



Classroom Teacher Preparation

Physics 3: Collisions

Please use the following to prepare for the next SfS lesson.

Description:

Students explore a “marble roller coaster” with two marbles that can collide with each other. Students ask questions about their observations and then test a few of their questions about force or energy with the apparatus. Groups describe their experiments and share the conclusions they draw based on their results. *Note that this lesson can be taught with an explanation given in terms of energy (4th grade standard) or in terms of forces (3rd grade standard).*

Lesson Objectives – SWBAT (“Students Will Be Able To...”):

3rd-5th

- (3rd) Explain what unbalanced forces cause stationary marbles to begin to move and rolling marbles to change direction or speed
- (4th-5th) Explain that energy is transferred when a moving object collides with a stationary object
- (4th-5th) Identify a way to change the amount of energy that is transferred

Disciplinary Core Idea (DCI)

3rd - PS2 Motion & Stability: Forces and Interactions - PS2.A Forces and Motion and PS2.B Types of Interactions

- (3rd-5th) The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion...

4th-5th - PS3 Energy - PS3.A Definitions of Energy and PS3.B Conservation of Energy and Energy Transfer

- (3rd-5th) Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.

Science & Engineering Practice (SEP)

Asking Questions

- (3rd-5th) Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

Crosscutting Concept (CCC)

3rd - Cause and Effect: Mechanism and Prediction

- (3rd-5th) Cause and effect relationships are routinely identified, tested, and used to explain change

4th-5th - Energy and Matter: Flows, Cycles, and Conservation

- (3th-5th) Energy can be transferred in various ways and between objects.



Preparation:

This lesson can be an introduction to energy transfer during collisions, but it will be helpful if students are already familiar with the concept that objects in motion have energy, and the faster they move the more energy they have.

Room Set Up for Activities:

Students will work in groups of 2-3, 16 groups max, to ask questions that can be tested by rolling marbles down a track into a cup. The tracks are 6 feet long and are designed to start from a height of 12 inches off the ground. The tracks can either be taped to a stack of books, a box, or directly to the wall, and may be adjusted by students during the activity, but there must be room for each group's track to stretch out straight for 6 feet.

Safety:

The marbles are glass and there is a possibility that they can break. The initial hill of the track should not be higher than table height. Students should not throw the marbles and should keep them on the tracks or in the cups.

Related Modules:

This lesson may be taught as part of a sequence or group of related modules on **Energy** or **Force & Motion**. Modules include:

Physics 16: Energy – This station-based module familiarizes students with many forms of energy. Students explore various conversions of energy through different activities.

Physics 10: Sound – This station-based module introduces students to sound. Students focus on how to change the pitch and volume of different simple instruments at each station.

Physics 5: Pendulum Patterns – Students are introduced to pendulums and their periodic motion. After experimenting individually with pendulums of different lengths and bob masses, they systematically measure the period of pendulums with different lengths.

Physics 19b: Friction Basics – This lesson introduces the concept of friction. Students experiment with different surfaces and rank the relative amounts of friction as different surfaces slide on a tray.

For other module sequences and groups, look here: www.sciencefromscientists.org/sequences

Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state: www.sciencefromscientists.org/standards/

Lessons are matched to both national NGSS and local state standards.

After Our Visit:

Extend this lesson by playing a game of Ring TAW: Use shooter marbles to knock marbles out of a ring.

Access this Extension activity by visiting the Classroom Post found on our website at sciencefromscientists.org/cohorts. Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at sciencefromscientists.org/open-response-questions. They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

Additional Resources:

- Activity adapted from <https://mysteryscience.com/energy/mystery-2/energy-conversion-engineering/33?r=46102584#>



- Natural follow-up to this lesson is the next Mystery Science lesson on potential energy and kinetic energy: <https://mysteryscience.com/energy/mystery-3/energy-collisions/34?r=46102584#>
- Force and Motion: Video Short <https://mass.pbslearningmedia.org/resource/idptv11.sci.phys.maf.d4kfom/force-and-motion/>
- Lesson: Energy Transfer in a Roller Coaster: <https://mass.pbslearningmedia.org/resource/midlit11.sci.splenergy/energy-transfer-in-a-roller-coaster/>