InquirySpace Teacher Guides:
Ramp Game

1) Summary

The Ramp Game was designed to be the first game in the InquirySpace sequence and serves as a fun introduction to graphs in the CODAP environment. The initial goal of this activity is to position a car on a ramp such that it will stop at a target position. The target changes position and becomes smaller as students level up through the game. At first the friction is constant and the starting height on the ramp must be adjusted. Later on, the starting height is fixed and the friction must be adjusted.

At first, the game is easy and most students use trial-and-error to land on the target. This gets more difficult as the game progresses. In the later levels, students must use the graphs to succeed.

2) Learning Goals

Students will:

- Set and run a model, collect data for various values of the parameters (starting height and friction), and export it to the CODAP table.
- Use graphs to predict the necessary values for starting height and friction so that the car lands on the target.
- Interpolate values between given grid lines on a graph.
- Use the scaling, hide/show, connecting-lines and movable-line features in CODAP to study graphs.
- Explore relationships in the data when two overlapping variables are present.

3) Teacher Preparation

The most important step in preparing to run InquirySpace activities with students is to run the "Teacher Version" of each activity. These are available on the InquirySpace portal.

http://inquiryspace.portal.concord.org

Teacher versions are essentially duplicates of the student versions with the addition of tips for successful classroom use. These tips are written in red within each activity. By running the activities yourself, you will become familiar with many important elements of the activity including the:

- flow of the activity between Lab and Experiment Tabs,
- functionality within the CODAP environment,
- questions that students will be asked to answer, and
- approximate amount of time needed to complete it.

4) Materials

Break students into groups of three. Each group will need the following:

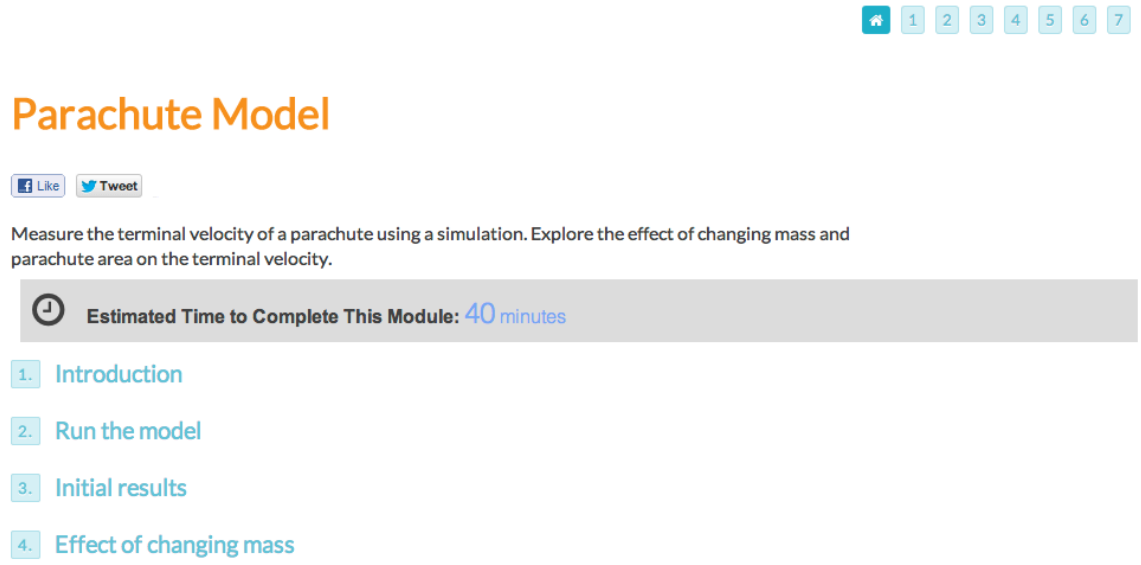
An account on the InquirySpace Portal. For help on registration and class set up, please see the Portal and Quick Start Guide.

Materials:

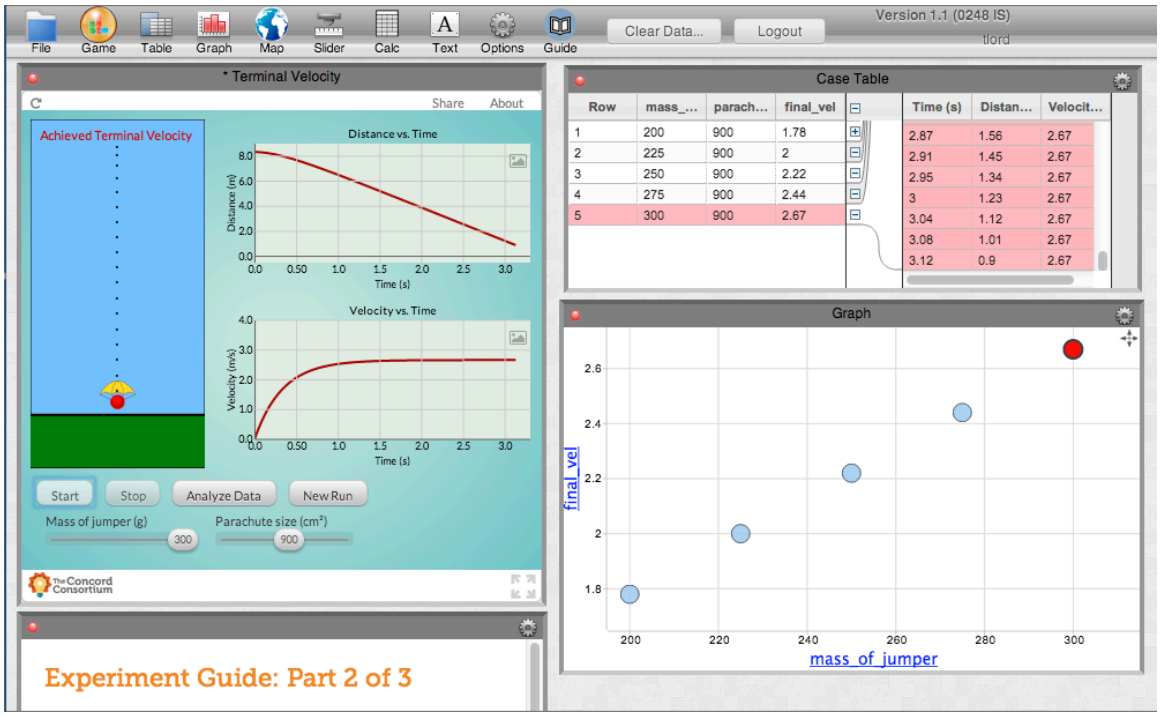
- Computer
- Internet connection

5) The Student Experience

When you run the Teacher Version of the activity, you will become more familiar with the flow of InquirySpace activities. The student version of each activity follows the same flow. When the student clicks the **Run** button under an activity, the activity will open in a new tab. Students should follow the steps of the activity in sequence. Any answers to questions within the activity are automatically saved to their account.

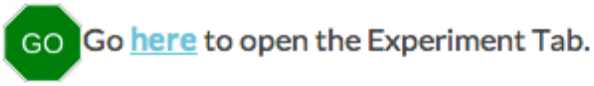


Each InquirySpace activity has two parts, the Lab Report (shown in the example screenshot above) and the Experiment Tab (shown in the example screenshot below).

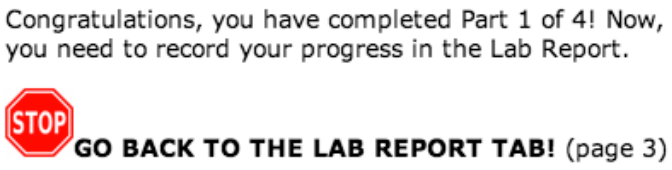


The Lab Report Tab is what is first launched via the Portal. The Lab Report for each activity gives background information and instructions for setting up experiments, asks questions, and saves answers. Eventually, the instructions within the Lab Report will ask students to collect and analyze data using the CODAP environment, which is referred to as the Experiment Tab. The Experiment Tab is where students will use sensors or run models to collect data, create graphs, and analyze data.

When it is time to use CODAP, students will see this sign in the Lab Report:

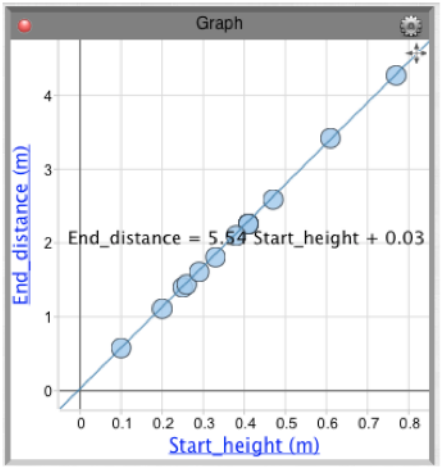


The CODAP environment will open in a new browser tab. CODAP is a separate piece of software with its own ability to save work. Work in the Experiment Tab is not yet shown in the Portal Reports (this feature is in development). As students work through the InquirySpace activity, they will move back and forth from the Experiment Tab to the Lab Report Tab. Remind students to read the instructions carefully and watch for Stop and Go signs! They will be directed to return to the Lab Report with messages like this:



6) Potential Trouble Spots

- Most students will lean toward trial-and-error, even when the game gets harder. Instruction and encouragement for interpreting the graphs will help. For instance, students can add a “movable line” to the graph. Since start height and end distance have a linear relationship, students can read the right starting height for each distance and the game will be much easier.



- Interpolating values between the given grid lines may prove to be a challenge. Students can rescale the graph to make estimating more accurate.
- There are various ways in CODAP to hide/show and highlight the various runs so that that can be analyzed one at a time. This may take some practice and extra instruction. One approach is to give each challenge a different color. The CODAP template is preset to do this. Another way is to highlight the data for an individual challenge in the table, which in turn highlights it in the graph.
- It will take some manipulation of the graphs to reveal the inverse relationship between friction and distance. This is explained in the activity.

7) Discussion Topics

Students will need your help to make their work with InquirySpace activities a meaningful experience. Help them make sense of their observations by facilitating full class and small group discussions at the beginning of class at the end of each activity and before the start of the next one. Often stopping a class in the middle of an activity for discussion is difficult because groups work at their own pace. However, bringing the class together between activities is an important role for teachers to play.

- How did you use the graph to help do the game?
- What was the difference between the effect of friction and the effect of starting height?
- What did you do to sort out the friction effect from the starting height effect?
- Why didn’t mass make a difference?

8) The Physics

- The physics is this game is correct, but it is likely that students will not think about that. They may just see it as an arbitrary interplay of variables. Engage students in discussion about the physics to help them understand how models are created to illustrate real-world phenomena.
- The height of the car up the ramp sets its energy (PE=mgh). The energy loss along the horizontal surface is directly proportional to distance traveled (E = Fd), since the friction force F does *not* depend on the velocity. Therefore, distance traveled is directly proportional to starting height and inversely proportional to the coefficient of friction.
- Mass has no effect on stopping distance. The acceleration down the ramp due to gravity is independent of mass, and the slowing down of the car is also independent of mass. The friction force slowing down the car is proportional to its mass, which exactly balances the inertia of the car.