

06 The Universe

Content Area: **Science**
Course(s): **CP Astronomy**
Time Period: **Marking Period 1**
Length: **3-4 weeks**
Status: **Published**

Course Pacing Guide

Since the dawn of man, humans have been on a quest to understand who we are. At its most basic level, this quest is inextricably linked to a desire to discover how the universe is put together, how it works, and what our place is in it. In this course, we will explore the science that guides the phenomena we observe in the natural world as we stand on our Planet Earth and gaze into the furthest expanses of the universe. As we journey through the cosmos, we will also explore the social, historical, and philosophical impacts of scientific exploration.

Unit	MP/Trimester	Weeks
A Cosmic Perspective	1	4
The Daytime and Nighttime Sky	1	4
The Space Program	1-2	2
The Solar System	2	3
The Stars	2	3
The Universe	2	2

Unit Overview

In this unit, we study the building blocks of the universe—galaxies—and the entire structure of the universe on the grandest scale. We look at the origin and evolution of the universe and study how we are able to gain this knowledge from present-day observations. We discuss Einstein's theories of special and general relativity and consider the strange phenomena that those theories allow.

Enduring Understandings

- On large scales, the universe is homogeneous and isotropic. We do not occupy a special place in the universe.

- Thought experiments help us to understand confusing phenomena and gain new insights.

Students will know:

- The Milky Way is one of hundreds of billions of galaxies in the universe. Because of the redshift we observe in the spectra of different galaxies, we know that galaxies recede "from us" with a velocity that is directly proportional to their distance from us.
- The universe is expanding at an accelerating rate because of the stretching of spacetime.
- The normal matter that we are familiar with only makes up 4.5% of the entire universe. The universe is dominated by dark matter and dark energy.
- Gravity is the weakest of the four fundamental forces but the one that dominates on the large scales of the universe.
- The speed of light is the ultimate speed limit in the universe.
- When a clock is moving relative to an observer, the observer sees the clock ticking more slowly than a clock in her own reference frame.
- Massive objects warp the fabric of spacetime.
- Special relativity allows for "time travel" to the future.

Students will be able to:

- Create a history of the universe on the scale of a human lifetime.
- Analyze galaxy data to create a Hubble diagram and calculate the Hubble constant.
- Create a classification scheme for galaxies to identify the morphological type of various galaxies.
- Resolve the twin paradox.
- Propose resolutions to the grandfather paradox and explain how it affects our concept of time travel to the past.
- Debate the validity of the self-consistent interpretation of time travel to the past versus the many-worlds interpretation.

Essential Questions

- Where do we come from?
- How do we learn about things that are so far away (in both time and space)?
- What does the universe look like on the grandest scales?
- How realistic is science fiction?
- How has the universe evolved?

New Jersey Student Learning Standards (No CCS)

9-12.HS-ESS1-2

Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

9-12.HS-ESS1-1.3.1

students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one

scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

9-12.HS-ESS1-4.5.1	Use mathematical or computational representations of phenomena to describe explanations.
9-12.HS-ESS1-2.5.1	Energy cannot be created or destroyed— only moved between one place and another place, between objects and/or fields, or between systems.
9-12.HS-ESS1-2.6.1	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
9-12.HS-ESS1-2.ESS1.A.2	The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
9-12.HS-ESS1-2.ESS1.A.3	Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

Amistad Integration

Holocaust/Genocide Education

Interdisciplinary Connections

MA.N-Q.A	Reason quantitatively and use units to solve problems.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LA.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.

Technology Standards

List specific standards that are relevant
No general statements

TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS3	Evaluate and select information sources and digital tools based on the appropriateness for specific tasks.

21st Century Themes/Careers

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP11	Use technology to enhance productivity.

Financial Literacy Integration

Instructional Strategies & Learning Activities

1. Galaxy Classification: Activity and Questions
2. Galaxies: Guided Notes and Discussion
3. Is the Universe Expanding—Part 1: Activity and Questions
4. Is the Universe Expanding—Part 2: Activity and Questions
5. Hubble Ultra Deep Field: Article and Questions
6. Big Bang: Guided Notes and Discussion
7. Episode "Black Holes" from *How the Universe Works*: Questions
8. Relativity: Guided Notes and Discussion
9. Study Guide
10. Jeopardy Review
11. Unit Test

Differentiated Instruction

Examples may include:

- Inquiry/Problem-Based Learning
- Variety of learning preferences (visual, auditory, kinesthetic)
- Meaningful Student Voice & Choice
- Self-Directed Learning
- Debate
- LMS use
- The Hot Seat/Role-Play
- Mastery Learning (feedback toward goal)
- Simulation-Based Learning
- Grouping

- Socratic Seminar
- Rubrics
- Concept Attainment
- Assessment Design & Backwards Planning

Formative Assessments

- Various Do-Now Activities
- Observation
- Question and answer
- Informal check-ins

Summative Assessment

Unit test

Benchmark Assessments

Alternate Assessments

Resources & Technology

- Astronomy Picture of the Day
- Materials for Galaxy Classification activity
- TV episode "Black Holes" from *How the Universe Works*
- Materials for Is The Universe Expanding?—Part 1

BOE Approved Texts

none

Closure

Such as:

- Gallery Walk - On chart paper, small groups of students write and draw what they learned. After the completed works are attached to the classroom walls, others students affix post-its to the posters to extend on the ideas, add questions.
- Low-Stakes Quizzes - Give a short quiz using technologies like Kahoot or a Google form.
- Have students write down three quiz questions (to ask at the beginning of the next class).
- Question Stems - Have students write questions about the lesson on cards, using [question stems framed around Bloom's Taxonomy](#). Have students exchange cards and answer the question they have acquired.
- Kids answer the following prompts: "What takeaways from the lesson will be important to know three years from now? Why?"
- Ask a question. Give students ten seconds to confer with peers before you call on a random student to answer. Repeat.
- Have kids orally describe a concept, procedure, or skill in terms so simple that a younger student would understand it.
- Kids write notes to peers describing what they learned from them during class discussions.

ELL

Such as:

- Alternate Responses
- Advance Notes
- Extended Time
- Teacher Modeling
- Simplified Written and Verbal Instructions
- Frequent Breaks
- E-Dictionaries
- Google Translate

Special Education

List is not inclusive but may include examples such as:

- Shorten assignments to focus on mastery of key concepts.
- Specify and list exactly what the student will need to learn to pass.
- Evaluate the classroom structure against the student's needs (flexible structure, firm limits, etc.).
- Keep the classroom quiet during intense learning times.
- Provide a computer for written work.

- Seat the student close to the teacher or a positive role model.
- Provide an unobstructed view of the chalkboard, teacher, movie screen, etc.
- Keep extra supplies of classroom materials (pencils, books) on hand.
- Give directions in small steps and in as few words as possible.
- Number and sequence the steps in a task.
- Have student repeat the directions for a task.
- Provide visual aids.
- Go over directions orally.
- Provide a vocabulary list with definitions.
- Permit extra time as indicated in IEP.
- Allow tests to be taken in a room with few distractions (e.g., the library).
- Have test materials read to the student, and allow oral responses.
- Divide tests into small sections of similar questions or problems.
- Show a model of the end product of directions (e.g., a completed math problem or finished quiz).
- Stand near the student when giving directions or presenting a lesson.

504

Examples of accommodations in 504 plans include but are not limited to:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

At Risk

Examples may include:

- Use of mnemonics
- Have student restate information
- Concrete examples
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
- No penalty for spelling errors or sloppy handwriting
- Teach time management skills
- Verbal and visual cues regarding directions and staying on task
- Adjusted assignment timelines

- Immediate feedback
- Work-in-progress check
- Pace long-term projects
- Preview test procedures
- Cue/model expected behavior

Gifted and Talented

Focus on effort and practice

Offer the Most Difficult First

Offer choice

Speak to Student Interests

Allow G/T students to work together

Encourage risk taking