

A Sense of Place

1. Our Modern View of the Universe

- What is our place in the universe?
- How can we know what the universe was like in the past?
- Can we see the entire universe?

2. The Scale of the Universe

- How big is Earth compared to our Sun? Our solar system?
- How far away are the stars?
- How big is the Milky Way Galaxy?
- How big is the universe?

3. Spaceship Earth

- How is Earth moving in our solar system?
- How is our solar system moving in the Milky Way Galaxy?
- Are we ever sitting still?

Key Definitions and Terms

The Astronomical Unit

The light-year

The parsec

Planet

Star

Galaxy

Universe

Reading Assignments

Comins, *Discovering the Essential Universe*, chapter 1

Ferris, *Coming of Age in the Milky Way*, chapter 1

A Historical Perspective: The Emergence of a Science

1. Patterns in the Night Sky

- What are constellations?
- How do we locate objects in the sky?
- Why do stars rise and set?
- Why don't we see the same constellations throughout the year?

2. The Reason For Seasons

- What causes the seasons?
- How do we mark the progression of the seasons?
- Does the orientation of Earth's axis change with time?

3. The Ancient Mystery Of The Planets

- What was once so mysterious about the movement of planets in our sky?
- Why did the ancient Greeks reject the real explanation for planetary motion?

4. Ancient Greek Science

- Why does modern science trace its roots to the Greeks?
- How did the Greeks explain planetary motion?
- How did Islamic scientists preserve and extend Greek science?

Key Definitions and Terms

| | | |
|----------------------------|-----------------|----------------|
| Constellation | Ecliptic | Precession |
| The celestial sphere | Equinox | Geocentric |
| North/South celestial pole | Solstice | Circumpolar |
| Celestial equator | Right ascension | Declination |
| Retrograde motion | Ptolemaic model | Synodic period |
| Planetary alignments | Sidereal period | |

Reading Assignments

Bartusiak, *Archives of the Universe*, chapters 1 – 6

Ferris, *Coming of Age in the Milky Way*, chapters 1 and 2

Comins, *Discovering the Essential Universe*, chapter 2

Going Through the Motions: It's all Relative

1. The Copernican Revolution

- How did Copernicus, Tycho, and Kepler challenge the Earth-centered idea?
- What are Kepler's three laws of planetary motion?
- What observations by Galileo cast doubt on the Aristotelian worldview?
- How did Galileo solidify the Copernican revolution?

2. The Nature of Science

- How can we distinguish science from nonscience?
- What is a scientific theory?

3. Describing Motion: Examples from Daily Life

- How do we describe motion?
- How is mass different from weight?

4. Newton's Laws

- How did Newton change our view of the universe?
- Newton's three laws of motion
- The Law of Universal Gravitation
- What determines the strength of gravity?
- How does Newton's law of gravity extend Kepler's laws?

5. Conservation Laws in Astronomy

6. Einstein's Special Theory of Relativity

- Maxwell's equations and the unification of physics
- Failure of the Michaelson-Morley experiment
- What are the postulates of special relativity
- Consequences of relativistic motion

7. Einstein's General Theory of Relativity

- What is the principle of equivalence?
- How does Einsteinian spacetime differ from classical space and time?
- How does the curvature of spacetime explain gravity?

Key Definitions and Terms

| | | |
|------------------|----------------------|-----------------|
| Copernican model | Planetary alignments | Sidereal period |
| Inertia | Mass | Semimajor axis |
| Velocity | Acceleration | Weight |
| Angular momentum | Simultaneity | Hypothesis |
| Theory | Scientific Model | |

Reading Assignments

Bartusiak, *Archives of the Universe*, chapters 7 – 11, 35 and 36
Ferris, *Coming of Age in the Milky Way*, chapters 3 – 7
Comins, *Discovering the Essential Universe*, chapter 2