|  |  |  |  |
| --- | --- | --- | --- |
| **Big Ideas:**  ✓ Continuous linear relationships can be identified and represented in many connected ways to identify regularities and to make generalizations. | | | |
| **Curricular competency being assessed: *Communicating & Representing***  **Content**  **✓ Two-variable linear relations using graphing, interpolation, & extrapolation** | | | |
| **BEGINNING** | **DEVELOPING** | **PROFICIENT** | **EXTENDING** |
|  | | **I can…**   * Use technology to accurately gather data to complete a data table * Communicate data collected pictorially using appropriate scale and line of best fit * Explain and justify why multiple trials resulting in an average were necessary * Accurately communicate interpolation and extrapolation on a graph to determine bounce height * Communicate the relationship in the data symbolically using an equation and apply it to a contextualized situation * Explain the usefulness of each type of representation |  |

Linear Relation Project

Modelling Bounce Height of a Ball

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Unit 3 – Linear Relations: Modelling Bounce Height of a Ball**

**Question:** How high would a ball bounce back up if it were dropped from the Empire State

Building?

**Task:** Data can be expressed in a variety of ways. In this project, you will be conducting an experiment to gather data. You will represent that data in a chart, graph and with an equation. Your ultimate task will be to identify the pros and cons to each representation and the usefulness of each in the “real world”.

**Procedure:**

1) **Tape a metre stick** to the wall or lab table, so that the bottom touches the ground. Choose a ball from those provided and **record the type** at the top of your data table, and your graph.

2) In a group two, choose roles of: ball dropper & bounce height measurer.

3) Start by holding the ball so that the bottom of it is at 1m (100cm). Release the ball without pushing down. Practice a few times before recording bounce heights. Get used to seeing the approximate height the ball bounces up to on the metre stick. Practice measuring the bounce from the **bottom** of the ball. Try a few different methods to perfect your technique – you may incorporate technology if you wish.

4) When the group is ready, drop the ball from 1m (100cm) and see where it bounces back to on the metre stick. Record on the table in **cm**. Do this three times to get a total of three readings. Calculate the average of the three trials, **round to the nearest whole number**, and record on the table.

**Question**:

Using the information from #4 above, estimate how high you think a ball would bounce back if it was dropped from the observation deck of the Empire State Building.

Height from observation deck of Empire State Building: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Estimated bounce height: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Show calculation.)

5) Repeat #4 by dropping the ball from 90cm.

6) Repeat #4 for 80cm, 70cm, 60 cm, 50cm, 40cm, etc. until you can no longer record the

bounce height.

7) Record what a bounce height will be from 0 cm

**Data:**

**Bounce Height for a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ball**

|  |  |  |  |
| --- | --- | --- | --- |
| Drop Height (cm) | Bounce Height (cm) | | |
| Trial  1 | Trial  2 | Trial  3 |
| 100 |  |  |  |
| 90 |  |  |  |
| 80 |  |  |  |
| 70 |  |  |  |
| 60 |  |  |  |
| 50 |  |  |  |
| 40 |  |  |  |
| 30 |  |  |  |
| 20 |  |  |  |
| 10 |  |  |  |
| 0 |  |  |  |

|  |  |
| --- | --- |
| Drop  Height  (cm) | Average  Bounce  Height (cm) |
| 100 |  |
| 90 |  |
| 80 |  |
| 70 |  |
| 60 |  |
| 50 |  |
| 40 |  |
| 30 |  |
| 20 |  |
| 10 |  |
| 0 |  |

This is the table you will use to graph your data on the next page. The first column is your ***x*** axis (horizontal), and the second column is

your ***y*** axis!

Now, it’s time to graph your data! **EACH PERSON DOES THEIR OWN GRAPH!**

Try to use as much of the grid as possible!

**\*\*Your x-axis will need to go up to x = 150 cm\*\***

Label your axes include units!

**Bounce Height for a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ball**

Table

Description automatically generated

**Graph Analysis:**

Notice your graph is NOT a perfect straight line – it is a **scatter plot.** Exclude any points that are too far off. Draw a straight line (with a transparent ruler) that is an average of all the data points. This ‘*line of best fit’* should have roughly the same number of data points above it as it does below it and should start at (0, 0). Take your time with this step and draw as accurate of a *line of best fit* as you possibly can.

**Questions:** (Answer in full sentences on a separate piece of paper & attach)

1) Why do you think we did three trials to get an average before using the average on the graph?

2) Describe the errors that may have been made during the experiment.

3) Using ***interpolation*** with your *line of best fit*, what would be the bounce height if the ball was dropped from 85cm? Show this on your graph (with a ruler).

4) Using ***extrapolation*** with your *line of best fit*, determine the bounce height of your ball (in cm) if it was dropped from 150cm. Show your work!

5) Using your *line of best fit*, calculate the ***slope*** of your line (Show this on your graph). Remember, that slope = . Pick a point somewhere on your *line of best fit*, find the bounce height for it (your rise), and then the drop height for it (your run). This will only work correctly if your *line of best fit* starts at (0, 0).

6) Now, write the equation for the line in ***y = mx + b*** form. Make sure to either show/explain how you found your “**b**”. This is the mathematical equation for the bounciness of your ball!

7) Now, ‘*google*’ the height of the **Empire State Building** in metres, and using your equation, determine how high your ball will bounce when dropped from the top.

8) How does this compare to your estimation in the procedure?

**Reflection:**

1. Notice that we represented the linear relation of the ball bounciness with a table, a graph, and an equation. What are the advantages and disadvantages of each method?
2. Why is using an equation to measure the bounce height off the Empire State Building more reasonable than using the graph or table?