

ASTRO-NOT PRESENTS



Explorer Series

15 space projects you can run tonight

One project per page. Read it, open the simulator, and figure the rest out yourself. That's the point.

**"Beyond the sky. Beyond the stars.
Into the unknown."**



SKY

LIGHT

STARS

PLANETS

COSMOS



PROJECT 01 · SKY & MOTION

Solar System Models

Ptolemy got the planets roughly right with the wrong model.

WHAT IT IS

Long before telescopes, astronomers built models to predict where the planets would appear. This project puts Ptolemy's Earth-centred universe, with its wheels-on-wheels, beside the Sun-centred model of Copernicus. Two simulators let you run both and compare what each one predicts about the planets' paths across our sky.

YOUR MISSION

- Run both models and watch how each one moves the planets.
- Find one thing the Earth-centred model gets right, and one thing it can never explain.
- Decide which observation finally settles the debate, and defend it.

Beginner

About 1 hour

Simulator: NAAP · Solar System Models



Extraordinary claims require extraordinary evidence.

CARL SAGAN · ASTRONOMER



PROJECT 02 · SKY & MOTION

Coordinates & Seasons

Why is June hot in Hyderabad but cold in Australia?

WHAT IT IS

Every place on Earth has an address in latitude and longitude, and every star has one too, in right ascension and declination. This project teaches both grids with map and globe explorers, then follows the Sun along its yearly path, the ecliptic, to show where the seasons really come from.

YOUR MISSION

- Locate your own city and three bright stars on the two grids.
- Track where the Sun sits on the sky map across one full year.
- Prove what causes the seasons, and rule out the most popular wrong answer.

Beginner

About 1 hour

Simulator: NAAP · Basic Coordinates and Seasons



Science is a way of thinking much more than it is a body of knowledge.

CARL SAGAN · ASTRONOMER



PROJECT 03 · SKY & MOTION

The Rotating Sky

Some stars never set. Which ones, and from where?

WHAT IT IS

The whole sky seems to wheel around us every night. This project introduces the horizon system, altitude and azimuth, and links it to the star map. In the Rotating Sky Explorer you pick any latitude on Earth and watch the stars rise, set, or circle without ever setting.

YOUR MISSION

- Set Hyderabad's latitude and sort the stars into three groups by how they move.
- Find the two latitudes where the sky behaves in the most extreme ways.
- Explain the whole pattern with one clear diagram of your own.

Beginner

About 1 hour

Simulator: NAAP · The Rotating Sky



Remember to look up at the stars and not down at your feet.

STEPHEN HAWKING · THEORETICAL PHYSICIST



PROJECT 04 · SKY & MOTION

Motions of the Sun

How high will the Sun climb on your birthday?

WHAT IT IS

This project ties Projects 02 and 03 together into one full picture of the Sun's daily and yearly path. The Paths of the Sun Simulator shows where the Sun rises, how high it gets at noon and how long the day lasts for any date and place, and the background explains how to calculate it yourself.

YOUR MISSION

- Predict, on paper, the noon Sun's height in Hyderabad on 21 June and 21 December.
- Check both predictions in the simulator and explain any difference.
- Find the dates when the noon Sun stands directly overhead in Hyderabad.

Intermediate

About 1 hour

Simulator: NAAP · Motions of the Sun



At rest, however, in the middle of everything is the Sun.

NICOLAUS COPERNICUS · ASTRONOMER, 1543



PROJECT 05 · SKY & MOTION

Planetary Orbits

Build your own planet and put Kepler's laws to the test.

WHAT IT IS

Kepler's three laws describe how every planet moves around its star. In the Planetary Orbit Simulator you design a planet of your own, change the size and shape of its orbit, and measure its speed and the Sun's pull as it goes round, with the real planets drawn behind it for comparison.

YOUR MISSION

- Test each of Kepler's three laws with your own measurements.
- Build an orbit where the planet moves 3 times faster at its closest point than at its farthest.
- Explain why your orbit works, using a law rather than a guess.

Beginner

About 1 hour

Simulator: NAAP · Planetary Orbit Simulator



I measured the skies, now the shadows I measure.

JOHANNES KEPLER · ASTRONOMER, HIS OWN EPITAPH



PROJECT 06 · SKY & MOTION

Lunar Phases

Why does the full Moon always rise at sunset?

WHAT IT IS

The Moon's phases come from the geometry of the Sun, Earth and Moon. This project shows the same moment two ways at once: from far out in space, and from a person standing on Earth looking at the horizon. You move the Moon around its orbit and watch its phase and its rising time change together.

YOUR MISSION

- Work out when a first-quarter Moon rises and when it sets.
- Draw the Sun, Earth and Moon positions that explain your answer.
- Watch the real Moon for one week and compare it with your predictions.

Beginner

About 1 hour + 1 week

Simulator: NAAP · Lunar Phase Simulator



Space isn't remote at all. It's only an hour's drive away if your car could go straight upwards.

FRED HOYLE · ASTROPHYSICIST



PROJECT 07 · LIGHT & ATOMS

Blackbody Curves & UBV Filters

How do you take a star's temperature from 100 light-years away?

WHAT IT IS

Every hot object glows with a spectrum that depends only on its temperature. This project lets you heat up a star and watch its blackbody curve shift and change shape, then measure its brightness through three coloured filters, U, B and V, the same way observatories sort stars by colour.

YOUR MISSION

- Find the temperature at which a star's light peaks in the green.
- Explain why no star in the sky ever looks green to us.
- Rank five stars by temperature using only their filter measurements.

Intermediate

About 1 hour

Simulator: NAAP · Blackbody Curves and UBV Filters

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The cosmos is within us. We are made of star-stuff.

CARL SAGAN · ASTRONOMER



PROJECT 08 · LIGHT & ATOMS

Hydrogen Energy Levels

Every element writes a barcode in its light.

WHAT IT IS

Atoms can only hold certain exact amounts of energy. This project uses a Bohr-model hydrogen atom: you fire photons at it, watch the electron jump between levels, and see which colours of light come out. A second tool heats a whole gas of hydrogen and shows which levels fill up at each temperature.

YOUR MISSION

- Find the electron jump that produces red light at 656 nm.
- Map which jumps give ultraviolet, visible and infrared light.
- Explain why the hottest stars show weak hydrogen lines.

Intermediate

About 1 hour

Simulator: NAAP · Hydrogen Energy Levels

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The reward of the young scientist is the emotional thrill of being the first person in the history of the world to see something or to understand something.

CECILIA PAYNE-GAPOSCHKIN · ASTROPHYSICIST WHO FOUND STARS ARE MOSTLY HYDROGEN



PROJECT 09 · STARS

The HR Diagram

Are the stars you see at night typical stars?

WHAT IT IS

The Hertzsprung–Russell diagram plots stars by temperature and brightness, and it is the most important chart in stellar astronomy. This project teaches you to read it, from spectral types to luminosity classes, then lets you plot real groups of stars and read off each star's temperature, luminosity and size.

YOUR MISSION

- Plot the nearest stars, then the brightest stars in the sky.
- Compare the two diagrams and describe exactly how they differ.
- Explain what that difference tells us about the stars we can see.

Beginner

About 1 hour

Simulator: NAAP · Hertzsprung-Russell Diagram

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The black holes of nature are the most perfect macroscopic objects there are in the universe.

SUBRAHMANYAN CHANDRASEKHAR · ASTROPHYSICIST, NOBEL PRIZE 1983



PROJECT 10 · STARS

Eclipsing Binary Stars

Measure two stars you can't even see apart.

WHAT IT IS

Many stars come in pairs. When we see the orbit edge-on, each star passes in front of the other and their combined light dips. The Eclipsing Binary Simulator lets you set each star's size and temperature and the tilt of the orbit, then watch the light curve form as they go round.

YOUR MISSION

- Find how far you can tilt the orbit before the eclipses vanish.
- Work out which eclipse makes the deeper dip, and why.
- Match one of the preset light curves by tuning the stars yourself.

Intermediate

About 1 hour

Simulator: NAAP · Eclipsing Binary Stars

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However difficult life may seem, there is always something you can do and succeed at.

STEPHEN HAWKING · THEORETICAL PHYSICIST



PROJECT 11 · STARS

Variable Star Photometry

Find the star that's changing, like a real astronomer.

WHAT IT IS

Some stars pulse in and out, or get eclipsed, and change brightness over hours or days. This project gives you a set of sky images and a photometry tool to measure how bright each star is, build light curves, and identify eclipsing binaries, Cepheids and RR Lyrae stars. It is the closest project to real observing work.

YOUR MISSION

- Find the variable star hiding in the image set.
- Measure its period to within 5%.
- Identify what type of variable it is, and justify your call with evidence.

Advanced

About 2 hours

Simulator: NAAP · Variable Star Photometry

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The good thing about science is that it's true whether or not you believe in it.

NEIL DEGRASSE TYSON · ASTROPHYSICIST



PROJECT 12 · PLANETS & LIFE

Hunting Exoplanets

Why were the first alien planets all scorching gas giants?

WHAT IT IS

We find planets around other stars by the tiny wobble they cause and the shadow they cast. This project simulates both methods: the radial-velocity wobble, with realistic noise in the data, and the transit dip as a planet crosses the face of its star. You control the planet, the star and the view.

YOUR MISSION

- Find the smallest planet you can still detect 1 AU from a Sun-like star.
- Test how noise and orbit tilt change what you can and can't see.
- Use your results to explain why early surveys found so many hot Jupiters.

Intermediate

About 1 hour

Simulator: NAAP · Extrasolar Planets

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Science progresses best when observations force us to alter our preconceptions.

VERA RUBIN · ASTRONOMER WHO FOUND EVIDENCE FOR DARK MATTER



PROJECT 13 · PLANETS & LIFE

Atmospheric Retention

Titan is smaller than Mercury, yet has thicker air than Earth.

WHAT IT IS

Whether a world keeps its atmosphere is a race between fast-moving gas molecules and the pull of gravity. This project introduces molecular speeds through the Maxwell-Boltzmann distribution, and escape velocity, then shows which planets and moons can hold on to which gases.

YOUR MISSION

- Compare which gases Earth, the Moon, Mars and Titan can each keep.
- Explain Titan's thick atmosphere using numbers, not words alone.
- Predict what would happen to the Moon if it were as cold as Titan.

Intermediate

About 1 hour

Simulator: NAAP · Atmospheric Retention

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The universe is under no obligation to make sense to you.

NEIL DEGRASSE TYSON · ASTROPHYSICIST



PROJECT 14 · PLANETS & LIFE

Habitable Zones

Red dwarf or Sun-like star: where should we look for life?

WHAT IT IS

A planet needs the right temperature for liquid water on its surface. This project explores the habitable zone around different kinds of stars, how that zone drifts outward as a star ages, and, on a bigger scale, where in the Milky Way life is most likely to survive.

YOUR MISSION

- Compare the habitable zones of a red dwarf, the Sun and a hot blue star.
- Find a star where a planet stays habitable for over 10 billion years.
- Name the catch for life around that star, and argue whether it matters.

Beginner

About 1 hour

Simulator: NAAP · Habitable Zones

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Look again at that dot. That's here. That's home. That's us.

CARL SAGAN · PALE BLUE DOT



PROJECT 15 · COSMOS · CAPSTONE

Cosmic Distance Ladder

How far away is a galaxy you can never visit?

WHAT IT IS

No single method can measure every distance in space. Astronomers use a ladder of methods, from parallax and main-sequence fitting to variable stars and supernovae, each one calibrated by the rung below it. This project walks you up every rung, with a simulator for each step.

YOUR MISSION

- Use each method on the ladder to measure at least one distance.
- Draw the ladder, showing the range of distances each rung covers.
- Predict what a 10% error on the bottom rung does to everything above it.

Advanced

About 2 hours

Simulator: NAAP · Cosmic Distance Ladder

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Equipped with his five senses, man explores the universe around him and calls the adventure Science.

EDWIN HUBBLE · ASTRONOMER



How every mission works

01

Pick a project

Any one that grabs you. One project per person or pair.

02

Find the simulator

Search the NAAP site for the simulator named on your page. A laptop works best.

03

Figure it out

No answer sheets, no hints. Read, experiment, test your ideas.

04

Write one page

Your findings on a single page, in the format below.

Your one-page report

1. **The question**, in one sentence of your own.
2. **What you did**: what you changed and what you kept fixed.
3. **Evidence**: one screenshot, sketch or small table.
4. **Your answer**, in 3–5 sentences, using real numbers.
5. **One surprise**, or where this shows up in real astronomy.

SUBMIT BY

**31 October
2026**

WHERE

Submit your report on the Astro-Not website.

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Into the unknown.”**