Lab 14
Galaxy Morphology

Names: ____

14.4 Lab Exercises
Section # 1: Classification of Spiral Galaxies

Exercise #1: In pictures 1 through 3 are standard spiral galaxies of types Sa, Sb, Sc. Using the discussion above, and Figures 14.3 to 14.6, classify each of the spiral galaxies in these three pictures and describe what properties led you to decide which subclass each spiral galaxy fell into. (3 points)

Exercise #2: Classify the spiral galaxies in Pictures #5, 6, 7 and 8. In each case, describe what led you to these classifications. (4 points)

Exercise #3: In pictures #9, 10, and 11 are three more spiral galaxies. Try to classify them. Use the same techniques as before, but try to visualize how each subtype of spiral galaxy would change if viewed from the side. (Remember that in a negative image, bright white means no light, and dark means lots of light, so dusty regions show up as white!) (3 points)

Section #2: Elliptical Galaxies

Exercise #4: In pictures #12, 13, 14, and 15 are some elliptical galaxies. Using Figure 14.8 as a guide, classify each of these four galaxies as either E0, E1, E2, E3, E4, E5, E6, or E7. Describe how you made each classification. (4 points)

Exercise #5: If the measurements for an elliptical galaxy are a = 30 mm and b = 20 mm, what subclass is that galaxy? (Round to the nearest integer.) (2 points)

Measure the major and minor axes for each of the galaxies in pictures #12, 13, 14, and 15, and calculate their subtypes. Note: it can sometimes be hard to determine where the edge of the galaxy is - try to be consistent and measure to the same level of brightness. (4 points)

Exercise #6: Measure the major and minor axes of the two elliptical galaxies shown in Pictures #16 and #17, and classify them using the same equation/technique as before. (2 points)

Section #3: Irregular Galaxies

Exercise #7: The peculiar shapes and features of the irregular galaxies shown in Pictures #18, 19 and 20 are believed to be caused by galaxy collisions or galaxy–galaxy interactions (that is, a close approach, but not a direct collision). Why do you think astronomers reached such a conclusion for these three galaxies? (4 points)

Exercise #8: In the two dwarf irregular galaxies shown in Pictures #21 and 22, the large numbers of blue stars, and the high number of bright red supergiants (especially in NGC 1705) indicate a high star formation ratethat is lots of new, young stars. Why are large numbers of hot, luminous blue stars, and red supergiants linked to young stars? [Hint: If you have learned about the HR diagram, try to remember how long hot, blue O and B stars live. As their internal supply of hydrogen runs out, they turn into red supergiants.] (4 points)

Section #4: Full Color Images of Galaxies

Exercise #9: Comparison of Spirals and Ellipticals

In Pictures #23 through 27 we show some color pictures of elliptical and spiral galaxies. Describe the average color of an elliptical galaxy (i.e., #23 & #24) compared to the colors of spiral galaxies (#25 to #27). (3 points)

Compare the large bulge of the Sombrero galaxy (Picture #27) to the giant E0 galaxy M87 (Picture #23). (3 points)

If the bulges of spiral galaxies are made-up of old, red giant stars, what does this say about elliptical galaxies? (3 points)

Of the spiral galaxies shown in Pictures 25 to 27, which has the most HII regions? Which appears to have the least? What does this imply about M51? (3 points)

Section #5: Multi-wavelength Views of Galaxies

Exercise #10: Comparison of Optical and Ultraviolet Images of Galaxies

Compare the number of hot stars in NGC 1365 with NGC 2841. Describe the spiral arms of NGC 2841. What do you think is happening in the nucleus of NGC 2841? (4 points)

In Picture #31 are FUV, U and R images of two more galaxies: the Sc galaxy NGC 2403, and the irregular galaxy IC 2574. Compare the number of red and blue stars in these two galaxies - are they similar? What is the main difference? (3 points)

In Picture #32 is a similar set of images for two elliptical galaxies, NGC 5253 and NGC 3115 (which can also be seen in Pictures #15 and 16) Compare these two galaxies. While NGC 3115 is a normal elliptical galaxy, NGC 5253 seems to have something interesting going on near its nucleus. Why do we believe that? Describe how we might arrive at this conclusion? (3 points)

Exercise #11: Comparison of Optical and Infrared Images of Galaxies

In Pictures #33 through #35 are blue ("B", 450 nm) and infrared ("H", 1650 nm) images of spiral galaxies. In Picture #33 we have Sa galaxies, in #34 we have Sb galaxies, and in #35 we have Sc galaxies. Compare how easy/hard it is to see the spiral arms in the B images versus the H images. Where are the blue stars? Where are the red stars? Note that while the hot O and B stars are super-luminous (1 million times the Suns luminosity), they are very rare. For each O star in the Milky Way galaxy there are millions of G, K, and M stars! Thus, while an O star may have 60 times the Suns mass, they are tiny component of the total mass of a spiral galaxy. Thus, what does the infrared light trace? (5 points)

We think that the Milky Way is an Sc galaxy. Make an argument in support of this claim, compare it to the photographs of other tilted spiral galaxies from Exercise #3. (8 points)