LESSON PLAN

Solar System

Science · Year 12 · 60 min

CURRICULUM ALIGNMENT

Aligns to NCEA Level 2 Science, Achievement Standard 91191 (2.7): Demonstrate understanding of the properties of waves. Note: for a Solar System focus at Year 12, the teacher should confirm alignment to the most applicable standard (e.g. 91192 for atomic and nuclear physics contexts, or Earth and Space Science contexts); the specific standard should be verified against the school's timetabled achievement standard for this unit.

Te Mātaiaho: Science □

LEARNING INTENTION

Explain the structure, scale, and dynamics of the solar system using evidence from modern astronomy

SUCCESS CRITERIA

- I can describe the structure of the solar system, distinguishing between terrestrial planets, gas giants, ice giants, and dwarf planets using IAU classifications.
- I can explain how Kepler's laws of planetary motion account for observed orbital behaviour, including elliptical orbits and orbital period relationships.
- I can analyse the scale of the solar system using scientific notation and compare relative distances between objects.
- I can evaluate how scientific understanding of the solar system has changed, using the IAU reclassification of Pluto (2006) as a case study in how science updates itself.

Lesson Structure

HOOK

• Two distances on the board: 150 million km and 4.5 billion km. Which two objects?
• If Earth were a marble, how far away would Neptune be?
• Current scientific consensus defines eight planets. What changed in 2006, and why?

TEACHING

• Solar system structure: four terrestrial, two gas giants, two ice giants, belt objects, dwarf planets.
• IAU 2006 definition: orbits the Sun, hydrostatic equilibrium, clears its orbital neighbourhood.
• Kepler's First Law: planetary orbits are ellipses, Sun at one focus.
• I notice inner planets cluster tightly. Orbital periods scale dramatically outward — why?

PRACTICE

• Solar system scale model: place objects on a 1:10 billion number line using scientific notation.
• Apply Kepler's Third Law: T^2 proportional to a^3. Calculate Neptune's period from its semi-major axis.
• Which students can justify why Pluto fails the third IAU criterion? That is the formative check.

CLOSURE

- Return to 2006: does Pluto's reclassification weaken science or strengthen it?
- Name one piece of evidence that distinguishes ice giants from gas giants.
- Exit ticket: state the IAU criterion Pluto fails, in one sentence.

Task Details

TASK

- Scale model: plot solar system objects on a 1:10 billion number line.
- Use scientific notation to calculate and record each object's distance.
- Apply Kepler's Third Law ($T^2 \propto a^3$) to calculate Neptune's orbital period.
- Justify in writing why Pluto fails the third IAU criterion.

MATERIALS

A3 number line sheets (one per student), pre-cut object labels (Sun, 8 planets, Pluto, asteroid belt), scientific calculators (one per student), Kepler's Third Law reference card (one per student), lined answer booklets (one per student), whiteboard and markers for worked examples

TEACHER ROLE

- Circulate during scale model task. Prompt students who misplace belt objects.
- Pause class at the Kepler calculation. Work through $T^2 \propto a^3$ on the board with Neptune's semi-major axis (30.07 AU) before students calculate independently.
- Collect exit tickets. Read written justifications for IAU criterion 3 before next lesson.

ASSESSMENT NOTES

- Success criterion 1: students correctly label and categorise all eight planets by type on their number line. Watch for confusion between ice giants (Uranus, Neptune) and gas giants (Jupiter, Saturn).
- Success criterion 2: written Kepler calculation shows correct use of $T^2 \propto a^3$ with units. Merit and Excellence signals include unprompted reference to Kepler's First Law in written work.
- Success criterion 3: number line placements use scientific notation correctly. Check that inner planet spacing is proportionally compressed relative to outer planets.
- Success criterion 4: exit ticket justification names IAU criterion 3 explicitly. Acceptable response identifies orbital neighbourhood clearance. Flag students who cite only size or mass.

RESOURCES

YouTube solar system video

Pinterest solar system activities

RELIEF TEACHER NOTES

• All materials are on the front desk: A3 number line sheets, object labels, calculators, Kepler reference cards, and answer booklets.

• Students complete the scale model task first, then the Kepler calculation, then the written IAU justification in that order.

• The Kepler reference card includes the formula T² □ a³ and Neptune's semi-major axis (30.07 AU). Students do not need prior instruction to use it.

• The emerging group (6 students, seated nearest the whiteboard) will need the most support. Work through the Neptune calculation on the board before releasing them to work independently.