

Race Track Lab

Teacher's Guide

Topic:

Circular Motion and Satellite Motion

The following information is provided to the student:

Question:

What is the most effective strategy for successfully guiding a simulated car around a race track using force buttons and how does the strategy relate to Newton's laws of motion and vector principles?

Purpose:

To use Newton's laws of motion and vector principles to successfully guide a simulated car around a race track using force buttons, to describe a successful strategy for doing so, and to relate the strategy to Newton's laws of motion.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion of Results. The Data section must include the instructors initials indicating that you successfully navigated the track (and also include any notes which you wish to take). The Conclusion/Discussion describes the features of a successful strategy, focusing on how to avoid troublesome situations and what to consider when confronted with a *difficult move*. Particular attention should be given to how to navigate a turn. The application of Newton's laws of motion to the strategy should be explicitly explained.

<http://www.physicsclassroom.com/shwave/racetrack.cfm>

Materials Required:

A page from The Shockwave Physics Studios:

<http://www.physicsclassroom.com/shwave/racetrack.cfm>

Description of Procedure:

Students log on to the above page and use the on-screen force buttons to guide a race car around an oval track. The horizontal and vertical components of the car's velocities are shown at every instant. Students will have to start over if they run the car off the track. The number of *moves* required to get from starting line to finish line is kept track of. S/he who finishes in the least number of moves wins.

Alternative Materials and Procedure:

An alternative is to simply do the lab for fun without asking students to report on their findings.

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 the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

Suggestions, Precautions, Notes:

The Laboratory

1. This is a challenging activity. Review in advance with students that a force causes a change in velocity, that a force in the direction of motion causes an object to speed up, that a force in the opposite direction of the motion causes an object to slow down, and that a force perpendicular to the motion causes an object to turn.
2. This activity may bring to mind a quote from Einstein: "The definition of insanity is doing the same thing over and over again and expecting different results." Resist the temptation of sharing the quote with your students.
3. Pairing students up may result in more learning than having them work alone.
4. This activity is an assessment of a number of concepts: velocity and acceleration, force and acceleration, inertia, the centripetal force requirement, components of velocity, and the independence of perpendicular components of motion. It is also an assessment of observation skills, problem-solving skills, intelligence, and experience with electronic gaming.

Auxiliary Materials:

None

Scoring Rubric:

CG3. Race Track Lab	Score
— Included, labeled and organized all parts of the lab report. — Data section includes the instructor's initials indicating a successful completion of the simulation; may include other information. — Conclusion/Discussion describes the elements of a successful strategy, explicitly referencing Newton's second law of motion and vector principles; accurately and thoroughly explained how to negotiate a turn.	—/—

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/circles/u6l1a.cfm>

<http://www.physicsclassroom.com/Class/circles/u6l1b.cfm>

<http://www.physicsclassroom.com/Class/circles/u6l1c.cfm>

Connections to Minds on Physics Internet Modules:

Sublevels 1 through 4 of the Circular and Satellite Motion module are suitable accompaniments to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>