

Astronomy: The Evolving Universe (9/e)

Concept Clusters™

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Astronomical Unit/Kepler's laws

Heliocentric parallax/triangulation

Inverse-square law for light/flux

Luminosity classes from H-R diagram/spectroscopic distances

Doppler shifts of interstellar clouds/rotation curve of the Galaxy

Period-luminosity relation for cepheids

Structure of the Milky Way Galaxy/distances

Distance indicators to galaxies (cepheids, supernovas)

Clusters and superclusters of galaxies

Hubble law/Hubble constant/red shifts/age of universe

2. Heavenly Motions

Angles/angular speeds/relative distances

Motions of sun, moon relative to horizon, stars/eclipses

Motions of the planets relative to sun, stars/retrogrades/oppositions/elongations

Geocentric/heliocentric

Heliocentric parallax

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Binary stars/masses of stars/center of mass

Tidal forces

Gravitational accretion/contraction

General relativity/spacetime/curved geometry

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Atomic energy levels/photons/excitation/radiative energy

Telescopes: detectors; resolving, light-gathering, magnifying power; interferometers

Planck curve/black body/colors/temperature

Synchrotron emission/magnetic fields

Fusion reactions/nucleosynthesis

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Hertzsprung-Russell (H-R) diagram/star clusters

Mass-luminosity (M-L) relation/stellar lifetimes

Spectra of the interstellar medium/intergalactic medium

Spectra of galaxies/ red shifts/expansion of cosmos

Cosmic background radiation/Big Bang model

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Quantum theory/photons/energy levels

Age/radioactive dating/half life

Properties of matter (solids, liquids, gases, plasmas)/density

Solar system (geocentric/heliocentric)

Planets/planetary evolution/tectonics/volcanism/thermal energy

Magnetic fields/dynamo model

Sun/stars/stellar evolution/H-R diagram

Novas/supernovas/nucleosynthesis/mass loss

Stellar corpses /white dwarfs/neutron stars/black holes

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Milky Way Galaxy/normal galaxies

Active galaxies/supermassive black holes

Formation of galaxies/protogalaxies

Big Bang model/critical density/inflationary models/GUTs

Chapter 1

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

2. Heavenly Motions

Angles/angular speeds/relative distances

Motions of sun, moon relative to horizon, stars/eclipses

Motions of the planets relative to sun, stars/retrogrades/oppositions/elongations

3. Celestial Light and Spectra

None

4. Scientific Models

None

Chapter 2

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Heliocentric parallax

2. Heavenly Motions

Angles/angular speeds/relative distances

Motions of sun, moon relative to horizon, stars/eclipses

Motions of the planets relative to sun, stars/retrogrades/oppositions/elongations

Geocentric/heliocentric

Heliocentric parallax

3. Celestial Light and Spectra

None

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Solar system (geocentric/heliocentric)

Chapter 3

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Astronomical Unit/Kepler's laws

Heliocentric parallax

2. Heavenly Motions

Angles/angular speeds/relative distances

Motions of sun, moon relative to horizon, stars/eclipses

Motions of the planets relative to sun, stars/retrogrades/oppositions/elongations

Geocentric/heliocentric

Heliocentric parallax

Kepler's laws/orbits/

3. Celestial Light and Spectra

None

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Solar system (geocentric/heliocentric)

Chapter 4

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Astronomical Unit/Kepler's laws

Heliocentric parallax

2. Heavenly Motions

Angles/angular speeds/relative distances

Motions of sun, moon relative to horizon, stars/eclipses

Motions of the planets relative to sun, stars/retrogrades/oppositions/elongations

Geocentric/heliocentric

Heliocentric parallax

Kepler's laws/orbits/

3. Celestial Light and Spectra

None

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Solar system (geocentric/heliocentric)

Chapter 5

Concept Clusters

1. Cosmic Distances

None

2. Heavenly Motions

Conservation of energy/types of energy

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Atomic energy levels/photons/excitation/radiative energy

4. Scientific Models

Quantum theory/photons/energy levels

Chapter 6

Concept Clusters

1. Cosmic Distances

None

2. Heavenly Motions

None

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Telescopes: detectors; resolving, light-gathering, magnifying power; interferometers

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Chapter 7

Concept Clusters

1. Cosmic Distances

None

2. Heavenly Motions

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

General relativity/spacetime/curved geometry

Conservation of angular momentum

3. Celestial Light and Spectra

Telescopes: detectors; resolving, light-gathering, magnifying power; interferometers

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Chapter 8

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Astronomical Unit/Kepler's laws

2. Heavenly Motions

Angles/angular speeds/relative distances

Kepler's laws/orbits/periodic motion

Newton's laws of motion and gravitation/orbits/mass/weight/escape speed

Gravitational accretion

Conservation of energy/types of energy

3. Celestial Light and Spectra

Energy transport (radiation, convection, conduction)

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Age/radioactive dating/half life

Properties of matter (solids, liquids, gases, plasmas)/density

Solar system (geocentric/heliocentric)

Planets/planetary evolution/tectonics/volcanism/thermal energy

Chapter 9

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Astronomical Unit/Kepler's laws

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Conservation of energy/types of energy

3. Celestial Light and Spectra

Energy transport (radiation, convection, conduction)

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Age/radioactive dating/half life

Properties of matter (solids, liquids, gases, plasmas)/density

Planets/planetary evolution/tectonics/volcanism/thermal energy

Chapter 10

Concept Clusters

1. Cosmic Distances

Astronomical Unit/Kepler's laws

Inverse-square law for light/flux

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Planck curve/black body/colors/temperature

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

4. Scientific Models

Properties of matter (solids, liquids, gases, plasmas)/density

Planets/planetary evolution/tectonics/volcanism/thermal energy

Magnetic fields/dynamo model

Chapter 11

Concept Clusters

1. Cosmic Distances

Astronomical Unit/Kepler's laws

Inverse-square law for light/flux

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

4. Scientific Models

Age/radioactive dating/half life

Properties of matter (solids, liquids, gases, plasmas)/density

Planets/planetary evolution/tectonics/volcanism/thermal energy

Magnetic fields/dynamo model

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Chapter 12

Concept Clusters

1. Cosmic Distances

Astronomical Unit/Kepler's laws

Inverse-square law for light/flux

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Atomic energy levels/photons/excitation/radiative energy

Planck curve/black body/colors/temperature

Fusion reactions/nucleosynthesis

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Quantum theory/photons/energy levels

Properties of matter (solids, liquids, gases, plasmas)/density

Magnetic fields/dynamo model

Sun/stars/stellar evolution/H-R diagram

Chapter 13

Concept Clusters

1. Cosmic Distances

Astronomical Unit

Heliocentric parallax/triangulation

Inverse-square law for light/flux

Luminosity classes from H-R diagram/ spectroscopic distances

Doppler shifts

2. Heavenly Motions

Heliocentric parallax

Kepler's laws/orbits/periodic motion

Newton's laws of motion and gravitation

Binary stars/masses of stars/center of mass

Tidal forces

Conservation of energy/types of energy

3. Celestial Light and Spectra

Electromagnetic spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Atomic energy levels/photons/excitation/radiative energy

Planck curve/black body/colors/temperature

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Hertzsprung-Russell (H-R) diagram/star clusters

Mass-luminosity (M-L) relation/stellar lifetimes

4. Scientific Models

Stars/H-R diagram

Chapter 14

Concept Clusters

1. Cosmic Distances

Inverse-square law for light/flux

Luminosity classes from H-R diagram/ spectroscopic distances

2. Heavenly Motions

Binary stars/masses of stars/center of mass

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Telescopes: detectors; resolving, light-gathering, magnifying power; interferometers

Planck curve/black body/colors/temperature

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Hertzsprung-Russell (H-R) diagram/star clusters

Mass-luminosity (M-L) relation/stellar lifetimes

Spectra of the interstellar medium

4. Scientific Models

Sun/stars/stellar evolution/H-R diagram

Novas/supernovas/nucleosynthesis/mass loss

Stellar corpses /white dwarfs/neutron stars/black holes

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Chapter 15

Concept Clusters

1. Cosmic Distances

Inverse-square law for light/flux

Luminosity classes from H-R diagram/ spectroscopic distances

2. Heavenly Motions

Newton's laws of motion and gravitation/orbits/mass/

Binary stars/masses of stars/center of mass

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Electromagnetic radiation/spectrum

Emission/absorption

Kirchhoff's rules (emission, absorption, continuous spectra)

Planck curve/black body/colors/temperature

Fusion reactions/nucleosynthesis

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Hertzsprung-Russell (H-R) diagram/star clusters

Mass-luminosity (M-L) relation/stellar lifetimes

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Properties of matter (solids, liquids, gases, plasmas)/density

Sun/stars/stellar evolution/H-R diagram

Nucleosynthesis/mass loss

Chapter 16

Concept Clusters

1. Cosmic Distances

Inverse-square law for light/flux

Luminosity classes from H-R diagram

2. Heavenly Motions

Kepler's laws/orbits

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Binary stars/masses of stars/center of mass

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Planck curve/black body/colors/temperature

Fusion reactions/nucleosynthesis

Energy transport (radiation, convection, conduction)

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Hertzsprung-Russell (H-R) diagram/star clusters

Mass-luminosity (M-L) relation/stellar lifetimes

4. Scientific Models

Quantum theory/photons/energy levels

Properties of matter (solids, liquids, gases, plasmas)/density

Sun/stars/stellar evolution/H-R diagram

Novas/supernovas/nucleosynthesis/mass loss

Stellar corpses /white dwarfs/neutron stars/black holes

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Chapter 17

Concept Clusters

1. Cosmic Distances

Inverse-square law for light/flux

Doppler shifts of interstellar clouds/rotation curve of the Galaxy

Period-luminosity relation for cepheids

Structure of the Milky Way Galaxy/distances

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Binary stars/masses of stars/center of mass

Tidal forces

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Atomic energy levels/photons/excitation/radiative energy

Planck curve/black body/colors/temperature

Synchrotron emission/magnetic fields

Doppler shift/radial velocity/blue and red shifts

Stellar spectral and luminosity classes

Mass-luminosity (M-L) relation/stellar lifetimes

Spectra of the interstellar medium

4. Scientific Models

Sun/stars/stellar evolution/H-R diagram

Novas/supernovas/nucleosynthesis/mass loss

Stellar corpses /white dwarfs/neutron stars/black holes

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Milky Way Galaxy/galaxies

Chapter 18

Concept Clusters

1. Cosmic Distances

Angles/angular diameters

Inverse-square law for light/flux

Period-luminosity relation for cepheids

Distance indicators to galaxies (cepheids, supernovas)

Clusters and superclusters of galaxies

Hubble law/Hubble constant/red shifts/age of universe

2. Heavenly Motions

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freelfall/escape speed

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Planck curve/black body/colors/temperature

Synchrotron emission/magnetic fields

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Spectra of galaxies/ red shifts/expansion of cosmos

4. Scientific Models

Novas/supernovas/nucleosynthesis/mass loss

Stellar corpses /white dwarfs/neutron stars/black holes

Starbirth/planetary systems/protostars and protoplanets/brown dwarfs

Milky Way Galaxy/galaxies

Chapter 19

Concept Clusters

1. Cosmic Distances

Angles/angular diameters/positions

Angular speeds/relative motions

Inverse-square law for light/flux

Hubble law/Hubble constant/red shifts

2. Heavenly Motions

Angles/angular speeds/relative distances

Kepler's laws/orbits/periodic motion/dark matter

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Tidal forces

Gravitational accretion/contraction

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Synchrotron emission/magnetic fields

Chemical composition/spectra

Doppler shift/radial velocity/blue and red shifts

Spectra of galaxies/ red shifts/expansion of cosmos

4. Scientific Models

Properties of matter (solids, liquids, gases, plasmas)/density

Milky Way Galaxy/galaxies/active galaxies

Chapter 20

Concept Clusters

1. Cosmic Distances

Clusters and superclusters of galaxies

Hubble law/Hubble constant/red shifts/age of universe

2. Heavenly Motions

Newton's laws of motion and gravitation/orbits/mass/weight/freefall/escape speed

Binary stars/masses of stars/center of mass

Gravitational accretion/contraction

General relativity/spacetime/curved geometry

Conservation of energy/types of energy

Conservation of angular momentum

3. Celestial Light and Spectra

Kirchhoff's rules (emission, absorption, continuous spectra)

Planck curve/black body/colors/temperature

Doppler shift/radial velocity/blue and red shifts

Spectra of galaxies/ red shifts/expansion of cosmos

Cosmic background radiation/Big Bang model

4. Scientific Models

Assumptions, aesthetics/Geometry, physics

Observations (errors)/Predictions, explanations

Milky Way Galaxy/normal galaxies

Active galaxies/supermassive black holes

Formation of galaxies/protogalaxies

Big Bang model/critical density/inflationary models/GUTs