Name: $\qquad$ Date: $\qquad$ Period: $\qquad$
Purpose: To calculate and identify any changes in speed due to an $\qquad$ in ramp or a change in the marble's $\qquad$ _.

## Research:

## Materials per Group:

Speed is the measurement of $\qquad$

The formula for speed is $\qquad$
Acceleration is any change in $\qquad$

- PVC Tube (1 meter long)
- Marbles
- Stopwatch
- Textbooks (8)
- Lab Bin
- Calculator

Prediction: Will increasing the ramp height always increase the speed of the marble?

## Experiment \#1, Marbles:

1. Set up the equipment as drawn below:
2. Place the marble at the top of the ramp and have your stopwatch ready. Release the marble and begin timer. When the marble hits the table, stop the timer and record the time for the marble to roll 100 cm in the data table.
3. Repeat the above steps for three (3) trials, and average the time for all three rolls for the same ramp height.
4. Repeat steps $\mathbf{2 - 3}$ for the remaining 7 ramp (book) heights.
5. Calculate the average marble speed for each ramp height.

## Data Collection:

| Ramp Height <br> in Books | Distance <br> Rolled | Marble Roll Times in Seconds <br> (round to the nearest hundredth) <br> Trial 2 |  |  | Trial 3 | Average <br> Marble Time <br> (sec) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 100 cm |  |  | Average Marble Speed <br> (show correct unit) |  |  |
| 2 | 100 cm |  |  |  |  |  |
| 3 | 100 cm |  |  |  |  |  |
| 4 | 100 cm |  |  |  |  |  |
| 5 | 100 cm |  |  |  |  |  |
| 6 | 100 cm |  |  |  |  |  |
| 7 | 100 cm |  |  |  |  |  |
| 8 | 100 cm |  |  |  |  |  |

## SPEED LAB

Experiment \#2, Predictions: Does the size of the marble change how fast it rolls \& why?
** Get the data from nearby teams that tested a marble of different sizes than your team. Fill out the data table below then graph the results using different colored lines.

| Results: SPEED of Different Marble Size |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Ramp <br> Height | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Different <br> Marble \#1 |  |  |  |  |  |  |  |  |
| Different <br> Marble \#2 |  |  |  |  |  |  |  |  |

Analysis: Graph your results from the experiment by creating a LINE GRAPH showing the change in SPEED vs RAMP HEIGHT. Use different colored lines for each marble's data. Be sure to add a Title, label each axis, and add appropriate numbers to reflect speed of each experiment. Remember to use different colored lines to represent the data collected from other groups (marbles of a different sizes).

Title:

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## SPEED LAB

Experiment \#3, Middle School Speed: Do all middle school students have the same speed when running a 40 m dash? Complete the data table for calculating speed while running this type of race for students at your table:

| Date Table for Student 40m Run by Table Group |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  | Student Name (from table) | Student Age | Race Distance (m) | Total Time (s) |
|  |  |  |  | Speed (m/s) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | Group Average Speed: |

1. Were either of your predictions correct for experiments $1 \& 2$ ? Explain $\qquad$
2. What is the relationship between the average speed of the marble and the height of the ramp?
3. Would increasing the ramps steepness always increase the marbles speed? Is there a limit, and if so, why? $\qquad$
$\qquad$
$\qquad$
4. Would the average speed be the same if you measured the time to roll 500 cm ? Explain.
5. Calculate the average acceleration between ramp height \# 1 and ramp height \#8 for your team's marble size? Show your work!
6. What force do you think is causing the marble motion? When is it a balanced force and when is it an unbalanced one? $\qquad$
7. Compare another group's calculation for acceleration that used a different sized marble than your team. Which one did you compare, and which marble accelerated faster? $\qquad$
$\qquad$
8. Was there a significant difference between the speeds of the different marbles? Why do you suppose this is? $\qquad$
$\qquad$
$\qquad$
9. Compare the average speeds of your group's 40 m speed to that of another table. What was the difference between your group speed and their speed? What do you think was the significant difference between your table's results versus the other table's result?
10. How long would it take for your table to travel to the Sun at your current table's average speed? Show your work, and look up the distance online.

Distance from Earth to Sun = $\qquad$

## SPEED LAB <br> Individual Student Times for 40m Dash Run: Period

| Student Name | Biological Gender (M/F) | Student Age | Total Time (s) |
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