

**Stars, Galaxies, and the Universe** • *Enrich*

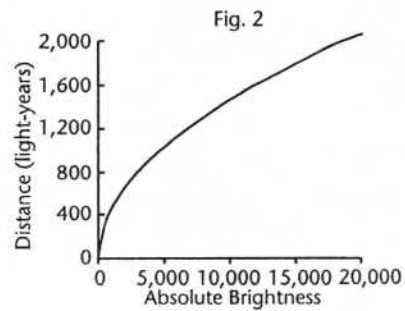
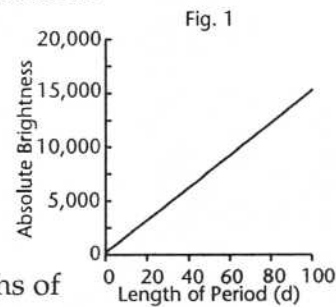
## Distances to the Galaxies

For nearly 100 years after galaxies were first seen with telescopes, astronomers didn't know what they were. At first, they were thought to be small nearby objects. Astronomers can use parallax to measure the distance to objects up to a few hundred light-years away. Galaxies were too far away to be measured by parallax. In 1923, the astronomer Edwin Hubble solved the problem by using a class of stars called variable stars. These unusual stars become brighter and dimmer in repeating cycles of 1 to 100 days.

By examining variable stars whose distance from the sun was determined by parallax, astronomers had discovered a useful relationship between the length of their brightness/dimness cycles and their average absolute brightness. Usually, to figure out a star's absolute brightness, you have to know both its apparent brightness and its distance from Earth. With a variable star, if you know the time period of its brightness/dimness cycle, you can calculate its absolute brightness. Then, comparing its absolute brightness with its apparent brightness, you can calculate its distance, even if it is much farther than 1,000 light-years away.

Hubble identified some faint variable stars in photographs of the Andromeda galaxy. Using these, he calculated that the Andromeda galaxy and other galaxies were millions of light-years away and very large.

Suppose astronomers discover the five variable stars in the table. Use the graph in Figure 1 to estimate their absolute brightness. All five have an average apparent brightness of 5. For variable stars with this apparent brightness, you can use the graph in Figure 2 to determine each star's distance from Earth.



	Length of bright/dim cycle (days)	Absolute brightness (sun = 1)	Distance (light-years)
Variable star A	5		
Variable star B	20		
Variable star C	35		
Variable star D	50		
Variable star E	90		

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