

## Dune Buggy Challenge Lab

### Teacher's Guide

**Topic:**

One Dimensional Kinematics

**The following information is provided to the student:**

**Question:**

At what location must a moving car be located in order for a dropped marble to land in its seat?

**Purpose:**

To determine the distance out from a drop location where a *constant motion* cart must be located in order for a dropped ball to land in the cart.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Discussion of Results. The Data section should include an informative diagram of the physical situation; measured data (or symbols for customary quantities) should be recorded and labeled (with unit) on the diagram. An organized solution to the presented challenge should be shown and labeled; each step of the solution should be briefly annotated. The Discussion of Results should simply identify whether you successfully met the challenge. In the event that you were unsuccessful, you should identify and discuss possible sources of error.

**Materials Required:**

Battery-powered constant motion car; a small cup to be placed on the car; putty or masking tape to secure the cup to the car; meter sticks; a ball drop assembly; steel ball.

**Description of Procedure:**

A ball drop assembly is built using lab poles and clamps. A 6-inch long section of PVC pipe through which the steel ball is dropped serves the purpose of insuring that the ball is dropped straight down; this PVC pipe is clamped at the top of the ball drop assembly; the top of it marks the starting position of the dropped ball. A small cup (e.g., Dixie cup) is secured to the top of the car. Once shown the apparatus and having read the Purpose, students make measurements of the speed of their car and the height of the ball drop apparatus. They then combine the free fall kinematics of the steel ball with the constant motion mathematics of the car in order to calculate the horizontal distance which the car must be from the drop location in order for the dropped ball to land in the cup on top of the car.

**Alternative Materials and Procedure:**

Alternative procedures are not recommended.

**Safety Concern:**

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that working environment is as safe as possible. Student *horseplay* (especially the act of using the steel balls as long-range and high speed projectiles) and off-task behaviors should not be tolerated.

**Suggestions, Precautions, Notes:**

## The Laboratory

1. It is useful to have students use the same constant motion car which they used in the Speedometer Lab and the Interpreting the Slope Lab. Students may want to quickly re-measure the speed of the car.
2. Do not allow students access to the ball prior to making their calculation.
3. Three or four ball drop apparatus' can be arranged about the room. Student groups can be assigned to a specific location. Have the drop location at different heights for different stations limits the amount of unproductive cheating which occurs.
4. Students often fail to account for the height of the cup above the ground.
5. Having a drop height of at least 1 meter and preferably 2 meters above the floor insures that student success is the outcome of good physics and not good guessing.
6. A line of meter sticks or a straight piece of wood (or other object) can be used to insure that the car travels in a straight line. When placed on the floor, they will guide the car to a spot directly under the drop location.

### Auxiliary Materials:

None

### Scoring Rubric:

<b>K10. Dune Buggy Challenge Lab</b>	<b>Score</b>
___ Included, labeled and organized all parts of the lab report.	
___ Data section includes an informative and labeled diagram; distances and other information is labeled. An organized solution to the lab challenge is shown and labeled. The logic behind each step of the solution is annotated. Calculations are correct. Prediction was successful.	___/___
___ Discussion of Results identifies the results as being either successful or unsuccessful. If unsuccessful, possible sources of error were discussed.	

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/1DKin/u115b.cfm>

<http://www.physicsclassroom.com/Class/1DKin/u115c.cfm>

<http://www.physicsclassroom.com/Class/1DKin/u115d.cfm>

### Connections to Minds on Physics Internet Modules:

None