Fair Lawn

Public Schools

Fair Lawn, NJ

Astronomy

August

2015

Updated August 2015
Developed July 2011

Astronomy is a high school science class developed by the Fair Lawn Schools high school science faculty and aligned to the 2009 NJCCCS and correlated to the Common Core State Standards for Literacy & Math.

Science Department

Fair Lawn School District

Committee Credits

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2004

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UPDATED TO REFLECT 2009 NJCCCS
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August 2015
Updated to Reflect New Curriculum Requirements

Astronomy

I. Course Synopsis

STUDENT OUTCOMES AND OBJECTIVES

ASTRONOMY 450

At the completion of this course, participating students will be able to demonstrate:

1. A working knowledge of the basic vocabulary of Astronomy
2. An understanding of the motions of the earth and other planets
3. An understanding of the Universal Laws of Gravitations and its effects on objects in space and their satellites
4. A knowledge of the workings and structure of simple telescope
5. A knowledge of the basic principles of the nature and behavior of light
6. A basic knowledge of the modern theories concerning the development of stars
7. An understanding of the theories concerning the development of stars
8. A knowledge of the theories associated with the origin of the solar system
9. An understanding of the relationship between time and distance
10. A basic understanding of how the variability of light from a star is used to measure and analyze information about that star
11. An understanding of the Milky Way as a separate and distance galaxy in a universe of many galaxies
12. A knowledge of the modern concepts of atomic structure and how it relates to astronomical observations
13. A familiarity with the theories associated with eventual death of stars and the states of matter following a star's collapse
14. A general understanding of the structure of the universe in accordance with present day observations
15. A knowledge of the major theories that deal with the origin and evolution of the universe

This course will be taught in a manner which promotes inquiry-based investigations to study the dynamic nature of space and the bodies in space. NJCCCS 5.1.12 A-D will be incorporated throughout the course.

II. Philosophy & Rationale

To be competitive in a technological society, it is desirable for students to be well-grounded in all aspects of science, regardless of what their future career goals may be. The study of astronomy can enable a student to understand the natural laws that govern the universe. It also helps to improve deductive and inductive reasoning and develop problem-solving skills through the scientific method.

III. Scope & Sequence

Standard 5.1 will be addressed throughout this course. In addition, students will be expected to utilize and analyze data using the school's planetarium.

ASTRONOMY 450

A. Classical Anatomy **(September – October)**
   1. Observations of the sky
      a. Movements of stars: sun and moon: planets
         1) east to west movements
         2) west to east movements (right ascension)
         3) retrograde movement
      b. Originate (reinvent) time and calendar based upon celestial observations.
      c. Understand our standard time and calendars: uses. definitions errors, corrections
         1) diurnal cycles
         2) lunar cycles
         3) solar cycles
         4) seasonal changes
         5) ecliptic
         6) meridian
         7) altitude-azimuth
         8) celestial coordinates

   2. Constellations
      a. Invent original constellations based upon modern civilization (people, wars, technologies, etc)
      b. constellations of various cultures (Native American, Norse, Asian, ect)

      c. Constellations of Greco-Roman culture (our present standards)
         1) stories behind the picture modern star maps
         2) star naming and catalogue designation
         3) true scale 3-D view of constellation

B. Modern Concepts of the Universe **(Nov)** **5.4.12.A.1, 5.2.12.E.3**
   1. Size and shape of the earth
   2. Earth-moon as a binary planet
      a. true to scale model of the earth-moon system
      b. lunar phases
      c. eclipses: lunar and solar
      d. effect on orbital motion
         1) location
         2) calculations of the orbital paths
   3. Earth as a satellite of the sun
      a. true to scale model of the Earth-Sun system
      b. Galileo's evidence from Venus and Jupiter
         (optional night lab possible)
   4. Other satellites system and the nature of orbits
      a. Venus's phase
         1) mythical explanations
         2) Ptolemaic explanation
         3) modern explanations
            a) inferior orbit in a heliocentric system
            b) inferior conjunction-elongation
            c) retrograde motion
      b. Retrograde orbit motion on Mars
         1) mythical explanations
         2) Ptolemaic explanation
         3)modern explanation
            a) superior planet orbit in a heliocentric system
            b) superior conjunction, opposition, quadrature
      c. Sun's Analemma
         1) solar times vs. sidereal time
         2) right ascension along the ecliptic

C. A cause for the effect, or "Why does it look that way" **Dec.**
   Why do all the motions discussed in the units A&B
   Work the way that they do?
   1. Students suggested explanations and debate.
   2. Models of the universe and the cause of motion.
      a. Primitive Concepts
      b. Classical
      c. Ptolemy
      d. Copernicus/Galileo/Tycho/Bruno
      e. Kepler: Laws of Planetary Motion
      f. Newton: Laws of Motion and Gravitation
         A reason for tides/precessions/Kepler

D. The Nature of Light ' **January – February** **5.2.12.C.1**

1. Properties of light
   a. wave or particles
   b. visible light and colors
   c. absorption and diffusion: the behavior of filters
   d. reflections: the laws of mirrors
   e. refraction: lenses
   f. invisible light: the total electromagnetic spectrum
2. The effect of light
   a. Illumination (energy transport via Radiation
   b. the universe square law
   c. apparent and absolute magnitudes
3. The uses of light properties
   a. spectral analysis
   b. optical devices: the telescope
      1) magnification, resolution, focal lengths
      2) various telescope designs
4. Light as a standard of distance measurements
   a. Parallax
   b. magnitude system
   c. astronomical unit; light year; parsec

E. What does it mean to be earth, the planet? **March-Apr** **5.4.12.A.2-6**

1. Theories of cosmogony of our star and its system

2. The sun as a star
3. A true scale concept of the sun's-earth relationship
4. A true scale concept of the Sun's planetary system
   a. Can you predict any of the characteristics of the planets after studying the true scale model?
   b. What are the best known characteristics of the objects in the sun's system?
      1) terrestrial planets: Mercury, Venus, Earth, Mars
      2) gas giants: Jupiter, Saturn, Uranus, Neptune
      3) minor planets, Pluto
      4) comets, meteoroids
      5) solar wind
      6) "Planet X"; Nemesis

   c. Gravitational influences between planets
      1) perturbational of orbits

2) predictions, explanations and mysteries

F. A galactic view of the universe **May - June**

1. The Milky Way
   a. star clusters
      1) open clusters and globular clusters
      2) uses for mapping the Milky Way
   b. mapping the Milky way
      1) locating the skeleton with special features
      2) finding our location within the galaxy
   c. true to scale model of our galaxy and the distance between galaxies
2. Types of galaxies
   a. elliptical, spiral, irregular
   b. special types
3. Our universe as a group of galaxies
   a. galactic clusters
   b. superclusters

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Students with special needs and ELL learners may be provided with key vocabulary terms prior to the unit beginning. In particular, the amount of key vocabulary terms should be reduced for ELL students.
2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

Cross-Content Connections:

CCCS Literacy: Click on the link to the High School Evidence Statements to see expectations related to literacy for this unit. In addition, a focus of the course will be on the development of the LAL standards for science & technical subjects.

CCCS Math: Students will be expected to perform measurement, modeling, apply algebra, and geometry and statistics. There is a great deal of mathematical applications in the study of astronomy.

Assessments

Classroom assessments are included to primarily guide instruction (formative assessment) and to support decisions made beyond the classroom (summative assessment).

Interdisciplinary Connections and Alignment to Technology standards

Science classes in the Fair Lawn Public schools promote career-readiness skills related to Personal Financial Literacy (9.1) and Career Awareness, Exploration, and Presentation (9.2). Some course concepts from the Career and Technical Education Standards (9.3), but these are not directly correlated since our district is not a CTE program.

The Fair Lawn Public Schools District fosters an environment that promotes career-readiness skills in all content areas. Whereas Career Ready Practices are explored consistently, specific alignment to Personal Finance Literacy (9.1) and Career Awareness, Exploration, and Presentation Standards (9.2) are included in the district level document (below). When appropriate, the Career and Technical Education Standards (9.3) have been reviewed and aligned as well.

Examples: 9.2B: Career exploration in each unit of study.

In addition, every effort is made to integrate technology and engineering into our science classes. Educational Technology (8.1) and Technology Education, Engineering, Design, and Computational Thinking – Programming (8.2) standards are cross connected throughout our science programs.

Examples:
- 8.1A: Use spreadsheets to analyze & interpret data from laboratories, 6-12.
  Use the internet to increase productivity and efficiency, 9-12.
- 8.1B,C: Use data to solve real-world problems, 6-12.
  Use online platforms to collaborate & address global issues, 9-12.
- 8.1F: Collect and analyze data using internet and data simulations, 6-12.
- 8.2A: Become aware of the invention process, 3-5.
- 8.2B: Become aware of the global impacts on technology, 6-12.
- 8.2C: Apply the design process to pushes & pulls, K-2.
- 8.2D: Use tools to reduce work, K-2.

For additional detail on how these standards are integrated throughout the Fair Lawn Schools curriculum, review the Fair Lawn Public Schools District Alignment to Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix.