

Syllabus¹

Week 1 (Jan. 28 - Feb. 1): A Beginning

Topics covered – Introduction and overview.

Readings and Activities – Pick a Universe: Hesiod, Plato or Lucretius. Nighttime star-gazing: A special star.

Week 2 (Feb. 4-8): Inventing Nature's Language

Topics covered – The study of *ideas*. Prehistoric attitudes towards nature, and the Children of Woot; beginnings of science in Egypt and Mesopotamia; ancient Greece, and the development of writing -- the world of Homer, Hesiod, and the rise of philosophy; the Ionian School and the question of ultimate reality; free-will vs. determinism; the validity of the senses. A grain of sand and the 2-sphere cosmology.

Readings and Activities – Hesiod: Theogony. Lucretius: The Nature of the Universe.

Week 3 (Feb. 11-15): A Question of Freedom

Topics covered – Lucretius, free will, and the basic tenets of Ionian philosophy. The discovery of the invisible: Empedocles and the ‘‘water thief’’. Harmony in music: An introduction to Pythagoras and the Pythagorean Brotherhood. Unity behind diversity -- numbers or atoms. Retrograde motion and the problem of the planets.

Readings and Activities – Empedocles: Love and Strife. Socrates. Ferris: ‘‘The Dome of Heaven.’’

Week 4 (Feb. 18-22): A Leap of Faith

Topics covered – A different perspective: Socrates, Plato. The beauty of a sphere. The power of pure thought. Euclid's axiomatic method. A Timid Monk solves the problem: Copernicus, and the last gasp of Plato.

Readings and Activities – Euclid: Elements. Plato: The Simile of the Caves; Theory of Art. Abell: Copernicus and the Heliocentric Hypothesis. Copernicus: On the Revolutions of the Heavenly Spheres.

Week 5 (Feb. 25 - March 1): Understanding Everything

Topics covered – Aristotle explains it all. Violent motion and an idealized cosmos. Tycho's island. The marriage of Kepler and Pythagoras, and the struggle to smash the sphere. Kepler's 3rd law. Galileo's telescope.

Readings and Activities – Aristotle: Physics and On the Heavens. Tycho Brahe: A pictorial salute. Kepler: The moment of his conception, and the Harmonies of the World. Abell: Kepler, Copernicus, and Galileo. Telescopic viewing of sunspots.

¹Rough and subject to change!

Week 6 (March 4-8 [no Wed. class]): *Having Eyes but Refusing to See*

Topics covered – The entrenchment of Aristotelian thought: Anasazi petroglyphs and the invisible supernova of 1054. Galileo, falling bodies, and the death of Aristotle. Once per civilization: Introduction to Isaac Newton and the physics of motion.

Readings and Activities – Newton: Certain Philosophical Questions. Wolf on Galileo and Newton. Hewitt: Motion and Inertia.

Week 7 (March 11-15): *Newton's New Language – The End of Explanation*

Topics covered – The Newtonian synthesis and a glimpse into the world of genius: Newton's laws, gravity, the *Principia*, the secret life of an alchemist, the search for truth and his fundamental reality, theory of light, the immutable nature of time, theology and spiritualism. Momentum. Newton's version of Kepler's 3rd law. Newton's legacy: The nightmare of determinism. Fuzzy patches hold the key -- The question of the nebulae: Island universes or solar systems forming?

Readings and Activities – Newton: Principia, Letters to Richard Bentley, and his alchemical notebooks. Laplace: On Probability. Hewitt: Force and acceleration; universal gravitation. Wolf: The Nightmare of Determinism.

→First paper (book review) due by Fri., March 15.

Week 8 (March 18-22): *Spring Break*

Topics covered – Matter at rest.

Week 9 (March 25-29): *Light*

Topics covered – How does energy get from here to there? The union of physics and astronomy, and the study of particles and waves. It sure looks like a wave: Young's experiment and Maxwell's discovery. The science of spectroscopy -- Kirchoff's Laws and the fingerprints of the elements. The Doppler effect and discovering black holes.

Readings and Activities – Hewitt: Vibrations and Waves; Diffraction and Interference. Gribbon: Light. Ferris: Island Universes.

Week 10 (April 1-5): *Finding Our Place in the Universe*

Topics covered – The controversy rages, and the mystery is solved. Hubble discovers a law; the expanding universe; looking back to the Big Bang, shadows of creation; the unity of physics and cosmology. The fate of the universe. An invisible universe: Dark matter.

Readings and Activities – Hubble: The Realm of the Nebulae. Pasachoff: The Dark Side of Matter. Lab: The Expansion of the Universe.

Week 11 (April 8-12): *Smashing Certainty*

Topics covered – Einstein draws a picture: The photon is born. A new look at Young's double-slit experiment. Einstein's "biggest blunder": The Cosmological Constant. Inside the atom.

Readings and Activities – Gribbon: The Atom. Wolf: The End of the Mechanical Age.

Week 12 (April 15-19): *Inventing a New Language*

Topics covered – Bohr takes a quantum leap; a Prince imagines a wave; the end of pictures: Schrodinger's unimaginable world; God's dice and uncertainty; Einstein's hidden orders.

Readings and Activities – Feynman: Quantum Behavior. Wolf: The End of Mechanical Models; Einstein and Bohr. Griffiths: The Wave Function.

Week 13 (April 22-26): *A Paradoxical World*

Topics covered – Einstein's challenge -- The EPR paradox and Bell's stunning discovery.

Readings and Activities – Gribbon: The EPR Paradox. Griffiths: What is a measurement?

Week 14 (April 28 - May 3): *An Ending*

Topics covered – Supernovae and dark energy; Sisyphean nightmares and happiness.

Readings and Activities – Albert Camus: The Myth of Sisyphus.

→Final paper due by Fri., May 3.