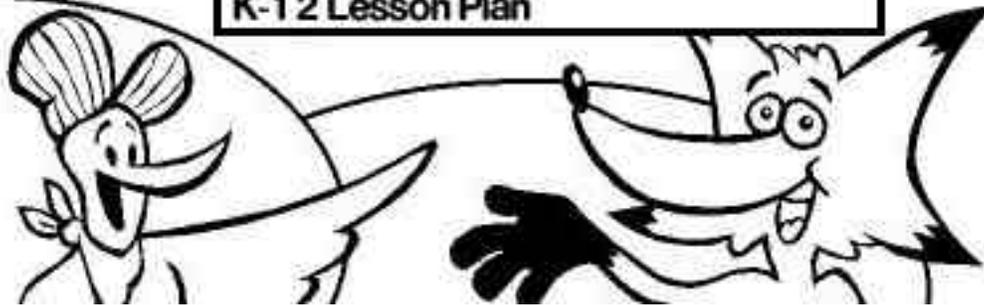




K-12 Lesson Plan



Hit and ????

Grade: Eleventh and Twelfth Grades

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OVERVIEW

This lesson provides three options for completing a lab experiment, depending upon the equipment available. The lab demonstrates the effects of the impact between a train and a car and illustrates the principle of momentum before and after collisions.

SUGGESTED TIME ALLOWANCE

One or two 40-50 minute class periods, depending upon version of experiment done

OBJECTIVES

Students will be able to:

- Demonstrate the effects of impact between a train and a car.
- Discuss difference between size and mass.
- Analyze change in momentum before and after collision.
- Relate the experiment to train-car incidents that can occur if safety messages are not followed.

SAFETY MESSAGE:

- If your vehicle stalls on a railroad crossing, everyone should get out of the vehicle and run in the direction of the train and away from the tracks.

National Academic Content Standards addressed by this lesson.

MATERIALS

Physics Problems Handout – one per student

Activity 1:

- 1000 gram solid weight
- Ring stand with large ring
- Facial tissue
- Scotch or masking tape
- One pea from a can of peas

Activity 2:

- Pitsco basswood CO₂ cars
- CO₂ cartridges with detonator
- Fish line (60 feet)
- Wooden blocks and screw eyes
- 1 box toothpicks
- 1 can of peas
- Small piece of modeling clay

Activity 3:

- Air track

VOCABULARY

Mass, velocity, speed, momentum

PROCEDURES

TEACHER PREPARATION:

Refer to the teacher's guide for solutions to physics problems.

Review the difference between velocity and speed, if necessary, in order to lead discussion with students. If using an air track, test it out before use and develop the third activity more thoroughly, based upon activity #2. Refer also to the general background information about trains and railways.

MOTIVATION:

Give different-sized matchbox cars to three students. Have them come up in the front of the room and play with the cars, making sure to demonstrate collisions. Ask the rest of the class to observe what happens to the cars' positions before and after collisions: *What do you note about the impact on a car that is in motion when it is hit? A car that is standing still when it is hit? The car that is being hit vs. the car that is hitting?* Also, have students notice the different sizes of the cars and how this might affect what happens to the car. Lead in to description and purpose of lab experiment.

ACTIVITY:

Choose the option that works best for your class.

Activity 1- Students follow these steps:

1. Place a single layer of tissue across the large ring and tape it down.
2. Set the pea in the middle of the tissue and set the ring stand on the floor. The pea represents the car.
3. Suspend and tether the weight about five feet above the ring. (The weight represents the train.)
4. Drop the weight. (Be sure the weight stops before it hits the ground.)
5. Observe the pea after the collision and any change in the speed of the weight.
6. Write a conclusion.

Activity 2- Students follow these steps:

1. Assemble a car (per kit instructions) to represent a train.
2. String 60 feet of fish line, on which the car will run. Attach the line to screw eyes on wooden blocks at each end.
3. Place a pea on a toothpick to represent a car and put it on a piece of modeling clay or tape.
4. Detonate the CO₂.
5. Observe what happens to the speed of the "train" and effect on the "car."

6. Write a conclusion.

Activity 3- Set up an experiment similar to Activity 2 using the air track.

CONCLUSION:

After students complete the activity, have them work out the physics problems provided on the student worksheet. Discuss momentum, force and impact during collisions, as observed in experiments. Emphasize car-train collisions. Review relationship of experiment to safety messages.

HIGHER ORDER THINKING

To assure students are using critical thinking skills, present questions such as these at an appropriate place within the lesson: *What different things could happen to a car during/after a collision? List at least three examples. Why do these different things happen?* Discuss forces, differences in velocity, speed and mass of trains.

ASSESSMENT

- Completion of lab activity as member of a group (Demonstrate the effects of impact between a train and a car.)
- Participation in discussion (Discuss difference between size and mass.)
- Completion of problems on worksheet and conclusions (Analyze change in momentum before and after collision.)
- Discussion (Relate the experiment to train-car incidents that can occur if safety messages are not followed.)

EXTENSIONS

Language Arts/Communications: Have students produce a short video to demonstrate why safety messages should be followed.

Driver's Ed: Have students present their findings to a class of students

who are preparing for their driver's permit.

TEACHER RESOURCES

Die Hard If You're Dumb video

Die Hard video clips (Quicktime Required):

Vehicles Crash with Train

Three Areas of Railroad Safety

Trespassing Facts

Judging Train Speed

Video utilization tips for *Die Hard If You're Dumb*

Teacher's guide for physics problems

General background information

NATIONAL ACADEMIC CONTENT STANDARDS

These standards are provided by the Mid-continent Regional Educational Laboratory (McREL) online publication, Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education. <<http://www.mcrel.org/standards-benchmarks/>>

The following standards are addressed by the activities of this lesson:

Language Arts

Level IV: High School (Gr. 9-12)

Standard 1: Demonstrates competence in the general skills and strategies of the writing process

Benchmark: Writes compositions that fulfill different purposes (e.g., to reflect, to analyze, to persuade)

Mathematics

Level IV: High School (Gr. 9-12)

Standard 1: Uses a variety of strategies in the problem-solving process

Benchmark: Uses formal mathematical language and notation to represent ideas, to demonstrate relationships within and among

representation systems, and to formulate generalizations

Standard 3: Uses basic and advanced procedures while performing the processes of computation

Benchmark: Adds, subtracts, multiplies, divides, and simplifies rational expressions

Benchmark: Uses a variety of operations (e.g., finding a reciprocal, raising to a power, taking a root, taking a logarithm) on expressions containing real numbers

Science

Level IV: High School (Gr. 9-12)

Standard 12: Understands motion and the principles that explain it

Benchmark: Knows that laws of motion can be used to determine the effects of forces on the motion of objects

Standard 15: Understands the nature of scientific inquiry

Benchmark: Designs and conducts scientific investigations by formulating testable hypotheses, identifying and clarifying the method, controls, and variables; organizing and displaying data; revising methods and explanations; presenting the results and receiving critical response from others

To see related standards for your state, search [Achieve's Clearinghouse](http://www.achievetest.org/achieve/achievestart.nsf/Search?OpenForm):
< <http://www.achievetest.org/achieve/achievestart.nsf/Search?OpenForm> >

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