
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Explain the Phenomenon
Explain the Phenomenon

Record and organize our questions

DQB

How can we explain the differences in CRD and LRI case numbers and health outcomes between communities?
## Anchoring Phenomena Routine Tracker

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Resource 3

[https://my.nsta.org/collection/Q7_sxTSq1w9Y_E](https://my.nsta.org/collection/Q7_sxTSq1w9Y_E)
We built it… now how do we sustain that coherence?
How we Support Coherence from the Student Perspective

Looking Back
- Where did we leave off?

Looking Forward
- What are we trying to figure out?
- How can we work on this today?

Looking Back
- What have we agreed on?
- Where are we not sure?

Looking Forward
- Where should we go next?

What's Next?
What do we need to know more about?

Lesson 2
How can we investigate the relationship between PM2.5 exposure and respiratory diseases?
How we Support Coherence from the Student Perspective
Based on our discussion, we have figured out that one component of air pollution is PM2.5 which can enter the body and get stuck in air sacs in the respiratory system. It looks like we need more information about what PM2.5 does once it is ‘stuck’ there.
How do we Answer our Questions in this Unit?

A lot of our questions are about the PM2.5 levels in different countries, states, and counties. Let’s investigate that next!
After analyzing the data, we have concluded that some differences in health outcomes can’t be fully explained by exposure to PM2.5. What else is different about these counties? How can we investigate that?
How do we Answer our Questions in this Unit?

It seems like there might be a lot of confounding variables making it hard to identify direct cause and effect relationships… What can we do to start to figure out these relationships better?

Resource #6

https://my.nsta.org/collection/Q7_sxTSq1w9Y_E
We figured out how the factors we’ve been thinking about throughout the unit can act as threats or protections in relation to health outcomes, but it seems like we have a lot of questions about why the threats and protections in different communities are so different…
It looks like we have figured out some interesting patterns that contribute to the disparities in case numbers and health outcomes from respiratory diseases depending on where you live and other factors. We have a useful model to help us think about how different factors may contribute to these disparities. Can we use our model to plan a mitigation strategy for a specific community of your choice?
How do we Answer our Questions in this Unit?

What are the realities public health campaigns often come up against? What challenges do public health campaigns encounter? How do they attempt to overcome them?
How do we Answer our Questions in this Unit?

Lesson 8
How can we effectively communicate actionable public health information?

**Presentation Criteria**

This presentation provides an opportunity for students to share in a public forum what they have learned about the topic and what they propose to do about it. Presentations are made by individuals or small groups of students. Peer evaluations can be used to assess peers' feedback. Use the following rating scale: 4 = good; 5 = excellent; 6 = perfect; 7 = exemplary. For each of the sections:

<table>
<thead>
<tr>
<th>Category</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td></td>
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**Strategies of crowd implementation:**

- Clearly state the mitigation strategy the group has designed using meaningful and evidence-based information.
- Identify the advantages and disadvantages of their proposed strategy.
- Evaluate your presentation's effectiveness.

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</thead>
<tbody>
<tr>
<td>Analysis of strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explore the advantages/disadvantages of the proposed strategy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How did these strategies use data to inform their strategy?</td>
<td></td>
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<td>Clearly state the mitigation strategy the group has designed using meaningful and evidence-based information.</td>
<td></td>
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<td>Identify the advantages and disadvantages of their proposed strategy.</td>
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<tr>
<td>Evaluate your presentation's effectiveness.</td>
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</tbody>
</table>
Final Reflection

In the chat:

Share your thoughts

- Did you have any aha moments and/or gain key takeaways?
- How might you use these instructional materials?
- What additional support would you like?
- Any other ideas or questions you would like to share?
Thank you for your participation!

Holly Hereau
hhereau@nsta.org

Patrice Scinta
pscinta@nsta.org

Syril Pettit
hesi@hesiglobal.org