# Gallery of Galaxies Tour - Teacher Guide

The Gallery of Galaxies tour features the more common galaxies observed in space or described in textbooks. This teacher guide is designed to provide ways for you to actively engage your students in exploring the First Look Rubin's Cosmic Treasure Chest image. The guide assumes that you as the instructor are moving through the tour stops (images) and using the material below to engage students in conversation and to elicit questions.

The tour makes use of 2-3 different text boxes for each tour stop. The first text box will describe the type of object. "Did You Know?" text boxes will highlight an interesting fact related to the type of object. "Do You Wonder?"  text boxes will pose a question with no displayed answer. Additional information for each of the "Do You Wonder?"questions are provided below.

Optionally, you may choose to go through the tour without discussing the *Do You Wonder?* questions.

**Takeaway**
Most objects in this image are galaxies.

**Notes**

- Stars usually appear as bright spots with (diffraction) spikes pointing outward. These spikes are the result of starlight bending around the telescope's internal support structures. Spikes are not a real feature of a star.
- Most nearby galaxies appear larger and may show structure and features. The colors of nearby galaxies may be used to determine the relative rate of star formation: Galaxies that are bluer are actively forming stars, while galaxies that appear yellow or orange have likely ceased star formation.
- For most of the small galaxies in the image that do not show any features/structure, the apparent color is due to redshifted light and may be used to determine distance (redder is farther).

## Click here to go to the Gallery of Galaxies Tour

| Tour Stop and Title | Do You Wonder? |
|---|---|
| 1 A Universe of Galaxies | Do you wonder if Rubin Observatory will let us see further back in time than ever before?<br>*No. While Rubin's powerful combination of the high-resolution image, wide sky coverage, and a decade-long survey will enable detections of countless new faraway galaxies (more than ever seen before), other telescopes have made observations of objects farther than Rubin will detect. For instance, radio telescopes have detected the Cosmic Microwave Background, which existed even before the formation of galaxies, when the Universe was only 380,000 years old.* |
| 2 Spiral galaxy<br><br>*(view of a face-on spiral)* | Do you wonder what causes the arms to appear in a spiral shape?<br>*A common theory is that the disturbance (caused from the different rotational speeds of stars around the galaxy) travels through the galaxy, causing a "traffic jam" of stars and interstellar material that form spiral arms. The arms are not permanent structures, but are the current location where star formation is happening. The location of the arms (and the stars that are in an arm) will change over the lifetime of the galaxy. Therefore, if you were to look at a galaxy in the distant future, you would see arms at a different location than you do now.* |
| 3 Spiral galaxy<br><br>*(view of an edge-on spiral)* | Do you wonder what causes the bulge in the center of a spiral galaxy?<br>*The bulge is a region of densely-packed stars that are generally older and may have resulted from the first era of star formation in the galaxy when it was young. The bulge is thought to form by a combination of processes:*<br>● *The initial collapse of gas clouds early in the galaxy's history,*<br>● *Mergers with other galaxies,*<br>*Ongoing evolution processes like gas flowing into the center along bars or spiral arms.*<br>● *A supermassive black hole at the galaxy's center that can attract and concentrate stars in the bulge* |
| 4 Barred spiral galaxy | Do you wonder how a bar forms in a spiral galaxy?<br>*As stars and gas clouds move through the dense spiral arms sequence, their orbits become elongated and no longer perfectly circular. Over time, these orbits overlap, creating a bar-shaped structure in the center of the galaxy.* |

| | |
|---|---|
| 5 Elliptical galaxy | Do you wonder why elliptical galaxies don't have a flattened disk with arms?<br>*Elliptical galaxies are believed to form due to galaxy mergers. This causes the stars to move in random directions, causing an elliptical shaped galaxy rather than a galaxy with a rotating disk and spiral arms.* |
| 6 Irregular galaxy | Do you wonder why some galaxies could end up without a disk, arms, or an elliptical shape?<br>*Irregular galaxies have often been involved in a significant gravitational interaction or merger with other galaxies, leaving them with a lack of structure and irregular shape.* |
| 7 Galaxy cluster | Do you wonder if there is any pattern to the distribution of galaxy types within a cluster?<br>*The distribution of galaxy types in a cluster is not random! More elliptical galaxies are in the central regions (likely the result of galaxy mergers), while spirals are found more towards the edges.* |
| 8 Dwarf galaxy | Do you wonder what the difference is between a small dwarf galaxy and a large star cluster?<br>*Dwarf galaxies have their own dark matter halos, while star clusters do not. The presence of a dark matter halo can be inferred from the motions of their stars.* |
| 9 Interacting/ merging galaxies | Do you wonder if our galaxy will someday merge with another galaxy?<br>*The Milky Way Galaxy is predicted to merge with the Andromeda Galaxy in about 4.5 billion years. The Milky Way is also currently interacting with, and accreting materials from nearby dwarf galaxies, such as the Large and Small Magellanic Clouds.* |
| 10 High redshift galaxy | Do you wonder if there are galaxies whose light has been so red-shifted they do not give off visible light?<br>*Yes, many distant galaxies have been detected whose light is shifted beyond red into infrared and radio wavelengths. (The more distant an object, the greater it will be redshifted.)* |