The Rainforest Canopy Tour

Tropical rain forests are dense, lush forests located in the tropical regions of the Earth- Central America, northern South America, central Africa, and southeast Asia. Large, tall trees, growing well over 100 feet tall, form the top layer of the rain forest. Their leaves and branches form what is called the "canopy" of the rain forest, shading the forest floor below.

Some entrepreneurs developed what they call "Canopy Tours." If you go on a Canopy Tour, you will be tied in with a harness then sent at high speeds along wire "zip lines" from treetop to treetop, landing on platforms constructed in the treetops.

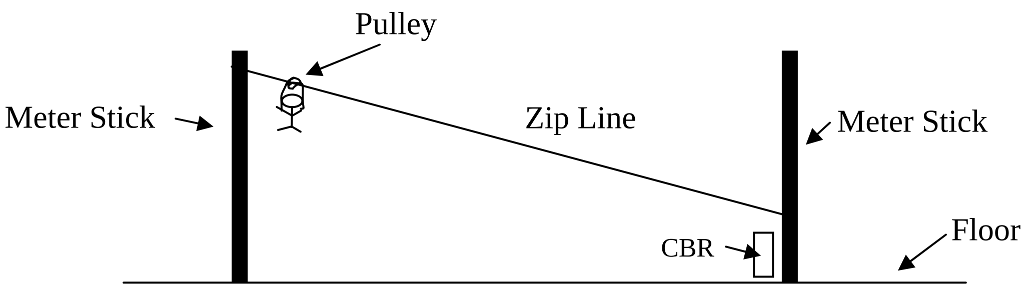
Just how long does it take to travel from one treetop to another? One way to determine the time is to examine the relationship between time and distance traveled.

1. **Imagine stepping off a platform 30 meters above the forest floor and zipping 300 meters along a zip line to the next platform 25 meters above the forest floor. Predict and sketch a distance versus time graph of your journey.**

2. **Suppose, instead of 25 meters, the second platform were 20 meters above the forest floor. How would this change your graph from the graph in question 1? Sketch your new graph.**

When you design a canopy tour, you must predict the time it will take to travel from platform to platform. You can make the predictions using function rules.

To determine these function rules, you will set up an experiment to simulate a person traveling along a zip line from platform to platform high above the floor of the rainforest. You will collect data using a CBR then use your data to determine a function rule.



Set up the experiment as shown so that your zip line is about 3 meters long.

Canopy Tours and Slopes of Zip Lines

To conduct this experiment your group members will need to assume the following roles:

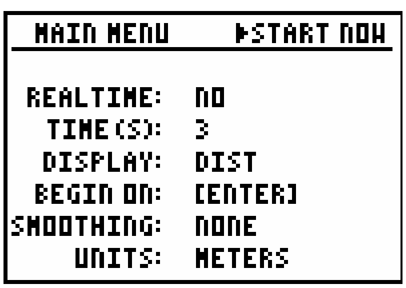
- **2 Meter Stick Managers** pull the zip line tight while keeping the meter stick perpendicular to the floor.
- **Release Manager** holds the pulley on the zip line, against the meter stick. When the CBR operator says "Go," he/she releases the pulley.
- **CBR Operator** starts data collection when he/she says, "Go."

Data Collection Phase 1

1. **Place one end of the zip line 20 centimeters above the floor and the other end 100 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. Sketch the graph from your calculator.**



4. **What type of relationship does your graph appear to represent? How do you know?**

5. **What is the parent function for this type of relationship?**

6. **Graph the parent function over your scatterplot. Sketch your results.**

7. **Is the parent function a good fit to your data? Why or why not?**

8. **Adjust your function rule until you have a curve that fits the data. Write your rule and sketch your graph.**

9. **In phase 2 of this experiment, you will decrease the slope of the zip line. Predict how the decrease in slope will affect your function rule and your graph.**
   Write your predicted function rule and sketch your predicted graph.

Data Collection Phase 2

1. **Place one end of the zip line 20 centimeters above the floor and the other end 85 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. Sketch the graph from your calculator.**

4. **Determine a function rule that fits your data. Write your rule and sketch your graph.**

5. **In phase 3 of this experiment, you will further decrease the slope of the zip line. Predict how this decrease in slope will affect your function rule and your graph. Write your predicted function rule and sketch your predicted graph.**

Data Collection Phase 3

1. **Place one end of the zip line 20 centimeters above the floor and the other end 70 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. Sketch the graph from your calculator.**

4. **Determine a function rule that fits your data. Write your rule and sketch your graph.**

Making Connections

1. Summarize your findings in the table below.

	Slope of the Zip Line	Function Rule	Graph
Phase #1			
Phase #2			
Phase #3			

2. How are the function rules alike? What accounts for these similarities?

3. How are the function rules different? What accounts for these differences?

4. Graph all three function rules in the same window. Sketch your graph.

5. How are the graphs alike? What accounts for these similarities?

6. How are the graphs different? What accounts for these differences?

7. In the context of this experiment, what is the meaning of the y-intercept in each of your graphs?

8. In the context of this experiment, what is the meaning of the x-intercept in each of your graphs?

9. In general what is the effect on the value of *a* in the function rule $y = ax^2 + c$ when the slope of the zip line decreases? Why does this happen?

10. What happens to the function rule as the slope of the zip line approaches 0?

11. In general what is the effect on the value of *a* in the function rule $y = ax^2 + c$ when the slope of the zip line increases? Why does this happen?

12. What happens to the function rule as the zip line becomes vertical?

13. The Rainforest Canopy Tour Company advertises it longest zip line to be 430 meters from platform to platform. If the slope of this zip line is the same as your slope in phase 2 of this experiment about how much time should it take Jose to zip along the line from one platform to the other?

14. When Jose travels along the 430-meter line, about how far will he be from the next platform after 10.3 seconds?

Canopy Tours and Length of Zip Lines

To conduct this experiment your group members will need to assume the following roles:

- **2 Meter Stick Managers** pull the zip line tight while keeping the meter stick perpendicular to the floor.
- **Release Manager** holds the pulley on the zip line, at different distances from the meter stick. When the CBR operator says "Go," he/she releases the pulley.
- **CBR Operator** starts data collection when he/she says, "Go."

Data Collection Phase 1

1. **Place one end of the zip line 20 centimeters above the floor and the other end 100 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. For this phase of the data collection the Release Manager needs to start by holding the pulley against the meter stick and releasing it from that position. Sketch the graph from your calculator.**

4. **What type of relationship does your graph appear to represent? How do you know?**

5. **What is the parent function for this type of relationship?**

6. Graph the parent function over your scatterplot. Sketch your results.

7. Is the parent function a good fit to your data? Why or why not?

8. Adjust your function rule until you have a curve that fits the data. Write your rule and sketch your graph.

9. In phase 2 of this experiment, you will decrease the distance your action figure travels on the zip line. Predict how the decrease in distance will affect your function rule and your graph.

Write your predicted function rule and sketch your predicted graph.

Data Collection Phase 2

1. **Once again, place one end of the zip line 20 centimeters above the floor and the other end 100 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. For this phase of the data collection the Release Manager needs to start by holding the pulley one foot from the meter stick and releasing it from that position. Sketch the graph from your calculator.**

4. **Determine a function rule that fits your data. Write your rule and sketch your graph.**

5. **In phase 3 of this experiment, you will further decrease the distance your action figure travels on the zip line. Predict how the decrease in distance will affect your function rule and your graph.**

   Write your predicted function rule and sketch your predicted graph.

Data Collection Phase 3

1. **Once again, place one end of the zip line 20 centimeters above the floor and the other end 100 centimeters above the floor. Pull the zip line tight while keeping the meter sticks perpendicular to the floor. What is the distance between your meter sticks?**

2. **What is the slope of your zip line?**

3. **Collect the data. For this phase of the data collection the Release Manager needs to start by holding the pulley two feet from the meter stick and releasing it from that position. Sketch the graph from your calculator.**

4. **Determine a function rule that fits your data. Write your rule and sketch your graph.**

Making Connections

5. Summarize your findings in the table below.

	Slope of the Zip Line	Function Rule	Graph
Phase #1			
Phase #2			
Phase #3			

6. How are the function rules alike? What accounts for these similarities?

7. How are the function rules different? What accounts for these differences?

8. Graph all three function rules in the same window. Sketch your graph.

9. How are the graphs alike? What accounts for these similarities?

10. How are the graphs different? What accounts for these differences?

11. In the context of this experiment what is the meaning of the y-intercept in each of your graphs?

12. In the context of this experiment what is the meaning of the x-intercept in each of your graphs?

13. In general what is the effect on the value of c in the function rule $y = ax^2 + c$ when the starting point on the zip line is closer to the CBR? Why does this happen?

Down Hill Racing

In the Winter Olympics, a snow skiing race was conducted on a mountainside that has a constant slope. The winner of the race skied straight down the hill after starting from a dead stop. His distance from the finish line for the first 6 seconds was recorded each second and is shown in the table.

Elapsed Time in Seconds	Distance from the Finish Line
0	225
1	221
2	209
3	189
4	161
5	125
6	81

What was the elapsed time when he crossed the finish time?

1 How does the graph of the function $y = 3.2x^2 + 4.5$ compare to the graph of the function $y = x^2$?

A The graph of $y = 3.2x^2 + 4.5$ opens opposite of $y = x^2$.

B The graph of $y = 3.2x^2 + 4.5$ is a vertical shift of $y = x^2$.

C The graph of $y = 3.2x^2 + 4.5$ is “flatter” than $y = x^2$.

D The graph of $y = 3.2x^2 + 4.5$ is a horizontal shift of $y = x^2$.

2 Frank used a CBR to collect distance versus time data while he rolled a ball down a ramp. He used his data to determine the function rule $y = -8.5x^2 + 13.3$.

Which of the following is a correct assumption about his experiment?

A The ball rolled away from the CBR.

B The ball started 8.5 feet away from the CBR.

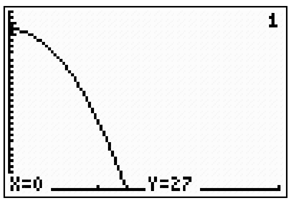
C The ball rolled toward the CBR.

D The ball rolled for 13.3 seconds.

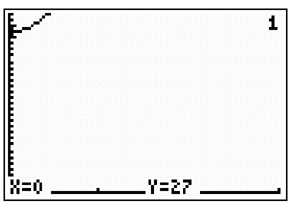
3 Lindsay dropped a book from her second story bedroom window. She determined the function that modeled the distance versus time relationship to be $y = -16x^2 + 18$.

Which of the following graphs could represent dropping a book from a third story window?

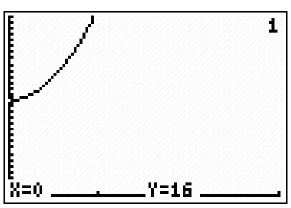
A



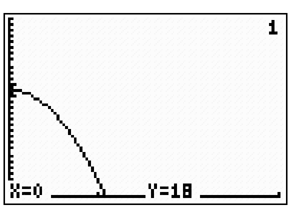
B



C



D



4 Gander collected the data shown in the table.

x	y
0	9
0.2	8.8
0.4	8.3
0.6	7.3
0.8	6.1
1.0	4.4
1.2	2.4

Which function rule best describes this relationship?

A $y = -16x^2 + 9$

B $y = -4.6x^2 + 9$

C $y = -4.9x^2 + 9$

D $y = -9.8x^2 + 9$