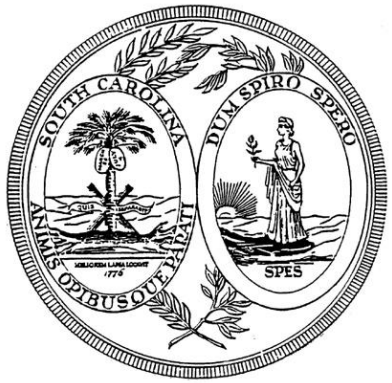
South Carolina Academic Standards and Performance Indicators for Science 2014



Instructional Unit Resource

8th Grade

South Carolina Academic Standards and Performance Indicators for Science 2014
Eighth Grade Science Instructional Unit Resource

As support for implementing the *South Carolina Academic Standards and Performance Indicators for Science 2014*, the standards for Eighth Grade have been grouped into possible units. In the Overview of Units below, the titles for those possible units are listed in columns. Refer to the Overview document to note these unit titles and how Standards, Conceptual Understandings, Performance Indicators, Science and Engineering Practices, and Crosscutting Concepts align. Following the Overview of Units, an Instructional Unit document is provided that delivers guidance and possible resources in teaching our new *South Carolina Academic Standards and Performance Indicators for Science 2014*. The purpose of this document is to provide guidance as to how all the standards in this grade may be grouped into units and how those units might look. Since this document is merely guidance, districts should implement the standards in a manner that addresses the district curriculum and the needs of students. This document is a living document and instructional leaders from around the state will continuously update and expand these resource documents. These documents will be released throughout the 2016-2017 school year with the intentionality of staying ahead of instruction. Teachers should also note that links to the Standards document, A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, the SEP Support Document, and the Support Document 2.0 are embedded throughout the Instructional Unit format for reference.

Acknowledgments

Jean Baptiste Massieu, famous deaf educator, made a statement that is now considered a French proverb. “Gratitude is the memory of the heart. Indeed, appreciation comes when you feel grateful from the depths of your heart. The head keeps an account of all the benefits you received and gave. But the heart records the feelings of appreciation, humility, and generosity that one feels when someone showers you with kindness.” It is with sincere appreciation that we humbly acknowledge the dedication, hard work and generosity of time provided by teachers and instructional leaders across the state that have made and are continuing to make the Instructional Unit Resources possible.

Grade Eight Overview of Units

Unit 1	Unit 2	Unit 3	
Physical Science: Forces & Motion	Physical Science: Waves	Earth Science: Earth's Place in the Universe	
Standard	**Standard**	**Standard**	
8.P.2	8.P.3	8.E.4	
Conceptual Understanding	**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**
8.P.2A	8.P.3A	8.E.4A	8.E.4B
Performance Indicators	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
8.P.2A.1 8.P.2A.2 8.P.2A.3 8.P.2A.4 8.P.2A.5 8.P.2A.6 8.P.2A.7	8.P.3A.1 8.P.3A.2 8.P.3A.3 8.P.3A.4 8.P.3A.5 8.P.3A.6	8.E.4A.1 8.E.4A.2	8.E.4B.1 8.E.4B.2 8.E.4B.3 8.E.4B.4 8.E.4B.5 8.E.4B.6
Science and Engineering Practices	**Science and Engineering Practices**	**Science and Engineering Practices**	
8.S.1A.2 8.S.1A.3 8.S.1A.4 8.S.1A.5 8.S.1A.6	8.P.1A.2 8.P.1A.4 8.P.1A.6 8.P.1A.8	8.P.1A.2 8.P.1A.4 8.P.1A.6 8.P.1A.7 8.P.1A.8	
CrossCutting Concepts	**CrossCutting Concepts**	**CrossCutting Concepts**	
2, 4, 3,7	1, 2, 6	1, 2, 3, 4	

**Teachers have the discretion to enhance the selected SEP's and CCC's.*

Grade Eight Overview of Units

Unit 4			Unit 5	
Earth Science: Earth Systems & Resources			Earth Science: Earth's History & Diversity of Life	
Standard			**Standard**	
8.E.5			8.E.6	
Conceptual Understanding	**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**	**Conceptual Understanding**
8.E.5A	8.E.5B	8.E.5C	8.E.6A	8.E.6B
Performance Indicators	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**	**Performance Indicators**
8.E.5A.1 8.E.5A.2 8.E.5A.3 8.E.5A.4 8.E.5A.5	8.E.5B.1 8.E.5B.2 8.E.5B.3	8.E.5C.1	8.E.6A.1 8.E.6A.2 8.E.6A.3 8.E.6A.4 8.E.6A.5	8.E.6B.1 8.E.6B.2
Science and Engineering Practices			**Science and Engineering Practices**	
8.P.1A.2 8.P.1A.4 8.P.1A.6 8.P.1A.8 8.S.1B.1			8.P.1A.2 8.P.1A.4 8.P.1A.6 8.P.1A.7 8.P.1A.8 8.S.1B.1	
CrossCutting Concepts			**CrossCutting Concepts**	
1, 2, 3, 4, 6, 7			1, 2, 3, 4, 5, 7	

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Unit Title
Physical Science: Forces & Motion
Standard http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf
8.P.2 The student will demonstrate an understanding of the effects of forces on the motion and stability of an object.

Conceptual Understanding
8.P.2A. Motion occurs when there is a change in position of an object with respect to a reference point. The final position of an object is determined by measuring the change in position and direction of the segments along a trip. While the speed of the object may vary during the total time it is moving, the average speed is the result of the total distance divided by the total time taken. Forces acting on an object can be balanced or unbalanced. Varying the amount of force or mass will affect the motion of an object. Inertia is the tendency of objects to resist any change in motion.
New Academic Vocabulary **Some students may need extra support with the following academic vocabulary in order to understand what they are being asked to understand and do. Teaching these terms in an instructional context is recommended rather than teaching the words in isolation. A great time to deliver explicit instruction for the terms would be during the modeling process. Ultimately, the student should be able to use the academic vocabulary in conversation with peers and teachers. These terms are pulled from the essential knowledge portion of the Support Doc 2.0 (http://ed.sc.gov/instruction/standards-learning/science/support-documents-and-resources/) and further inquiry into the terms can be found there.**

Speed	Average speed	Constant speed	Velocity	Friction
Weight	Mass	Inertia	Force	Net force
Balanced force	Unbalanced force	Gravity	Direction	Position
Action and reaction forces	Newton's First Law of Motion	Newton's Third Law of Motion		

Performance Indicators **Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's**
8.P.2A.1 *Plan and conduct* controlled scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and direction), shape, or orientation of an object.

8.P.2A.2 *Develop and use models* to compare and predict the resulting effect of balanced and unbalanced forces on an object's motion in terms of magnitude and direction.
8.P.2A.3 *Construct explanations* for the relationship between the mass of an object and the concept of inertia (Newton's First Law of Motion).
8.P.2A.4 *Analyze and interpret data* to support claims that for every force exerted on an object there is an equal force exerted in the opposite direction (Newton's Third Law of Motion).
8.P.2A.5 *Analyze and interpret data* to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.
8.P.2A.6 *Use mathematical and computational thinking* to generate graphs that represent the motion of an object's position and speed as a function of time.
8.P.2A.7 *Use mathematical and computational thinking* to describe the relationship between the speed and velocity (including positive and negative expression of direction) of an object in determining average speed (v=d/t).

***Science and Engineering Practices :**

Support for the guidance, overviews of learning progressions, and explicit details of each SEP can found in the Science and Engineering Support Doc (http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf). It is important that teachers realize that the nine science and engineering practices are not intended to be used in isolation. Even if a performance indicator for a given standard only lists one of the practices as a performance expectation, scientists and engineers do not use these practices in isolation, but rather as part of an overall sequence of practice. When educators design the learning for their students, it is important that they see how a given performance expectation fits into the broader context of the other science and engineering practices. This will allow teachers to provide comprehensive, authentic learning experiences through which students will develop and demonstrate a deep understanding of scientific concepts.

8.S.1A.2: Develop and Use Models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
8.S.1A.3: Plan and Carry out Investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
8.S.1A.4: Analyze and Interpret Data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.
8.S.1A.5: Use Mathematics and Computational Thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.
8.S.1A.6: Construct Explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

***Cross Cutting Concepts** (http://www.nap.edu/read/13165/chapter/8)

The link above provides support from the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) The text in blue and *italicized/underlined* below provides a brief explanation of how the specific content ties to the CCC's.

2. Cause and effect: Mechanism and explanation: The National Research Council (2012) states that "events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts" (p. 84). *Forces cause a change in the motion and stability of an object. Newton's Laws of motion explain the cause and effect relationships between forces, motion, and mass.*

3. Scale, proportion, and quantity: The National Research Council (2012) states that "in considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance" (p. 84). *The ideas of ratio and proportionality are important here along with being able to predict the effect of a change in one variable on another. For example, how will the speed of an object change if the time traveled is increased but the distance remains the same?*

4. Systems and systems models: The National Research Council (2012) states that "Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering" (p. 84). In this simple mechanical system, the interactions between forces and resulting changes in motion should be modeled using graphs or mathematical relationships.

7. Stability and change: The National Research Council (2012) states that "For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study" (p. 84). The motion of an object remains stable unless an outside force causes a change in that motion. The rate of change is dependent upon force and mass.

**Teachers have the discretion to enhance the selected SEP's and CCC's.*

Prior Knowledge

- 2.P.4 Effects of pushes, pulls, and friction on the motion of objects
- 5.P.5 The factors, i.e. a change of force, a change in mass, or friction, that affect the motion of an object

Subsequent Knowledge

- H.P.2.A Linear motion of an object can be described by its displacement, velocity, and acceleration.
- H.P.2.B Interactions among objects and their subsequent motion can be explained and predicted by analyzing the forces acting on the

objects and applying Newton's laws of motion.

- H.P.2.C Contact interactions among objects and their subsequent motion can be explained and predicted by analyzing the normal, tension, applied, and frictional forces acting on the objects and by applying Newton's Laws of Motion.
- H.P.2.D Non-contact (at a distance) interactions among objects and their subsequent motion can be explained and predicted by analyzing the gravitational, electric, and magnetic forces acting on the objects and applying Newton's laws of motion. These non-contact forces can be represented as fields.

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

8.P.2A.6-7 Graphing & Calculating Speed

- The Speed of a Toy Car Students follow the scientific method to calculate and graph speed. This prepares students for both the end of the lesson on reading VT graph, but also the final project. This resource can be found at: https://wais.springbranchisd.com/LinkClick.aspx?fileticket=-55-BZpOENw%3D&tabid=12517

- Marble Motion - Students calculate the speed of marbles as they roll down a ramp. This resource can be found at: http://science-class.net/archive/science-class/Lessons/Physics/Force_Motion/marblemotion_speed.pdf

- Distance Time Graph Analysis can provide good practice for students to learn how to read the 'story' of a graph. An example lesson can be found here: http://www.cpalms.org/Public/PreviewResourceLesson/Preview/76109

- Interpreting Distance–Time Graphs is a very detailed activity which takes a few days, but does a good job of showing students the relationship between the shapes of graphs and the stories they tell. This resource can be found at: www.opi.mt.gov/pdf/CCSSO/InterpTimeDistance.pdf

8.P.2A.2 and 5 Forces

- Hovercraft Racers! This show how to make-your-own inexpensive vehicles to use for friction experiments in place of an air track. This resource can be found at: https://www.teachengineering.org/activities/view/cub_mechanics_lesson05_activity1

- Buckle Up(See Appendices) is a scientific method based lab that teaches the importance of seat belts.

- Friction Factors Lab (See Appendices) shows the effects of 3 different factors on the force it takes to pull a wood block across a flat surface. Great for showing how changing one factor to the independent variable makes a different experiment.

8.P.2A.1, 3 and 4 Newton's Laws of Motion

- Understanding Car Crashes is a video (https://www.youtube.com/watch?v=yUpiV2I_IRI) and teacher's guide (https://education.ufl.edu/gjones/files/2013/04/teachers_guidePhysics.pdf) complete with additional activities to reinforce the concepts.

- Inertia Crash Test Dummies is another lab that teaches seatbelt safety using 3 different variables. This resource can be found at: http://blog.wsd.net/psakurada/files/2011/12/Inertia-Crash-Test-Dummies.pdf

- Newton's Races is a lab that uses masses in a car to teach Newton's 2nd Law of Motion. This resource can be found at: http://www.melodyshaw.com/files/Newton_s_race.pdf

- Balloon Racer Students will create a car for use in designing their own experiment as well as collecting and interpreting data to address the SEPs and indicators. There are many resources available on the web for this activity. One example can be found at http://campuses.fortbendisd.com/campuses/documents/teacher/2012%5Cteacher_20121219_1044.pdf

- How Roller Coasters Work has a nice description of the relationship between roller coasters and Newton's Laws. This resource can be found at: http://science.howstuffworks.com/engineering/structural/roller-coaster3.htm

- Roller Coaster Physics is a website complete with activities, videos, and assessments. Once students have completed the learning portion, have them start on the project below. This resource can be found at: http://rollercoasterphysics.webnode.com/newtons-laws/

- Roller Coaster Design Students will create a roller coaster for use in designing their own experiment as well as collecting and interpreting data to address the SEPs and indicators. There are many resources available on the web for this activity. One example can be found at http://www.asdk12.org/staff/lasee_jennifer/CALENDAR/89009_Roller_Coaster.doc

- SketchUp is a free program that can be used by students with advanced computer skills to design their roller coaster. This resource can be found at http://download.cnet.com/SketchUp-Make/3000-6677_4-10257337.html#/h

- 2nd Law Lab Students answer the question, "How can Newton's 2nd Law be used to find acceleration", using spring scales and masses. One resource can be found at https://www.filamentlearning.com/sites/default/files/motion-force-lab-sheet-force-mass-acceleration.pdf

- Newton's 2nd Law Practice Problems provides several F=ma calculation problems. This resource can be found at: http://www.upsd.wednet.edu/cms/lib07/WA01000687/Centricity/Domain/129/Skill%20and%20Practice%20Sheets.pdf (page 44/Skills sheet 5.2)

Resources

- Virtual Car (Interactive) is an interactive activity demonstrating vectors. Vectors change as you drive a car, changing speed and direction. In addition, speed vs. time graphs change in real time showing speed and acceleration of the car you are driving. This resource can be found at http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.accel/virtual-car-velocity-and-acceleration/

- Physlets has information on 1-D motion in general. There are animations for position v time, velocity v time, and acceleration v time, along with graphs for free-fall and feel-fall with air resistance. This resource can be found at http://acme.highpoint.edu/~atitus/physlets/1Dmotion/

- NBC Learn Science of the NFL has videos related to Newton's 3 Laws of Motion, along with Position, Velocity, and Resistance. This resource can be found at https://www.nbclearn.com/nfl/cuecard/51076

- PhET Interactive Simulations - Forces and Motion Interactive simulation illustrating force, motion, and friction. Materials can be selected by grade level. This resource can be found at https://phet.colorado.edu/en/simulation/forces-and-motion-basics

- Algadoo is 2D-simulation software that encourages creativity by allowing students to create interactive scenes, allowing them to explore physics while having fun. The download is free and for Windows and Mac. This resource can be found at http://www.algodoo.com/

Sample Formative Assessment Tasks/Questions

Additional sample formative assessment tasks/questions for grade bands are located at the end of each of the SEP Support Doc. (http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

Formative Assessment Tasks:

- Have students create a presentation to the public concerning the need for seatbelt use. In their presentation students must explain physics concepts learned in class.

- Develop and use a model to demonstrate to a small child the effects of both balanced and unbalanced forces on an object.
- Draw a picture that shows an example of action / reaction pairs and show the direction of the forces with vectors.
- Describe how the forces of friction and gravity affect playing your favorite sport.
- Make up and solve 5 speed calculation problems.

Formative Questions:

- You push on a crate with a force of 10 N to the right, and your friend pushes on the crate with a force of 25 N to the left. Describe and explain the motion of the crate.
- Forces of 10 N down, 10 N to the right, and 5 N to the left are acting on a ball. It accelerates horizontally to the right. What other force, if any, is acting on the ball? Explain.
- Two objects that have the same weight are dropped from a tall building. One object is larger and flatter than the other. Explain why the larger object hits the ground last.
- List the forces that act on a table tennis ball during a game and explain how they affect the ball.
- A net force of –10 N acts on a wagon moving at a constant velocity to the right. What happens to the wagon?
- When an object, such as an asteroid or meteoroid, travels through space at a constant speed and then enters the Earth's atmosphere, which two forces act upon it to change its speed?
- When a nail is pulled out of a wooden board, the nail becomes warm. Explain why.
- Two crates, one heavy and one light, are at rest on a waxed floor. Which crate will need the greater force to give the same change in speed? Explain.

- Explain why an object moves if the action-reaction forces are equal.
- Using a rocket as an example, describe Newton's Three Laws of Motion.

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8th Grade- Forces and Motion

Buckle Up!

MATERIALS: ruler, toy car or truck, board (~2 X 8 X 100 cm), 2 meter sticks, masking tape, books (total thickness of about 30 cm), flat box at least 40 cm long, sand, modeling clay (about 20 grams), and "seat belt" materials, including thread or fishing line, wide rubber bands, and shoelaces

OVERVIEW AND PURPOSE

Newton's First Law says that a moving object will keep moving unless an outside force acts on it. When you ride in a car, there are really two "bodies" in motion. You and the car are both moving at the same speed. What happens if the car suddenly stops? If you're wearing a seat belt, the seat belt will exert a force that stops you too. But if you're not wearing a seat belt, there is no outside force on you. You keep going forward at the same speed. In this lab you will

- observe and measure the motion of objects during a sudden stop
- investigate the effectiveness of different types of seat belts

PROBLEM

How does the speed of the car affect the distance that the "passenger" goes?

HYPOTHESIS

If I start the car lower on the ramp, then the clay

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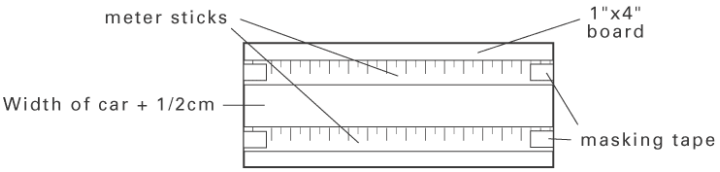
because

PROCEDURE: PART A

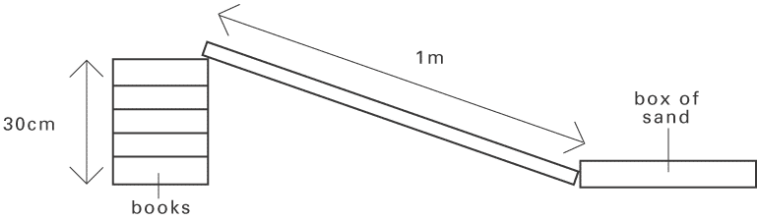
☐ 1. Measure the toy car at its widest point.

☐ 2. Prepare the board.



a) Tape the meter sticks on top of the board.
b) The distance between them should be 1/2 cm greater than the width of the car.

☐ 3. Prepare the ramp.

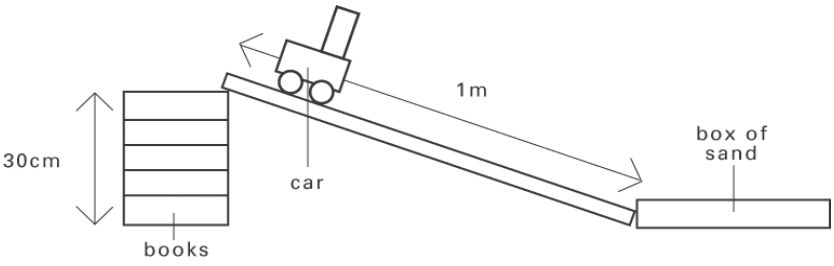


a) Place the 100-cm end of the board on a pile of books about 30 cm high.
b) Set the narrow end of the box on the floor at the bottom end of the board.
c) Add several centimeters of sand to the box and pat the sand smooth.

☐ 4. Make the driver.

a) Shape the clay into a cylinder about 2 cm in diameter and 3-4 cm in length.
b) Press the clay onto the top of the car so that it stays in place.

☐ 5. Release the car down the ramp.



a) Place the front end of the car at the 90 cm mark on the ramp.
b) Release the car.

☐ 6. Measure how far the clay driver goes.

a) When the car stops, measure the distance from the front end of the car to the mark in the sand where the clay hit.
b) Record the measurement in Table 1 in the 90 cm row.
c) Smooth the surface of the sand.

☐ 7. Do two more trials.

a) Repeat steps 5 and 6 two more times.
b) Record your distances in Table 1.
c) If necessary, reshape the clay to its original form each time.
d) Calculate the average distance the clay traveled. To find the average, add the three trials together and divide by 3.

Table 1. Distance Traveled by the Clay Driver				
Starting position	**Distance traveled by the clay (cm)**			
	Trial 1	**Trial 2**	**Trial 3**	**Average**
90 cm				
80 cm				
70 cm				

☐ 8. Change starting points.

Repeat steps 5-7 with the front of the car at 80 cm, and then at 70 cm.

PART B

☐ 9. Make a seat belt.

a) Use a piece of thread or fishing line for a seat belt.
b) Attach the clay to the car using a piece of thread or fishing line.

☐ 10. Test the fishing line seat belt.

a) Place the front end of the car at the 90 cm mark on the ramp. Release the car.
b) In Table 2, record what happens to the clay when the car stops.
c) Release the car two more times. Reshape the clay and reattach the fishing line seat belt before each trial.

☐ 11. Test different types of seat belts and record your observations in Table 2.

a) Repeat steps 9 and 10 using a rubber band to attach the clay to the car.
b) Repeat steps 9 and 10 using a shoelace to attach the clay to the car.

Table 2. Effects of Seat belt on Clay

Type of "Seat belt"	Effect on Clay
Thread	
rubber band	
shoelace	

OBSERVE AND ANALYZE

1. Identify Variables In Part A, what factors influenced the distance that the clay flew?

2. Interpret Compare your results from step 8 to your hypothesis. Did your results support your hypothesis? If not, why not?

3. Analyze In Part B, how could you attach the clay to the car to produce the least damage to the clay? Why does this method produce the least damage to the clay?

CONCLUDE

1. Predict How far do you think the clay would have gone if you had started the front of the car at 100 cm? Why?

2. Analyze In Part A, how is the speed of the clay just after the car stops related to the speed of the car just before it hits the sand? Explain.

3. Apply Why should shoulder harnesses be used along with seat belts? Explain your answer in terms of motion and force

8th Grade- Forces and Motion

Buckle Up!

Standard
8.P.2 The student will demonstrate an understanding of the effects of forces on the motion and stability of an object.

Conceptual Understanding
8.P.2A. Motion occurs when there is a change in position of an object with respect to a reference point. The final position of an object is determined by measuring the change in position and direction of the segments along a trip. While the speed of the object may vary during the total time it is moving, the average speed is the result of the total distance divided by the total time taken. Forces acting on an object can be balanced or unbalanced. Varying the amount of force or mass will affect the motion of an object. Inertia is the tendency of objects to resist any change in motion.

Performance Indicators
8.P.2A.2 *Develop and use models* to compare and predict the resulting effect of balanced and unbalanced forces on an object's motion in terms of magnitude and direction.
8.P.2A.5 *Analyze and interpret data* to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

Science and Engineering Practice
8.S.1A.2 Develop and Use Models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
8.S.1A.4 Analyze and Interpret Data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

Cross Cutting Concepts:
2. Cause and effect: Mechanism and explanation: The National Research Council (2012) states that "events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts" (p. 84). *Forces cause a change in the motion and stability of an object. Newton's Laws of motion explain the cause and effect relationships between forces, motion, and mass.*
4. Systems and systems models: The National Research Council (2012) states that "Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering" (p. 84). In this simple mechanical system, the interactions between forces and resulting changes in motion should be modeled using graphs or mathematical relationships.

References

South Carolina Department of Education. (2015). South Carolina Academic Standards and Performance Indicators for Science 2014. Retrieved from http://ed.sc.gov/scdoe/assets/file/agency/ccr/StandardsLearning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

8th Grade- Forces and Motion

FRICTION FACTORS

Step #1 Question: What factors affect frictional force?

Step #2 Research: Friction is a force that one surface exerts on another when they make contact with each other. Friction acts in a direction opposite to the direction of the moving object. Friction will eventually cause an object to come to a stop. Surface friction occurs between any two surfaces that touch or rub against one another. The cause of surface friction is mutual contact of irregularities between the touching surfaces. The irregularities act as obstructions to motion. Even surfaces that appear to be very smooth are irregular when viewed microscopically. Luckily, during motion surface friction is unaffected by the relative speed of an object; even though the speed of an object may increase, the force of surface friction will remain constant. This means that the same force is required to slide an object at a slow or fast rate of speed on a given surface. The amount of friction acting between two surfaces depends on the kinds of material from which the two surfaces are made and how hard the surfaces are pressed together. For example, ice is more slippery than concrete; therefore, ice has less friction or less resistance to slippage. A heavier brick is harder to push and has more friction than a lighter brick only because the heavier brick pushes into the ground with more force or weight.

Step # 3 Hypothesis: _____

Step #4 Plan:

A. Variables: Independent _____ Dependent _____

Controlled _____

B. Materials:

- 2 - 2 " x 3" x 6" wood blocks (per group)with small screw hooks attached (Mass = _____g)
- Masking Tape
- 1 ea. (5 N & 20 N) spring scale
- Different surfaces (lab table, carpet sample)

C. Procedures:

1. To test for surface area: Turn one block on its side. Attach the 20 N spring scale. See how much force is required to start pulling it across your lab table. If the spring scale reading is less than 5N, switch to the 5 N spring scale. Repeat this 4 more times recording the force in Newtons on your table. Repeat this procedure again 5 times using the large side of the block.
2. To test for weight: Use one block. Attach the 20 N spring scale. See how much force is required to start pulling it across your lab table. If the spring scale reading is less than 5N, switch to the 5 N spring scale. Repeat

this 4 more times recording the force in Newtons on your table. Repeat this procedure again 5 times with the other block taped to the first block in a way that the masking tape does not touch the surface in contact with the lab table. Be sure to use the same side of the block as you did in the first 5 trials.
3. To test for surface type: Take one block and attach the 20 N spring scale. See how much force is required to start pulling it across your lab table. If the spring scale reading is less than 5N, switch to the 5 N spring scale. Repeat this 4 more times recording the force in Newtons on your table. Repeat this procedure again 5 times using the carpet sample as a surface. Be sure to use the same side of the block as you did in the first 5 trials.

Step #5 Data Tables:

Surface Area	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Small Side					
Large Side					

Weight	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
1 Block					
2 Blocks					

Surface Type	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Lab Table					
Carpet					

Step #6 Graph:

Step #7 Conclusion (Things to include in your discussion: which factors affect friction, weight, surface type, or surface area? What data did you get to support your hypothesis? What other things may have affected your results (errors)(ex. spring scale at an angle, different sides of the block might have a different grain which can affect results)?

8th Grade- Forces and Motion

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