



Mission Brief: Four Teams, Thirteen Lessons

DRIVING QUESTION

How do we know so much about places no one can visit, and where is Earth among them?

YOUR CHALLENGE

Build it. Make it work. Teach it. Your team is the class expert on three lessons, and your build is how you teach them.

THE PROJECT

The phenomenon

No one has ever touched a star or a galaxy. Almost everything we know about them reached Earth as light. Yet we know how the Moon formed, how the planets move, what powers the Sun, and how old the universe is. To see how, you need all of Module 6: the Moon, the solar system, the stars, and the galaxies. No one team can learn it all in time, so each team becomes the expert on one part and teaches it.

THE PROJECT

How it works

- Your group forms on your Scholar Dashboard and picks one focus.
- Each focus covers three Module 6 lessons.
- Each teammate leads one of your three lessons.
- In a group of four, the fourth teammate is the Verifier.
- Your team builds something that works.
- It is not a poster.
- It has to do something you can test.
- Your team keeps one shared group note in Note Studio.
- Everyone types in it at the same time.
- You photograph your build.
- When Dr. Ijezie approves the photos, they appear on the Module 6 page.
- On teach-back day your team teaches its three lessons with the build.
- Everyone learns all thirteen lessons.
- Each of you turns in the group note to the Assessment Center, like notes homework.

TEAMS

Four teams, four focuses

Three teams of three and one team of four. Every focus is part of the same driving question: how do we know about places no one can visit, and where is Earth among them?

TEAM	FOCUS QUESTION
Team 1 • Moon Watch Telescopes, the Moon, and the Sun-Earth-Moon system	How do we study the Moon from Earth, and why does it look different every night?
Team 2 • Planet Builders How the solar system formed, its planets, and its smaller objects	How did one spinning cloud become a Sun, eight planets, and a swarm of smaller objects?
Team 3 • Star Lab The Sun, measuring the stars, and how stars live and die	How can we measure a star we can never touch, and what decides how it lives and dies?
Team 4 • Galaxy Mappers The Milky Way, other galaxies, and the expanding universe	Where is Earth in the universe, and how do we know the universe is expanding?

TEAMS

Form your group

Groups form on your Scholar Dashboard. First come, first served: once a group takes a focus, no other group can take it.

1. Talk with your partners first and agree on the focus you want, plus a backup.
2. When Dr. Ijezie opens group forming, a pop-up appears on your Scholar Dashboard.
3. Your dashboard shows the opening time before then.
4. One person signs in to the Scholar Dashboard with their alias and PIN.
5. That person adds each partner by typing at least 3 letters of their alias.
6. Then they pick the group's focus and press Create group.
7. Taken focuses are crossed out.
8. Groups are 3 people.
9. One group in the class can have 4.
10. Everyone in the group now sees the group and focus on their own dashboard.
11. To change a group, talk to Dr. Ijezie.

Team roles

EVERY TEAM

Lead Investigator

- Runs the lab investigation and the build tests, and records every setting and reading.
- Keeps the team on schedule and checks each day's checkpoint in the group note.
- Leads one of your three lessons.

Hands the raw readings to the Data Analyst by the end of Day 2.

EVERY TEAM

Data Analyst

- Does the team's calculation and checks it with the self-check.
- Builds the data table in the group note, with units on every number.
- Leads one of your three lessons.

Hands a checked table and one finished calculation to the Communicator by the end of Day 3.

EVERY TEAM

Science Communicator

- Leads the build and takes the build photos for approval.
- Plans the teach-back so every lesson gets equal time.
- Leads one of your three lessons.

Uploads at least two approved-quality photos by the test day.

ONLY THE TEAM OF FOUR

Verifier

- Repeats every test and calculation on their own and settles differences.
- Checks every number in the group note against its source.
- Helps each lesson lead and builds the strongest argument against the team's claim before teach-back.

Turns in a one-page verification log with the team's products. In a team of three, the Analyst writes the uncertainty statement and the Lead writes the counter-argument.

What every team makes

- **Working build** (Presented in class · Day 4).
 1. The thing your team builds.

2. It must pass its 'It works when' tests at least twice.
- **Build photos** (Group note · Day 4).
 1. At least two clear photos of the build only (no faces or people), uploaded in your group note.
 2. Approved photos appear on the Module 6 page.
 - **Group note** (Note Studio → Assessment Center · Day 7).
 1. Your shared Note Studio group note: your three lessons, build plan, test data, results, teach-back plan, and each teammate's own contribution and reflection.
 2. Each of you turns in your copy like notes homework.
 - **Teach-back lesson** (Presented in class · Day 7).
 1. A ten-minute lesson: show the build working, then each lesson lead teaches their lesson with it and asks one check question.

Your Note Studio group note

Open Note Studio and choose **ESS Group Project**. Your team types in one shared note at the same time, and nobody can erase a teammate's section.

Build plan and materials

- Sketch description.
- Materials list.
- Who brings what.

What this lesson teaches (one per lesson)

- Two to four key ideas.
- Vocabulary.
- One example.
- The lesson lead writes this; teammates add.

Build log and test data

- Every try:
- Date.
- What you changed.
- Results with units.

What our build shows and what it leaves out

- Claim.
- Evidence from your tests.
- One limit of the build.

Teach-back plan and check questions

- Who teaches what.
- In what order.
- One check question per lesson with the answer.

What I did (each scholar, only you type here)

- Your own work on each day.
- Only you type here.

My reflection (each scholar, only you type here)

- What you learned from another team.
- One thing you would change.

Turn in your copy

Photos: at least two of the build only, no faces or people. Dr. Ijezie approves them before they appear on the Module 6 page. On teach-back day:

1. Each of you presses Update my turn-in copy.
2. Turn it in on the Assessment Center.

THE PLAN

Seven days, seven checkpoints

DAY	WHAT HAPPENS	CHECKPOINT
Day 1 Thu, May 6	Form up and plan. Know your three lessons and plan the build. • Form your group on the Scholar Dashboard. • Pick your focus. • Open your group note in Note Studio. • Choose who leads each lesson. • Read your three lessons and your slides from the module deck. • In the note, write two key ideas from each. • Sketch the build. • List the materials.	Group note: lesson leads chosen, two key ideas per lesson, build sketch and materials list.
Day 2 Mon, May 10	Learn deeply. Become the expert on your lesson. • Each lesson lead fills in their lesson section: key ideas, vocabulary, one example. • Run your team's lab investigation. • Record every reading. • Gather materials.	Every lesson section filled in; lab readings recorded with units.
Day 3 Tue, May 11	Build. Build the thing and make it run once. • Build it. • Follow your build steps. • Try it once. • Write what happened and what you will fix. • Take progress photos (build only, no faces).	Build log in the group note; first try recorded.
Day 4 Wed, May 12	Test and photograph. Prove it works. • Run every 'It works when' test at least twice. • Record results with units. • Upload at least two photos of the finished build in the group note. • Do your team's calculation. • Check it.	Test data complete; two photos uploaded for approval.

DAY	WHAT HAPPENS	CHECKPOINT
Day 5 Thu, May 13	Improve and plan the lesson. Fix what failed and plan how to teach. - Fix one thing that did not work. - Test again. - Plan the ten-minute teach-back: two minutes of demo, then each lesson lead teaches with the build. - Write one check question per lesson, with an answer key.	Teach-back plan and three check questions in the group note.
Day 6 Mon, May 17	Rehearse. Practise until it runs smoothly. - Rehearse with another team. - They give one strength, one question, one fix. - Every teammate practises every part, not only their own lesson. - Each of you writes your own contribution and reflection in the group note.	Rehearsal feedback written; every teammate's contribution filled in.
Day 7 Tue, May 18	Teach-back day. Teach your lessons and learn all the others. - Each team teaches for ten minutes with its build. - Everyone takes learning notes. - Everyone answers every check question. - Press 'Update my turn-in copy' in the group note. - Turn it in to the Assessment Center. - Last-day partner review in the Assessment Center.	Teach-back given; learning notes; group note turned in; partner review done.

Moon Watch

FOCUS QUESTION

How do we study the Moon from Earth, and why does it look different every night?

The Moon is the closest world and one of the first that people studied with a telescope. Your team teaches how astronomers collect light, what the Moon is like and how it formed, and how the Sun, Earth, and Moon line up to make phases and eclipses.

Your lessons

1. Tools of Astronomy

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

2. The Moon

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

3. The Sun-Earth-Moon System

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

Also read: Module 6 Slides — Earth in Space: Orbits, Starlight, and the Architecture of the Cosmos. Read the slides "One Face, Many Phases" and "Tides — Differential Gravity in Action", and the trap about Moon phases (vantage or shadow?). Your phase stage teaches them.

Big ideas you will use

- A telescope's main job is to collect more light than your eye can. Bigger lenses or mirrors collect more light and show fainter things.
- Most of the Moon's craters were made by impacts. With almost no air and no liquid water to wear them down, the Moon can keep its craters for billions of years.
- Most scientists think the Moon formed from debris thrown out when a body about the size of Mars hit the young Earth.
- Sunlight always lights half of the Moon. A phase is how much of that lit half we can see, and eclipses are rare because the Moon's orbit is tipped about 5°.

BUILD IT

Moon Watch stations: telescope, crater tray, and phase stage

Build three working stations. Classmates use them to see like an astronomer, make Moon craters, and watch the phases happen.

Materials

- Two convex lenses (a weak one with a long focal length and a strong one with a short focal length) and two cardboard tubes that slide one inside the other
- Tape, a ruler, and a large printed letter chart
- A plastic tub with 3 cm of flour, dusted on top with cocoa powder
- A marble or small ball and a metre stick
- A lamp with an LED bulb or a bright flashlight (the Sun), and a foam or tennis ball on a pencil (the Moon) with a small sticker on it (your base)
- Masking tape and a stopwatch

Your model must show

1. Tools of Astronomy: the telescope makes a far chart look bigger. Its magnification is the objective focal length $\div$ the eyepiece focal length.
2. The Moon: a faster impact (a higher drop) makes a wider crater and throws out bright rays, like the craters on the Moon.
3. The Sun-Earth-Moon System: half the ball is always lit, the phase you see depends on where the ball is, and the sticker base is dark for about half of each trip.

Build steps

1. Find each lens's focal length: hold it so the image of a window is sharp on paper, and measure from the lens to the paper.
2. Tape the weak lens in the front tube and the strong lens in the back tube.
3. Slide the tubes until the far chart is sharp.
4. Smooth the flour 3 cm deep and dust cocoa on top.
5. Drop the same marble from 0.5 m, 1.0 m, and 1.5 m onto fresh spots.
6. Measure each crater's width from rim to rim.
7. Stand 2 m from the lamp and tape 8 marks on the floor around you, one for each phase.
8. Hold the ball at arm's length with the sticker toward you and turn slowly in a full circle in 60 seconds.
9. Label each station with its lesson and one sentence on what it shows.

It works when

- Through your telescope, a letter chart at least 5 m away looks bigger (and upside down), and you can read at least one line smaller than you can with your eyes alone.
- Crater width grows with drop height in both trials. Record the widths in mm for 0.5 m, 1.0 m, and 1.5 m.
- The sticker base is dark for 24 to 36 seconds of the 60-second turn (40% to 60%), in both trials.

Test it: Run each station twice. Record both focal lengths in cm and the smallest chart line you can read, the crater widths in mm at each height, and the seconds the sticker is lit and dark. Then scale the dark time to the 29.5-day cycle.

Safety: Never point the telescope or any lens at the Sun: it can blind you in an instant. Wear goggles at the crater tray, and drop the marble while standing on the floor, not on a chair. Use an LED bulb or a flashlight so nothing gets hot, tape down cords, and turn slowly.

Orbit & Starlight Explorer: Investigation 2, The Missing Eclipses

1. Open the Orbital System scene and set Focus to Earth–Moon.
2. Drag Moon elongation to 0° , 90° , 180° , and 270° .
3. At each one, record the phase name, the percent lit, and the day of the 29.53-day month from the Moon line.
4. Turn the 5.1° lunar inclination + line of nodes toggle OFF.
5. Step the Moon to new (0°) and to full (180°).
6. Record what the Eclipse line says.
7. Say why a flat model predicts too many eclipses.
8. Turn the toggle back ON.
9. Set Camera to Edge-on and watch the Moon pass above and below the shadow cones.
10. Change Day of year until the Eclipse line says an eclipse is possible at new or full moon.
11. Record those days and explain eclipse seasons.
12. Turn on tide-raising vectors.
13. Record the Tides line at new moon, first quarter, and full moon.

Calculate: Telescope magnification and the length of a lunar night

1. Your telescope's front lens (the objective) focuses at 30 cm and its eyepiece at 5 cm.
2. Find the magnification: objective $\div$ eyepiece.
3. Next, the Moon goes once around Earth in 27.32 days, and Earth goes once around the Sun in 365.25 days.
4. Find the phase cycle: $1 \div (1/27.32 - 1/365.25)$.
5. A spot on the Moon's equator is dark for about half of that cycle.
6. Find the night length in days and in hours.
7. Last, find how much energy, in kilowatt-hours, a base needs to run 40 kW all the way through that night.

Self-check: $30 \div 5 = 6$, so things look 6 times bigger. $1 \div 27.32 = 0.036603$ and $1 \div 365.25 = 0.002738$; $0.036603 - 0.002738 = 0.033865$; $1 \div 0.033865 = 29.53$ days, the same as NASA's Moon fact sheet. Night = $29.53 \div 2 = 14.77$ days; $14.77 \times 24 =$ about 354 hours; $354 \times 40 \text{ kW} =$ about 14,200 kWh.

Real data

- **The Moon's basic numbers** · NASA Space Science Data Coordinated Archive, Moon Fact Sheet. NASA lists a synodic period (the phase cycle) of 29.53 days, an orbit tipped 5.145° to the ecliptic, surface gravity of 1.62 m/s^2 , and a temperature range at the equator of 95 K to 390 K (about -290°F to $+240^\circ\text{F}$).
<https://nssdc.gsfc.nasa.gov/planetary/factsheet/moonfact.html> · Figures read from the NASA fact sheet on 2026-09-23.

- **How the Moon formed** · NASA Science, Moon Formation. NASA says a large body, named Theia, smashed into the young Earth and threw out material that became the Moon. Older ideas, that Earth captured the Moon or that the two formed from the same debris, fell out of favour after the Apollo missions. Apollo rocks showed the young Moon was covered by a deep ocean of magma.
<https://science.nasa.gov/moon/formation/> · Read on 2026-09-23. NASA's Moon Facts page (<https://science.nasa.gov/moon/facts/>) adds that the body was about the size of Mars.
- **Power through the lunar night** · NASA Glenn Research Center, NASA's Fission Surface Power Project Energizes Lunar Exploration. NASA's project aims for a reactor that makes 40 kilowatts of electrical power, stays under six metric tons, and works through lunar nights that NASA describes as 14-and-a-half Earth days long.
<https://www.nasa.gov/centers-and-facilities/glenn/nasas-fission-surface-power-project-energizes-lunar-exploration/> · Figures read from the NASA page on 2026-09-23.
- **Sunlight at the south pole** · NASA, NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation. NASA says the Moon's axis is tilted only 1.5 degrees, so at the south pole the Sun skims along the horizon. Higher ground, such as crater rims, gets longer periods of light. Some of the coldest craters dip to about -235°C (-391°F).
<https://www.nasa.gov/humans-in-space/nasas-artemis-base-camp-on-the-moon-will-need-light-water-elevation/> · Figures read from the NASA page on 2026-09-23.

The limit to test

1. Surviving the lunar night.
2. A base near the Moon's equator faces about two weeks of darkness at a time, and the ground cools to about 95 K (-178°C).

Two mission options to compare

- Land on a high crater rim near the south pole, where the Sun skims the horizon and NASA says astronauts would see longer periods of light (NASA's Artemis plan)
- Bring a small fission power plant that makes 40 kW day and night (NASA's Fission Surface Power project)

Your map hotspot

1. On your phase stage, mark the two spots where an eclipse could happen: new moon and full moon.

Trap to avoid

Moon phases are not Earth's shadow. The dark part of a quarter moon is the Moon's own night side, seen from an angle.

TEACH IT

Show your build working, then teach:

1. A telescope collects more light than your eye. Its magnification is the objective focal length $\div$ the eyepiece focal length.
2. Impacts made most of the Moon's craters. With almost no air or water to wear them down, they can last for billions of years.
3. Half the Moon is always lit. Phases are our view of that half, and one lunar day and night takes about 29.5 Earth days.

Check question: Why does a base on the Moon's equator face about two weeks of darkness at a time?

Texas standards

- **ESS.5C** Explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal. §112.49(c)(5)(C) *You compare the older and current ideas for the Moon's origin, including the collision of the young Earth with a Mars-sized body, using NASA's summary of the Apollo evidence.*
- **ESS.1G** Develop and use models to represent phenomena, systems, processes, or solutions to engineering problems. §112.49(c)(1)(G) *You build and use a telescope, a crater tray, and a Sun-Earth-Moon model.*
- **ESS.2A** Identify advantages and limitations of models such as their size, scale, properties, and materials. §112.49(c)(2)(A) *You name what each station gets right and what its size and scale leave out.*
- **6.9B** Describe and predict how the positions of the Earth, Sun, and Moon cause daily, spring, and neap cycles of ocean tides due to gravitational forces. §112.26(b)(9)(B) *Grade 6–8 foundation.*

Word bank: telescope · focal length · magnification · impact crater · phase · eclipse · synodic month · tide

Planet Builders

FOCUS QUESTION

How did one spinning cloud become a Sun, eight planets, and a swarm of smaller objects?

Your team covers four publisher lessons as three: how the solar system formed, the inner and outer planets side by side, and the asteroids, comets, and other objects left over. Your orbit table shows all three working.

Your lessons

1. Formation of the Solar System

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

2. The Inner Planets — and the Outer Planets

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

3. Other Objects in the Solar System

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

Also read: Module 6 Slides — Earth in Space: Orbits, Starlight, and the Architecture of the Cosmos. The deck has no planet slides, so your publisher lessons carry the planets. Read "The Tilt, Not the Distance" and the trap about seasons (distance or tilt?). They explain your Tilt Audit, where you test a Mars-like tilt.

Big ideas you will use

- The solar system formed from a spinning cloud of gas and dust. It flattened into a disk, the Sun formed at the centre, and small grains stuck together into planetesimals and then planets.
- Near the Sun only rock and metal could stay solid, so the inner planets are small and rocky. Past the frost line, ice could stay solid too, so the outer planets grew into giants.
- Planets farther from the Sun move more slowly and take longer to go around. Kepler found that a planet's year squared equals its distance cubed, in years and AU.
- Asteroids, comets, meteoroids, and dwarf planets are leftovers from the forming solar system. A comet's stretched orbit brings it close to the Sun, where its ice turns to gas and makes a tail.

BUILD IT

Orbit table: a working model of the solar system

Build a stretched-fabric gravity well with a heavy "Sun" in the middle. Use it to show how the solar system formed, why inner and outer planets move differently, and how comets travel.

Materials

- A large round frame: a hula hoop, a big embroidery hoop, or a wide laundry tub
- Stretchy fabric (spandex or lycra) and binder clips or strong tape to pull it tight
- A heavy ball for the Sun (a softball, or a can of food in a sock)
- Marbles of two sizes, plus a spoonful of small beads or dry rice
- A stopwatch and a tape measure
- Small sticky dots and a marker for the orbit and frost-line labels

Your model must show

1. Formation of the Solar System: beads swirled in all circle the same way and gather toward the centre, like the spinning cloud that built the Sun in the middle and the planets in a disk.
2. The Inner Planets — and the Outer Planets: a marble near the centre laps faster than a marble near the rim, like fast Mercury and slow Neptune.
3. Other Objects in the Solar System: a "comet" marble launched off-centre swings in close, speeds up, and swings back out on a stretched path.

Build steps

1. Stretch the fabric tight and even across the frame and clip it all the way round.
2. Set the heavy ball in the middle.
3. Mark two orbits with sticky dots: one about 10 cm from the Sun (rocky planets) and one near the rim (giant planets).
4. Mark the frost line between them.
5. Launch a marble with a sideways flick at each orbit.
6. Time 3 laps at each and find the seconds per lap.
7. Launch a "comet" marble from the rim, aimed to the side of the Sun, and watch where it moves fastest.
8. Swirl in a spoonful of beads and watch which way they circle and where they end up.

It works when

- In every trial, the inner marble takes fewer seconds per lap than the outer marble. Record the seconds per lap for each.
- A marble launched sideways makes at least 3 full laps before it reaches the centre.
- The "comet" marble moves fastest when it is closest to the Sun and slows down as it swings back out.

Test it: Run each launch at least twice. Record the orbit distance in cm, the time for 3 laps in seconds, and the number of laps before each marble reaches the centre.

Safety: Keep marbles and beads inside the frame, and pick up any that fall so no one slips. Keep the heavy ball low and set it down gently.

Orbit & Starlight Explorer: Investigation 1, The Tilt Audit

1. Open the Orbital System scene.
2. Set Axial tilt ϵ to 0° and Observer latitude to 45° .
3. Record the Day length and the Noon Sun altitude on Day of year 80, 172, 264, and 355.
4. Repeat all four readings at 23.5° , then at 25.0° , which is close to Mars's tilt.
5. The lab still uses Earth's orbit, so these readings show what a Mars-like tilt does, not Mars's real calendar.
6. Set Day of year to 3, in early January.
7. Record the Earth–Sun distance.
8. Earth is closest to the Sun then, in northern winter.
9. Distance is not the season machine.
10. Set Camera to Edge-on.
11. Write one sentence on what the fixed tilt means for a solar panel in winter.

Calculate: Kepler's third law: a planet's year from its distance

1. For a planet going around the Sun, $P^2 = a^3$, where P is its year in Earth years and a is its average distance in AU.
2. Mars is 1.524 AU from the Sun and Jupiter is 5.20 AU.
3. Find a^3 for each, then take the square root to find P . Change Mars's year into days (1 year = 365.25 days) and compare it with NASA's value.

Self-check: Mars: $1.524^3 = 3.540$; $\sqrt{3.540} = 1.881$ years; $1.881 \times 365.25 = 687.2$ days, close to NASA's 686.980 days. Jupiter: $5.20^3 = 140.6$; $\sqrt{140.6} = 11.86$ years. Check: $1.881^2 = 3.54$ and $11.86^2 = 140.7$.

Real data

- **Mars's basic numbers** · NASA Space Science Data Coordinated Archive, Mars Fact Sheet. NASA lists Mars at 1.524 times Earth's distance from the Sun, a year of 686.980 days, a day of 24.6597 hours, a tilt of 25.19° , sunlight of 586.2 W/m^2 (0.431 of Earth's), surface pressure of 6.36 millibars, and air that is 95.1% carbon dioxide. Mars comes as close as 206.650 million km to the Sun and goes as far as 249.261 million km (orbit eccentricity 0.0935; Earth's is 0.0167).
<https://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html> · Figures read from the NASA fact sheet on 2026-09-23.
- **Venus's basic numbers** · NASA Space Science Data Coordinated Archive, Venus Fact Sheet. NASA lists a surface pressure of 92 bars, an average temperature of 737 K (464°C), air that is 96.5% carbon dioxide, a black-body temperature of 226.6 K, a Bond albedo of 0.77, sunlight of $2,601.3 \text{ W/m}^2$, a year of 224.701 days, a backward spin of 5,832.6 hours, and a tilt of 177.36° .
<https://nssdc.gsfc.nasa.gov/planetary/factsheet/venusfact.html> · Figures read from the NASA fact sheet on 2026-09-23.
- **Jupiter's distance and sunlight** · NASA Space Science Data Coordinated Archive, Jupiter Fact Sheet. NASA lists Jupiter at 5.20 AU from the Sun, between 588.5 and 968.5 million km from Earth, with sunlight of 50.26 W/m^2 (0.037 of Earth's).
<https://nssdc.gsfc.nasa.gov/planetary/factsheet/jupiterfact.html> · Figures read from the NASA fact sheet on 2026-09-23.

- **A spacecraft built for Europa** · NASA Science, Europa Clipper. NASA reports that Europa Clipper launched on Oct. 14, 2024, will reach Jupiter in April 2030, and will make 49 close flybys of Europa. With its solar arrays open, it spans more than 100 feet (about 30 metres).

<https://science.nasa.gov/mission/europa-clipper/> · Figures read from the NASA page on 2026-09-23.

- **How Europa Clipper survives the radiation** · NASA Jet Propulsion Laboratory, How NASA Is Protecting Europa Clipper From Space Radiation. JPL says the science electronics sit inside an aluminum vault just under half an inch (1 cm) thick. The spacecraft makes wide loops around Jupiter to stay away from the worst radiation and flies past Europa nearly 50 times. Jupiter's magnetic field is 20,000 times as strong as Earth's.

<https://www.jpl.nasa.gov/news/how-nasa-is-protecting-europa-clipper-from-space-radiation/> · Figures read from the JPL page on 2026-09-23.

The limit to test

1. Sending a spacecraft to an outer planet.
2. Europa Clipper needs about five and a half years just to reach Jupiter (launch October 2024, arrival April 2030), and Jupiter's moon Europa sits inside strong radiation belts.

Your map hotspot

1. Mark the frost line on your orbit table, between the orbits of Mars and Jupiter.

Trap to avoid

Most solar system pictures are not to scale. The real planets are tiny dots separated by huge empty gaps.

Two mission options to compare

- Shield the most sensitive parts inside a metal vault, like Europa Clipper's aluminum vault, just under half an inch (1 cm) thick
- Stay out of the worst radiation: orbit Jupiter in wide loops and fly past Europa many times instead of orbiting it, as Europa Clipper does (49 planned flybys)

TEACH IT

Show your build working, then teach:

1. The solar system formed from a spinning disk of gas and dust. The Sun formed at the centre, and planets built up from grains that stuck together.
2. Inner planets are small, rocky, and fast. Outer planets are giants made mostly of gas and ice, and they are slow.
3. Asteroids, comets, and meteoroids are leftovers. A comet's stretched orbit carries it close to the Sun and back out, and some small objects hit Earth.

Check question: Why are the planets close to the Sun small and rocky, while the far planets are giants?

Texas standards

- **ESS.5A** Analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets. §112.49(c)(5)(A) *You model how a spinning cloud of gas and dust gathers into a Sun, planetesimals, and planets.*
- **ESS.5B** Identify comets, asteroids, meteoroids, and planets in the solar system and describe how they affect the Earth and Earth's systems. §112.49(c)(5)(B) *You identify planets, comets, asteroids, and meteoroids, and show how their orbits differ.*
- **ESS.1G** Develop and use models to represent phenomena, systems, processes, or solutions to engineering problems. §112.49(c)(1)(G) *You build and use a working orbit table.*
- **ESS.2C** Use mathematical calculations to assess quantitative relationships in data. §112.49(c)(2)(C) *You use Kepler's third law to calculate a planet's year.*
- **7.9A** Describe the physical properties, locations, and movements of the Sun, planets, moons, meteors, asteroids, comets, Kuiper belt, and Oort cloud. §112.27(b)(9)(A) *Grade 6–8 foundation.*
- **7.9B** Describe how gravity governs motion within Earth's solar system. §112.27(b)(9)(B) *Grade 6–8 foundation.*

Word bank: solar nebula · planetesimal · accretion · frost line · terrestrial planet · gas giant · comet · asteroid

Star Lab

FOCUS QUESTION

How can we measure a star we can never touch, and what decides how it lives and dies?

The Sun is the one star we can study up close. Your team teaches what powers the Sun, how astronomers measure the brightness, colour, and distance of other stars, and how a star's mass sets its whole life.

Your lessons

1. The Sun

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

2. Measuring the Stars

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

3. Stellar Evolution

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

Also read: Module 6 Slides — Earth in Space: Orbits, Starlight, and the Architecture of the Cosmos. Read "Reading Starlight — The H-R Diagram", "The Main Sequence — Mass Is the Master Variable", "Endings That Build Beginnings", the stellar endpoints summary, and the trap about brightness (temperature or area?). Your star-fate wheel is built from them.

Big ideas you will use

- The Sun is a star. It makes its energy in its core by fusing hydrogen into helium.
- A star's colour tells its surface temperature: blue-white stars are hot and red stars are cool.
- How bright a star looks depends on how much light it gives off and how far away it is. Twice as far away looks one-fourth as bright.
- A star's mass at birth sets its life. Sun-like stars end as white dwarfs; stars above about 8 Suns explode as supernovas and leave neutron stars or black holes.

Star Lab: pinhole Sun meter, starlight bench, and star-fate wheel

Build three working tools: one that measures the Sun's size safely, one that shows how distance changes a star's brightness, and a paper wheel that tells a star's life from its mass.

Materials

- Aluminium foil, a pin, a card with a hole cut in it, and white paper for a screen
- Two lamps with bare LED bulbs (shades off, no reflector), one bulb dimmed with a few layers of tissue
- A phone with a light-meter app your teacher approves (reads lux), or a classroom light sensor
- A metre stick and masking tape to mark distances
- Two paper plates or card circles, a paper fastener (brad), scissors, and markers

Your model must show

1. The Sun: the Sun's image through a pinhole gives its size. Image width $\div$ screen distance matches the Sun's width $\div$ its distance (about 0.0093).
2. Measuring the Stars: twice as far gives about one-fourth the light, so a dim light up close can look as bright as a bright light far away.
3. Stellar Evolution: turning the wheel to a mass shows that star's colour, lifetime, and ending.

Build steps

1. Tape foil over the hole in the card and poke one clean pinhole.
2. Outside, stand with your back to the Sun and hold the card so sunlight passes through the pinhole onto white paper 1.00 m behind it.
3. Measure the width of the bright circle in mm.
4. In a dim corner, first read the lux with both lamps off and subtract it from every reading.
5. Measure the lux at 25, 50, and 100 cm from the bright bulb.
6. Then move the meter toward the dim bulb until it reads what the bright bulb gave at 100 cm, and record that distance.
7. On the bottom circle, write five masses (0.3, 1, 2, 5, and 15 Suns) with each star's colour, lifetime, and ending.
8. Cut a window in the top circle and join the two with the brad.
9. Label each tool with its lesson and one sentence on what it shows.

It works when

- Your Sun image width $\div$ screen distance is between 0.0079 and 0.0107 (within 15% of 0.0093).
- Each time you double the distance from the bright light, the lux reading drops to between one-fifth and one-third.
- Two classmates set the wheel to 1 Sun and to 15 Suns and read the right lifetime and ending both times.

Test it: Run the Sun meter and the light bench twice each. Record the image width and the screen distance in mm, the lux at each distance, and the matching distance for the dim light in cm. Record each classmate's wheel answers.

Safety: Never look at the Sun, directly or through the pinhole. Look only at the image on the paper, with your back to the Sun. Do not stare into the bulbs. Use LED bulbs only, so the tissue never touches a hot bulb. Handle scissors and pins with care.

Orbit & Starlight Explorer: Investigation 3, Two Stars, Two Fates

1. Open the H-R Life Cycles scene.
2. Set Initial mass to $1.0 M_{\odot}$.
3. Record the main-sequence residence point, the giant tip, and the white-dwarf radius from the ladder, plus the Main-sequence lifetime.
4. Use Inspect a named star to pick Proxima Cen.
5. Record its temperature and luminosity from the Selected star line.
6. Set Initial mass to $0.3 M_{\odot}$.
7. Record the Main-sequence lifetime and read the warning about small stars.
8. Set Initial mass to $15 M_{\odot}$ and press ► Run life cycle.
9. Say why the track simply stops.
10. Turn on radius iso-lines.
11. Explain how cool Betelgeuse outshines a hot white dwarf.

Calculate: The Sun's size from a pinhole, and a star's lifetime from its mass

1. Your pinhole makes an image of the Sun 9.3 mm wide on a screen 1.00 m (1,000 mm) behind the pinhole.
2. The Sun is 150,000,000 km away.
3. Find the Sun's width: (image width $\div$ screen distance) $\times$ 150,000,000 km.
4. Then use the lab's rule of thumb, lifetime = 10 billion years $\div$ $M^{2.5}$, where M is the star's mass in Suns.
5. Find the lifetime of a 2-Sun star ($2^{2.5} = 5.66$) and a 15-Sun star ($15^{2.5} = 871$).

Self-check: $9.3 \div 1,000 = 0.0093$; $0.0093 \times 150,000,000 \text{ km} = 1,395,000 \text{ km}$, about 1.4 million km. 2 Suns: $10 \div 5.66 = 1.77$ billion years. 15 Suns: $10 \div 871 = 0.0115$ billion years, about 11.5 million years. Check: $1.77 \times 5.66 = 10.0$ and $0.0115 \times 871 = 10.0$.

Real data

- **How far away** · NASA Science, Our Nearest Celestial Neighbor? An Exotic 3-Star System. NASA gives the distance to Proxima Centauri as 4.25 light-years and calls it a red dwarf, smaller and cooler than the Sun.
<https://science.nasa.gov/exoplanets/other-stars-other-worlds/our-nearest-celestial-neighbor-an-exotic-3-star-system/> · Figures read from the NASA page on 2026-09-23.
- **How stormy** · NASA Science, Neighboring Star's Bad Behavior: Large and Frequent Flares. NASA reports that Proxima's biggest recorded flare briefly made the star 14,000 times brighter than normal in ultraviolet light.
<https://science.nasa.gov/universe/exoplanets/neighboring-stars-bad-behavior-large-and-frequent-flares/> · Figures read from the NASA page on 2026-09-23.

- **The planet Proxima b** · NASA Science, Exoplanet Catalog: Proxima Centauri b. NASA lists Proxima b with a mass a little more than Earth's (1.055 Earth masses in its table), a radius of about 1.02 Earths (an estimate), and an orbit of 11.2 days at about 0.0485 AU. It was found in 2016 by the radial velocity (star-wobble) method, around an M-type (red dwarf) star.
<https://science.nasa.gov/exoplanet-catalog/proxima-centauri-b/> · Figures read from the NASA page on 2026-09-23. The page's own summary line rounds the numbers a little differently (1.07 Earth masses, 0.04856 AU).
- **Voyager 1, far from home** · NASA Science, Voyager 1. NASA reports that Voyager 1 launched on Sept. 5, 1977, moves at 17.0 km/s relative to the Sun, and on Aug. 25, 2012 became the first spacecraft to leave the heliosphere.
<https://science.nasa.gov/mission/voyager/voyager-1/> · Figures read from the NASA page on 2026-09-23.
- **A proposed tiny probe** · Breakthrough Initiatives, Breakthrough Starshot. Read the project's page. Record its travel-time goal for reaching Alpha Centauri, what pushes the probes, and whether any probe has flown yet.
<https://breakthroughinitiatives.org/initiative/3> · Look this up yourself. Record the date you read it. This is a research program's own goal, not a NASA result.

The limit to test

1. Reaching another star.
2. At Voyager 1's speed of 17.0 km/s, a trip to Proxima Centauri, 4.25 light-years away, would take tens of thousands of years, and the star sends out powerful flares.

Two mission options to compare

- Keep studying the planet from Earth with telescopes, the way it was found in 2016 by measuring the star's wobble
- Send a tiny uncrewed probe instead of a crew, such as the proposed Breakthrough Starshot light sails (a research program; no probe has flown)

Your map hotspot

1. On your star-fate wheel, mark where the Sun is in its life today and what it will become.

Trap to avoid

The brightest stars are not always the hottest. A star's brightness depends on its size as well as its temperature.

TEACH IT

Show your build working, then teach:

1. The Sun is our nearest star. It shines by fusing hydrogen into helium in its core, and a pinhole lets us measure its size safely.
2. How bright a star looks depends on its real light output and its distance. Its colour tells its temperature.
3. A star's mass at birth sets its lifetime and its ending. Massive stars live fast and explode; small stars last far longer.

Check question: A star looks dim in our sky. Give two different reasons it might look dim.

Texas standards

- **ESS.1E** Collect quantitative data using the International System of Units (SI) and qualitative data as evidence. §112.49(c)(1)(E) *You collect SI data as evidence: millimetres, metres, and lux.*
- **ESS.2C** Use mathematical calculations to assess quantitative relationships in data. §112.49(c)(2)(C) *You calculate the Sun's width and a star's lifetime.*
- **ESS.2A** Identify advantages and limitations of models such as their size, scale, properties, and materials. §112.49(c)(2)(A) *You name what your light bench leaves out: the phone reads only visible light, and a bulb is not a point like a star.*
- **8.9A** Describe the life cycle of stars and compare and classify stars using the Hertzsprung- Russell diagram. §112.28(b)(9)(A) *Grade 6–8 foundation.*
- **8.8A** Compare the characteristics of amplitude, frequency, and wavelength in transverse waves, including the electromagnetic spectrum. §112.28(b)(8)(A) *Grade 6–8 foundation.*

Word bank: nuclear fusion · apparent brightness · luminosity · light-year · H-R diagram · main sequence · white dwarf · supernova

Galaxy Mappers

FOCUS QUESTION

Where is Earth in the universe, and how do we know the universe is expanding?

Every star you can see is part of one galaxy. Your team teaches the shape of the Milky Way and where we sit in it, the other galaxies beyond it, and the evidence that space itself is expanding.

Your lessons

1. The Milky Way

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

2. Other Galaxies

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

3. Cosmology

Publisher lesson: your textbook pages. Dr. Ijezie shares the pages in class.

Also read: Module 6 Slides — Earth in Space: Orbits, Starlight, and the Architecture of the Cosmos. Read "The Expanding Blueprint": the Milky Way, Hubble's redshift pattern, and the two kinds of evidence for the Big Bang. It is the core of your three lessons.

Big ideas you will use

- The Milky Way is a barred spiral galaxy about 100,000 light-years across, with several hundred billion stars. The Sun is one of them, out in the disk.
- The band of the Milky Way across the night sky is our view along the flat disk, from inside it.
- Galaxies come in three main types: spiral, elliptical, and irregular. In the 1920s Hubble showed that the farther away a galaxy is, the more its light is stretched toward red. This is called redshift.
- Space itself is expanding. Run it backward and the universe began hot and dense about 13.8 billion years ago; the cosmic microwave background and the amounts of hydrogen and helium support this.

Universe kit: galaxy disk, galaxy sorter, redshift stretcher, and balloon universe

Build four working models: a scale Milky Way that shows where we live, a sorting key that tells galaxy types apart, a stretcher that shows how distant galaxies' light turns red, and a balloon universe that expands.

Materials

- A stiff card circle 20 cm across (or a paper plate trimmed to 20 cm), markers, and a ruler
- About 50 cm of wide, flat sewing elastic
- A large round balloon (latex-free if anyone has a latex allergy), and a hand pump if you have one
- String and a tape measure
- Nine printed galaxy photos (three spiral, three elliptical, three irregular) from NASA's Hubble image gallery, plus index cards for the key
- Small sticker dots for galaxies
- A stopwatch

Your model must show

1. The Milky Way: a scale disk (1 cm = 5,000 light-years) with the Sun about 26,000 light-years (5.2 cm) from the centre. Seen edge-on, the disk looks like a thin band.
2. Other Galaxies: a sorting key that separates spiral, elliptical, and irregular galaxies, and an elastic stretcher that makes the drawn wave longer, the way the light of distant galaxies is stretched toward red.
3. Cosmology: as the balloon grows, every dot moves away from every other, and dots that start farther apart move apart faster.

Build steps

1. Draw the Milky Way on the card: a central bar, spiral arms, and a Sun dot 5.2 cm from the centre.
2. Hold it edge-on at eye level and look.
3. Make a yes-or-no sorting key on index cards (for example: Does it have arms? Is it a smooth oval?).
4. Test it on the nine galaxy photos, then shuffle them.
5. Lay 20 cm of the elastic flat.
6. Draw a wave with a crest every 2 cm.
7. Stretch it to 30 cm (one and a half times as long) and measure the crest spacing in the middle again.
8. Blow the balloon up a little.
9. Stick on 6 dots, away from the knot, and mark one as home.
10. Measure each dot's distance from home with string along the surface.
11. Blow the balloon up more for 10 seconds and measure again.
12. Find how far each dot moved and its speed in cm per second.

It works when

- A classmate uses only your scale to find the Sun's distance from the centre, and gets within 2,500 light-years (0.5 cm) of 26,000 light-years.
- A classmate uses only your key to sort the nine shuffled galaxy photos into spiral, elliptical, and irregular, with at least 8 of 9 correct.
- At one and a half times the length, the crest spacing is about one and a half times as long: between 2.6 and 3.4 cm (3 cm expected).

- Every dot ends farther from home, and the new distance $\div$ old distance is about the same for every dot (within 20%).

Test it: Run the sorting key with two different classmates, and the stretcher and the balloon twice each. Record how many photos each classmate sorted correctly, the crest spacing in cm before and after, and each dot's distance in cm before and after, with the time in seconds.

Safety: Do not blow the balloon up until it pops; stop when it is firm. Hold both ends of the elastic and never aim it at anyone. Anyone with a latex allergy uses a latex-free balloon or does not handle it.

Orbit & Starlight Explorer: Investigation 5, The Long Road Out

1. Open the Scale Journey scene.
2. Press ► Fly outward and ride from the Sun to Neptune.
3. Count how many ten-times steps (decades) you cross.
4. Use Jump to object to pick Jupiter.
5. Record its distance, its Light-travel time from the Sun, and its Travel time at Voyager 1's 17 km/s.
6. Jump to Earth and record the same three numbers.
7. Subtract to find how far Jupiter is from Earth when both sit on the same side of the Sun.
8. Jump to Sedna.
9. Explain why it is drawn as a range, and why it is nearer to us right now than Voyager 1.
10. Write one sentence: why is a logarithmic scale the only honest way to draw this trip?

Calculate: Expansion speed and Hubble's law

1. In your balloon test, dot A moved from 3.0 cm to 6.0 cm from the home dot, and dot B moved from 6.0 cm to 12.0 cm, while you blew for 10 seconds.
2. Find each dot's speed in cm per second.
3. Then use Hubble's law, $v = 70 \times d$, where v is in km/s and d is in megaparsecs (Mpc).
4. Find the speed of a galaxy 120 Mpc away, and the distance of a galaxy moving away at 14,000 km/s.

Self-check: Dot A: $6.0 - 3.0 = 3.0$ cm in 10 s = 0.30 cm/s. Dot B: $12.0 - 6.0 = 6.0$ cm in 10 s = 0.60 cm/s. B started twice as far and moved twice as fast: $0.30 \div 3.0 = 0.10$ and $0.60 \div 6.0 = 0.10$. Hubble's law: $70 \times 120 = 8,400$ km/s, and $14,000 \div 70 = 200$ Mpc. Check: $8,400 \div 120 = 70$.

Real data

- **How far away** · NASA Science, Our Nearest Celestial Neighbor? An Exotic 3-Star System. NASA gives the distance to Proxima Centauri as 4.25 light-years and calls it a red dwarf, smaller and cooler than the Sun. <https://science.nasa.gov/exoplanets/other-stars-other-worlds/our-nearest-celestial-neighbor-an-exotic-3-star-system/> · Figures read from the NASA page on 2026-09-23.
- **The speed of light** · National Institute of Standards and Technology (NIST), CODATA value: speed of light in vacuum. NIST gives the speed of light as exactly 299,792,458 metres per second, which is about 299,792 km each second. <https://physics.nist.gov/cgi-bin/cuu/Value?c> · Read on 2026-09-23.

The limit to test

1. Studying galaxies we can never visit.
2. The nearest star is 4.25 light-years away and the Milky Way is about 100,000 light-years across, so almost everything we know about galaxies arrives as light.

Two mission options to compare

- Build bigger telescopes on the ground, which collect more light and show fainter galaxies
- Put telescopes in space, above the air that blurs starlight and blocks some kinds of light

Your map hotspot

1. Mark the Sun on your galaxy disk, and draw an arrow along the disk to show which way you look to see the band of the Milky Way.

Trap to avoid

The Big Bang was not an explosion from one centre into empty space. Space itself is stretching everywhere at once.

TEACH IT

Show your build working, then teach:

1. We live inside the flat disk of the Milky Way, a barred spiral about 100,000 light-years across. The band across the night sky is that disk seen from inside.
2. Other galaxies are spiral, elliptical, or irregular. The light of distant galaxies is stretched toward red, and more for farther galaxies.
3. Space is expanding everywhere at once, with no centre. The Big Bang theory is backed by the cosmic microwave background and the amounts of hydrogen and helium.

Check question: On your balloon, which dot is the centre of the expansion, and why?

Texas standards

- **ESS.1H** Distinguish between scientific hypotheses, theories, and laws. §112.49(c)(1)(H) *You tell a law (Hubble's law, a measured pattern) apart from a theory (the Big Bang, an explanation backed by evidence).*
- **ESS.1G** Develop and use models to represent phenomena, systems, processes, or solutions to engineering problems. §112.49(c)(1)(G) *You build models of our galaxy and of expanding space.*
- **ESS.2A** Identify advantages and limitations of models such as their size, scale, properties, and materials. §112.49(c)(2)(A) *You name the limits of the balloon model: the dots sit on a 2-D surface, the inside and outside of the balloon stand for nothing in real space, and the dots stretch while real galaxies do not.*
- **ESS.2C** Use mathematical calculations to assess quantitative relationships in data. §112.49(c)(2)(C) *You use Hubble's law to calculate a galaxy's speed and distance.*
- **8.9B** Categorize galaxies as spiral, elliptical, and irregular and locate Earth's solar system within the Milky Way galaxy. §112.28(b)(9)(B) *Grade 6–8 foundation.*
- **8.9C** Research and analyze scientific data used as evidence to develop scientific theories that describe the origin of the universe. §112.28(b)(9)(C) *Grade 6–8 foundation.*

Word bank: galaxy · light-year · spiral galaxy · elliptical galaxy · redshift · Hubble's law · Big Bang theory · cosmic microwave background

Day 7: teach, learn, decide

Teach-back day. Every team teaches its three lessons, so everyone leaves knowing all thirteen.

ABOUT 40 MINUTES

Teach-back lessons

Each team teaches for ten minutes: two minutes showing the build working, then each lesson lead teaches their lesson with the build and asks one check question. Every visitor writes an answer.

ABOUT 7 MINUTES

Council

Mixed groups answer the driving question using evidence from all four teams.

ABOUT 8 MINUTES

On your own

Exit ticket, then turn in your group note and do the partner review.

Your learning notes, for every team's lesson

- Team and lessons
- What the build showed
- Key idea from each lesson
- My answers to their check questions
- A question I still have

SCORING

The rubric

One rubric for every ESS team project. Your team is scored together on the first four rows; the last row is scored for you alone. Read it before you start and check your work against it before teach-back day.

STRAND	4 • EXEMPLARY	3 • PROFICIENT	2 • DEVELOPING	1 • BEGINNING
Lesson science Content accuracy across all your lessons • 25% • team	Every lesson is correct and complete, uses the right vocabulary, and connects to the other lessons and the driving question.	Every lesson is correct, with key ideas and vocabulary.	One lesson has errors or gaps, or the ideas are listed without explanation.	Lessons are missing or mostly wrong.
The build works Function, testing, and photos • 25% • team	The build passes every 'It works when' test at least twice, the results have units, one fix improved it, and clear approved photos show it.	The build passes its tests, with recorded results and photos.	The build works only partly, or the tests are not recorded.	The build does not work or was not tested.
Teaching the class Teach-back and check questions • 20% • team	Each lesson lead teaches clearly with the build; most classmates answer the check questions correctly; timing is right.	Every lesson is taught with the build, and check questions are asked.	Some lessons are rushed or taught without the build.	The lesson is missing or unclear.
Group note Note Studio group note and evidence • 20% • team	Every section is complete, data has units and sources, the claim matches the evidence, and it names one limit of the build.	Every section is complete, with data and a claim.	Some sections are thin or missing.	The note is mostly empty.
My contribution Individual work, partner and teacher ratings • 10% • each scholar	You led your lesson well, did your role on time, and made a teammate's work better. Your contribution section, partner ratings, and teacher rating agree.	You led your lesson and did your role on time.	Your part was late or only partly done.	Little evidence of your part.

The first four rows are scored for the team. My contribution, your learning notes, and your exit ticket are scored for you alone.

ON YOUR OWN

Exit ticket

1. Pick a lesson another team taught. Explain its main idea in two or three sentences.
2. Name one test from another team's build and what it proved.
3. Write one number you learned today, with its unit and where it came from.
4. Name the part of your team's work you did yourself, and one thing you would rebuild.

Sentence starters

- *Our team claims that ___ because ___.*
- *We observed ___. From that we infer ___.*
- *The evidence that supports this is ___, which shows ___.*
- *In the Orbit & Starlight Explorer, when we changed ___, the ___ changed from ___ to ___.*
- *The data came from ___, and we read it on ___.*
- *One limit of our model is ___.*
- *I agree with ___ because ___. I would add ___.*
- *I have a different idea. The evidence ___ suggests ___.*
- *Can you explain how ___ connects to ___?*

Supports you can use

- Every packet has a word bank. Look up any word in the Ascent Lexicon.
- You may draft in the language you think in best and then write the final version in English.
- Use the sentence starters above in your claim, your lesson, and the council.
- The teach-back lesson can be split between teammates, and it can use the slide's pictures and numbers as notes.
- Ask your teacher for a printed packet, a larger-print copy, or extra time on any checkpoint.

STANDARDS

Standards for the whole project

These are selected connections to the Texas standards for Earth Systems Science (19 TAC §112.49), not a claim that this project fully covers each one. Stars, galaxies, and cosmology are enrichment in this course, not direct Earth Systems Science standards, so Star Lab and Galaxy Mappers point to the science practices they actually do. No engineering-design (HS-ETS) standard is claimed.

- **ESS.3B** Communicate explanations and solutions individually and collaboratively in a variety of settings and formats. §112.49(c)(3)(B) *Every team teaches its lessons to the class and explains its build.*
- **ESS.3C** Engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. §112.49(c)(3)(C) *The council argues from evidence across all four teams.*

SOURCES

Where the numbers come from

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<https://nssdc.gsfc.nasa.gov/planetary/factsheet/moonfact.html> (read 2026-09-23)
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4. NASA. NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation. <https://www.nasa.gov/humans-in-space/nasas-artemis-base-camp-on-the-moon-will-need-light-water-elevation/> (read 2026-09-23)
5. NASA Science. Moon Formation. <https://science.nasa.gov/moon/formation/> (read 2026-09-23)
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7. NASA Science. Exoplanet Catalog: Proxima Centauri b. <https://science.nasa.gov/exoplanet-catalog/proxima-centauri-b/> (read 2026-09-23)
8. NASA Science. Our Nearest Celestial Neighbor? An Exotic 3-Star System. <https://science.nasa.gov/exoplanets/other-stars-other-worlds/our-nearest-celestial-neighbor-an-exotic-3-star-system/> (read 2026-09-23)
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13. NASA Science. Europa Clipper. <https://science.nasa.gov/mission/europa-clipper/> (read 2026-09-23)
14. NASA Jet Propulsion Laboratory. How NASA Is Protecting Europa Clipper From Space Radiation. <https://www.jpl.nasa.gov/news/how-nasa-is-protecting-europa-clipper-from-space-radiation/> (read 2026-09-23)
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16. NASA Space Science Data Coordinated Archive. Venus Fact Sheet. <https://nssdc.gsfc.nasa.gov/planetary/factsheet/venusfact.html> (read 2026-09-23)

Mission Brief: Four Teams, Thirteen Lessons · drijezie.com/courses/earth-systems-science/projects/mission-brief/