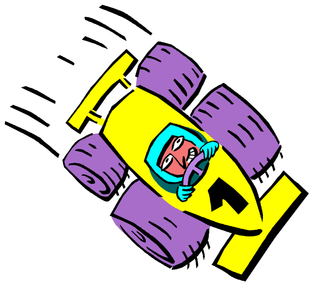
Ramp It Up

Lesson at a glance:
Students will begin to understand the difference between potential and kinetic energy and conduct an investigation to discover how a toy car's vertical position or height on a ramp affects the distance it travels.

Skills:
Investigating, Measuring, Recording, Predicting, Cooperating, Calculating, Graphing

Grades:
3-5



Materials:
Per group of two students:
- A ruler
- A marking pen
- Four thick books
- One Hot Wheels toy car
- One piece of thick cardboard or foam board (about 30" long and at least
- 3" wide)
- Two 2.5" x 28" strips of poster board (cut from a 22" x 28" sheet of poster board) folded the long way to make a "track"
- Tape
- "Ramp It Up Data Sheet"

Background:
Potential energy is energy that is stored within an object either because of its position or the way in which its parts are arranged. A car parked on the top of a hill, the chemical energy in gasoline, and a coiled spring are all examples of potential energy. Kinetic energy is the energy of motion. A boulder rolling down the hill is an example of kinetic energy.

In the activity below, when the car is being held at the top of the ramp, it has energy stored in it due to its elevated position above the floor. This stored energy is potential energy. When the vehicle is released, the pull of gravity acts on the vehicle, and the car rolls down the ramp. As the car travels down the ramp, its potential energy is converted into energy of motion or kinetic energy. At the bottom of the ramp all of the car's potential energy has been changed to kinetic energy. The car eventually slows down and stops because of friction.

The distance the car travels will depend on how much energy was originally stored in the vehicle when it was at the top of the ramp and this depends on the car’s vertical position or height above the floor and the steepness of the ramp. If the car’s starting point on the ramp remains constant and the length of the ramp is not changed, the vehicle’s speed and the distance it travels after it leaves the ramp will depend on the height of the ramp.

Activity:

1. Divide your students into groups of two.
2. Have each pair decide who will be the recorder and who will be the measurer.
3. On the poster board strips that will serve as the track, have the students draw straight lines lengthwise ½” in from both edges of each of the strips and then tape both strips together. Have the students use their rulers to fold the edges along the lines to create a track. See Figure 1.

   
   Figure 1

4. Have the students draw a straight line across the width of the cardboard or foam board five inches from one end of the board. Explain to the students that his line will serve as the starting line for the car.
5. Have each pair construct a ramp by stacking four books on top of each other and then placing the end of the board with the starting line on top of the books. Tell the students to line the starting line up with the edge of the stack and to apply tape at the base of the ramp to keep it in place.
6. Now have the students tape their track to the ramp, taping one end at the starting line and the other end on the floor beyond the edge of the ramp.
7. Have the students develop a hypothesis regarding at what height on the ramp they think the car will have the most stored energy or potential energy. Have the students record their hypothesis on the Ramp It Up Data Sheet.
8. Have the measurer measure the height of the ramp from the floor to the starting line at the top of the ramp.
9. Have the recorder record the height.
10. Have the measurer place the car immediately behind the starting line and release it. Tell the students they are not to give the car a push.
11. When the car has stopped, have the students measure how far the car traveled from the end of the ramp to where it came to rest (measured to the rear tires of the car).
12. Repeat steps 10 and 11 for a total of five trials. Have your students calculate the average distance traveled for the five trials. (The total distance divided by the number of trials equals the average distance traveled.)
13. Have the students remove one of books from the stack of four and repeat steps 8-12.
14. Have the students remove another book from the stack of three and repeat steps 8-12.
15. Have the students remove another book from the stack of two and repeat steps 8-12.
16. Have the students construct a graph showing the relationship between the height of the ramp and the average distance traveled in each case.

Conclusion:

1. Ask students: At which height did your car have the greatest potential energy? Why?

Extensions:

1. Ask students: How do you think the potential energy will change if you change the length of the ramp but keep the height of the ramp the same? Design an experiment, including procedure, to test this problem.
2. Give each pair of students a stopwatch and ask them to design an experiment to see how changing the height of the ramp affects the speed of the car.

Ramp It Up Data Sheet

Names: ____

____

Hypothesis:

____

____

____

____

____

Height of Ramp (four books):________________________

Trial Number	Distance Traveled
1	
2	
3	
4	
5	

________________________ **÷ 5 trials =** __________________________

Total Distance Traveled **Average Distance Traveled**

Height of Ramp (three books): ______________________

Trial Number	Distance traveled
1	
2	
3	
4	
5	

______________________ ÷ 5 trials = ______________________

Total Distance Traveled **Average Distance Traveled**

Height of Ramp (two books): ______________________

Trial Number	Distance traveled
1	
2	
3	
4	
5	

______________________ ÷ 5 trials = ______________________

Total Distance Traveled **Average Distance Traveled**

Height of Ramp (one book): ______________________

Trial Number	Distance traveled
1	
2	
3	
4	
5	

______________________ ÷ 5 trials = ______________________

Total Distance Traveled **Average Distance Traveled**

Graph Your Data

Height of the Ramp

0

Average Distance Traveled