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Bouncing Balls

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Grade level(s)/Subject taught: Math 7th

Objectives: Students will conduct an experiment that produces a graph that appears linear and permits prediction to be made beyond the data collected. Students realize the many phenomena are constrained by linear relations. Students collect data make tables and graphs to make predications.

Mathematical Concept: Mathematical Reasoning – Number and Numeration: 1 & 2, Operations – Modeling/Multiple Representation: 3. & 4, Patterns/Functions: 7.

Lesson Overview: Students will conduct an experiment that produces a graph that appears linear and permits prediction to be made beyond the data collected. Students investigate the relationship between the drop height of a ball and its bounce height, which is controlled by the fraction of the ball's energy that is lost on impact. This fraction varies for different balls but is constant for an individual ball. The graphs for this experiment should theoretically be linear and pass through the origin; even with measurement errors, the graphs should allows students to make predications confidently.

What Students will:

Know: How to collect data and create a table.

Understand: The how to recognize a linear relation.

Be able to do: Make predications based on data, tables and graphs.

Activating Learning Strategies: (Learners mentally activity): Have students review the "Conceptualizing and Representing Linear Relationships – Growing Dots 1". Describe the pattern. Assuming the sequence continues in the same way, how many dots are there at 3 minutes, 4 minutes, 5 minutes, 10 minutes, 100 minutes, t minutes? Write an equation that you can use to determine how many dots there will given the time.

Cognitive Teaching Strategies: (Distributed guided practice &/or Distributed summarizing in pairs; graphic organizers; etc.)

- Limited lecture
- Students work alone and/or in pairs

Launch:

Students will conduct an experiment for this lesson. They will investigate how the height from which a ball is dropped is related to the height it bounces. This experiment is modeled using Interactive Physics.

Student will:

1. Make a table with columns for recording drop height and bounce height

2. Run the IP model Bouncing Balls. Students will need an understanding of IP.

   Students will open IP and run the Bouncing Ball simulation. They will change the height of the balls and run again, each time they will record the bounce height for each ball.

3. Record the drop height and bounce height for each ball. Repeat, running IP, students will need to change the drop height of the balls. Students can record the bounce height by a variety of ways i) exporting data to excel, ii) use the play bar, iii) observer the bounce height in the model, iv) observe y-position table in the model, v) etc.

Summarizing Strategies:

1. Students will answer Problem 1.1 questions A through D.

2. Students will work Review 1.1 Bouncing Balls.

3. Students will complete the homework sheet.

Material: Interactive Physics, calculators, Worksheet (bellwork, classwork, homework).

NAME: ____________________________________ DATE: ____________________

Class work - Experiment

BOUNCING BALLS:

After bouncing a ball many times, you are better able to predict the balls behavior. Basketball players for example with much practice become very good at bouncing (i.e., dribbling a basketball). In this experiment, you will investigate how the height from which a ball is dropped is related to the height it bounces. You will model this experiment using Interactive Physics.

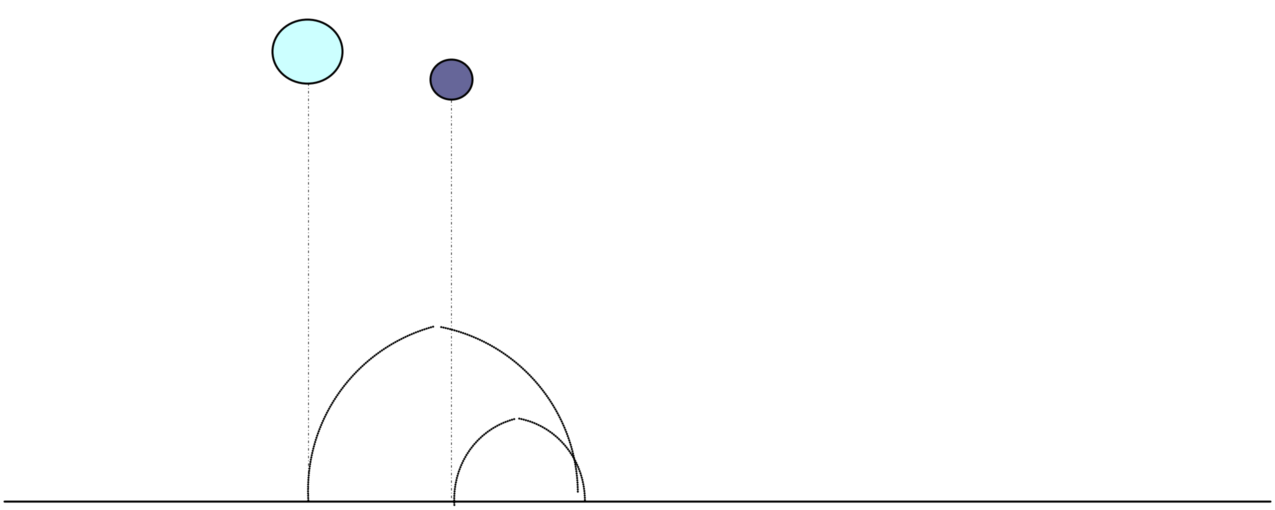
Record the drop height and bounce height for each ball. Repeat, running IP, students will need to change the drop height of the balls.

<u>Experiment:</u>

1. Make a table with columns for recording drop height and bounce height

2. Run the IP model Bouncing Balls. Open IP and run the Bouncing Ball simulation, record the bounce height. Change the bounce height from 5 to 10 and run the simulation again. Repeat this 3 more times increasing the height by 5 each time. The drop heights will be 5, 10, 15, 20, and 25).

3. Record the drop height and bounce height for each ball at five similar drop heights. You may can record the bounce height by a variety of ways i) exporting data to excel, ii) use the play bar, iii) observer the bounce height in the model, iv) observe y-position table in the model, v) etc.



Problem 1.1

A. Make a coordinate graph of the data you collected.

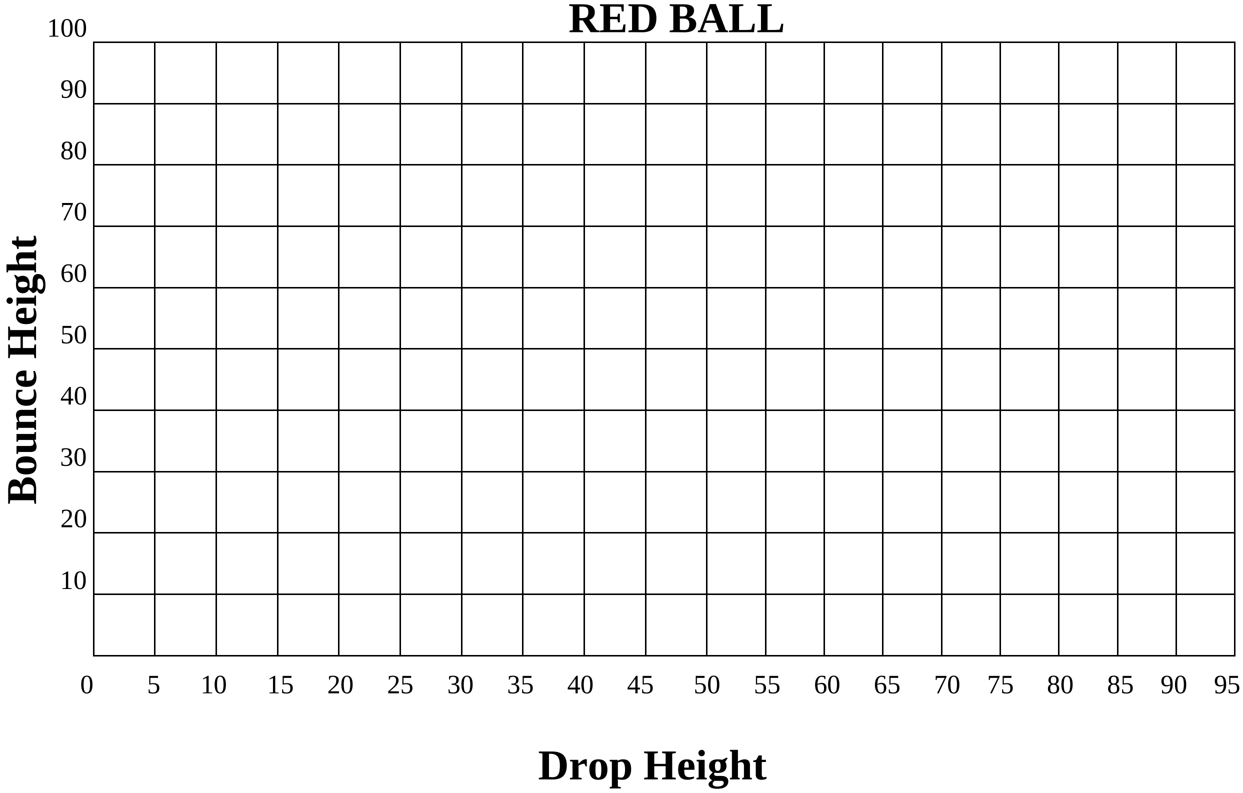
B. What variables did you investigate in this experiment? Describe the relationship between the variables.

C. Predict the bounce height for a drop height of 2 meters. Explain how you made your prediction. Did you use the table, the graph, or the IP model. What clues in the data helped you?

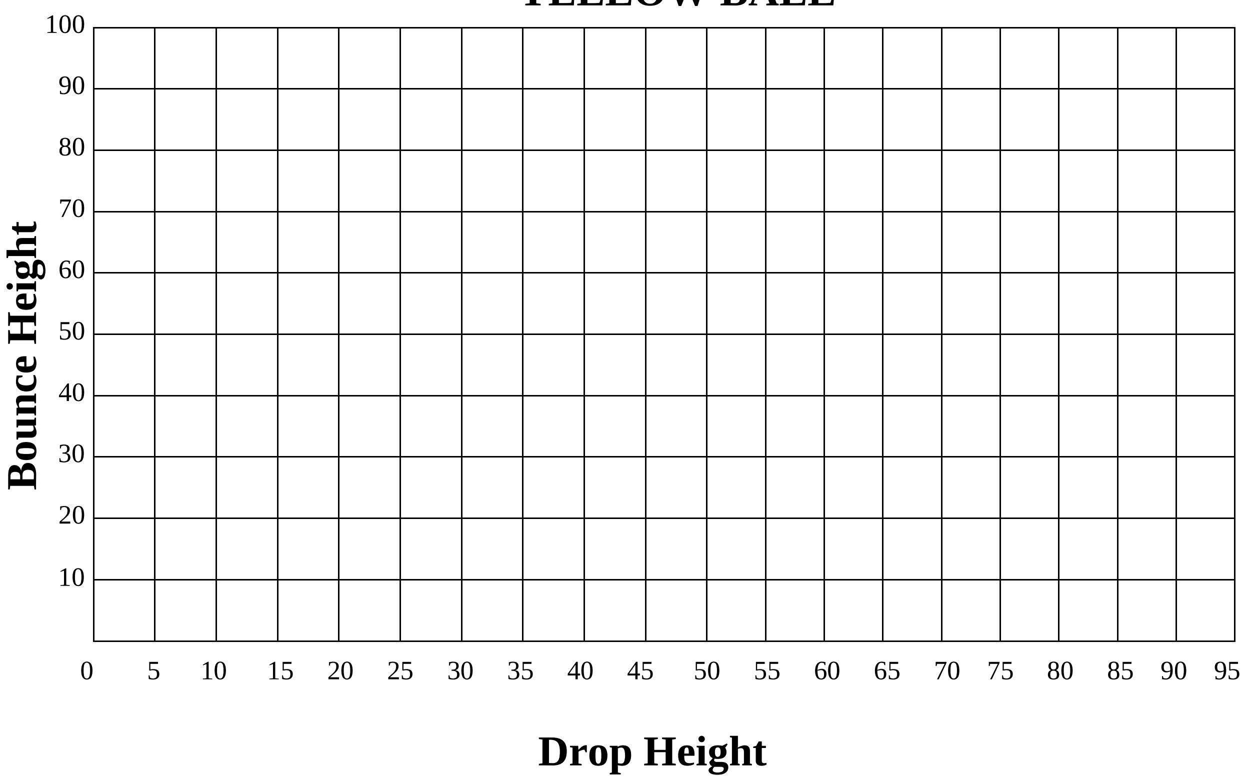
D. Predict the drop height needed for a bounce height of 2 meters. Explain how you made your prediction. Did you use the table, the graph, or the IP model. What clues in the data helped you?

E. What bounce height would you expect for a drop height of 0 centimeters? Where would this be on the graph?

RED BALL



YELLOW BALL



Name__________________Date_________

Drop Height	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**	**0**
Bounce Height	80	77	70	60	52	41	34	23	17	10	0

1. Find the centimeter increase from:

   a) 30 cm to 40 cm __________

   b) 50 cm to 60 cm __________

   c) 70 cm to 80 cm __________

   d) 90 cm to 100 cm _________

2. If the drop height of a ball was 120 cm, what would the bounce height be?

3. Find the bounce heights for the following drop heights:

   Drop Height (cm) Bounce Height (cm)

   a) 150 cm _________cm

   b) 200 cm _________cm

   c) 55 cm _________cm

   d) 210 cm _________cm

NAME: ________________________________ **DATE:** _________________

Homework

1. Jerry and Connie counted the number of students who passed through the cafeteria line. They recorded a new total each, minute for 8 minutes. They organized the data in this table.

Time (minutes)	1	2	3	4	5	6	7	8
Number of students	9	21	30	39	48	59	70	81

a. Make a graph of the data with time on the x-axis and the number of students on the y-axis.
b. Predict how much time it would take for 55 students to pass through the cafeteria line.
c. How many students would you expect to buy lunches in a 10-minute period?
d. Predict how many students could buy lunches over a 30-minute period.