Student Instruction

Phase 1
Variable Balloon Staging: Part 1

QuickView
Work in small groups to construct balloon racers and test the effect of pressure on speed and distance.

Materials
Kite string (or monofilament)
3 balloons
Stopwatch
Straws
Tape measure
"Balloon Racer" worksheet
Scissors
Transparent tape

Procedure

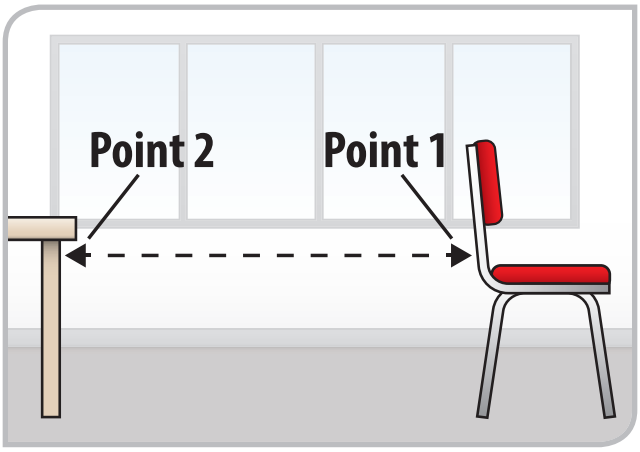
1. Find two points above the ground that are at least six meters apart to which you can connect a string (or monofilament). Point 1 and Point 2 should be the same height above the ground (at least 0.6 meter). There should be no slope to the string track. The backs of two chairs might work well (Figure 1).

2. Using the tape measure, measure the distance between these two points. Record this length on your "Balloon Racer" worksheet in the Setup 1 section. Record the slope as 0.

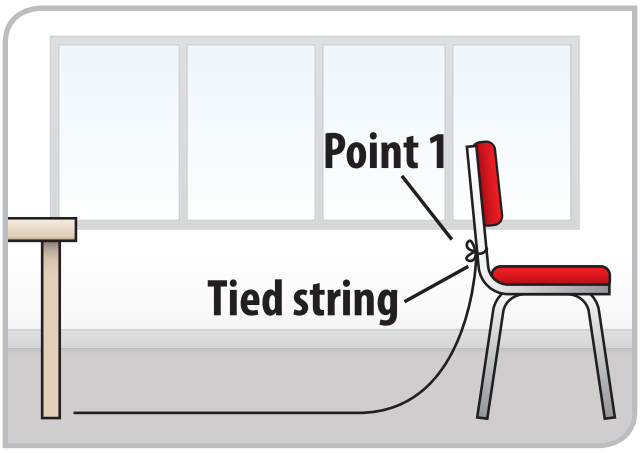
3. Cut a length of string a little longer than this length and either tape or tie one end of the string to Point 1 (Figure 2).

4. Thread the other end of the string through a straw and slide the straw all the way down the string to Point 1. Now, connect the loose end of the string to Point 2. Make sure the string is taut – stretched tightly between the two points.

5. Cut two lengths of string. The first should be 60 centimeters. The second should be 75 centimeters. These pieces of string will be used to measure the amount of inflation.



(Figure 1)



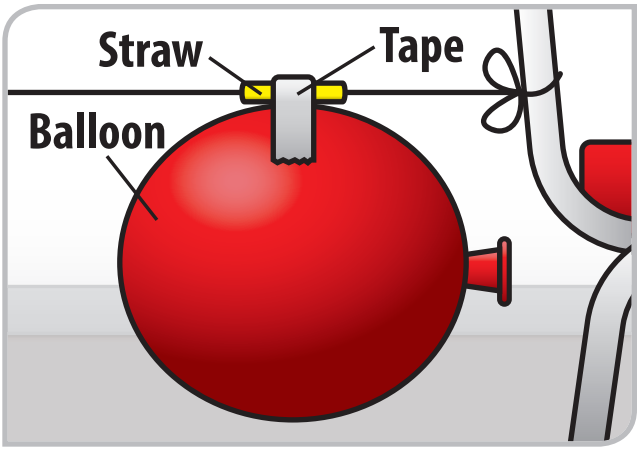
(Figure 2)

Student Instruction

6. Blow up one of the balloons until it is just large enough that the 60-centimeter piece of string goes around its circumference (the distance around the outside of a circle). The ends of the string should touch with no overlap.

7. Pinching the mouth of the balloon so that the air doesn't escape, tape the balloon to the straw at Point 1. The mouth of the balloon should be pointed at Point 1 (Figure 3).

8. Let go of the balloon. Time it with the stopwatch as it travels from Point 1 to whatever spot it stops at.



(Figure 3)

9. Write down the time on your "Balloon Racer" worksheet in the Trial 1 column. Measure how far it traveled and write that down as well.

10. Calculate meters per second using the method on the worksheet.

11. Repeat the experiment two more times, doing everything exactly the same way. This time, record your measurements and calculations in the Trial 2 and Trial 3 columns. Find the averages of the distance, time, and speed for Trial 1, Trial 2, and Trial 3 and record them.

12. Now, it is time to perform the experiment again with a different setup. This time, inflate the balloon until the circumference is 75 centimeters. Perform three trials with this setup and record the results.

13. For Setup 3, inflate the balloon to 60 centimeters. Change the slope of the string track. Lower Point 2 at least 0.3 meter. Calculate the new slope using the formula on your worksheet. Perform three trials with this setup and record the results.

14. On the worksheet, answer the question about Newton's third law. Leave the rest of the worksheet blank for now.

Balloon Racer Worksheet

Student Designer/Engineer: _____

Teacher: _____

Date: _____ Class Period: _____

Setup 1

String length: _____

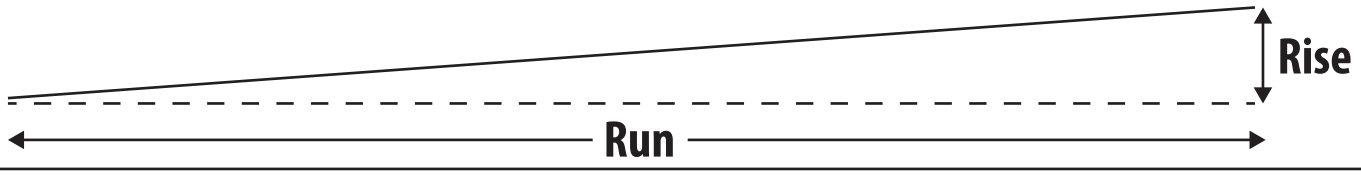
Balloon circumference: _____

Slope* = $\frac{\text{Rise}}{\text{Run}}$ ⟶ _____ = _____

	Trial 1	Trial 2	Trial 3	Average
Distance				
Time				
Speed**				

*The formula for calculating slope is rise over run, written as a fraction. Measure the difference in height between Point 2 and Point 1. This is your rise. The run is the length between the two points. This can be measured in centimeters or meters, but your units should be the same for both measurements. Reduce the fraction to lowest terms.

**To find the speed, divide the distance (in meters) traveled by the time (in seconds) taken. Write the answer in mps, or meters per second.



Setup 2

String length: _____

Balloon circumference: _____

Slope = $\frac{\text{Rise}}{\text{Run}}$ ⟶ _____ = _____

	Trial 1	Trial 2	Trial 3	Average
Distance				
Time				
Speed				

Setup 3

String length: _____

Balloon circumference: _____

Slope = $\frac{\text{Rise}}{\text{Run}}$ ⟶ _____ = _____

	Trial 1	Trial 2	Trial 3	Average
Distance				
Time				
Speed				