Name_____ **Section**_____

Partner(s)_____ **Date**_____

IN FAR OFF DISTANT GALAXIES: CLASSIFICATION BY SHAPE

View the three objects in the classroom from three different positions such as from the front, then the side, and then from above. Try to find views which are very different. Sketch what you see.

	Object X - round ball	Object Y - football	Object Z - fan blade
Front			
Side			
Top			

If you were observing these objects from a great distance, do you foresee any mistakes or errors in classification of the objects like X, Y, and Z. Explain.

These three shapes could easily represent different types of galaxies. A **galaxy** is a massive collection of stars held together by gravitational attraction. They come in a number of shapes. In this activity, we will use a photograph from Mt. Palomar Telescope to classify galaxies.

Obtain the photograph (DO NOT WRITE ON IT) and hand magnifier. The galaxies in this photograph are in the Virgo Cluster, 15 million parsec (Mpc) from the Earth, and are part of the constellation Virgo.

Using the photograph, which is a negative (bright objects are dark), and hand magnifier, observe objects A, B, and C. Sketch them below and describe their differences. As you look at each object move the magnifier up and down, this may help you see structure in the objects!

Object A	Object B	Object C

Object A is a **star** in the fore ground (located between observer and Virgo Cluster). They are bright Milky Way Galaxy stars showing diffraction spikes (an artifact of the telescope).

Object B is a **spiral galaxy** in the Virgo Cluster. It is disk shaped with arms. The two or more arms are visible due to dust lanes which block light.

Object C is an **elliptical galaxy** in the Virgo Cluster. The brightness decreases uniformly from the central area. Elliptical galaxies contain no dust lanes. Some elliptical galaxies are more elliptical than others.

Now using the photograph again, classify the ten objects in the table below, include a brief description (or illustration) especially if different from objects A, B, and C above.

Object	What?	Description	Object	What?	Description
1			6		
2			7		
3			8		
4			9		
5			10		

Of any of the elliptical galaxies seen in objects 1 through 10 above, rank them from most elliptical in shape to least elliptical.

MOST LEAST

Now look at the two galaxies labeled D. Offer two possible different explanations for what you see.

Possibility 1 -

Possibility 2 -

Galaxies come in a variety of shapes including spiral (arms from center), barred spiral (arms from central bar), elliptical, and some that do not fit the two classes, called irregular. The early classification of galaxies was the work of Hubble.

- Elliptical galaxies are dominated by red stars.
- Dust is common in spiral galaxies which tend to be bluer than elliptical galaxies because hot stars form in the spiral arms.

A spherical galaxy is a special type of elliptical or spiral galaxy? Support your choice.

What type of galaxy is the Milky Way Galaxy, the home of our solar system?

If the objects X, Y, and Z were galaxies, how would you classify them?

X _____ Y _____ Z _____

Using TheSky™ , the planetarium program used earlier (see page33), set the location for Washington, DC for today's date at 10 pm. View the southern horizon in the zenith setting. Move the view to include a good section of the Milky Way Galaxy (gray area in sky), which is our home galaxy. Now turn the stars off, and view the following, one at a time, and note location and any pattern of distribution for the objects.

Objects	Location	Any pattern? If so, what?
galaxies		
clusters		
nebulae		

Here are some properties of the various types of galaxies.

Property	Elliptical galaxies	Spiral Galaxies	Irregular Galaxies
Mass (M_{sun})	10^5 - 10^{13}	10^9 - 10^{11}	10^8 - 10^{10}
Luminosity (L_{sun})	10^5 - 10^{11}	10^8 - 10^{10}	10^7 - 10^9
Diameter (kpc)	1 -200	5-50	1 -10
Presence of Dust	almost none	yes	yes
Star Population	II	I in arms	I

Source: Zeilik et al. (1992) *Introductory Astronomy and Astrophysics*, 3rd ed., Saunders

Of *all observed galaxies* about 77% are spirals, 20% are ellipticals, and 3% are irregulars. When a survey is done to 9 Mpc, a short distance out, the distribution of galaxies becomes: 33% spiral, 13% elliptical, and 54% irregular. Offer an explanation for the difference in distribution using the data above.

Go to the Hubble Space Telescope website and view the HST deep field image of galaxies. How does it compare to the Virgo Cluster photograph?