STARGAZING LIVE

A STUDY GUIDE BY CHERYL JAKAB

http://www.metromagazine.com.au

http://theeducationshop.com.au

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A SCHOOLS STUDY GUIDE
BY CHERYL JAKAB

SUITABILITY:
Recommended for Years 3–11
Highly recommended for Science
Understandings Years 3, 5, 7, 10
and 11
STARGAZING LIVE

A three-night live television event celebrating the wonders of space with Professor Brian Cox

Website: abc.net.au/stargazing
Hashtags: #StargazingABC and #StargazingQuestions
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INTRODUCTION
When looking out into the night sky, humans have long wondered about what we see there. We name these objects, including the wanderers, Jupiter, Saturn and Mars and create patterns in what we see as constellations, for example Leo, the Southern Cross and the Emu in the Sky. Wondering about what these lights are has led to many questions, tales, stories and science.

Stargazing Live gives public access to current research frontiers using some of the biggest and most powerful telescopes. The three episodes are co-hosted by much-loved Australian comedian and presenter Julia Zemiro.

Stargazing Live aims to actively engage the public, students and teachers with the long history and up to date knowledge of stargazing. We hear ancient stories and find out current research on the Moon, planets of the Solar System and beyond to our galaxy, the Milky Way. Students, teachers and the public are seen interacting with the ‘stars’ of both kinds – celebrities and objects in the sky.
Expert explanations, spectacular images and various methods of modelling used in astronomy are used to explain current knowledge about how we know what we know about exoplanets, black holes, the Milky Way, Jupiter, our Moon and much, much more.

This guide presents activities and related worksheets that support students and teachers in exploring such contemporary scientific questions in structured and open investigations and extended research projects, with links across the curriculum, including STEM subjects, Humanities and Social Sciences, Critical and Creative Thinking, English and Media Arts.

Importantly for everyday people taking part, the series shows how the public (non-professional astronomers) can contribute to the advancement of our scientific knowledge of exoplanets and other space objects.
SERIES AT A GLANCE
SERIES AT A GLANCE

Synopsis of curriculum links and topics

The series begins with Professor Cox at the outset showing that the view of the stars is better in the south and explaining why this is the case.

Questions that have long been asked by cultures across the world, and throughout human history, are discussed and explored, and current evidence is explained.

QUESTIONS EXPLORED INCLUDE:

Why choose the Southern Hemisphere for this event?

How do people today investigate ‘the stars’?

What do we know about the planets of the Solar System?

Are we alone in the universe? What is the Milky Way and how do we know?

What is the evidence for our knowledge, today and in the past?

How can we know what we think we know?

Running time
3 × 56 minutes (approx.)

Suitability
Years 3–10, with links to senior-level Biology, and Earth and Environmental Science

Curriculum connections
Activities in this guide are linked to the Australian Curriculum 8.3 Science, Technologies, Mathematics, Humanities and Social Sciences, Media Arts, Critical and Creative Thinking, and English.

Credits
Presenters: Professor Brian Cox, Julia Zemiro. 
Stargazing Live is based on a format devised by the BBC, licensed by BBC Worldwide and produced by FremantleMedia Australia for ABC.

For more information on the show and production credits please visit <http://www.abc.net.au/ourfocus/stargazing/>. Stargazing Live can be accessed through the following ABC channels and platforms:

Dates: 4,5,6 April – 8.30pm, ABC TV (live, ex WA), iview (until September 2017) and live-streamed on ABC TV’s Facebook and YouTube channels

Website: abc.net.au/stargazing

Hashtags: #StargazingABC and #StargazingQuestions
Episode 1

- The night sky in the Southern Hemisphere (Science, HASS, Arts)
- Stories of the night sky (English, HASS: Diversity and Identity, History)
- The Moon, the Milky Way and black holes (Maths, Science, Technologies)
- How we know what we know about the night sky? (Critical Thinking, Science, Maths)
- The telescope challenge exoplanets (Technology, Critical Thinking, Civics & Citizenship)

Episode 2

- Exploring Jupiter (Science, English, HASS, History)
- Saturn (Science, HASS)
- Technologies for exploring (Critical Thinking, Technologies, Science, Maths)
- Asteroids and meteors (Maths, Science, Technologies)
- Telescope challenge and citizen science (Technologies, Critical Thinking, Citizenship)

Episode 3

- Aliens and the search for extraterrestrial (off-Earth) life (Science, English, Critical thinking, Arts)
- Moons of the Solar System, including Europa (Critical Thinking, Technology, Science, Maths)
- Moon exploration and Apollo missions (Science, HASS, Technologies)
- Effects of Moon and other space objects on conditions on Earth (Science, Critical Thinking)

Opposite is a summary by episode of the main concepts covered and the curriculum area links of the related activities in this guide.
Planet and Minor Planet

The traditional model of Solar Systems defines a ‘planet’ as a celestial body larger than an asteroid or comet. Technically, there was never a scientific definition of the term ‘planet’ before 2006. The definition of a planet set in Prague in 2006 by the International Astronomical Union (IAU) states that, in the Solar System, a planet is a celestial body that is in orbit around the Sun, has sufficient mass to assume hydrostatic equilibrium (a nearly round shape) and has cleared the space around its orbit.

Reference: <https://www.iau.org/public/themes/pluto/>
THE DRAKE EQUATION

The Drake Equation estimates the number of technological civilisations that may exist in our galaxy. The Drake Equation is simple, but it was also useful for encouraging curiosity about the universe.

\[ N = R^* \cdot f_p \cdot n_e \cdot f_i \cdot f_l \cdot f_c \cdot L \]
KEY TO TERMS

N  The number of technologically advanced civilisations in the Milky Way galaxy whose electromagnetic emissions are detectable.

R*  The rate of formation of stars suitable for the development of intelligent life.

f_p  The fraction of those stars with planetary systems.

n_e  The fraction of those stars with planetary systems.

f_i  The number of planets, per Solar System, with an environment suitable for life.

f_i  The fraction of suitable planets on which life actually appears.

f_c  The fraction of civilisations that develop a technology that releases detectable signs of their existence into space.

L  The number of planets, per Solar System, with an environment suitable for life.
Keywords for information searches

- black hole
- galaxy
- Milky Way
- Moon
- Solar System

Recommended search websites

YEARS 3–6
See Kids Astronomy
<http://www.kidsastronomy.com/dictionary.htm>

<http://www.enchantedlearning.com/subjects/astronomy/glossary/>

YEARS 7–10
Start at NASA or
<http://www.seasky.org/astronomy/astronomy-glossary.html>
CURRICULUM AND EDUCATION SUITABILITY
CURRICULUM AND EDUCATION SUITABILITY

This guide outlines activities linked to outcomes expressed in the Australian Curriculum 8.3.

N.B. Links to the various state documents on implementation can be found in the references section of this guide and at: <http://www.australiancurriculum.edu.au/Curriculum/Overview>

DETAILED DESCRIPTIONS

Teachers should select from the outcomes listed below depending on their year levels and curriculum focus.

SCIENCE

### SCIENCE UNDERSTANDINGS: EARTH AND SPACE SCIENCES

| Year 3 | Earth’s rotation around its axis causes regular changes, including night and day. | ACSSU048 |
| Year 4 | Earth’s surface changes over time as a result of natural processes and human activity. | ACSSU075 |
| Year 5 | The Earth is part of a system of planets orbiting around a star (the Sun). | ACSSU078 |
| Year 6 | Sudden geological changes and extreme weather events can affect Earth’s surface. | ACSSU096 |
| Year 7 | Predictable phenomena on Earth, including seasons and eclipses, are caused by the relative positions of the Sun, Earth and the Moon. | ACSSU115 |
| Year 8 | Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales. | ACSSU153 |
| Year 9 | The theory of plate tectonics explains global patterns of geological activity and continental movement. | ACSSU180 |
| Year 10 | The Universe contains features including galaxies, stars and Solar Systems, and the Big Bang theory can be used to explain the origin of the universe. Energy conservation in a system can be explained by describing energy transfers and transformations. The motion of objects can be described and predicted using the laws of physics. | ACSSU188 ACSSU190 ACSSU229 |
### Senior

**Earth and Environmental Science Unit 1: Introduction to Earth systems**

Precise dates can be assigned to points on the relative geological time scale using data derived from the decay of radioisotopes in rocks and minerals; this establishes an absolute time scale and places the age of the Earth at 4.5 billion years.

Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence; use reasoning to construct scientific arguments.

**Biology Unit 1: Biodiversity and the interconnectedness of life**

Ecosystems can change dramatically over time; the fossil record and sedimentary rock characteristics provide evidence of past ecosystems and changes in biotic and abiotic components.

### SCIENCE AS A HUMAN ENDEAVOUR: NATURE AND DEVELOPMENT OF SCIENCE

**Years 3 & 4**

Science involves making predictions and describing patterns and relationships.  

ACSHE050

**Years 5 & 6**

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions.  

ACSHE081

**Years 7 & 8**

Scientific knowledge has changed peoples’ understanding of the world and is refined as new evidence becomes available.  

ACSHE119

**Years 9 & 10**

Advances in science and emerging sciences and technologies can significantly affect people’s lives, including generating new career opportunities. The values and needs of contemporary society can influence the focus of scientific research.  

ACSHE195

ACSHE230

### SCIENCE INQUIRY SKILLS

**Years 3-6**

**Communicating**

Year 3: Represent and communicate observations, ideas and findings using formal and informal representations.  

ACSIS060

Year 4: Represent and communicate observations, ideas and findings using formal and informal representations.  

ACSIS071

Year 5: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts.  

ACSIS093

Year 6: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts.  

ACSIS110
### STARGAZING LIVE

#### EVALUATING

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<thead>
<tr>
<th>Years 7-10</th>
<th>Evaluating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 7: Use scientific knowledge and findings from investigations to evaluate claims based on evidence.</td>
</tr>
<tr>
<td></td>
<td>Year 8: Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements.</td>
</tr>
<tr>
<td></td>
<td>Year 9: Critically analyse the validity of information in primary and secondary sources and evaluate the approaches used to solve problems.</td>
</tr>
<tr>
<td></td>
<td>Year 10: Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.</td>
</tr>
</tbody>
</table>

#### HUMANITIES AND SOCIAL SCIENCES

##### KNOWLEDGE AND UNDERSTANDING

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<thead>
<tr>
<th>Years 3-7</th>
<th>HASS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Aboriginal or Torres Strait Islander Country/Place on which the school is located and why Country/Place is important to Aboriginal and Torres Strait Islander Peoples.</td>
</tr>
<tr>
<td></td>
<td>The ways in which Aboriginal and Torres Strait Islander Peoples maintain special connections to particular Country/Place.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 7</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The importance of conserving the remains of the ancient past, including the heritage of Aboriginal and Torres Strait Islander Peoples.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 8</th>
<th>Geography</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spiritual, aesthetic and cultural value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 9</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The extension of settlement, including the effects of contact (intended and unintended) between European settlers in Australia and Aboriginal and Torres Strait Islander Peoples</td>
</tr>
</tbody>
</table>

##### INQUIRY AND SKILLS

<table>
<thead>
<tr>
<th>Years 3 &amp; 4</th>
<th>Questioning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pose questions to investigate people, events, places and issues.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Communicating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present ideas, findings and conclusions in texts and modes that incorporate digital and non-digital representations and discipline specific terms.</td>
</tr>
</tbody>
</table>
### STARGAZING LIVE

#### Years 5 & 6

**Questioning**
- Develop appropriate questions to guide an inquiry about people, events, developments, places, systems and challenges.

**Communicating**
- Present ideas, findings, viewpoints and conclusions in a range of texts and modes that incorporate source materials, digital and non-digital representations and discipline-specific terms and conventions.

#### Years 7-10

**Explanation and communication:**
- Develop texts, particularly descriptions and explanations that use evidence from a range of sources that are acknowledged.
- Use a range of communication forms (oral, graphic, written) and digital technologies.

### CIVICS AND CITIZENSHIP

#### DIVERSITY AND IDENTITY

<table>
<thead>
<tr>
<th>Years</th>
<th>Topic</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 &amp; 4</td>
<td>The importance of making decisions democratically. Who makes rules, why rules are important and the consequences of rules not being followed.</td>
<td></td>
<td>ACHASSK070 ACHASSK071 ACHASSK072</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>Why people participate within communities and how students can actively participate and contribute.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td>Investigate how people with shared beliefs and values work together to achieve their goals and plan for action.</td>
<td></td>
<td>ACHASSK118</td>
</tr>
<tr>
<td>9 &amp; 10</td>
<td>Different perspectives about Australia’s national identity, including Aboriginal and Torres Strait Islander perspectives, and what it means to be Australian.</td>
<td></td>
<td>ACHCK066</td>
</tr>
<tr>
<td>9 &amp; 10</td>
<td>Examine the influence of a range of media, including social media, in shaping identities and attitudes to diversity.</td>
<td></td>
<td>ACHCK080</td>
</tr>
</tbody>
</table>

### ENGLISH

#### CONTENT DESCRIPTIONS

<table>
<thead>
<tr>
<th>Year</th>
<th>Component</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Language</td>
<td>Identify the features of online texts that enhance navigation.</td>
<td>ACELA1790</td>
</tr>
<tr>
<td></td>
<td>Literature</td>
<td>Create imaginative texts based on characters, settings and events from students’ own and other cultures using visual features, for example perspective, distance and angle.</td>
<td>ACELT1601</td>
</tr>
<tr>
<td></td>
<td>Literacy</td>
<td>Identify the point of view in a text and suggest alternative points of view.</td>
<td>ACELY1675</td>
</tr>
<tr>
<td>Year 4</td>
<td>Language</td>
<td>Understand differences between the language of opinion and feeling and the language of factual reporting or recording.</td>
<td>ACELA1489</td>
</tr>
<tr>
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<td>-------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Year 4</td>
<td>Literature</td>
<td>Make connections between the ways different authors may represent similar storylines, ideas and relationships.</td>
<td>ACELT1602</td>
</tr>
<tr>
<td>Year 4</td>
<td>Literacy</td>
<td>Plan, rehearse and deliver presentations incorporating learned content and taking into account the particular purposes and audiences.</td>
<td>ACELY1689</td>
</tr>
<tr>
<td>Year 5</td>
<td>Language</td>
<td>Understand how texts vary in purpose, structure and topic as well as the degree of formality.</td>
<td>ACELA1504</td>
</tr>
<tr>
<td>Year 5</td>
<td>Literature</td>
<td>Create literary texts that experiment with structures, ideas and stylistic features of selected authors.</td>
<td>ACELT1798</td>
</tr>
<tr>
<td>Year 5</td>
<td>Literacy</td>
<td>Plan, draft and publish imaginative, informative and persuasive print and multimodal texts, choosing text structures, language features, images and sound appropriate to purpose and audience.</td>
<td>ACELY1704</td>
</tr>
<tr>
<td>Year 6</td>
<td>Language</td>
<td>Investigate how vocabulary choices, including evaluative language, can express shades of meaning, feeling and opinion.</td>
<td>ACELA1525</td>
</tr>
<tr>
<td>Year 6</td>
<td>Literature</td>
<td>Analyse and evaluate similarities and differences in texts on similar topics, themes or plots.</td>
<td>ACELT1614</td>
</tr>
<tr>
<td>Year 6</td>
<td>Literacy</td>
<td>Use a range of software, including word processing programs, learning new functions as required to create texts.</td>
<td>ACELY1717</td>
</tr>
<tr>
<td>Year 7</td>
<td>Language</td>
<td>Understand the way language evolves to reflect a changing world, particularly in response to the use of new technology for presenting texts and communicating.</td>
<td>ACELA1528</td>
</tr>
<tr>
<td>Year 7</td>
<td>Literature</td>
<td>Discuss aspects of texts, for example their aesthetic and social value, using relevant and appropriate metalanguage.</td>
<td>ACELT1803</td>
</tr>
<tr>
<td>Year 7</td>
<td>Literacy</td>
<td>Use prior knowledge and text processing strategies to interpret a range of types of texts.</td>
<td>ACELY1722</td>
</tr>
</tbody>
</table>
### Year 8

**Language**
Understand the effect of nominalisation in the writing of informative and persuasive texts.

**Literature**
Recognise and explain differing viewpoints about the world, cultures, individual people and concerns represented in texts.

**Literacy**
Experiment with text structures and language features to refine and clarify ideas to improve the effectiveness of students’ own texts.

| ACELA1546 | ACELT1807 | ACELY1810 |

### Year 9

**Language**
Understand how certain abstract nouns can be used to summarise preceding or subsequent stretches of text.

**Literature**
Present an argument about a literary text based on initial impressions and subsequent analysis of the whole text.

**Literacy**
Explore and explain the combinations of language and visual choices that authors make to present information, opinions and perspectives in different texts.

| ACELA1559 | ACELT1771 | ACELY1745 |

### Year 10

**Language**
Understand conventions for citing others, and how to reference these in different ways.

**Literature**
Create imaginative texts that make relevant thematic and intertextual connections with other texts.

**Literacy**
Choose a reading technique and reading path appropriate for the type of text, to retrieve and connect ideas within and between texts.

| ACELA1568 | ACELT1644 | ACELY1753 |

### MATHEMATICS

#### CONTENT DESCRIPTIONS

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Measure, order and compare objects using familiar metric units of length, mass and capacity.</th>
<th>ACMGG061</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies.</td>
<td>ACMSP069</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Compare objects using familiar metric units of area and volume.</th>
<th>ACMGG290</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluate the effectiveness of different displays in illustrating data features including variability.</td>
<td>ACMSP097</td>
</tr>
</tbody>
</table>
### STARGAZING LIVE

<table>
<thead>
<tr>
<th>Year</th>
<th>Objective</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 5</td>
<td>Choose appropriate units of measurement for length, area, volume, capacity and mass. Describe and interpret different data sets in context.</td>
<td>ACMMG108, ACMSP120</td>
</tr>
<tr>
<td>Year 6</td>
<td>Interpret secondary data presented in digital media and elsewhere.</td>
<td>ACMSP148</td>
</tr>
<tr>
<td>Year 7</td>
<td>Describe and interpret data displays using median, mean and range.</td>
<td>ACMSP172</td>
</tr>
<tr>
<td>Year 8</td>
<td>Solve a range of problems involving rates and ratios, with and without digital technologies.</td>
<td>ACMNA188</td>
</tr>
<tr>
<td>Year 9</td>
<td>Apply index laws to numerical expressions with integer indices.</td>
<td>ACMNA209</td>
</tr>
<tr>
<td></td>
<td>Express numbers in scientific notation.</td>
<td>ACMNA210</td>
</tr>
<tr>
<td></td>
<td>Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly and from secondary sources.</td>
<td>ACMSP228</td>
</tr>
<tr>
<td>Year 10</td>
<td>Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids.</td>
<td>ACMMG242</td>
</tr>
</tbody>
</table>

### TECHNOLOGIES

#### DIGITAL TECHNOLOGIES

<table>
<thead>
<tr>
<th>Years 3-6</th>
<th>Knowledge and Understanding</th>
<th>Processes and production skills</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identify and explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data.</td>
<td>Collect, access and present different types of data using simple software to create information and solve problems.</td>
<td>ACTDIK007</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACTDIP009</td>
</tr>
<tr>
<td>Years 7-10</td>
<td>Knowledge and Understanding</td>
<td>Processes and production skills</td>
<td>ACTDEK013</td>
</tr>
<tr>
<td></td>
<td>Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance.</td>
<td>Analyse and visualise data using a range of software to create information, and use structured data to model objects or events.</td>
<td>ACTDEP015</td>
</tr>
</tbody>
</table>
### DESIGN TECHNOLOGIES

<table>
<thead>
<tr>
<th>Years</th>
<th>Knowledge and Understanding</th>
<th>Processes and production skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-6</td>
<td>Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes.</td>
<td>Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques.</td>
</tr>
<tr>
<td>7-10</td>
<td>Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment.</td>
<td>Use project management processes when working individually and collaboratively to coordinate production of designed solutions.</td>
</tr>
</tbody>
</table>

### THE ARTS

### MEDIA ARTS

<table>
<thead>
<tr>
<th>Years</th>
<th>Activity</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 &amp; 4</td>
<td>Investigate representations of people in their community, through settings, ideas and story structure in images, sounds and text.</td>
<td>ACAMAM058</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>Explore representations, characterisations and points of view of people in their community, including themselves, using settings, ideas, story principles and genre conventions in images, sounds and text.</td>
<td>ACAMAM062</td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td>Develop and refine media production skills to shape the technical and symbolic elements of images, sounds and text for a specific purpose and meaning. Analyse how technical and symbolic elements are used in media artworks to create representations influenced by story, genre, values and points of view of particular audiences.</td>
<td>ACAMAM068, ACAMAR071</td>
</tr>
<tr>
<td>9 &amp; 10</td>
<td>Evaluate how technical and symbolic elements are manipulated in media artworks to create and challenge representations framed by media conventions, social beliefs and values for a range of audiences. Produce and distribute media artworks for a range of community and institutional contexts and consider social, ethical and regulatory issues.</td>
<td>ACAMAR078, ACAMAM077</td>
</tr>
</tbody>
</table>
### GENERAL CAPABILITIES

**CRITICAL AND CREATIVE THINKING**

<table>
<thead>
<tr>
<th>Years 3-10</th>
<th>Inquiring – identifying, exploring and clarifying information: Explore the coherence and logic of multiple perspectives on an issue.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reflecting on thinking, actions and processes: Give reasons to support their own thinking, show awareness of opposing viewpoints and possible weaknesses in their own positions.</td>
</tr>
<tr>
<td></td>
<td>Drawing conclusions and designing a course of action: Identify a problem, isolate its important aspects, and use logical and abstract thinking to formulate a response.</td>
</tr>
</tbody>
</table>

BEFORE-VIEWING ACTIVITIES: ENGAGING WITH THE TOPIC
**ACTIVITY 1: NIGHT SKY FACT CHECKER**

(Worksheet 1a: Years 3-6
and Worksheet 1b: Years 7-10)

**Purpose**

Encourage critical thinking and questioning scientific study of objects in space

**Curriculum focus**

General capabilities: critical and creative thinking; HASS: History of astronomy; Sciences: Science as human endeavour; Maths Understanding and Reasoning

**Time allocation**

1 hour plus, prior to watching *Stargazing Live* Episode 1.

**Teaching**

Group work, Strategy 5e’s and Think/Know/Wonder

**Focus**

Science understandings and Science as human endeavour

**Topic focus**

Engage with scientific ideas about studying the night sky, including the Moon, stars, galaxies and black holes. Worksheets are intended as supportive discussion openers. The questions as presented are appropriate to orient discussions rather than extending understandings.

**Focus questions**

What do you already know and wonder about what is in the night sky?

---

### What to do

**Working as a class**

1. **Engage:** Outline the task using Worksheet/s 1a and/or b: Ask students to offer their prior knowledge, interests, experience and questions about the night sky, astronomy or space exploration. Encourage students to think about how scientists, and others, might explore these ideas. Ask: Where have you heard about astronomy before, in schooling and everyday life

**Working individually**

2. Students complete Worksheets 1a and 1b using hard copy or electronically in preparation for sharing and discussing with a partner or the class. Recording wonderings/questions.

**Working in pairs**

3. **Explain:** Check and discuss responses to worksheet/s and share questions raised before watching *Stargazing Live*.

---

### Answers to Worksheet 1a: Stargazing Quiz

1. Scientists believe that there is a black hole at the centre of
   - c. the Milky Way
2. All known planets are
   - c. orbiting a star
3. Which is biggest?
   - c. Jupiter
4. The Milky Way is
   - a. spiral shaped
5. Which is furthest from the Sun?
   - b. Jupiter
6. Can anything escape from a black hole?
   - a. Yes, some energy does escape (though matter does not)
7. Scientists think life might exist today on which other place in the Solar System?
   - c. Jupiter’s moons might have conditions for life. It is thought conditions for life are present on Mars and Jupiter’s moons, and that Europa around Jupiter is the best bet.
8. When a star explodes, we might see a
   - c. supernova
9. We know galaxies
   - b. have different shapes
10. Star closest to the Earth is
    - c. The Sun
4. Ask pairs to add to a class display of questions raised, then discuss. Record answers and further ideas. N.B. Keep these on display and return to help stimulate project ideas, adding to them after watching each episode of Stargazing Live.

5. Culmination and Evaluation – Numbers Crunch: Record current knowledge including statistics about one of the listed topics that are the focus of Stargazing Live.

6. Create a Space Fact File that includes tables, graphs and/or diagrams to organise and present information, to add to a class display:
   - the Earth as a planet in space,
   - our Moon,
   - Jupiter and the other planets of the Solar System,
   - Stars near and far;
   - the Milky Way and other galaxies

Start with a keyword search on NASA or other suitable websites such as:

http://www.sciencekids.co.nz/sciencefacts/space.html
https://theplanets.org/space-facts/
http://scot.curriculum.edu.au

Extension activities

Who does science? (Years 3–6)

Draw a scientist.
Discuss stereotypes of who scientists are.

What is meant by a stereotype?

See ‘draw-a-scientist’ tests and women in science blogs and on YouTube, e.g. The Myth of the Scientist: Crystal Dilworth at TEDxYouth@Caltech: <https://www.youtube.com/watch?v=w8Uo_OAbCSo>

What is science? (Years 7–10)

Discuss how we know what we know in science. Science is self-correcting. Questions are asked, answered and lead to greater understanding and changing the questions that we then ask. Make sure students keep a record of their research process.
Focus question
What do I know about our Solar System and beyond?

What to do
Circle what you choose as the best answer to each question. Record one thing you wonder/question when deciding on your answer.

1. Scientists believe that there is a black hole at the centre of
   a. the Solar System
   b. the Universe
   c. the Milky Way

I/We wonder/question:

2. All known planets are
   a. in our Solar System
   b. likely to have life
   c. orbiting a star

I/We wonder/question:
3. Which is biggest?
   a. Saturn
   b. Mars
   c. Jupiter

I/We wonder/question:

4. The Milky Way is
   a. spiral-shaped
   b. a distant galaxy
   c. at a fixed point in the sky

I/We wonder/question:
5. Which is furthest from the Sun?  
   a. Mars  
   b. Jupiter  
   c. Mercury

I/We wonder/question:

6. Can anything escape from a black hole?  
   a. yes  
   b. no  
   c. not sure

I/We wonder/question:

7. Scientists think life might exist today on which other place in the Solar System?  
   a. our Moon  
   b. Mercury  
   c. Jupiter's moons

I/We wonder/question:

8. When a star explodes, we might see a  
   a. comet  
   b. new galaxy  
   c. supernova

I/We wonder/question:
9. We know galaxies

a. are spirals
b. have different shapes
c. are fictional

I/We wonder/question:

10. Star closest to the Earth is

a. Sirius
b. Proxima Centauri
c. the Sun

I/We wonder/question:
2. List some technologies humans have developed to help in searching the night sky. Provide a sentence about how you think at least four work.

Focus questions

What do you already know and wonder about what is in the night sky?

What to do

Working by yourself

1. When/what have you been stargazing before? Where? How? What did you see?
3. Think/Know/Wonder: Record at least one question for all eight of the following space objects in the middle column.

<table>
<thead>
<tr>
<th>SPACE OBJECTS</th>
<th>I THINK/KNOW/WONDER</th>
<th>I/WE FACT CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANETS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STARS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOLAR SYSTEMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GALAXIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMETS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLACK HOLES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXOPLANETS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Working with in groups of 2–4

4. **Fact check:** Compare and discuss the ideas recorded above and record your fact check details in Column 3.

5. **List** at least five more objects (other than those listed above) that you know exist out in space.
VIEWING QUESTIONS AND DISCUSSION STARTERS
ACTIVITY 2: RESPONDING TO STARGAZING LIVE

These starters link directly to the activities that follow in this study guide.

The questions are ideal for use by teachers when planning and/or as student worksheets, depending on the year level/s and use/s being made of the programs.

Curriculum focus

Humanities and Social Sciences: Science: Science as Human Endeavour, Science Understanding; General capabilities: Critical and creative thinking.

The questions are divided into four groups, corresponding to sections of the program (approximately 15 minutes in duration).
WORKSHEET 2A: EPISODE 1

1. What gives Australia such a great night-sky view?

2. What do we know about the Milky Way and how?

3. What would you ask the Stargazing Live team?

4. What is your favourite object in the night sky?

5. What ‘stories’ have you heard about our place in space?

6. What is our ‘story’ today about exoplanets?

7. What is meant by the term ‘Goldilocks Zone’?

8. How do scientists locate exoplanets?
9. How would you describe a black hole?

10. When were black holes discovered and how?

11. What problems do we have with studying the Milky Way?

12. What do you think might be on the other side of the Milky Way?

13. What is ‘good’ for astronomers about using Australian telescopes to find out more about the night sky?

14. What do you think makes a telescope image awesome?

15. What might you be able to see in telescope images of the night sky that a computer may not?

16. How would you like / have liked to participate in the telescope challenge?
**WORKSHEET 2B: EPISODE 2**

**What do we know about Jupiter?**

1. What do planets of the Solar System look like in the night sky?

2. How do we know what we know about Jupiter?

3. How do we explain the 'wanderers' in the night sky?

4. What would you ask the *Stargazing Live* team about Jupiter?

**Weather on planets**

5. What causes weather?

6. What is the weather like on other planets of the Solar System?

7. What is 'The Coriolis Effect'?

8. How do our place in space and conditions on Earth interact?
WORKSHEET 2B: EPISODE 2

Ways of exploring the skies

9. What is the advantage of robotic probes (for space exploration)?

10. What is so unsuitable about human bodies for going into space?

11. How do traditional stories present knowledge of skies and Earth?

12. What kinds of ‘tales’ are we now telling about the stars (and in the past)?

Telescope challenge and citizen science

13. How interested are you now in stargazing?

14. How interesting do you now find looking at different telescopic images?

15. What is the difference between an asteroid, a comet and a meteor?

16. How would you participate in the challenge?
WORKSHEET 2C: EPISODE 3

Search for ET life and aliens

1. Do you think there might be life, and/or intelligent life, elsewhere in the universe?

2. What do you know about Project Breakthrough or SETI?

3. Have you had prior experience of ‘reading’ or interpreting telescope images?

4. What is the news from Europa?

Moon fact, fiction and fable

5. What features on the Moon’s surface can you identify?

6. How have we collected information about the Moon?

7. Why do you think people wanted to go to the Moon?

8. What do you think of the idea of people going back to the Moon?
WORKSHEET 2C: EPISODE 3

Life on Earth and the Moon

9. Why do we see phases of the Moon?

10. How can we know about links between life on Earth and the Moon, e.g. between the Great Barrier Reef and the Moon?

11. Why do we have difficulty learning about ‘off-Earth’ objects?

12. Where do you think we might find intelligent extra-terrestrial life?

Telescope challenge and citizen science

1. What are some different types of telescopes and how do they work?

2. What kind of telescope has taken the image of space that you find most awesome?

3. What would you most like to find in telescope images of the night sky?

4. How would you continue the challenge, if you had the chance?
‘Aboriginal people in Australia have a rich astronomical tradition such as the “Emu in the Sky” constellation of dark clouds, and stories about the Sun, Moon, and stars, revealing a depth and complexity of pre-contact Aboriginal cultures which are not widely appreciated by outsiders. Not only did they know the sky intimately, but they were familiar with planetary motions, tides, and eclipses. Their songs and stories show that Aboriginal Australians sought to understand their Universe in a similar way to modern science. They used this knowledge of the sky to construct calendars, songlines, and other navigational tools, enabling them to navigate across the country, trading artefacts and sacred stories.’ Professor Ray Norris
AFTER-VIEWING
ELABORATED LEARNING OPPORTUNITIES
(Activities 3-6)
ACTIVITY 3: GREAT SPACE IMAGES
(WORKSHEET 3)

Purpose
To encourage engagement and aesthetic responses to/about space (STEAM).

Curriculum focus
Arts: Aesthetic awareness; Digital Technologies; Sciences: Science as human endeavour

Teaching strategy
5e’s and Think/Pair/Share

Time allocation
1–2 hours; After watching Stargazing Live

Task
Choose a space image as favourite and create a caption for its display

Focus question
What makes a space object image interesting and appealing? (See Episode 1, Q14)

What to do

Working as a class

1. Engage: Display and discuss some supernovas or other great space images. Explore the idea of the ‘beauty’ and emotional responses to the image perspectives, e.g. seeing the Earth from the Moon. Worksheet 3 provides some great images of ‘space objects’ explored in the Stargazing Live series. Ask students to think about the aesthetic appeal of each image for themselves, while also identifying and discussing what they represent in science knowledge.

2. Explore: Students list the ways images of space are taken (e.g. Earth-based telescopes that capture light, radio signals and space-based probes and telescopes) and create CGI effects (e.g. The Earth from space always has clouds over the surface, while Earth space images are combinations that remove the cloud covering).

Working individually

3. Think: Have students individually complete Worksheet 3: Great Space Images.

Working in pairs

4. Pair: Students share and compare ideas expressed in their responses/answers to questions in Worksheet 3.

5. Explore available resources to choose their own ONE favourite space image for display, including Stargazing Live, NASA and ESA free images. Discuss the format the display will take, e.g. hard-copy, artwork, gallery, PowerPoint or other audiovisual (e.g. 20 slides in 20 seconds or PechaKucha, see http://blog.indezine.com/2012/05/10-tips-to-create-and-present-pecha.html)

Working as a class

6. Share: Use display to evaluate the student processes and products, using an agreed rubric.
EXTENSION: FACT CHECKER (YEARS 7-10)

How can we know?

What do you need to understand about units of measurement to appreciate space facts?

Choose an astronomy factual statistic to check, explain or elaborate on how we know, using NASA or other websites (e.g. https://theplanets.org/milky-way/). You could select one from the list below or another of your own choosing:

1. Our best estimate is that the Milky Way is 100,000–120,000 light years across.
2. The footprints on the Moon will be there for 100 million years.
3. One day on Venus is longer than its year.
4. The mass of our Sun is around 330,000 times that of Earth.
Your task

Choose one space image as your favourite and create a caption for the class display.

Images like those of Saturn and Jupiter by Cassini and Juno probes are without doubt some of the most breathtaking images ever taken in space. And Australia plays a crucial role in getting these images back to Earth; in fact, we’ve been involved since the Galileo probe days ....

What’s incredible is that these images were taken almost a billion miles away, yet here we are looking at them in incredible detail, as if with our own eyes. How on Earth does a picture like this travel a billion kilometres through space and get safely to Earth for us to enjoy? (Episode 2)
What to do:

1. Think: Working by yourself.
   For each of the images attached, record below the image:
   - what you think it is showing;
   - how you think the image was taken/created; and
   - why do you find/feel/think this image is interesting.

2. Pair: With a partner, discuss your ideas about each image and then search online for another image as your ‘favourite’ to add to a class display in the agreed format. Write a short caption (what/how/why) as display notes:
   - what it is;
   - how, when and where you think it was taken/made, and;
   - why you find it interesting / like it.

3. Share: Add your Great Space Image to the class art gallery display.

Extension

What responses to art, science and/or space ideas do people experience?

Devise your own scale to measure people’s interest in / responses to art, science and/or space.

NB. Consider the scale below about people’s responses to insects. Human responses to insects and other arthropods are classified on a five-point entomophobia scale:

1. React hysterically (show entomophobia);
2. Go on a killing spree (believing that the only good insect is a dead insect);
3. Tolerate insects (when no serious or permanent harm is seen to be done);
4. Appear indifferent (do not respond); or
5. Respond pro-environmentally (protect living things, and denounce all insecticides and repellents).
GREAT SPACE ART

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]

What: [Image of a black background with a bright dot]
How: [Image of a starry night sky]
Why: [Image of Jupiter]
ACTIVITY 4: SPACE IS BIG: MODELS AND MATHS

(WORKSHEET 4 AND INFORMATION SHEET: YEARS 3-10)

Purpose
To explore ways of representing current space science knowledge that helps explain a current idea/question about space by creating a story, demonstration and/or models.

Task
Create, make and present a story or demonstration about space facts and figures that uses some form of modelling for representing the ideas. The model you choose should help your chosen audience to make sense of size, distances, scales, units, numbers or other mathematical knowledge about the ‘space is big’ topic.

Recommended teaching strategy
Jigsaw home and expert groups; group work projects

Curriculum focus
Mathematics; Science: Science understandings, Earth and space sciences, Science as a human endeavour, Nature and development of science; Technologies: Digital Technologies, Design Technologies, Processes and production skills

N.B. Highly recommended for Science understandings Years 3, 5, 7 and 10

Focus question
What ways of (re)presenting ideas did you find most informative in Pqαd^wkd?1 fsb?

What to do
Working as a class

1. Class discussion: Review one or more of the demonstrations or models used in Stargazing Live to explain a point being made (e.g. Ep 1: Why the stars are better in the Southern Hemisphere).

Ask: What ways of explaining, reporting and arguing ideas were used in Stargazing Live? What other models and demonstrations were used? What way of presenting facts and figures helped you to understand? What brings an idea ‘to life’ for you?

2. Hand out Information Sheet 4: Quantities & Questions to assist discussion of facts and figures explored in Stargazing Live. What are some problems in understanding the facts and figures involved in space science? What ways of describing and explaining in mathematics help you/do you think work best? What ways of presenting quantities can help capture your attention and help you understand? Consider Dreamtime stories, myths and legends from across the globe and how they represent information and compare these with mathematical and other forms of modelling.

3. What topic would you like to explore further and communicate to a chosen audience, e.g. write a book for younger children, demonstrate a complex idea in a model, give a class PowerPoint presentation on ‘Space statistics’?
4. Focus students’ attention on how they can learn more about a chosen topic using online sources. Consider raising questions that focus on the four fields of STEM:

**Science:** What questions are being asked today about your topic e.g. the Moon, exoplanets, Jupiter, the Milky Way? What is a fact?

**Technology:** How is the information gained? How are probes and telescopes designed and made? How do scientists on Earth learn the results from soil testing on Mars?

**Engineering:** What systems are used and how are they put together in telescopes? How do space probes reach their destinations? How do they move?

**Maths:** What units are used to measure size? What are the dimensions of space? How far is ... from Earth? How far have we travelled from Earth? What shape is ...?
Working in groups:

5. Home groups of four: Hand out Worksheet 4. Have students select or allocate home groups to investigate an agreed topic.

- Earth’s Moon and/or Moon missions
- Jupiter (or another planet from our Solar System)
- stars and constellations
- the Milky Way and other galaxies.

Ask groups to discuss, search for and record information about ways they might represent information for a report, explanation, argument or discussion project, including Models, Myths and Stories, Metaphors and Mathematics.

6. Jigsaw: Create four expert groups to explore the ideas of Models, Myths and Stories, Metaphors and Mathematics. Have one student from each home group go to form expert groups. Discuss the problems of (re)presenting their home group topic ideas/data/concepts using the table on Worksheet 4.

7. Students in expert groups are to discuss how to explain facts and figures to their home groups in a way that is interesting and easy to understand.

<table>
<thead>
<tr>
<th>REPRESENTATION</th>
<th>ISSUES</th>
<th>EXAMPLE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
<td>Not all parts of the target concept being modelled and the model are the same</td>
<td>Models of Solar System. Most physical models showing relative sizes or distances, not both.</td>
<td>Distances too big to show in scale, hard to get information in one model</td>
</tr>
<tr>
<td>MYTH &amp; STORY</td>
<td>Fact and fiction</td>
<td>Constellations as patterns seen in the sky</td>
<td>Not real pattern in space. Stars seen in an area in the sky at different distances from Earth.</td>
</tr>
<tr>
<td>METAPHOR</td>
<td>Similarities and differences</td>
<td>The beginning of the universe (the Big Bang) – the Big Bang is a theory, not an object or event like those in space/time</td>
<td>‘Bang’ is a sound of an explosion on Earth, would not be the same as the event</td>
</tr>
<tr>
<td>MATHEMATICS</td>
<td>Tables, graphs, units, accuracy</td>
<td>Astronomical units Lightyears</td>
<td>Distance from Earth to Sun used to make sense of big numbers Measure of distance – The distance covered/takes light to get from one place to another</td>
</tr>
</tbody>
</table>
Discuss:

How might overextending a model or metaphor lead to problems in thinking?

8. In home groups, finalise and negotiate with the teacher a focus question and how they will create a ‘Space is big’ model and/or story for their chosen topic. (Emphasise this must include one or more Models and Maths about the topic.)

9. Have students design a list of headings (and subheadings) to use in their organisation of the project and decide who will be responsible for each part by thinking about:

- What is the content?
- What is the main message?
- What type of model would work well for this idea?
- Interesting features to engage the audience
- Sources of information / References

10. Negotiating task details: Confirm and agree to details and then complete the research project, ensuring it has all the required components.

11. Reporting: Have students present their results to the class group.

Extension activity

Take and present your models and stories to other audiences.
Choose your model

You might consider creating a book for younger children, a cartoon strip, a physical model or diorama, or a PowerPoint presentation.

What to do

1. Choose a home group (of 4) to work with and then select your topic from those listed above.

2. Numbers crunch: Collect facts and figures about your chosen topic area. Use tables, graphs and/or diagrams to help organise and (re)-present the information.

Hint: Start with a keyword search on the NASA or Science Kids sites.

Note: Remember to keep track of your researching and record sources of information.

3. Develop a target question to answer with the assistance of models. You could use one of the following or write your own:
   - How long did it take people to get to the Moon and how fast were they travelling?
   - How big (volume, mass) is Jupiter compared to …?
   - How might you explain that constellations are illusions?
   - How far away are our closest neighbouring stars outside the Solar System?

Your task

Model for a chosen audience some big facts and figures to help explain some details about dimensions, distances, sizes, volumes or other ‘space statistics’ of one of the following topic areas:

- Earth’s Moon and/or Moon missions
- Jupiter (or another planet from our Solar System)
- stars and constellations
- the Milky Way and other galaxies.
Circle one or write your own below

4. Jigsaw to expert group: Discuss and record ideas about one of the representation approaches below – Model, Myth, Metaphor or Maths. In your expert group, complete your row of the table to take back to your home groups, to explain ideas about using that way of representing.

<table>
<thead>
<tr>
<th>REPRESENTATION</th>
<th>ISSUES</th>
<th>EXAMPLE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>The target idea and the model have differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myth &amp; story</td>
<td>Fact and/or fiction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metaphor</td>
<td>A way of thinking … similarities and differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical tools</td>
<td>Dimensions 3D, tables, graphs, units, accuracy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. **Working in home groups:** Discuss how you might create/make a model that helps your audience appreciate the information more easily / make it interesting to them.

Negotiate and then record your task details by completing the table below:

<table>
<thead>
<tr>
<th>TASK TITLE &amp; CHOSEN AUDIENCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMELINE &amp; RESPONSIBILITIES</td>
<td></td>
</tr>
<tr>
<td>What is the content?</td>
<td></td>
</tr>
<tr>
<td>• Science</td>
<td></td>
</tr>
<tr>
<td>• Technology</td>
<td></td>
</tr>
<tr>
<td>• Engineering</td>
<td></td>
</tr>
<tr>
<td>What is the Maths message?</td>
<td></td>
</tr>
<tr>
<td>What is the medium you will use to model?</td>
<td></td>
</tr>
<tr>
<td>Interesting target features of your modelling</td>
<td></td>
</tr>
<tr>
<td>Sources of information / references</td>
<td></td>
</tr>
</tbody>
</table>
6. Record and track your individual part of the group project, for example:

<table>
<thead>
<tr>
<th>NEGOTIATED</th>
<th>COMPLETED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TASKS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRODUCTS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Negotiated presentation: Report, presenting your model when the project is complete. Negotiate with your group and your teacher about how you will do this and individual responsibilities.

EXTENSION ACTIVITY

Confidence levels:

How accurate are the figures?

How do the available ‘facts and figures’ change as explorations of space develop over time?

How do we know what we know about objects in space?

How confident can we be about the figures?

How accurately can we measure anything?

What is the difference between margins of errors and mistakes?
The Milky Way – 200 billion stars, all in a giant disc, spinning around a central point, which is right there, above our heads. (Episode 1)

Last summer astronomers discovered a new EXOPLANET – an Earth-like planet orbiting another star. But this one is particularly exciting because it orbits our nearest star, Proxima Centauri, making this the closest exoplanet ever found to our own Solar System, at just 4.2 lightyears away … at current rocket speeds you could literally watch every movie ever made 9 times and still not get there … it would take 100,000 years! (Episode 1)

The night sky isn’t just beautiful to look at – we’re continually blown away by how much life down here on Earth is directly affected by it (Episode 3)

Now between Mars and Jupiter is an asteroid belt and this is where all our asteroids come from. Back in January 2017 we had a very close encounter with asteroid AG13; at almost ten stories high it slipped between us and the Moon … in space terms that’s like clipping the curb!

NASA’s Apollo program was a series of space missions that put the first men on the Moon. Apollo 11 being the most famous – the mission that finally achieved that incredible goal in 1969. Just four months later, Apollo 12 saw another two astronauts make the journey. But Apollo 13 is by far the most infamous. NASA’s third trip to the Moon almost ended in disaster after an explosion on board almost left the crew lost in space. (Episode 3)

If we look straight up, we’re looking straight into the heart of the galaxy.

And that means, as far as we can tell, that we’re looking straight at a massive black hole. A SUPERMASSIVE black hole, to be precise, 26,000 light years away. (Episode 1)
What to do

Working as a class

1. **Engage:** Discuss and agree on the nature of the extended projects to be conducted, e.g. the need to negotiate details of tasks, expectations, responsibilities and assessments. Introduce the idea of negotiating the assessment rubric after students have started exploring what they might be interested in pursuing. Discuss how this will be constructed – see e.g. <https://www.quickrubric.com/r#!/create-a-rubric>.

2. **Explore:** Ask students to think back to any questions they have raised before, during and after watching and responding to *Stargazing Live*. Refer to class lists of questions developed so far. Review students’ ideas and questions about topics:
   - Episode 1: Milky Way, black holes and exoplanets
   - Episode 2: Exploring Jupiter, the planets of the Solar System and beyond
   - Episode 3: The Moon and the Earth

Use Worksheet 5 to consider some examples and how projects might be developed, organised and presented.

(See also Science Reference Services, The Library of Congress, <https://www.loc.gov/rr/scitech/tracer-bullets/spacesciencetb.html>.)

Use meaning-making maps or other graphic organisers to record ideas and parameters of the task, e.g. time allocations and student responsibilities for research projects.

Ask students to suggest possible format/s, e.g. timelines, models, posters, PowerPoint to present extended projects in displays.

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**ACTIVITY 5: SPACE MISSIONS EXTENDED PROJECTS**

(Worksheet 5: Create Your Own Adventure)

**Purpose**

To provide an opportunity for individuals or groups to further develop their

- investigations into a chosen aspect of human explorations of our place in space
- skills in researching, questioning and presenting information
- curiosity about one or more aspects of the Science, Technology, Engineering, Maths, combined with Arts, History and/or Storying, of space exploration.

**Timing**

3–4 hours of class time (or more depending on class level, interest and independence)

**Curriculum focus**

STEM + Arts = STE(A)M Integrated project; culminating activity;

**Teaching strategy**

*Years 3–6:* Whole class teacher directed group display combining student sections of class project.

*Years 7–10:* Group self-directed research leading to a product for sharing with the class (or other specified audience) including models, posters, PowerPoint; performance, writing, debate or other negotiated format. Focus questions: What have we found so far and what do you think we would like to find out more about?

**Task**

Negotiated
3. **Explain:** Display and add to the list of approaches students suggest for each of the project ideas (Worksheet 5) to stimulate interest and explore possibilities of topics.

**Years 3–6 class project:** Offer students the opportunity to create a limited range of items on the topic, e.g. poster or other teacher-selected product, and allocate to groups. Ask group how they might like to contribute to the class display.

**Years 7–10 negotiated group extended task:** Allow time for students to review the listed areas/questions and add at least two more that have not been listed. Ask students to think about their interest area/topic and groups for the task.

**Working in groups**

4. **Explore:** Begin research using the NASA site.

Students should be encouraged to use a range of websites when searching for information about their chosen topic, and guided to understand what ‘savvy searching’ means. There are also numerous YouTube videos with excellent information about topics including specific space missions, sites for exo-life in the Solar System, etc. (see reference list).

5. **Evaluation and reporting:** Raise the possible topics focus in STEM, HASS and/or the Arts. Ask students to consider how they might go about planning for the recording and presentation of their research. Which tools have they used before (e.g. Google Docs or see reference list for suggestions of other tools)?

**Years 3-6**

Allocate one or more of the steps of the agreed task/s and assign or negotiate roles for each individual or group in exploring further and recording information. Ensure students are aware of the allocated time for the task and establish agreed features of the display prior to students conducting further research.
Years 7-10

Negotiate a rubric for assessment of quality of project's presentation, organisation and content, including STEM components. Have students report on ‘their mission’ and assess using the agreed rubric/s. Students might be encouraged to self-assess and/or peer-assess their works.

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>★ Requires improvements</th>
<th>★★ Developing</th>
<th>★★★ Meets expectations</th>
<th>★★★★ Proficient</th>
<th>★★★★★ Outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All basic science concepts and processes well described</td>
</tr>
<tr>
<td>TECHNOLOGY</td>
<td>Details of communication technologies outlined in the brief</td>
<td>IT and physical making considered</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGINEERING</td>
<td></td>
<td></td>
<td>Excellent description of design features being put into practice</td>
<td>Design/make/appraise ideas clearly and accurately used</td>
<td></td>
</tr>
<tr>
<td>MATHS</td>
<td>Units of measure not clearly/accurately shown or used</td>
<td>Details of basic measurements and distances clearly shown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESOURCES/REFERENCES</td>
<td>No websites or other resources listed</td>
<td>A few central resources correctly acknowledged</td>
<td>Extensive list of accurately acknowledged and relevant resources</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Allow allotted time for students to complete the negotiated task and work in the format agreed on at the agreed time.

2. Reporting: Have students report on their ‘space mission’ and assess using the agreed rubric/s. Students might be encouraged to self-assess and/or peer-assess their works using the developed rubric.

3. Self-evaluation and review: How might your group have done things differently? Record your ideas for mission improvements. N.B. You might discuss having other students or adults come and see the display, with students talking about their project with the visitors.
Your task

Choose, design and conduct your own ‘space mission’ in self-selected groups (1–3).

Time allocation

To be negotiated with teacher before commencing research

Focus questions

How can you find out more about ...?

Purpose

This extended project allows you the chance to:

- explore your own question/s about the Science/Technology/Engineering/Maths/History/Stories of human explorations of space,
- further develop skills in researching, questioning and presenting information,
- extend your understandings about an aspect of space exploration.

Topic areas

To be negotiated: You can choose from topics covered in Stargazing Live:

- robotic probes and space telescopes
- Moon explorations
- effects of the Moon on Earth
- search for exoplanets or extraterrestrial life

It’s hard to imagine a worse design for space exploration than a human body. We have to travel in billion-pound tin cans and wear clumsy pressurised suits just to stay alive in space.

In fact, space is so dangerous, all the biggest missions these days involve robot astronauts taking all the next steps into space. So when we want to boldly explore the final frontier, all we’ll need to do is boldly sit in an air-conditioned control room while robots do all the dangerous stuff first. (Episode 2)
What to do

Plan and conduct an extended investigation. Remember to record as you go and plan how you will present the results. You can choose one of the following questions to help direct your project or use these ideas as inspiration for designing your own question and project approach.

- What are the differences for a human body between being in space and being on Earth?
- How did we get to the Moon? Space probe timelines (e.g. The history of the Apollo Missions)
- The search for extraterrestrial life. How do space probes search for the basic requirements for life in space and on moons or planets?
- What happened to the Moon rock brought back from the Moon?
- How does finding water on a planet, moon or other space object indicate that life may be present?
- What might life be like on Europa?
- How likely is extraterrestrial life? See The Drake Equation http://www.seti.org/drakeequation
- What is the habitable zone? http://www.britannica.com/science/habitable-zone

When your mission comes to an end:

Review your steps. How might your group have done things differently? Record your ideas for what went well and how you might have improved your mission adventure.
ACTIVITY 6: TOMORROW IN SPACE
1-MINUTE VIDEO
(WORKSHEET 6: SPACE FUTURES)

Purpose
To celebrate storytelling and express ideas about current questions and possible future directions in space science.

Teaching strategy
Negotiated group project

Curriculum focus
Media Arts, Technologies, Science, English

The task
Create, design and make a short video based on the theme ‘Tomorrow in Space’.

Focus questions
What can we / do we know about possible futures in space science?

Working as a class
1. Engage using class discussion: Review a range of the images and content of each of the three episodes of Stargazing Live with a focus on how you might solve problems of telling a story within a short video.

2. Review Worksheet 6 and discuss the task. Share the 1-Minute Film Competition details and decide if students would like to make a product that might be entered: [http://1-minutefilmcompetition.org](http://1-minutefilmcompetition.org).

Working in groups
1. Discuss possible ideas and questions including choosing a topic and approaches. Create a class PowerPoint list of ideas with their names next to their suggestions.

2. Have students record what they think might be some next steps in space science into the future. What might we want to find out more about? What might be study tomorrow? For example:

- **Causes and effects:**

  **What causes what in the universe:**
  What causes the Moon’s phases?
  How does the Moon affect the tides?
  What effects does a black hole have on things around it?
  How do planets cause a wobble in their star?

- **Mars colonies:** Do you think we can set up colonies on other planets?

- **Contact:** How will we meet extraterrestrial life and what will we do?
Working as a class

1. Discuss the various media a video might include (e.g. photographic stills, words, diagrams, explanations, short scripted mock or actual interviews, drama, role play, recorded demonstration). Share some storyboards and concept maps or other graphic organisers to show how they might be used in planning ideas.

(See, for example, <http://www.storyboardthat.com/articles/e/cause-and-effect>; <http://cooltoolsforschools.wikispaces.com/Organiser+Tools>)

Working in groups

1. Complete the task of creating the video according to negotiated timelines.

Working as a class

1. Culmination: As students complete drafts of videos, share with class for feedback and refinement. Discuss whose videos might go into the competition.
WORKSHEET 6: SPACE FUTURES

Scenario

It is the year 2025. You are a scientist working at NASA in a group deciding which mission/s to fund. What role would you like to play in this?

What are some possible areas of interest that require further study? What do you think should be the next steps in our search for ... e.g. life in space?

Theme

Tomorrow

The task

Design and make a short (1-minute) video exploring some aspect of space futures. Your video can focus on current questions, possible future facts or fictional ideas about the topic, as well as present some current scientific information.

Topic

Your video should include some reference to changing scientific knowledge of one or more topics such as those covered in Stargazing Live:

- black holes
- exoplanets and/or extraterrestrial life
- our Solar System,
- telescope technologies
- space exploration with robots and/or astronauts
- the Milky Way and/or other galaxies
- stars and constellations

Genre:

Choose your own (e.g. factual report, argument, explanation, diary, fiction: historical retelling, fantasy or science fiction). Consider who the audience is you are pitching to, the point of view and perspective you want to present. How do these influence your viewers’ responses?

ABOUT THE 1-MINUTE FILM COMPETITION

The 1-Minute Film Competition provides Australian and New Zealand primary and secondary school students with the opportunity to make a 60-second short film or animation, and the chance to win cash prizes.

The theme for the 2017 competition is ‘Tomorrow’. The 1-Minute Film Competition is an initiative of Australian Teachers of Media (ATOM) and ClickView. see <http://1-minutefilmcompetition.org/>
What to do

Working as a class

1. Discuss the images and content of each of the three episodes of Stargazing Live with a focus on how you might solve problems of telling a story within a short video.

Working in groups

1. Record your ideas about the next steps in space science into the future, for example:

   - How will we meet ET and what will we do?
   - Do you think we can set up colonies on other planets?
   - What effects does a black hole have on things around it?
   - How do planets cause a wobble in their star?

Working as a class

1. What questions do you have about the task?

   - What method will you use to organise your ideas (e.g. storyboarding)?
   - What media might the video might (e.g. photographic stills, words, diagrams, explanations, short scripted mock or actual interviews, drama, role play, recorded demonstration)?

Working as a group

1. Complete the task of creating the video according to agreed procedures and timelines, as negotiated before you commence.

Working as a class

1. Assessment: Share drafts of your video with the class to get feedback and refine your product. Discuss whether you think you would like your video to be entered into the competition.
ONLINE RESOURCES FOR STUDENTS AND TEACHERS

IT Technical tools

Creating storyboards

**Storyboard That** – An excellent site with an educational portal that educators are using in a variety of ways, such as creating timelines, storyboards, graphic organizers (t-charts, grids, etc.) and more.

Video-making


Graphic organiser tools

http://cooltoolsforschools.wikispaces.com/Organiser+Tools


**Mind42** – Nice collaborative mind-mapping site with lots of templates and easy to use.

**MindMeister** – Beautiful-looking mind-mapping site with the ability to embed into a site or blog.

**MindMap** – An easy-to-use site for creating brainstorming or mind maps.

**Mindomo** – Brainstorming, use for flipped classroom, collaboration, comments see <https://www.mindomo.com>

**Popplet** – Brainstorming and mind mapping. <http://popplet.com>

**TotSplash** – A fun site for creating and organising ideas into a brainstorm or mind map.

**Webspiration Classroom** – From the creators of Inspiration, a very popular web-based program for creating visual brainstorming tools that can then be turned into an outline with a click of a button.

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**WiseMapping** – A great site for creating visual mind maps and brainstorms.

**Topics**

**Teacher information**


**Aliens and UFOs**

Whycliffe Well, NT – self proclaimed UFO Capital of Australia

https://open.abc.net.au/explore/20897

**Search for extraterrestrial life**

http://www.seti.org

**1-Minute Film Competition**

http://1-minutefilmcompetition.org

**Astronomy facts for kids**

http://www.sciencekids.co.nz/sciencefacts/space.html

https://theplanets.org/space-facts/

**Astronomy pictures**

https://apod.nasa.gov/apod/astropix.html

**Comets**


**Drake Equation – Frank Drake, 1961**

http://www.seti.org/draykeequation

**European Space Agency**

ESA's Space in Images contains images used throughout the ESA Portal. The images offered in this website are in the highest resolution available. ESA must be credited as the source of the images. Examples: Photo: ESA; Photo: ESA/Cluster; Image: ESA/NASA - SOHO/LASCO

http://www.esa.int/spaceinimages/ESA_Multimedia/Copyright_Notice_Images
Extraterrestrial life

Goldilocks zone
NASA JSC Astrobiology: Fingerprints of Life – It’s Just Right, pp. 1–5
http://solarsystem.nasa.gov/docs/Its_Just_Right.pdf

Habitable zones – NASA classroom activities
Offers a number of classroom activity suggestions including conditions that are right for life, the habitable zone, and extremes that life can tolerate.
https://www.nasa.gov/pdf/562183main_LS3_HabitableZones_C5.pdf

The Sun’s Habitable Zone – Build your own planet temperature calculator
http://www.astro.indiana.edu/gsimonel/build.html

International Astronomical Union
Definitions for a planet and other astronomical bodies

NASA still Images
https://nasasearch.nasa.gov/search/images?affiliate=nasa&query=

NASA videos
https://www.youtube.com/NASA

Space station videos

Space science projects
Science Reference Services, The Library of Congress,
https://www.loc.gov/rr/scitech/tracer-bullets/spacesciencetb.html

Project Breakthrough – Are We Alone?
Letter signed by many eminent people claiming ‘now is the time to find out’.
https://breakthroughinitiatives.org/AreWeAlone

Spacecraft and missions
All topics A–Z
https://www.nasa.gov/topics/

Curiosity and Mars missions

Kepler Space Observatory
http://www.seti.org/kepler


Rosetta and Philae
EarthSky magazine article about Philae data, which suggests organic compounds existed in the early Solar System
http://earthsky.org/space/philae-lander-finds-life-ingredients-on-comet

Voyager
Full information about Voyager missions
http://voyager.jpl.nasa.gov

Statistics of star distances
https://www.nasa.gov/pdf/562183main_LS3_HabitableZones_C5.pdf

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Curriculum links by state

New South Wales:

South Australia:
https://myintranet.learnlink.sa.edu.au/educating/curriculum-years-r-10/australian-curriculum

Tasmania:

Victoria:
http://victoriancurriculum.vcaa.vic.edu.au

Western Australia:
http://k10outline.scsa.wa.edu.au
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