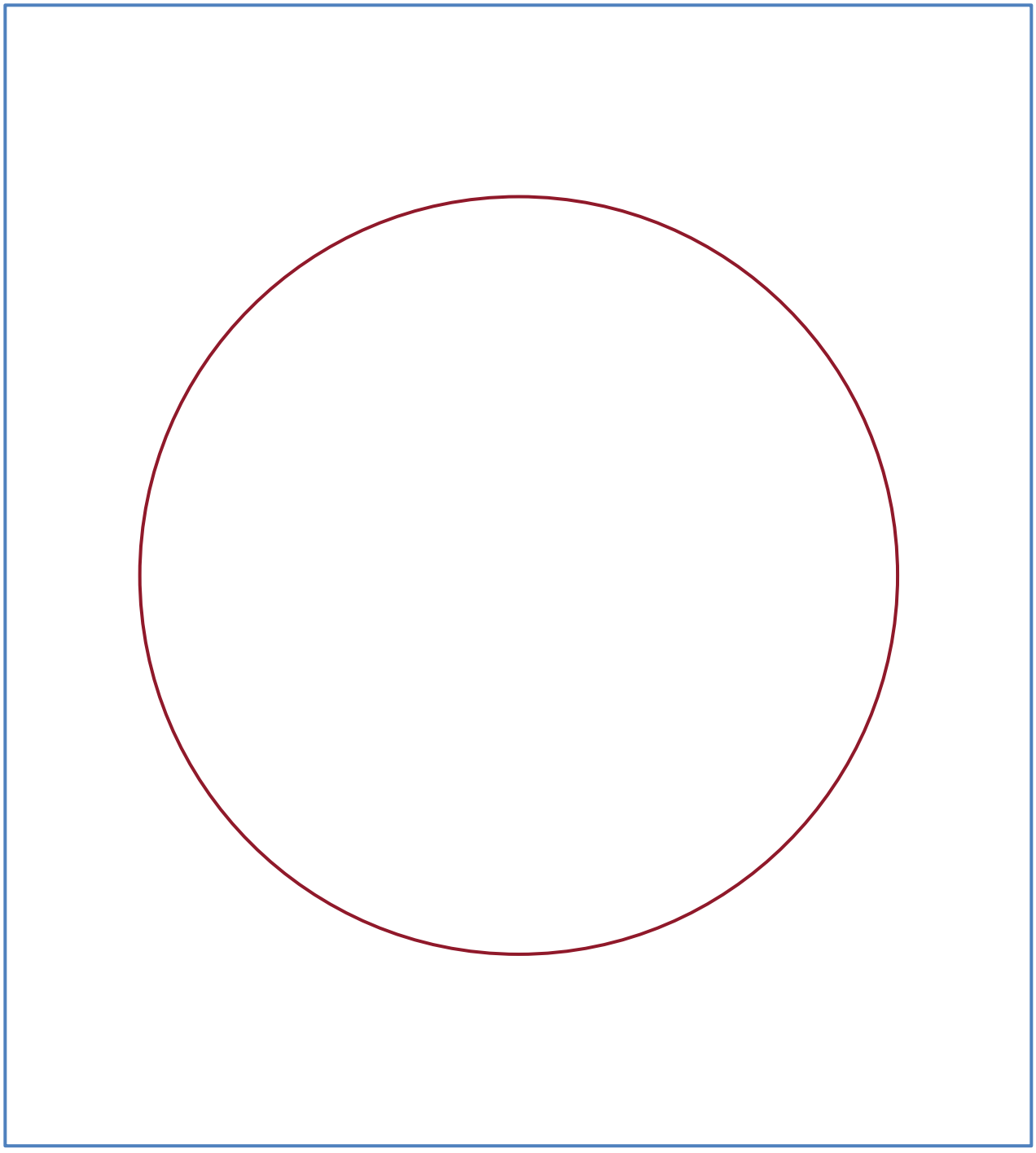
LAB INVESTIGATION

How I Know It

Within the circle, write all the information you already know about the terms. Outside the circle but still within the rectangle, write how you know this information. Where did your knowledge come from?



Hypothesis:

Write a one sentence hypothesis to answer the question: What effect does increasing the potential energy of an object have on the work that is done on another object during a collision?

Variables:

Make a list of all the variables that can be measured when potential energy, kinetic energy, and work are involved. Also, mark each variable you should keep constant.

Objective:

- Understand and be able to explain the relationship that potential energy of one object has to do with the amount of work done on another object.

Key Terms:

- potential energy
- kinetic energy
- work
- dependent variable
- independent variable

Background:

In collisions, energy is transferred from one object to another. When one object causes another object to change its position due to a colliding force, work is done on the second object. This can be observed during a car collision. In this activity, students will discover how increasing the potential energy of a car will affect the work done to a car when a collision occurs.

Materials:

- Ruler (one with center groove)
- Meter stick
- 5 marbles (same size)
- Toy car (small, Hot Wheel size)
- Calculator
- Electronic scale
- Textbooks for stacking

Procedure A: The Effect of Mass on the Amount of Work

1. Create a ramp using the grooved ruler and one textbook.
2. Record the height of the ramp in centimeters in the data table. It will remain constant during this part of the investigation.
3. Put the toy car at the bottom of the ramp so the back wheels are touching the end of the ruler.
4. Place the meter stick next to the car's back wheels so the wheels are aligned with the first mark on the meter stick.
5. Record the mass of 1 marble, 2 marbles, 3 marbles, 4 marbles, and 5 marbles in the data table. Do not record the mass of one marble and then multiply by 2, 3, etc. Don't assume they all weigh the same. There will be some variation in the mass of each marble. The marbles represent five cars of different masses. One marble is a small car while five marbles is a much larger truck.
6. Begin setting one marble on the center groove and releasing it. It will collide with the car below.
7. Measure the distance in centimeters the car rolls by measuring the location of the back tires in reference to the starting point. Record in the data table.
8. Repeat the procedure with 2 marbles, 3 marbles, 4 marbles, and then 5 marbles.
9. Be sure to fill in the data table with each trial.

Number of Marbles	Mass (m)	Height of Ramp (h)	Distance (d) of the car	Potential Energy of the marbles at the top of the ramp (PE) Equation: mgh	Kinetic energy of the marbles at the bottom of the ramp (KE) Equation: $1/2mv^2$	Force applied to the car (F) Equation : KE/d	Work applied to the car (w) Equation : Fd
One							
Two							
Three							
Four							
Five							

3-2-1

Three things you have learned:

1.

2.

3.

Two questions:

1.

2.

One thing you found interesting:

1.

What would you change in the investigation? What error sources did you observe?

Analysis:

Calculate the potential energy for the corresponding number of marbles. Record in the data table. What is the relationship of mass to the amount of potential energy?

Now, calculate the kinetic energy of each trial and record in the data table. What is the relationship of mass to the amount of kinetic energy?

Explain why the kinetic energy of each trial should be equal to the potential energy of each trial?

Calculate the amount of force placed on the car at the bottom of the ramp. Record in the data table. What is the relationship of the potential energy to the force applied on the car?

Calculate the amount of work done to the car at the bottom of the ramp. Record in the data table. What is the relationship to the amount of potential energy to the amount of work done on the car at the bottom of the ramp? How does this relate back to the mass?

In this investigation, we assume that all the kinetic energy at the bottom of the ramp is passed to the other car by doing work on the car. All of the kinetic energy is probably not actually passed on as work. Explain how we might account for the "loss" of the rest of the kinetic energy?

Describe the importance of keeping the height constant in this part of the investigation.

What is the independent variable? What is/are the dependent variables?