

# 15. Our Place in the Galaxy

Edexcel GCSE Astronomy Course

# What is this topic about?

Students will gain an understanding of the Milky Way, our place in it and how it fits into the Universe. They will study different types of galaxies and the main theories for their evolution.

The Milky Way is our galaxy, a spiral of billions of stars orbiting a supermassive black hole at its centre. This simulation from the European Southern Observatory shows how it would look if we travelled outside it and on into the cosmic web of galaxies filling the observable universe. Watch out for some highlights of the tour:

- At about 35s you first start to see the whole galaxy
- At about 40s two more galaxies can be seen to the right - Andromeda (M31) and the Triangulum Galaxy (M33), the largest galaxies in our local group
- After about 50s more and more galaxies appear and you start to see how they cluster along the strands of the cosmic web

<https://www.eso.org/public/videos/eso50milkywayflythrough/>

## 15.1 Understand the appearance of the Milky Way from Earth as seen with binoculars or a small telescope

If you search online you will find amazing images of the Milky Way, but most of us are unlikely to see it like this because of light pollution and weather effects.

Here is a guide to how get a good view of it in the summer sky

<https://www.space.com/26901-milky-way-summer-observing-tips.html>

Open up Stellarium, set it for nighttime around mid-summer and practise finding the Milky Way. You might need to adjust the atmosphere and light pollution index in the settings to get a clear picture of it.

What sort of places on Earth would be good viewing locations for observing the Milky Way?

If you want to know how it got its name, read this

<https://www.universetoday.com/84662/why-is-our-galaxy-called-the-milky-way/>

15.2 Know the size and shape of our Galaxy and the location of the Sun, dust, sites of star formation and globular clusters

Let's make a sketch of the spiral shape of our Milky Way galaxy and mark in our location within it. Get some paper and a pencil ready and follow the steps in this video:

[https://www.youtube.com/watch?v=ZFZlzagACsY&ab\\_channel=ArticcoDrawi](https://www.youtube.com/watch?v=ZFZlzagACsY&ab_channel=ArticcoDrawi)

Next add more detail to your sketch using the images at this NASA site to help (be careful though, it's the other way up to the sketch you made!):

<https://www.nasa.gov/jpl/charting-the-milky-way-from-the-inside-out>

Add star clusters along the spirals, dust clouds surrounding them and labels showing the names of the spiral arms.

### 15.3 Understand how 21 cm radio waves, rather than visible light, are used to determine the structure and rotation of our Galaxy

How do we know that the Milky Way is a spiral shape if we can only see it from the inside? Images from Earth show that it definitely forms a band across the sky, but we could be looking across a solid disc not a spiral. These are the key points about the method used to show it is a spiral:

- Hot hydrogen gas emits radio waves with a wavelength of 21cm
- Radio astronomers can detect signals with this wavelength from clouds of hydrogen along the spiral arms
- As the galaxy is rotating, parts of the arms will be rotating towards us and parts away, causing blueshift and redshift in the signal
- By measuring how much redshift and blueshift there is in different directions, the radio astronomers can show a pattern explained by a spiral shape  
(If you like geometry and algebra, this site gives a full explanation:

<https://astronomylog.wordpress.com/radio-astronomy/milkyway-in-21cm/> )

15.4 Know that the group of galaxies gravitationally linked to the Milky Way is called the Local Group

15.5 Know the composition and scale of the Local Group, including its principal components: a Andromeda Galaxy (M31) b Large and Small Magellanic Clouds (LMC and SMC) c Triangulum Galaxy (M33)

15.13 Understand why galaxies are grouped in larger clusters and superclusters

The local group was mentioned briefly in the introduction, it is the cluster of galaxies nearest the Milky Way whose gravity is pulling them together.

This site gives the details of all the objects known to be in our local group: [https://en.wikipedia.org/wiki/Local\\_Group](https://en.wikipedia.org/wiki/Local_Group)

This video is worth watching for 5 mins - it shows how clusters of galaxies may be formed into superclusters in the cosmic web:

[https://www.youtube.com/watch?v=rENyyRwxpHo&feature=emb\\_logo&ab\\_channel=naturevideo](https://www.youtube.com/watch?v=rENyyRwxpHo&feature=emb_logo&ab_channel=naturevideo)

15.6 Be able to classify galaxies using the Hubble classification system, including:  
a spiral b barred spiral c elliptical d irregular

15.7 Know how the different types of galaxies were placed by Hubble on his 'Tuning Fork' diagram

15.8 Know that the Milky Way is a barred spiral (SBb) type galaxy

The Hubble Tuning Fork classification scheme for galaxies is explained here:

<https://www.schoolsobservatory.org/learn/astro/gals/class>

Once you have read this page, try it out for yourself using this exercise:

[https://www.schoolsobservatory.org/discover/activities/galaxy\\_classification](https://www.schoolsobservatory.org/discover/activities/galaxy_classification)

(you will need a copy of the student sheet to refer to as you look at each galaxy image provided)

This page tells you more about the Milky Way and its classification:

<https://www.schoolsobservatory.org/learn/astro/gals/milkyway>

15.9 Know that some galaxies emit large quantities of radiation in addition to visible light

Astrophysicists use all parts of the electromagnetic spectrum to find out information about objects in the universe, including galaxies.

Different wavelengths of electromagnetic radiation may be emitted by different elements or by different processes in the objects being observed.

Different types of telescope are used to collect the different wavelengths of radiation e.g. radio telescopes, infrared telescopes, X-ray and gamma ray telescopes.

This site shows amazing images of the Milky Way in different wavelengths - which features of the galaxy show up best in the different wavelengths?

[https://asd.gsfc.nasa.gov/archive/mwmw/mmw\\_images.html](https://asd.gsfc.nasa.gov/archive/mwmw/mmw_images.html)

15.14 Understand the main theories for the formation and evolution of galaxies

15.10 Know that an Active Galactic Nucleus (AGN) is powered by matter falling onto a super-massive black hole

15.12 Know that information about AGNs can be obtained from many regions of the electromagnetic spectrum

This NASA site gives an explanation of theories of galaxy formation, including an exciting video showing small galaxies merging to form bigger ones:

<https://svs.gsfc.nasa.gov/11534>

This site will explain what an AGN is, as well as a supermassive black hole and an accretion disk. Write down definitions of these three things in your notes:

[https://imagine.gsfc.nasa.gov/science/objects/active\\_galaxies1.html](https://imagine.gsfc.nasa.gov/science/objects/active_galaxies1.html)

15.11 Know types of active galaxies, including: a Seyfert galaxies b quasars c blazars

Quasars - just watch this amazing explanation!

[https://www.youtube.com/watch?v=fsKd61KhVQE&feature=emb\\_logo&ab\\_channel=FraserCain](https://www.youtube.com/watch?v=fsKd61KhVQE&feature=emb_logo&ab_channel=FraserCain)

And this is a slightly eccentric explanation of the difference between quasars and blazars:

[https://www.youtube.com/watch?v=M2EDWzA75Jo&ab\\_channel=SciShow](https://www.youtube.com/watch?v=M2EDWzA75Jo&ab_channel=SciShow)

Here are some examples of a Seyfert galaxy - like a quasar, but not as bright:

<https://astronomynow.com/2021/01/07/a-stunning-intermediate-spiral-a-brilliant-seyfert-galaxy-shows-off-a-compact-core/>

# Taking things further:

If you want to learn even more about Galaxies you can sign up for this free Open University Open Learn course:

<https://www.open.edu/openlearn/science-maths-technology/galaxies-stars-and-planets/content-section-0?active-tab=description-tab>

