Lesson Title: Bungee Jumping Barbie
Course: Mathematics 8
Designer: Taelynn Chesney, Abdullah Aboulkhir, Anna Mohr, Jada Wright

Learning Outcomes/Intentions

Formal Unit Outcome(s):
P8.1
Demonstrate understanding of linear relations concretely, pictorially (including graphs), physically, and symbolically.
[CN, ME, PS, R, T, V]
(a) Analyze and describe the relationship shown on a graph for a given situation (e.g., "The graph is showing that, as the temperature rises, the number of people in the mall decreases").

(b) Explain how a given linear relation is represented by a given table of values.

(c) Model a linear relation shown as an equation, a graph, a table of values, or a concrete or pictorial representation in one or more other forms.

Objectives:

1) Students can collect data and create a scatter plots using the graph and table information from the activity.
2) Students can predict and speculate the relationship between the number of rubber bands and the distance Barbie drops.

Mathematical Process:
[R] Reasoning: Students will use reasoning by constructing a graph based on the distances Barbie drops with every additional rubber band to see if they can create a line or not. Students will use reasoning to decide what each component of the graph decides.

Essential Question:
How many rubber bands are used to safely jump Barbie without her hitting the ground?

First Nations Content

N/A

Assessment Evidence

Formative Assessments (Assessment for Learning):
Worksheet

Summative Assessments (Assessment of Learning):
N/A

Materials

- x2 meters sticks (100 cm)
- Tape (easy to pull off the wall)
- Video recording (needs to be in slow-mode to find the height) (phones can be used)
- Worksheet (will be provided to students)

- Pencil(s)
- ~about 10 large rubber bands (depending on size/length/amount)
- Barbie doll (can be off-branded)
- Ladder (depending location/students heights)

Learning Plan

Learning Experiences & Instruction: (5-E's)
ASK:
Engage:
Review how to create a graph with the students.
What is a x-intercept? What is the y-intercept?
Where is the 'x' and 'y' on the graph?
How do we label the graph?
How do we read a graph?
How can we properly adjust the x and y axis to have the same distance between their intervals/increments? Follow your data table.
To begin the lesson, ask students some personal questions to engage with the activity;
Has anyone ever been bungee jumping before?
Has anyone ever thought about wanting to go bungee jumping? Why or why not?
Have you ever made a bungee jump before with your own toys?
Predict how many rubber bands you think we should attach to Barbie.
After having a small discussion as a class, explain to the students briefly about the experiment and make them into groups. Allow the students to try and figure out the experiment themselves.
Remember to ask students;
What's the maximum number of rubber bands that we can attach to Barbie to drop her as low as possible without touching the floor? **Don't kill Barbie!!!**
NOTE: The teacher will need to set-up the activity before students begin; the two meters sticks taped against the wall (reaching the floor). You may need a ladder so students can reach the top.

Explore:
Students in their groups will perform the activity together. Students will follow the guide line to the activity; slowly increase the number of attached rubber bands by one until they have reached the maximum number of rubber bands attached without Barbie hitting the ground. Students will record their finding on the worksheet to keep track of the distance.
Collect the data with the use of a graph on the number of rubber bands and the lowest point that the head reaches in centimeters.
What is a scatter plot?
How can we label our table information on our graph?
Can you make a scatterplot with your table of values?
Do you notice any patterns?
Where should Barbie be tied? How does the placement of where she is tied on change the experiment?
How should the rubber bands be tied to each other without losing their length?
Does Barbie's height change the distance she travels?
How would the experiment be altered if we used Ken instead?
How many rubber bands before Barbie hits the floor?

Explain: After the students have completed the activity, allow them time to complete the worksheet questions together as a group and be able to compare the information with other groups/students.

Why is it important to know how far of a distance Barbie can go before hitting her head? Don't want her brains scattered all over the floor, and have future knowledge and awareness in case you ever want to go bungee jumping.
What procedure will your group use to collect your data?
How did you collect your data? Who was doing what?

Elaborate: Construct a table of values for the number of rubber bands attached and the distance reached. Use your data to construct a probably labeled scatter plot with a best-fit line and an equation for the line.
Ask students to interpret different parts of the graph.
What is the y-intercept and what does it mean?
What is the slope?
What does the slope represent in this activity?

Evaluate: Students will compare and contrast their table and graph information with other groups in order to synthesize the results and average number of bands that Barbie can go.
What are some patterns from the information? Is anything similar? Is anything different? Why or why not?
Did you do the experiment differently than others? How do you know?
What would you do differently next time? What would you do the same?
If you could change 1 thing about this experiment, what would it be? Why?

'If Barbie were going to bungee jump in the 'south stairwell' (tall location in your school), what are some variables to consider so she can predict how long to make the cord?

She wants the longest jump that still keeps her safe." Discussion might include knowing how heavy or tall a person is, how much the cord stretches, how high the jump point is, and other variables. As the discussion wraps up, explain the task below to students.

Barbie Bungee Activity

NAME: **Taelynn Chesney, Abdullah Aboulkhir, Anna Mohr, Jada Wright**

Purpose
You are going to create a bungee line for Barbie that will give her the most thrilling, yet SAFE, fall from a height of 2 meters.

Procedures
Using 1 rubber band, drop Barbie from the top of the meter stick and measure how far down the lowest point that her head reaches (cm). Now collect data for 2, 3, 4, 5, 6, and 7 rubber bands.

1. Explain the procedure your group will use to collect your data.

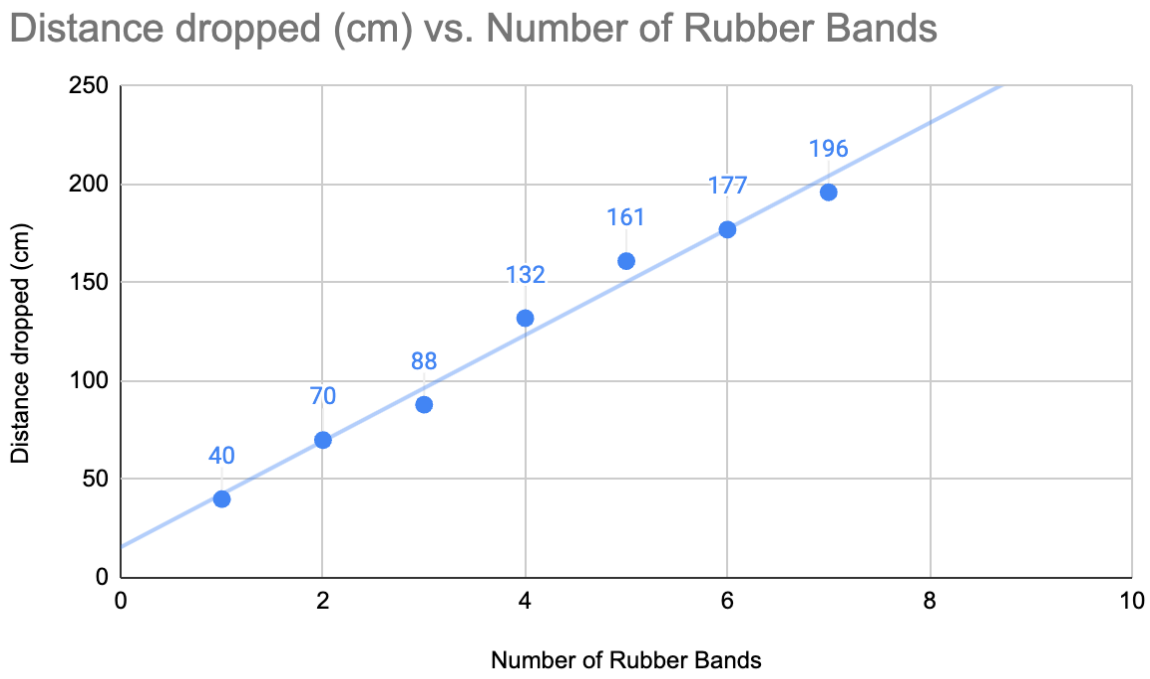
We will drop Barbie from a height of 2 meters, and we will progressively add more rubber bands. We will take slow-motion videos of every trial to record an accurate estimate of how far she drops in centimeters during every trial.

2. Collect the data.

NUMBER RUBBER BANDS	LOWEST POINT HEAD REACHES (CM)
0	40cm
1	70cm
2	88cm
3	132cm
4	161cm
5	177cm
6	196cm

7	200+cm

3. Make a scatterplot.



4. What patterns do you notice?
On average, Barbie dropped 27 cm for every rubber band added.

5. Make an initial prediction for how many rubber bands we should attach to Barbie.
- 8 Rubber bands

Barbie's Line of Best Fit

NAME: **Taelynn Chesney, Abdullah Aboulkhir, Anna Mohr, Jada Wright**

Record your data from yesterday.

NUMBER RUBBER BANDS	LOWEST POINT HEAD REACHES (CM)
0	40
1	70
2	88
3	132
4	161
5	177
6	196
7	200+

hit her head w/ 7 rubber bands

Input the data into the NCTM applet or into L1 and L2 on your graphing calculator. Find the line of best fit using the NCTM applet or your graphing calculator. Record the line of best fit below:

_____

1. What does the x represent in this equation?

The X represents the number of rubber bands used in this equation.

2. What does the y represent in this equation?

The Y represents the lowest point the head reaches for Barbie.

3. What is the slope of your line of best fit? What does this number represent in the context of the problem?

The slope is 27. This number represents the average distance that Barbie drops with every rubber band added.

4. What is the y-intercept of your line of best fit? What does this number represent in the context of the problem?

The y-intercept is 16. This number represents how far a single rubber band stretches without Barbie's weight.

5. Use the applet or your graphing calculator to find the correlation coefficient (r). What is r?
0.9919. If this measurement equaled 1, then the line would run through all of our points perfectly.

6. Change the numbers for x and y by making up some new values. Look at the scatterplot and then calculate the correlation coefficient ("r") for the new data. Do this several times. What do you think "r" is measuring?

Assessment

Barbie Bungee Assessment Some students wondered whether their prediction for the number of rubber bands would be the same if they used Ken instead of Barbie. They collected the following data:

Number of rubber bands	0	1	2	3	4	5	6	7
Lowest point head reaches (cm)	32	42	54	65	74	86	96	104

The line of best fit for the data is y = 32.5 + 10.464x.

1. Interpret the y-intercept of the line of best fit.
21 because our slope is approximately 11, so if we subtract 10 from our initial value which is 32 we get 21

2. Barbie has a y-intercept of 25.33. Is the y-intercept for Ken's data larger or smaller? Why?
Smaller because 21<25.33

3. Interpret the slope of the line of best fit.
The slope is 10.464

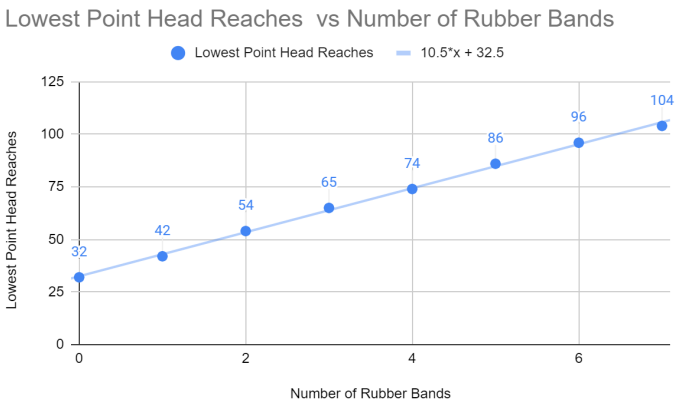
4. Barbie has a slope of 7.512. Is the slope for Ken's data larger or smaller? Why?
Smaller because 10.464 < 7.521

5. The correlation value (r) for the data is 0.998. What does this value mean?

It describes how perfect the best line is, a value of 0.998 means the line is fairly close to most points on our graph
0.9992

6. Use the line of best fit to predict the lowest point that the head reaches for 4 rubber bands. Show work.
75

7. Calculate the residual for x = 4 rubber bands.
1
Below is the residual plot for the data.



8. What does the residual plot tell us about the quality of the line of best fit? Why?
It tells us how well our collected data compares to our hypothetical mathematical data. This helps us determine if our trials are consistent or not.

9. Make a prediction for the number of rubber bands needed for Ken to make a bungee jump from 500 cm. Show your work.
If 7 reaches a height of 100 approximately then if we multiply 7 by 5 which is 35 rubber bands, we should be able to jump a height of 500.

Barbie Bungee Activity

NAME _____

Purpose
You are going to create a bungee line for Barbie that will give her the most thrilling, yet SAFE, fall from a height of _____ meters.

Procedures Using 1 rubber band, drop Barbie from the top of the meter stick and measure how far down the lowest point that her head reaches (cm). Now collect data for 2, 3, 4, 5, 6, and 7 rubber bands.

1. Explain the procedure your group will use to collect your data.

2. Collect the data.

NUMBER RUBBER BANDS	LOWEST POINT HEAD REACHES (CM)
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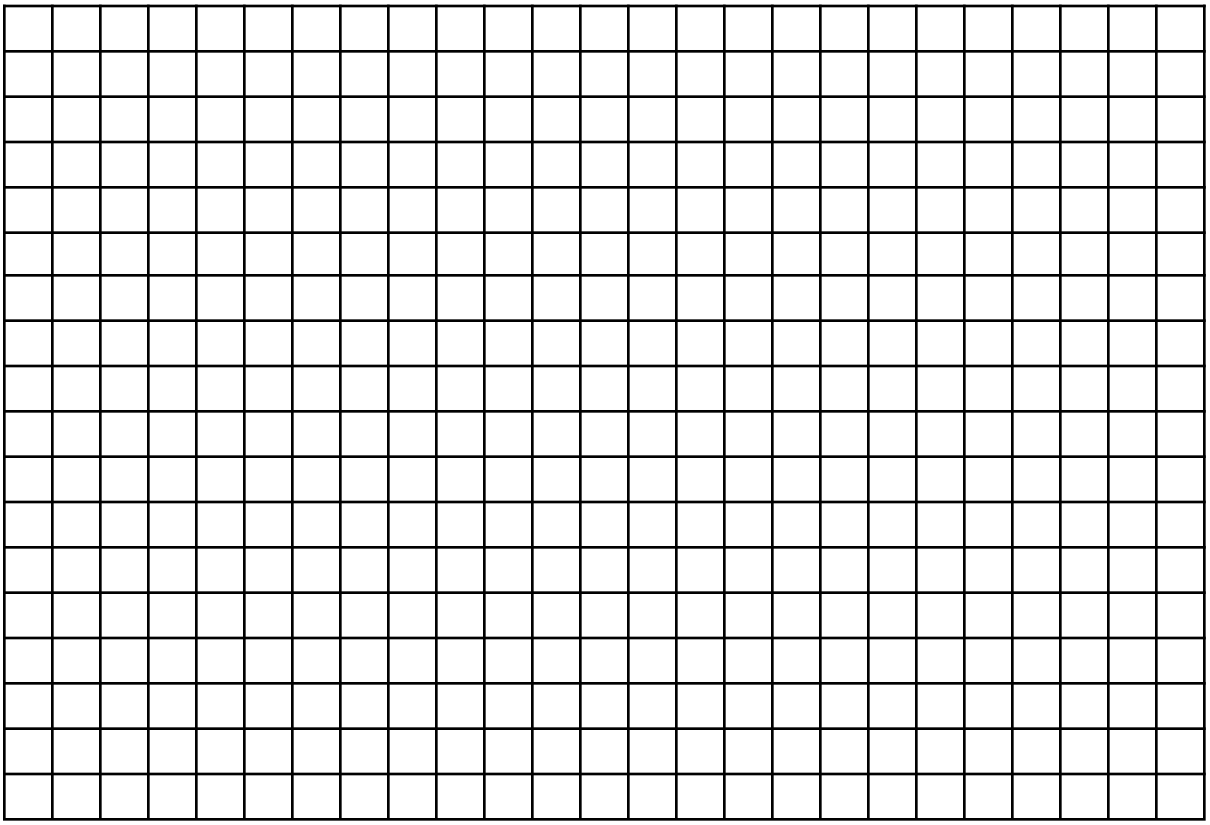
3. Make a scatterplot.



4. What patterns do you notice?

5. Make an initial prediction for how many rubber bands we should attach to Barbie.

Barbie's Line of Best Fit

NAME_____

Record your data from yesterday.

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_____

1. What does the x represent in this equation?

2. What does the y represent in this equation?

3. What is the slope of your line of best fit? What does this number represent in the context of the problem?

4. What is the y-intercept of your line of best fit? What does this number represent in the context of the problem?

5. Use the applet or your graphing calculator to find the correlation coefficient (r). What is r?

6. Change the numbers for x and y by making up some new values. Look at the scatterplot and then calculate the correlation coefficient (r) for the new data. Do this several times. What do you think r is measuring

Assesment

Barbie Bungee Assessment Some students wondered whether their prediction for the number of rubber bands would be the same if they used Ken instead of Barbie. They collected the following data:

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1. Interpret the y-intercept of the line of best fit.

2. Barbie has a y-intercept of 25.33. Is the y-intercept for Ken's data larger or smaller? Why?

3. Interpret the slope of the line of best fit.

4. Barbie has a slope of 7.512. Is the slope for Ken's data larger or smaller? Why?

5. The correlation value (r) for the data is 0.998. What does this value mean?
6. Use the line of best fit to predict the lowest point that the head reaches for 4 rubber bands. Show work.

7. Calculate the residual for x = 4 rubber bands.

Below is the residual plot for the data.

8. What does the residual plot tell us about the quality of the line of best fit? Why?

9. Make a prediction for the number of rubber bands needed for Ken to make a bungee jump from 500 cm. Show your work.