Module Overview

ESSENTIAL QUESTION

How can we prevent a storm from becoming a disaster?

Introduction

The storm came not without warning, but the danger which threatened was not realized, not even when the storm was upon the city.

—Nathan Green, 1900

Throughout the module, students study the 1900 Galveston, Texas, hurricane—the anchor phenomenon—and build an answer to the Essential Question: **How can we prevent a storm from becoming a disaster?** As they learn about each new concept, students revisit and refine a model to represent their understanding of what happened during the hurricane and why it caused so much destruction. At the end of the module, students use their knowledge of weather, climate, and weather hazards to explain the anchor phenomenon and apply these concepts in new contexts. Through these experiences, students begin to develop the enduring understanding that weather conditions and severe weather events occur in predictable patterns that remain stable over time.

Lessons 1 through 10 address the Concept 1 Focus Question: **How do we describe weather?** Lessons 1 through 3 introduce the anchor phenomenon through photographs taken after the 1900 Galveston hurricane and firsthand accounts from Galveston residents who survived the storm. Reflecting on this phenomenon, students organize their questions on a driving question board and develop an initial class anchor model to explain why the hurricane caused so many casualties and destroyed the city. Students revisit the driving question board and the anchor model throughout the module to build a coherent understanding of what happened during the 1900 hurricane and how people can take steps to avoid a similar disaster in the future. Engaging in these practices

allows students to take an active role in the educational process and gives teachers insight into students' background knowledge and current understanding of weather and the damage that severe weather can cause. In Lessons 4 through 7, students work to define weather and use devices to collect local weather data each day. Students then use their understanding of weather conditions to analyze graphs to describe how the weather changes throughout a month. In Lessons 8 through 10, students use what they have learned about weather conditions as well as online weather data to graph and analyze weather data for every month during an entire year. This analysis leads students to develop a description of how the weather changes each season throughout a year.

Lessons 11 through 15 address the Concept 2 Focus Question: **How do people know what weather to expect?** Students develop an understanding that weather follows the same pattern every year and that this pattern of typical weather conditions is called climate. In Lessons 11 and 12, students compare their descriptions of local weather each season for one year with online weather data collected across several years. Students use this comparison to determine that the weather in their location follows the same pattern every year. They then use this pattern to describe their local climate. In Lessons 13 through 15, students use what they have learned about their local climate to find out whether the climate is the same everywhere. Students analyze historical weather data for other locations and determine that climate varies across different regions in the United States. Through this analysis, students work to identify the differences between five major climate zones. They apply their understanding of these climate zones to determine the expected weather conditions at different times of year in various locations.

Lessons 16 through 20 address the Concept 3 Focus Question: **How can we plan for severe weather?** Students develop an understanding about what happens during severe weather to describe the solutions that people use to protect themselves from weather hazards. In Lessons 16 and 17, students identify hazards related to different types of severe weather and examine their potential effects. Students also explore scales designed to rate severe weather systems such as the Saffir-Simpson scale for hurricanes and the Enhanced Fujita scale for tornadoes. In Lesson 18, students study the different solutions people put in place to reduce the impact of weather hazards related to different types of severe weather. In Lessons 19 and 20, students consider which solutions are needed in specific locations by examining where and when severe weather events such as hurricanes and tornadoes are most likely to occur.

In Lessons 21 through 26, students apply their understanding of weather hazard solutions in an engineering challenge, further building on their understanding of the Essential Question: **How can we prevent a storm from becoming a disaster?** Lesson 21 introduces students to the engineering design process through the story of Margaret E. Knight. Students learn that engineers strive to improve the human condition through an iterative process. Lessons 22 and 23 introduce students to the problem of flooding caused by storm surge and task them with designing a seawall that helps block water from reaching a coastal community. In Lesson 23, students create and test their prototypes, consider the success of their designs, and identify opportunities for improvement. In Lessons 24 and 25, students share the results of their design solutions in a class presentation. Students then compare Hurricane Katrina with the 1900 Galveston hurricane in Lesson 26. Students use this comparison to recognize that coastal communities need to implement a combination of weather hazard solutions to protect themselves from a disaster like the 1900 Galveston hurricane.

Students participate in a Socratic Seminar on how people protect themselves from weather hazards in Lesson 27, revisiting the module questions and synthesizing their understanding. In Lesson 28, students reflect on their study and apply their conceptual understandings in an End-of-Module Assessment. Finally, the class debriefs the End-of-Module Assessment in Lesson 29, giving the teacher and students an opportunity to revisit concepts that need further explanation and to clarify misconceptions.

Module Map

Anchor Phenomenon: 1900 Galveston Hurricane

Essential Question: How can we prevent a storm from becoming a disaster?

People analyze weather and climate data to anticipate future weather conditions and develop solutions to reduce the impact of weather hazards.

Concept 1: Weather Conditions

Focus Question: How do we describe weather?

People collect and analyze weather data over time to reveal stable and changing conditions.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
1900 Galveston Hurricane *Phenomenon Question: What happened in Galveston, Texas, in 1900?*	Weather hazards pose a threat to life and property. ▪ Lesson 1: Observe photographs of Galveston, Texas, before and after the 1900 hurricane and describe the damage. ▪ Lesson 2: Develop a class anchor model to explain what happened in Galveston, Texas, during the 1900 hurricane. ▪ Lesson 3: Ask questions about how a hurricane can cause a disaster such as the disaster in Galveston, Texas.	3.3B 3.8A	2I 3D 4F
Describing Weather Conditions *Phenomenon Question: What is the weather like where we live?*	Weather data collected over time reveal stable and changing conditions. ▪ Lesson 4: Build on prior knowledge to describe different types of weather conditions. ▪ Lesson 5: Make observations to describe wind speed and direction and cloud cover. ▪ Lesson 6: Build a rain gauge to measure precipitation and use a thermometer to measure temperature. ▪ Lesson 7: Graph and analyze data to describe weather conditions throughout a month.	3.2B 3.2C 3.2D 3.3C 3.4 3.5A 3.8A	2C 3E 4A

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
Seasonal Weather Conditions *Phenomenon Question: How does the weather change throughout a year?*	Seasonal changes occur in weather conditions throughout a year. ▪ Lesson 8: Graph and analyze yearlong temperature and precipitation data to describe weather conditions throughout a year. ▪ Lesson 9: Combine and interpret multiple data sets to describe weather conditions during each season. ▪ Lesson 10: Describe Galveston's seasonal weather conditions to help explore what happened during the 1900 Galveston hurricane.	3.2C 3.2D 3.2F 3.3B 3.8A	2I 3B 5G

Concept 2: Climate

Focus Question: How do people know what weather to expect?

Climate describes a location's typical weather conditions over time.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
Seasonal Weather Patterns *Phenomenon Question: Does the weather follow the same pattern every year?*	Climate remains relatively stable over time. ▪ Lesson 11: Interpret data to describe seasonal patterns in weather conditions over time. ▪ Lesson 12: Compare seasonal weather conditions to notice that the climate of a location remains relatively stable over time.	3.2C 3.2D 3.8A	1H 4A
Climate Zones *Phenomenon Question: Is the climate the same everywhere?*	Different regions of the world have different climate zones that are determined by patterns in average monthly temperature and annual precipitation. ▪ Lesson 13: Analyze and interpret patterns in weather data to describe the climate of various locations. ▪ Lesson 14: Compare climate data to explain that climate varies in different regions of the world. ▪ Lesson 15: Analyze the climate of Galveston, Texas, and explain how climate data can be used to make predictions about weather conditions.	3.2C 3.2D 3.3A 3.3B 3.8A	2E 3E

Concept 3: Weather Hazards

Focus Question: How can we plan for severe weather?

The ability to predict severe weather can help people reduce the impact of weather hazards.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
Weather Hazards and Their Effects *Phenomenon Question: What happens when the weather becomes severe?*	Different severe weather systems are made up of a variety of weather hazards. ▪ Lesson 16: Identify weather hazards and examine their potential effects. ▪ Lesson 17: Investigate scales designed to rate severe weather systems.	3.7B 3.9C	3E 4G
Preparing for Severe Weather *Phenomenon Question: How can people reduce the impact of weather hazards?*	The impact of weather hazards can be reduced by designing and implementing solutions. ▪ Lesson 18: Investigate how people protect themselves from weather hazards.	3.7B 3.9C	3B
Severe Weather Patterns *Phenomenon Question: How can people predict severe weather?*	People can use patterns of severe weather to predict weather hazards. ▪ Lesson 19: Identify patterns related to when and where hurricanes frequently occur. ▪ Lesson 20: Use patterns of severe weather to predict weather hazards.	3.2D 3.3B 3.7B 3.8A 3.9C	2E 3E

Application of Concepts

Task	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
Engineering Challenge *Phenomenon Question: How can people design better solutions to reduce the impact of weather hazards?*	People can use the engineering design process to design solutions to protect themselves from weather hazards. ▪ Lesson 21–25: Apply the engineering design process to design a structure that reduces the impact of flooding caused by storm surge. ▪ Lesson 26: Explore modern solutions that reduce the impact of weather hazards related to hurricanes.	3.2A 3.2D 3.2F 3.3B 3.7B 3.9C	1C 4G 5F

Application of Concepts

Task	Student Learning	Texas Essential Knowledge and Skills for Sience	English Language Proficiency Standards
End-of-Module Socratic Seminar, Assessment, and Debrief *Essential Question: How can we prevent a storm from becoming a disaster?*	People analyze weather and climate data to anticipate future weather conditions and develop solutions to reduce the impact of weather hazards. ▪ Lesson 27: Explain how understanding weather and climate can help people anticipate future weather conditions and develop solutions to reduce the impact of weather hazards. (Socratic Seminar) ▪ Lesson 28: Explain how understanding weather and climate can help people anticipate future weather conditions and develop solutions to reduce the impact of weather hazards. (End-of-Module Assessment) ▪ Lesson 29: Explain how understanding weather and climate can help people anticipate future weather conditions and develop solutions to reduce the impact of weather hazards. (End-of-Module Assessment Debrief)	3.2D 3.3A 3.8C 3.9C	3F 3G

Focus Standards*

Texas Essential Knowledge and Skills for Science

3.1 Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate practices. The student is expected to

- 3.1A *demonstrate safe practices as described in Texas Education Agency-approved safety standards during classroom and outdoor investigations using safety equipment as appropriate, including safety goggles* or chemical splash goggles, as appropriate, and gloves; and
- 3.1B *make informed choices in the use and conservation of natural resources by recycling or reusing materials* such as paper, aluminum cans, and plastics.

3.2 Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to

- 3.2A *plan and implement descriptive investigations, including asking and answering questions,* making inferences, and selecting and using equipment or technology needed, *to solve a specific problem in the natural world;*
- 3.2B *collect and record data by observing and measuring* using the metric system *and recognize differences between observed and measured data;*
- 3.2C *construct maps,* graphic organizers, simple tables, *charts, and bar graphs using tools* and current technology *to organize, examine, and evaluate* measured *data*;
- 3.2D *analyze and interpret patterns in data to construct reasonable explanations based on evidence* from investigations; and
- 3.2F *communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.*

3.3 Scientific investigation and reasoning. The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to

- 3.3A *analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning,* and experimental and observational testing;
- 3.3B *represent the natural world using models* such as volcanoes or the Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials; and
- 3.3C *connect grade-level appropriate science concepts with* the history of science, *science careers,* and contributions of scientists.

3.4 Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to

- 3.4 *collect, record, and analyze information using tools, including* cameras, *computers,* hand lenses, metric rulers, Celsius *thermometers, wind vanes, rain gauges,* pan balances,

*The bold text identifies standards that students should master in this module. The italicized text identifies standards that students will develop knowledge of in this module and should master in later modules. Some italicized standards are part of the assessments in this module, but they will be assessed throughout the year.

graduated cylinders, beakers, spring scales, hot plates, meter sticks, magnets, collecting nets, notebooks, and Sun, Earth, and Moon system models; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums.

3.5 Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to

3.5A *measure*, test, *and record physical properties of matter, including temperature,* mass, magnetism, and the ability to sink or float.

3.8 Earth and space. The student knows there are recognizable patterns in the natural world and among objects in the sky. The student is expected to

3.8A **observe, measure, record, and compare day-to-day weather changes in different locations at the same time that include air temperature, wind direction, and precipitation.**

3.9 Organisms and environments. The student knows and can describe patterns, cycles, systems, and relationships within the environments. The student is expected to

3.9C **describe environmental changes such as floods and droughts** where some organisms thrive and others perish or move to new locations.

Building Content Knowledge

Kindergarten lays the foundations for understanding weather and natural hazards. In Kindergarten, students describe weather as the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time, and students recognize that people measure and record these conditions to describe patterns in weather over time. Students also develop an understanding that some kinds of severe weather are more likely than others to occur in a given region and learn that weather scientists forecast severe weather so communities can prepare for and respond to these events.

In Level 3, students develop their knowledge of science and social studies as they study weather, climate, and natural hazards. Students begin the Weather and Climate module by observing photographs of Galveston, Texas, before and after the 1900 hurricane. Students describe the damage caused by the hurricane (SS.3.3A) in order to develop a class anchor model (3.3b), and they ask questions about how a hurricane can cause a disaster. Throughout Concept 1, students make a plan to collect and record weather data each day, and they analyze data to describe stable and changing weather conditions during a single month and throughout a year. Students analyze and interpret patterns in data to describe weather conditions during each season (3.2D, 3.8A). Students use what they know about weather to update the anchor model to show their understanding of the hurricane at Galveston.

In Concept 2, students analyze data to describe patterns in seasonal weather conditions for each season across multiple years. In Lessons 11 and 12, students conclude that their location's weather follows the same seasonal patterns year after year. Students then analyze and interpret patterns in weather data to describe the climate in various locations (3.2D). Using climate data, students explain that climate varies in different regions of the world. Students then analyze the climate of Galveston

and explain how climate data can be used to make predictions about weather conditions.

In Lessons 16 through 18 of Concept 3, students explore types of severe weather, such as drought, and are introduced to rapid environmental changes (3.8.A, 3.7B, 3.9C). Students identify related hazards and the effects of hazards, such as flooding, that occur as a result of severe weather. Additionally, students investigate scales designed to rate severe weather systems. Students then investigate solutions to reduce the impact of weather hazards. In Lessons 19 and 20, students analyze and interpret patterns related to when and where hurricanes frequently occur (3.2D) and recognize that this information can be used to predict potential severe weather. Then students revisit the model of Galveston.

In the Engineering Challenge in Lessons 21-26, students apply the engineering design process to design a structure that reduces the impact of flooding caused by storm surge (SS.3.3C, 3.7B, 3.9C). Students reflect on their learning about weather, climate, and natural hazards in Lessons 27 through 29, and students apply their understanding of weather and climate to a new context in the End-of-Module Assessment.

Key Terms

In this module, students learn the following terms through investigations, models, explanations, class discussions, and other experiences.

- Climate
- Degree Fahrenheit
- Hurricane
- Meteorologist
- Precipitation
- Season
- Seawall
- Severe weather
- Storm surge
- Weather condition
- Weather hazard

Advanced Materials Preparation

Several activities in this module require advanced preparation. See the lesson resources for more details on material preparation and instructions.

Lesson Set	Time in Advance	Investigation	Description
4–7	1 day	Weather Graph Stations	Prepare table and graphs for weather graph stations.
11–12	1 day	Analyze Historical Weather Data	Prepare historical weather graphs for analysis.
21–26	1 day	Engineering Challenge	Prepare materials for engineering challenge.

Safety Considerations

The safety and well-being of students are of utmost importance in all classrooms, and educators must act responsibly and prudently to safeguard students. Science investigations frequently include activities, demonstrations, and experiments that require extra attention regarding safety measures. Educators must do their best to ensure a safe classroom environment.

The hands-on, minds-on activities of this module involve the use of devices to gather weather data and the use of clay and water to build a seawall prototype in an engineering challenge. In addition to safety notes included in lessons, important safety measures to implement in this module include the following:

1. **Teachers must explain to and review safety expectations with students before each activity.**
2. **Students must listen carefully to and follow all teacher instructions.** Instructions may be verbal, on classroom postings, or written in the Science Logbook or other handouts.
3. **Students must demonstrate appropriate classroom behavior (e.g., no running, jumping, pushing) during science investigations.** Students must handle all supplies and equipment carefully and respectfully.
4. **Students and adults must wear personal protective equipment (e.g., safety goggles) during investigations that require the use of such equipment.**
5. **Debris must be cleaned up immediately.** During investigations, items can fall to the floor even when everyone is careful. Immediate removal of debris from the floor is essential to help prevent slips and falls.

6. **Students must never place any materials in their mouth during a science investigation.**
7. **Put away all food and drinks during science investigations.** Food and drinks can be easily contaminated by investigation materials. Additionally, spilled food or drinks can disrupt investigations.
8. **Monitor student activity on the internet.** If students are permitted access to the internet for science research purposes, their activity must be monitored to ensure that it conforms with school and district policies.

Because this is the first module of the school year, stressing the importance of safety and setting procedures with students are critical tasks. Teachers are encouraged to have students and parents sign a science safety contract that outlines rules and procedures to ensure a safe science experience. Additionally, administration of a safety quiz is recommended to assess understanding of the rules and procedures. Teachers may use the sample contract and quiz in Appendix A: Module Resources or create their own.

More information on safety in the elementary science classroom appears in the Implementation Guide. Teachers should always follow their school's or district's health and safety guidelines. For additional information on safety in the science classroom, consult the Texas Education agency-approved safety standards (3.1A).

Additional Reading for Teachers

Air, Water, and Weather: Stop Faking It! Finally Understanding Science So You Can Teach It by William C. Robertson

An Observer's Guide to Clouds and Weather by Toby Carlson, Paul Knight, and Celia Wycoff

"The National Climate Assessment and the Next Generation Science Standards" resource from the NOAA (National Oceanic and Atmospheric Administration) Climate.gov website: http://phdsci.link/1180

"State of the Climate" resource from the NOAA National Centers for Environmental Information website: http://phdsci.link/1181w