

Storm Lab: What Makes a Thunderstorm?

Grades 6-8 · 45 minutes

Science



Slides, rubric and answer key

Print and go

No student accounts

NGSS MS-ESS2-5

What's included

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- A ten-minute walkthrough to rehearse before class, and background in plain words for the teacher
- A 45-minute lesson sequence: warm-up, direct instruction, guided practice, independent practice, closure
- Slides for the board: a PowerPoint file that also opens in Google Slides
- A student worksheet with a QR code
- A 3-question exit ticket, two to a page, with an answer key
- A rubric: 3 criteria, 4 levels, scored out of 12
- Differentiation for English learners, students with IEPs or 504 plans, and students who need more support or more challenge
- Cross-curricular extensions, and notes for teaching it in grades 4-5 and 9-12
- Standards: NGSS middle school earth science

Storm Lab: What Makes a Thunderstorm?

Grades 6-8 · 45 minutes · Science

Students make a thunderstorm from a hot, humid summer afternoon, then take its ingredients apart one at a time. A little drier air, and the result says the cap held; drier still, and only small clouds form; nothing to lift the air, and there is no storm at all. Then they fix days that make no storm, a capped spring day and a dry desert day, by changing one ingredient and predicting each result first. By the end, they can explain the three ingredients forecasters check for a thunderstorm, and why plenty of fuel is not enough on its own.

At a glance

ESSENTIAL QUESTION

What does the air need to make a thunderstorm?

OBJECTIVES

Students will be able to:

- name the three ingredients of a thunderstorm, moisture, instability and lift, and say what each one does
- explain how a cap of warm air can delay or stop a storm even when there is plenty of fuel
- predict what removing or adding one ingredient will do, then test it and record the result
- fix a day that makes no storm by changing one ingredient, and explain which ingredient was missing

VOCABULARY

moisture, instability, lift, cap, dew point, wind shear

STANDARDS

MS-ESS2-5

TIME AND MATERIALS

45 minutes, grades 6-8.

- One computer or Chromebook per student or pair
- A projector
- The worksheet and exit ticket, one copy each per student
- The rubric, one copy per student if you grade the project

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/stormlab?lesson=what-makes-a-thunderstorm&ref=tpt-stormlab-1 once on a student computer and press Make the storm, to check that your school's filter allows it. No account is needed.

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet's prediction table and the student's written explanation of one fixed day, scored with the rubric out of 12.

TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. The weather is worked out from rules, not a full simulation, so every computer gets the same result for the same settings. Students need no account and no email: the link works signed out, and nothing they make is stored on our server unless they choose to save it to an account. If your school blocks new sites, ask IT to allow mytekdev.com.

Before you teach: do it once yourself

Make the storms and fix the days yourself once before class, about ten minutes.

1. **Open the lesson.** Go to mytekdev.com/try/stormlab?lesson=what-makes-a-thunderstorm&ref=tpt-stormlab-1. The app opens on the Storm bench with a summer afternoon set. Press Make the storm: a tall cloud grows and the result reads **An ordinary thunderstorm**.
2. **Read the ingredients.** Scroll to **The ingredients** under the result. Moisture, instability, lift and the push through the cap are green; wind shear is not.
3. **Take one away.** Drag **Humidity near the ground** a little toward dry, a notch or two past where the word changes from humid, and make the storm: **The cap held**. Further toward dry: **Small clouds, no storm**. Press Undo until the humidity is back.
4. **Fix The cap holds.** Pick **The cap holds** under Start from a real kind of day and make the storm: **The cap held**. Press **wind blowing up a hillside** under What pushes the air up and make the storm again: **A supercell**.
5. **Look at Desert heat.** Pick **Desert heat** and make the storm: **No cloud**. Under the result, **What would make a storm** lists the one change that works alone: much damper air near the ground, about 45 percent humidity.



The Storm bench: the sky on the left, the example days, the result and the ingredients list on the right.

Every slider change clears the result, so students have to press Make the storm again. Run it again keeps the same sky and rolls the dice again, which can change whether a supercell makes a tornado, but not what kind of storm forms. Undo and Redo are at the top right.

Background in plain words

A thunderstorm starts when a bubble of air near the ground rises and keeps rising. Forecasters check three ingredients. Moisture: damp air makes a cloud soon after it starts rising, and turning vapor into cloud gives off heat that keeps the bubble warm. Instability: the air high up has to be cold enough that the rising bubble stays warmer than the air around it, so it keeps going up on its own. Lift: something has to push the air up to start it, such as the sun heating the ground, wind blowing up a hill, a sea breeze, a dry line or a cold front.

The cap is a layer of warmer air partway up. A bubble that reaches it is suddenly cooler than the air around it and stops, unless the lift pushes it through. Above the cap, the bubble is warm again and rises fast. That is why a capped day can have plenty of fuel and no storm, and why forecasters watch the cap all day: when something finally pushes through, the storms can be strong. How hard each kind of lift pushes in the app is the lab's own rule; the order, with the sun weakest and a cold front strongest, follows how forecasters describe them (cold fronts lift the air most abruptly). In the real air, the sun mostly works a different way: it warms the air near the ground through the day until rising bubbles can get through the lid on their own.

Wind shear, wind that changes with height, decides what kind of storm forms rather than whether one forms. With little shear, a storm stands straight up, its rain falls into its own updraft, and it dies within about an hour. With strong shear the storm tilts and can last for hours; the strongest kind, the supercell, rotates.

STUDENTS ASK	A GOOD ANSWER
Why does drier air stop the storm?	Drier air has to rise higher before it makes a cloud, so it stays cool longer and has less fuel. With less fuel, the sun's push is no longer enough to get it through the cap.
The desert is so hot. Why no storm?	Heat is not the same as moisture. The air is so dry that a bubble would have to rise about 15,600 feet before it made a cloud.
Why is wind shear not green, when there is a storm?	Shear is not needed to start a storm. It organizes storms and helps them last.
Is a stronger push always better?	It breaks the cap more easily, but what forms also depends on the wind. On The cap holds, a cold front makes a squall line and a hill makes a supercell.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 7	Warm-up Hook	Show the title, essential question and Today I can slides (about 1 minute). Then have students open the link or scan the QR code on the worksheet. The app opens on the Storm bench with a hot, humid summer afternoon already set. A short guide runs along the bottom: tell students to do its first step only, which is to press Make the storm and watch the sky, then wait. A tall cloud grows and the result reads An ordinary thunderstorm . Ask: "What did the air need to make this storm?"	Make the storm, watch the cloud grow, and answer the question.
7 to 17	Direct instruction (I do) Model it	Show the Three ingredients slide and the vocabulary. On the projector, scroll to The ingredients under the result. Each line has a dot: green means this sky has it. Read the first three: moisture, instability (the app also calls it fuel), and lift. Point out that Wind shear is not green, yet there is a storm: shear organizes storms and helps them last, but a storm can form without it, and this one rains itself out within about an hour. Then show The cap slide: a layer of warmer air partway up works like a lid, and the line The push is strong enough to break through the cap says whether the lift got a bubble through it. Today the sun heating the ground was enough. It's working when: The sliders for temperature, humidity, how fast it gets colder and the cap show words, not numbers (humidity also shows a percent). The All checkbox at the top shows the numbers; leave it off for this lesson.	Fill in worksheet step 2: the three ingredients, and which ones are green on the summer afternoon.
17 to 25	Guided practice (We do) Take one away	Together: before anyone moves a slider, students write a prediction for drier air. Then drag Humidity near the ground a little toward dry, a notch or two past where the word changes from humid, and press Make the storm. The result reads The cap held: the air still has fuel, but drier air has to rise further before it makes a cloud, and the sun's push no longer gets it through the lid. Drag it further toward dry and make the storm again: Small clouds, no storm, with almost no fuel. Put the humidity back (Undo works). Last, press nothing pushing the air up under What pushes the air up, and make the storm: No storm yet. Ask which ingredient was missing each time. Watch for: A slider change clears the result, so students have to press Make the storm again after every change. Run it again keeps the same sky with a new roll of the dice; it is not needed today.	Predict, then test three changes, and record each result and the missing ingredient in the table.

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
25 to 38	Independent practice (You do) Fix a day	Students pick a day under Start from a real kind of day. First The cap holds: make the storm and read why it failed (plenty of fuel, but the sun is not enough push to get through the strong lid). Students change one thing, writing a prediction first. Three single changes work: a stronger lift (wind blowing up a hillside, dry line, where desert air pushes into moist air or cold front), weakening the cap into the lower part of a firm lid or to a weak lid, or a little more humidity. Then Desert heat: No cloud, because the air is so dry a bubble would rise about 15,600 feet before it made a cloud. Students find that humidity alone has to rise from 10 percent to about 45 percent before a storm forms, far more than The cap holds needed; on the way there, the result reads The cap held. Walk the room and ask the questions under What to look for. Whenever a day makes no storm, the app shows What would make a storm under the result: the smallest single changes, measured by the app's model, each with a Try it button. Ask students to read it and press Try it only after their own prediction is written. Watch for: On The cap holds, weakening the cap or adding humidity makes a supercell, and with the lesson's starting settings the result is A supercell with a tornado, an EF3. Treat it like the rest of the lab: a science result, not a disaster. Some students may have lived through severe weather. How often a supercell makes a tornado in the app is the lab's own rule: forecasters can say when the air is the kind that has made strong tornadoes before, but not which storm will make one, and as few as 20 percent of supercells do. Watch for: The Thunderstorm, Hurricane and Winter storm buttons switch kinds of storm. Keep everyone on Thunderstorm.	Fix The cap holds and Desert heat , one change at a time, writing each prediction before Make the storm . Then write which ingredient each day was missing.
38 to 45	Closure Explain it, and exit ticket	Show the last slide and ask: "There was plenty of fuel under the cap. Why did nothing happen until something changed?" (A bubble has to be pushed through the warm lid before it can rise on its own. The sun alone was not enough push; a hill, a dry line or a front pushes harder, and a weaker lid needs less push.) Ask the essential question again, then hand out the exit ticket.	Answer out loud, then answer the exit ticket on their own.

What to look for

Ask these while students work. A student who has understood the lesson can answer them without help:

- Which three ingredients does a thunderstorm need? Point to them on the screen.
- You made the air drier. Which ingredient did that change?
- The desert day is very hot. Why does it make no storm?
- There was plenty of fuel under the cap. Why did nothing happen until something changed?
- Before you press **Make the storm**: what will this change do?

The fourth one is the real test. A student who can explain why fuel is not enough on its own understands the cap, which is the part forecasters watch most closely on a stormy afternoon.

Cross-curricular extensions

- Math: the app's cloud base comes from a forecasters' rule of thumb, about 125 meters of rise for each degree Celsius between the temperature and the dew point. If the air is 30 degrees and the dew point is 20, about how high is the cloud base? (About 1,250 meters.)
- Science: a dry line is where hot, dry desert air meets warm, moist air. Why would that push air up? (The dry air is denser and lifts the moist air ahead of it.)
- Science: look up a weather forecast for a stormy day and find the words they use: unstable, a cap, a front. Which ingredients is the forecaster talking about?
- Writing: write a weather forecast for one of the example days, using the three ingredients to explain your forecast.

Vocabulary

moisture	Water vapor in the air. Damp air makes a cloud sooner as it rises.
instability	When a rising bubble of air stays warmer than the air around it, so it keeps rising. The app calls it fuel.
lift	Something that pushes air up to start it rising: the sun heating the ground, a hill, a sea breeze, a dry line or a cold front.
cap	A layer of warmer air partway up that works like a lid. A rising bubble has to be pushed through it.
dew point	The temperature air must cool to before its water vapor turns into cloud. The closer it is to the air temperature, the damper the air.
wind shear	A change in the wind's speed or direction with height. It organizes storms but is not needed to start one.

Differentiation

ENGLISH LEARNERS

- Post the vocabulary with a picture for each word: a damp cloud, a rising bubble, a hill pushing air up, a lid.
- Model each step on the projector before students try it, and point at the slider as you name it.
- Let students record results by copying the result's title from the screen.

STUDENTS WITH IEPs OR 504 PLANS

- Where the IEP allows a modified assignment, fix one day instead of two.
- Pair students: one moves the slider, the other presses Make the storm and reads the title aloud.
- Raise the browser zoom so the result text is easier to read.
- Read the exit ticket aloud, or let students answer by pointing at the ingredient on their screen.

STUDENTS WHO NEED MORE SUPPORT

- Give a sentence starter for the table: "I think ... will happen because ..."
- Write the three ingredients on the board with a picture for each.
- Check in at minute 30: is the student pressing Make the storm after every change?

STUDENTS READY FOR MORE

- Try `Cool gray day`. No single change makes a storm there. Find two changes that do, and explain why it needed both.
- Turn on the All checkbox and read the fuel (CAPE) and the push needed (CIN) under the result. How do they change when you weaken the cap?
- On The cap holds, try each kind of lift in turn. Which ones break the cap, and what do they make?

Adapting for other grades

Younger students: For grades 4 and 5, do the take-one-away test together on the projector, fix The cap holds as a class, and score only the first two rubric rows (out of 8; 6 or more meets the objectives).

Older students: For grades 9 to 12, turn on the All checkbox and use the numbers: record the fuel (CAPE) and the push needed (CIN) for each change, and explain the cap as a comparison between the lift's push and the CIN.

Student worksheet

Name: _____ Date: _____



Open the app: scan the QR code, or go to mytekdev.com/try/stormlab?lesson=what-makes-a-thunderstorm

Essential question: What does the air need to make a thunderstorm?

1. **Make the storm.** Press Make the storm. The result says: _____
2. **Read the ingredients.** The three ingredients are _____, _____ and _____.
3. **Predict, then test.** Change one thing at a time. Write your prediction before you press Make the storm.

CHANGE	I PREDICT	THE RESULT SAYS	MISSING INGREDIENT
Summer afternoon: a little drier			
Summer afternoon: no lift			
The cap holds: my change			
Desert heat: my change			

1. There was plenty of fuel under the cap. Why did nothing happen until something changed?

2. Why did Desert heat need so much more humidity than The cap holds?

Exit ticket

Name: _____

1. Which of these is NOT one of the three ingredients of a thunderstorm? (A) moisture, (B) lift, (C) wind shear, (D) instability.
2. A day has plenty of fuel, but a strong cap. The only lift is the sun heating the ground. What is most likely? (A) a thunderstorm, (B) no storm, (C) a hurricane.
3. A very hot day makes no cloud at all. Which ingredient is most likely missing, and what would you change?

Exit ticket

Name: _____

1. Which of these is NOT one of the three ingredients of a thunderstorm? (A) moisture, (B) lift, (C) wind shear, (D) instability.
2. A day has plenty of fuel, but a strong cap. The only lift is the sun heating the ground. What is most likely? (A) a thunderstorm, (B) no storm, (C) a hurricane.
3. A very hot day makes no cloud at all. Which ingredient is most likely missing, and what would you change?

Answer key: exit ticket

Measured in the app with the lesson's starting settings: the summer afternoon makes an ordinary thunderstorm; a little drier, the cap held; drier still, small clouds and no storm; with nothing pushing the air up, no storm yet. The cap holds makes a storm with a hillside, a dry line or a cold front, with the cap weakened to a weak lid, or with a little more humidity. Desert heat makes no cloud, and humidity alone has to rise from 10 percent to about 45 percent before a storm forms.

QUESTION	ANSWER	WHY
1	C	Wind shear organizes storms but is not needed to start one. The three ingredients are moisture, instability and lift.
2	B	The bubble has to be pushed through the warm lid first, and the sun alone is not enough push under a strong cap.
3	Moisture. Make the air near the ground damper	Full credit for naming moisture and a change that adds it. Very dry air has to rise very high before it makes a cloud.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Predicts, then tests	Every prediction was written before Make the storm and has a result, and the student explains the one that surprised them most.	Every prediction was written before Make the storm and has a result.	Results are written, but some predictions are missing or were written after.	Sliders were changed, but nothing is written down.
Names the ingredients	Names moisture, instability and lift, says what each does, and explains how the cap can delay or stop a storm with plenty of fuel.	Names moisture, instability and lift and says what each does.	Names some of the ingredients, or names them without saying what they do.	Cannot yet name an ingredient.
Fixes a day	Fixes both days and explains which ingredient each was missing, including why Desert heat needed so much more humidity.	Fixes one day by changing one ingredient and names what was missing.	Makes a storm, but changed several things at once or cannot say what was missing.	Does not make a storm on either day.

Total: ____ / 12. A score of 9 or more meets the objectives.

Standards

This NGSS middle school standard asks students to collect evidence of how the motions and interactions of air masses change the weather. Students change the air near the ground, the air above it and what lifts it, and record which conditions make a thunderstorm.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	MS-ESS2-5	6-8	Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.	Students change the warm, moist air near the ground, the air above it and what lifts it, and collect evidence of which conditions make a thunderstorm.

Checked October 2026 against: NGSS MS-ESS2-5.

Optional: save student work in a free class

The whole lesson runs at the link on the worksheet, with no accounts and no sign-up. Work stays in the browser tab until it is closed.

To keep students' work, and see every student's storm in one place, make a free class. It takes about ten minutes, once, and covers every lesson in this series: mytekdev.com/tools/class-setup

Students in a class open mytekdev.com/tools/storm-lab/lessons/what-makes-a-thunderstorm/start instead of the worksheet link. Each one gets their own copy of the summer afternoon, and the same link reopens it next time. A student who started at the worksheet link and then signs up keeps what they made.

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