

BEMIDJI AREA SCHOOLS

ASTRONOMY

Grades 9-12

I. HISTORY AND NATURE OF SCIENCE

A. Scientific World View

Standard: The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time.

The student will:

1. Be able to distinguish among hypothesis, theory and law as scientific terms and how they are used to answer a specific question.
Activities: *General discussion of hypothesis, theory and law and how they do not lie on a continuum.*
Application of terms in activities such as investigations of parallax, angular size, etc....
2. Be able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including but not limited to atomic theory.
Activities: *Discussion of the uses of the telescope and other tools used by astronomers and how this has changed the human's view of the cosmos.*
The History of NASA Project
Future Missions of NASA Project
3. Recognize that in order to be valid, scientific knowledge must meet certain criteria including that it: be consistent with experimental, observational and inferential evidence about nature; follow rules of logic and reporting both methods and procedures; and, be falsifiable and open to criticism.
4. Explain how traditions of ethics, peer review, conflict and general consensus influences the conduct of science.
Activities: *Discussion of how theories of the origin of the universe among others, has evolved over the millennium and how open discourse on these theories have led to new insights.*
5. Recognize that some scientific ideas are incomplete, and opportunity exists in these areas for new advances.
Activity: *Weekly examination of current findings in astronomy through the use of computers and the internet.*

B. Scientific Inquiry

Standard: The student will design and conduct a scientific investigation.

The student will:

1. Distinguish between qualitative and quantitative data.
Activities: *Spectral analysis with diffraction gradients*
Use of hand-made telescopes
Direct observations of the moon, stars, and sun
2. Apply mathematics and models to analyze data and support conclusions.
Activities: *Modeling the moon phases*
Modeling the seasons due to the tilt of the earth and its position relative to the sun
3. Identify possible sources of error and their effects on results.
Activity: *Experiments with spectral lines, angular size vs. distance, telescopes, solar viewers, etc....*
4. Give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.
Activity: *Various activities that deal with the properties of matter and light, borrowed from the realm of physics.*

C. Scientific enterprise

Standard: The student will understand the relationship between science and technology and how both are used.

The student will:

1. Compare and contrast the purposes and career opportunities of engineering, technology and science.
Activities: *Discussion of the use of traditional tools of astronomy through the new satellite based tools.*
Future Missions of NASA Project
2. Provide an example of a need or problem identified by science and solved by engineering or technology.
Activities: *Discussions on the use of the telescope and other tools used by astronomers.*
The History of NASA Project
Future Missions of NASA Project
3. Provide an example of how technology facilitates new discoveries and the development of scientific knowledge.
Activities: *Reports on the use of radio telescopes and discoveries made through their use.*
The History of NASA Project
Future Missions of NASA Project

4. Know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.
Activities: *Discussion of how the change of our place in the cosmos (i.e. away from an earth-centered universe) has changed the way we, as a society, have changed.*
The History of NASA Project
Future Missions of NASA Project
Contact video essay

5. Recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.
Activities: *Discussion of the history of astronomy.*
Contact Video Essay

D. Historic perspectives

Standard: The student will recognize the historical and cultural context of scientific endeavors and how they influence each other.

The student will:

1. Be able to trace the development of a scientific advancement, invention or theory and its impact on society.
Activities: *Discussion of the history of astronomy.*
History of astronomy time line

2. Provide examples of scientific advancements contributed by other civilizations and cultures.
Activities: *Discussion of the history of astronomy including how different cultures contributed to present day understandings.*
History of Astronomy time line

3. Compare and contrast the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.
Activities: *Discussion of the history of astronomy and the contributions made to the discipline of cosmology by other disciplines.*
Astronomy vs. Astrology project & activities

II. PHYSICAL SCIENCE

A. Structure of Matter

Standard: The student will understand the nature of matter including its forms, properties and interactions.

The student will:

1. Identify protons, neutrons and electrons as the major components of the atom, their mass relative to one another, their arrangement and their charge.
Activity: *Discussions and activities related to hydrogen fusion and stellar birth and evolution.*

2. Be able to explain the relationship of an element's position on the periodic table to its atomic number and atomic mass.

Activity: *Discussions and activities related to fusion and spectral signatures coming from stars.*

3. Explain how neutral atoms become ions.

Activity: *Discussions and activities related to how plasmas form in a star.*

4. Compare and contrast the states of matter in terms of interactions between particles.

Activity: *Discussions of how stellar fusion works.*

B. Chemical Reactions

Standard: The student will describe chemical reactions and the factors that influence them.

The student will:

1. Distinguish between a chemical reaction and a nuclear reaction.

Activities: *Discussions of how stellar fusion works.
Sun structure Website Investigation*

2. Explain how the rearrangement of atoms and molecules in a chemical reaction illustrates conservation of mass.

Activity: *Discussions of how stellar fusion works.*

C. Energy Transformations

Standard: The student will understand energy forms, transformations and transfers.

The student will:

1. Know that potential energy is stored energy and is associated with gravitational or electrical force, mechanical position or chemical composition.

Activity: *Discussions and activities dealing with the properties of matter and light.
For example: How a planet remains in orbit.*

2. Differentiate between kinetic and potential energy and identify situations where kinetic energy is converted into potential energy and vice versa.

Activity: *Discussions dealing with the law of gravity and how it relates to the motion of the planets.*

3. Be able to describe physical and chemical changes in terms of the law of conservation of energy.

Activity: *Discussion of stellar evolution and cycles.*

4. Compare and contrast the amount of energy released through chemical reactions and nuclear fission and fusion.

Activities: *Discussion of hydrogen fusion with other types of fusion in stars of different ages and compared to nuclear fission.
Sun Structure Website Investigation*

5. Describe applications of the different wavelengths of the electromagnetic spectrum.

Activity: *Discussion of EMR as it relates to radiation from star
Labs on defraction gradients and on the making and use of different
types of telescopes*

D. Motion

Standard: The student will understand the nature of force and motion.

The student will:

1. Use Newton's three laws of motion to qualitatively and quantitatively describe the interaction of objects.

Activity: *Discussion and labs on planetary motion and gravity.*

2. Describe the effect of friction and gravity on the motion of an object.

Activities: *Discussion of planetary motion (gravity).
Reports/presentations on planetary probes needing heat shields (friction)*

E. The Water Cycle, Weather and Climate

Standard: The student will explain the causes and effects of the Earth's atmospheric and hydrologic processes.

The student will:

1. Explain how the transfer of energy and motions of the Earth contribute to global climatic processes including wind, waves and ocean currents.

Activity: *Comparing weather on Earth with planets such as Jupiter and Mars.*

2. Demonstrate the effect of the Earth's tilt, rotation and revolution on the seasons, day length and tides.

Activity: *Discussion of and construction of models on the "reason for the seasons"*

3. Discuss the impact of the use of natural resources and other human activities on the Earth's climate.

Activity: *Comparison of Earth with Venus and discussion of the "runaway greenhouse affect".*

F. The Universe

Standard: The student will relate the formation and components of our solar system to the conditions necessary for life.

The student will:

1. Explain how the sun, Earth and solar system formed.
Activities: *Discussion of the Big Bang theory and various theories of solar system formation.*
Research on how examination of phenomenon in our galaxy fits with these theories.
Sun Structure Website Investigation

2. Compare the characteristics of Earth with the characteristics and movement patterns of the other planets, their satellites and other objects in our solar system.
Activities: *Lab on orbits of planets in our solar system.*
Planets Project

3. Compare and contrast the environmental parameters that make life possible on Earth with conditions found on the other planets of our solar system.
Activities: *Comparisons of Earth and Mars*
Planets Project

G. The Universe

Standard: The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.

1. Identify different types of stars and galaxies and describe how stars, galaxies and the universe change over time.
Activities: *Discussions of the Big Bang theory*
Discussions of, and labs on, the red-shift of light from stars
Stars PowerPoint Project

2. Explain how nuclear fusion produces energy and other elements.
Activities: *Discussions of the fusion reactions that power stars, particularly our sun.*
Sun Structure Website Investigation

3. Describe the evidence from current technologies that has been used to understand the composition and the early history of the universe.
Activities: *Discussions on, videos of, and research of various types of radio telescopes, neutrino detection, and space craft used to collect data on various types of radiation.*
The History of NASA Project
Future Missions of NASA Project

4. Explain how Doppler evidence indicates our universe is expanding in all directions.
Activities: *Discussion and demonstrations of red and blue shift*
Stars Project