Year 10 unit overview — Australian Curriculum: Science

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA), *Australian Curriculum v3.0: Science for Foundation–10* <www.australiancurriculum.edu.au/Science/Curriculum/F-10>.

| School name | Unit title | Duration of unit |
| --- | --- | --- |
| Our School | Galileo’s new science | One term |

| Unit outline |
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| Students learn the foundations of the mathematical and experimental basis of physics — forces, motion and energy. In the context of Galileo’s experiments on motion they will develop an appreciation of the place of evidence, models, explanation and theories in the development of scientific knowledge. Science progresses through evidence and argumentation, and the development of models and theories that describe the observations of scientists. Models and theories can be thought of as simplified constructions that:* attempt to objectify and quantify observations
* can be confirmed or falsified through experiment and observation
* are further improved through the use of technology and scientific equipment.

This unit has two overarching aims — that students understand:* the historical and cultural development of science — how scientific theories can change or be overthrown over time
* the importance of mathematics and precise measurement in physics.

They will:* recognise that the law of conservation of energy explains that total energy is maintained in energy transfer and transformation
* compare energy changes in interactions such as car crashes, pendulums, lifting and dropping
* gather data to analyse everyday motions produced by forces, such as measurements of distance and time, speed, force, mass and acceleration
* use models to describe how energy is transferred and transformed within systems
* use mathematical equations to describe the motion of objects
* represent motion graphically
* research the experiments and arguments that Galileo used to overthrow Aristotle’s ideas on motion.
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| Identify curriculum |
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| Content descriptions to be taught | General capabilities and cross‑curriculum priorities |
| Science Understanding | Science as a Human Endeavour | Science Inquiry Skills |
| **Physical sciences*** Energy conservation in a system can be explained by describing energy transfers and transformations [(ACSSU190)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU190)
* The motion of objects can be described and predicted using the laws of physics [(ACSSU229)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU229)
 | Nature and development of science* Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community [(ACSHE191)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSHE191)
* Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries [(ACSHE192)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSHE192)
 | Questioning and predicting* Formulate questions or hypotheses that can be investigated scientifically [(ACSIS198)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS198)

Planning and conducting* Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods [(ACSIS199)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS199)
* Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data [(ACSIS200)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS200)

Processing and analysing data and information* Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies [(ACSIS203)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS203)
* Use knowledge of scientific concepts to draw conclusions that are consistent with evidence [(ACSIS204)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS204)

Evaluating* Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data [(ACSIS205)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS205)
* Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems [(ACSIS206)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS206)

Communicating* Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations [(ACSIS208)](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSIS208)
 | Description: gc_literacy Literacy* Write scientific reports.
* Hypothesise.
* Use appropriate technical terminology.

Description: gc_numeracy Numeracy* Recognise and understand the central role of mathematics in physics.
* Measure, collect, represent and interpret data.
* Consider uncertainty and reliability in measurement.

Description: gc_ict ICT capability* Use the internet and online databases to research science concepts.
* Analyse data using a spreadsheet.
* Construct graphs using computer software.

Description: gc_critical Critical and creative thinking* Pose questions, speculate, make evidence-based decisions, analyse, evaluate secondary and primary sources, summarise information.

Description: gc_ethical Ethical behaviour* Evaluate a claim based on science.
* Consider the intellectual rigour and moral integrity that Galileo displayed.

Description: gc_personal_social Personal and social capability* Set personal academic goals for completing extended experimental investigation.
* Work in teams to complete practical work.

Description: gc_intercultural Intercultural understanding* Focus on the historical development of a major scientific theory to consider a range of cultural contexts and the influence of many cultures in the development of scientific knowledge and understanding.
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| Achievement standard |
| By the end of Year 10, students [analyse](http://www.australiancurriculum.edu.au/Glossary?a=S&t=analyse) how the periodic [table](http://www.australiancurriculum.edu.au/Glossary?a=S&t=table) organises elements and use it to make predictions about the [properties](http://www.australiancurriculum.edu.au/Glossary?a=S&t=properties) of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within [systems](http://www.australiancurriculum.edu.au/Glossary?a=S&t=systems). They apply [relationships](http://www.australiancurriculum.edu.au/Glossary?a=S&t=relationships) between [force](http://www.australiancurriculum.edu.au/Glossary?a=S&t=force), mass and acceleration to predict changes in the motion of objects. Students describe and [analyse](http://www.australiancurriculum.edu.au/Glossary?a=S&t=analyse) interactions and cycles within and between Earth’s spheres. They [evaluate](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evaluate) the [evidence](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evidence) for scientific [theories](http://www.australiancurriculum.edu.au/Glossary?a=S&t=theories) that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students [analyse](http://www.australiancurriculum.edu.au/Glossary?a=S&t=analyse) how the [models](http://www.australiancurriculum.edu.au/Glossary?a=S&t=models) and [theories](http://www.australiancurriculum.edu.au/Glossary?a=S&t=theories) they use have developed over time and discuss the factors that prompted their review.Students develop questions and [hypotheses](http://www.australiancurriculum.edu.au/Glossary?a=S&t=hypotheses) and independently [design](http://www.australiancurriculum.edu.au/Glossary?a=S&t=design) and improve appropriate methods of [investigation](http://www.australiancurriculum.edu.au/Glossary?a=S&t=investigation), including [field work](http://www.australiancurriculum.edu.au/Glossary?a=S&t=field+work) and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where [digital technologies](http://www.australiancurriculum.edu.au/Glossary?a=S&t=digital+technologies) can be used to enhance the quality of [data](http://www.australiancurriculum.edu.au/Glossary?a=S&t=data). When [analysing](http://www.australiancurriculum.edu.au/Glossary?a=S&t=analysing) [data](http://www.australiancurriculum.edu.au/Glossary?a=S&t=data), selecting [evidence](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evidence) and developing and justifying [conclusions](http://www.australiancurriculum.edu.au/Glossary?a=S&t=conclusions), they identify alternative explanations for findings and explain any sources of uncertainty. Students [evaluate](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evaluate) the [validity](http://www.australiancurriculum.edu.au/Glossary?a=S&t=validity) and reliability of claims made in [secondary sources](http://www.australiancurriculum.edu.au/Glossary?a=S&t=secondary+sources) with reference to currently held scientific views, the quality of the methodology and the [evidence](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evidence) cited. They construct [evidence](http://www.australiancurriculum.edu.au/Glossary?a=S&t=evidence)-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes. |

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| Relevant prior curriculum | Curriculum working towards |
| In the Australian Curriculum: Science at Year 9:Science understandingPhysical sciences* Energy transfer through different mediums can be explained using wave and particle methods.

Science as a Human Endeavour* The content descriptions for Science as a Human Endeavour are the same for Year 9 and Year 10.

Science Inquiry Skills* The content descriptions for Science Inquiry Skills are the same for Year 9 and Year 10.

In the Australian Curriculum: Science at Year 7:Science understandingPhysical sciences* Change to an object’s motion is caused by unbalanced [forces](http://www.australiancurriculum.edu.au/Glossary?a=S&t=forces) acting on the object
 | In the Queensland senior science syllabuses: * recall, describe, explain, interpret and apply scientific facts and concepts
* conduct investigations
* collect and analyse data
* evaluate data and information
* justify conclusions
* communicate information using scientific terminology.

This unit develops students’ familiarity with the assessment required in the senior sciences — extended experimental investigations. |
| Bridging content |
| The **Year 9 Essential Learnings: Energy and change** provide a good foundation to this unit. In Year 9, students have learned about balanced and unbalanced force, energy transfer, transformation and conservation. They have planned investigations, gathered and analysed data, drawn conclusions and written scientific reports. |
| Links to other learning areas |
| Australian Curriculum Year 10 Mathematics* Substitute values into formulas to determine an unknown.
* Graph solutions.
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| Assessment | Make judgments |
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| Describe the assessment | Assessment date | Teachers gather evidence to make judgments about the following characteristics of student work:**Understanding*** description and identification of scientific information and concepts
* use of science knowledge to generate solutions and explanations
* description of the development and review of scientific models and theories and the use of scientific knowledge to test claims, explanations or predictions

**Skills*** formulation of questions and hypotheses that can be investigated scientifically
* description of methods designed to control and measure variables, collect data, considering safety, reliability and ethical actions
* analysis of trends in data to identify relationships between variables and to develop conclusions
* use of science knowledge to examine the claims and methodologies in secondary sources
* analysis of methods; identification of sources of uncertainty and proposals of modifications to improve the quality of evidence
* use of appropriate scientific language and representations to communicate findings and ideas.

For further advice and guidelines on constructing guides to making judgments refer to the Learning area standard descriptors: [www.qsa.qld.edu.au](http://www.qsa.qld.edu.au) |
| Students are given opportunities to demonstrate their knowledge, skills and understanding through both formative and summative assessment. The assessment is collated in student folios and allows for ongoing feedback to students on their learning.Year 10 teachers make decisions about the length of time required to complete the tasks and the conditions under which the assessment is to be conducted.The teaching and learning experiences throughout the term provide opportunities for students to develop the understanding and skills required to complete these assessments. As students engage with these learning experiences the teacher can provide feedback on specific skills.**Experimental investigation: Scientific report (Written)**The Ancient Greek philosopher Aristotle suggested that natural motion, such as a body falling, was due to it trying to seek its “natural” place in the world. As such, he thought the rate at which a body fell was proportional to its weight. This was accepted as conventional wisdom until the Italian natural philosopher Galileo conducted a series of ingenious experiments, the results of which he discussed in his *Dialogues Concerning Two New Sciences*. Task — test Galileo’s hypothesis: A falling body accelerates uniformly — it picks up equal amounts of speed in equal time intervals so that, if it falls from rest, it is moving twice as fast after two seconds as it was moving after one second, and moving three times as fast after three seconds as it was after one second. See University of Virginia Physics Department: <http://galileoandeinstein.physics.virginia.edu/lectures/gal_accn96.htm>Use:* materials: ticker timer, power pack, blocks, ticker tape, electrical leads, ramp, trolley. Optional — data logger and air track.
* data collection — in groups of two or three.

Produce an individual scientific report including: * introduction, aim, hypothesis, outline of method
* displacement–time and velocity–time graphs
* discussion, conclusion and evaluation.
 | Weeks 4–6 |
| Suggested conditions:* 600–800 words
* open.
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| **Supervised assessment: Short responses, paragraph responses and practical exercises (Written)**Suggested conditions:* 60 minutes
* supervised.
 | Weeks 9–10 |

| Teaching and learning | Supportive learning environment |
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| Teaching strategies and learning experiences | Adjustments for needs of learners | Resources |
| * Construct a glossary of terms relevant to studying motion and energy, e.g. force, mass, weight, distance, displacement, speed, velocity, acceleration, vector, scalar, linear, gradient, kinetic energy, gravitational potential energy, work, acceleration due to gravity.
* Construct a class wiki or online space for students to share class notes, independent research notes and other relevant information.
* Review the elements of graphing such as: title, axis labels, dependent variable, independent variable, units, scale, trend line.
* Compile and communicate findings using appropriate formats, including graphs, tables, and annotated diagrams.
* Represent motion graphically with displacement-time and velocity-time graphs.
* Calculate the acceleration from a velocity–time graph.
* Solve problems involving Newton’s laws.
* Solve problems using the equations of motion.
* Solve problems involving gravitational potential energy, kinetic energy and work done.
* Use relevant audio-visual materials, e.g. Commander David R Scott’s feather-and-hammer drop on the moon during the Apollo 15 mission (see Resources: Web).
* Plan and carry out motion investigations using appropriate investigation methods and equipment, e.g.
* an object travelling at a constant velocity using a ticker timer
* a falling golf ball using a strobe light.
* Analyse motion using digital technologies, such as graphing calculators, spreadsheets, and data loggers.
* Identify safety issues when conducting experiments.
* Use research tools such as the library, internet, reference material, audiovisual resources to research Galileo’s use of experiment to overthrow the Aristotelian theories of motion.
* Explore how to construct a testable hypothesis, frame a scientific argument and draw conclusions supported by scientific evidence.
* Practise writing paragraphs and sequencing information, including using connectives that establish relationships between ideas and information in sentences.
 | Section 6 of the *Disability Standards for Education* (The Standards for Curriculum Development, Accreditation and Delivery) state that education providers, including class teachers, must take reasonable steps to ensure a course/program is designed to allow any student to participate and experience success in learning. The *Disability Standards for Education 2005* (Cwlth) is available from: <www.ag.gov.au> select Human rights and anti-discrimination > Disability standards for education. | Web* computers with internet access
* websites for factsheets
* YouTube clips, such as Commander David R Scott’s feather-and-hammer drop: [www.youtube.com/watch?v=KDp1tiUsZw8](http://www.youtube.com/watch?v=KDp1tiUsZw8%20)

Khan Academy physics: [http://www.khanacademy.org/ #physics](http://www.khanacademy.org/%20#physics) Print* textbooks
* worksheets

Equipment* graphing calculators
* ticker timer and tape
* power pack
* blocks
* electrical leads
* ramp
* trolley
* optional — data logger and air track

Safety equipment* student-completed risk assessment for assessment
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| Use feedback |
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| Ways to monitor learning and assessment | Teachers collaboratively plan the teaching, learning and assessment to meet the needs of all learners.Teachers mark a small random sample of the research task and investigation design report, moderate the samples to ensure consistency of judgments, then mark their own class. |
| Feedback to students | Teachers plan opportunities through the teaching strategies and learning experiences of the unit. Teachers provide ongoing feedback and encouragement to students on their strengths and areas for improvement. Through particular learning experiences students can reflect on and discuss with their teachers and peers what they are able to do well and what they need to do to improve. |
| Reflection on the unit plan | At the conclusion of the unit, all teachers who have been involved in planning, teaching, learning and assessment come together to reflect on the successes and challenges of the unit. They come with their personal reflections through answers to the following questions:* What worked well in this unit?
* What was a stumbling block?
* How would you refine it?
* What trends and gaps in learning have you identified?
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