

## Exploring Momentum Post-Lab Activities

### More Fun with Momentum

Action: Students conduct additional experiments with objects rolling down ramps changing a different variable each time.

Background: The momentum of an object is defined by the product of its mass times its velocity. When one of these quantities is increased, the object will have more momentum and will therefore travel farther before forces of friction stop it from moving. When the students roll the ball down the ramp in the class activity, the velocity of the ball changes each time the ramp height is changed. The mass of the ball, of course, stays the same. When the ball is released from a greater height, it has more potential energy since it has more time for gravity to act upon it before it reaches the table. Gravity accelerates the ball downwards until it reaches the bottom of the ramp. From that point on, the ball will continue to roll at decreasing velocities until it is stopped by friction. The greater room for acceleration in a high ramp causes a greater velocity at the bottom of the ramp. This is why it is so important to convince students to let go of the ball instead of pushing it down the ramp. Any additional force exerted on the ball will increase its velocity and hence its momentum. Gravity is the only force we can be sure will be constant. In the classroom, it is possible to try objects with different masses while keeping the ramp at the same height. We encourage you to experiment with changing both variables, but we recommend that you change one at a time so students can see how each variable affects an object's momentum.

Procedure: The basic idea of testing how far a ball rolls down the ramp can be extended in a classroom setting using easily accessible materials. Students can make a simple ramp by leaning a book against a stack of books. The height of the ramp can be altered by adding or reducing books to the stack. Students can also test different balls on the same ramp and draw conclusions as to what type of ball will roll further (ex. one that is heavier or one that is bigger?). Try taking the students to a larger area (ex. playground, gymnasium, sidewalk) to try rolling larger objects. An object such as a tennis ball will roll quite far even from a short height and can probably not be tested on a standard student desk. With enough space, you can get quite creative and let students bring in different objects to test. Imagine rolling a steel ball bearing versus an orange. Challenge the students to have two objects of different mass roll the same distance by varying the ramp heights from which they are released.

Extension: It is always a good idea to help students summarize their results. This can be done graphically or numerically, but it helps students bring together each part of what they are doing.

\*\* For younger kids, we have attached an activity that will help you discuss why we need ramps and why we should worry about how far things will roll. If you are creative with what you use for wheels and how you attach the axles, students can even do experiments with their manmade vehicles. These activities were taken from **Vroom! Vroom! Making 'dozers, 'copters, trucks, & more** by Judy Press, published by Williamson Publishing, Charlotte, VT, 1997.