UCAR CENTER FOR SCIENCE EDUCATION

TEACHER GUIDE

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ANCHOR

BSCS SCIENCE LEARNING

NASA

THE GLOBE PROGRAM

An Unexpected Storm

What do we know about storms?

The Anchoring Phenomenon for the unit is a storm in Colorado that caused widespread flooding in September of 2013. Because an unusually large amount of precipitation fell, it was called a 1,000-year storm (meaning that the odds of a storm like it happening in the area are one in a thousand). Students brainstorm what they already know about conditions that could have caused the storm and then broaden beyond the Colorado storm to consider other types of storms. Broadening beyond the Colorado storm gives students the opportunity to share what they already know about storms they've experienced and can serve as a bridge between the science they are about to learn and their experiences in their own communities. Students work together to generate a set of questions to investigate in this unit to better understand the Colorado storm and other kinds of storms as the unit driving question—What causes different kinds of storms?—is introduced.

SCIENCE IDEAS

Weather impacts our lives and the communities where we live. There are many factors that have an impact on how storms form and the amount of precipitation they cause.

LESSON 1 An Unexpected Storm

What do we know about storms?

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AT A GLANCE

ACTIVITY DESCRIPTION	MATERIALS
(100 minutes)	
Introduce the Anchoring Phenomenon Students watch a video profiling a storm with extreme precipitation and its impact on a community.	**Lesson 1: Student Activity Sheet** Colorado flood video/images
Eliciting Prior Knowledge and Experiences Students share their initial ideas about what caused the heavy precipitation and where all the water came from. The discussion broadens to students' experiences of storms and precipitation, particularly in their community.	
Modeling Storm Formation Students illustrate what they know about storm formation using a diagrammatic model. They compare their representations to those of their classmates looking for similarities and differences. Students wonder about parts of their models that are different or incomplete.	
Driving Question Board Students are introduced to the driving question: "What causes different kinds of storms?" Students generate their own questions related to the driving question. The questions are recorded publicly and are used as one way to create a shared mission to figure out more about storms and precipitation.	Whiteboard, smart board, or chart paper and markers (to make the Driving Question Board) Sticky notes (or comparable way to post student questions)

LESSON 1 AN UNEXPECTED STORM

What do we know about storms?

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NGSS Sensemaking

The Anchor lesson is sequenced to encourage students to draw on their prior experiences and knowledge of storms and water cycling. Prior to this unit, students should have studied water cycling (MS-ESS2-4). Students use their experiences and knowledge to start explaining causes of storms. At this point in the lesson, it is not expected that students will have correct or fully developed ideas about the Anchoring Phenomenon (the Colorado storm). Through the process of sharing their initial ideas and broadening to related phenomena, students recognize that they know some "stuff" about storms but that they also have questions about the Colorado storm and storms more generally. Uncertainty about what is happening in a storm motivates students to ask questions. The class develops a joint mission to know more about what causes storms to form, why some storms have exceptional amounts of precipitation like the Colorado storm, and what kinds of storms and global circulation patterns typically affect their community.

NGSS DIMENSIONS (GRADES 6-8)

- Water continually cycles among land, ocean, and atmosphere via evaporation, condensation, and precipitation. Global movement of water and its changes are propelled by sunlight.
- Ask questions that can be investigated within the scope of the classroom and outdoor environment.

Teacher Procedures

Introduce the Anchoring Phenomenon

1. **Introduce the new unit on weather.** Students should have some prior understanding of water cycling and its role in weather formation. This lesson will build upon that understanding. (It may be helpful to review the water cycle together using a diagram your students are familiar with.) Your introduction should take into account where your students are in their learning about water cycling and weather.

   An example introduction could be:
   "Severe weather can put people's lives and property at risk. If we can predict when severe weather is likely to happen, we can help people be better prepared when it happens. In this unit, we are going to explore where, when, and why storms form and how we can predict the ways in which they might impact communities, especially by bringing heavy rain or snow."

2. **Watch the video of the Colorado storm.** Before showing the video, ask students to think about the different ways communities are affected by precipitation or a lack of precipitation. Help students identify a few ways our communities are uniquely dependent on precipitation. Then show the video.

CASE STUDY: COLORADO FLOODS

In September 2013, a storm stalled over the region around Boulder, Colorado bringing a weeklong deluge of rain, resulting in dangerous floods.

Video: How the City's Resilience Strategy Saved It
(http://scied.ucar.edu/video/boulder-colorado-flood-how-citys-resilience-strategy-saved-it)

Before/After Images: What Flooding Looked Like in Boulder
(https://scied.ucar.edu/interactive/boulder-floods)

The video is 6 minutes, 48 seconds in length and provides a case study. For this lesson, focus on the first part of the video (up to 2:08). If you would like to show more of the video, the following break down and time codes are provided:

0:00-2:08—Introduction to the 2013 Colorado floods and past floods in this same area. Some effects are shown.

2:09-4:11—Engineering considerations related to managing future floods based on past experiences are addressed.

4:12—End of video on the 2013 flood and community resilience.

6:13—A cause is mentioned.

LESSON 1 STEP 1

3. **Discuss students' ideas about the causes of the storm.** Direct students to the *Lesson 1: Student Activity Sheet*. After watching the video, have students write their ideas in *Lesson 1: Step 1*. Allow students to share what they heard about causes of the precipitation in the video (e.g., a very slow-moving storm, an unusual amount of water vapor in the air) or their own ideas about what caused the heavy precipitation. As students share, wonder aloud: "Is that a cause of the storm or an effect from the storm?"

Suggested prompts for discussion:

- *Where did all the moisture over Colorado come from?*
- *What had to happen to make that moisture turn into rain?*
- *Has our community experienced too much or too little precipitation before?*

Note: Remind students to focus on what factors caused the rainstorm and not the flood.

Cause-Effect
Have students focus their ideas on the causes of precipitation. Students may also want to discuss the effect of precipitation on communities. A cause and effect organizer may be useful for structuring this discussion.

ELICITING PRIOR KNOWLEDGE AND EXPERIENCES

LESSON 1 STEP 2

1. **Broaden the discussion to other storms and precipitation.** Working in small groups, ask students to share their experiences of storms and precipitation in *Lesson 1: Step 2*. This can include their experiences with storm impacts such as flooding, damage to structures, or loss of power, as well as safety considerations such as avoiding lightning or floods. This is a great opportunity to incorporate any recent or significant local storm experiences that your students might remember into your discussion.

2. **Focus the discussion on water cycling and precipitation.** Students will bring a variety of experiences to the broadening discussion. As students share, elicit what they know about water cycling processes. As students share, record important ideas that students appear to agree upon. These ideas will be helpful leading into the modeling activity next.

Suggested prompts:

- *How do storms begin in the first place?*
- *What needs to happen so that rain or snow starts to fall?*
- *Why do some places get heavier precipitation but other places do not?*
- *Where does all the water come from before it falls as rain or snow?*

3. **Notice if your students have any misconceptions pertaining to a specific part of the water cycle.** For example, a common misconception is that clouds are made of water vapor instead of liquid water. Addressing any misconceptions now will aid your students as they progress through the lessons.

The Water Cycle
Elicit what students know about water cycling processes that lead to precipitation (ESS2.C).

MODELING STORM FORMATION

LESSON 1 STEP 3

1. **Prompt students to draw an initial model.** Their model in *Lesson 1: Step 3* should represent the factors they believe led to the unusual amount of precipitation in the area around Boulder, Colorado. Tell students to draw and label as much as they know about how storms form, including when and where, that can help them explain the Colorado storm. If students are not yet familiar with drawing graphic models, summarize the activity by explaining how their illustration is a model because it represents processes that happen on Earth. This type of model development is a consistent feature of GLOBE Weather.

LESSON 1 STEP 4

2. **Compare students' initial models.** Use small groups for students to share and compare their models. Ask students to compare similarities and differences between how each group member represented the storm in *Lesson 1: Step 4*. Then, groups summarize for the class what they noticed and wondered about as they compared their models. At the same time, support the discussion by doing the following:

    - Voice how the models make you wonder and question what's happening in the storm: *"This is really interesting, as we see all these different ideas about how this might work. It makes me think of lots of questions. I'm curious about all the ideas I didn't really think about before."*
    - Point out common features/mechanisms that students were using across models, such as clouds, wind, air, precipitation, and temperature differences. Consider recording these common features in a public space.

3. **Set the class mission.** After students share their models, tell them that more investigation is needed to better understand the cause of storm formation: *"We should try to figure out how all of this works to cause a storm."*

Developing a Model
Visual representations, like graphic models and concept maps, are one way to represent important relationships in a system.

Asking Questions
Students generate questions (collaboratively) to explore throughout the unit to better understand the phenomenon of storms and heavy precipitation.

DRIVING QUESTION BOARD

1. **Orient students to the Driving Question Board.** In a public space—either physical or digital—share the Driving Question Board with students. The Driving Question Board can be a bulletin board, a piece of butcher paper or chart paper posted on the wall, or a piece of paper projected on a document camera. A digital board is possible, but the purpose of the Driving Question Board is to publicly document students' questions. Therefore, the Driving Question Board should be visible to students throughout the unit. This is where the students post their questions and where students return to answer their questions throughout the unit. The Driving Question Board should have the unit driving question written at the top: *"What causes different kinds of storms?"*

LESSON 1 STEP 5

2. **Ask students to write and share questions.** Explain to students that by the end of the unit, they should be able to answer the driving question but that they also should have their own questions. Ask students to write their own questions related to the driving question and the Anchoring Phenomenon at the bottom of their activity sheet in *Lesson 1: Step 5.* Then have students share these initial questions in a small group to refine the questions before posting them to the Driving Question Board.

3. **Post students' questions to the Driving Question Board.** Pass out sticky notes (or a comparable method) to groups of students and have them write their questions on the notes. Ask individual students or student groups to share their questions with the class. As student groups share their questions have them post the questions to the Driving Question Board.

Storyline Link
Brainstorming helpful investigations and data can serve as the bridge for transitioning to data analysis in the next lesson.

(Note: If you choose a digital option, be prepared to project the digital board for the whole class now and also revisit the digital board throughout the unit.)

4. **Organize questions on the Driving Question Board.** As you notice patterns emerge with student questions, help students to organize the questions around similar themes.

5. **Prompt students to brainstorm what data or information they need to answer their questions.** After students share their questions, focus students on: *"What sort of data could we analyze or what sort of investigations could we do in our class to help us answer our questions."* Ask students to take a moment to think about this, then record their ideas on a piece of chart paper or in a designated area on the Whiteboard and/or near the Driving Question Board (e.g., *"we need videos of storms and clouds, we need weather reports and data, maybe we need to do some experiments with water").*