RAINY MORNING is a lab activity that is designed to address the NGSS standard MS-PS2:

Students who demonstrate understanding can:

> **Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [*Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.*]

RAINYMORNING:

Students are given the following scenario. "Bill's mother is driving him to school on a rainy morning. She is coming down a hill, with another car stopped at the bottom. As she steps on the brakes, her car slides into the other car. Her car stops, but the other car is pushed further down the hill."

Students brainstorm questions about the scenario, are given materials (a small piece of 2x4, a small dowel, a plastic cup, and several large washers) and asked to design a model to test some questions about the scenario.

Examples: What if the hill was steeper? What if the car at the bottom of the hill was a truck? These two questions would lead to a look at how velocity (which increases the force) and mass affect the motion of both vehicles.

NAME:_____

RAINY MORNING

Melissa woke up one morning to find the street covered with water from a heavy rain. On the way to school, his mother coasted down a steep hill. At the foot of the hill, it happened! Their car would not stop on the slippery road and it slid into a car parked at the bottom of the hill.

Luckily, Melissa and her mom had their seat belts fastened, and both were fine. Melissa was surprised that, although her mom's car almost immediately, the parked car moved quite a ways along the flat and slippery road at the bottom of the hill – even though both cars were small.

Later on in science class, Melissa thought about force and the motion of moving objects. She wondered what would have happened if they had hit a large car. She also wondered what would have happened if the hill were not so steep.

MAKING PREDICTIONS

Prediction A: How do you think the mass of the parked car will affect the distance the parked car moves when it is hit? Be sure to give a reason for your prediction.

_____

_____

_____

_____

_____

Prediction B: How do you think the slope of the hill will affect the distance the parked car moves when it is hit? Be sure to give a reason for your prediction.

_____

_____

_____

_____

_____

You decide to conduct an experiment to test your predictions.

SMALL CAR TESTS

1. Use the block and cardboard to make a ramp with the least possible slope.
2. Place two (2) washers in the plastic container. This will represent a small car.
3. Put the plastic container at the bottom of the ramp.
4. Roll the wooden cylinder down the ramp and measure how far the container moves.
5. Do this three times and find the average.
6. Make a ramp with a medium slope and repeat steps #4 and #5.
7. Make a ramp with the greatest possible slope and repeat steps #4 and #5.
8. Record your data in a data chart. Be sure to include a title and units.

distance container moves

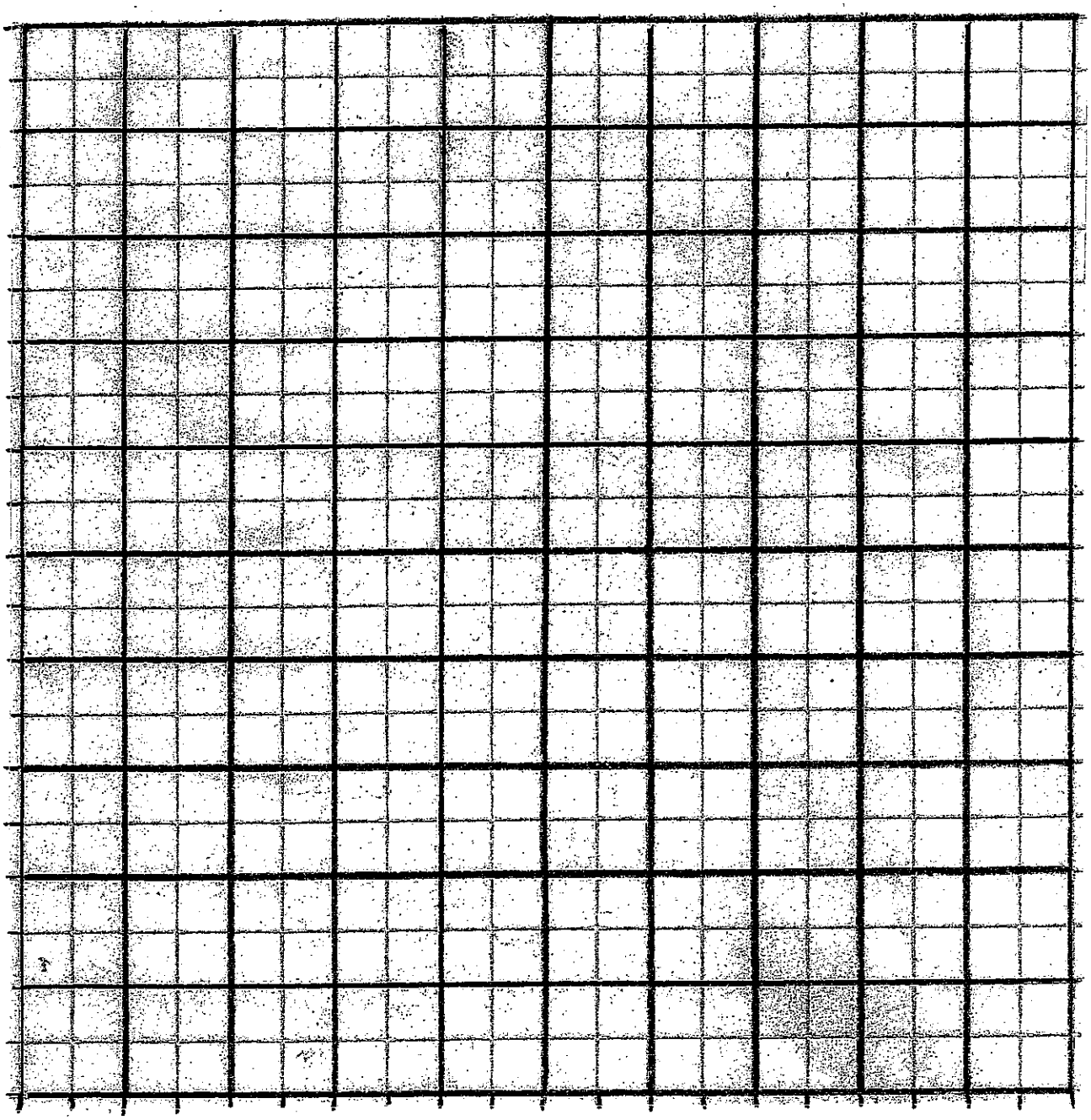
	trials			average
	1	2	3	
low slope				
medium slope				
steep slope				

LARGE CAR TESTS

1. Use the block and cardboard to make a ramp with the least possible slope.
2. Place two (6) washers in the plastic container. This will represent a large car.
3. Put the plastic container at the bottom of the ramp.
4. Roll the wooden cylinder down the ramp and measure how far the container moves.
5. Do this three times and find the average.
6. Make a ramp with a medium slope and repeat steps #4 and #5.
7. Make a ramp with the greatest possible slope and repeat steps #4 and #5.
8. Record your data in a data chart. Be sure to include a title and units.

distance container moves				
		trials		average
	1	2	3	
low slope				
medium slope				
steep slope				

Use the information in your data tables to make ONE line graph. Use the slope of the hill as your independent variable and the average distances the small and large mass cars moved as your dependent variable. Be sure to include a title, labels for each axis, and a key to show which line on your graph is the small mass car and which is the large mass car.



Write a CLAIM, with EVIDENCE and REASONING to support your claim about how the mass of the parked car will affect the distance it moves when it is hit. Be sure to use data to support your answer.

Write a CLAIM, with EVIDENCE and REASONING to support your claim about how the slope of the hill will affect the distance it moves when it is hit. Be sure to use data to support your answer.

RAINY MORNING GRADING

10	**Title Page:** **title, illustration, student name**
10	**Initial Claims:** **Which moves a greater distance?** **Reason for claim**
10	**Data Chart:** **titles, averages, all data included**
20	**Graph:** **titles, labels units** **data plotted correctly and neatly**
20	**CER (Mass):** **supported by data** **at least 4 data points (2 pairs of data)** **at least two science vocabulary words**
20	**CER (Slope):** **supported by data** **at least 4 data points (2 pairs of data)** **at least two science vocabulary words**
10	**Extra:** **extra data** **extra data points on graph** **creative cover page**

You decide to conduct an experiment to test your predictions, using this procedure.

SMALL CAR TESTS

1. Use the block and cardboard to make a ramp with the least possible slope.
2. Place two (2) washers in the plastic container. This will represent a small car.
3. Put the plastic container at the bottom of the ramp.
4. Roll the wooden cylinder down the ramp and measure how far the container moves.
5. Do this three times and find the average.
6. Make a ramp with a medium slope and repeat steps #4 and #5.
7. Make a ramp with the greatest possible slope and repeat steps #4 and #5.
8. Record your data in a data chart. Be sure to include a title and labels.

LARGE CAR TESTS

1. Use the block and cardboard to make a ramp with the least possible slope.
2. Place two (6) washers in the plastic container. This will represent a large car.
3. Put the plastic container at the bottom of the ramp.
4. Roll the wooden cylinder down the ramp and measure how far the container moves.
5. Do this three times and find the average.
6. Make a ramp with a medium slope and repeat steps #4 and #5.
7. Make a ramp with the greatest possible slope and repeat steps #4 and #5.
8. Record your data in a data chart. Be sure to include a title for your data chart.

SAMPLE DATA

trials	low slope (cm)	medium slope (cm)	high slope (cm)
1	12	21	37.5
2	12	23	25.5
3	11.3	24.5	36
average distance			

trials	low slope (cm)	medium slope (cm)	high slope (cm)
1	4	8	10.5
2	4.5	9.5	12.5
3	7	10	15
average distance			