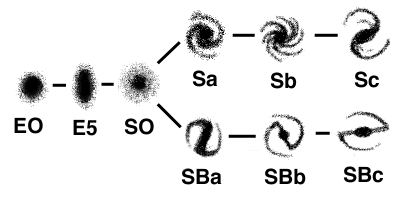
**Hubble’s Classification Scheme**

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Edwin Hubble developed a galaxy classification scheme consisting of four types: elliptical, spiral, barred spiral, and irregular.  Three of these types are represented in the "tuning fork" diagram below.



**Elliptical Galaxies**

An elliptical galaxy shows no spiral structure and can vary from almost round (what Hubble called E0) to almost cigar shaped (called E7).  This classification is based on our perspective from Earth and not on the actual shape.

**Spiral Galaxies**

As their name implies, spiral galaxies have outstretched, curving arms suggestive of a whirlpool or pinwheel.  Hubble distinguished different sub-classes according to the tightness of the arms and the size of the nucleus.  He called these Sa, Sb, and Sc. In terms of the arms, Sa is the tightest wound while Sc is the most open.  In terms of the nucleus, Sa has the largest while Sc has the smallest.  The galaxies that appear to have a spiral disc but no visible arms are called S0.

**Barred Spirals**

Barred spirals show the same spiral structure as normal spirals, and also a prominent bar through the nucleus.  The spiral arms emerge from the end of the bar.  The sub-classifications are the same as for normal spirals.

**Irregulars**

Certain galaxies lack either an obvious spiral structure or nuclear bulge, appearing instead as a random collection of stars with no obvious order.  They are distinguished from ellipticals by their lack of symmetry.

**CLASSIFYING GALAXIES Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Activity 1: Developing a Classification Scheme**

Although Immanual Kant first advanced the idea of "island universes" to explain the observed compact clouds during the eighteenth century, it wasn’t until this century that astronomers began to develop an understanding of the nature of galaxies.  Your instructor will provide you a [sheet](http://btc.montana.edu/ceres/html/Galaxy/galunknsheet.html) with fifteen galaxy photographs.  Your first task is to sort the galaxies by creating and applying a classification scheme based on appearance. Complete the table below.

|  |  |  |
| --- | --- | --- |
| Galaxy Classification | Galaxy ID Numbers | Defining Characteristics  *(provide enough detail so that anyone could use your scheme)* |
| Category I | Galaxy Classification | Galaxy Classification |
| Category II | Galaxy Classification | Galaxy Classification |
| Category III | Galaxy Classification | Galaxy Classification |
| Category IV | Galaxy Classification | Galaxy Classification |

**Activity 2: Applying Hubble’s Classification Scheme**

After you have completed Table 1, ask your instructor for a [copy of Edwin Hubble’s classification scheme](http://btc.montana.edu/ceres/html/Galaxy/galhubble.html), which was developed in the 1920’s.  Complete the following table using his scheme.

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|  |  |  |
| --- | --- | --- |
| Hubble's Catagories | Galaxy ID Numbers | Defining Characteristics  *(provide enough detail so that anyone could use your scheme)* |
|  | Galaxy Classification | Galaxy Classification |
|  | Galaxy Classification | Galaxy Classification |
|  | Galaxy Classification | Galaxy Classification |
|  | Galaxy Classification | Galaxy Classification |

**Question 1:** Unless there is an underlying model, classification systems are completely arbitrary as long as the defining characteristics are clear to everyone.

Which of the two systems, yours or Hubble’s, does your group prefer?  Why?

**Question 2:**Hubble viewed the tuning fork diagram as representing an evolutionary sequence for galaxies.  Using the tuning fork diagram, explain what he meant.

**Question 3:**Astronomers now realize that the tuning fork diagram does not represent an evolutionary sequence.  Does this mean that Hubble’s scheme is useless?  Explain.