



Cherokee
County
School
District

Teaching &
Learning
Standards

ASTRONOMY

Science

Course Description

The Astronomy Cherokee Teaching & Learning Standards are designed to provide students with an introduction to the concepts of modern astronomy, the origin and history of the Universe, and the formation of the Earth and the solar system. Students will compare the Earth's properties with those of the other planets and explore how the heavens have influenced human thought and action. This course gives a description of astronomical phenomena using the laws of physics and addresses many standard topics including planets, stars, the Milky Way and other galaxies, and black holes. Laboratory exercises include experiments in light properties, measurement of radiation from celestial sources, and observations at local observatories and/or planetariums.

Science standards integrate the three dimensions of **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)** to provide a comprehensive framework that emphasizes active engagement, interdisciplinary connections, and core scientific principles. Together, they show how science standards engage *students* in obtaining, evaluating, and communicating information.

Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas
Asking Questions (Science) and Defining Problems (Engineering)	Patterns	Engineering, Technology, and the Application of Science (TLS)
Developing and Using Models	Cause and Effect: Mechanism and Explanation	
Planning and Carrying Out Investigations	Scale, Proportion, and Quantity	Physical Science (P)
Analyzing and Interpreting Data	Systems and System Models	
Mathematics and Computational Thinking	Energy and Matter: Flows, Cycles, and Conservation	Life Science (L)
Constructing Explanations (Science) and Designing Solutions (Engineering)		
Engaging in Argument from Evidence	Structure and Function	Earth and Space Science (E) Astronomy (AST)
Obtaining, Evaluating, and Communicating Information	Stability and Change	

Science and Engineering Practices are fundamental approaches that scientists and engineers use to investigate the natural world and solve practical problems. **Crosscutting Concepts** in science are overarching themes that bridge various disciplines, helping students and researchers see connections and deepen their understanding of the natural world. **Disciplinary Core Ideas** are fundamental concepts that students need to understand to develop a deep knowledge of science across various disciplines.

Thinking Like a Scientist (2 weeks)

Thinking Like a Scientist standards represent scientific thinking skills that should be incorporated throughout the entire course.

Overarching Standard

TLS9-12: Refine scientific inquiry and problem-solving skills by designing and conducting investigations, applying scientific theories, and critically evaluating scientific literature.

Supporting Standards for Student Mastery

TLS9-12.a: Use specialized scientific terms and concepts to analyze and explain scientific phenomena.

TLS9-12.b: Design and conduct independent experiments with multiple variables.

TLS9-12.c: Engage in complex data collection using advanced tools and technology (e.g., sensors, probes, software, simulations). Apply statistical methods to interpret data and generate a variety of graph types.

TLS9-12.d: Critically evaluate and communicate complex findings through reports and presentations. Contribute to scientific discussions by constructing and defending scientific explanations. Use and critique evidence to strengthen scientific arguments and discussions.

Semester 1 (August – December)

Unit 1: Ancient Astronomy (3-4 weeks)

In this introductory unit, students will explore the rich history and development of ancient astronomy, focusing on how early civilizations observed and interpreted the skies. They will assess the validity of historical astronomical theories and examine how ancient structures, instruments, and philosophies influenced the field. Students will investigate the daily and seasonal motions of the sky, the significance of constellations for navigation and timekeeping, and the relationship between the relative positions of the Earth, Moon, and Sun. Students will use the celestial sphere to understand how latitude and time of year affect the visibility of celestial objects.

Overarching Standard for Unit 1

AST1: Obtain, evaluate, and communicate information to assess the validity of historical theories of astronomy.

AST1.b: Obtain, evaluate and communicate information about how ancient structures, instruments, philosophies and civilizations influenced ancient astronomy.

(Clarification statement: Philosophies include but are not limited to geocentric theory, Aristotelian physics, and the Ptolemaic model with epicycles.)

Supporting Standards for Student Mastery in Unit 1

AST1.a: Ask questions to investigate the daily/seasonal motions of the sky and communicate the significance of constellations, for navigation and timekeeping.

(Clarification statement: Compare and contrast astronomy and astrology and describe how the zodiac relates to the motions of solar system objects.)

AST2: Obtain, evaluate, and communicate information to explain astronomical observations made from the point of reference of Earth.

AST2.a: Develop and use models to evaluate the relationship between the relative positions of the Earth, Moon and Sun and observable phenomena.

(Clarification statement: This includes moon phases, eclipses, tides, and seasons.)

AST2.b: Plan and carry out an investigation using the celestial sphere to explain how latitude and time of year affect visibility of constellations and other celestial objects.

Unit 2: Modern Astronomy (2 weeks)

In this unit, students will study the evolution of astronomical theories, focusing on the transition from the geocentric to the heliocentric model. They will construct arguments based on historical and scientific evidence to support the heliocentric model, examining contributions from key figures such as Galileo, Copernicus, Kepler, and Newton. Additionally, students will use mathematics and computational thinking to relate Kepler's Laws to Newton's Law of Gravitation and develop models to explain the retrograde motion of planets.

Overarching Standard for Unit 2

AST1: Obtain, evaluate, and communicate information to assess the validity of historical theories of astronomy.

AST1.c: Construct an argument based on evidence to support the scientific claims made by the heliocentric model.

(Clarification statement: Include observational evidence from Galileo's work, and the ideas of Copernicus, Kepler, and Newton.)

Supporting Standards for Student Mastery in Unit 2

AST1.d: Use mathematics and computational thinking to relate Kepler's Laws to Newton's Law of Gravitation.

AST2.c: Develop and use models of relative orbital motion of planets within our solar system to explain retrograde motion.

Unit 3: Tools of Exploration (3-4 weeks)

In this unit, students will explore the development and impact of astronomical tools and technologies, particularly telescopes, in advancing our understanding of the universe. They will investigate how reflecting and refracting telescopes have evolved and improved, enabling more detailed observations of celestial objects using the visible light spectrum. Additionally, students will dive into the properties of light and its relationship to cosmic distances, utilize mathematical and computational thinking to interpret spectroscopic data, and analyze various electromagnetic spectra to evaluate their applications in modern astronomy.

Overarching Standard for Unit 3

AST1: Obtain, evaluate, and communicate information to assess the validity of historical theories of astronomy.

AST1.e: Construct an explanation for how technological advances in the design of reflecting and refracting telescopes have improved our ability to study the universe.

(Clarification statement: The focus is on the historical use of optical telescopes utilizing only the visible light spectrum.

Supporting Standards for Student Mastery in Unit 3

AST2.d: Use mathematics and computational thinking to explain the relationship between the properties of light and the vast distances in the cosmos.

(Clarification statement: This includes but is not limited to the Doppler Effect, cosmological red shifts, parsecs, light years, and astronomical units.)

AST2.e: Plan and carry out an investigation to analyze the electromagnetic spectrum and spectroscopic data to obtain information about the inherent properties and motions of objects.

(Clarification statement: Consider the use of diffraction gratings to analyze spectroscopic wavelength data along with other quantitative telescopic data.)

AST6.b: Analyze and interpret telescopic data of various electromagnetic spectra in order to evaluate the uses and advantages of the data from each.

(Clarification statement: This includes but is not limited to atmospheric analysis, solar monitoring, and exoplanet detection.)

Unit 4: Exploring the Universe (3-4 weeks)

In this unit, students will investigate the profound impact of space exploration on our understanding of the universe and its connection to the conditions necessary for life. They will investigate the historical milestones and future possibilities of space missions, examining their significance in advancing technology, fostering cultural cooperation, and inspiring knowledge and innovation. Students will also delve into the analysis and interpretation of telescopic data across various electromagnetic spectra, using mathematical and computational thinking to understand the vast distances in the cosmos and the properties of light.

Overarching Standard for Unit 4

AST6: Obtain, evaluate, and communicate information to discuss how the past, current, and future explorations of space impact our investigations of the connections between cosmic phenomena and conditions necessary for life.

AST6.a: Construct an argument based on evidence of the significance of historical and future space exploration as they relate to leaps in technology, cultural cooperation, knowledge, and inspiration.

(Clarification statement: Historical space exploration begins with Sputnik and continues to the present day, including possible future extrasolar exploration, space stations, and colonization.)

Supporting Standards for Student Mastery in Unit 4

AST6.b: Analyze and interpret telescopic data of various electromagnetic spectra in order to evaluate the uses and advantages of the data from each.

(Clarification statement: This includes but is not limited to atmospheric analysis, solar monitoring, and exoplanet detection.)

AST2.d: Use mathematics and computational thinking to explain the relationship between the properties of light and the vast distances in the cosmos.

(Clarification statement: This includes but is not limited to the Doppler Effect, cosmological red shifts, parsecs, light years, and astronomical units.)

Unit 5: The Planets (4-6 weeks)

In this unit, students will explore the formation and major properties of our solar system and its celestial objects. They will investigate the planets and delve into the nebular theory to understand how the solar system was formed, examine the chemical composition and characteristics of the Sun and other solar system objects, and explore the role of nuclear fusion and hydrostatic equilibrium. Additionally, they will construct explanations for the existence and importance of habitable zones, the impact of astronomical and planetary hazards on the evolution of life, and possible signatures of life in our solar system and beyond.

Overarching Standard for Unit 5

AST3: Obtain, evaluate, and communicate information to illustrate the formation of the solar system and the properties of celestial objects within it.

AST3.c: Ask questions to investigate and communicate major properties of our solar system bodies and the zones they inhabit.

(Clarification statement: This includes planets, dwarf planets, major moons, asteroid belt, comets, Kuiper belt, and the Öort cloud.)

Supporting Standards for Student Mastery in Unit 5

AST3.a: Develop and use models to explain the formation of the solar system.

(Clarification statement: This includes the nebular theory.)

AST3.b: Develop and use models to explain the chemical composition and characteristics of the Sun and other solar system objects.

(Clarification statement: This should include addressing the role of nuclear fusion in the formation of elements in the sun and the role that hydrostatic equilibrium plays in the formation of different objects in the solar system.)

AST6.c: Construct an explanation for the existence and importance of habitable zones, habitable planetary bodies, and possible signatures of life in our own and in other solar systems.

AST6.d: Construct an explanation of how astronomical and planetary hazards and global atmospheric changes have impacted the evolution of life on Earth.

(Clarification statement: This includes but is not limited to asteroid impacts, changes in solar radiation, and gamma ray bursts.)

Semester 2 (January – May)

Unit 6: Non-Planetary Objects (3 weeks)

In this unit, students will research the diverse and fascinating non-planetary objects within our solar system. They will investigate the major properties and zones of celestial bodies, including dwarf planets, major moons, the asteroid belt, comets, the Kuiper belt, and the Öort cloud. Students will develop and use models to understand the formation of the solar system through the nebular theory, and to explain the chemical composition and characteristics of the Sun and other solar system objects.

Overarching Standard for Unit 6

AST3: Obtain, evaluate, and communicate information to illustrate the formation of the solar system and the properties of celestial objects within it.

AST3.c: Ask questions to investigate and communicate major properties of our solar system bodies and the zones they inhabit.

(*Clarification statement:* This includes planets, dwarf planets, major moons, asteroid belt, comets, Kuiper belt, and the Öort cloud.)

Supporting Standards for Student Mastery in Unit 6

AST3.a: Develop and use models to explain the formation of the solar system.

(*Clarification statement:* This includes the nebular theory.)

AST3.b: Develop and use models to explain the chemical composition and characteristics of the Sun and other solar system objects.

(*Clarification statement:* This should include addressing the role of nuclear fusion in the formation of elements in the sun and the role that hydrostatic equilibrium plays in the formation of different objects in the solar system.)

AST6.c: Construct an explanation for the existence and importance of habitable zones, habitable planetary bodies, and possible signatures of life in our own and in other solar systems.

AST6.d: Construct an explanation of how astronomical and planetary hazards and global atmospheric changes have impacted the evolution of life on Earth.

(Clarification statement: This includes but is not limited to asteroid impacts, changes in solar radiation & gamma ray bursts.)

Unit 7: The Sun (2 weeks)

In this unit, students will explore the Sun, its chemical composition, and its essential characteristics. They will investigate the processes of nuclear fusion and how it contributes to the formation of elements within the Sun. Students will also examine the concept of hydrostatic equilibrium and its role in shaping different objects in the solar system. Additionally, students will develop models to understand the formation of the solar system and delve into the processes of stellar evolution from star birth to star death, including the dynamics of binary star systems.

Overarching Standard for Unit 7

AST3: Obtain, evaluate, and communicate information to illustrate the formation of the solar system and the properties of celestial objects within it.

AST3.b: Develop and use models to explain the chemical composition and characteristics of the Sun and other solar system objects.

(Clarification statement: This should include addressing the role of nuclear fusion in the formation of elements in the sun and the role that hydrostatic equilibrium plays in the formation of different objects in the solar system.)

Supporting Standards for Student Mastery in Unit 7

AST3.a: Develop and use models to explain the formation of the solar system.

(Clarification statement: This includes the nebular theory.)

AST5.a: Develop and use models to explain the process of stellar evolution from star birth to star death, including binary systems.

Unit 8: Other Stars (3-4 weeks)

In this unit, students will study the life cycle of stars, focusing on the connections between mass, gravity, and fusion. They will investigate how these factors influence the evolution of stars from birth to death. By utilizing the Hertzsprung-Russell diagram, students will assess the properties of stars, including density, luminosity, temperature, rates of fusion, and spectral class. This unit will also delve into stellar remnants and events such as neutron stars, pulsars, black holes, and supernovae, allowing students to evaluate the evidence predicting the lifespan and final stages of stars.

Overarching Standard for Unit 8

AST5: Obtain, evaluate, and communicate information about the connections between mass, gravity and fusion with respect to the life cycle of stars.

AST5.b: Construct an argument based on evidence from the Hertzsprung-Russell diagram to assess the properties of stars, including density, luminosity, temperature, rates of fusion, and spectral class.

Supporting Standards for Student Mastery in Unit 8

AST5.a: Develop and use models to explain the process of stellar evolution from star birth to star death, including binary systems.

AST5.c: Ask questions to evaluate evidence that predicts the lifespan and final stage of stellar evolution based on mass.

(Clarification statement: Include stellar remnants and events such as neutron stars, pulsars, black holes, supernovae.)

AST5.d: Construct an argument based on evidence that explores the connections among various cosmic phenomena and leading theories.

Unit 9: Exotic Objects (2-3 weeks)

In this unit, students will explore the fascinating and often mysterious realm of exotic objects in the universe. They will investigate the final stages of stellar evolution and the formation of stellar remnants such as neutron stars, pulsars, black holes, and supernovae. By evaluating evidence and developing models, students will gain a deeper understanding of how mass, gravity, and fusion contribute to the life cycle of stars. Additionally, they will explore the connections among various cosmic phenomena and leading theories in astrophysics.

Overarching Standard for Unit 9

AST5: Obtain, evaluate, and communicate information about the connections between mass, gravity and fusion with respect to the life cycle of stars.

AST5.c: Ask questions to evaluate evidence that predicts the lifespan and final stage of stellar evolution based on mass.

(Clarification statement: Include stellar remnants and events such as neutron stars, pulsars, black holes, supernovae.)

Supporting Standards for Student Mastery in Unit 9

AST5.a: Develop and use models to explain the process of stellar evolution from star birth to star death, including binary systems.

AST5.d: Construct an argument based on evidence that explores the connections among various cosmic phenomena and leading theories.

Unit 10: Galaxies (2-3 weeks)

In this unit, students will learn about the vast and intriguing world of galaxies. They will delve into the scientific view of the origin of the universe, the evolution of matter, and the development of galaxies. Using models, students will describe the conditions of the early universe that led to the formation and evolution of matter, as well as the birth of the first stars and galaxies. They will also use mathematics and computational thinking to explain the properties of light and the vast distances in the cosmos and analyze spectroscopic data to obtain information about the motions and characteristics of celestial objects. Additionally, students will investigate how galactic evolution occurs through mergers and collisions.

Overarching Standard for Unit 10

AST4: Obtain, evaluate, and communicate information to describe the scientific view of the origin of the universe, the evolution of matter, and the development of galaxies.

AST4.b: Use models to describe the conditions of the early universe that led to the formation and evolution of matter as well as the birth of the first stars and galaxies.

Supporting Standards for Student Mastery in Unit 10

AST2.d: Use mathematics and computational thinking to explain the relationship between the properties of light and the vast distances in the cosmos.

(Clarification statement: This includes but is not limited to the Doppler Effect, cosmological red shifts, parsecs, light years, and astronomical units.)

AST2.e: Plan and carry out an investigation to analyze the electromagnetic spectrum and spectroscopic data to obtain information about the inherent properties and motions of objects.

(Clarification statement: Consider the use of diffraction gratings to analyze spectroscopic wavelength data along with other quantitative telescopic data.)

AST4.d: Develop and use models to relate how galactic evolution occurs through mergers and collisions.

Unit 11: Big Bang (2-3 weeks)

In this unit, students will research the Big Bang theory and its implications for the origin and evolution of the universe. They will investigate the evidence supporting the Big Bang, including the cosmological principle, cosmic microwave background radiation, and the concept of space-time expansion. Additionally, students will use indirect evidence to construct explanations for the existence of dark matter and dark energy, and how these components influence the universe's structure and expansion. Through modeling and analysis, students will gain a comprehensive understanding of how the Big Bang theory provides a framework for describing the early conditions of the universe and its subsequent development.

Overarching Standard for Unit 10

AST4: Obtain, evaluate, and communicate information to describe the scientific view of the origin of the universe, the evolution of matter, and the development of galaxies.

AST4.b: Use models to describe the conditions of the early universe that led to the formation and evolution of matter as well as the birth of the first stars and galaxies.

Supporting Standards for Student Mastery in Unit 10

AST4.a: Construct an argument from evidence in support of the Big Bang theory.

(Clarification statement: This includes but is not limited to the cosmological principle, cosmic microwave background radiation, and space-time expansion.)

AST4.c: Construct an explanation using indirect evidence to support the existence of dark matter and dark energy.