

# Endeavor

STEM Teaching Certificate Project



*Investigating the Atmosphere and Weather Patterns*

*Grade(s): 8th*

*Lesson Duration: Class 2 classes (50 minutes each)*

*Course Name(s): Earth Science*

*Lesson Author: Nashville, TN*

## BIG IDEAS

The big ideas for this lesson include understanding how air masses and their interactions shape weather conditions, recognizing the influence of atmospheric layers on climate and weather patterns, and exploring how satellite data is utilized to predict and track weather phenomena. These concepts provide students with a foundational understanding of the key factors that drive weather and climate systems.

## EDUCATION STANDARDS

**Tennessee Science Standards (6.ESS2.5):** Analyze and interpret data to describe how air masses flow from regions of high pressure to low pressure, affecting weather conditions.

**Mathematics (CCSS.MATH.CONTENT.6.SP.B.5):** Summarize numerical data sets, such as temperature and pressure changes over time, to identify patterns in weather conditions.

**Tennessee Science Standards (8.ESS3.1):** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

**Mathematics (CCSS.MATH.CONTENT.7.RP.A.2):** Recognize and represent proportional relationships when analyzing satellite data, such as comparing wind speeds or precipitation levels across regions.

**ELA/Literacy (CCSS.ELA-LITERACY.WHST.6-8.9):** Draw evidence from informational texts, such as satellite data summaries or weather reports, to support analysis and reflection on weather prediction methods.

**Tennessee Science Standards (8.ESS2.4):** Develop a model to describe the cycling of water through Earth's systems, including the role of atmospheric layers in regulating weather and climate.

**ELA/Literacy (CCSS.ELA-LITERACY.RST.6-8.7):** Integrate quantitative or technical information expressed in words in a text with visual representations (e.g., diagrams, graphs, or maps) of atmospheric layers and their effects on weather.

Science Performance Expectations (or state Science standard): *(List the PEs here, and then list the associated NGSS elements in the table below.)*

| Science and Engineering Practices:<br><i>(SEP elements connected to the PEs or standards)</i>  | Disciplinary Core Ideas:<br><i>(DCI elements connected to the PEs or standards)</i>  | Crosscutting Concepts:<br><i>(CC elements connected to the PEs or standards)</i>   |
|--|--|--|
| <p><b>Analyzing and interpreting data:</b> Students will analyze NASA satellite data to understand air mass movements and weather patterns.</p> <p><b>Developing and using models:</b> Creating models to simulate air mass interactions.</p> <p><b>Engaging in argument from evidence:</b> Discussing how air mass interactions lead to different weather phenomena.</p>  | <p><b>ESS2.D:</b> Weather and climate—students learn how interactions between the atmosphere, hydrosphere, and geosphere create weather patterns.</p> <p><b>PS3.B:</b> Conservation of energy and energy transfer—students will explore how energy moves within the atmosphere to drive weather changes.</p> | <p><b>Cause and effect:</b> How changes in atmospheric conditions cause different weather events.</p> <p><b>Systems and system models:</b> Understanding the atmosphere as a system where air masses interact and affect weather patterns.</p> <p><b>Patterns:</b> Identifying patterns in weather systems through satellite data.</p> |
| <p><b>Common Core State Standards:</b></p> <p><b>Math: Mathematics (CCSS.MATH.CONTENT.7.RP.A.2): Mathematics (CCSS.MATH.CONTENT.6.SP.B.5):</b></p> <p>and/or</p> <p><b>ELA: (CCSS.ELA-LITERACY.RST.6-8.7): (CCSS.ELA-LITERACY.WHST.6-8.9)</b></p> <p><b>State Math or ELA Standards: Tennessee Science Standards (8.ESS2.4): Tennessee Science Standards (8.ESS3.1): Tennessee Science Standards (6.ESS2.5):</b></p> |  |  |
| <p>ITEEA Standards: <i>If applicable</i></p>   |  |  |
| <p>Other Standards: <i>(as needed)</i></p>   |  |  |

## MEASURABLE STUDENT LEARNING OBJECTIVES

- Students will analyze and interpret satellite data to identify patterns in air mass movements and their

effects on specific weather conditions, such as storms or temperature changes.

- Students will construct a simple physical or digital model to simulate how air masses interact to produce observable weather phenomena, such as fronts or precipitation.
- Students will describe the role of specific atmospheric layers (e.g., troposphere and stratosphere) in influencing weather events, supported by examples.
- Students will research and present a case study on a specific weather event (e.g., a hurricane or cold front), explaining the atmosphere's role in its development and impact.

## MATERIALS NEEDED

- NASA satellite data (GPM, EOSDIS)
- Clear containers, hot/cold water, food coloring (for air mass simulation)
- Computers or tablets for research
- PowerPoint or poster board for presentations
- NASA Gold missing data and atmosphere-related resources from [Space Place](#)

## ENGAGING CONTEXT/PHENOMENON

The lesson begins by engaging students with real-world images and data from a recent extreme weather event, such as a hurricane or tornado. The phenomenon of rapidly changing weather conditions is introduced, drawing attention to how air masses interact to cause these events..

## DATA INTEGRATION

NASA Global Precipitation Measurement (GPM) data will be used to visualize air mass movements.

NASA GOLD Mission data and A-Train Satellites will be used to show atmospheric layer interactions.

Real-time satellite data will be analyzed in the Explain and Elaborate phases, providing students with authentic data to support their learning..

## TEACHER BACKGROUND KNOWLEDGE

Teachers should be familiar with:

- Basic concepts of meteorology, including air masses, pressure systems, and weather fronts.
- How to access and interpret NASA satellite data from resources such as GPM and the A-Train Satellites.
- The layers of the atmosphere and their role in weather and climate patterns.

## DIFFERENTIATION OF INSTRUCTION

Advanced learners can analyze more complex weather phenomena, such as hurricanes, and predict their development using satellite data.

Students needing support will work with simplified data and simulations, focusing on core concepts like basic air mass interaction.

ELL students will be provided with visual aids and simplified language to ensure understanding.

## REAL-WORLD CONNECTIONS FOR STUDENTS

Students will see the connection between the content and their everyday lives by

tracking real-time weather systems and making predictions about upcoming local weather. They will understand how meteorologists use satellite data to predict weather and keep people safe.

## POSSIBLE PRIOR or MISCONCEPTIONS

**Weather changes randomly:** Students may think weather changes are random, not caused by the interaction of air masses.

**Air masses are just air:** Students may not realize that air masses differ in temperature, humidity, and pressure, influencing weather patterns.

**Weather only happens at ground level:** Students may not understand how atmospheric layers impact weather phenomena.

## LESSON PROCEDURE

*This is where you include each phase of the 5E. They should be extremely clear, well organized, and ready to be used by another educator. Be sure that each learning experience meets the guidelines for each "E". The template below will help you.*

| 5E   | <b>Details of 5E Lesson Implementation</b><br><i>(Visit <a href="#">BSCS</a> to learn more about the 5E instructional model)</i>  |
|--|---|
| <p><b>Engage</b></p> <p>*Begin the lesson by showing a video of the 2020 <i>Derecho</i> in Iowa, a weather phenomenon characterized by hurricane-force winds caused by rapidly moving air masses.</p> <p>*Video Resource: <a href="#">NASA Earth Observatory</a>.</p> <p>*Pose discussion questions to the class:</p> <p>^ <i>What could cause such intense winds across a large area?</i></p> <p>^ <i>How might</i></p> | <p><b>Lesson Objective</b> Introduce students to the phenomenon of changing weather patterns using satellite images and real-world weather events.</p> <p><b>Standards Addressed MS-ESS2-5:</b> Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.</p> <p><b>Materials &amp; Resources</b> Video of the Derecho: <a href="#">NASA Earth Observatory</a></p> <p><b>Procedure:</b></p> <p>    Show the video and pause at key moments to encourage student observations.</p> <p>    Facilitate a brief discussion, ensuring students connect what they see in the video to prior knowledge about weather patterns (if applicable).</p> <p>    Use guided questioning to prompt students to hypothesize the role of air masses and atmospheric layers in creating such a severe weather event..</p> <p><b>Formative/Summative Assessments</b></p> <p>    <b>Observations:</b> Monitor student participation during the discussion to assess their ability to make connections between air mass movements and weather phenomena.</p> <p>    <b>Quick Write:</b> After the discussion, have students jot down a response to the question: <i>What do you think caused the Derecho, and how do you think atmospheric layers and air masses contributed?</i></p> <p><b>Modifications</b></p> |

|  |  |
|--|--|
| <p><i>warm and cold air masses interact to create this event?</i></p> <p><i>^What role might atmospheric layers play in this phenomenon?</i></p> <p>*Display satellite imagery from NASA or NOAA illustrating the air mass movements during the <i>Derecho</i>. Use a digital tool, such as Google Earth or My NASA Data, to highlight regions of air mass collisions and pressure differences.</p> <p>*Introduce the concept of air masses and their role in shaping weather conditions, connecting it to the upcoming lesson objectives.</p> | <p><b>For Visual Learners:</b> Include annotated satellite imagery with labels for air masses, temperature zones, and wind patterns to support comprehension.</p> <p><b>For ELL Students:</b> Provide key vocabulary (e.g., air masses, atmosphere, wind patterns) with definitions and visuals before the discussion.</p>                           |
| <p><b>Explore</b><br/>Conduct hands-on simulations to explore air mass interactions.<br/>Students record observations and compare</p>  | <p><b>Lesson Objective</b><br/>Students explore the interaction of air masses through hands-on simulations to observe the creation of weather conditions.</p> <p><b>Standards Addressed</b><br/><b>MS-ESS2-5:</b> Focus on data collection and observation of interactions between different air masses.</p> <p><b>Materials &amp; Resources</b></p> |

| <p>findings..</p>  | <ul style="list-style-type: none"> <li>□ Clear containers, warm/cold water, food coloring, thermometers</li> <li>□ NASA GOLD Mission: <a href="#">Link</a></li> </ul> <p><b>Procedure:</b><br/>In groups, students simulate air mass interactions using hot/cold water and food coloring.<br/>Record observations of how air masses interact and form weather conditions.</p> <p><b>Formative/Summative Assessments</b><br/>Observation logs where students record what they see in their simulations.</p> <p><b>Modifications</b><br/>For students who struggle with fine motor tasks, assign roles that accommodate their abilities (e.g., recorder).<br/>Advanced students can be given more complex materials, such as different temperature gradients.</p>   |             |         |                             |  |                              |  |                              |  |
|--|---|-------------|---------|-----------------------------|--|------------------------------|--|------------------------------|--|
| <p><b>Explain</b><br/>Facilitate a class discussion where students share their observations from the satellite data. Introduce the concept of atmospheric layers, focusing on the troposphere and stratosphere, and explain their roles in influencing weather. Use a visual model or diagram to show how air masses interact within these layers.</p> | <p><b>Lesson Objective</b><br/>Students will analyze and interpret satellite data to identify patterns in air mass movements and their effects on specific weather conditions, such as storms or temperature changes.<br/>Students will construct a simple physical or digital model to simulate how air masses interact to produce observable weather phenomena, such as fronts or precipitation.</p> <p><b>Standards Addressed</b><br/><b>MS-ESS2-5:</b> Understanding how air masses affect weather systems.</p> <p><b>Materials &amp; Resources</b></p> <p><b>Part 1: Observing Air Mass Movements</b></p> <ol style="list-style-type: none"> <li>Examine the satellite images and maps provided to your group. Use the guiding questions below to help you analyze the data: <ul style="list-style-type: none"> <li>What patterns do you notice in the movement of air masses?</li> <li>Where do warm air masses meet cold air masses?</li> <li>Are there areas where these interactions might cause precipitation or storms?</li> </ul> </li> <li>Use colored pencils or markers to annotate your map: <ul style="list-style-type: none"> <li>Draw <b>blue arrows</b> to show the direction of cold air mass movement.</li> <li>Draw <b>red arrows</b> to show the direction of warm air mass movement.</li> <li>Circle areas where air masses collide and label them as potential "fronts."</li> </ul> </li> </ol> <p><b>Part 2: Recording Observations</b></p> <p>Fill in the table based on your analysis:</p> <table border="1" data-bbox="443 1608 1013 1717"> <thead> <tr> <th>Observation</th> <th>Details</th> </tr> </thead> <tbody> <tr> <td>Areas of air mass collision</td> <td></td> </tr> <tr> <td>Predicted weather conditions</td> <td></td> </tr> <tr> <td>Additional patterns observed</td> <td></td> </tr> </tbody> </table> <p>Satellite imagery of air mass movements (e.g., NASA’s My NASA Data or NOAA resources)<br/>Digital tools for graphing or modeling (e.g., Google Earth, Scratch, or Excel)<br/>Printable weather maps with air mass boundaries</p> | Observation | Details | Areas of air mass collision |  | Predicted weather conditions |  | Additional patterns observed |  |
| Observation  | Details   |             |         |                             |  |                              |  |                              |  |
| Areas of air mass collision  |   |             |         |                             |  |                              |  |                              |  |
| Predicted weather conditions   |   |             |         |                             |  |                              |  |                              |  |
| Additional patterns observed   |   |             |         |                             |  |                              |  |                              |  |

|   |  |
|---|--|
|   | <p>Colored pencils or markers for annotations<br/>Student observation sheet (to record findings and patterns)</p> <p><b>Procedure:</b></p> <p><b>Introduce Satellite Data:</b> Provide students with satellite imagery and maps that show recent air mass movements. Explain how to interpret these visuals, focusing on warm and cold air masses and their interactions.</p> <p><b>Group Work:</b> Divide students into small groups and provide each group with a set of maps or digital data.</p> <ul style="list-style-type: none"> <li>• Task: Analyze the data and identify patterns in air mass movement (e.g., areas of collision or fronts).</li> <li>• Students will annotate their maps with arrows indicating air mass movement and highlight regions where interactions may lead to weather changes, such as precipitation or storms.</li> </ul> <p><b>Record Observations:</b> Students will complete an observation sheet detailing their findings, including identified patterns and predicted weather conditions.</p> <p><b>Share and Discuss:</b> Groups will present their findings to the class, focusing on how air mass interactions lead to specific weather phenomena.</p> <p><b>Formative/Summative Assessments</b></p> <p><b>Observation Sheets:</b> Review student responses to check for accurate identification of air mass movements and weather predictions.</p> <p><b>Modifications</b></p> <p><b>For Visual Learners:</b> Provide annotated examples of air mass maps as a reference.</p> <p><b>For ELL Students:</b> Use visuals and labeled diagrams to support understanding of terms like "warm air mass," "cold air mass," and "fronts."</p> |
| <p><b>Elaborate</b></p> <p>Students will construct a model to simulate air mass interactions. This can be a physical model using colored water to represent warm and cold air masses or a digital simulation using tools like</p> | <p><b>Lesson Objective</b></p> <p>Students will construct a simple physical or digital model to simulate how air masses interact to produce observable weather phenomena, such as fronts or precipitation.</p> <p>Students will research and present a case study on a specific weather event (e.g., a hurricane or cold front), explaining the atmosphere's role in its development and impact.</p> <p><b>Standards Addressed</b></p> <p>MS-ESS2-5: Analyze and interpret data to describe how air masses flow from regions of high pressure to low pressure, affecting weather conditions.</p> <p>MS-ESS3-1: Construct a scientific explanation for how the uneven distribution of Earth's energy and resources drives weather phenomena.</p>  |

Scratch or Google Earth Engine.

### **Common Core Math Standards:**

- CCSS.MATH.CONTENT.6.SP.B.5: Summarize numerical data sets in relation to the weather event being studied.
- CCSS.MATH.CONTENT.7.RP.A.2: Recognize and represent proportional relationships between quantities, such as temperature changes and wind speed.

### **Materials & Resources**

□ Colored water (blue for cold air, red for warm air) and clear plastic containers for physical modeling.

Access to digital tools such as Google Earth, Scratch, or NASA's My NASA Data for digital modeling.

Case study resources on weather events (e.g., NOAA or NASA websites).

Student observation sheets (for data collection during modeling).

Large poster paper or digital slides for presentations.

### **Procedure:**

#### **1. Model Construction:**

- o **Physical Model:** Students will create a simple model using containers of colored water to represent warm and cold air masses. When the two water masses meet, they will observe how the warm water rises and the cold water sinks, mimicking atmospheric interactions.
- o **Digital Model:** Alternatively, students can use a coding platform like Scratch to simulate air mass interactions, visualizing the formation of a cold or warm front.

#### **2. Case Study Research:**

- o Students will work in small groups to research a specific weather event (e.g., Hurricane Katrina, a recent tornado, or a polar vortex).
- o Groups will collect data on the role of air mass movements and atmospheric layers in the event, using provided resources like NASA or NOAA datasets.

#### **3. Prepare Presentations:**

- o Each group will create a short presentation (poster or slide deck) summarizing their findings. Presentations should include:
  - An explanation of their model.
  - A description of the chosen weather event and the atmosphere's role in it.
  - Visuals such as graphs, diagrams, or annotated maps.

|   |  |
|---|--|
|   | <p><b>Formative/Summative Assessments</b></p> <p><b>Summative Assessments:</b></p> <ul style="list-style-type: none"> <li>• Evaluate group presentations using a rubric that assesses: <ul style="list-style-type: none"> <li>o Accuracy and depth of scientific explanation.</li> <li>o Clarity and creativity of the model (physical or digital).</li> <li>o Relevance and quality of visuals and data presented.</li> </ul> </li> </ul> <p><b>Modifications</b></p> <p><b>For Visual Learners:</b> Provide examples of completed models and visuals to guide their construction process.</p> <p><b>For ELL Students:</b> Use labeled diagrams and sentence starters to support their explanations during research and presentations.</p>  |
| <p><b>Evaluate</b><br/>Students will present their weather event case studies to the class, using data and visuals to explain how air mass movements and atmospheric layers contributed to the event.</p> | <p><b>Lesson Objective</b><br/>Students will analyze and interpret satellite data to identify patterns in air mass movements and their effects on specific weather conditions, such as storms or temperature changes.</p> <p><b>Standards Addressed</b></p> <p><b>Tennessee State Science Standards:</b></p> <ul style="list-style-type: none"> <li>• MS-ESS2-5: Analyze and interpret data to describe how air masses flow from regions of high pressure to low pressure, affecting weather conditions.</li> <li>• MS-ESS3-1: Construct a scientific explanation for how the uneven distribution of Earth’s energy and resources drives weather phenomena</li> </ul> <p><b>Materials &amp; Resources</b><br/>Group-created models (physical or digital).<br/>Case study presentations (posters, slides, or other formats).<br/>Presentation rubric for assessment.<br/>Student reflection sheets for self-assessment and peer feedback.</p> <p><b>Procedure:</b></p> <p><b>Group Presentations:</b></p> <ul style="list-style-type: none"> <li>• Each group will present their weather event case study, including: <ul style="list-style-type: none"> <li>o A demonstration or explanation of their physical or digital model.</li> <li>o An overview of the chosen weather event and its connection to air mass interactions and atmospheric layers.</li> <li>o Visuals, such as annotated satellite imagery or graphs, to</li> </ul> </li> </ul> |

support their findings.

**Class Discussion and Feedback:**

- After each presentation, peers will ask questions or provide constructive feedback.
- Facilitate a brief class discussion to highlight key takeaways, ensuring connections between the models, weather events, and lesson objectives.

**Individual Reflection:**

- Students will complete a reflection sheet to assess their learning, answering questions such as:
  - o What did I learn about air masses and their role in weather phenomena?
  - o How does the atmosphere contribute to these events?
  - o What connections can I make between the science concepts and real-world weather?

**Formative/Summative Assessments**

Reflection sheets: Review individual reflections to identify areas of understanding and areas needing reinforcement.

**Modifications**

**For Visual Learners:** Provide visual prompts and sentence frames to support presentations.

**For ELL Students:** Allow for written explanations or visual aids (e.g., labeled diagrams) in place of verbal explanations if needed.

## REFERENCES

NASA Global Precipitation Measurement (GPM) Mission. (n.d.). Retrieved from <https://gpm.nasa.gov/>

Earth Observing System Data and Information System (EOSDIS). (n.d.). Retrieved from <https://earthdata.nasa.gov/>

NASA GOLD Mission. (n.d.). Retrieved from <https://science.nasa.gov/mission/gold>

NASA Space Place - Atmosphere. (n.d.). Retrieved from <https://spaceplace.nasa.gov/menu/atmosphere/>

