|  |
| --- |
| **Speed and Collisions**  |
| **Task with Student Directions** |
|

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Contributed by: Council of Chief State School Officers (CCSSO) **TO THE STUDENT**Welcome to this science exercise. We hope that you will find it interesting and worthwhile. Carefully read through these directions and the directions on the next page before you begin to work. You may be part of a group for the first part of this exercise. Each group should carry out the experiment and collect the data together, but each student must record the data in his or her own booklet. Be sure to record the data exactly as you observe them. After the data has been collected, each student should answer the questions independently. After you have finished your experiment and have recorded all of the data, you will be asked to answer some questions about the experiment and the data you recorded. Your answers must be written in this test booklet in the space provided. Make sure that you understand each question before you begin to write. At any time while you are writing your answers, you may look back to the directions for the experiment and the data you collected. Be sure that your answers are written as clearly and neatly as possible. Before you turn the page, read the list of materials given below and check to make sure that your group has everything listed.

|  |  |
| --- | --- |
| **Materials**

|  |
| --- |
| * car
* block
* track
* ramp
* stopwatch
* tape
* books
* meter stick
* calculator
* scissors
* pen or pencil
 |

 |

**AFTER YOU HAVE READ THE DIRECTIONS, TURN TO THE NEXT PAGE AND BEGIN.****The Effect of Speed on Car-Barrier Collisions** Cars are the most common means of transportation in this country. Although driving is usually safe, accidents do occur because of unsafe driving practices (such as speeding) or unsafe road conditions. Accordingly, car manufacturers have spent millions of dollars in an attempt to make cars safer to drive. The laws of physics describe the interaction of force, mass, and acceleration in a collision. In this event you will use a model system to investigate how the speed of a car affects the results of the collision of the car with a barrier. You will be varying the location on a ramp from which a car starts to roll. *Work in groups of four.* * Set up the equipment as shown in the diagram below.

http://pals.sri.com/tasks/9-12/Speed/swgifs/speed1.gif* Using a ruler and a pencil, carefully measure and mark the centers of two opposing faces of your wooden block.
* Place books under one end of your ramp surface so that the end of the ramp is elevated 20 to 25 cm. You will use this inclination throughout the experiment.
* Place the wooden block about 1 inch from the bottom of the ramp. Mark this position with tape so that you can return the block to the same starting position during the experiment. You may need to adjust this distance depending on your ramp. Your goal is for the car to hit the block after it builds momentum rolling down the ramp.
* Put your track on the ramp. You may need to cut the track with scissors to fit the ramp. Use tape to secure the track to the ramp if necessary. Choose a position on the ramp from which to start the car rolling. Mark this position with tape. This is the variable that you will change as you proceed.
* Remove the car (temporarily) and use your ruler to measure the distance between the front of the car and the front edge of the barrier. Record this distance in Table 1.
* Place the car back on the ramp exactly where you had marked it before. Hold it in position with a pencil or ruler and release it by lifting **upward** on the pencil or ruler. Start the stopwatch when you release the car and stop the stopwatch when the car hits the barrier.
* Measure the distance the barrier moved after the impact with the car. (After the collision, measure the distance from the original barrier front position to the center mark facing the ramp.)
* Repeat the procedure one more time and record your results in Table 1.
* Your group now needs to design and perform a study that will demonstrate how changes in the speed of the car affect the results of the collision between the car and the barrier. You should test at least two other speeds. For each speed, perform two trials. Record your results in Question 1.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Distance between car and barrier (cm)  | Trial  | Elapsed time (seconds)  | Speed  | Average speed  | Distance barrier moved (cm)  | Average distance barrier moved (cm)  |
|  | A  |  |  |  |  |  |
|  | B  |  |  |  |  |  |

Note: To calculate speed, divide the distance the car traveled by the time on the stopwatch (S=D/T). To calculate the average speed, add the speeds together and divide by two. Use this same method to calculate the average distance the barrier moved. **Questions** 1. Record the data that your group collected in the space below. Include a description of the procedures that your group used to perform your study. This description should be clear and complete enough so that someone could easily repeat your study.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2. Discuss any conclusions that you may draw from the data you collected. Include in your answer a discussion of whether you believe your results are an accurate reflection of the relationship between the speed of the car and the distance the barrier moved. Be sure to justify your answer.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

 |
|  |