

## Road Trip Lab

### Teacher's Guide

**Topic:**

Vectors and Projectiles

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

**Question:**

What overall displacement (magnitude and direction) and final destination results from the addition of three displacement vectors?

**Purpose:**

To determine the overall displacement and the final destination which results from the addition of three displacement vectors (beginning in Chicago).

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion, and a Post-Lab Questions section. The Data section should include the provided table of displacements; the table should be completed and the resulting displacement should be determined using trigonometry; all work should be clearly shown. The Conclusion (as always) should answer the question posed in the Purpose. The three provided questions should be answered.

**Materials Required:**

Map of the United States (with labeled cities and a scale); metric ruler.

**Description of Procedure:**

Students are provided with a map of the United States and three displacement vectors. The displacement vectors will take the student on a *road trip* from the starting location to a final destination which is marked on the map. When added in the provided order, the student will arrive at a marked city on the map after each individual displacement. When finished students can use trigonometric functions and vector components to determine the overall displacement.

**Alternative Materials and Procedure:**

The procedure can be modified by using a map of your state.

**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:**

1. Printable maps of the United States are available online. Select a map which has a few labeled cities or use a graphics program to place some strategic cities on a blank map.
2. Teacher preparation is required for this lab. Once a map is found, identify a few strategic cities and a starting city (Chicago is suggested but any nearby city will do). Using the indicated scale, plot out a three legged trip from the starting location to a final destination. Each leg of the trip should end

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in a labeled city on the map. Measure out the resulting displacement using a metric ruler and the indicated scale (or a calculator). Repeat for several destinations so that each student lab group can have a unique trip. Organizing the results of your preparation eliminates the need for repeating it next year.

3. This lab can be assigned as a take-home lab. Most students have some form of ruler at home (or they can be printed off the internet). The cm-to-inch conversion can be provided.
4. The overall displacement can be determined using the scale and the metric ruler. Emphasize to students that they are to use trigonometric functions and a component analysis to determine the overall displacement. They can use a measurement to check the validity of their answer.

### Auxiliary Materials:

None

### Scoring Rubric:

<b>VP4. Road Trip Lab</b>	<b>Score</b>
____ Included, labeled and organized all parts of the lab report. ____ Data section includes the provided table taped in. Table is completed; work is shown in each cell of the table; results of the work - both magnitude and direction - are clearly reported. Calculations are accurate. The sum of x- and y-components is determined and used to determine the resulting magnitude and direction; this work is shown in organized fashion somewhere in the report (beside the table or below it). The resulting magnitude and direction is reported in the appropriate box. Units are included. Results are accurate. ____ Conclusion states the resultant displacement resulting from the three-legged trip - both magnitude and direction - and identifies the ultimate destination. ____ Answers to post-lab questions are included; answers are accurate.	____/____

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/vectors/u311b.cfm>

<http://www.physicsclassroom.com/Class/vectors/u311d.cfm>

<http://www.physicsclassroom.com/Class/vectors/u311e.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevels 4 and 5 of the Vectors and Projectiles module are a suitable accompaniment to this lab:

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