**Galaxy Evolution**

The six images provided are clusters of galaxies. Coma, Perseus, and Centaurus are “relatively” nearby clusters, while the other three, Abell 851, Abel 1689, and MS 1054 03 lie at much greater distances and are seen at much younger ages.

The goal of this exercise is to estimate the fraction of spiral galaxies in each cluster to determine if the fraction of spirals changes as the Universe ages.

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|  | **Distance** | **Number**  **of Spirals** | **Number**  **of Ellipticals** | **Percentage**  **of Ellipticals** |
| **Nearby Clusters** |  |  |  |  |
| Coma | 99 Mpc |  |  |  |
| Perseus | 75 Mpc |  |  |  |
| Centaurus | 3.7 Mpc |  |  |  |
| **Distant Clusters** |  |  |  |  |
| Abell 851 | 1700 Mpc |  |  |  |
| Abell 1689 | 343 Mpc |  |  |  |
| MS 1054 03 | 355 Mpc |  |  |  |

Work in groups of six students, with each student responsible for one cluster. Select the brightest galaxies in each cluster and classify them as elliptical or as spiral galaxies. Record the number of spirals and ellipticals, and compute the percentage of ellipticals in each cluster. You should classify between 12 and 20 galaxies, depending on the cluster you are examining.

What is the average percentage of ellipiticals in the nearby clusters? In the distant clusters?

Has the percentage of spirals changed since the Universe was younger?