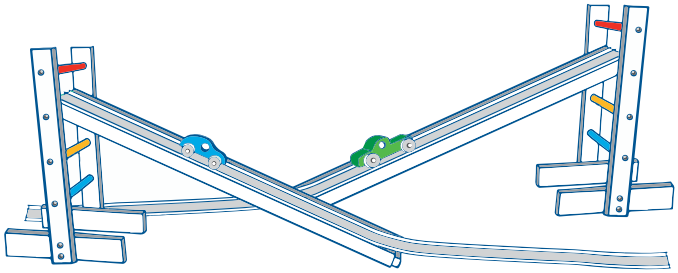


4. Ramp Height

Build Knowledge

INTRODUCTION

What Students Do in this Activity

In this activity, students begin to work in a more structured way with the cars and ramps. Students experiment with how ramp height affects how far cars move the crash box. Pairs of students choose one car to work with and explore how far the car moves the crash box when it is rolled down different ramp inclines. They record their data on ramp height and how far the crash box moves in a table and begin to draw conclusions (or reinforce prior knowledge) about the effect that ramp height has on how far the crash box is displaced. They also record their observations through drawing.

Objectives

Students will:

- Explore how scientists conduct trials
- Explore how the height of a ramp affects a car's momentum
- Share their results and discuss any conflicting results, as do scientists

Time

Because this activity is done by two pairs of students at a time, it will take a while to rotate all the students through the cars and ramps center. Refer to the Rolling Things Calendar (page 31) for additional information.

A-Ha

The higher the ramp, the more potential energy the car at the top has (as long as the car is launched from the top of the ramp each time). A car with more potential energy will have a higher velocity when it reaches the end of the ramp and—because momentum is the product of velocity times mass—it will also have more momentum.

Materials

For the teacher:

- 1 copy of **Letter from EarthToy Designs, Reproducible** Master 2
- 3 toy cars (convertible, truck, sedan)
- 1 ramp
- 1 ramp support
- 1 track
- 1 packet of sticky flags
- 1 measuring tape

For each pair of students:

- 3 toy cars (convertible, truck, sedan)
- 1 ramp
- 1 ramp support
- 1 track
- 1 crash box
- 1 copy of **Ramp Height Results, Reproducible Master 5**
- 1 measuring tape

For each student:

- 1 copy of **Testing Ramp Height, Reproducible Master 4**
- Car stickers (for **Ramp Height Results, Reproducible Master 5)**
- Science notebook (see Introduction for more information)

Preparation for the Activity

In *Presenting the Activity*, students will gather in a circle to discuss what they will be doing. Set up a ramp in the center of the circle and have some cars available for demonstration. Have students rotate through the cars and ramps area, two pairs at a time (at 10–15-minute intervals). Determine a schedule for student pairs. Take into account which pairs work best together when determining the schedule.

This unit begins to have students measure. While there is a measuring tape in the kit, if your students are not ready to formally measure, you can use the round sticker templates that come in the kit and put whole numbers down the side of the track.

CLASSROOM ACTIVITY

Presenting the Activity – Whole Group

1. **Gather students for circle time.**
   Have students sit next to their partners in the circle.

2. **Remind students of Letter from EarthToy Designs, Reproducible Master 2.**
   In particular, emphasize the line that says, *"We want to figure out: 2. How the height of the ramp changes a crash."*

3. **Ask students to think about how they might test how the ramp height changes the way a car crashes.**
   Have students turn and talk to their partners about strategies for testing ramp height.

   Encourage students to talk quietly and listen to their partners attentively. If students' conversations do not stay on topic, remind them that they should be discussing how they might carry out the tests. After about 45 seconds, ask some pairs to share their thoughts about how to test how the ramp height affects the way a car crashes. Some possible answers include the following:

   - *We'll start with the ramp at the highest spot and roll a car down. We'll mark how far the crash box moves. Then we'll try all the other heights the same way.*
   - *I think we should try every kind of car at every height.*

4. **Validate and synthesize students' responses.**
   For example, say, *"What I think I've heard is that…"* If appropriate, add, *"These are great ideas, and we are going to use some of them. You also will have a chance to try out some others as well."*

5. **Step through a procedure for testing how far the crash box moves using the ramp and cars in the center of the circle.**
   Explain that scientists and engineers are very careful about how they carry out tests.

   Elicit students' ideas about why scientists and engineers are careful about their testing. For example, you might ask them: *"Why do you think they need to be so careful?"* If students have trouble explaining why, it might help if you give them an example, such as, *"Why would an engineer need to be careful when she tests the metal that she's going to make a bridge out of?"* Guide students in thinking about problems that might arise if she is not careful. For example, the bridge might fail and cause people to be hurt.

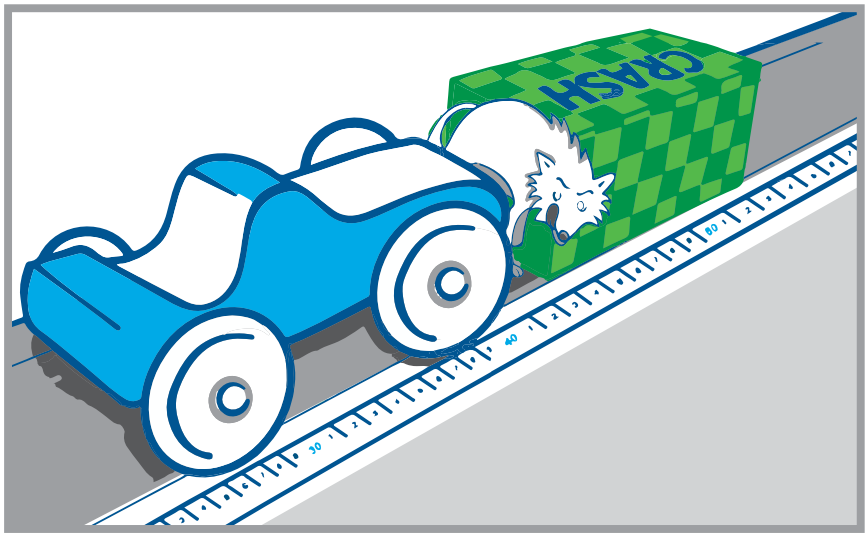
6. **Pass out copies of Testing Ramp Height, Reproducible Master 4.**
   The reproducible master shows a step-by-step procedure for carrying out ramp height tests.

7. **Ask a student or students to explain what they see in the drawings on the reproducible master.**
   The reproducible master shows the procedure for testing ramp height. First, students adjust the height of the ramp. Next, they place a car on the line at the top of the ramp. Then, they let go of the car. Last, they mark the final position of the crash box.

8. **Point out the arrow and the "3X" on the reproducible master.**
   Ask students to think about why scientists might do an experiment more than once.

   After a short discussion, synthesize student responses. If students do not make suggestions that results must be replicated to be valid, you might add something like, *"When scientists and engineers test something, they are very careful about how they do it. They always test things more than once to make sure that the results are the same or close to the same."*

9. **Explain to students how to measure how far the crash box moves.**
   Show them how to figure out how far the box moved by reading the number of centimeters on the measuring tape.



10. **Show students Ramp Height Results, Reproducible Master 5.**
    Explain that each pair will keep track of their results on this sheet. You may want to assign the job of recorder to one student in each pair.

    Model how to fill out the sheet. Students will note how far the crash box was moved in the boxes next to each ramp height. There is one box for each of the three trials a pair should carry out.

Facilitating Student Exploration – Pairs

11. **Show students how to carry out this activity during center time, with two pairs of students working in the cars and ramps area at a time.**
Accompany the pairs to the cars and ramps area and remind them that their job is to figure out how ramp height affects how far the car moves the crash box. Remind them that each pair will select one car to use for the testing. Each pair of students has their own cars and ramp set.

    Encourage students to talk quietly and listen to their partners attentively. Give students a minute or two to discuss.

12. **Observe pairs as each student launches his or her car for the first time.**

13. **Periodically return to the cars and ramps area when necessary to either remind students of the procedures they should be following or to ask them what they have observed.**
Remind students to keep track of their results on **Ramp Height Results, Reproducible Master 5**. Students may need help recording the information.

14. **Allow student pairs 10–15 minutes to test the ramp height.**
Explain that students will be sharing their observations with the whole class after everyone has finished with the activity.

    Explain the timeline to students as they complete their center work:
    It is time for us to finish up this activity. As scientists, it is important to explain what we have found out. When everyone has had a chance to explore how the height of the ramp affects how far the car moves the crash box, we'll share our results.

15. **Make copies of each pair's recording sheet and have students add their reproducible masters to their science notebooks.**

Teacher Tip:

The ramp ladder has color-coded rungs. The recording sheet shows a picture of each ramp height and a color.

Teacher Tip:

You may want to use the AWIM or parent volunteer to help you keep students on task or ask about their observations.

Sharing and Interpreting – Whole Group

16. **Gather all the pairs for circle time with their science notebooks.**
Ask each pair of students which ramp height made their car move the crash box the farthest.

    Students should have found that the highest ramp height caused the car to move the crash box the most. If any discrepancies arise, ask students why they think this might be. What might be different in what they did? Have them reproduce what they did for the class.

    Have students look at their record sheets and see whether the same car moved the crash box the same distance in each trial, or if there were times that the crash box moved very different amounts.

If students found variability in the distance that the crash box moved, ask them if they saw reasons for the differences. For example, students may have noticed that a car moved the crash box farther when the car did not touch the sides of the track. If there are large discrepancies, let them try again.

17. **Wrap up the group discussion.**
Ask students, *"What did you find out about which ramp height made the car move the crash box the farthest?"*

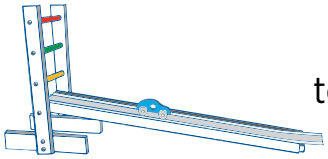
Follow up with these questions:

- *"Why do you think this is so?"*
- *"What ideas do you have about what makes the car push the box farther?"*

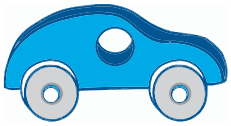
End by discussing how scientists deal with disparities in data collected.
Ask students, *"One of the things we seem to have found out is that you need to try things more than once. Why do you think that is so?"*

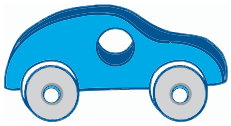
Students should recognize that it is important for test results to be consistent for them to be true.

TEST RAMP SETUP

1. Set the ramp  to one height.

3X

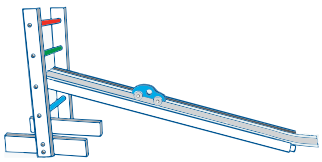
2. Put a car  on the line.

3. Let the car  go.

4. Put a sticky flag  where the crash box  stops.

5. Record your results in Reproducible Master 5

6. After the 3 trials, change the ramp height and start over.

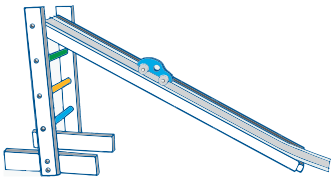
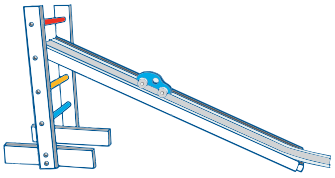
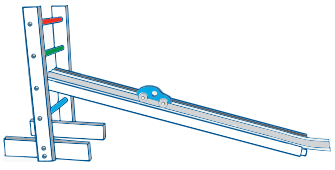
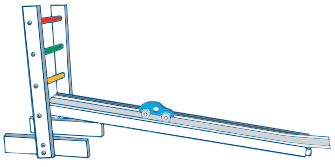


RAMP HEIGHT RESULTS

Names: _____

We tested this car:

Put a sticker in the circle below for the car you tested.

RAMP HEIGHT	TRIALS		
	1	2	3
 4 – RED			
 3 – GREEN			
 2 – YELLOW			
 1 – BLUE			