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|  | Astronomy Curriculum Guide2022-2023 |

<http://grading.dmschools.org>

<http://science.dmschools.org>

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| **Evidence shows the student ...** | **Topic Score** |
| Demonstrates proficiency (AT) in all learning targets and success at Level 4 | 4.0 |
| Demonstrates proficiency (AT) in all learning targets with partial success at Level 4 | 3.5 |
| Demonstrates proficiency (AT) in **all** learning targets  | 3.0 |
| Demonstrates proficiency (AT) in **at least half** of the learning targets | 2.5 |
| Demonstrates some success criteria (PT) toward **all** learning targets | 2.0 |
| Demonstrates some success criteria (PT) towards **some** of the learning targets | 1.5 |
| Does not yet meet minimum criteria for the targets.  | 1.0 |
| Produces no evidence appropriate to the learning targets at any level  | 0 |

**Standards-Referenced Grading Basics**

**Our purpose in collecting a body of evidence is to:**

* Allow teachers to determine a defensible and credible topic score based on a representation of student learning over time.

**Start at Level 3 when determining a topic → score.**

* Clearly communicate where a student’s learning is based on a topic scale to inform instructional decisions and push student growth.
* Show student learning of targets through multiple and varying points of data
* Provide opportunities for feedback between student and teacher.

**Scoring**

A collaborative scoring process is encouraged to align expectations of the scale to artifacts collected. Routine use of a collaborative planning and scoring protocol results in calibration and a collective understanding of evidence of mastery. Enough evidence should be collected to accurately represent a progression of student learning as measured by the topic scale. Teachers look at all available evidence to determine a topic score. All topic scores should be defensible and credible through a body of evidence.

**Guiding Practices of Standards-Referenced Grading**

1. A consistent 4-point grading scale will be used.
2. Student achievement and behavior will be reported separately.
3. Scores will be based on a body of evidence.
4. Achievement will be organized by learning topic and converted to a grade at semester’s end.
5. Students will have multiple opportunities to demonstrate proficiency.
6. Accommodations and modifications will be provided for exceptional learners.

**\*\*\*Only scores of 4, 3.5, 3, 2.5, 2, 1.5, 1, and 0 can be entered as Topic Scores**.

**Multiple Opportunities**

Philosophically, there are two forms of multiple opportunities, both of which require backwards design and intentional planning. One form is opportunities planned by the teacher throughout the unit of study and/or throughout the semester. The other form is reassessment of learning which happens after completing assessment of learning at the end of a unit or chunk of learning.

Students will be allowed multiple opportunities to demonstrate proficiency. Teachers need reliable pieces of evidence to be confident students have a good grasp of the learning topics before deciding a final topic score. To make standards-referenced grading work, the idea of “multiple opportunities” is emphasized. If after these opportunities students still have not mastered Level 3, they may then be afforded the chance to reassess.

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| ***Course*** | ***Content Topics*** | ***Connected NGSS Performance Expectations*** | ***Approximate Schedule*** |
| *Astronomy* | * *Introduction to Astronomy*
 | HS-PS4-5 | 2 weeks |
| * *Origin of the Universe*
 | HS-ESS1-2HS-PS4-1 | 4 weeks |
| * *Origin of Elements*
 | HS-ESS1-1 HS-ESS1-3HS-PS1-8 | 4 weeks |
| * *Motion of Objects in the Solar System*
 | HS-ESS1-4HS-PS2-4 | 4 weeks |
| * Formations and Age of the Earth
 | HS-ESS1-6HS-ESS2-5 | 4 weeks |

Potential Text Resource: <https://www.teachastronomy.com/textbook/>

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| Topic: Introduction to Astronomy |
| Driving Questions: What is astronomy? |
| Crosscutting Concept: Scale, Proportion, Quantify |
| Science and Engineering Practices: Developing Models |
| Performance Expectations: [HS-PS4-5](http://www.nextgenscience.org/hsps4-waves-applications-technologies-information-transfer) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | **Students who demonstrate understanding can:**1. Create a model to represent the scale of the universe
2. Outline the history of astronomy and describe how our understanding of our place in the universe has changed over time.
3. Evaluate the types of telescopes used by astronomers for examining different frequencies of electromagnetic radiation.
4. Compare and contrast the uses and advantages of different types of telescopes.
 | ***Students will:***A1. Describe our cosmic address A2. Represent distances in space with appropriate units and scientific notation A3. Describe issues of scale in known representations of the solar system and universeB1. Describe how astronomy was represented in the ancient world (Greek, Arabic, Plato, Ptolemy).B2. Describe the impact of Copernicus’s model of the solar systemB3. Describe how Kepler and Newton impacted our understanding of modern astronomy.C. Describe different types and benefits of telescopes.Recognize or recall specific vocabulary such as: Light year, astronomical unit, parallax, heliocentric, geocentric | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Origin of the Universe |
| Driving Questions: What evidence supports the Big Bang theory as the origin of the universe?  |
| Crosscutting Concept: Energy and Matter |
| Science and Engineering Practices: Constructing Explanations and Designing Solutions |
| Performance Expectation: [HS-ESS1-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) [HS-PS4-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | **Students who demonstrate understanding can:**1. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies and the composition of matter in the universe ([HS-ESS1-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)).
2. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ([HS-PS4-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-1%20Evidence%20Statements%20June%202015%20asterisks.pdf))
 | ***Students will:***A1. Use evidence from a galaxy’s light spectra to determine its relative motion in the universe. A2. Make a conclusion about the motion of the universe based on energy (light shift) versus distance relationship. A3. Describe the existence and implications of cosmic background radiation (energy).A4. Describe the distribution of elements (matter) is the same throughout the universe.B1. Describe how the wavelength and frequency of a wave are related to one another by the speed of travel of the wave.B2. Describe how we use electromagnetic radiation to learn about the universe.B3. Show that the product of the frequency and the wavelength of a particular type of wave in a given medium is constant, and identify this relationship as the wave speed according to the mathematical relationship 𝑣=𝑓𝜆.Recognize or recall specific vocabulary such as: Big Bang theory, wavelength, red shift, visible light spectrum, microwaves, universe, galaxy, element, cosmic radiation | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Origin of Elements |
| Driving Questions: How old is the sun? How do stars produce the elements that compose our universe? |
| Crosscutting Concept: Scale, Proportion and Quality; Energy and Matter |
| Science and Engineering Practices: Developing and Using Models; Obtaining, Evaluating, and Communicating Information |
| Performance Expectation: [HS-ESS1-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-ESS1-3](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-PS1-8](https://www.nextgenscience.org/sites/default/files/HS-PS1-8_Evidence%20Statements%20Jan%202015.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | **Students who demonstrate understanding can:**1. Develop a model to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fusion ([**HS-PS1-8**](https://www.nextgenscience.org/sites/default/files/HS-PS1-8_Evidence%20Statements%20Jan%202015.pdf)).
2. Develop a model based on evidence to illustrate the life span of the sun and how nuclear fusion in the sun’s core generates energy in the form of radiation ([**HS-ESS1-1**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)).
3. Use their model to communicate how different elements (matter) are produced throughout the various stages in a star's lifecycle ([**HS-ESS1-3**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)**).**
 | ***Students will:***1. 1. Identify and describe the relevant components of a fusion model

2. Illustrate the fusion process and its associated products (matter and energy).1. 1. Describe the relationship between hydrogen and helium in the sun’s fusion processes.

2. Use the quantity of hydrogen as a contributing factor to determine the age of a star.3. Use the model to qualitatively describe the scale of energy released by fusion process and how it compares to energy released from chemical reactions.1. 1. Describe how lighter elements (hydrogen) through collisions can form other light elements (helium).

2. Describe how massive elements, up to iron, are produced in cores of stars by a chain of processes of nuclear fusion, which also releases energy.3. Identify the correlation between the size of the star and elements it can produce in its lifetime.4. Analyze the energy relationships between the mass, power output, and the life span of our sun and other stars.5. Describe how spectroscopy is used to determine the composition of stars.Recognize or recall specific vocabulary such as: nuclear fusion, protons, energy, protostar, main sequence, supernova, neutron stars, red giant, dwarf stars, HR diagram | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Motion of Objects in the Solar System |
| Driving Questions: Why do objects in our solar system orbit the sun? |
| Crosscutting Concept: Scale, Proportion and Quantity, Patterns |
| Science and Engineering Practices: Using Mathematical and Computational Thinking |
| Performance Expectation: [HS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-ESS1-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | **Students will:**1. Use mathematical or computational representations (Kepler's and Newton's laws) to predict and explain the motion of orbiting objects in the solar system ([HS-ESS1-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf)**).**
2. Use mathematical representations of Newton’s Law of Gravitation to describe and predict the gravitational forces between objects. **(**[HS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf)**)**
3. Construct an argument based on evidence for the feasibility of travel between planets and or solar systems.
4. Evaluate the effects of the relative position of the Earth, Moon, and Sun on observable phenomena. (lunar phase, seasons, tides)
 | ***Students will:***A 1. Identify and describe Kepler's first law of planetary motion (eccentricity, foci, etc.) 2. Use a given mathematical or computational representation of Kepler's second law of planetary motion to predict an orbiting object's velocity. 3. Use a given mathematical or computational representation of Kepler's third law of planetary motion to describe the relationship between the orbital distance and period. 4. Use Newton's law of gravitation to predict how acceleration of a planet towards the sun varies with distance. 5. Describe the relationship of scale, proportion and quantity in the context of gravitational attraction. B. Using Newton’s law of gravitation, students describe the gravitational attraction between two objects as a relationship of their masses and distance. $F\_{g}=-G\frac{m\_{1}m\_{2}}{d^{2}}$ D. Describe the effects of axial tilt on Earth’s Seasons E. Compare and contrast the relative sizes and location of the following celestial bodies: asteroids, comets, meteors, meteorites, and meteoroids. Recognize or recall specific vocabulary such as: Revolution, orbit, orbital period, ellipse, focus, eccentricity, area, gravity, mass, acceleration, lunar phases | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Formation and Age of the Earth |
| Driving Questions: What evidence supports the accepted age of the Earth? |
| Crosscutting Concept: Stability and Change |
| Science and Engineering Practices: Constructing Explanation and Designing Solutions ; Engaging in Argument from Evidence |
| Performance Expectation: [HS-ESS1-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-ESS2-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | **Students who demonstrate understanding can:**1. Use available evidence within the solar system to reconstruct the early history of Earth. [HS-ESS1-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf)
2. Plan and conduct an investigation of the properties of water and its effect on Earth’s appearance and surface processes. [HS-ESS2-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)
3. Compare and contrast the climate of Earth and Venus and discuss the implications of the greenhouse effect.
 | ***Students will:***1. 1. Use the ratio of parent to daughter atoms produced during radioactive decay as a means for determining ages of lunar rocks, meteorites and Earth’s oldest rocks.

2. Examine other planetary surfaces and their patterns of impact cratering and describe evidence of such patterns on Earth.3. Account for the lack of impact craters and younger age of most rocks on Earth compared to other bodies in the solar system.1. 1. Conduct an investigation into the chemical and mechanical effects of water on Earth materials.

2. Evaluate whether the data from the investigation can be used to account for Earth’s current appearance and estimated age.Recognize or recall specific vocabulary such as: Radiometric dating, half-life, isotope, radioactive decay, impact craters, meteorites, uniformitarianism, erosion, mechanical weathering, chemical weathering, greenhouse effect. | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |