

# ASTRONOMY 9: HISTORY OF COSMOLOGY

## Syllabus

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**Note:** Preliminary and subject to change!!

### *Week 1.*

- 1/19 **Introduction.** What is Cosmology? Science and Society. Origin Myths and Magic. The Structure and Meaning of Cosmological Myth.  
1/21 **Origin Myths.** Africa.

### *Week 2.*

- 1/24 **Origin Myths.** Siberia and the Americas.  
1/26 **Origin Myths.** Australia and the Pacific.  
1/28 **Origin Myths.** India, China, and Japan.

### *Week 3.*

- 1/31 **Origin Myths.** The Middle East and Europe.  
2/2 **Astrology.** History. Relationship with pre-scientific cosmology. Scientific tests. An unscientific world?  
2/4 **Ancient Astronomy.** The naked-eye sky. The role of astronomy in the ancient world. China. The Mayans. The Celts. Babylon and Egypt.

### *Week 4.*

- 2/7 **The Ancient Greeks.** The dawn of rationality. The Ionians. Thales. The Eleatics: All is change. The Pythagoreans and the harmony of the spheres.  
2/9 **The Ancient Greeks.** Atoms and the Void. Plato's Cave.  
2/11 **The Ancient Greeks.** Aristotle and Eudoxus. The onion universe.

### *Week 5.*

- 2/14 **The Ancient Greeks.** The central fire. Aristarchus—the heliocentric universe. Ptolemy—the ferris wheel universe.  
2/16 **The Medieval Cosmos.** Augustine and the City of God. Cosmic innovation continues in Arabia.  
2/18 **The Medieval Cosmos.** Aquinas. Rediscovering the Greeks.

### *Week 6.*

- 2/21 *President's Day:* Go skiing!  
2/23 **Copernicus.** The heliocentric model. A reluctant revolutionary.  
2/25 **Tycho Brahe and Johannes Kepler.** The new astronomy. Tycho's cosmos. Planetary motion. Nature and geometry. Kepler's laws. The changing heavens.

### *Week 7.*

- 2/28 **Galileo.** The principle of inertia. The telescope. The heliocentric model and the church. A theory of the tides. The Inquisition.  
3/1 **Descartes and Newton.** The problem of gravitation. Vortices. Newton's Three Laws.  
3/3 **Newton.** The great synthesis. Universal gravitation. The mathematical clock-work cosmos.

### *Week 8.*

- 3/6 **The Birth of Astrophysics.** Stars and nebulae. Electromagnetism and light. Emission and absorption lines. Thermodynamics.

- 3/8 **Problems in Physics.** The end of the 19th century. The mysterious ether. The ultraviolet catastrophe.
- 3/10 **Midterm exam.** Study hard!

*Week 9.*

- 3/13 **Special Relativity.** The Principle of Relativity. The theory of an absolute. The ultimate speed limit. Length and time contraction.
- 3/15 **Special Relativity.** Fun with paradoxes. A new view of space and time.
- 3/17 **General Relativity.** The mysteries of gravity. The Principle of Equivalence.

*Week 10.*

- 3/20 **General Relativity.** Gravity and curved space.
- 3/22 **General Relativity.** Tests of the theory. Black holes. Physical laws and their limits of applicability.
- 3/24 **Life in the Quantum World.** The sub-atomic world. Quantum indeterminism. The interpretation of quantum mechanics.

3/27–3/31. *Spring Break.* Have fun!

*Week 11.*

- 4/3 **The Great Debate.** Shapley, Curtis, and the nature of the “spiral nebulae”.
- 4/5 **The Expanding Universe.** Einstein’s “greatest blunder”. Friedmann makes the universe expand. The Einstein–de Sitter model.
- 4/7 **Steady State vs. Big Bang.** An eternal universe? Controversy in cosmology.

*Week 12.*

- 4/10 **Structure in the Universe.** To live and die as a star. Black holes in the universe.
- 4/12 **Structure in the Universe.** Galaxies and clusters of galaxies. Superclusters. Is the universe a fractal?
- 4/14 **Echoes of the Bang.** The cosmic microwave background radiation.

*Week 13.*

- 4/17 **The Formation of the Elements.** Nucleosynthesis in the early universe. Production in stars.
- 4/19 **Inflation.** Cosmic coincidences force a new paradigm.
- 4/21 **Physics of the Early Universe.** The four fundamental forces and their unification. The problem of gravity. Initial conditions. Baby universes and worlds without end.

*Week 14.*

- 4/24 **The Dark Side of Matter.** Evidence for dark matter. Hot vs. cold. Neutrino physics.
- 4/26 **Structure Formation.** Digital universes. The evolution of structure: theory and observation. Current problems.
- 4/28 **The Ultimate Fate.** Supernovae and the evidence for dark energy. Eternal inflation and quantum cosmology. The future of civilization.

*Week 15.*

- 5/1 **Cosm.** Growing a universe in the lab. How science works.
- 5/3 **Cosm.** A brief history of the universe.
- 5/5 **Other topics.** The anthropic principle. Life in the universe. Cosmology, religion and philosophy. ...
- 5/8 **Review.** Good luck on the final!
- 5/16 **Final exam.** 5:00 pm (group 11).