Laboratory 5: Galaxy Classification

Experiments are to be completed on the provided laboratory sheets below; any supporting material (eg. graphs) should be attached. Make sure your name and your partners name(s) are clearly indicated on the front page of your lab. **Neatness and clarity count!** Use complete sentences in answering all questions, explain your answers when asked clearly, and if you use an equation to do a calculation, *write the equation down* first, then put in numbers and solve. **Show all your work!**

Labs are due on VIULearn one week after the lab; please use the provided lab pages and submit your lab (in the correct order) as a single, reasonably sized PDF file.

APPARATUS

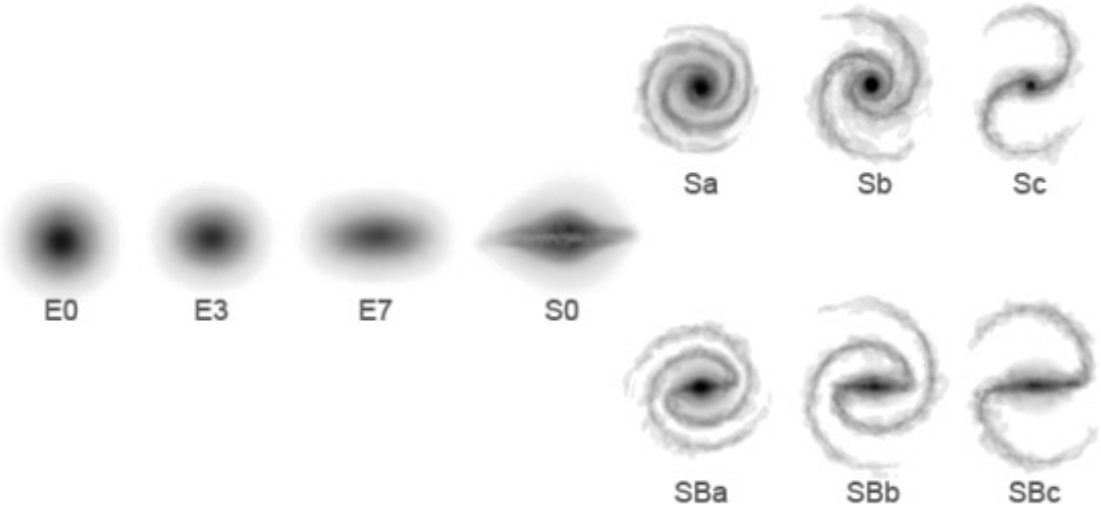
Computer with web access, website with (colour) galaxy images, notes.

OBJECTIVE

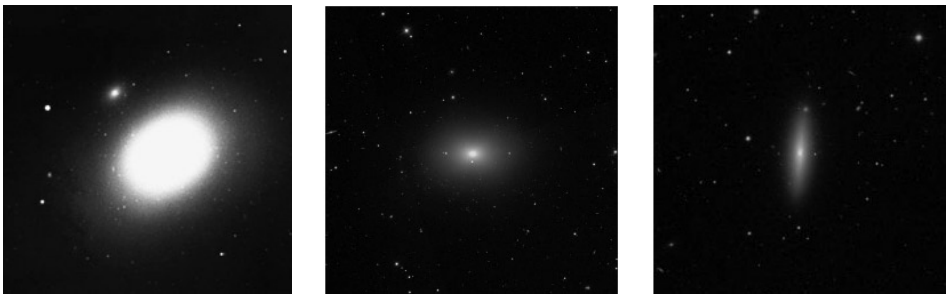
1. To learn about the (basic) classification of galaxies.
2. To identify and apply criteria useful in galaxy classification.

THEORY

Edwin Hubble originally envisioned his classification scheme (the 'Tuning Fork' diagram below) as *evolutional*; today it is used primarily to demonstrate the distinctions between galaxy classes.

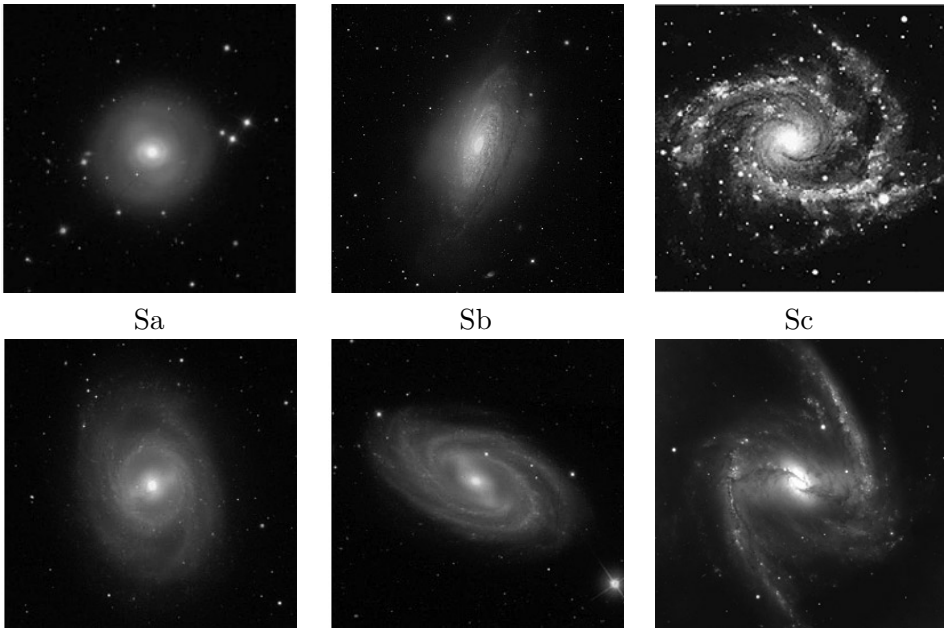


- **Elliptical Galaxies** tend to be smooth and regular in appearance, and are elliptical in outline, resembling a 'fuzzy football' in appearance. They range in shape from round (E0) to strongly elongated (E7). Ellipticals do not have a defined disk or core, but do have a more dense central region. Ellipticals contain relatively little gas and dust, though a interacting ellipticals may show dusty patches (however, these appear very different from spiral arms).



E1 E4 E7

- **Spiral Galaxies** have a central core surrounded by a flattened disk, and show varying degree of spiral structure. Spirals are classified by the size of their nuclei, definition and shape of their spiral arms, and their gas and dust content. Moving from class Sa $\rightarrow$ Sc, the trend is for a smaller core, less tightly wound & better defined spiral arms, and a dustier disk. Barred spirals also behave as above, but are denoted by 'SB' rather than 'S'.



Sa Sb Sc

SBa SBb SBc

- **Irregular Galaxies** do not have a well defined shape or symmetry as do ellipticals or spirals.
- **Lenticular Galaxies** (also denoted S0) have a core & disk but are without defined spiral arms. They are too dusty and structured to be an elliptical, but too smooth to be a spiral.

Mark this lab: ☐ individually ☐ as a group

NAME:
PARTNER:

Laboratory 5:
Galaxy Classification

**** Refer to the *'Galaxies'* image gallery on the class website for this lab. ****

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1. [***2 marks***] **How does the *core*-to-*disk* ratio change for spiral galaxies as you proceed from class 'a' to 'c'? How do the characteristics of the spiral arms change? Be specific!**

2. [***1 mark***] Compare the cores of spiral galaxies & elliptical galaxies in the colour images. **In what way(s) are they similar? What does this imply about stars in galactic cores?**

3. [***1 mark***] **How does *viewing angle* complicate the classification of *elliptical* galaxies?**

4. [***12 marks***] **Examining the detailed images on the website, use Hubble's scheme to classify all 12 galaxies. Clearly state *ALL* feature(s) used to (uniquely) identify each galaxy (eg. core vs disk size, winding of spiral arms, roundness, dustiness, etc.)**.

Galaxies *must* be identified as belonging to **ONE** of: *E0-E7, S0, Sa, Sb, Sc, SBa, SBb, SBc,* or *Irr.*

Galaxy	Type	Main identifying feature(s)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

5. [***1 mark***] **Describe some of the issues which may arise when attempting to utilize Hubble's simple 'Tuning Fork' scheme to classify galaxies.**

6. [***1 mark***] Examine galaxies 3, 5, 6, 8 10, 11 & 12. **How do the colours of their cores compare to their spiral arms? What does this tell us about the stars in each region?**

7. [***2 marks***] Examine the *detailed* Hercules & Coma Cluster website images. Pay attention to the colour, shape, and interactions of galaxies in the cluster(s). Record your impressions *WITHOUT further magnifying the detailed images* (zoom in & look around afterward for fun!). **What major differences exist between the two clusters? If the Hercules cluster is the *younger* cluster, what do the images suggest about how clusters (and galaxies) evolve? Explain.**