Science sample unit: Off the planet

Stage 4	Duration: 10 weeks

Unit context

Living on another planet may be a real possibility in the future. What problems would need to be overcome to enable humans to live away from Earth? What might be some of the different viewpoints held by people and the ethical considerations that would influence decisions to colonise other planets?

Outcomes

A student:

SC4-3VA	demonstrates confidence in making reasoned, evidence-based decisions about the current and future use and influence of science and technology, including ethical considerations
SC4-4WS	identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge
SC4-5WS	collaboratively and individually produces a plan to investigate questions and problems
SC4-7WS	processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions
SC4-8WS	selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems
SC4-9WS	presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations
SC4-10PW	describes the action of unbalanced forces in everyday situations
SC4-12ES	describes the dynamic nature of models, theories and laws in developing scientific understanding of the Earth and solar system
SC4-14LW	relates the structure and function of living things to their classification, survival and reproduction

Unit overview

In teams, students design and produce a creative presentation to raise public awareness and debate about the proposal to send people to live on another planet in the solar system, based on scientific evidence gathered during investigations. Students conduct a survey to gather information about the range of views, including social, economic and ethical issues, associated with the proposal to have humans live on another planet. They devise their own questions about the planet's environment and identify some problems associated with living there. Students investigate forces including gravity, the requirements of humans and how they interact with other living organisms, to help them solve problems associated with establishing an artificial ecosystem on their chosen planet. As part of a rich task or extension activity in conjunction with Technological and Applied Studies, students could design and construct a model of a building that may be used to support human life on another planet.

Content	Teaching, learning and assessment
Skills – Working Scientifically **Planning Investigations** WS5.1 Students identify data to be collected in an investigation by: a. identifying the purpose of the investigation	**Introducing the team project** **Teacher background** *Teacher presents the context and focus of the team project to the class.* An international consortium of major businesses has employed project teams from the class to investigate the possibility of sending humans to live on another planet in the solar system. Each project team will survey people's views on the proposal, identify the problems to be solved and gather relevant information from their own scientific investigations and secondary sources. The evidence gathered by each team of four students will form the basis of a short, scientifically accurate, creative advertising campaign to raise public awareness and/or debate about the proposal. The team project and presentation will be assessed on: • suitability for the intended audience • scientific accuracy of information • use of persuasive language • creativity of the presentation • teamwork. Throughout the unit, each student will establish and maintain a digital and/or hard copy portfolio. The portfolio will be used as evidence for students to monitor and reflect on their own learning and for the teacher to provide feedback. Time should be allocated throughout the unit for students to record findings and reflections in their portfolio and for the team's ongoing design and development of their presentation. **Group activity** As a model of a self-sustaining ecosystem, students set up and observe a terrarium throughout the unit.
Skills – Working Scientifically **Planning Investigations** WS5.2 Students plan first-hand investigations by: a. collaboratively and individually planning a range of investigation types, including fieldwork, experiments, surveys and research (ACSIS125, ACSIS140) **Conducting Investigations** WS6 Students conduct investigations by: d. following the planned procedure, including in fair tests, measuring and controlling variables (ACSIS126, ACSIS141)	**Designing and conducting a survey** **Teacher background** *To assist students to identify the audience for their team presentation, they design a survey to gather and analyse data on a range of community views about the proposal for humans to live on another planet.* **Class activity** What do people think about living on another planet? With teacher guidance, the class designs and produces a short survey (4–6 questions) to gather data about community views on the proposal to send humans to live on another planet. The survey should provide opportunities to take into account social, economic and ethical considerations.

Content	Teaching, learning and assessment
Processing and Analysing Data and Information WS7.1 Students process data and information by: a. summarising data from students' own investigations and secondary sources (ACSIS130, ACSIS145) WS7.2 Students analyse data and information by: c. identifying data which supports or discounts a question being investigated or a proposed solution to a problem	Each student: • within the agreed timeline, uses the questions to survey 3–5 family members and/or friends from a variety of age groups using a range of methods, including digital technologies • analyses their survey information to identify the range of views • shares their analysed data/information with the class. The class collates the data/information and discusses the range of views to identify the groups that make up potential audiences. In individual portfolios, students: • keep a record of their own and the class data and ideas • prepare a summary of the range of views about living on another planet and how this relates to potential audiences.
Skills – Working Scientifically **Questioning and Predicting** WS4 Students question and predict by: a. identifying questions and problems that can be investigated scientifically (ACSIS124, ACSIS139) b. making predictions based on scientific knowledge and their own observations (ACSIS124, ACSIS139) **Communicating** WS9 Students communicate by: a. presenting ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate (ACSIS133, ACSIS148)	**Questioning and predicting: Identifying problems associated with living on another planet** **Teacher background** *Students identify questions that can be investigated to solve problems associated with the possibility of living on another planet.* **Class activity** As stimulus for discussion, students view a short excerpt from a documentary, movie, video or YouTube that shows real or fictional images and representations of conditions that impact on living on another planet. In project teams, students: • identify questions relating to the possibility of living on another planet that they could investigate scientifically • make predictions about the problems to be solved if people are to live on other planets. In discussion with each team, the teacher questions the students about their ideas, provides feedback and encourages students to share their ideas with another group to extend and refine their questions and predictions. The teams share their questions and predictions about problems that could be investigated. With teacher guidance, they discuss and summarise broad areas to investigate in addressing their questions, including: • planetary physical conditions, eg gravity, atmosphere, temperature and distance • technological advances that have produced evidence that has increased scientific understanding of these planetary conditions. Each student keeps records in their individual portfolio of suggested questions that can be investigated, the problems to be solved and the main ideas/conclusions from the class discussion.

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Skills – Working Scientifically **Questioning and Predicting** WS4 Students question and predict by: b. making predictions based on scientific knowledge and their own observations (ACSIS124, ACSIS139) **Planning Investigations** WS5.1 Students identify data to be collected in an investigation by: b. proposing the type of information and data that needs to be collected in a range of investigation types, including first-hand and secondary sources c. locating possible sources of data and information, including secondary sources, relevant to the investigation **Processing and Analysing Data** WS7.1 Students process data and information by: b. using a range of representations to organise data, including graphs, keys, models, diagrams, tables and spreadsheets c. extracting information from diagrams, flowcharts, tables, databases, other texts, multimedia resources and graphs including histograms and column, sector and line graphs d. accessing information from a range of sources, including using digital technologies	**Gathering and processing data and information about planets** **Teacher background** *To provide students with scientific knowledge on which to make an informed decision about the planet that will be the focus of their team project, they identify data that needs to be collected about each planet in the solar system, locate reliable sources of information, and record and discuss the data/information collected.* **Project team activity** Students: • discuss the data that needs to be collected about the physical (non-living) conditions on each planet in the solar system (eg mass and gravity compared to Earth, distance from Earth, length of a day, mean temperature, dimensions, composition of the atmosphere, etc) • propose possible, reliable sources of data/information • select a method by which the team will record and collate the data, eg table, spreadsheet • allocate planets to each team member. For each allocated planet, the team members: • locate a variety of resources and extract relevant information about their planets • use the agreed method to organise and record relevant data/information about the physical (non-living) conditions on the planets • record sources of information using an acceptable method. Each project team: • collates the data/information collected by team members • uses the data to review their questions and predictions about problems likely to be faced if people were to live on each planet in the solar system • uses the data to reach a consensus and justify the choice of the planet that will be the focus for their team project. Each student records, in their individual portfolio, the team findings and ideas.
Skills – Working Scientifically **Problem Solving** WS8 Students solve problems by: d. using cause-and-effect relationships to explain ideas and findings **Communicating** WS9 Students communicate by: c. using a recognised method to acknowledge sources of data and information	**Processing and analysing information about technological advances** **Teacher background** *To provide evidence to support their ideas about the major problems faced by living on another planet in the solar system, students access a variety of secondary sources to extract information about technological advances that have led to an increased scientific understanding of the solar system and planetary conditions. After collating the information, the class creates a visual presentation to display their findings.* **Class activity** With teacher guidance, students:

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d. constructing and using a range of representations to honestly, clearly and/or succinctly present data and information including diagrams, keys, models, tables, drawings, images, flowcharts, spreadsheets and databases **Knowledge and Understanding** **Earth and Space** ES2 Scientific knowledge changes as new evidence becomes available. Some technological developments and scientific discoveries have significantly changed people's understanding of the solar system. Students: d. describe some examples of how technological advances have led to discoveries and increased scientific understanding of the solar system	• propose some examples of technological advances, both historical and recent, that have provided evidence of planetary conditions, eg development of telescopes, advances in computer technology, research and simulations on Earth, developments in space craft, planetary space stations and deep space probes • agree on a method of collecting and summarising information and the type of visual presentation (eg timeline, multimedia) to be created by the class. In pairs, students: • access, extract and record information from a variety of reliable secondary sources about how at least one technological advance has increased scientific understanding of the solar system • summarise and present the gathered information using the agreed method for inclusion in the class visual representation • acknowledge sources of information using an acceptable method. The class collates the information provided by each team, to create a visual representation describing how a range of technological advances have led to discoveries and increased scientific understanding of the solar system. **Project team activity** Students use their own and relevant information from the visual presentation to: • describe the major challenges that people will face by living in the physical conditions on their chosen planet, eg gravitational force compared to Earth and different atmospheric conditions • brainstorm some solutions that could be used to overcome these challenges • construct and use an appropriate method to record their ideas about challenges, and suggest possible solutions for surviving these challenges on their selected planet. In their individual portfolios, students record their own and team findings about the technological advances investigated and ideas about challenges and solutions for survival on the selected planet.
Skills – Working Scientifically **Conducting Investigations** WS6 Students conduct investigations by: b. assembling and using appropriate equipment and resources to perform the investigation, including safety equipment d. following the planned procedure, including in fair tests, measuring and controlling variables (ACSIS126, ACSIS141) e. recording observations and measurements accurately, using appropriate units for physical quantities **Processing and Analysing Data and Information** WS7.1 Students process data and information by: a. summarising data from students' own investigations and	**Conducting investigations about forces** **Teacher background** *A major problem that the students are likely to identify will be the difference in gravity on their chosen planet compared with that on Earth. To assist them in proposing some solutions to managing this problem in their team project, students undertake first-hand investigations about unbalanced forces including gravity,* **Pair activity: Investigating unbalanced forces** Students follow the procedures to undertake teacher-selected, first-hand investigations about forces that have been set up at workstations around the laboratory. In their individual portfolios, students record for each practical activity, the question investigated, the method used, their results and conclusions. Students compare their results and conclusions with another pair and discuss questions raised with their peers and teacher. Students reflect on the feedback, review their findings and record a summary about forces including:

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secondary sources (ACSIS130, ACSIS145) b. using a range of representations to organise data, including graphs, keys, models, diagrams, tables and spreadsheets e. applying simple numerical procedures, eg calculating means when processing data and information, as appropriate WS7.2 Students analyse data and information by: b. constructing and using a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate (ACSIS129, ACSIS144) d. using scientific understanding to identify relationships and draw conclusions based on students' data or secondary sources (ACSIS130, ACSIS145) e. proposing inferences based on presented information and observations **Problem Solving** WS8 Students solve problems by: d. using cause-and-effect relationships to explain ideas and findings **Knowledge and Understanding – Physical World** PW1 Change to an object's motion is caused by unbalanced forces acting on the object. (ACSSU117) Students: a. identify changes that take place when particular forces are acting b. predict the effect of unbalanced forces acting in everyday situations PW2 The action of forces that act at a distance may be observed and related to everyday situations. Students: e. identify that the Earth's gravity pulls objects towards the centre of the Earth (ACSSU118) f. describe everyday situations where gravity acts as an unbalanced force g. distinguish between the terms 'mass' and 'weight'	• different types and examples of unbalanced forces that exist on Earth • changes that take place when particular forces are acting • their predictions about the effect of unbalanced forces acting in everyday situations • gravity as an unbalanced force acting at a distance that pulls objects towards the Earth. **Pair activity: Investigating the difference between mass and weight** Students conduct a first-hand investigation process and analyse data to answer the question 'How is mass different from weight?' Students: • record the known densities of cubes of different materials, eg wood, foam, metal • measure and record the weight of each cube • measure and record the volume of each cube, eg by displacement of water • repeat the measurements and average results to increase reliability • determine the mass of each cube using the relationship mass = density x volume • tabulate collected data using appropriate units for mass and weight • share results with other pairs and the class • compare collated class results with own results and account for differences • use class results to construct a graph to show the relationship between mass and weight, eg Excel • use the graph to describe the relationship between mass and weight. **Project team activity** Students conduct a first-hand investigation and use gathered data from secondary sources to answer the question 'How will weight change on another planet?' Students: • use the collated class data to calculate, tabulate and compare the weight of 1 kg of potatoes and/or their own weight on various planets • use the relationship between mass and weight to explain their answer to the question posed • make and record their findings, predictions and inferences about how changes in an object's weight would affect people's lives on different planets • use gathered data and their own results to explain and account for their ideas. Students undertake self-assessment of their learning using a teacher-provided evaluation sheet. The teacher reviews and provides feedback on individual student portfolios.

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Skills – Working Scientifically **Planning Investigations** WS5.1 Students identify data to be collected in an investigation by: a. identifying the purpose of the investigation **Problem Solving** WS8 Students solve problems by: a. using identified strategies to suggest possible solutions to a familiar problem b. describing different strategies that could be employed to solve an identified problem with a scientific component	**Problem solving: Developing ideas for the design of the team presentation** **Teacher background** *To assist students in developing and designing their team presentation, they evaluate features of successful advertising and public information campaigns.* **Class activity** The teacher invites a guest speaker (eg a person in the advertising industry, a member of the English staff) to talk about strategies used in advertising and in promotional and public information campaigns. AND/OR Using teacher-provided and/or student-selected examples of creative advertising and public information campaigns, eg from YouTube, TV advertisements, etc, students: • use a scaffold to identify the key features and strategy used to promote a product, eg pictures, symbols, persuasive language • identify the features of the potential audience for each advertisement/campaign • identify, discuss and record key elements or criteria of a successful advertisement/campaign • review their gathered survey data/information on the range of views about living on another planet to identify the audience for whom their presentation will be designed • generate, develop and record some strategies for the design of their presentation based on the selected audience and data collected about successful campaigns.
Skills – Working Scientifically **Planning Investigations** WS5.1 Students identify data to be collected in an investigation by: a. identifying the purpose of an investigation **Conducting Investigations** WS6 Students conduct investigations by: a. collaboratively and individually conducting a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125, ACSIS140) b. assembling and using appropriate equipment and resources to perform the investigation, including safety equipment d. following the planned procedure, including in fair tests, measuring and controlling variables (ACSIS126, ACSIS141) e. recording observations and measurements accurately, using appropriate units for physical quantities	**Conducting investigations about the requirements for survival of living things** **Teacher background** *To assist students to gather information that provides evidence for how the basic needs of people on their chosen planet might be met, students undertake first-hand investigations relating to the requirements of living things for survival, eg gases, water and disposal of wastes.* Students plan and conduct simple, teacher-selected first-hand investigations relating to the requirements of living things. Possible practical experiences could include: • observations over several weeks of a self-sustaining land ecosystem, eg terrarium • requirements for photosynthesis and respiration • the role of microbes in decomposition. For each investigation students record in their portfolios the purpose, method used, results obtained and, based on the data collected, an explanation of how their findings relate to the survival of living things.

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Processing and Analysing Data and Information WS7.2 Students analyse data and information by: d. using scientific understanding to identify relationships and draw conclusions based on students' data or secondary sources (ACSIS130, ACSIS145) e. proposing inferences based on presented information and observations **Knowledge and Understanding** **Living World** LW2 Cells are the basic units of living things and have specialised structures and functions. (ACSSU149) Students: a. identify that living things are made of cells c. outline the role of respiration in providing energy for the activities of cells LW3 Multicellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce. (ACSSU150) Students: a. identify the materials required by multicellular organisms for the processes of respiration and photosynthesis LW5 Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems. Students: c. describe examples of beneficial and harmful effects that micro-organisms can have on living things and the environment	
Skills – Working Scientifically **Processing and Analysing Data and Information** WS7.1 Students process data and information by: a. summarising data from students' own investigations and secondary sources (ACSIS130, ACSIS145) b. using a range of representations to organise data, including graphs, keys, models, diagrams, tables and spreadsheets d. accessing information from a range of sources, including using digital technologies	**Problem solving: Planning and designing a sustainable artificial ecosystem on the chosen planet** **Teacher background** *Taking into account the physical conditions on their chosen planet and the evidence gathered about the requirements for survival of living things, students propose a plan for the organisms and materials that would be needed to establish a self-sustaining ecosystem on the planet.* Students process and analyse data and information from their investigations and from secondary sources about Australian ecosystems and an artificial ecosystem, eg Biosphere 2 project, to develop their understanding of interactions between producers, consumers and decomposers in food chains and food webs.

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WS7.2 Students analyse data and information by: c. identifying data which supports or discounts a question being investigated or a proposed solution to a problem d. using scientific understanding to identify relationships and draw conclusions based on students' data or secondary sources (ACSIS130, ACSIS145) e. proposing inferences based on presented information and observations **Problem Solving** WS8 Students solve problems by: d. using cause-and-effect relationships to explain ideas and findings e. evaluating the appropriateness of different strategies for solving an identified problem **Knowledge and Understanding** **Living World** LW5 Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems. Students: a. construct and interpret food chains and food webs, including examples from Australian ecosystems b. describe interactions between organisms in food chains and food webs, including producers, consumers and decomposers (ACSSU112) d. predict how human activities can affect interactions in food chains and food webs, including examples from Australian land or marine ecosystems (ACSSU112)	In project teams, students: • relate ideas about the requirements of living things to the solution of problems faced by living things on their chosen planet • propose inferences based on the findings from their investigations about solutions to managing a sustainable ecosystem on their chosen planet, such as: – the source of energy for the ecosystem – the processes occurring within the ecosystem (photosynthesis, respiration, decomposition) – the recycling of non-living materials (gases, water) • construct food chains and food webs • describe the interrelationships between the non-living and living components of ecosystems. Students summarise data and information extracted from secondary sources about Australian land and water ecosystems to identify examples of: • sustainable management by local Aboriginal communities and other Indigenous peoples • human activities that have had an adverse impact on these ecosystems. They record, in individual portfolios, examples of human environmental impact on interactions in food chains and food webs in Australian land or marine ecosystems. In project teams, students use information gathered from their research and investigations to: • outline the organisms and non-living components that would be needed for a self-sustaining ecosystem on the planet • discuss ways in which the effects of human activity could be reduced or eliminated in the artificial ecosystem to be established on their chosen planet.
Skills – Working Scientifically **Problem Solving** WS8 Students solve problems by: c. using scientific knowledge and findings from investigations to evaluate claims (ACSIS132, ACSIS234) e. evaluating the appropriateness of different strategies for solving an identified problem	**Communicating: Preparing and presenting the team project** **Teacher background** *Using summaries and evidence gathered from their individual portfolios, students produce a short, scientifically accurate, creative advertising campaign to raise public awareness and/or debate about the proposal to send humans to live on another planet in the solar system.* Each project team: • discusses the choice of audience and selects, from strategies recorded by the team members, the one to be used for the presentation

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Communicating WS9 Students communicate by a presenting ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate (ACSIS133, ACSIS148) b. using appropriate text types in presentations, including a discussion, explanation, exposition, procedure and recount d. constructing and using a range of representations to honestly, clearly and/or succinctly present data and information, including diagrams, keys, models, tables, drawings, images, flowcharts, spreadsheets and databases	• selects, reviews and justifies the scientific knowledge and findings to include in their presentation using appropriate text types • develops and presents their production to the class and/or to their identified audience • assesses the effectiveness of the processes used by the team and the contribution of each team member • uses feedback from the audience and teacher to evaluate the effectiveness of their advertising/public awareness-raising campaign. Using a teacher-developed scaffold, each team presentation is assessed by the class/audience and teacher using the criteria: • suitability for intended audience • scientific accuracy of information • use of persuasive language • creativity of presentation • teamwork. **Class activity** In the role of reporting back to the international consortium that employed the project team, the class discusses/debates, based on the scientific evidence, the possibility of humans living successfully on another planet in the future.
Skills – Working Scientifically **Processing and Analysing Data and Information** WS7.2 Students analyse data and information by: f. reflecting on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected (ACSIS131, ACSIS146)	**Reflecting on the team presentation and on individual learning** **Teacher background** *Students reflect on how their team project could be improved and on their personal learning during the unit.* With teacher guidance, each team reflects on the results of the assessment process in terms of: • how well the team addressed the criteria • what could have been done differently to ensure that the advertising campaign raised sufficient awareness and/or debate about the proposal to send humans to live on another planet in the solar system. Students reflect on their own learning by: • identifying new learning acquired during the unit • identifying new learning acquired from each team presentation • comparing and contrasting the team presentations • identifying what they learned from working with others in a group. Through their portfolios and team discussion, the teacher assesses the ability of individual students to reflect on the design process, the effectiveness of their advertising campaign and their own learning.

Resources	Assessment overview
Materials and equipment required for hands-on practical investigations, including: • constructing terrariums • investigating forces • investigating mass and weight, eg density cubes, measuring cylinders, balances, wood, foam and metal • investigating photosynthesis, respiration and decomposition. **Online file sharing:** Google Docs, SkyDrive, School Portal **Applications:** Excel and Numbers Spreadsheets **Presentation applications:** PowerPoint, SMART Notebook, Storybird **Word-processing/Publishing:** Word, Publisher, Pages **Survey software:** SurveyMonkey, LimeSurvey, Kwik Surveys **Scootle:** Resources for Australian Curriculum Science Years 7 and 8 **Websites** • National Assessment Program – www.nap.edu.au/NAPLAN/About_each_domain/Writing/index.html (guide to writing, including persuasive writing) • NASA – www.nasa.gov (technological advances) • Infrared Processing and Analysis Centre – www.ipac.caltech.edu • University of Arizona Biosphere 2 – www.b2science.org/ • Euronews – www.euronews.com/2011/05/03/first-ever-biosphere-project-is-20-years-old • Windows to the Universe (National Earth Sciences Teachers' Association) – www.windows2universe.org/our_solar_system/planets_table.html (data table solar system, interactives) • NASA – Curiosity Has Landed (on Mars) • www.youtube.com/watch?v=N9hXqzkH7YA	Assessment opportunities could include: • student records and reflections in individual portfolios • practical techniques and records of practical investigations • processing and analysing data • student self-assessment of learning using a teacher-provided evaluation sheet • cause-and-effect reasoning • use of digital applications • use of listed criteria to assess team presentations • ability of each student to reflect on the design process and their own learning.