NAME:_____

GALAXY MORPHOLOGY[1]

What will you learn in this Lab?

In this lab, you will learn how to separate galaxies into the different morphological types of the Hubble Classification scheme.

What do I need to bring to the Class with me to do this Lab?

For this lab you will need:

- A copy of this lab script
- A pencil

I. Background

A galaxy is a gravitationally bound grouping of stars, dust and gas that is isolated in space. Our solar system resides in a galaxy called the Milky Way, which is also sometimes referred to as "the Galaxy." As we have observed many galaxies, we have discovered that the number of stars can vary from millions to billions and that the amount of gas and dust varies between different galaxies. As part of an endeavor to better understand galaxies, in the early twentieth century Edwin Hubble developed a classification scheme in which the galaxies were separated into different types based on shape. These classifications are called "morphological" types, because morphology is the study of form or structure.

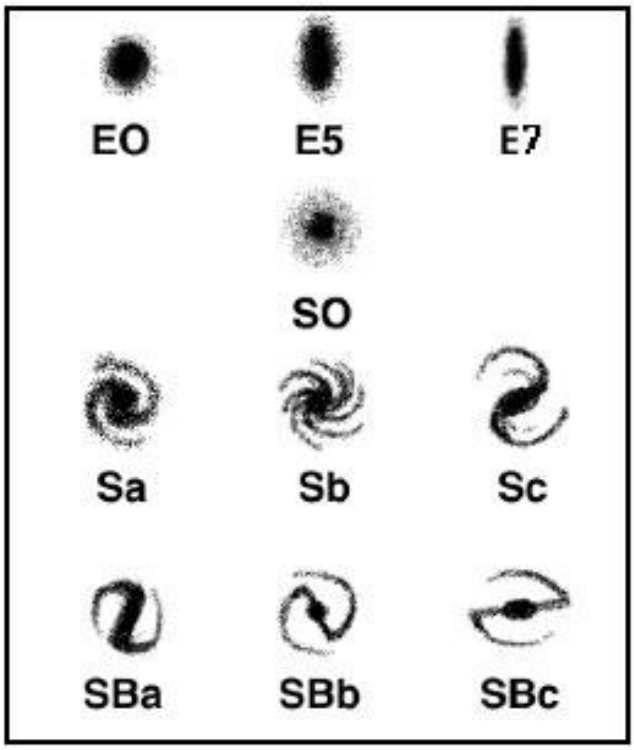
In the simplest form of the Hubble classifications, there are three primary types of galaxies:

- Ellipticals – Elliptical galaxies appear as smooth distributions of stars with little evidence of substructure. The usual designation for an elliptical galaxy is "En", where the number n is a function of the relative size of the major and minor axes of the observed ellipse. In this scheme, an elliptical galaxy that was perfectly spherical would be an "E0" (most spherical), whereas the most oblong elliptical would be an "E7" (most elliptical).

- Spirals – Spiral galaxies are characterized by a distinct spiral shape in the distribution of stars. Spirals also appear to have prominent dust lanes, which can be seen even if the galaxy is observed from a side view where the spiral structure is not evident. The subclasses of spirals are related to the size of the galactic nucleus and the tightness of the spiral arms. Also noted is whether or not the galaxy shows a bar; in a barred spiral, the spiral arms appear to trail from an elongated nucleus, as opposed to a spherical nucleus. Spirals are classified Sa, Sb, or Sc, whereas barred spirals are denoted SBa, SBb, or SBc. The nucleus of an Sc galaxy is smaller than in an Sa galaxy, and the arms of the Sc are wrapped more loosely.

[1] Hubble Morphology Type graphic is from the University of Washington's Hubble Galaxy Classification lab.

- Irregulars – Irregular galaxies do not exhibit an obvious spiral or elliptical structure. Some astronomers hypothesize that irregulars may once have been spirals or ellipticals, but have lost those structures due to gravitational interaction with another galaxy(ies). Or that some irregulars are too small to have formed a disk of stars with spiral arms.



II. Procedure

Now it is your turn to decide the Hubble Morphological type for several galaxies. In this figure are displayed the typical shapes of several morphological types. When deciding which classification to give to a galaxy, make certain to denote a **subtype**. Please use one of the **subclasses** given here. If you **cannot decide** between an Sa or Sb, make a choice and **explain why** you were having difficulty.

Part I: Provided Images

- Use the classroom computers to view the provided images (at http://windhorst114.asu.edu/galmorph.html) of galaxies to determine their Hubble Classification type.
- Fill in the provided table with morphological type and your reasons for choosing the type.
- Make certain to include an estimate of subtype using the classes established above.

Part II: Additional Questions

Q1. Could any of the Hubble Classification types represent objects in other classes seen from different angles? If so, which? How could you tell them apart?

Q2. What type of galaxies (spirals or ellipticals) contain large regions of gas and dust?

Q3. If stars form out of large clouds of gas and dust, in which type of galaxy is there *least likely* to be ongoing star formation? (In other words, in which type (E,S,Irr) did not seem to contain much gas and/or dust?)

Q4. Recalling earlier work on spectral types of stars and the color magnitude diagram, what is the typical color of a young group of stars? What is the typical color of an older group of stars?

Q5. Based on the above question, which type of galaxy (spiral or elliptical) has an older population of stars? Explain using complete sentences.

Q6. Which type of galaxy (spiral or elliptical) has a mainly younger population of stars? Where in the galaxy are these young stars? Is the entire galaxy made of young stars? Explain using complete sentences.

Q7. Look again at galaxy NGC 4038. Was this galaxy easy to classify? If not, what do you think is happening?

Part I: Table

Name	Hubble Type	Reason? Short answer justification.
M51		
M99		
IC 2233		
NGC 1232		
NGC 1407		
NGC 1507		
NGC 1550		
NGC 1600		
NGC 1637		
NGC 1700		
NGC 1752		
NGC 1832		
NGC 1888		
NGC 1954		
NGC 2339		
NGC 2344		
NGC 2377		
NGC 2389		
NGC 2424		
NGC 2486		
NGC 2487		
NGC 2493		
NGC 2500		
NGC 2513		
NGC 2525		
NGC 2532		
NGC 2537		
NGC 2541		
NGC 2549		

NGC 2552		
NGC 2595		
NGC 2841		
NGC 2903		
NGC 2964		
NGC 2967		
NGC 2974		
NGC 3003		
NGC 3041		
NGC 3077		
NGC 3198		
NGC 3227		
NGC 3344		
NGC 3486		
NGC 3631		
NGC 4038		
NGC 4125		
NGC 4535		
NGC 4536		
NGC 4565		
UGC 5373		

Summarize what you have learned tonight: