teachers guide

Evolution of the Universe 1:
Galaxies

Components

	NAME	DESCRIPTION	AUDIENCE
	Galaxies teachers guide	This guide shows how students may be engaged in astronomy through use of virtual planetarium software to study galaxies and the motion of celestial objects.	teachers
	Galaxy classification background sheet	This background sheet provides information on the structure and classification of galaxies.	teachers
	A guide to using Stellarium manual	This manual introduces users to Stellarium, guides them to select target objects and plan the best time to observe them at night.	teachers students
	Stellarium quick guide	This quick guide provides a summary of Stellarium's features and a list of navigation commands.	students
	Looking at galaxies worksheet	This worksheet guides students to explore galaxies; investigate their apparent movement across the sky; and determine the best conditions to observe them.	students

Purpose

To **Engage** students interest in astronomy through use of virtual planetarium software; to investigate the apparent movement of celestial objects across the night sky; and to determine the best conditions for viewing deep sky objects.

Outcomes

Students:

- familiarise themselves with Stellarium planetarium software;
- use Stellarium to explore and classify galaxies;
- investigate the apparent movement of celestial objects across the night sky;
- explore the celestial sphere and RA/DE coordinate system; and
- determine the best conditions to observe celestial objects.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Teachers should familiarise themselves with Stellarium virtual planetarium software, prior to undertaking this activity. Working through *A guide to using Stellarium* will be useful.	teacher preparation
Teacher divides class into groups of two or three students, allocates them to a computer, instructs them to open Stellarium and explains the purpose of the program and worksheet activities.	teacher to whole class
Teacher distributes worksheet, *Looking at galaxies*, and quick guide to Stellarium and guides students through **Part 1: Setting up Stellarium for your location** (if required) and **Part 2: Exploring Stellarium**.	small groups
Students work through **Part 3: Exploring galaxies** and **Part 4: Classifying galaxies**.	small groups
Teacher explains Messier (M) and New General Catalogue (NGC) numbers for identifying galaxies and other stellar objects.	teacher explanation

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NEALS

ACTIVITY	POSSIBLE STRATEGY
Students describe: what galaxies are; what they are made of; how they are classified using Hubble's classification scheme; and why some galaxies are difficult to classify.	teacher/whole class discussion
Students work through **Part 5: Exploring the motion of stars across the sky**.	small groups
Students call out Part 5 answers. Teacher emphasises significance of South celestial pole and focuses on their suggestions (hypotheses) for why the Sun and stars move across the sky every day.	teacher-led questions and answers
Teacher introduces the celestial sphere as a means of describing the position of objects in the sky and explains the RA/DE systems.	teacher explanation
Students work through **Part 6: The celestial sphere**.	small groups
Students call out Part 6 answers, emphasising the value of the RA/DE system as a common language amongst astronomers.	teacher/whole class discussion
Students work through **Part 7: What is the best time to image a celestial object?**	small groups
Students call out Part 7 answers, explaining their reasons for deciding on which conditions provide the best results for imaging galaxies.	teacher/whole class discussion
Students summarise their findings.	individual work

Information for teachers

Stellarium is planetarium software that enables users to view and identify astronomical objects and gain understanding of a range of astronomical concepts. It can be downloaded, free of charge, from www.stellarium.org.

Teachers may download the Stellarium user's guide in PDF format from www.stellarium.org/wiki/index.php/Main_Page to familiarise themselves with the program. Alternatively, an introductory manual and quick guide to Stellarium are included with this SPICE resource.

The quick guide, *Stellarium*, may be photocopied for students to use as a reference.

The worksheet for this actity contains five separate activities:

1. exploring galaxies,
2. classifying galaxies,
3. exploring the motion of stars across the sky,
4. exploring the celestial sphere and the Right Ascension/Declination (RA/DE) coordinate system, and
5. investigating the best conditions for imaging celestial objects.

The background sheet, *Galaxy classification*, contains information about galaxies and Hubble's classification scheme in which galaxies are classified as elliptical, lenticular (lens-shaped), spiral or irregular. Images and descriptions are provided for each class of galaxy. Finally, information is provided about our own galaxy, the Milky Way.

More information

If you would like to know more about galaxy classification, check out http://www.galaxyzoo.org. This citizen science project includes activities for school classes to investigate galaxy characteristics.

Extension activities

The following extension activities use Stellarium.

The Local Group

Students explore some members of the Local Group of galaxies:

- The Andromeda Galaxy (M 31) is the largest galaxy in the Local Group and the nearest spiral galaxy to the Milky Way. In summer, M 31 can be viewed from Perth low in the northern sky, but it is better observed from northern hemisphere locations. It can be viewed in Stellarium by 'removing' Earth (press **G**).
- The Large Magellanic Cloud (LMC) is an irregular satellite galaxy of the Milky Way. It is visible as a faint cloud in the night sky of the southern hemisphere.
- The Small Magellanic Cloud (SMC or NGC 292) is a dwarf irregular galaxy and one of the Milky Way's nearest neighbours. However it only appears as a hazy, light patch in the sky and is best viewed from a dark location.

Common constellations

Students find (**control F**) and explore constellations such as the Southern Cross (Crux), Orion, Scorpius or constellations that make up the zodiac. Using keyboard actions, they can view them, display lines joining stars (press **C** on the keyboard), add their names (**V**) and display art forms (**R**). Tasks may include investigating whether a constellation can be viewed from Perth and the best time of year to view it.

Explore the azimuth/altitude coordinate system

Students locate a deep sky object and observe changes in RA/DE and Az/Alt coordinates over time. Students may research advantages and disadvantages of the Az/Alt coordinate system.

Acknowledgements

Technical requirements

The guides, background sheet, manual and worksheet require Adobe Reader, which is a free download from www.adobe.com. The worksheet is also provided in Microsoft Word format. Activities in this resource require Stellarium software, which is a free download from www.stellarium.org.

SPICE resources and copyright

Associated SPICE resources

Evolution of the Universe 2: Galaxies may be used in conjunction with related SPICE resources to address the broader topic of how astronomers study the visible Universe and its origins.

DESCRIPTION	LEARNING PURPOSE
Evolution of the Universe (overview) This learning pathway shows how a number of SPICE resources can be combined to teach the topic of the origin and evolution of the Universe.	
Evolution of the Universe 1: Galaxies Students are introduced to astronomy through use of Stellarium planetarium software to classify galaxies visible in the night sky.	**Engage**
Evolution of the Universe 2: The SPIRIT telescopes Students explore the night sky using a remotely-operated telescope. They image deep sky objects in real time; research these objects; and publish their images.	**Explore**
Evolution of the Universe 3: History of the Universe The Big Bang theory is used to explain the origin and subsequent development of the Universe.	**Explain**
Evolution of the Universe 4: Stars Students use filters on the *SPIRIT* telescopes to capture images of a star cluster and compile a full-colour image. They use this image to discover why stars differ in colour, and relate star colours to stages in stellar life cycles.	**Elaborate**