Extreme Weather Coming to a Place Near You? - Teacher Materials

Unit 5	Earth and Space Science

The Curriculum and Instruction Department at New Visions for Public Schools develops free, full-course materials for all areas of high school science, math, ELA, and social studies, for use across our network of 80 New York City schools and beyond.

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Unit 5 Extreme Weather Coming to a Place Near You?

Weather

Performance Expectations

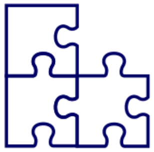
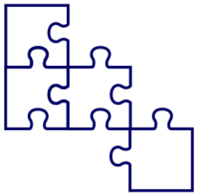
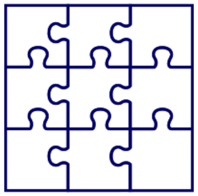
HS-ETS1-1, HS-ETS1-2, HS-ESS2-8, HS-ESS1-7

Time

21-30 days

How can we address the large and expensive problem of storm damage in the United States?

In this unit, students figure out the processes that cause weather phenomena such as strong winds, precipitation, and coastal flooding. They divide the overall complex challenge of storm damage into subproblems that can be mitigated using engineering solutions. To do this, they use a variety of physical and computer models related to these weather phenomena to explore the patterns in weather phenomena at different scales, which illuminate the causal relationship between variables such as temperature, water vapor, and air pressure. Students use this information and the engineering design process to evaluate and design solutions aimed at addressing these local and global problems.

Unit Opening	Wind 5E	Water 5E	Flooding 5E	Unit Closing
Anchor Phenomenon	→	**5E Lessons connect learning to the performance task**	→	**Performance Task**
				
What is the true cost of storms in the United States?	*How do meteorologists predict where storms will land? How do strong winds form? How can we protect ourselves from storm damage?*	*How does precipitation form? How can we design solutions that protect communities from water damage?*	*How do moon phases contribute to storm flooding severity?*	*How can we design solutions to address storm damage?*

Unit Introduction

How do we make science education meaningful and relevant to our students? High school earth and space science courses are traditionally filled with lectures and cookbook labs, memorizing vocabulary, and an occasional research report. New science education standards (NGSS/NYSSLS) require a more engaging, accessible vision of science teaching and learning to help *all* students learn about the natural world and become scientifically literate citizens.

The three-dimensional, phenomenon-driven materials in this unit support students in engaging in the authentic practices of science. Students construct meaning about the natural world through modeling, investigations, labs and experiments. As students have opportunities to manipulate the physical tools of science, they also engage in productive struggle that can be resolved through creating models from evidence and engaging in consensus building discussions. The materials support teachers in becoming skillful facilitators of student sense-making and deepen teachers' understanding of how to teach science in an interactive way that is driven by students' questions and ideas.

This unit was intentionally designed to build on the fourth unit of this course, Climate Change, in which students analyze data to construct explanations. In Extreme Weather Coming to a Place Near You?, students continue to engage with data to construct communications about future climate impacts. The common embedded group learning routines and curriculum structures introduced in the first unit are revisited, providing students and teachers multiple opportunities to engage in a culture of collaborative sensemaking around a phenomenon. In this unit, students are encouraged to design solutions to the increasingly prevalent problem of storm damage.

The embedded group learning routines and formative assessments found in each of the Earth and Space Science units support teachers in learning about their students, both academically and personally. Whether students had strong science programs prior in prior courses, or if three-dimensional teaching and learning is brand new to them (or the teacher!), this unit is designed to reinforce and further build on students' earlier experiences with three-dimensional learning.

Unit Coherence

In Unit 5, the overall problem of damage from storms is intended to motivate student engagement across the unit. From the students' perspective, there should be a clear and explicit unit storyline that guides the sequence of activities. Rather than one long continuous unit, we have chosen to use an instructional model to develop four coherent sequences of lessons within Unit 5. Each sequence is based on students' questions and builds towards figuring out something that contributes to the overall unit-level question about how we know that humans are causing climate change and how that matters. This in turn allows students to construct a communication from data analysis explaining how storms may change in the future. The phenomena, the instructional model, and the routines embedded throughout the sequences of lessons are all used in service of coherence across Unit 5.

Phenomenon-Driven Instruction

Phenomena are a key part of instruction in A Framework for K-12 Science Education and the NGSS. As in the work of scientists, students should be encouraged to move from observable phenomena to generalizable explanations of the natural world. Too often, traditional science instruction has started with generalizable principles, sidelining the lived experience and intuitions that all young people bring to school. In this unit (and all New Visions units) there are two kinds of phenomena: anchor phenomena and investigative phenomena.

Anchor Phenomenon	Investigative Phenomena
• One per unit; drives the learning of the unit • Attention-grabbing and relevant • Does not have to be phenomenal	• One per 5E sequence (three in this unit) • Presented in the Engage phase of each 5E

Anchor Phenomenon

To support coherence, students are prompted to figure out one overarching, real-world question over the course of the unit. The anchor phenomenon question is revisited across the unit, and this question motivates the investigations conducted in each of the 5E instructional sequences. A good anchor phenomenon should be attention-grabbing and relevant to students but also thought-provoking, comprehensible, and connected to the science learning goals. It needs to be observable to students through firsthand experiences or through someone else's experiences, such as through a video or secondary data. If a teacher feels the anchor phenomenon will not be familiar or accessible to all students, we suggest relating it to similar, more familiar phenomena. It is important to notice that the phenomenon question anchoring the unit is different from the more generalized and abstracted science question for the unit. This difference is part of what helps make the unit more student-centered, rather than teacher-centered.

Investigative Phenomena

Based on the Anchor Phenomenon and three-dimensional learning goals for students for the unit, each 5E instructional sequence has a related investigative phenomenon, typically presented in the Engage phase. This phenomenon brings students together around a shared puzzle or experience that frames the learning for that 5E sequence. Similar to the anchor phenomenon question, the questions about the investigative phenomena are intended to be specific and contextualized, rather than the traditional content questions teachers use as their lesson aims. They present what is being figured out; therefore, the scientific concepts that are in the learning goal cannot be part of the wording of the question!

Storyline and Pacing Guide

Unit Opening	What is the true cost of storms in the United States?	**Performance Expectations** HS-ETS1-1, HS-ETS1-2	**Anchor Phenomenon** Storms cost the United States billions of dollars every year and affect the quality of human lives. This challenge can be addressed through engineering solutions.	**Time** 1-2 days

Student Questions	What Students Do	Student Ideas
These questions motivate the unit storyline. *What causes floods, winter storms, and hurricanes?* *Why are some disasters more costly than others?* *How can costs and damage from these disasters be minimized?* *What would good solutions for these problems look like?* *How can we design solutions to minimize storm damage? Are those solutions the same for different types of storm disasters?*	Students observe examples of winter storms and tropical cyclones that have caused significant damage to property and put lives at risk. Students consider how they could divide this large problem into subproblems and define criteria for success to solving them,	*These ideas are revisited throughout the unit storyline.* ● Characteristics of a hurricane include heavy rain and extremely strong wind. ● Characteristics of a blizzard include heavy snow and very strong wind. ● Both types of storms can cause a great deal of disruption, damage to property, and harm human life. ● Both types of storms can result in extreme flooding ● Hurricanes and blizzards only happen during certain months of the year and tend to occur and move in specific places on Earth. ● In order to design solutions, we need to break the big problem of "storm damage" down into categories ● Solutions will have different criteria for success, like reducing damage without costing more than the damage costs

After students consider how storms cause damage, students will dive into an investigation about how strong winds form in order to think about how to address the mechanisms of storm formation and damage.

Wind 5E	How do meteorologists predict where storms will land? How do strong winds form? How can we protect ourselves from storm damage?	**Performance Expectations** HS-ESS2-8, HS-ETS1-1, HS-ETS1-2	**Investigative Phenomenon** Winter storm Jonas produced strong winds that caused significant disruptions to society, damage to property, and harm to human life, but also warnings about the coming storm helped people prepare for its arrival.	**Time** 7-11 days

Student Questions	What Students Do	Student Ideas
These questions motivate this 5E sequence and the unit storyline. ● *How do storms form and move?* ● *What causes high-speed winds?* ● *How can we use our understanding of the mechanism of storms and their motion to design solutions that protect people and property from damage?*	Students use models at different scales to determine how factors like air temperature and density affect wind patterns in order to explain how different air masses meet, form wind, and travel across the planet. They apply their understanding of global winds to understand how the same types of pressure differentials cause storm winds on smaller scales and identify winter storms on maps using weather symbols and analysis. Finally, they use the engineering principals of specifying and prioritizing criteria and tradeoffs to analyze real-world solutions to storm wind damage.	*Students figure out these ideas in this 5E sequence.* ● Wind is caused by uneven heating of Earth's surface, leading to differences in pressure and density. Air moves from high to low-pressure areas across Earth's surface; we call this wind. ● Global winds drive the motion of air masses and storms ● When two air masses of different temperatures and pressures meet, wind forms between them ● We can represent different kinds of air masses and fronts on maps with symbols. ● Maps help us to identify weather systems and communicate this information to others.

After working individually to analyze the solution of wind farms to reduce storm wind damage, the class discusses if that solution makes sense to implement based on the evidence they've gathered throughout the 5E. Students should identify that the locations of these wind farms should be based on where global winds carry storms.

Then students identify that they have not yet discussed the other factors of storms that cause damage: precipitation and flooding. Tell students that in the next sequence of lessons, they will investigate how precipitation forms in order to determine how to implement solutions aimed at reducing storm water damage.

Water 5E	How does precipitation form? How can we design solutions that protect communities from water damage?	**Performance Expectations** HS-ESS2-8, HS-ETS1-1, HS-ETS1-2	**Investigative Phenomenon** Hurricane Helene dropped 30 inches of water on Asheville. Winter storm Jonas dropped 30 inches of snow in New England. These quantities of water caused floods, damage, power outages, and landslides.	**Time** 5-7 days

Student Questions	What Students Do	Student Ideas
These questions motivate this 5E sequence and the unit storyline. ● *How does precipitation form?* ● *How can we prevent water damage from storms impacting people and property?*	Students investigate the conditions that cause precipitation to form. They synthesize their understanding of the mechanism of precipitation formation with their knowledge about climate change in order to make predictions about how precipitation may change in the future, and evaluate solutions intended to reduce storm damage from rain and snow.	*Students figure out these ideas in this 5E sequence.* ● When two air masses of different temperatures collide with each other, the colder, more dense air mass forces the warmer, less dense air mass up. As the warmer air mass rises, it loses high amounts of energy to the cold air at higher elevations and condenses. When the warm air contains enough water vapor, the water vapor condenses to form clouds and sometimes precipitation. ● Both wind and precipitation occur at fronts over the US and other places. ● Mid-latitude cyclones become blizzards in the northern part of the US, mostly the midwest and northeast, as well as other places in the northern hemisphere where warm moist air masses meet cold dry air masses and it's cold enough. ● Global climate models predict that temperatures and moisture in the atmosphere will increase in the future. This may have implications for severe storms in the future. ● Engineering solutions like rain gardens can mitigate some storm damage from precipitation ● Cooling the oceans is the biggest thing that would reduce precipitation by reducing the scale of warm, moist air

After the previous 5E, where students explained how wind forms and causes damage, students now turn to the subproblem of precipitation. In this lesson sequence, students refine their ability to specify criteria and constraints for a solution and apply that analysis to a provided solution aimed at reducing damage from snow and rain. This sequence prepares them for the next sequence, in which they will investigate coastal flooding and design their own solutions to the local subproblems.

Flooding 5E

How do moon phases contribute to storm flooding severity?

Performance Expectations
HS-ESS1-7,
HS-ETS1-1,
HS-ETS1-2

Investigative Phenomenon
In addition to large amounts of precipitation, storms in Marin county, Winter Storm Jonas, and Hurricane Sandy caused massive amounts of coastal flooding.

Time
8 days

Student Questions	What Students Do	Student Ideas
These questions motivate this 5E sequence and the unit storyline. • *How can winter storms that drop snow also result in flooding?* • *Why are some flooding events worse than others?* • *How can we predict which storms might include extreme coastal flooding?*	In this 5E, Students are tasked with explaining why the flooding from hurricane Sandy, Winter storm Jonas, and the recent flooding in Marin County were so damaging. First, students determine the relationship between lunar phases and tides, and then how combination of lunar phases and Earth's orbit around the sun result in seasonally stronger or weaker tides. By looking at the orbital conditions during each of the named storm events, they explain why these events were so catastrophic and design solutions to mitigate flood damage in the future.	*Students figure out these ideas in this 5E sequence.* • Moon cycles drive tides, which influence storm flooding • The orbit of the moon is elliptical and at an angle; tides change monthly as a result of where the moon is in its orbit • The sun exerts gravitational pull on Earth • The combined effects of the moon's and sun's gravitational pulls affect tides • The relative positions of the Earth, moon, and sun control tidal strength • When tides are higher than usual during a storm event, flooding can be exacerbated

After explaining how cyclic factors impact storm flooding severity, students design their own solutions to mitigate damage to people and property in future storms.

Unit Closing	How can we design solutions to address storm damage?	**Performance Expectations** HS-ETS1-1, HS-ETS1-2	**Anchor Phenomenon** Storms cost the United States billions of dollars every year and affect the quality of human lives. This challenge can be addressed through engineering solutions.	**Time** 0-2 days

Student Questions	What Students Do	Student Ideas
These questions are addressed in the performance task. ● *What mechanisms of storm development can we address?* ● *What criteria would a solution have to meet in order to be considered successful?* ● *What constraints exist in the system that may work against the solution?* ● *How do we weigh costs and benefits of a solution and think deeply about unintended consequences?*	Students design solutions to a real-world subproblem of storm damage, considering its design elements, criteria, constraints, and undertaking a cost-benefit analysis.	*These ideas were developed throughout the unit storyline.* ● *Storms occur as a result of the combination of strong winds, precipitation, and sometimes flooding* ● *Solutions should try to address the mechanisms of a problem* ● *If solutions cannot target the mechanism of the problem directly, understanding the mechanism can give key information about what limitations may exist in the system or what constraints a solution may be working against* ● *Every solution has costs and benefits, and may have unintended consequences*

Now that students have context about winds, rains, floods, climate change, and tides, students are able to consider all of the subproblems to storm damage in order to design a solution to one subproblem that can address the larger overarching issue facing humanity.

Unit Standards

This unit is designed to meet Next Generation Science Standards Performance Expectations. Since this unit is part of a full-year Biology course, the design includes intentional foregrounding of a limited number of Crosscutting Concepts (CCCs) and Science and Engineering Practices (SEPs). Further, since an aspect of NGSS design is connections to Common Core Math and ELA standards, these connections are highlighted in this section.

Performance Expectations

HS-ETS1-1 * **Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**
Clarification Statement: None
Assessment Boundary: None

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.**
Clarification Statement: None
Assessment Boundary: None

HS-ESS2-8
Clarification Statement:
Assessment Boundary:

This PE, added by NYS, is not in the NGSS: Evaluate data and communicate information to explain how the movement and interactions of air masses result in changes in weather conditions. [Clarification Statement: Examples of evidence sources could include station models, surface weather maps, satellite images, radar, and accepted forecast models. Emphasis should focus on communicating how the uneven heating of Earth's surface and prevailing global winds drive the movement of air masses and their corresponding circulation patterns, the interaction of different air masses at frontal boundaries, and resulting weather phenomena.] [Assessment Boundary: Analysis is limited to surface weather maps and general weather patterns associated with high and low pressure systems.]

HS-ESS1-7
Clarification Statement:
Assessment Boundary:

This PE, added by NYS, is not in the NGSS: Construct an explanation using evidence to support the claim that the phases of the moon, eclipses, tides and seasons change cyclically. [Clarification Statement: Emphasis of the explanation should include how the relative positions of the moon in its orbit, Earth, and the Sun cause different phases, types of eclipses or strength of tides. Examples of evidence could include various representations of relative positions of the Sun, Earth and moon.] [Assessment Boundary: Assessment does not include mathematical computations to support explanations but rather relies on conceptual modeling using diagrams to show how celestial bodies interact to create these cyclical changes.]

The performance expectations marked with an asterisk (*) integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Three-Dimensional Learning Goals in This Unit

Given the breadth of three-dimensional standards for high school Earth and Space Science, Unit 5 focuses primarily on ideas related to Earth's weather and the engineering design process. This unit also engages students' use of the SEP of Constructing Explanations and Designing Solutions and has a secondary focus on the SEP of Obtaining, Evaluating, and Communicating Information. That is not to say that students will not engage in other SEPs throughout the lessons; however, it is important to foreground and be explicit about a limited number of practices with enough duration to see how students develop their understanding and ability to use this practice. This is important for both student and teacher learning! Similarly, the foregrounded CCCd for this unit are *Patterns*, which fits well with our selected SEP and the understanding that patterns in weather and lunar events helps provide evidence for causal mechanisms of those processes and *the Influence of Science, Engineering, and Technology on Society and the Natural World*. The design of instruction across the unit supports students' three-dimensional learning and shifts classrooms to become more NGSS-aligned spaces.

Three Dimensions Foregrounded in Unit 5

This chart is a high-level summary of the foregrounded standards. For more detail about specific elements, see the section on Assessment later in this document.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	ESS1.B Earth and the Solar System ESS2.D Weather and Climate ETS1.A Defining and Delimiting an Engineering Problem ETS1.C Optimizing the Design Solution	Patterns Influence of Science, Engineering, and Technology on Society and the Natural World

Building on Middle School

High school science teaching necessarily builds on student learning from middle school. It is helpful to consider the middle school standards in order to enact a unit that builds on students' prior experiences. As we are in the middle of a multi-year transition, however, it is also critical to keep in mind that not all students will have experienced an NGSS-designed unit when they come to high school, so the process of building on middle school learning may be particularly complex for years to come. The following sections detail the ways in which this unit builds on middle school standards across the three dimensions.

Disciplinary Core Ideas from Middle School
ESS2.D Weather and Climate

- In middle school, students learn that weather is the result of complex interactions between sunlight, the ocean, living things, and varies based on latitude, altitude, and geography. In this unit, students build upon that understanding by learning about how latitude influences temperature and its role in the density and characteristics of air masses, the interactions of which result in weather patterns.

ESS1.B Earth and the Solar System

● Students in middle school learn to construct models of the sun-Earth-moon system that explain moon phases and eclipses. This unit builds on that basic idea by adding complexity about the importance of that motion being relative and the role of an observer in one location on Earth.

ETS1.A Defining and Delimiting Engineering Problems

● In middle school, students learn foundational concepts about the importance of clearly defining criteria and constraints. In this unit, students deepen their understanding of these components of design solutions by prioritizing criteria and considering quantitative measurement in determining a solutions' success.

Crosscutting Concepts from Middle School

Influence of Science, Engineering, and Technology on Society and the Natural World

● Middle school students learn that humans use various types of technology to meet different needs. This unit builds on that background as students examine how technology may have unintended consequences on society and the environment.

Science and Engineering Practices from Middle School

Constructing Explanations and Designing Solutions

● Students in middle school have experience with engaging in the design cycle using criteria and tradeoffs. This unit expands on that practice with students designing solutions for complex real-world problems using evidence from their own investigations and other sources of knowledge.

Obtaining, Evaluating, and Communicating Information

● Students in middle school have experience presenting information in writing and orally. This unit blends those experiences with other modes of communication, including graphically and textually.

Assessment

Performance expectations (PEs) in the NGSS describe what students should know and be able to do. Unit 5 targets a bundle of three PEs taken from high school Earth and Space Science; those standards are HS-ESS1-7 (NYSED), HS-ESS2-8 (NYSED), and HS-ESS3-5. This PE bundle informs the types of three-dimensional tasks in which students engage across the unit. Each sequence of lessons within the unit targets elements from one or more of the performance expectations for the unit, and the teacher has opportunities to collect evidence of student learning around these elements within that learning sequence. The unit-level Performance Task only targets a subset of three-dimensional learning goals informed by the bundled PEs for the unit. All other evidence of learning related to the other dimensions/elements in the PEs can be found within the instructional sequences. The **Teacher Materials** for each sequence of lessons includes a matrix that lists which student artifacts can provide evidence of student learning for each of three-dimensional learning goals from that sequence.

This unit was designed to support teachers in tracking student progress across the three dimensions, not for mastery within individual lessons. The targeted disciplinary core ideas (DCIs) listed below will be developed throughout the unit. While all of the science and engineering practices (SEPs) may be utilized across the unit, the three target SEPs for the unit are listed below. Similarly, many crosscutting concepts (CCCs) may be useful in making sense of the phenomena in this unit, however the foregrounded, targeted CCCs are listed below.

The following Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts are assessed throughout the unit:

	Wind 5E	Water 5E	Flooding 5E
Asking Questions and Defining Problems	✔	✔	✔
Constructing Explanations and Designing Solutions		✔	✔
Obtaining, Evaluating, and Communicating Information	✔	✔	✔
ESS1.B Earth and the Solar System			✔
ESS2.D Weather and Climate	✔		
ETS1.A Defining and Delimiting an Engineering Problem	✔	✔	✔
ETS1.C Optimizing the Design Solution	✔		✔
Patterns	✔	✔	✔
Influence of Science, Engineering, and Technology on Society and the Natural World	✔	✔	✔

At the end of Unit 5, teachers will have evidence in student work (tasks) related to the elements listed in this table and can therefore make claims at the end of this unit related to student proficiency for all three performance expectations.

To support assessment throughout the unit, rubrics have been included in the **Student Materials** to support the Evaluate phase in every 5E instructional sequence. Teachers should customize these rubrics to support their schools' grading systems. Rubrics address both individual reflection, peer review, and the teacher's feedback. The Unit 5 Performance Task also includes a rubric, and the task can be considered a final summative assessment for the unit - we have not included a traditional "unit test" in our materials. Teachers may opt to create their final exam using their states' previous exam questions, however we believe that the formative assessment tasks embedded in the materials (such as the Looks and Listen For notes, the Explore phase summaries, and the modeling done in the Evaluate phases), along with the Performance Task can serve as sufficient evidence of what students know and can do.

Common Core State Standards (ELA/Literacy)

Reading Standards for Literacy in Science and Technical Subjects

RST.9-10.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Implementing Unit 5

This unit is designed to be the fifth unit of the Earth and Space Science course. We do not recommend spending more than two months on this unit, as our field testing showed that six to eight weeks is the maximum amount of time students can stay engaged with the unit-level anchor phenomenon.

Within the unit, we also suggest spending no more than two weeks on each 5E instructional sequence. It is important to trust that ideas will build over time. Part of learning to teach NGSS-designed curriculum is getting comfortable with moving on, even if not every student "gets it," with the knowledge that there are additional opportunities to revisit particular standards. See the Assessment section below for guidance on providing multiple opportunities for assessment throughout the unit.

The first time enacting any unit with students may take longer than anticipated, particularly if the pedagogical approach is significantly different from what a teacher is used to. A teacher may want to skip entire lessons or activities, or revert to more traditional approaches when it seems like time is running out. We often ask teachers to think about the best way to modify recipes. Just like when using a recipe for the first time, it's a good idea to stay as true to the materials as possible before making modifications or substitutions! As teachers become more familiar and comfortable with the instructional model, the embedded routines, and three-dimensional teaching overall, the desire to skip things will dissipate. Teachers using our curriculum over time have noticed that they are able to move a bit quicker through this and other NGSS-designed units each year.

Routines

The table below summarizes the routines embedded in this unit. The number indicates the number of times a given routine appears in a lesson.

	Unit Opening	**Wind 5E**	**Water 5E**	**Flooding 5E**	**Unit Closing**
Class Consensus Discussion			1	1	

	Unit Opening	Wind 5E	Water 5E	Flooding 5E	Unit Closing
Class consensus Discussion		1			
Consensus-Building Share		1			
Domino Discover		4	1	3	
Driving Question Board	1				
Idea Carousel		1	1	1	
Read-Generate-Sort Solve				1	
Read-Generate-Sort-Solve		1			
Rumors		1	1	1	
Tell the Story	1				
Think-Talk-Open Exchange			1	2	
Think-Talk-Open Exchange + Buzzwords		1			

Literacy Strategies

The table below summarizes the literacy strategies embedded in this unit. The number indicates the number of times a given strategy appears in a lesson.

	Unit Opening	Wind 5E	Water 5E	Flooding 5E	Unit Closing
Text Annotation	1				
Text annotation			1		

Simulations in this Unit

Lesson	Simulation Title	Source	Technical Notes	Permissions Notes
Wind 5E	Gas Properties Simulation	https://simulations.newvisions.org/gasproperties.html	NA	NA
Wind 5E	Global Circulation Model	https://simulations.newvisions.org/globalcirculation.html	NA	NA
Water 5E	Weather Fronts Simulator	https://learn.weatherstem.com/courses/wxstem_meteorology_01/module-01/03/09.html	NA	NA
Flooding 5E	Moon Phases Simulator	https://astro.unl.edu/smartphone/MoonPhases/	NA	NA
Flooding 5E	Tidal Forces Simulation	https://simulations.newvisions.org/tidalforces.html	NA	NA

Videos in this Unit

Lesson	Video Title	Source	Technical Notes	Permissions Notes
Unit Opening	Winter Storms Wipe Off $170 Billion from US Economy So far in 2026	https://www.youtube.com/watch?v=bRL3yqSQqdo	NA	NA
Wind 5E	Snow-M-G! Monster storm to hit DC in bullseye	https://www.youtube.com/watch?v=ggceuUZxoCg	NA	NA

Lesson	Video Title	Source	Technical Notes	Permissions Notes
Wind 5E	Winter Storm Jonas: a Historic Storm	https://www.youtube.com/watch?v=0nlWfuoeAgw	NA	NA
Wind 5E	The coriolis effect and winds	https://www.youtube.com/watch?v=PDEcAxfSYaI	NA	NA
Wind 5E	Coriolis Carousel	https://www.youtube.com/watch?v=78Yymgk6qrM	NA	NA
Wind 5E	Video: How to Draw Isolines #1	https://www.youtube.com/watch?v=iYon-S6wCBw	NA	NA
Wind 5E	Video: How to Draw Isolines #2	https://www.youtube.com/watch?v=gSYje6UbPZU	NA	NA
Wind 5E	Mid-Latitude Cyclone Clip	https://www.youtube.com/watch?v=n4rJX4IIRaU	NA	NA
Wind 5E	Mid-Latitude Cyclones Explained	https://www.youtube.com/watch?v=RAqZpjIaoKM	NA	NA
Wind 5E	NOAA Site with Complete Guidelines for Analyzing Weather observation Maps	https://www.noaa.gov/jetstream/wxmaps-max/learning-lesson-drawing-conclusions	NA	NA

Lesson	Video Title	Source	Technical Notes	Permissions Notes
Wind 5E	High and Low Pressure Zone Winds	https://drive.google.com/file/d/1jCmzWysIdbQvqmqsxNWgMdyxGRJct337/view?usp=sharing	NA	NA
Wind 5E	Winter Storm Jonas: 1/22 9pm-1am on the Weather Channel	https://www.youtube.com/watch?v=diNsYgPRn84	NA	NA
Wind 5E	New stats show how truly bad Hurricane Helene was in the CSRA	https://www.youtube.com/watch?v=86r6RbIlt9c	NA	NA
Wind 5E	Hurricane Helene's Devestation and Recovery: Improving Rural Power	https://www.youtube.com/watch?v=_Rj45pkUoqk	NA	NA
Wind 5E	Scientists Fear the World's Largest Wind Turbine Will Change the Weather	https://www.youtube.com/watch?v=x89rE-QnKW4	NA	NA
Wind 5E	How Giant Wind Farms Can Save the Planet	https://www.youtube.com/watch?v=kmxpM2LZqzM	NA	NA
Water 5E		https://www.youtube.com/watch?v=OpReYTP4Nx0	NA	NA

Lesson	Video Title	Source	Technical Notes	Permissions Notes
	How Hurricane Helene Spawned Record Landslides in NC			
Water 5E	Winter Storm Jonas Ingredients	https://www.youtube.com/watch?v=Q2EyodmiCnU	NA	NA
Flooding 5E	Snowstorm Jonas rocks East Coast (3:00-4:20)	https://www.youtube.com/watch?v=7S3pPQKpbKU	NA	NA
Flooding 5E	High and Low Pressure Zone Winds (1:17:07-1:18:49)	https://drive.google.com/file/d/1jCmzWysIdbQvqmqsxNWgMdyxGRJct337/view?usp=sharing	NA	NA
Flooding 5E	"Intense" King Tides bring 3rd day of flooding, stress to Marin County residents	https://www.youtube.com/watch?v=hEXIzK1vjM0	NA	NA
Flooding 5E	Superstorm Hurricane Sandy 2012: Inside NYC's Flooded Subways	https://www.youtube.com/watch?v=wtb-OK4bEs4	NA	NA
Flooding 5E	Eclipses: Crash Course Astronomy #5	https://www.youtube.com/watch?v=PRgua7xceDA&t=414s	NA	NA

Lesson	Video Title	Source	Technical Notes	Permissions Notes
Flooding 5E	Watching the Tides	https://www.youtube.com/watch?v=QcbN9SVkqYU	NA	NA

Lab Materials in this Unit

Lesson	Lab	Materials needed (per group)
Wind 5E	Wind Formation Investigation Lab minutes: 30 minutes	❑ Two 1 liter bottles with a hole that fits the tubing to connect the two bottles ❑ Tubing ❑ Incense ❑ Hot and cold water ❑ balloon ❑ 3 colors of permanent marker
Wind 5E	Local Wind Investigation Lab minutes: 30 minutes	❑ Colored pencils
Water 5E	Precipitation Formation Investigation Lab minutes: minutes	❑ 3 wide clear plastic cups per group ❑ 3 taller clear plastic cups per group ❑ Hot tap water ❑ Warm tap water ❑ Cold tap water ❑ Magnifying glass ❑ Ice
Flooding 5E	Moon Phases and Eclipses Investigation	

Lesson	Lab	Materials needed (per group)
	Lab minutes: 45 minutes	❏ Ball on stick with one side marked ❏ Lamp

Other Materials in this Unit

Lesson	Materials needed
Unit Opening	❏ Chart paper ❏ Sticky notes ❏ chart paper ❏ markers
Wind 5E	❏ Sticky notes ❏ Chart paper ❏ markers ❏ *Weather Maps* ❏ Sticky notes ❏ Chart paper ❏ Markers ❏ Wind Turbined in Extreme Weather: Solutions for Hurricane Resiliency
Water 5E	❏ Post-its ❏ Computers ❏ Chart paper ❏ markers
Flooding 5E	❏ Post-its

Lesson	Materials needed
	❑ Chart Paper ❑ *Moon Phases and Eclipses Investigation Scaffold* ❑ Computers ❑ High and Low Tide Pictures ❑ *Tidal Fluctuation Data* ❑ *High Tides and Moon Phases Graphing Scaffold* ❑ Climate Change: Global Sea Level
Unit Closing	❑ Driving Question Board