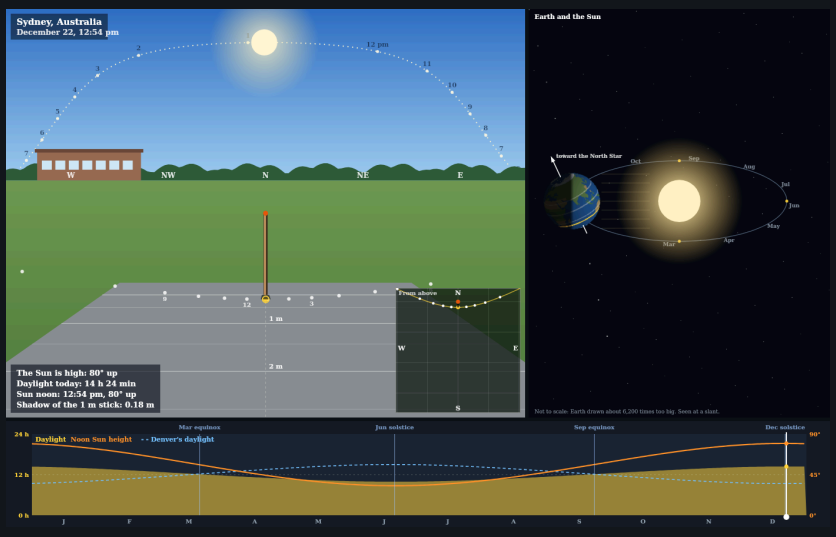
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# Sun and Seasons Lab: Opposite Seasons

## Grades 6-8 · 45 minutes

Earth and space science · Astronomy




**Slides, rubric and answer key** **Print and go** **No student accounts**

**Chromebook friendly**

**What's included**

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- 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 and a four-town table
- 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 and 5 and in high school Earth and space science
- Standards: NGSS and Texas TEKS

# Sun and Seasons Lab: Opposite Seasons

Grades 6-8 · 45 minutes · Earth and space science, Astronomy

On December 22 Denver has winter, Sydney has summer, Quito on the equator has no big seasons at all, and in Tromso, Norway the Sun does not rise. Students visit all four on the same day, then press June solstice and watch Tromso's Sun stay up all night. Then they break the model: an axis that turns to face the Sun gives the north summer all year, and a tilt of zero gives almost every place 12 hours of daylight all year. The Sunlight chapter's size test puts numbers on it, town by town.

## At a glance

### ESSENTIAL QUESTION

**Why do Sydney, Quito and Tromso have such different seasons on the same day?**

### OBJECTIVES

Students will be able to:

- explain why the northern and southern halves of Earth have opposite seasons, using the direction of the tilted axis
- describe the year near the equator and near the poles, and explain the difference from the tilt
- predict the season at a place from Earth's place on its orbit, and Earth's place from a season and a town
- use the wrong axis and a tilt of zero to show that the tilt, keeping its direction, makes the seasons

### VOCABULARY

Hemisphere, Equator, Midnight sun, Polar night, Tilt

### STANDARDS

MS-ESS1-1, 112.26(b)(9)(A)

### TIME AND MATERIALS

45 minutes, grades 6-8.

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

### PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/sunseasonslab?lesson=opposite-seasons&ref=tpt-sunseasonslab-4 once on a student computer: it opens on Denver on December 22 at noon, with every control showing. Pick Sydney, Quito and Tromso in the Town list, press `June solstice`, then open `Tilt and Orbit` and try `The wrong axis` and the tilt slider, about ten minutes.

### ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet, scored with the rubric.

### TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. Students need no account and no email: the link works signed out, and nothing they do is stored on our server unless they choose to save. The app never reads where a device is: a town is picked from a list or a map.

## Lesson sequence

| MINUTES | STAGE | WHAT YOU DO | WHAT STUDENTS DO |
|---|---|---|---|
| 0 to 5 | **Warm-up**<br>Hook | Show the title, essential question and Today I can slides (about 1 minute). Then the warm-up: is it winter everywhere on December 22? Collect guesses about Australia, the equator and the Arctic. | Answer the warm-up on the worksheet. |
| 5 to 12 | **Direct instruction (I do)**<br>Model it | Project the app. In Tilt and Orbit, point at the arrow toward the North Star: it points the same way all year, so in December the south end leans toward the Sun. Show Tromso, Norway on June 21, then The wrong axis.<br><br>> **It's working when:** Hold a globe tilted with its axis pointed at one wall and walk it around a chair. Keep the axis on the wall: students often turn it to face the chair, which is the wrong axis. | Fill in the vocabulary. |
| 12 to 22 | **Guided practice (We do)**<br>Around the world together | Students open the link or scan the QR code. The guide asks them to pick Sydney, Quito and Tromso, press June solstice, open Tilt and Orbit, turn on the wrong axis, drag the tilt to zero, then set the real tilt and open Sunlight.<br><br>> **Watch for:** Students who leave the tilt at zero when they open Sunlight. The size test then shows almost no seasons anywhere; send them back to Real tilt. | Follow the guide and fill in the season and daylight for each town. |
| 22 to 38 | **Independent practice (You do)**<br>Four towns | Students fill in the four-town table: the season on December 22, the daylight on December 22 and June 21, and the size test in Sunlight for each town. Then the puzzles What season is it? and Place Earth. Walk the room with the What to look for questions.<br><br>> **If they ask:** "Quito's day is about 12 hours long on every one of the four days. What does that tell you about seasons on the equator?" Quito | Fill in the table and solve the two puzzles. |
| 38 to 45 | **Closure**<br>Showcase and exit ticket | Show the Showcase slide. Go back to the warm-up guesses. Hand out the exit ticket. | Answer the exit ticket. |

## Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/sunseasonslab?lesson=opposite-seasons&ref=tpt-sunseasonslab-4. Denver on December 22 at noon, with every control showing: the heading says Winter in Denver, 9 hours 21 minutes of daylight, the noon Sun 27 degrees up.

1. **Sydney.** Pick Sydney, Australia in the Town list. The same day: Summer in Sydney, 14 hours 24 minutes, the noon Sun 80 degrees up. Look north to see it.
2. **Quito.** Pick Quito, on the equator: No big seasons, 12 hours 8 minutes of daylight, the noon Sun 67 degrees up.
3. **Tromso.** Pick Tromso, Norway: the Sun does not rise today. Press `June solstice`: daylight all 24 hours.
4. **Break the model.** Open `Tilt and Orbit`, turn on `The wrong axis` (summer all year in the north), turn it off, and drag the tilt slider to 0 (about 12 hours of daylight everywhere).
5. **The size test.** Press `Real tilt`, open `Sunlight`, and pick each town. Denver: a summer day gets 3.1 times the sunlight of a winter day. Sydney: 2.7 times. Quito shows only the distance row. Tromso: winter gets none.

> Moving to another town keeps the date and the clock time, in that town's own time zone, so every town is on the same calendar day.

## Background for the teacher

Earth's axis is tilted about 23.4 degrees and keeps pointing the same way, toward the North Star, all year. In December the south end leans toward the Sun, so the southern half of Earth has the high Sun and the long days: summer. In June it is the other way round. One Earth at one distance has two opposite seasons.

Near the equator the noon Sun is high all year and the day stays close to 12 hours, so there are no big seasons; Quito's day runs from 12 hours 7 minutes to 12 hours 8 minutes. Near the poles the tilt is extreme: in Tromso, at 69.6 degrees north, the Sun stays up from mid-May to late July and does not rise from late November to mid-January.

Two tests of the cause. An axis that always leaned toward the Sun, which is what students mean by "the axis flips", would give the north a June day every day: 14 hours 59 minutes and a 74 degree noon Sun in Denver on December 22. With no tilt at all, almost every place would get about 12 hours of daylight all year and there would be no real seasons, only the small 7 percent change from distance, for the whole Earth at once.

## What to look for

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

- Which end of the axis leans toward the Sun in December? How can you tell in the picture?
- Why does Quito have no big seasons?
- Why does Tromso get no sunrise in December and no sunset in June?
- What did the wrong axis do to Denver's year?
- With no tilt, what would Denver's seasons be like?

> The first question is the real test: a student who points to the arrow toward the North Star and says it never turns has the model.

## Cross-curricular extensions

- Math: in the size test, Denver's summer day gets 3.1 times the sunlight of a winter day. Is that more or less than Sydney's 2.7? Why might that be?
- Geography: find three cities near the equator and say what their year is like.
- Social studies: how do people in Tromso live through two months with no sunrise?
- English: write a postcard from Sydney on December 25 to a friend in Denver.

## Vocabulary

| | |
|---|---|
| **Hemisphere** | Half of Earth. The northern hemisphere is north of the equator, the southern hemisphere south of it. |
| **Equator** | The line around the middle of Earth, halfway between the poles. Quito is almost on it. |
| **Midnight sun** | Summer days far north or far south when the Sun does not set at all. |
| **Polar night** | Winter days far north or far south when the Sun does not rise at all. |
| **Tilt** | How far Earth's axis leans: about 23.4 degrees. It keeps pointing the same way, toward the North Star, all year. |

## Differentiation

#### ENGLISH LEARNERS

- Keep the vocabulary slide up, and point north and south on a globe as you say "northern" and "southern".
- Pair each learner with a partner; the table is season words and numbers from the screen.
- Accept the explanation as a labeled drawing of Earth in December with the axis and the Sun.

#### STUDENTS WITH IEPS OR 504 PLANS

- Pair students, one at the controls and one recording.
- Zoom the browser to 150%.
- Allow Denver and Sydney only where the IEP allows a modified assignment.

#### STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "In December the ___ end of the axis leans toward the Sun, so ___ has summer."
- Fill in Denver's row of the table together.
- Walk the globe around a chair at the front again before the independent work.

#### STUDENTS READY FOR MORE

- Solve Midnight sun and No tilt in Puzzles, and explain each answer.
- Drag the tilt slider to 60 degrees and describe Denver's year. Where would the midnight sun reach?
- Pick your own town and Sydney and compare the year graphs: when are the two lines the same?

### Adapting for other grades

**Younger students:** In grades 4 and 5, visit the four towns and compare the day length only; the cause of seasons is beyond grade 5, so leave out the wrong axis and the tilt slider. Drop the third rubric row; total 8, and 6 meets the objectives.

**Older students:** In high school, switch the level to High school, read the size test in W/m2, and use the tilt card for the tilt's slow swing between about 22.1 and 24.5 degrees over 41,000 years (HS-ESS2-4).

# Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/sunseasonslab?lesson=opposite-seasons

Essential question: Why do Sydney, Quito and Tromso have such different seasons on the same day?

Warm-up: Is it winter everywhere on December 22? Where might it be summer? _____

1. **Vocabulary.** Hemisphere, equator, midnight sun, polar night, tilt: write each in your own words.

2. **Four towns.** For Denver, Sydney, Quito and Tromso: the season on December 22, daylight on December 22 and on June 21, and the size test in Sunlight.

3. **Break the model.** With the wrong axis, Denver on December 22 had _____ of daylight. With a tilt of 0, it had _____.

1. Why does Sydney have summer in December? Draw Earth, its axis and the Sun.

2. Which of the four towns has the biggest difference between summer and winter, and why?

## Exit ticket

Name: _____

1. On December 22, Sydney, Australia has (A) winter (B) summer (C) no seasons at all

2. If Earth's axis were not tilted at all, Denver would have (A) bigger seasons (B) about 12 hours of daylight all year and no real seasons (C) summer all year

3. Why does Quito, on the equator, have no big seasons?

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## Exit ticket

Name: _____

1. On December 22, Sydney, Australia has (A) winter (B) summer (C) no seasons at all

2. If Earth's axis were not tilted at all, Denver would have (A) bigger seasons (B) about 12 hours of daylight all year and no real seasons (C) summer all year

3. Why does Quito, on the equator, have no big seasons?

# Answer key: exit ticket

| QUESTION | ANSWER | WHY |
|---|---|---|
| 1 | B | In December the south end of the axis leans toward the Sun: 14 hours 24 minutes of daylight and a noon Sun 80 degrees up. |
| 2 | B | With no tilt the Sun would sit over the equator every day. The puzzle No tilt and the slider both show it. |
| 3 | The Sun is high all year | The noon Sun stays high and the day stays close to 12 hours all year, so the sunlight hardly changes. A full answer names the day length. |

## Rubric

Score each row from 1 to 4.

Name: _____

| CRITERIA | 4 EXCEEDS | 3 MEETS | 2 APPROACHING | 1 BEGINNING |
|---|---|---|---|---|
| **Data** | All four towns with the season, both daylight lengths and the size test, and both puzzles solved. | All four towns with the season and both daylight lengths. | Two or three towns. | No data. |
| **Model** | Draws Earth in December and in June with the axis pointing the same way, the Sun, and the hemisphere having summer shaded each time. | Draws Earth in December with the axis and shades the southern summer. | Draws Earth with no axis, or an axis that turns to face the Sun. | No drawing. |
| **Explanation** | Explains opposite seasons from the axis keeping its direction, Quito's year from the high Sun all year, and what the wrong axis and a tilt of zero showed. | Explains opposite seasons from the axis and Quito's lack of big seasons. | Explains one town with no reason. | No explanation. |

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

## Standards

The lesson is built for MS-ESS1-1, the seasons part, and its evidence statement: the tilted axis keeps its direction, the two hemispheres have opposite seasons, and the season is predicted from the positions and the positions from a season. Texas TEKS 112.26(b)(9)(A) is the grade 6 standard for the seasons (2021 adoption).

| FRAMEWORK | CODE | GRADES | STANDARD | HOW THE LESSON MEETS IT |
|---|---|---|---|---|
| NGSS | **MS-ESS1-1** | 6-8 | Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. | Students use the model to describe opposite seasons in the two hemispheres from the tilted axis keeping its direction, and predict the season from the positions and the positions from a season. |
| Texas TEKS | **112.26(b)(9)(A)** | 6 | Model and illustrate how the tilted Earth revolves around the Sun, causing changes in seasons. | Students model the tilted Earth going round the Sun and illustrate why the two hemispheres, the equator and the poles have different seasons on the same day. |

Checked November 2026 against: NGSS MS-ESS1-1, Earth's Place in the Universe, NGSS MS-ESS1-1 evidence statement (June 2015), Texas Administrative Code, 19 TAC 112.26, Science, Grade 6, Trumper 2001, A cross-age study of senior high school students' conceptions of basic astronomy concepts, Research in Science and Technological Education 19(1).

## 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.

To keep students' work, and see it all 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/sun-and-seasons-lab/lessons/opposite-seasons/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time. The Sheet button in the app collects their predictions, readings, puzzles and written answers to hand in.

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