

Cosmology

Since long before the era of recorded history, humans have created stories about the origin of our amazing universe. Creation myths form a deep part of our human heritage, and one can obtain insights into human history, psychology, sociology, and culture from a careful study of these myths. And they are beautiful stories, too.

Science is a story, too, or rather a grand collection of stories. But in science we search for evidence to support our stories, and scientific stories are continually revised based on new evidence and new understanding. The scientific stories about the origin and evolution of our universe as a whole, which form the core of cosmology, are also beautiful. And the story of how astronomers gathered the evidence, created the theories, and argued their way to our current understanding, is a remarkable one. Ingenuity, artistry, inspiration, agony, and ecstasy: All have played a role in this awesome story of how we humans have been able to infer so much about our universe using only our own brain power and our careful observations of the vast heavens from a precarious perch on our tiny little orb, in an undistinguished branch of the cosmos.

And, of course, together with the amazing things we have been able to understand about our universe, there are many more things that remain mysterious. Among the currently most popular and interesting mysteries are dark matter and dark energy, both of which are discussed in this unit.

The following questions will guide your reading of this unit. The relevant part of the textbook is Chapter 18.

1 The Dark Night Sky

- What is Olbers's paradox (also known as the problem of the dark night sky)?
- What is the history of Olbers's paradox, and what is its significance?

2 The Big Bang Theory of the Universe

- What is the Hubble time of the universe? What is the significance of this time?
- What is the Big Bang theory of the universe?
- What is some of the evidence supporting the Big Bang theory of the universe?
- What is cosmic microwave background radiation? When was it first observed? What was the significance of the first observation of the cosmic microwave background radiation?

3 The Future of the Universe

- What are the possible futures of the universe? What important parameter determines which possible future will be realized?
- What is the meaning of the Ω parameter? How is its value related to the overall curvature of spacetime?

- What is the effect of the cosmological constant, Λ , on the expansion of the universe?
- What is the connection between dark energy and Λ ?
- What are our best current estimates of the ultimate future of the universe?