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<tr>
<th>2021 Knowledge and Skill Statement/Student Expectation</th>
<th>2021 Text</th>
<th>2017 Knowledge and Skill Statement/Student Expectation</th>
<th>2017 Text</th>
<th>Notes from TEA Staff</th>
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<tbody>
<tr>
<td>SCIENCE.ASTRO.1</td>
<td>Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations. The student is expected to:</td>
<td>ASTRO.1</td>
<td>scientific process. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally-appropriate, and ethical practices. The student is expected to:</td>
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<td>The use and conservation of resources are covered in elementary and middle school science.</td>
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<tr>
<td>SCIENCE.ASTRO.1.A</td>
<td>Ask questions and identify problems based on observations or information from text, phenomenon, module, or investigations;</td>
<td>ASTRO.2</td>
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<td>SCIENCE.ASTRO.1.B</td>
<td>Apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;</td>
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<td>SCIENCE.ASTRO.1.C</td>
<td>Use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency approved safety standards;</td>
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<td>SCIENCE.ASTRO.1.D</td>
<td>Use appropriate tools such as protractors, sundials, Planisphere; use charts, globe of the Earth, diffraction gratings, spectrophotometers, color filters, lenses of multiple focal lengths; concave, plane, and convex mirrors; binoculars; telescopes; potential sources; online astronomical databases; and online access to observatories;</td>
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<td>SCIENCE.ASTRO.1.E</td>
<td>Collect quantitative data using the International System of Units (SI) and qualitative data as available;</td>
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<td>SCIENCE.ASTRO.1.F</td>
<td>Organize quantitative and qualitative data using probes, spreadsheets, lab notebooks or journals, models, diagrams, graphs, paper, computers, or cellphone applications;</td>
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<td>SCIENCE.ASTRO.1.G</td>
<td>Develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and</td>
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<td>SCIENCE.ASTRO.1.H</td>
<td>Distinguish between scientific hypotheses, theories, and laws;</td>
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### SCIENCE.ASTRO.2

*Scientific and engineering practices.* The student analyzes and interprets data to derive meaning, identify features and patterns, and analyze relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>SCIENCE.ASTRO.2.A</td>
<td>Identify advantages and limitations of models such as their size, scale, properties, and materials.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.2.B</td>
<td>Analyze data by identifying significant statistical features, patterns, sources of error, and limitations.</td>
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<tr>
<td>SCIENCE.ASTRO.2.C</td>
<td>Use mathematical calculations to assess quantitative relationships in data, and evaluate and design.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.2.D</td>
<td>Evaluate experimental and engineering designs.</td>
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### ASTRO.2.G

Organizes, analyzes, evaluates, makes inferences, and predicts trends from data, including making new student hypotheses when appropriate.

### SCIENCE.ASTRO.3

*Scientific and engineering practices.* The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

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<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>SCIENCE.ASTRO.3.A</td>
<td>Develop explanations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.3.B</td>
<td>Communicate explanations and solutions individually and collaboratively in a variety of settings and formats, and evaluate and design.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.3.D</td>
<td>Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials.</td>
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### ASTRO.3.A

Scientific reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

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<tbody>
<tr>
<td>SCIENCE.ASTRO.3.A</td>
<td>Engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.</td>
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</table>

### ASTRO.3.C

Draw inferences based on data related to promotional materials for products and services. The student is expected to:

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<tbody>
<tr>
<td>SCIENCE.ASTRO.3.C</td>
<td>Draw inferences based on data related to promotional materials for products and services.</td>
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</tbody>
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### ASTRO.3.H

Communicate valid conclusions in writing, oral presentations, and through collaborative projects and products; and evaluate scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student; and evaluate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content and context, and evaluate the impact of research on scientific thought, society, and the environment, and describe the connection between astronomy and future careers. The student is expected to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE.ASTRO.3.H</td>
<td>Communicate valid conclusions in writing, oral presentations, and through collaborative projects and products.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.3.D</td>
<td>Analyze the impact of research on scientific thought, society, and the environment, and describe the connection between astronomy and future careers.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.3.E</td>
<td>Describe the connection between astronomy and future careers.</td>
</tr>
</tbody>
</table>

### ASTRO.4.D

Explain the contributions of modern astronomy to today's society, including the identification of potential asteroid/comet impact hazards and the Sun's effects on communication, navigation, and high-tech devices. The student is expected to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE.ASTRO.4.D</td>
<td>Explain the contributions of modern astronomy to today's society, including the identification of potential asteroid/comet impact hazards and the Sun's effects on communication, navigation, and high-tech devices.</td>
</tr>
</tbody>
</table>

### SCIENCE.ASTRO.5

Science concepts. The student understands how astronomy influenced and advanced civilizations. The student is expected to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE.ASTRO.5</td>
<td>Understand how astronomy influenced and advanced civilizations.</td>
</tr>
</tbody>
</table>

### ASTRO.4

Science concepts. The student recognizes the importance and uses of astronomy in civilization. The student is expected to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE.ASTRO.4</td>
<td>Recognizes the importance and uses of astronomy in civilization.</td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.5.A</td>
<td>evaluate and communicate how ancient civilizations developed models of the universe using astronomical structures, instruments, and tools such as the astrolabe, gnomons, and charts and maps; and how those models influenced practical, ceremonial, and navigational activities.</td>
</tr>
<tr>
<td>ASTRO.4.A</td>
<td>research and describe the use of astronomy in ancient civilizations such as the Egyptians, Mayans, Greeks, and the native Americans;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.5.B</td>
<td>research and evaluate the contributions of scientists, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, and Newton, as astronomy progressed from a geocentric model to a heliocentric model; and</td>
</tr>
<tr>
<td>ASTRO.4.B</td>
<td>research and describe the contributions of scientists such as Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, Newton, Einstein, and Hubble, and the contributions of women astronomers including Maria Mitchell and Henrietta Swan Leavitt;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.5.C</td>
<td>describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation.</td>
</tr>
<tr>
<td>ASTRO.4C</td>
<td>describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.6</td>
<td>Science concepts. The student conducts and explains astronomical observations made from the point of reference of Earth. The student is expected to:</td>
</tr>
<tr>
<td>ASTRO.5</td>
<td>observe, record, and analyze the apparent motion of the Sun, Moon, and stars and predict sunrise and sunset.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.6.A</td>
<td>observe record, and analyze the apparent motion of the Sun, Moon, and stars and predict sunrise and sunset.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.6.B</td>
<td>observe the movement of planets throughout the year and measure how their positions change relative to the constellations.</td>
</tr>
<tr>
<td>ASTRO.5.B</td>
<td>observe and record the apparent movement of the Sun and Moon during the day.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.6.C</td>
<td>identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations along the ecliptic and describe their importance and role in ancient societies.</td>
</tr>
<tr>
<td>ASTRO.5.C</td>
<td>recognize and identify constellations such as Ursa Major, Ursa Minor, Orion, Cassiopeia, and constellations along the ecliptic.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.6.D</td>
<td>understand the difference between astronomy and astrology, the reasons for their historical conflict, and their eventual separation.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.7</td>
<td>Science concepts. The student knows our relative place in the solar system. The student is expected to:</td>
</tr>
<tr>
<td>ASTRO.6</td>
<td>Science concepts. The student knows our place in space. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.7.A</td>
<td>demonstrate the use of units of measurement in astronomy, including astronomical units and light years, minutes, and seconds.</td>
</tr>
<tr>
<td>ASTRO.6.E</td>
<td>demonstrate the use of units of measurement in astronomy, including Astronomical Units and light years.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.7.B</td>
<td>model the scale, size, and distances of the Sun, Earth, and Moon system and identify the limitations of physical models.</td>
</tr>
<tr>
<td>ASTRO.6G.</td>
<td>model the scale, size, and distances of the Sun, Earth, and Moon system and identify the limitations of physical models.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.7.C</td>
<td>model the scale, size, and distances of the Sun and the planets in our solar system and identify the limitations of physical models.</td>
</tr>
<tr>
<td>ASTRO.6C.</td>
<td>model the scale, size, and distances of the Sun, Earth, and Moon system and identify the limitations of physical models.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.8</td>
<td>Science concepts. The student observes and models the interactions within the Sun, Earth, and Moon system. The student is expected to:</td>
</tr>
<tr>
<td>ASTRO.7</td>
<td>Science concepts. The student knows the role of the Moon in the Sun, Earth, and Moon system. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.8.A</td>
<td>observe the phases of the Moon during the course of a month; and identify the causes of lunar phases and solar eclipses.</td>
</tr>
<tr>
<td>ASTRO.7.A</td>
<td>observe and record data about lunar phases and use that information to model the Sun, Earth, and Moon system.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.8.B</td>
<td>model the scale, size, and distances of the Sun, Earth, and Moon system and identify the causes of lunar phases and solar eclipses.</td>
</tr>
<tr>
<td>ASTRO.7.C</td>
<td>identify and differentiate the causes of lunar and solar eclipses, including differentiating between lunar phases and eclipses.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.8.C</td>
<td>examine and investigate the dynamics of tides ( \text{using the Sun, Earth, and Moon models} )</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.9</td>
<td>Science concepts. The student models the cause of planetary seasons. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.9.A</td>
<td>examine the relationship of a planet's axial tilt to its potential seasons;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.9.B</td>
<td>predict how changing latitudinal position affects the length of day and night throughout a planet's orbit (year);</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.9.C</td>
<td>investigate the relationship between a planet's axial tilt, angle of incidence of sunlight, and concentration of solar energy; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.9.D</td>
<td>explain the significance of Earth's solstices and equinoxes.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.10</td>
<td>Science concepts. The student knows how astronomical tools collect and record information about celestial objects. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.10.B</td>
<td>calculate the relative light-gathering power of different sized telescopes to compare telescopes for different applications.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.10.D</td>
<td>analyze the importance and limitations of space telescopes in the collection of astronomical data across the electromagnetic spectrum.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.11</td>
<td>Science concepts. The student uses models to explain the formation, development, organization, and significance of solar system bodies. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.11.A</td>
<td>relate Newton's law of universal gravitation and Kepler's laws of planetary motion to the formation and motion of the planets and their satellites;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.11.B</td>
<td>explore and communicate the origins and significance of planets, planetary rings, satellites, asteroids, comets, pluto cloud, and Kuiper belt objects;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.11.C</td>
<td>compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, magnetic fields, and geological activity; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.11.D</td>
<td>compare the factors essential to life on Earth such as temperature, water, gases, and gravitational and magnetic fields to conditions on other planets and their satellites.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.12</td>
<td>Science concepts. The student knows that one Sun goes by a model for stellar activity. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.12.A</td>
<td>Identify the approximate mass, size, motion, temperature, structure, and composition of the Sun;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.12.B</td>
<td>distinguish between nuclear fusion and nuclear fission and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.12.C</td>
<td>describe the eleven-year solar cycle and the significance of sunspots; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.12.D</td>
<td>analyze the origins and effects of space weather, including ( \text{the solar wind} ), coronal mass ejections, prominences, flares, and sunspots.</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13</td>
<td>Science concepts. The student <strong>understands</strong> the characteristics and life cycle of stars. The student is expected to:</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.A</td>
<td>Identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.B</td>
<td><strong>Describe and communicate</strong> star formation from relative to protostars to the development of main sequence stars;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.C</td>
<td>Evaluate the relationship between mass and fusion on stellar evolution;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.D</td>
<td>Compare how the mass of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.E</td>
<td><strong>Describe</strong> the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.F</td>
<td>Use the Hertzsprung-Russell diagram to <strong>distinguish</strong> stars and plot and examine the life cycle of stars from birth to death;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.G</td>
<td><strong>Illustrate</strong> how astronomers use spectroscopy to determine stellar distances and intrinsic luminosities;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.13.H</td>
<td><strong>Describe</strong> how stellar distances are determined by comparing apparent brightness and intrinsic luminosity when using spectroscopic parallax and the Luyten relation for variable stars;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.A</td>
<td>Science concepts. The student knows the structure of the universe and our relative place in it. The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.B</td>
<td><strong>Illustrate</strong> the structure and components of our Milky Way galaxy and <strong>model</strong> the size, location, and movement of our solar system within it;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.C</td>
<td>Compare spiral, elliptical, irregular, dwarf, and active galaxies;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.D</td>
<td><strong>Describe</strong> the local Group and its relation to larger-scale structures in the universe; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.E</td>
<td>The student is expected to:</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.15.A</td>
<td><strong>Describe and evaluate</strong> the historical development of evidence supporting the Big Bang Theory;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.15.B</td>
<td><strong>Describe</strong> the limits of observational astronomy methods used to formulate the distance ladder;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.15.C</td>
<td>Evaluate the indirect evidence for the existence of dark energy;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.15.D</td>
<td><strong>Describe</strong> the current scientific understanding of the evolution of the universe, including estimates for the age of the universe; and</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.15.E</td>
<td><strong>Describe current scientific hypotheses about</strong> the fate of the universe, including open and closed universes, and the role of dark matter and dark energy;</td>
</tr>
<tr>
<td>ASTRO.11</td>
<td>Science concepts. The student <strong>knows</strong> the characteristics and life cycle of stars. The student is expected to:</td>
</tr>
<tr>
<td>ASTRO.11.A</td>
<td>Identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition;</td>
</tr>
<tr>
<td>ASTRO.11.B</td>
<td><strong>Characterize</strong> star formation including nurseries from giant molecular clouds, to protostars, to the development of main sequence stars;</td>
</tr>
<tr>
<td>ASTRO.11.C</td>
<td>Evaluate the relationship between mass and fusion on stellar evolution;</td>
</tr>
<tr>
<td>ASTRO.11.D</td>
<td><strong>Differentiate among</strong> the end states of stars: including white dwarfs, neutron stars, and black holes;</td>
</tr>
<tr>
<td>ASTRO.11.E</td>
<td><strong>Describe</strong> how the mass of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole;</td>
</tr>
<tr>
<td>ASTRO.11.F</td>
<td><strong>Describe</strong> the use of spectroscopy in obtaining physical data on celestial objects such as temperature, chemical composition, and relative motion; and</td>
</tr>
<tr>
<td>ASTRO.11.G</td>
<td>Use the Hertzsprung-Russell diagram to <strong>plot</strong> and examine the life cycle of stars from birth to death.</td>
</tr>
<tr>
<td>ASTRO.12.C</td>
<td>Compare and contrast the different types of galaxies, including spiral, elliptical, irregular, and dwarf.</td>
</tr>
<tr>
<td>ASTRO.12.D</td>
<td><strong>Describe characteristics of galaxies</strong>;</td>
</tr>
<tr>
<td>ASTRO.13</td>
<td>Science concepts. The student knows the scientific theories of cosmology. The student is expected to:</td>
</tr>
<tr>
<td>ASTRO.13.A</td>
<td><strong>Describe</strong> and <strong>evaluate</strong> the historical development of evidence supporting the Big Bang Theory, including current scientifc hypotheses about the age of the universe, and other supporting evidence;</td>
</tr>
<tr>
<td>ASTRO.13.B</td>
<td><strong>Describe</strong> the limits of observational astronomy methods used to formulate the distance ladder;</td>
</tr>
<tr>
<td>ASTRO.13.C</td>
<td>Evaluate the indirect evidence for the existence of dark energy;</td>
</tr>
<tr>
<td>ASTRO.13.D</td>
<td><strong>Describe</strong> the current understanding of the evolution of the universe, including estimates for the age of the universe; and</td>
</tr>
<tr>
<td>ASTRO.13.E</td>
<td><strong>Describe</strong> current scientific hypotheses about the fate of the universe, including open and closed universes, and the role of dark matter and dark energy;</td>
</tr>
<tr>
<td>SCIENCE.ASTRO.14.B</td>
<td>The student is expected to:</td>
</tr>
</tbody>
</table>
| SCIENCE.ASTRO.15.C | Dark matter is covered in Student Expectation ASTRO.15.C and dark energy is in ASTRO.15.E.
| **SCIENCE.ASTRO.16** | **Science concepts.** The student **understand**s the benefits and challenges of **expanding our knowledge** of the universe. The student is expected to: |
| **ASTRO.14** | **Science concepts.** The student **recognize**s the benefits and challenges of **space exploration** to the study of the universe. The student is expected to: |
| **SCIENCE.ASTRO.16.A** | **describe and communicate the historical development** of human space flight and its challenges; |
| **ASTRO.14.A** | **identify and explain the contributions** of human space flight and **future plans** and challenges; |
| **SCIENCE.ASTRO.16.B** | **describe and communicate the uses and challenges of robotic space flight;** |
| **ASTRO.14.B** | **recognize the advancement of knowledge in astronomy through robotic space flight;** |
| **SCIENCE.ASTRO.16.C** | **evaluate the evidence of the existence of habitable zones and potentially habitable planetary bodies in extrasolar planetary systems;** |
| **SCIENCE.ASTRO.16.D** | **evaluate the impact on astronomy from light pollution, radio interference, and space debris;** |
| **SCIENCE.ASTRO.16.E** | **analyze and describe current developments and discoveries in astronomy;** |
| **ASTRO.14.E** | **demonstrate an awareness of new developments and discoveries in astronomy.** |
| **SCIENCE.ASTRO.16.F** | **explore and explain careers that involve astronomy, space exploration, and the technologies developed through them;** |
| **KEY** | Blue double underline: indicates content new to the grade level. Orange strike through: indicates content was deleted. |