Geneva CUSD 304
Content-Area Curriculum Frameworks
Grades 6-12
Science

Mission Statement	<u>The Mission of Science Education Is:</u> 1) to nurture an active interest in science that continues throughout life. 2) to teach the learning skills and concepts necessary for the scientific process. 3) to develop student understanding of the interrelationships between science, society, and the environment 4) to encourage students to discover and develop their talent in science.
Course Sequence (Grades 6-12)	**6th grade:** Earth Science **7th grade:** Life Science **8th grade:** Physical Science **9th grade:** General Science Earth Science Biology Biology Honors **10th ,11th,12 grade:** Chemistry Chemistry Honors Physics Astronomy Natural Disasters Anatomy and Physiology I and II Horticulture I and II AP Chemistry AP Biology AP Environmental Science

Course Framework

Course Title	**Astronomy**
Grade Level	11th/12th
Semesters (1-2-3-4)	1
Prerequisite	Biology and Geometry
Course Description	This laboratory science is an upper level science elective. It is intended for students to either continue the study of Earth Science in depth or for students to be introduced to the study of Earth Science in a more rigorous setting than the beginning year course offered to 9th graders (see Earth Science description). Students will develop an appreciation for the study of astronomy and the methods by which it is accomplished. Topics include but are not limited to location and identification of celestial bodies and constellations in the night sky, the history of astronomy, light and instrumentation, the solar system, stars, galaxies and an introduction to cosmology.
District-approved Materials and/or Resources	Astronomy Publisher: Thompson Learning ISBN: 0-03-033488-8 Copy write: 2002

Unit Frameworks

Unit of Study: major topics	**Introduction to Modern Astronomy**	Resources that will support instruction Video: Powers of Ten, by Eams & Rey
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.** **A. Know and apply the concepts, principles and processes of scientific inquiry.** **11.A.4a** Formulate hypotheses referencing prior research and knowledge. **11.A.4e** Formulate alternative hypotheses to explain unexpected results. **11.A.4f** Using available technology, report, display and defend to an audience conclusions drawn from investigations. **11.A.5a** Formulate hypotheses referencing prior research and knowledge. **11.A.5b** Design procedures to test the selected hypotheses **11.A.5e** Report, display and defend the results of investigations to audiences that may include professionals and technical experts. **STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate	

	tectonics). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4a** Compare and contrast scientific inquiry and technological design as pure and applied sciences. **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs.
Objectives o **Conceptual** o **Factual** o **Procedural**	I. Introduction to Modern Astronomy (*Chapter 1)* A. Scientific Misconceptions 1. Identify and explain the certainty of personal beliefs and expectations. 2. Define, explore, challenge, and revise misconceptions in

<table>
<tr><td></td><td colspan="2">science.
B. Scientific Observation
1. Understand the principles of thorough observation.
2. Apply principles of observation to the night sky.
C. A Sense of the Universe
1. Define astronomy.
2. Compare the values of astronomical verses earthly scale and time.
D. Mathematics in Astronomy
1. Convert measurements from one unit to another.
2. Successfully calculate numbers using scientific notation with correct significant digits.
3. Calculate values using basic trigonometry and algebra.</td></tr>
<tr><td>Assessments</td><td>Performance Tasks
▪ Homework completion
▪ Design a controlled experiment
▪ Lab work and reports
▪ Quizzes
▪ Exams</td><td>Other Evidence</td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**The Sky**	Resources that will support instruction Video: Redshift College Edition
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.** **A. Know and apply the concepts, principles and processes of scientific inquiry.** **11.A.4a** Formulate hypotheses referencing prior research and knowledge. **11.A.4b** Conduct controlled experiments or simulations to test hypotheses. **11.A.4c** Collect, organize and analyze data accurately and precisely. **B. Know and apply the concepts, principles and processes of technological design.** **11.B.5b** Select criteria for a successful design solution to the identified problem. **11.B.5c** Build and test different models or simulations of the design solution using suitable materials, tools and technology **11.B.5d** Choose a model and refine its design based on the test results. **11.B.5e** Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements. **11.B.5f** Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. **STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences).	

	12.D.5b Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	II. The Sky and the Calendar (*Chapter 6)* A. The Constellations 1. Explore and understand the historical views of the night sky. 2. Define zodiac, identify common constellations, and describe their origins. 3. Learn and use techniques of amateur astronomy in observing the night sky. 4. Observe and sketch some common constellations using star charts. 5. Explain why stars twinkle. B. Coordinate Systems 1. Identify and understand the celestial sphere and use it to locate objects. a. Know and understand the features on the celestial sphere (celestial meridians, celestial poles, celestial equator,

zenith).
b. Define and demonstrate the use of right ascension and declination.

2. Define, observe, and explore the concepts that deal with the motions of the stars with respect to the horizon system.

C. Earth In Space

1. Identify and describe the ecliptic plane of the sun with respect to the celestial sphere.
   a. Compute the Sun's right ascension and declination at various times of the year.
   b. Locate the vernal and autumnal equinox positions of the Sun along the ecliptic.
   c. Explain how the Earth revolves around the Sun.
2. Diagram and explain why the Earth has seasons.
   a. Identify the tilt of the Earth.
   b. Define and describe equinox and solstice, when they occur, and where they occur on the ecliptic (right ascension and declination).
   c. Describe aphelion and perihelion and how they affect the seasons.
   d. Explain why there are areas on the Earth that experience "midnight sun".
3. Describe rotation and precession and how they affect the Earth's view of the stars.

D. Measuring Time

1. Explore the history of time measurement.
2. Define and explain what a sundial is and how it is used.
3. Compare and contrast sidereal time with solar time.
4. Explain time zones.
5. Identify the origin of calendars and how a year was defined for each.
   a. Describe the different calendars invented in the past.
   b. Compare and contrast sidereal year with a solar (tropical) year.
6. Discuss the origin of monthly time and distinguish between a sidereal month and a synodic month.

E. Sun, Earth, Moon System

1. Calculate the size and scale of the Sun, Earth, and Moon using the stars.
2. Create a scale model of the Sun, Earth, and Moon system.
3. Explore the ways ancient astronomers determined the Earth's size and astronomical distances.
4. Analyze the phases of the moon (*Chapter 7.2*).
5. Compare and contrast solar and lunar eclipses (*Chapter 7.3*).
6. Explain the rotation and revolution of the moon.
7. Give a mathematical explanation concerning why the Earth has

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<tr><td></td><td colspan="2">tides (Chapter 8.3).
F. The Planets
1. Describe the positions of the planets with respect to the Earth.
2. Identify the phase a planet is in as seen from Earth.</td></tr>
<tr><td>Assessments</td><td>Performance Tasks
▪ Homework completion
▪ Design and carry out a controlled experiment
▪ Lab work and reports
▪ Quizzes
▪ Exams</td><td>Other Evidence
▪ Scale Model of the Solar System Walk
▪ Modeling Our Sky Analogy Project</td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**The History of Astronomy**	Resources that will support instruction

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	12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4a** Compare and contrast scientific inquiry and technological design as pure and applied sciences. **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs.

	13.B.5e Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	III. History of Astronomy (*Chapters 2&3)* A. Early Astronomy 1. Identify and understand the contributions made by the Egyptian, Mesopotamian, Sumerian, Chinese, Polynesian, and Babylonian societies to astronomy. 2. Describe the contributions made by the Mayans and Native Americans to astronomy. 3. Explore the impact ancient astronomy had on later astronomical thought. B. Greek Astronomy 1. Understand the principles of a geocentric universe, retrograde motion, deferents, and epicycles. 2. Analyze the concepts contributed by Eudoxus, Pthagorus, Aristarchus, Thales, Eratosthenes, and Hipparchus. 3. Describe and illustrate the Universe's of both Aristotle and Ptolemy. 4. List the main principles or beliefs that ancient astronomers held for many centuries. C. The Origin of Modern Astronomy 1. Define and illustrate the Universe according to Nicolas Copernicus. 2. Describe the impact that the theories of Nicolas Copernicus and a heliocentric universe had on society. 3. Outline and understand the achievements of Tyco Brahe and how they paved the way for modern astronomy. D. Johannes Kepler 1. Outline the observations made by Kepler. 2. Summarize Kepler's three laws of planetary motion and make calculations using these laws. E. Galileo Galilei 1. Give a brief history of Galileo's life and studies. 2. Summarize Galileo's discoveries with the aid of a telescope (maria, distance and brightness of the stars, star clusters, the Milky Way, Jupiter's moons, sunspots, the phases of Venus). F. Isaac Newton 1. Give a brief history of Newton's life and studies. 2. Define gravity. 3. Use Newton's law of universal gravitation to calculate the gravitational pull of celestial objects. 4. Understand, analyze, and use Newton's laws of motion. G. Albert Einstein 1. Define the Theories of Special and General Relativity.

	2. Compare and contrast the Theories of Special and General Relativity with Newton's Laws of motion, particularly describing where Newton's Laws break down.	
Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence ▪ Mural of Ancient Astronomy Project

Unit Frameworks

Unit of Study: major topics	**Planetary Science**	Resources that will support instruction TASA Graphics: The Solar System

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	of study, careers and job markets and aspects of everyday life.	
Objectives o **Conceptual** o **Factual** o **Procedural**	IV. Planetary Science A. The Origin of the Solar System (*Chapter 7*) 1. Explore the theories of cosmogony (catastrophe, tidal, and nebular). 2. Explain the evolution of a solar system according to the nebular theory. 3. Analyze the rotation and revolution of the planets (*Chapter 7.4*). B. The Earth (*Chapter 8*) 1. Summarize the current popular theory of the earth's origin. 2. Describe the interior of the earth. 3. Explain plate tectonics. 4. Identify and describe the layers of the earth's atmosphere. 5. Compare and contrast global warming with the ozone depletion. 6. Describe the Van Allen Belts, Aurora, and Magnetosphere and explain how they interact with one another. C. The Moon (*Chapter 9*) 1. Compare the theories surrounding the origin of the moon (Capture, Fission, Co-accretion, Giant Impact). 2. Describe the appearance and surface features of the moon (highlands, mare, mountain ranges, valleys, rilles, ridges, rims, librations, rocks, soils, craters) and its interior. D. The Planets, Comets, Asteroids, and Meteors (*Chapters 10 – 20*) 1. Summarize each of the nine planets with respect to their position in the solar system, history, physical makeup, atmosphere, rotation, revolution, satellites, and any other noteworthy facts and features. 2. Outline the structure, origin, and behavior of comets. 3. Describe the Oort Cloud and the Kuiper belt. 4. Discuss famous comets and comet impacts. 5. Compare and contrast meteors, meteorites, and asteroids. 6. Outline the location, composition, and features of the asteroid belt. 7. Evaluate the risk of a catastrophic meteoric impact.	
Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence

Unit Frameworks

Unit of Study: major topics	**Light and Telescopes**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.** **A. Know and apply the concepts, principles and processes of scientific inquiry.** **11.A.5e** Report, display and defend the results of investigations to audiences that may include professionals and technical experts. **STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant).	

	STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts. **A. Know and apply the accepted practices of science.** **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims.
Objectives o **Conceptual** o **Factual** o **Procedural**	V. Light and Telescopes (*Chapters 4 and 5)* A. The Nature of Light 1. Define and understand the spectrum. 2. Distinguish between the different wavelengths of visible light (ultraviolet and infrared). 3. Outline the electromagnetic spectrum. 4. Describe the Doppler effect and relate it to stars and galaxies. B. Telescopes and Observing 1. Define and describe what a telescope is. 2. Describe and explore the principles of refraction and the features of a refracting telescope. 3. Define chromatic aberration. 4. Describe and explore the principles of reflection and the features of a reflecting telescope. 5. Compare and contrast reflecting telescopes with refraction telescopes. 6. Compare and contrast Newtonian and Cassegrain telescopes. 7. Discuss the affect of seeing and light pollution on ground based telescopes. C. Observatories and Observational Technology 1. Identify the various world observatories. 2. Discuss wide field telescopes. 3. Give a brief history and description of the Hubble Telescope and research some of the current projects being conducted with it. 4. Discuss observing light at short (ultraviolet and X-ray astronomy) and long (infrared and radio astronomy) wavelengths.

Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence ▪ Buying a Telescope Project ▪ Illuminating Light Project

Unit Frameworks

Unit of Study: major topics	**The Stars**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.** **A. Know and apply the concepts, principles and processes of scientific inquiry.** **11.A.4a** Formulate hypotheses referencing prior research and knowledge. **11.A.4c** Collect, organize and analyze data accurately and precisely. **11.A.4d** Apply statistical methods to the data to reach and support conclusions. **11.A.4f** Using available technology, report, display and defend to an audience conclusions drawn from investigations. **11.A.5e** Report, display and defend the results of investigations to audiences that may include professionals and technical experts. **STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics).	

	F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it. **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	VI. The Sun A. The Sun's Interior and the Solar Atmosphere (*Chapter 22*) 1. Describe size, magnitude, and position of the sun. 2. Outline the layers of the sun's interior (core, radiative zone, convective zone) and explain how they behave. 3. Summarize the characteristics of the sun's photosphere, chromosphere, and corona. B. Solar Activity and the Earth (*Chapters 23)* 1. Analyze sunspots and the sunspot cycle. 2. Explain how solar flares, plages, filaments, prominences, and solar winds affect the earth and other objects in the solar system. VIII. The Stars A. Stars and their Spectra (*Chapter 24)*

	1. Analyze and evaluate the relationship between star color, temperature, and energy output using Wien's displacement law and the Stefan-Boltzman law. 2. Discuss Planck's law and black bodies. 3. Describe quantum mechanics and how it relates to a star's spectrum. 4. Understand the concepts surrounding the Balmer series and the energy states of hydrogen. 5. Explore stellar spectral types and what they reveal about stellar composition. B. Stellar Distances and Motions (*Chapter 25)* 1. Become familiar with apparent magnitude and the magnitude scale. 2. Define absolute magnitude and luminosity and use the inverse-square law to relate apparent with absolute magnitude. 3. Describe the Hertzsprung-Russel Diagram and use it to evaluate the life of a star. 4. Explain parallax, astronomical unit, parsec, and light-year. 5. Use the principle of Doppler Shift to relate the wavelength of emitted light to stellar velocity. 6. Discuss the principles of stellar motion including proper motion and space velocity. C. Star Groupings (*Chapter 25 - 26)* 1. Define binary and double stars. 2. Compare binary with single star systems. 3. Discuss variable stars and what we can use them for. 4. Compare and contrast galactic clusters with globular clusters. D. Star Formation and Evolution (*Chapter 27 - 31)* 1. Describe how a star is formed. 2. Discuss energy production in stars. 3. Outline the life cycle of small, medium, and large stars from their birth to their death. 4. Summarize the formation and effects of supernovae. 5. Define and describe the behavior of pulsars and neutron stars. 6. Discuss the features and behaviors of black holes.	
Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence ▪ Reach for the Stars Project ▪ Creating a Star Project

Unit Frameworks

Unit of Study: major topics	**Galaxies and Cosmology**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **B. Know and apply concepts that describe how living things interact with each other and with their environment.** **12.B.5a** Analyze and explain biodiversity issues and the causes and effects of extinction. **12.B.5b** Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-	

	term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	IX. Galaxies A. The Milky Way Galaxy (*Chapter 32)* 1. Diagram the structure of the Milky Way Galaxy. 2. Describe the results of infrared, radio, and gamma ray observations of the Milky Way Galaxy. 3. Explain the spiral structure of the Milky Way Galaxy.

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<tr><td></td><td colspan="2">B. Types of Galaxies and Interstellar Medium (Chapters 33 – 34)
1. Describe interstellar space and the materials found there.
2. Summarize the characteristics of elliptical, spiral, and irregular galaxies.
3. Give evidence that black holes may lie at the center of galaxies.
4. Describe the kinds of galactic clusters and how they interact.
5. Define radio inteferometry.

X. Cosmology
A. The Universe (Chapters 35 - 36)
1. Use Hubble’s law to understand the expansion of the universe.
2. Speculate on whether the universe is speeding up or slowing down.
3. Define quasars.
B. Theories of Cosmology (Chapters 37 – 38)
1. Discuss the Big Bang Theory, Steady State, and Oscillating Universe Theories.
2. Define cosmology and survey the current research in cosmology.</td></tr>
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