SCIENTIFIC CASE:

The secrets of the galaxies

Team members

Documentalist: _____

Telescope operator: _____

Astronomer: _____

Support astronomer: _____

Spokesperson: _____

Context

A century ago, astronomers believed that our Galaxy, the Milky Way, was the entire Universe. However, as larger, more powerful telescopes were built astronomers observed many nebulous objects scattered among the stars. These objects included some that looked like spiral shaped clouds, which at the time astronomers called 'spiral nebulae'.

By the 1910s and early 1920s, there was much debate about whether these 'spiral nebulae' were outside the Milky Way or part of it. This was until work by Edwin Hubble (1889-1953) and Milton Humason (1891-1972) in the 1920s, established that **each of the spiral nebulae was in fact, a huge star system, called a *galaxy***.

Hubble and Humason were able to measure the distance to some of these galaxies, proving that the Universe was much vaster than previously thought, and that o**ur Galaxy is just one of billions of galaxies in the Universe**.

Since then, astronomers have learned a lot about galaxies: how many there are, what types of galaxies exist, and the stars that they contain. They have also started to figure out how galaxies formed and how they evolve.

And, **all these discoveries were possible because of the light coming from those galaxies**, emitted by the thousands to trillions of stars within them.

*Figure 1: A field of galaxies observed by the Hubble Space Telescope. **Credit:** NASA/ESA*

Classifying galaxies

Your task is to classify a sample of galaxies and study some of their properties, as Edwin Hubble did in 1920. You will view images of these galaxies using the *ESASky* tool, which will play the role of a virtual telescope.

Research equipment

You have access to the following:

- Colour pencils, paper, eraser.
- An interactive screen displaying *ESASky*, with a list of galaxies uploaded.

Note: You could watch the *ESASky* video tutorial to see how to upload and inspect a list – see link below: https://www.youtube.com/watch?v=AgQHC36rCUo

Part 1. Make your own classification of galaxies

You are going to look at the optical (visible) images of a set of galaxies that have been specially selected for this activity.

Activity 1: Group the galaxies that, from your point of view, have something in common and answer the following questions:

- What do they have in common?

- How many different of shapes can you recognise?

Give a name to each type of galaxy in your classification, explain their characteristics, and sketch them.[1]

Name	Characteristics	Sketch
Type 1:		
Type 2:		
Type 3:		
Type 4:		
Type 5 (optional):		

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1   Fill as many types as needed for your classification.

Part 2. Classify the galaxies according to the Hubble Tuning Fork

Edwin Hubble was the first astronomer to attempt to classify galaxies. His classification scheme, known as the *Hubble Tuning Fork*, is still in use today. In this scheme, galaxies are classified into the following broad categories: **elliptical, spiral,** and **irregular.** Spiral galaxies are further classified into two types: ***regular* spirals** and ***barred* spirals**.

Carefully study the Hubble Tuning Fork (available in the *Research Equipment section*).

Activity 2.1: After looking at Hubble's classification, do you see any similarities to your classification?

Hubble's classification:	Your classification:
Elliptical galaxies	[Name 1]
Spiral galaxies	[Name 2]
Barred spiral galaxies	[Name 3]

Irregular galaxies	[Name 4]

What are the main differences between Hubble's and your classification?

Activity 2.2: Now that you are familiar with Hubble's Tuning Fork classification, use it to classify the galaxies (that you studied using the *ESASky* tool), as Hubble would have done.

In the table below, write down the name of the galaxies in your list that belong to each of these groups.

Hubble type	Galaxies
Spiral	
Barred spiral	
Elliptical	

Irregular	

Part 3. The colours of galaxies

Everything astronomers know about galaxies comes from the light emitted by the stars within them. Because galaxies are far away, we see the light coming from their most massive stars. Astronomers know that there is a **connection between the colour of the stars** and **their surface temperature.**

In fact, astronomers know that blue stars are hotter and tend to be younger, while red stars are colder and tend to be older.

Thus, the colours of galaxies provide clues about the stars they contain.

Study the galaxies again, paying attention to their colours.

Which galaxies contain young stars? And, to which galaxy classification group, or groups, do they belong?

Where are, these young stars located within the galaxies?

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Do these galaxies also contain old stars? Where?

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Are there galaxies that contain only young or only old stars? Which type (shape) are they?

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Activity 3.1: Based on the experience that you have already gained during this activity, write down your conclusions about how you think galaxies evolve (remember which types of galaxies have young (hot blue) stars and red (cool older) stars).
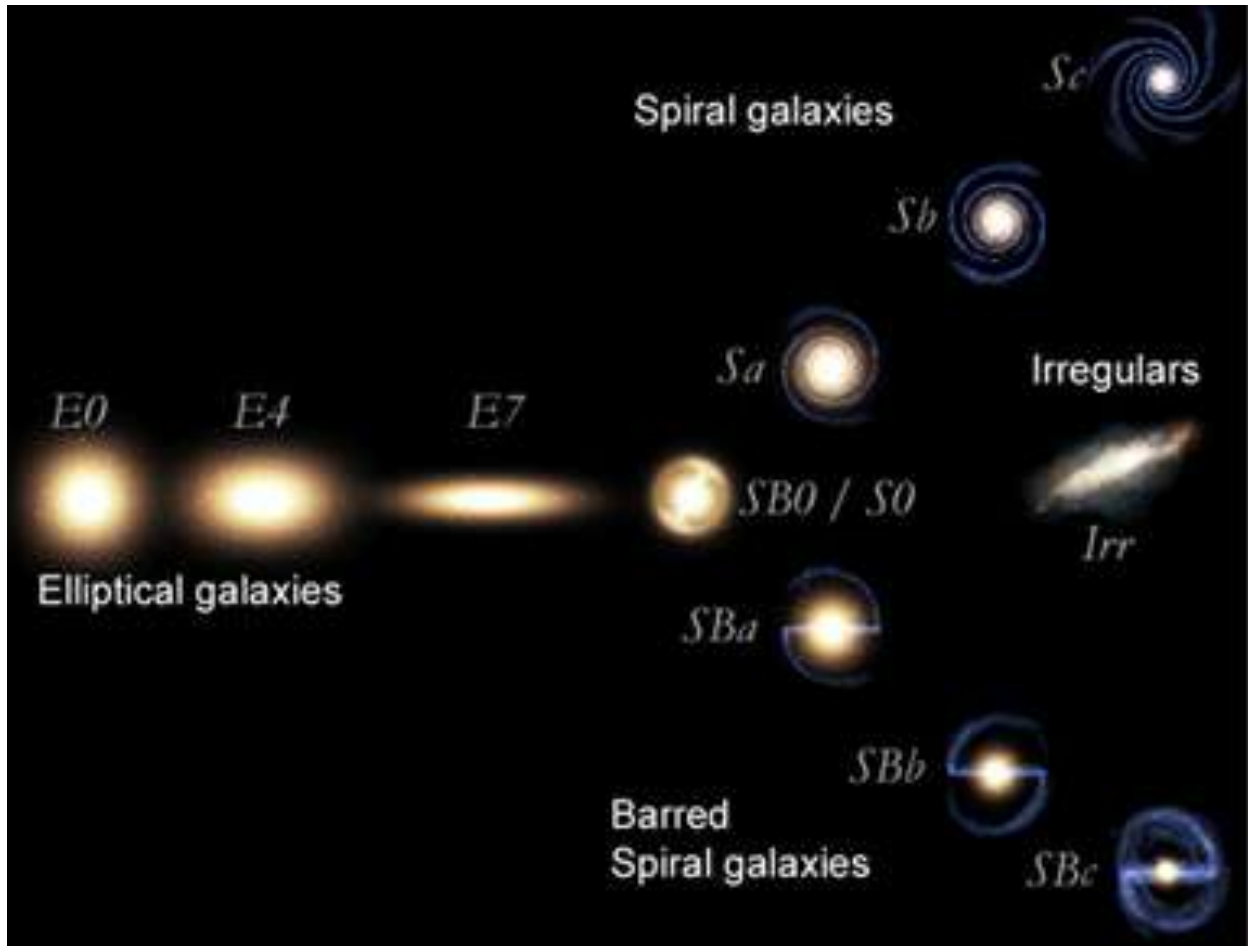
Conclusions:

Research equipment

Hubble Tuning Fork

The Hubble Tuning Fork. **Credit:** *NASA/ESA*