The Mission of the Chardon Local Schools is High Achievement for All Students, Where Learning is Our Most Important Work.

Science Course of Study:

ASTRONOMY

Revised January 2022

CHARDON LOCAL SCHOOLS

#WeAreChardon

Astronomy

Committee Members: Dan Robertson

Strand: Understanding the Starry Night

Learning Standards:	**How Taught?**
5.ESS.1 The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. ● The distance from the sun, size, composition and movement of each planet are unique. ● Planets revolve around the sun in elliptical orbits. ● Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun. ● students create models of the solar system. 5.ESS.2 The sun is one of many stars that exist in the universe. ● The sun appears to be the largest star in the sky because it is the closest star to Earth. 5.ESS.3 Most of the cycles and patterns of motion between the Earth and sun are predictable. ● Earth's revolution around the sun takes approximately 365 days. ● Earth completes one rotation on its axis in a 24-hour period, producing day and night. ● The Earth's rotation makes the sun, stars and moon appear to change position in the sky. ● The night sky changes depending on location on the Earth ● The night sky changes depending on the time of the year. ● Explain why the stars appear to move along arcs in the sky during the night. ● Explain why some different constellations appear in the sky each season **ODE Nature of Science:** Scientific knowledge is open to revision in light of new evidence. Science is not static. Science depends on curiosity, imagination, creativity and persistence. ● Locate sky objects by their right ascension and declination on the celestial ● Identify some bright stars and constellations visible each season. ● Define the zodiac ● Explain why the polestar and the location of the	**Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure, development, and consequent meanings ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions ● Cooperative learning groups ● Students to define, use, and connect to content area and based vocabulary ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction

vernal equinox change over a period of thousands of years.	
Materials: ● Astronomy textbook ● Lab equipment ● Worksheets ● Star Project ● Gradecam/Google Forms ● Art supplies ● Calculators	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports) ● Summative Assessments (formal essays, using rubrics; tests/exams, project, evaluation, demonstration, lab practicals)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● games and hands-on activities ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Strand: Light and Telescopes

Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move.

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Learning Standards:

HS-PS4-1.Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

- **Students create models of the electromagnetic spectrum relating everyday events**
- **State the relationship between the color of a star and its temperature.**

HS-PS4-3.Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

5.PS.2 Light and sound are forms of energy that behave in predictable ways.

- Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed.
- Describe the wave nature of light, including how it is produced and how it travels.

P.W.1: Wave properties • Conservation of energy • Reflection • Refraction

P.W.2: Light phenomena • Ray diagrams (propagation of light) • Law of reflection (equal angles) Wave—particle duality of light • Visible spectrum of color

- Explain how refracting and reflecting telescopes work
- Determine the magnification using various eye pieces.

ODE Nature of Science:

Scientific knowledge is open to revision in light of new evidence. Science is not static. Science depends on curiosity, imagination, creativity and persistence.

- Explain how radio telescopes work

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How Taught?
Teaching activities may include, but are not limited to:

- Students closely read select passages from documents to analyze text structure, development, and consequent meanings
- Teacher provides direct instruction, give feedback, and model critical thinking
- Small group and class discussions
- Cooperative learning groups
- Students to define, use, and connect to content area and based vocabulary
- Students analyze video content related to standards that provide a broader global perspective of content.
- Design and conduct lab-based investigations that connect content to real-life experiences.
- Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards.
- Using technology and mathematics to improve investigations and communications.
- Utilize data to impact instruction

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Materials:

- Astronomy textbook

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How Assessed?
Assessments may include, but are not limited to:

- Pre-Assessments (pre-tests, observation, questioning, diagnostics)

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Lab equipment
Worksheets
Star Project
Gradecam/Google Forms
Art supplies
Calculators

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Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports)

● Summative Assessments (formal essays, using rubrics; tests/exams, project, evaluation, demonstration, lab practicals)
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How Re-Taught?
Re-teaching activities may include, but are not limited to:

descriptive feedback on original task/assessment
student examples of expectations
modeling
student self assessments
manipulatives
presenting the information again in a different way
review sessions
graphic organizers
small-group instruction
practice activities
computer tutorials / programs
peer tutoring
breaking down concept into smaller components
games and hands-on activities
cooperative learning
Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

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Strand: Exploring the Solar System

Learning Standard:	**How Taught?**
5.PS.1 The amount of change in movement of an object is based on the mass of the object and the amount of force exerted. ● Revolution and rotation of planets caused by conservation of angular momentum 5.ESS.1 The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. ● Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t). ● Any change in speed or direction of an object requires a force and is affected by the 5.ESS.3 Most of the cycles and patterns of motion between the Earth and sun are predictable. **HS-PS2-1.Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.** ● **Gravitational forces determine the paths of celestial objects.** **HS-PS2-4.Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.** ● **The mass and distance between objects affects the gravitational attraction** **7.ESS.4: The relative patterns of motion and positions of Earth, moon and sun cause solar and lunar eclipses, tides and phases of the moon.** ● **The moon's orbit and its change of position relative to Earth and sun result in different parts of the moon being visible from Earth (phases of the moon).** ● **A solar eclipse is when Earth moves into the shadow of the moon (during a new moon). A lunar eclipse is when the moon moves into the shadow of Earth (during a full moon).** ● **Gravitational force between Earth and the moon causes daily oceanic tides. When the gravitational forces from the sun and moon align (at new and full moons) spring tides occur.** ● **When the gravitational forces of the sun and**	**Teaching activities may include, but are not limited to:** • Students closely read select passages from documents to analyze text structure, development, and consequent meanings • Teacher provides direct instruction, give feedback, and model critical thinking • Small group and class discussions • Cooperative learning groups • Students to define, use, and connect to content area and based vocabulary • Students analyze video content related to standards that provide a broader global perspective of content. • Design and conduct lab-based investigations that connect content to real-life experiences. • Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. • Using technology and mathematics to improve investigations and communications. • Utilize data to impact instruction

moon are perpendicular (at first and last quarter moons), neap tides occur.

7.ESS.5: The relative positions of Earth and the sun cause patterns we call seasons.

- Earth's axis is tilted at an angle of 23.5°. This tilt along with Earth's revolution around the sun, affects the amount of direct sunlight that the earth receives in a single day and throughout the year.

P.F.2: Gravitational force and fields Gravitational interactions are very weak compared to other interactions and are difficult to observe unless one of the objects is extremely massive (e.g., the sun, planets, moons).

- The force law for gravitational interaction states that the strength of the gravitational force is proportional to the product of the two masses and inversely proportional to the square of the distance between the centers of the masses, Fg = (G·m1 ·m2)/r2 .
- The proportionality constant, G, is called the universal gravitational constant and has a value of 6.674·10-11 m3 /(kg·s2). Problem solving may involve calculating the net for

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How Assessed?

- Pre-Assessments (pre-tests, observation, questioning, diagnostics)
- Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports)
- Summative Assessments (formal essays, using rubrics; tests/exams, project, evaluation, demonstration, lab practicals)

How Re-Taught?

Re-teaching activities may include, but are not limited to:

- descriptive feedback on original task/assessment
- student examples of expectations
- modeling
- student self assessments
- manipulatives
- presenting the information again in a different way
- review sessions
- graphic organizers

	● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● games and hands-on activities ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Strand: Stars

Learning Standard:	**How Taught?**
HS-PS1-8. **Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.** ● Nuclear Fusion is the source of energy produced by stars. 5.ESS.2 The sun is one of many stars that exist in the universe. ● Some stars are larger than the sun and some stars are smaller than the sun. C.PM.1: Atomic structure ● Atoms are usually in the ground state where the electrons occupy orbitals with the lowest available energy. However, the atom can become excited when the electrons absorb a photon with the precise amount of energy (indicated by the frequency of the photon) to move to an orbital with higher energy **ODE Nature of Science:** Scientific knowledge is open to revision in light of new evidence. Science is not static. Science depends on curiosity, imagination, creativity and persistence. ● Describe the types of spectra: emission, absorption, and continuous spectra. ● Explain how a star's chemical composition, surface temperature, and radial velocity are determined from its spectrum. ● Explain the difference between apparent brightness and luminosity. ● Describe the H-R diagram and explain the relationship of a star's mass to its luminosity and temperature. ● Compare red giants and white dwarfs with our Sun in terms of mass, diameter, and density. ● Determine the distance to stars using the parallax method	**Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure, development, and consequent meanings ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions ● Cooperative learning groups ● Students to define, use, and connect to content area and based vocabulary ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
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Strand: Stellar Evolution

Learning Standard:	**How Taught?**
PS.U.1: History of the universe ● The big bang model is a broadly accepted theory for the origin and evolution of our universe. ● Gravity pulled the atoms together into gas clouds that eventually became stars, which comprise young galaxies. Foundations for the big bang model can be included to introduce the supporting evidence for the expansion of the known universe (e.g., Hubble's law and red shift or cosmic microwave background radiation). ● A discussion of Hubble's law and red shift is found in the Galaxies. PS.U.2: Galaxies ● A galaxy is a group of billions of individual stars, star systems, star clusters, dust and gas bound together by gravity. ● The Milky Way is a spiral galaxy. It has more than 100 billion stars and a diameter of more than 100,000 light years. ● The solar system is part of the Milky Way galaxy. Hubble's law states that galaxies that are farther away have a greater red shift, so the speed at which a galaxy is moving away is proportional to its distance from Earth. ● Red shift is a phenomenon due to Doppler shifting, so the shift of light from a galaxy to the red end of the spectrum indic PS.U.3: Stars • Formation: stages of evolution • ● Fusion in stars heated to a sufficiently high temperature by gravitational attraction, stars begin nuclear reactions, which convert matter to energy and fuse the lighter elements into heavier ones. ● All elements, except for hydrogen and some helium and lithium, originated from nuclear fusion reactions of stars. ● Stars are classified by their color, size, luminosity and mass. A Hertzprung-Russell diagram can be used to estimate the sizes of stars and predict how stars will evolve. ● List the main steps in the birth of a star ● Explain the importance of the H-R diagram to theories of stellar evolution ● Compare and contrast what happens in the advanced stages of evolution for stars of large and small mass	● Students closely read select passages from documents to analyze text structure, development, and consequent meanings ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions ● Cooperative learning groups ● Students to define, use, and connect to content area and based vocabulary ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
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