Developing and Using Science and Engineering Practices (by Lesson)

SEP Element #	Lesson	Elements of Science and Engineering Practice(s)	Rationale
1.1	1	Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.	Students ask questions about what might affect the outcome of a collision based on data over the past three decades. They ask questions to seek additional information regarding how various factors and features of vehicles and the vehicle system might contribute to some of the trends the class identified.
1.8	14	Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations	Students define a design problem that is relevant to people or things they care about and then consider social, environmental, or technical considerations to identify specific criteria to focus on.
2.3	8	Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	Students develop timeline models of vehicle and crash test dummy systems in a collision in order to compare the timing of the velocity changes with and without safety features.
2.6	1	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.	Students develop a model to predict how components and interactions in a vehicle system might contribute to vehicle safety data trends over time.
2.6	5	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.	Students use a graphical model to explain the differences in reaction and stopping time in wet versus clear road conditions, and develop solutions to the delayed stopping that occurs in wet and rainy conditions.
2.6	14	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.	Students apply a mathematical model to generate data to support explanations of why the problem they chose is dangerous and/or why their solution makes it safer.
4.1	2	Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	Students analyze videos of two drivers encountering a sudden obstacle: one who is undistracted and one who is distracted. They make a plot for each driver to show how being distracted affects the motion of the vehicle over time, and thus the outcome of a potential vehicle collision.
4.5	7	Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.	Students use new data showing the factors explored in Lessons 1-6 over time and compare the data to the Lesson 1 trend lines chart to evaluate their initial explanations about what could be contributing to changes in injuries, fatalities, and crashes over time.
4.6	9	Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.	Students analyze data from simulation graphs across both days of the lesson to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

SEP Element #	Lesson	Elements of Science and Engineering Practice(s)	Rationale
4.6	10	Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.	Students analyze force data gathered from cart collisions and compare it to the crumple zone designs. In addition, they use survivability data from a simulation in which they can adjust the length and rigidity of the crumple zone design.
4.6	11	Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.	Students analyze graphical data of velocity and force over time for a vehicle and crash test dummy to figure out how the length and rigidity design characteristics of crumple zones can be designed to increase likelihood of survival in a collision.
5.2	3	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Students use a mathematical model (distance = speed * time) to describe how speed affects reaction distance for vehicles in danger of collision with an obstacle.
5.2	4	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Students use a graph of speed versus time and Newton's second law to make a quantitative claim that predicts how much changing braking force will affect the time it takes a vehicle to stop.
5.2	5	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	In the Electronic Exit Ticket, students use graphs and mathematical models to explain the movement of a cart over time as variables such as the mass and friction on the cart change.
5.2	6	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Students use multiple mathematical representations (bivariate graphs, geometric models, and algebraic equations) to identify and describe patterns in the relationship between the masses and velocity changes of two vehicles in a collision. They use bivariate graphs to identify patterns on day 1 and day 2. They use a geometric/area model of the masses and velocity changes on day 3. They develop and test an algebraic representation of the relationships across all three days.
5.2	7	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	In the transfer task, students use mathematical representations (graphs) of car and bus motion after a rear-end collision to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
5.2	10	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Students analyze force versus time graphs of collisions of carts with various crumple zone designs. They use that data to conclude that the designs that reduce the peak force acting on the car also increase the amount of time of the collision.
5.2	11	Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	Students use graphical representations of velocity and force during a collision in order to support their claims on how crumple zones can be designed to increase safety.

SEP Element #	Lesson	Elements of Science and Engineering Practice(s)	Rationale
5.3	6	Apply techniques of algebra and functions to represent and solve scientific and engineering problems.	Students apply techniques of algebra to represent relationships and solve for unknowns (force, change in velocity, starting and ending velocities, and mass) in different collision scenarios.
5.4	4	Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world.	Students use simple limit cases to test whether the curve fits of their data match their real-world predictions about how changing the braking force, mass, and/or initial speed will affect the stopping time of a vehicle.
5.4	5	Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world.	In the Electronic Exit Ticket, students compare the reduction in the net force of the cart to a real-world scenario and compare the movement of the cart to the motion of objects in everyday life.
6.1	4	Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.	Students develop quantitative claims regarding the relationship between the time it takes a vehicle to stop and the mass, braking force, and initial speed of a vehicle.
6.1	9	Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.	Students look for patterns in force and time data to determine a possible relationship between lower peak forces and the increased duration of a collision in which safety features are used versus not used and explain how this contributes to higher survival rates.
6.3	9	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Students apply scientific ideas and evidence to provide an explanation for why two safety features together improve survivability and why survivability changes in two-vehicle collisions at different speeds with the same safety features.
6.3	12	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Students apply the science ideas they compile in the Gotta-Have-It Checklist to explaining design solutions for making vehicles safer and consider how optimizing one design element may impact other aspects of safety or driving.
6.3	15	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Students revisit the unanswered questions on the Driving Question Board. They construct explanations to answer the questions using science ideas from across the unit. Students will also apply this element as part of a transfer task. See key for details.
6.5	3	Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Students use what they have figured out from video data and mathematical modeling to identify design features that can decrease reaction distances to prevent collisions in the event of a sudden obstacle.

SEP Element #	Lesson	Elements of Science and Engineering Practice(s)	Rationale
6.5	10	Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Students design crumple zones to be attached to a cart. After a collision, they evaluate their designs and, if time permits, create new crumple zones in order to meet the design criteria of reducing the force on collision.
6.5	14	Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Students define a solution to the design problem based on scientific knowledge (physics models), evidence they generated earlier in the unit, their own prioritized criteria, and trade-off considerations, then evaluate peers' solutions and refine their own based on this feedback.
7.1	12	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.	Students compare two competing arguments over the speed limits. Students consider evidence gained in prior investigations and how this can support either argument, and they also consider the tradeoffs, constraints, and ethical issues.
7.1	13	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.	Students use the *Argument Comparison Tool* to evaluate both sides of an argument about a mass transit-related tradeoff, considering science ideas, constraints, and ethical issues.
7.1	15	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.	In the transfer task, compare and evaluate competing design solutions and weigh tradeoffs to argue for which is the best design solution. See key for details.

Developing and Using Crosscutting Concepts (by Lesson)

CCC Elements #	Lesson	Elements of Crosscutting Concept(s)	Rationale
1.3	11	Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.	Students will analyze patterns of performance from simulated collisions involving cars with varying crumple zone rigidities and lengths to consider how the design of the crumple zone can improve safety.
1.4	2	Mathematical representations are needed to identify some patterns.	Students use mathematical representations (graphs of position versus time) to identify patterns that reveal differences between the motion of a vehicle when the driver is undistracted versus distracted.
1.4	6	Mathematical representations are needed to identify some patterns.	Students use bivariate graphs to identify patterns related to regions of constant versus changing velocity, force symmetry, and an inversely proportional relationship between the masses of the vehicles and the changes in velocity they experience in a two-vehicle collision.
1.5	1	Empirical evidence is needed to identify patterns	Students use multiple data sets to identify complex patterns related to vehicle safety that the class is unable to predict without empirical evidence.

CCC Elements #	Lesson	Elements of Crosscutting Concept(s)	Rationale
2.1	7	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Students explicitly consider the distinction between correlation and causality and refrain from making claims about specific causes and effects.
2.2	14	Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.	Students suggest and predict possible cause-effect mechanisms by examining what is known about smaller-scale mechanisms in the system of their design problem to target their design solution to areas where it is likely to have real impact.
2.3	1	Systems can be designed to cause a desired effect.	Students brainstorm and model system components that are designed to prevent traffic collisions and fatalities.
2.3	3	Systems can be designed to cause a desired effect.	Students identify design solutions that, if implemented, could cause a decrease in reaction distances.
2.3	5	Systems can be designed to cause a desired effect.	Students analyze and develop solutions to the increased reaction and reduced stopping times in wet and rainy conditions.
2.3	9	Systems can be designed to cause a desired effect.	Students develop force diagrams to illustrate where forces from two designed safety features are acting on a crash test dummy, and they explain how the characteristics of those features could be changed to improve survivability at higher speeds.
2.3	10	Systems can be designed to cause a desired effect.	Students design physical crumple zones that attach to the front of a smart cart to reduce the peak force on impact in a collision. They use a simulation to adjust crumple zone length and rigidity in order to test which designs lead to the greatest chance of driver survivability in a crash.
2.3	11	Systems can be designed to cause a desired effect.	Students are figuring out how crumple zones can be designed in order to increase safety in a vehicle collision.
2.3	12	Systems can be designed to cause a desired effect.	Students construct explanations about how criteria or design elements of vehicles can be designed in order to increase vehicle safety.
2.3	15	Systems can be designed to cause a desired effect.	Students will answer questions on the DQB by applying cause-effect thinking, considering how the safety features we had questions about may have been designed to apply the science ideas we developed to mitigate risk. Students will also apply this element as part of a transfer task. See key for details.
2.4	12	Changes in systems may have various causes that may not have equal effects.	Students compare arguments about speed limits, including considering how some people may be unequally benefited by changes in speed limits.

CCC Elements #	Lesson	Elements of Crosscutting Concept(s)	Rationale
3.1	14	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	When prioritizing design problems to focus on for their Design Challenge project, students use the lens of scale, proportion, and quantity (How widespread is the problem? How often does it occur? In what place(s) does it occur?), then consider peer feedback to further identify details to help narrow to a specific location, policy, or safety system.
3.2	8	Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.	Students slow down a collision that is too fast to observe directly by using a simulation-based animation and looking at velocity data over time to revise timelines of events.
3.5	3	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	Students use a mathematical model (distance = speed * time) to generate data, which they then examine in order to predict the effect of one variable (speed) on another (reaction distance).
3.5	4	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	Students use algebraic thinking to examine empirical data and predict the effect of the mass, braking force, and initial speed of a vehicle on the time it takes it to stop.
3.5	5	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	Students use their mathematical representations to predict the effect of changing the friction force on the movement of the cart and the initial speed of the cart on its movement.
4.2	6	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.	Students define the boundaries of a two-object system and the input (initial momentum) and output (starting momentum) of that system as a conserved quantity in that system when completing the *Momentum Self-Assessment Key*.
4.2	7	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.	In the transfer task, students must consider how the way the system is defined (boundaries and initial conditions) changes the way they set up their equation.
4.4	14	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models	Students discuss as a class how to decide whether specific assumed or approximated values used in models are valid or reasonable given the limited precision and reliability of this application, then choose reasonable values in their own modeling.
6.2	10	The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials	Students design physical crumple zone models to have a structure that will collapse and reduce the peak force during a collision. They then analyze these designs to see which best met this function.
7.2	2	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.	Students model change (position) and rate of change (speed) over time by making a plot for each driver to show how being distracted affects the motion of the vehicle over time, and thus the outcome of a potential vehicle collision.

Disciplinary Core Ideas (by Lesson)

DCI Elements #	Lesson	Elements of Disciplinary Core Idea(s)	Rationale
ETS1.A.1	2	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account~~, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them~~. (HS-ETS1-1, secondary to HS-PS2-3)
ETS1.A.1	10	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, ~~and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.~~
ETS1.A.1	15	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, ~~and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them~~. (secondary to HS-PS2-3)
ETS1.A.2	1	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)	Humanity faces major global challenges today, ~~such as the need for supplies of clean water and food or for energy sources that minimize pollution,~~ which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)
ETS1.A.2	2	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)	Humanity faces major global challenges today, ~~such as the need for supplies of clean water and food or for energy sources that minimize pollution,~~ which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)
ETS1.A.2	3	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)	Humanity faces major global challenges today, ~~such as the need for supplies of clean water and food or for energy sources that minimize pollution,~~ which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)
ETS1.B.1	3	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)	When evaluating solutions, it is important to take into account a range of constraints, including ~~cost~~, safety, ~~reliability,~~ and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
ETS1.B.1	12	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)	When evaluating solutions, it is important to take into account a range of constraints, including ~~cost~~, safety, ~~reliability,~~ and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

DCI Elements #	Lesson	Elements of Disciplinary Core Idea(s)	Rationale
ETS1.B.1	13	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)	When evaluating solutions, it is important to take into account a range of constraints, including ~~cost~~, safety, ~~reliability,~~ and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
ETS1.B.2	10	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
ETS1.C.1	12	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HSETS1-2) (secondary to HS-PS1-6) (secondary to HS-PS2-3)	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-ETS1-2) (secondary to HS-PS1-6) (secondary to HS-PS2-3)
ETS1.C.1	14	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HSETS1-2) (secondary to HS-PS1-6) (secondary to HS-PS2-3)	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-ETS1-2)
ETS1.C.1	15	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HSETS1-2) (secondary to HS-PS1-6) (secondary to HS-PS2-3)	~~Criteria may need to be broken down into simpler ones that can be approached systematically,~~ and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-PS2-3)
ETS2.B.3	7	New technologies can have deep impacts on society and the environment, including some that were not anticipated or that may build up over time to a level that requires attention or mitigation. Analysis of costs, environmental impacts, and risks, as well as of expected benefits, is a critical aspect of decisions about technology use.	New technologies can have deep impacts on society and the environment, including some that were not anticipated.
ETS2.B.3	14	New technologies can have deep impacts on society and the environment, including some that were not anticipated or that may build up over time to a level that requires attention or mitigation. Analysis of costs, environmental impacts, and risks, as well as of expected benefits, is a critical aspect of decisions about technology use.	New technologies can have deep impacts on society and the environment, including some that were not anticipated or that may build up over time to a level that requires attention or mitigation. Analysis of ~~costs,~~ environmental impacts, and risks, as well as of expected benefits, is a critical aspect of decisions about technology use.
PS2.A.1	1	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	~~Newton's second law accurately~~ predicts changes in the motion of macroscopic objects. (HS-PS2-1)
PS2.A.1	4	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

DCI Elements #	Lesson	Elements of Disciplinary Core Idea(s)	Rationale
PS2.A.1	5	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects.
PS2.A.1	6	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects.
PS2.A.1	8	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
PS2.A.1	9	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects.
PS2.A.1	10	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects.
PS2.A.1	11	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
PS2.A.1	12	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
PS2.A.1	15	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
PS2.A.2	6	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2)	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved.
PS2.A.2	7	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2)	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.
PS2.A.2	15	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2)	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)
PS2.A.3	7	If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2), (HS-PS2-3)	If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.
PS2.A.3	15	If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2), (HS-PS2-3)	If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-3)