# ON THE AIR

## 2020

CLEAN AIR PARTNERS
DC-MD-VA

A Middle School Air Quality Curriculum Resource

# ON THE AIR 2020

Developed By:
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DBY
STEM Education
Services

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Produced By:

CLEAN AIR PARTNERS DC-MD-VA

# Introduction

Twelve years ago, Clean Air Partners released the original On the Air curriculum as a way to help educators bring air quality stewardship to life for middle school students in the Washington D.C.-Maryland-Virginia region. This revised version of On the Air continues that commitment to supporting local educators in their efforts to teach a new generation of informed, active young people about their role in protecting themselves and our planet from air pollution. Welcome to On the Air 2020!

Much has changed since the original On the Air was released: new science standards have been adopted, and new perspectives on STEM education have developed. The same is true for the atmosphere: while local levels of many common air pollutants have decreased, climate changed has become even more of a pressing issue as greenhouse gas levels and the global temperatures continue to rise. This continual change is what prompted the need to update On the Air. So what can you expect from On the Air 2020?

- 5 modules aligned to the Next Generation Science Standards, the Virginia Standards of Learning (SOL), and the Common Core State Standards for Math & Literacy
- Inquiry-based 5E lesson sequences built around local phenomena
- Engaging and interactive lessons with a wide variety of student-centered activites
- Media and technology-rich experiences that enhance student learning
- A web-based interactive platform for accessing and implementing the curriculum

The 5 modules that comprise the curriculum revolve around key concepts in air quality:

- Module 1 uses modeling to investigate how ozone pollution affects human by systems
- Module 2 looks at how human activities and weather influence short and long-term trends in air quality
- Module 3 focuses on the effect of particulate matter on the health of a community
- Module 4 investigates the connection between air quality and water quality in the Chesapeake Bay
- Module 5 centers on climate change and the role of air pollution in rising sea levels

In the pages that follow, you'll find more about the curriculum itself and how to use it in your classroom. Explore it here or online, as you figure out how your students can play a part in making the air safe to breathe in 2020 and beyond.

Thank you!

- David Yarmchuk, Curriculum Developer for On the Air 2020

# Thanks & Acknowledgements

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# Curriculum Information Contents

# Guidelines for Teaching On the Air

On the Air 2020 is a standards-aligned air quality curriculum that was created to support inquiry-based science education for students in grades 5-12. This section includes a variety of information to help you implement On the Air 2020 successfully. For more details about how to use the curriculum, visit http://ontheair.cleanairpartners.net/how-to-use.

To access all of On the Air 2020 online go to: http://ontheair.cleanairpartners.net

## How is On the Air 2020 structured, and how should I use it?

**5 Independent Modules:** On the Air 2020 has 5 modules, which are each made of one complete 5E lesson sequence. These lesson sequences range from 9-13 activities, and all include a summative assessment. The modules can be used independently, or as a complete unit. The order of the modules is intentional, so it is recommended that you teach the modules in order if you plan to teach them all.

**Scientific Phenomena & Engineering Problems:** On the Air 2020 is built around explaining scientific phenomena and designing solutions to engineering problems. The Next Generation Science Standards (NGSS) and the Virginia Standards of Learning (SOLs) focus on engaging students in these practices of science and engineering as a way to foster authentic science learning. While these are not the only science and engineering practices that students undertake in standards-aligned science curricula, they are critical components of NGSS and the SOLs. Each module in the curriculum explicitly details the phenomena that students are looking to explain or the engineering problems they are looking to solve. When in doubt about how to teach the module, make sure that the scientific phenomena and engineering problems are at the forefront.

**Teach Whole Modules**: Because each module of On the Air is a complete 5E lesson sequence that leads students to explore and explain a phenomenon related to air quality, students will learn best if they progress through the modules as designed, from engaging with and exploring the phenomenon, to developing explanations, to elaborating and extending their understanding, to an evaluation of their learning. Pulling individual pieces out of each module will short-circuit this cycle of inquiry and prevent students from experiencing the full richness of the modules.

**Adopt & Adapt**: While we love the activities in On the Air 2020 that doesn't mean they're perfect for every classroom around the world. Where necessary, make adjustments to better suit your students or your classroom situation. That might mean adding in a mini-lesson here or there to fill in gaps in student understanding or skills, reteaching a lesson that students need more support with, swapping out a video, tweaking a handout, or adjusting the pacing. With that said, there is an intentionality built into each module and activity, so keep that in mind before you make sweeping changes to the curriculum.

**Connect to online materials and resources:** The online version of On the Air 2020 has embedded images and videos that you can show directly through the website. You can also download print materials for the curriculum, including student handouts (in both pdf and Word formats) and teacher guides. Access the website at: http://ontheair.cleanairpartners.net.

## What common structures and practices will I see in On the Air 2020?

**Activities that follow the 5E model of instruction**: The 5E instructional model is a student-centered method for teaching science and engineering through guided inquiry. The model gets its name from the 5 stages that students progress through when they are following the model: Engage, Explore, Explain, Elaborate, Evaluate. The model was developed by Biological Sciences Curriculum Study (BSCS) in 1978 as a tool for science educators to plan meaningful lessons and units. To learn more about the origins and adaptations of the 5E model, visit the BSCS 5E webpage.

**Claim-Evidence-Reasoning for scientific writing**: The Claim-Evidence-Reasoning (CER) structure is used throughout On the Air 2020 as a way to support student thinking, sensemaking, and scientific writing. It is a helpful method for improving students' analytical skills when it comes to interpreting data and expressing conclusions. Learn more about the CER model by watching this video from Bozeman Science: https://www.youtube.com/watch?v=5KKsLuRPsvU.

**Anchor charts:** Each module in On the Air 2020 is designed to be a coherent learning sequence. Phenomena, questions, concepts, and information form through-lines that enhance student sensemaking and understanding. Anchor charts that teachers and students create together and then display in the classroom throughout the unit serve as reference points and "anchors" to guide that sensemaking.

**"Know-Want to Know-Learned: (KWL) charts and "I see, I think, I wonder" charts**: As students progress through a module in the curriculum, they perform the same kinds of activities that scientists do in the real world. This starts with making observations, connecting observations to background information, raising questions, exploring those questions, and reflecting on learning. KWL charts and I see, I think, I wonder charts provide students with the opportunity to engage in authentic exploration and learning, and reflect on that process.

## What information is in each module?

On the Air 2020 modules have a common structure. Each module contains the following information:

- **Module overview**: a brief description of the module contents in narrative form
- **When to teach this module:** guidelines for incorporating On the Air 2020 into your current curriculum or scope & sequence
- **Standards overview**: how the module aligns to NGSS, VA SOL, and Common Core standards
- **5E module flow:** the purpose, timing, and objectives for each activity in the module
- **Module materials:** what handouts or other materials are required to teach each activity
- **Teacher background information:** helpful information for teachers to use to prepare for the module, and links to additional sources
- **Module activities:** directions for teaching each activity, as well as student handouts and teacher guides
- **Doing our part:** a set of actions that students can take to improve air quality in their communities or to keep themselves safe from air pollution. In Modules 4 & 5, this section is built into one of the activities as opposed to being a separate section.
- **Air quality champion in the community:** an interview with a member of the community who works to support healthy air

*Note: Module 4 contains additional information including: What is a MWEE, how to fund the module, and special timing considerations.*

# What does a typical activity page look like?

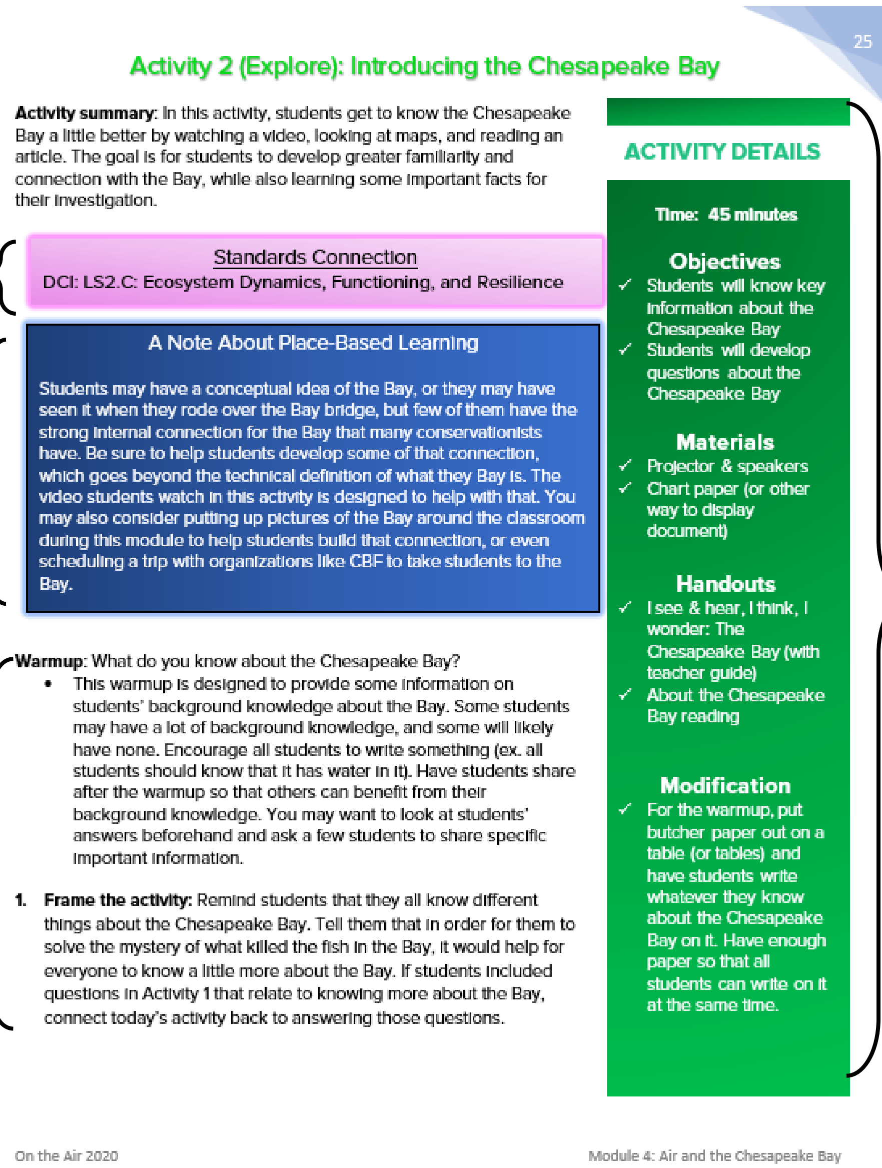
A typical page from On the Air 2020 looks like this:

Activity overview

Activity standards

Blue boxes have important information for teaching the activity successfully

Activity directions are written out in detail and often include images or links to videos



25

## Activity 2 (Explore): Introducing the Chesapeake Bay

**Activity summary**: In this activity, students get to know the Chesapeake Bay a little better by watching a video, looking at maps, and reading an article. The goal is for students to develop greater familiarity and connection with the Bay, while also learning some important facts for their investigation.

Standards Connection
DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience

A Note About Place-Based Learning

Students may have a conceptual idea of the Bay, or they may have seen it when they rode over the Bay bridge, but few of them have the strong internal connection for the Bay that many conservationists have. Be sure to help students develop some of that connection, which goes beyond the technical definition of what they Bay is. The video students watch in this activity is designed to help with that. You may also consider putting up pictures of the Bay around the classroom during this module to help students build that connection, or even scheduling a trip with organizations like CBF to take students to the Bay.

**Warmup**: What do you know about the Chesapeake Bay?

- This warmup is designed to provide some information on students' background knowledge about the Bay. Some students may have a lot of background knowledge, and some will likely have none. Encourage all students to write something (ex. all students should know that it has water in it). Have students share after the warmup so that others can benefit from their background knowledge. You may want to look at students' answers beforehand and ask a few students to share specific important information.

1. **Frame the activity:** Remind students that they all know different things about the Chesapeake Bay. Tell them that in order for them to solve the mystery of what killed the fish in the Bay, it would help for everyone to know a little more about the Bay. If students included questions in Activity 1 that relate to knowing more about the Bay, connect today's activity back to answering those questions.

ACTIVITY DETAILS

Time: 45 minutes

Objectives
- ✓ Students will know key information about the Chesapeake Bay
- ✓ Students will develop questions about the Chesapeake Bay

Materials
- ✓ Projector & speakers
- ✓ Chart paper (or other way to display document)

Handouts
- ✓ I see & hear, I think, I wonder: The Chesapeake Bay (with teacher guide)
- ✓ About the Chesapeake Bay reading

Modification
- ✓ For the warmup, put butcher paper out on a table (or tables) and have students write whatever they know about the Chesapeake Bay on it. Have enough paper so that all students can write on it at the same time.

On the Air 2020 Module 4: Air and the Chesapeake Bay

The sidebar has information about activity, including teacher tips, differentiation, extensions, and additional resources

After the activity directions, student handouts and teacher guides are included at the end of each activity.

# Module Overviews

## Module 1: Our Lungs, Our Air, Our Health

### The Effects of Ozone Pollution on Human Body Systems

Anchor phenomenon: Two students who are having difficulty breathing.

The air we breathe provides us with the oxygen we need to survive, but it can also introduce dangerous and harmful chemicals into our lungs and our bodies. In this module, students will take on the role of medical professionals to investigate the phenomenon of an asthma attack. They will begin by studying the structure and function of the human respiratory system, and how it connects to the circulatory system. They will use this understanding to develop a model of how our bodies get and transfer oxygen to our cells. Then they will investigate the effects of ground-level ozone and its role in exacerbating the effects of asthma. They will also have the opportunity to connect this understanding with a common treatment for asthma. Finally, students will demonstrate what they know by using their models to show how air pollution affects the human body.

## Module 2: What's the Forecast?

### Humans, Weather, and the Story of a Code Red Day

Anchor phenomenon: A hazy day that occurred in Washington D.C. in July, 2018.

This photograph of Earth, commonly known as "The Blue Marble," was taken by the crew of the Apollo 17 spacecraft. When humans first began taking pictures of Earth from space in the 1960s, air and water pollution had already become huge problems in the United States. Photographs like this one, as well as books like Silent Spring by Rachel Carson, inspired people to take action to save the planet. In 1970 the first Earth Day was held and the Clean Air Act was signed. The modern environmental movement was born. Since then, humans have done a lot to both damage and protect the Earth and its air. In this module, students will investigate a "bad air day" to understand the sources and types of man-made air pollution, focusing on ozone, a common contributor to bad air days in the region. They will also learn about weather, and the complex ways in which weather and air pollution interact. In doing so, they will use the same sophisticated computer models that meteorologists use to predict both the weather and air pollution. Students will also take a historical look at how air quality has changed over time, using both the Air Quality Index (AQI) and EPA data as guides. As a culminating activity, students will use what they have learned to create an air quality report to inform the public about whether their air is safe to breathe.

## Module 3: Air Pollution in the Community

### Combustion, Particulate Matter, and Community Health

Anchor phenomenon: Streams of particulate matter emitted from diesel vehicles.

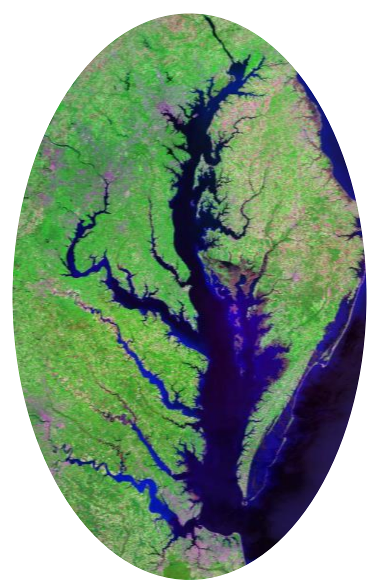
Burning fuel, the chemical process of combustion, has been a part of human civilization since we first started using fire for warmth and cooking. When the Industrial Revolution provided us electricity through widespread use of coal-burning power plants, combustion brought all new benefits, and many serious drawbacks. The advent of cars and trucks driven by internal combustion engines multiplied these effects. Combustion produces particulate matter, a form of air pollution that can have very serious repercussions for human health and the environment. In this module, students will take on the role of concerned community members who fear that their proximity to sources of particulate matter, both from combustion and other processes, is endangering their health. Acting as citizen scientists, they will learn about where particulate matter comes from, and how it affects human health. They will also measure particulate matter in their community. The module culminates in a simulated public meeting before a state committee where students will take on different roles to argue whether or not diesel trucks should be banned from traveling through residential neighborhoods.

## Module 4: Air and the Chesapeake Bay

### Dead Zones, Deposition and Nitrogen Pollution

Anchor phenomenon: Large areas of dead fish floating in the Chesapeake Bay.

The Chesapeake Bay is a natural treasure: it provides innumerable resources and ecosystem services to the living things in its watershed, especially humans. Yet the Bay is also a fragile ecosystem that has been inundated with pollution of all kinds. One of the oft-overlooked sources of pollution to the Bay is air pollution, which contributes a significant amount of nutrient pollution to its waters. In this Meaningful Watershed Educational Experience (MWEE) based module, students start by investigating a fish kill in the Bay, tracing the cause of this phenomenon back to algae blooms and nutrient pollution. Then they continue to work backwards to understand the sources of this nutrient pollution. Along the way they learn about watersheds and airsheds, and collect data on atmospheric deposition. Using this information, they build a model of pollution to the Bay, which they draw upon to create and implement an action plan to combat pollution. As a culmination of their investigation, students present their model and findings to local stakeholders.



# Module 5: Air and Climate Change

## Rising Temperatures, Rising Tides

Anchor phenomenon: A city that is flooding on a sunny day.

In 2006, former Vice President Al Gore went on tour with the new film "An Inconvenient Truth" to educate Americans about the dangers of climate change. Since then, people in this country and around the world have awakened to the new reality of a warming planet and all the consequences that go with it. In this module, students use the phenomenon of rising sea levels and "sunny day flooding" to investigate the causes and effects of climate change including melting polar ice, the greenhouse effect, atmospheric carbon dioxide levels, and burning fossil fuels. By the end of the unit, students will have developed a cause and effect chain that leads from power plants to flooded coastlines. They will also learn how they can fight climate change through individual action, group effort, and building climate resilience into their communities.

# Standards Alignment

The chart below and on the following pages show what middle school standards are taught in each module. Focus standards (F) appear multiple times throughout the module and receive specific instruction. Background standards (B) are utilized less frequently in the module and may not be addressed directly.

For more detailed information about the standards themselves, what aspects of each standard appear in each module, and standards for additional grade levels, see each module's specific standards overview pages.

| | | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|---|
| NGSS Science & Engineering Practices | Developing and Using Models | F | F | | F | |
| | Planning and Carrying Out Investigations | B | | | B | B |
| | Constructing Explanations | B | | B | F | |
| | Obtaining, Evaluating, and Communicating Information | | B | | | |
| | Engaging in Argument from Evidence | | | F | | |
| | Analyzing Data | | | B | | F |
| | Asking Questions & Defining Problems | | | | | B |
| | Using Mathematics & Computational Thinking | | | | | B |
| NGSS Disciplinary Core Ideas | LS 1.A Structure & Function | F | | | | |
| | LS 2.A Independent Relationships in Ecosystems | B | | B | | |
| | LS 2.C Ecosystem Dynamics, Functioning, and Resilience | | | B | F | |
| | ESS 2.D Weather & Climate | | B | | | |
| | ESS 3.D Global Climate Change | | | | | F |
| | ESS 3.C Human Impacts on Earth Systems | | F | F | B | B |
| | ETS 1.B: Developing Possible Solutions | | | B | | |
| NGSS Crosscutting Concepts | Systems and System Models | F | B | | F | |
| | Cause & Effect | B | | F | F | F |
| | Patterns | | F | | | B |
| | Scale, Proportion & Quantity | | | | | |

| NGSS Performance Expectations | | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|---|
| | MS-LS 1-3 The body is a system of interacting subsystems | **F** | | | | |
| | MS-LS 2-3 Cycling of matter and flow of energy in ecosystems | **B** | | | | |
| | MS-LS 2-4 Changes to physical or biological components of an ecosystem affect populations | | | **B** | **F** | |
| | MS-ESS 3-3 Monitor and minimize a human impact on the environment | | **B** | **F** | | **B** |
| | MS-ESS 3-4 Human population and consumption of natural resources impact Earth systems | | **F** | | | **B** |
| | MS-ESS 3-5 Rise in global temperatures | | | | | **F** |

| | | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|---|
| Virginia Standards of Learning Scientific Practices | 6.1 (b) Planning and Carrying Out Investigations | **B** | | | **B** | |
| | 6.1 (c) Interpreting, Analyzing, and Evaluating Data | | | **B** | | |
| | 6.1 (e) Developing and Using Models | **F** | **F** | | **F** | |
| | 6.2 (d) Constructing and Critiquing conclusions and explanations | **B** | | **F** | **F** | |
| | | | | | | |
| | | | | | | |
| Virginia Standards of Learning Science Content | 6.7 Air has properties and Earth's atmosphere has structure and is dynamic | | **B** | | | |
| | 6.8 Land and water have roles in watershed systems | | | | **F (a,c,d)** | |
| | 6.9 Human impact on the environment | **F (c)** | **F (c)** | **F (c,e,f)** | | |
| | Earth Science.6 Resource use is complex | | | | | **B (a)** |
| | Earth Science.11 Atmosphere is a complex, dynamic system | | | | | **F (d)** **B (c)** |
| | Earth Science.12 Earth's weather and climate | | | | | **F (e)** |

| | | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|---|
| Common Core State Standards – Literacy | RST.6-8.3: Follow a multistep procedure when carrying out experiments | ✓ | ✓ | ✓ | ✓ | ✓ |
| | RST.6-8.4: Determine the meaning of symbols, terms, words, and phrases in context | ✓ | | ✓ | | ✓ |
| | RST.6-8.7: Integrate information from a text with visual information | ✓ | ✓ | | ✓ | ✓ |
| | WHST.6-8.1: Write arguments focused on discipline-specific content | ✓ | | ✓ | ✓ | |
| | WHST.6-8.1B: Support claims with logical reasoning, data and evidence | | | ✓ | ✓ | |
| | WHST.6-8.2: Write informative/ explanatory texts | | | | | ✓ |
| | WHST.6-8.9: Draw evidence from informational texts | | | | ✓ | |
| | SL.8.1: Engage in a range of collaborative discussions | ✓ | ✓ | ✓ | ✓ | ✓ |
| | SL.8.4: Present claims and findings | | | ✓ | ✓ | |
| | SL.8.5: Integrate multimedia and visual displays into presentations | | | | ✓ | |
| Common Core State Standards – Math | MP.3: Construct viable arguments and critique the reasoning of others | ✓ | | | | ✓ |
| | 6.RP.A.1: Understand the concept of a ratio and use ratio language | | | | | |
| | 6.RP.A.3: Use ratio and rate reasoning to solve real world and mathematical problems | ✓ | | | | ✓ |
| | 6.SP.B.5: Summarize numerical data sets in relation to their context | ✓ | | ✓ | ✓ | ✓ |
| | 7.RP.A3: Use proportional relationships to solve multistep ratio and percent problems | | ✓ | | | |

# Teaching Strategies

On the Air 2020 *employs* a variety of teaching strategies designed to engage students in meaningful scientific work that promotes higher level thinking and communication skills. Sometimes these strategies are described directly in the activity directions. At other times, teachers are tasked with using generic "discussion strategies" or "questioning strategies" from their own repertoires. Below is a sample of teaching strategies that are recommended for use with On the Air 2020.

## Discussion Strategies

**Science circle (aka Socratic Seminar)**: Have students arrange their chairs into a circle facing one another to hold a group discussion, for example, to discuss and debate the meaning of the results from an experiment. Encourage students to talk to their peers (as opposed to the teacher) and to engage in meaningful debate and dialogue with one another. The teacher's role is to moderate the discussion, and sometimes to ask questions to the group to provoke further discussion. A variation on the science circle is the **fishbowl discussion,** where one group of students sits on the outside of the discussion circle and listens or observes the discussion circle. Then groups then switch roles partway through the discussion.

**Think, pair, share/Turn & Talk**: Give students a question or prompt to consider, and then have them turn to a partner to discuss. This partner talk allows all students to participate in the discussion, as opposed to a whole group discussion where many students listen but do not actively contribute. Think, pair, share and turn & talk discussions are often held before a whole group discussion in order to help students clarify their thoughts and hear a different point of view. These types of conversations especially support students with learning disabilities who may be reluctant to participate actively in whole group discussions.

**Student-led discussion:** Have students engage in a standard whole-group discussion, but have a student lead the discussion instead of the teacher. The student can use common question prompts (ex. "How did you reach that conclusion?", "What evidence do you have to support your claim?" or "Who agrees with what <x> said?"). Alternatively, have the student ask a set of specific questions developed by the student or the teacher in advance. Student-led discussions help promote leadership skills and allow students to learn better questioning techniques of their own. They tend to work best after students have participated in – and analyzed– several discussions led by the teacher.

**Silent discussion:** Give students a prompt to respond to on paper (ex. Do you think that air pollution is getting better or worse over time?). After they have written a short response, have students pass their papers to someone else in the class. The second student responds to the first students' statement as if they were having a discussion. Papers can then get passed back to the first student, or on to a third student to add to the conversation. After several back-and-forth statements, papers are returned to the original writer to read the full discussion. This discussion technique helps to support students' writing skills, and benefits those students who need additional time to develop their thoughts or who prefer a quieter classroom.

**Hand signals**: Students use hand signals during a whole-group discussion to indicate to each other and the teacher when they agree with, disagree with, want to link to, want to build on what another student has said, or for other purposes. This technique helps to build equitable classrooms, and works well in a virtual context.

**Accountable talk stems:** Students use verbal discussion sentence starters to lead safe and respectful conversations with one other. Stems such as, "I agree with…", "I disagree with…", "Can you explain what you mean?" promote meaningful conversations where students feel comfortable sharing without fear of being insulted or intimidated by others. Sentence stems such as, "I heard you say…" and "I like how you…" encourage students to listen to, and paraphrase one other, so conversations build as opposed to jump around.

## Sensemaking Strategies

**Stop & jot:** Students pause to write down thoughts from an activity, observation, or conversation before moving on. Stop and jots can precede a conversation to prepare for talking, or follow a conversation to summarize the discussion.

**Discussion:** Use any of the discussion techniques described above that promote sensemaking.

**Graphic organizers:** Venn diagrams, cause and effect charts, flowcharts, and other graphical representations can support sensemaking by providing a structure to students' thinking.

**Concept mapping**: Have students make their own graphic organizers to show how different concepts are related. These maps can be messy, and often benefit from a few drafts. Concept mapping is often less about the final product and more about the thinking process that goes into creating it.

**Modeling**: Modeling a scientific concept or process can involve making a graphic organizer or other written description that helps to explain a phenomenon. However, models can also be physical objects, drawings, or even kinesthetic movements that help to clarify or

**Analogies and examples:** Have students create analogies to help explain a scientific concept. For example, the way transpiration in plants works is similar to sucking water up a straw. You can also have students think of additional examples that exemplify a particular scientific principle. For example, students who are learning about how solids dissolve in liquids might think about sugar in a glass of iced tea, salt in a pot of boiling water, or marshmallows dissolving into a cup of hot cocoa.

## Questioning Strategies

Effective questioning strategies guide student sensemaking without taking away the heavy cognitive lifting that students must do for higher-level thinking and real learning. Here are some tips for asking strong questions:

- Ask questions that focus students' attention and require them to think. For example, "How does the graph of temperature relate to the graph of carbon dioxide emissions?"
- Ask open-ended questions that allow students to discuss and debate. For example, "Do these data support or refute your original hypothesis? How?"
- Avoid either/or questions that simplify the thinking too much for students. For example, "Does the graph go up or down?" followed by "Does that mean pollution is getting worse or getting better?"
- Ask questions that require students to back up their answers. For example, "What evidence from your research supports that claim?"

Asking good questions only gets you half way to your goal. Here are some tips for what to do after you've asked your questions:

- Provide adequate wait time after asking questions. Students need time to process questions and think of answers. Do not misinterpret silence as students being "lost." Using turn-and-talks or stop-and-jots (see discussion and sensemaking strategies above) after asking a question are good ways to provide additional processing time.
- Avoid answering your own questions when students don't immediately respond. Just as with providing adequate wait time, students need time to process, and if they learn that you will answer for them, they will stop thinking for themselves.
- Use equity sticks or other "cold-calling" techniques to ensure that you don't find yourself always calling on the same students to answer questions.
- Don't give up on a student if they get stuck or don't get an answer "right." You may let them call on a friend or classmate for support, but remember to return to them to see if they have corrected the previous misconception. This not only shows your confidence in their ability to learn, but it also holds them accountable for staying engaged and fixing any errors.

# Rubrics & Feedback Guides

Generic Presentation Rubric

| Project area | Beginning | Needs Improvement | Proficient | Advanced |
|---|---|---|---|---|
| Content | Student's presentation has significant factual inaccuracies and shows limited understanding of the scientific content. | Student's presentation has some factual inaccuracies, and shows some understanding of the scientific content. | Student's presentation is factually accurate, and shows strong understanding of the scientific content. | Student's presentation is factually accurate, and shows detailed and extensive understanding of the scientific content. |
| Completeness | Student's presentation is missing significant required parts. | Student's presentation addresses most required elements. | Student's presentation addresses all required elements, although some may not be fully complete. | Student's presentation addresses all required elements fully. |
| Answering questions (if applicable) | Student cannot answer questions about their presentation or answers incorrectly due to gaps in knowledge. | Student can answer some questions about their presentation, but struggles to answer others correctly because of gaps in their knowledge. | Student is able to answer questions about their presentation by drawing upon knowledge from the module, although they may have some gaps in their knowledge. | Student is able to fully answer questions about their presentation by drawing upon knowledge from the module |
| Craftsmanship | Student's presentation has numerous grammatical errors, and is not delivered smoothly. | Student's presentation has some grammatical errors, and may not be delivered smoothly. | Student's presentation is well-designed, with few grammatical errors. Their presentation may not be delivered smoothly. | Student's presentation is very well designed, with few or no grammatical errors. Their presentation is delivered smoothly and comfortably. |

Generic Modeling Rubric

| Project area | Beginning | Needs Improvement | Proficient | Advanced |
|---|---|---|---|---|
| Content | Student's model has significant scientific inaccuracies in depicting relationships or concepts which are not support by (or contrary to) evidence. The model will likely lead to inaccurate explanations or predictions of the phenomenon or modeling scenario. | Student's model has some scientific inaccuracies in depicting relationships or concepts which are not supported by evidence. The model may lead to inaccurate explanations or predictions of the phenomenon or modeling scenario. | Student's model is mostly scientifically accurate, and shows relationships and concepts based on evidence that can be used to explain the phenomenon or modeling scenario and can be used to make reasonable predictions. | Student's model is scientifically accurate, and shows relationships and concepts based on evidence that can be used to explain the phenomenon or modeling scenario and can be used to make reasonable predictions. |
| Completeness | Student's model has minimal components that are used to describe the phenomenon or modeling scenario. | Student's model is missing important components that are necessary to describe the phenomenon or modeling scenario | Student's model describes most aspects of the complexity and interconnectedness of the different elements that influence the phenomenon or modeling scenario. | Student's model fully describes the complexity and interconnectedness of the different elements that influence the phenomenon or modeling scenario. |
| Craftsmanship | Student's model is disorganized in a way that prevents others from understanding and interpreting the contents of the model. Errors in spelling in grammar (if present) make the model difficult to understand. | Student's model may be somewhat disorganized in a way that makes it difficult for others to understand and interpret the content of the model. Errors in spelling and grammar (if present) may prevent understanding. | Student's model is organized in a way that it is not difficult for others to understand and interpret the content of the model. Spelling and grammar (if present) are mostly correct. | Student's model is well organized in a way that allows others to easily understand and interpret the content of the model. Spelling and grammar (if present) are correct. |

Generic peer feedback form

Feedback from: ______________________________ to ______________________________

Feedback should be **specific**: what about your partner's work is good or needs improvement?

Feedback should be **helpful**: what suggestion can you make for improvement?

Feedback should be **kind**: use positive and supportive language

| **Feedback area** | **Glows**<br>What was good? | **Grows**<br>What are areas for improvement? |
|---|---|---|
| **Content**<br>Is the information correct and complete? | | |
| **Clarity**<br>Can you understand what they are trying to communicate? | | |
| **Craftsmanship**<br>Is the project, presentation, or writing well-made with correct spelling and grammar? | | |

What questions do you have? ______________________________

# Differentiation Guide

On the Air 2020 *includes* a variety of differentiation strategies to support learners who have learning disabilities or who struggle with the content for any number of reasons. The strategies below include some of the techniques you will find embedded in the activities themselves, as well as a few additional ideas. Many of these strategies support students of all kinds, regardless of their ability level.

**Word banks and vocabulary lists:** Word banks and vocabulary lists are helpful whenever students are first learning new vocabulary, but are expected to use that vocabulary as a part of an additional task. For example, if students are expected to build a concept map to summarize their learning from an activity, provide a word list or – better yet – slips of paper with the vocabulary words printed on them for students to arrange into the concept map. This will allow students to engage in the sensemaking task without getting held up by the vocabulary.

**Sentence starters:** Provide the first few words of a sentence to get students started on the right track when they are writing. These can be especially helpful when students are learning to write Claim-Evidence-Reasoning (CER) arguments so they develop strong habits for these structures.

**Small group instruction:** When students are assigned a task, pull any students that are struggling into a small group to go over directions or provide additional support. You can also do this in reverse at the end of a mini-lesson. Tell students that they can leave the mini-lesson to begin working independently when they are ready, but to stay and continue for additional instruction if necessary. This can help to alleviate any perceived stigma from being in the "low group."

**Provide choices:** When students are expected to show what they have learned through a project or presentation, give them choices for how to do it. Some students may prefer to make a poster, while others would rather give a presentation or record a video. Give students the opportunity to showcase their talents and play to their strengths.

**Use reading strategies:** Many of the readings in On the Air 2020 are in double-entry journal format to support reading comprehension. For other texts, provide strategies and protocols that will help enhance student understanding. For example, have students underline key ideas in a reading and put a question mark by anything they don't understand, or use a graphic organizer to help students organize their thoughts.

**Use extensions to challenge advanced students:** On the Air 2020 has a variety of built-in extensions for students who finish individual assignments quickly or who would benefit from more challenging work. Rather than make work "harder," provide additional opportunities for students to dig deeper into content, explore related topics of their own interest that will enhance their understanding of the core content, or that will push them to consider more complex viewpoints.

# Accessibility Guide

Making science learning equitable for all students is a key component of NGSS-aligned instruction. It is also a part of being an ethical educator. As with differentiation strategies, many of the strategies described below benefit all students, not just those who need the support. Below are some techniques for making sure your instruction is equitable for all the students in your classroom:

**Supports for non-native English speakers**

- Put up new vocabulary words on word walls and take time to repeat pronunciations and definitions
- Make dictionaries available for students to look up vocabulary words in their native languages. Google translate and other online tools can support this as well. Encourage students to bring in and use other resources they have that can provide assistance
- Teach prefixes, suffixes, and other root word techniques to help students understand where the meaning of specific vocabulary words comes from
- Speak slowly and provide additional processing time for students to understand questions

**Supports for students who are new to the area or to the country**

- Consider students' diverse cultural backgrounds and experiences when selecting examples or choosing phenomena. Students who grew up in one part of the country can relate well to snowstorms or wildfires, while these phenomena can be totally foreign to others.
- Ask students to share their experiences to enhance the sensemaking process. It is not necessary for the teacher to know everything about where a student comes from, but it is essential to invite students to share their experience.

**Supports for students with physical disabilities**

- Use technology where possible to support students with physical disabilities that may make it difficult to participate in certain activities. For example, have readings available on a computer or tablet so that the font can be enlarged. Allow students who have difficulty writing to use a computer to answer questions. Turn closed-captioning on in videos for students who are deaf or hard of hearing.
- To support colorblind students, print handouts in high contrast. If students are looking at graphs, charts, or maps that rely on interpreting colors, be sure to point out what parts of the visual are particular colors and/or pair the student with an understanding partner who can provide assistance.
- To support blind or vision-impaired students, provide verbal descriptions of videos or other media that are essential to activities. Make sure that written materials are available in a digital format so that technology can be used for assistance.

Universal Design for Learning (UDL) has additional guidelines and materials for making learning accessible to all. You can find UDL resources here: http://udlguidelines.cast.org/

# About Clean Air Partners

Clean Air Partners is a non-profit (501-c3), public-private partnership educating individuals, businesses, and organizations in the greater metropolitan Baltimore-Washington region about health risks associated with poor air quality and the impacts on our environment.

## History

For more than 20 years, Clean Air Partners has empowered individuals and organizations to take simple actions to reduce pollution and protect public health. The organization originally started as a joint task force to meet the federal standards under the Clean Air Act. In 1997, a public-private partnership was formed through its founding partners, the Metropolitan Washington Council of Government and the Baltimore Metropolitan Council, officially establishing Clean Air Partners as the local air quality experts in the metropolitan Baltimore-Washington region. Clean Air Partners is administered by the Metropolitan Washington Council of Governments.

## Our Team

Consisting of staff, a 31-person Board, and member organizations, Clean Air Partners' team is led by air quality, environmental, and transportation experts on behalf of local businesses and corporations, advocacy and community groups, and government organizations from across the greater metropolitan Baltimore-Washington region.

To learn more about Clean Air Partners and the work the organization does to support clean air throughout the Metropolitan Washington region, visit www.cleanairpartners.net