

# Exemplar Pack: STEM Instructional Activities

## Aeronautics: Weather at NYC Center for Space Science Education

### 6th Grade Weather

#### Overview

In the 6th Grade Weather unit, students learn how matter and energy interact to produce weather patterns. This Exemplar Pack builds upon and extends a NYC Center for Space Science Education (NYCCSSE) Aeronautics class trip experience through a case study on how weather patterns affect flight. This exemplar pack integrates the New York State Science content standards and Common Core Learning Standards (CCLS) for an integrated model of science investigation and literacy instructional shifts compiled to support current content units. The texts work together with hands-on science activities to build knowledge, create opportunities for deeper inquiry and understanding around specific areas of the NYC Science Scope & Sequence and provide opportunities for close reading of complex texts. The collections are best used in conjunction with other instructional practices. They are not designed to comprehensively cover the unit of study, but rather to support and enhance it while building students' ability to read and write proficiently in content areas.

**Each classroom set, available for purchase from American Reading Company, contains a teacher guide and student booklets that include:**

- A sample unit map locating the texts, activities and task in this resource within the NYC unit
- Integrated hands-on science activities
- Texts with the corresponding Lexile levels and qualitative analyses
- Representative text-dependent questions for each text
- Vocabulary activities to reinforce concepts and build student word bank related to these concepts
- A culminating STEM task that is CCLS-aligned
- A CCLS Close Reading Focus and Thinking Map

On the following sample pages, you will find:

- Task Overview
- Texts Overview and Suggested Activities
- Sample Weather Unit Map
- Unit Standards and Practices

# Task Overview

## Aeronautics: Weather at NYC Center for Space Science Education

In the 6th Grade Weather unit, students learn how matter and energy interact to produce weather patterns.

This Exemplar Pack is a case study specifically on how weather patterns affect flight.

### Exemplar Pack Focus Questions

How is flight safety dependent on weather?

- *What is air pressure and why does it matter?*
- *How do air pressure and other weather conditions impact flight?*

Although this resource covers many concepts necessary in understanding weather and weather patterns, the performance task itself focuses on an understanding of air pressure, a concept that is complex and counterintuitive, and its connection with lift and airplane flight. Students will be given time to investigate the concept itself in connection with weather patterns through hands-on activities and then be asked to apply it in a more challenging way at NYCCSSE via the engineering design process.

In your classroom, students will investigate air pressure, build their own barometer, and collect weather data while reading about our atmosphere and air pressure. Then, during a class trip to the NYCCSSE, students apply what they know about air pressure to the concept of flight through hands-on investigations and a flight simulation. Finally, students complete a performance task demonstrating what they have learned by writing a test report—an engineer’s version of a lab report.

Standards Assessed:

- CCLS RST.6-8.9
- CCLS WST.6-8.4
- CCLS WST.6-8.2
- CCLS WST.6-8.9

At NYCCSSE, students will work through a series of activities that include:

- *Principles of Lift:* Students work through a computer program to learn the basics of Bernoulli’s Principle and what lift is.
- *Principles of Control:* Students learn the terms for the control surfaces of a plane (rudder, aileron, elevator) and for the rotational motions (yaw, roll, pitch). Once they know the terms, students conduct experiments with foam planes to determine which control surface affects rotational motion.
- At the wind tunnel, students collect data to determine how angle of attack affects lift. They collect data to use for their test report.
- *Airport Weather Conditions:* Students look up the current weather at different NASA Center locations to plan a cross-country flight.
- Finally, at the flight simulators, students will apply what they learned in *Principles of Control* to fly a plane around NYC.

# Texts Overview

The texts included in this pack have been carefully selected for both text complexity and science content, and work in concert with the hands-on science experiences to enrich students' grasp of the unit concepts and their relevance to the world around them.

Included with each text is:

- A three-part Text Complexity Analysis
- Suggested text-dependent questions
- Suggested scaffolds for students who may struggle with the text/questions/task

## Three-Part Model of Text Complexity

The Common Core Standards introduce a three-part model for measuring text complexity.

### Qualitative Measures

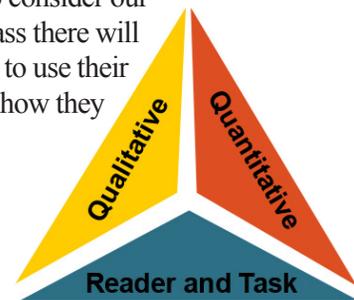
The qualitative measures of text complexity require an informed judgment on the difficulty by considering a range of factors. The Standards use purpose or levels of meaning, structure, language conventionality and clarity, and the knowledge demands as measures of text difficulty.

### Quantitative Measures

Quantitative measures of text complexity use factors such as sentence and word length and frequency of unfamiliar words to calculate the difficulty of the text and assign a single measure (grade level equivalent, number, Lexile, etc.). There are many formulas for calculating text difficulty and, while they provide a guide, the readability or difficulty level of a text can vary depending on which formulas or measures are used.

### Reader and Task

The third measure looks at what the student brings to the text and the tasks assigned. The Common Core's definition of text complexity encourages educators to consider our students and how we are expecting them to interact with the text. In any class there will be a range in the students' ability to read complex texts. Teachers will need to use their professional judgment when making decisions about what texts to use and how they should be used.



## Discipline-Specific Vocabulary

Vocabulary is one of the strongest indicators of how well students will learn subject area content when they come to school. Teaching science terms in a specific way is one of the strongest actions a teacher can take to ensure that students have the academic background knowledge they need to understand the science content they will encounter in school.

## Exemplar Pack Texts and Suggested Activities

Text or Activity	Purpose
<p><i>What Is Weather?</i></p>	<p>Explain the relationship between the sun, air, and weather.</p> <p>Introduce the concepts of air masses and cold and warm fronts.</p>
<p>Investigation: Push-Pull: A Moment in Science History</p> 	<p>Explore the impact of air pressure on water levels and use this information to develop a definition of air pressure.</p>
<p>Investigation: Make Your Own Barometer</p> 	<p>Create a barometer and use it to collect air pressure data.</p>
<p><i>Air on the Move</i></p>	<p>Explain air pressure, its relationship to air movement, and how air pressure varies throughout the layers of the atmosphere.</p>
<p><i>Great Day for a Picnic</i></p>	<p>Use air pressure to predict weather conditions.</p>
<p><i>Frontal Systems and Microbursts</i></p>	<p>Understand frontal systems and their associated weather conditions.</p> <p>Define and describe microbursts.</p>
<p><i>How Does the Weather Affect Flying?</i></p>	<p>Explain the relationship between weather and flying. Understand what factors a pilot must consider prior to taking flight.</p>
<p><i>What Is Air?</i></p>	<p>Understand how a plane becomes airborne. Explain how a pilot controls a plane.</p>
<p>Investigation: Wind Tunnel Test Report</p> 	<p>Perform a wind tunnel investigation on air pressure and lift and write a test report on the results.</p>
<p><i>Flight Testing</i></p>	<p>Mentor text for purpose of a test report.</p>

# Sample Weather Unit Map

**Essential Question: How do matter and energy interact to produce weather patterns?**

Week	Content Understandings	NYCCSSE <i>Aeronautics: Weather</i> program extension
1	<p><b>States of Matter</b></p> <ul style="list-style-type: none"> <li>• Matter is anything that takes up space and has mass.</li> <li>• The three states are solids, liquids, and gases.</li> <li>• The three states of matter relate to the arrangement of particles within them.</li> </ul>	
1	<p><b>Density</b></p> <ul style="list-style-type: none"> <li>• Density is the ratio of a mass to its volume.</li> <li>• If two solutions have equal volumes but differ in mass, the one with the greater mass is denser.</li> <li>• As matter heats up, it expands, causing the matter to become less dense.</li> </ul>	
2	<p><b>Energy</b></p> <ul style="list-style-type: none"> <li>• The sun is the major source of energy that heats the atmosphere.</li> <li>• Heat is kinetic energy of atoms and molecules.</li> <li>• Temperature is related to kinetic energy.</li> <li>• Thermometers measure the temperature of materials.</li> <li>• Energy moves from one material to another by radiation and conduction.</li> <li>• Thermal energy and heat have several differences.</li> <li>• Changes in thermal energy relate to changes of state.</li> <li>• Convection is the circulation of fluid (liquid or gas) that results from energy transfer; warm masses rise and cool masses sink.</li> </ul>	
3	<p><b>Water Cycle</b></p> <ul style="list-style-type: none"> <li>• Water changes from gas to liquid by condensation.</li> <li>• Water changes from liquid to gas (vapor) by evaporation.</li> <li>• Water circulates through the atmosphere, lithosphere, and hydrosphere in what is known as the water cycle.</li> </ul>	

Week	Content Understandings	NYCCSSE Aeronautics: Weather program extension
3-5	<p><b>Earth's Atmosphere</b></p> <ul style="list-style-type: none"> <li>Air is matter, it occupies space, has mass, and can be compressed.</li> <li>The atmosphere is the layers of gases surrounding Earth.</li> <li>The structure of the Earth's atmosphere</li> <li>Weather happens in the troposphere, the layer of the atmosphere closest to Earth's surface.</li> <li>The troposphere is a mixture of nitrogen (78%), oxygen (21%), and other gases (1%), including water vapor.</li> <li>The causes of air pressure</li> <li>Wind is movement of air from an area of high pressure to an area of low pressure.</li> <li>Air pressure is represented on a map by contour lines called isobars.</li> <li>Air masses are large bodies of air that are uniform in temperature and humidity.</li> </ul>	<p><i>* The performance task should be conducted in this part of the unit. The content in bold is addressed in the performance task.</i></p> <p><i>* If you are using the Glencoe Unit 2, this performance task should take the place of Atmosphere (Lessons 19-27).</i></p> <p><b><u>Weather Performance Task</u></b></p> <ul style="list-style-type: none"> <li>Introduction to weather</li> <li>Air pressure</li> <li>(Other weather factors)</li> <li>Air masses and fronts</li> <li>How weather affects flight</li> </ul>
6	<p><b>Weather</b></p> <ul style="list-style-type: none"> <li>Weather describes the conditions of the atmosphere at a given location for a short period of time.</li> <li>Weather instruments measure temperature, atmospheric pressure, humidity, wind direction, and wind speed.</li> <li>Differential heating of Earth's surface by the sun can create high and low-pressure areas.</li> <li>Local wind, called sea breezes, land breezes, mountain breezes, and valley breezes, blow in predictable ways determined by local differential heating.</li> <li>High-pressure systems generally bring fair weather. Low-pressure systems usually bring cloudy, unstable conditions.</li> <li>Fronts are boundaries between air masses. Precipitation is likely to occur at these boundaries.</li> </ul>	<p><i>* The concept of weather is introduced at the beginning of the performance task.</i></p> <p><i>* Lessons on weather instruments should be done during the time frame when students are collecting air pressure data for the performance task.</i></p>
7	<p><b>Weather Observations</b></p> <ul style="list-style-type: none"> <li>Meteorology is the science of weather, and meteorologists are the people who study Earth's weather.</li> <li>Collecting data for weather maps and forecasts</li> <li>Comparing forecasts to actual weather</li> <li>Identifying the symbols used in a weather station model</li> </ul>	
8	<p><b>Extreme Weather</b></p> <ul style="list-style-type: none"> <li>Severe weather has the potential to cause death and destruction in the environment.</li> <li>Hazardous weather conditions include thunderstorms, tornadoes, hurricanes, ice storms, and blizzards. Humans can prepare for and respond to these conditions if given sufficient warning.</li> </ul>	

# Unit Standards and Practices

## **New York State Intermediate Level Science Standard 4: The Physical Setting**

- 2.1a: Nearly all the atmosphere is confined to a thin shell surrounding Earth. The atmosphere is a mixture of gases, including nitrogen and oxygen with small amounts of water vapor, carbon dioxide, and other trace gases. The atmosphere is stratified into layers, each having distinct properties. Nearly all weather occurs in the lowest layer of the atmosphere.
- 2.1b: As altitude increases, air pressure decreases.
- 2.2p: High-pressure systems generally bring fair weather. Low-pressure systems usually bring cloudy, unstable conditions. The general movement of highs and lows is from west to east across the United States.

## **Common Core Learning Standards**

**CCLS RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

**CCLS RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

**CCLS WST.6-8.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

**CCLS WST.6-8.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to the task, purpose, and audience.

**CCLS WST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.

## **Next Generation Science Standards Performance Expectations**

### **Earth and Space Sciences: Earth Systems**

- MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
- MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

### **Engineering, Technology, and Applications of Science**

- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 Analyze data from texts to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.