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|  | Conceptual Physics 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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| Order | Topic | Standards | Semester | Time Frame |
| 1 | Describing Motion | [HS-PS2-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) | Semester 1 | 7 Weeks |
| 2 | Forces | [HS-PS2-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) | Semester 1 | 5 Weeks |
| 3 | Momentum | [HS-PS2-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-3](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) | Semester 1 | 6 Weeks |
| End of 1st Semester |
| 4 | Energy | [HS-PS3-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS3-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf),[HS-PS3-3](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) | Semester 2 | 6 Weeks |
| 5 | Electricity and Magnetism | [HS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS3-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-5%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-6](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-6%20Evidence%20Statements%20June%202015%20asterisks_0.pdf) | Semester 2 | 6 Weeks |
| 6 | Waves | [HS-PS4-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) | Semester 2 | 6 Weeks |

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| Topic: Describing Motion |
| Driving Questions: How is data used to describe and predict the motion of an object? |
| Crosscutting Concept: Patterns |
| Science and Engineering Practices: Asking questions, Developing and using models, Plan and carryout investigation, Analyzing and interpreting data,  |
| Performance Expectation: [HS-PS2-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-1%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. | ***In response to observed phenomena, students will…***1. Develop a model to describe and predict the motion of an object traveling at a constant velocity.

*1. Create and analyze position vs. time graphs and velocity vs. time graphs to describe the motion of an object.**2. Make a prediction from a 1-dimensional problem for an object traveling at a constant velocity.*1. Develop a model to describe and predict the motion of an object traveling at a constant acceleration.

*1. Create and analyze position vs. time graphs and velocity vs. time graphs to describe the motion of an object.**2. Make a prediction from a 1-dimensional problem for an object traveling at a constant acceleration.* | ***In response to observed phenomena, students will…***A1. Create position vs. time and velocity vs. time for an object traveling at a constant velocity.A2. Describe the motion of an object traveling at a constant velocity from given graphical representations.A3. Solve basic problems using velocity, change in position, and time for any variable in one dimension.A4. Recognize patterns in data that represent objects traveling at a constant velocity.B1. Create position vs. time and velocity vs. time for an object traveling at a constant acceleration.B2. Describe the motion of an object traveling at a constant acceleration from given graphical representations.B3. Solve basic problems using acceleration, change in velocity, and time for any variable in one dimension.B4. Recognize patterns in data that represent objects traveling at a constant acceleration.Recognize or recall specific vocabulary such as: position, displacement, distance, speed, velocity, acceleration, slope, and area | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Forces |
| Driving Questions: How do Newton’s Laws explain changes in motion? |
| Crosscutting Concept: Cause and Effect, Patterns |
| Science and Engineering Practices: Analyzing and Interpreting Data, Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena |
| Performance Expectation: [HS-PS2-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-1%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. | ***In response to observed phenomena, students will…***1. Analyze data to develop a relationship between acceleration, mass and force. ([HS-PS2-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf))
2. Analyze a system to determine net force and acceleration of an object in one dimension.
3. Analyze the force of gravity between two objects to describe and predict how the force varies by changing the mass of an object or the distance between the objects.
 | ***In response to observed phenomena, students will…***A1. Solve basic problems using net force, mass, and acceleration for any variable in one dimension.A2. Recognize patterns in the acceleration data for an object undergoing a constant force and a changing mass or for an object with a constant mass and a changing force.B1. Create free-body diagrams to show balanced or unbalanced forces.B2. Determine that balanced forces cause constant velocity.B3. Determine that unbalanced forces cause acceleration.C1. Calculate the weight of an object.C2. Describe the relationship between mass, the force of gravity, and the distance between two objects. C3. Explain the difference between mass and weight.Recognize or recall specific vocabulary such as: force, net force, mass, weight, acceleration, free fall, balanced forces, unbalanced forces, inverse square law | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Momentum |
| Driving Questions: What happens when two objects interact with each other? |
| Crosscutting Concept: Systems and System Models, Cause and Effect |
| Science and Engineering Practices: Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions |
| Performance Expectation: [HS-PS2-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-3](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-3%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. | ***In response to observed phenomena, students will…***1. Use mathematical representations or graphical representation to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
2. Draw conclusions about the force, time, and change in momentum in a given scenario using the momentum impulse theorem.
	* *Use quantitative analysis to determine the resulting interaction(s).*
	* *Given a graphical representation, analysis and interpret the data and draw conclusions about the cause and effect for the given scenario.*
3. Design, evaluate, and refine a device, using the momentum impulse theorem, to minimize force acting on an object in a collision.
	* *Identify the variable(s) which impact the force*
	* *Setup an experiment (or experiments) which isolates a given variable with the force to determine its relative impact.*
 | ***In response to observed phenomena, students will…***1. 1. Apply force pairs to scenarios to analyze the impact on the momentum of the system.

2. Evaluate the momentum of an object with no net force in one dimension.* 1. Use graphical analysis
	2. Use data/mathematical analysis
1. Use the momentum impulse theorem to determine the results of the interaction of the given particle(s) in one dimension.
2. Utilizing a Lab setup, gather data, analyze the results and draw conclusions about the force, time, and change in momentum in a given scenario using the momentum impulse theorem.

Recognize or recall specific vocabulary such as: Momentum, impulse, elastic, inelastic, collisions, conservation of momentum, impulse momentumtheorem, Newton’s 3rd Law, force pairs | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

**End of 1st Semester**

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| Topic: Energy |
| Driving Questions: How do we track the energy of an object as it moves through a system? |
| Crosscutting Concept: Systems and System Models, Energy and Models |
| Science and Engineering Practices: Math and Computational Thinking, Develop and Using Models, Constructing and Designing Solutions, Planning and Carrying out Investigations |
| Performance Expectation: [HS-PS3-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS3-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS3-3](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-3%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. | ***In response to observed phenomena, students will…***1. Develop and use models to illustrate that energy at the macroscopic scale is conserved.
2. Use a mathematical model to predict changes in a system based on conservation of energy.
	* *Predict changes in a system when energy is not transferred in or out of the system.*
	* *Predict changes in a system where energy is transferred in and out of the system*
3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
 | ***In response to observed phenomena, students will…***1. Identify where energy is stored and transferred in a macroscopic system.
2. Describe the relationships between energy stored gravitationally, mass, gravitational field, and change in height.
3. Describe the relationships between energy stored kinetically, mass, and velocity.
4. Describe the relationship between energy stored elastically, spring constant, and change in position.
5. Describe the relationship in a system between force, change in position, and energy transferred in or out of the system (work).

C1. Identify how a device works within given constraints to convert one form of energy into another form of energy.Recognize or recall specific vocabulary such as: Energy, Kinetic, gravitational, thermal, elastic, mechanical, conservation of energy, Joules, work | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Electricity and Magnetism |
| Driving Questions: How are electric and magnetic fields related? |
| Crosscutting Concept: Energy and Matter, Structure and Function, Systems and System Modeling |
| Science and Engineering Practices: Constructing Explanations and Designing Solutions, Planning and Carrying out Investigations |
| 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-PS3-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-5%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS2-6](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS2-6%20Evidence%20Statements%20June%202015%20asterisks_0.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. | ***In response to observed phenomena, students will…***1. Develop and use a model of two objects interacting through electric or magnetic fields.(HS-PS3-5)
2. Plan and conduct and investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce electric current. (HS-PS2-5)
	* *Conservation of Energy should be re-emphasized on the transformation of energy between objects and how it affects microscopic particle motion*
3. Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials. (HS-PS2-6)
4. Use mathematical representation of Coulomb’s Law to describe and predict electrostatic forces between objects. (HS-PS2-4)
	* *The emphasis is on the conceptual aspects of an inverse square relationship.*
 | ***In response to observed phenomena, students will…***A1. Students will understand the pattern that like charges repel  and opposite charges attractA2. Forces of attraction will depend on quantity of chargeB1. Explain the relationship between motors and generators on  the functions of the components. B2. Express the relationship between coils, electric potential, and  magnetic field strength in an electromagnet.  C1. Identify and explain properties that make a good conductor C2. Identify and explain properties that make a good insulator. C3. Identify and explain properties that make materials magnetic.  D1. Students can relate conceptually that distance affects force  of attraction D2. Students can relate conceptually that distance is more of a  factor than charge in determining force of attraction Recognize or recall specific vocabulary such as: Electric charge, proton, neutron, electron, Coulomb’s Law, magnetic field, electric field, attraction, repulsion, pole, polar, field lines | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Waves |
| Driving Questions: How do we describe waves in our world? |
| Crosscutting Concept: Patterns, Energy and Matter |
| Science and Engineering Practices:  |
| Performance Expectation: [HS-PS4-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)[HS-PS4-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS4-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-4%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS4-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-5%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. | ***In response to observed phenomena, students will…***1. 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)
2. Use a model to describe how energy is transferred through mechanical and electromagnetic waves.
	* Should include interference
	* Should include superposition
3. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy and debate the benefits of digital vs analog ([HSPS4-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-5%20Evidence%20Statements%20June%202015%20asterisks.pdf))
4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. ([HS-PS4-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-4%20Evidence%20Statements%20June%202015%20asterisks.pdf))
 | ***In response to observed phenomena, students will…***A1. Describe the relationship between wave speed, frequency, and wavelength.A2. Describe how wave speed changes when traveling through different media.B1. Describe what happens to the amplitudes of waves when two waves interact with each other.B2. Be able to identify visually wavelength, amplitude, longitudinal wave, and transverse waveRecognize or recall specific vocabulary such as: Frequency, Wavelength, Velocity, interference, period, superposition, amplitude, medium, transverse, longitudinal, crest, trough, compression, and rarefaction. | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |