

8.1 Contact Forces

Unit Structure



Driving question: Why do things sometimes get damaged when they hit each other?

Lesson Set 1: How do objects interact when they make contact in a collision?

Lesson Set 2: How are changes in energy related to force interactions?

Lesson 1

Students compare national phone damage statistics to their classroom experiences and reenact some scenarios in which they observed damage to a cell phone firsthand.

Lessons 2-4

Students investigate how motion and shape changes in a variety of collisions. Students investigate the relationship between the force applied and the amount and type of deformation in an object.

Lessons 5-6

Students investigate how the strength of forces compare when two objects of different mass or speed collide. They apply what they figure out to explain and predict soccer-related collision phenomena.

Lesson 7

Students test how changes in mass and speed affect the kinetic energy of an object and develop mathematical relationships between these variables.

Lessons 8-9

Students develop and revise models for energy transfers in the cart launcher system. They carry out investigations into surface friction and air resistance interactions in that system.

Lesson 10

Students apply what they figure out to explain why, in different collisions, some objects were damaged and others weren't and apply their understanding to a new set of baseball-related collision phenomena.

Lesson Set 3: What can we design to better protect objects in a collision?

Lessons 11-12

Students recall Lesson 1 and develop design criteria and constraints for new phone cases. Students draft initial protection device designs for something they want to protect.

Lessons 13-14

Students dissect materials and analyze slow-motion collision data of the internal structure of these materials to understand why some reduce the peak forces in a collision better than others. Students redesign their devices using this information and stakeholder feedback.

Lesson 15

Students apply what they figured out during the redesign of their devices to evaluate other engineers' design solutions to the problem of protecting cheerleaders from concussions and draft their own solutions to this problem.

Lesson 16 (optional)

Students create a scale prototype of their design solutions and develop a presentation to share with potential investors.

Before Teaching the Unit



Watch the unit webinar.



Read the unit storyline.



Join the Facebook Group for the unit.



Review the Assessment System Overview in the Unit Overview to complete the Grading Planning Tool for the unit.



Review the Unit Overview, Material List and Lesson Teacher Edition to check for the required materials and supplies necessary for the unit. Take note of these unit-specific items related to materials:

- Carefully read the Lesson 2 material preparation in the teacher guide and view the teacher prep video. Preparing the sugar glass in advance takes time. Saltines can be used as an alternative approach.
- Lesson 5 and Lesson 9 investigations require extended preparation time. Before conducting them with students, it is helpful to consider the logistics of these investigations and conduct them yourself.
- Lesson 7 teacher guidance and materials provide multiple options for graphing investigation results.
- The consensus discussion in Lesson 8 builds on students' experiences with systems and subsystems from previous units. Students who have not experienced OpenSciEd units before might need scaffolding to consider system and subsystem examples.

While Teaching the Unit

- Watch teacher set-up videos for investigations.
- Keeping a running record of class discoveries and investigations throughout the unit to help absent students catch up and as a reference for future years. Approaches could include a teacher version of a student notebook, or a running shared Google document.
- Organize handouts and digital materials as you go for future use.

After Teaching the Unit

- Make notes of future revisions, modifications.
- Take pictures of posters, consensus models and exemplary student work.
- Survey students at end of unit for feedback and self-reflection.

Unit Fast Facts for Planning

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| Unit Length | 16 Lessons, 33 Days |
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| Lessons with Hands-On Investigations | 1, 2, 3, 4, 5, 7, 9, 12, 13 |
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| Lessons Requiring Student Devices | 7, 9 |
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| Lessons that Require In-Advance Material Preparation | 2, 3, 4, 5, 9 |
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| Lessons with Mid-Point or Summative Assessment Moments | 6, 10, 15 |
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