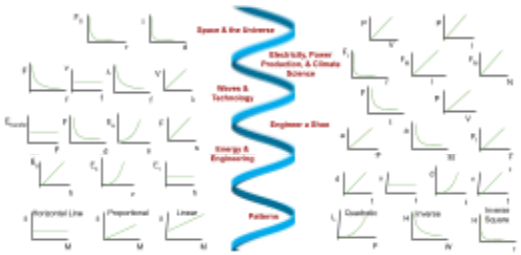
Unit 1: Patterns and Inquiry

Name: _____ Period: _____ Date: _____

How Do We Find and Use Patterns in Nature to Predict the Future, Make Data-Informed Decisions in the Present, and Understand the Past?



Progress Tracker for the Patterns & Inquiry

Task	What did we do?	How have I grown?

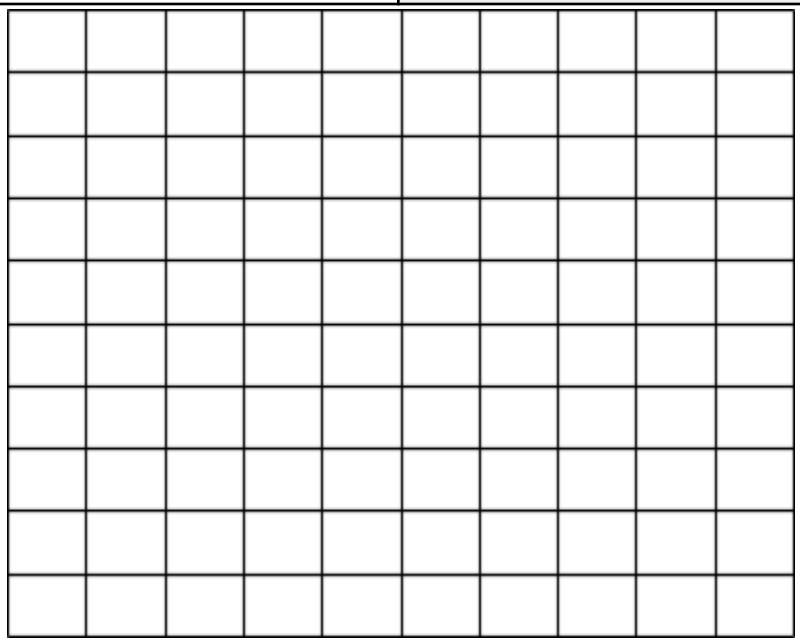
Practice with Technical Terms

Term	Definition / Picture / Example

Data Discussion for Ball on Floor Experiment

Orient to Data

Low Ramp	High Ramp
Diagram of setup:	Diagram of setup:
Mathematical model:	Mathematical model:



Analyze the Data

Similarities *Graph:*

Experience: *Mathematical Model:*

Differences *Graph:*

Experience: *Mathematical Model:*

Predict the distance each ball will travel after 0.5 seconds. Low Ramp: _____ m High Ramp: _____ m	Predict the distance each ball will travel after 10.0 seconds. Low Ramp: _____ m High Ramp: _____ m

☐ STOP: Get the card sort from your teacher and complete it, then move on to the next page.

Making Sense of Pattern

In the graph, the constant in our mathematical model affects the ___.	In the mathematical model, the constant is the ___.	In the real world, the constant in our mathematical model represents ___.

Write out the equation using all words (concepts):

Explain why the pattern discovered makes sense or should be expected, considering cause and effect.

Applications & Limitations

Returning to our *Starting Phenomenon Question: "What distance will this ball roll in 6 seconds?*" First, discuss and select which of the two mathematical models applies to the *Starting Phenomenon setup.* Then, show your calculations for your prediction below and include your confidence.

Describe a limitation or potential errors that may have accidentally changed the data. Then state if this limitation would modify your predicted distance the ball rolls in 6 seconds to be further, the same, or a shorter distance than using the model without considering the limitation.

List the steps of our *Making Better Predictions using the Inquiry* arrow from the *Inquiry Cube* and explain how they connected to making your prediction above.

Construct an argument for: “Is the cat going up or down?”

Claim: Write a sentence about the direction the cat is moving.

Evidence: Communicate the data that supports your claim. Typically, more data creates a better argument.

Evidence Piece #1	Evidence Piece #2	Evidence Piece #3 (Optional)

Reasoning: Write a statement that connects your evidence to your claim about the direction the cat is moving.

Reasoning about Evidence Piece #1	Reasoning about Evidence Piece #2	Reasoning about Evidence Piece #3 (Optional)

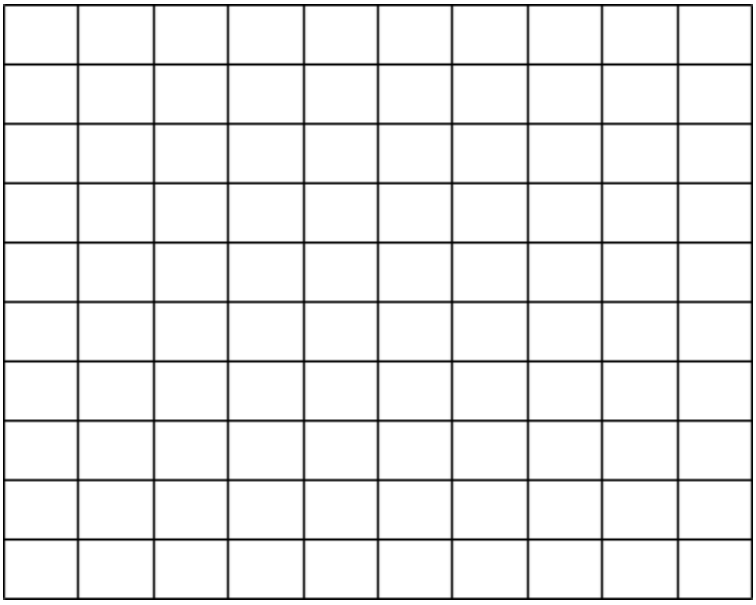
Concluding Sentence: Write a sentence summarizing your findings

Data Discussion for Ball on Ramp Experiment

Orient to Data

Low Ramp	High Ramp
Diagram of setup:	Diagram of setup:
Mathematical model:	Mathematical model:

Analyze the Data



Similarities *Graph:*

Experience: *Mathematical Model:*

Differences *Graph:*

Experience: *Mathematical Model:*

For each ramp height, predict the distance the ball will travel in 0.5 seconds and state your confidence in this prediction. Confidence: Low Ramp: _____ m High Medium Low High Ramp: _____ m High Medium Low	For each ramp height, predict the distance the ball will travel in 5 seconds and state your confidence in this prediction. Confidence: Low Ramp: _____ m High Medium Low High Ramp: _____ m High Medium Low

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Making Sense of Pattern

In the graph, the constant in our mathematical model affects the ___.	In the mathematical model, the constant is the ___.	In the real world, the constant in our mathematical model represents ___.

Write out the equation using all words (concepts):

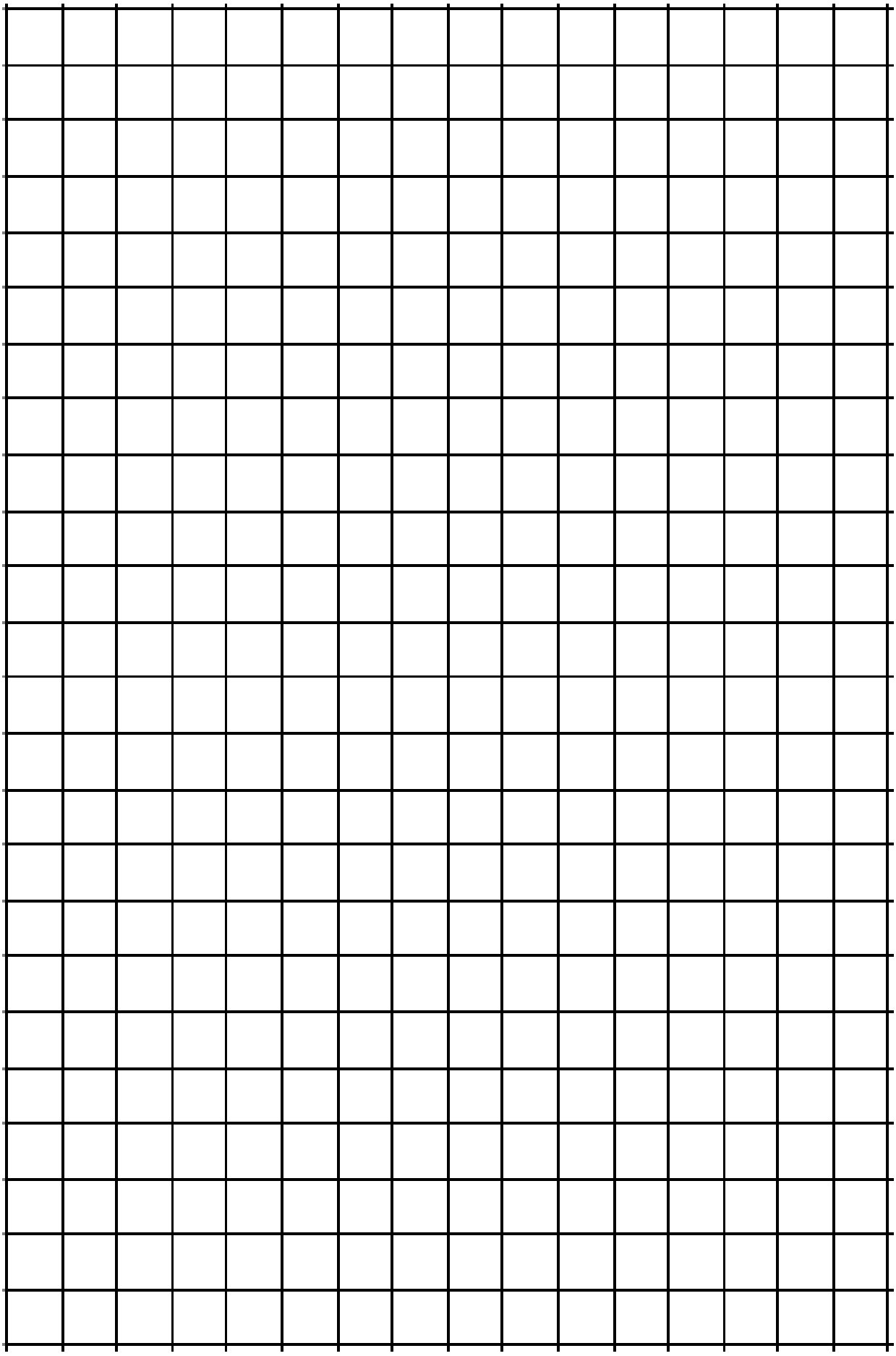
Explain why the pattern discovered makes sense or should be expected, considering cause and effect.

Applications & Limitations

Returning to our *Starting Phenomenon Question: "How far will this ball bearing roll on this angled ramp in ___ seconds?"* First, discuss and select the relevant mathematical model to inform your prediction about the *Starting Phenomenon setup*. Then, use the graph to determine your prediction and state it below with your confidence.

Describe a limitation or potential errors that may have accidentally changed the data. Then state if this limitation would modify your predicted distance the ball rolls in ___ seconds to be further, the same, or a shorter distance than using the model without considering the limitation.

Explain why the pattern we found in our quadratic mathematical models had the input variable twice or squared; specifically, from the marble activity, we had "diameter * diameter or d^2 " and "time * time or t^2 " in this lab.

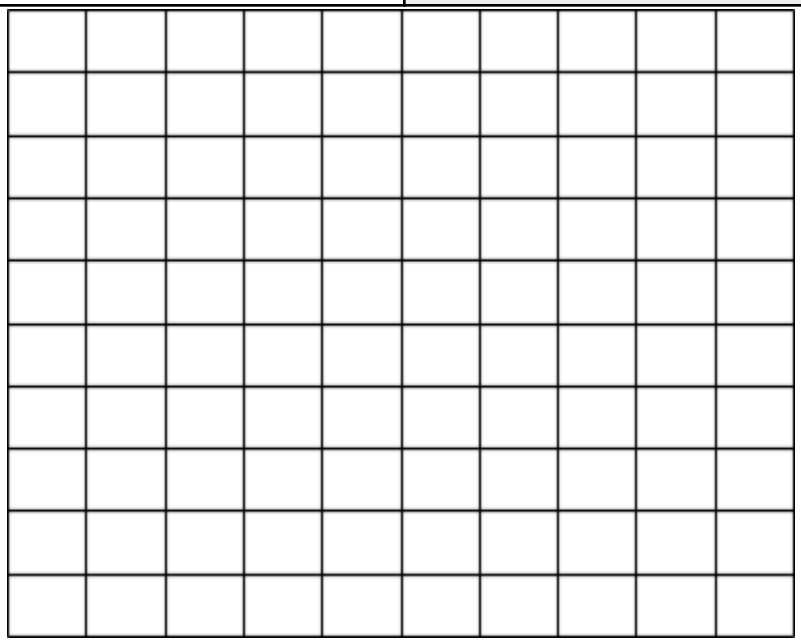


Data Discussion for Paragraph Experiment

Orient to Data

Paragraph from A_1 or A_2	Paragraph from B_3 or B_4
Diagram of your setup:	Diagram of your setup:
Mathematical model:	Mathematical model:

Analyze the Data



Similarities *Graph:*

Experience: *Mathematical Model:*

Differences *Graph:*

Experience: *Mathematical Model:*

For each set of paragraphs, predict the height when the width is 10 cm and state your confidence in this prediction.	For each set of paragraphs, predict the height when the width is 100 cm and state your confidence in this prediction.
Confidence:	Confidence:
Height: _____ cm High Medium Low	Height: _____ cm High Medium Low
Height: _____ cm High Medium Low	Height: _____ cm High Medium Low

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Making Sense of Pattern			
	In the graph, the constant in our mathematical model affects the ___.	In the mathematical model, the constant is the ___.	In the real world, the constant in our mathematical model represents ___.
	Write out the equation using all words (concepts):		
	Explain why the pattern discovered makes sense or should be expected, considering cause and effect.		

Applications & Limitations	
	Returning to our *Starting Phenomenon Question: "What is the height of this paragraph when it is printed about 30.0 cm wide?"* State and compare your answer from your graph to your answer using your mathematical model below.
	Describe a limitation or potential errors that may have accidentally changed the data. Then state if this limitation would modify your predicted paragraph height to be a higher, the same, or a lower height than using the model without considering the limitation.
	Describe an assumption or a situation with changing the widths of paragraphs where the mathematical model we found would no longer apply / be accurate.

Summary of Anchoring Patterns				
Pattern with constant (c-value)	1. Horizontal Line c = 10	2. Proportional c = 10	3. Quadratic c = 10	4. Inversely Proportional c = 10
Mathematical Model	y =	y =	y =	y =
Data Table Form	x | y 1 | 2 | 5 | 10 |	x | y 1 | 2 | 5 | 10 |	x | y 1 | 2 | 5 | 10 |	x | y 1 | 2 | 5 | 10 |
Graph Form	y x	y x	y x	y x
In Words				

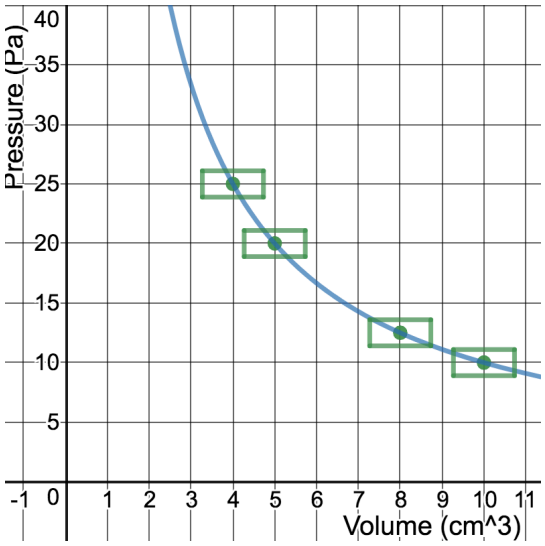
5. Select one of this unit's experiments as the basis for describing how, in the context of the experiment, you answered our essential question: *How do we find and use patterns in nature to predict the future, make data-informed decisions in the present, and understand the past?*

6. The process you described above produces data-informed predictions; explain why scientists and engineers prefer data-informed predictions over wild guess predictions.

7. Comparing and Contrasting the Patterns			
	Proportional	Quadratic	Inversely Proportional
Proportional		Find two similarities:	Find one difference:
Quadratic	Find two differences:		Find two similarities:
Inversely Proportional	Find one difference:	Find two differences:	

8. Rank the patterns from easiest to think about to most difficult to reason about:

9. Phenomenon — Dani squeezes a partially inflated balloon to make it smaller. She notices that as she decreases the volume of the balloon, the air pressure inside seems to feel stronger. She asks, "How does the volume of the balloon affect the pressure inside of the balloon?" She then collects and graphs the data to the right.



A) Using the graph, determine the pressure at 5 cm^3.

B) Using the graph and reasoning, predict the pressure for a volume of 20 cm^3.

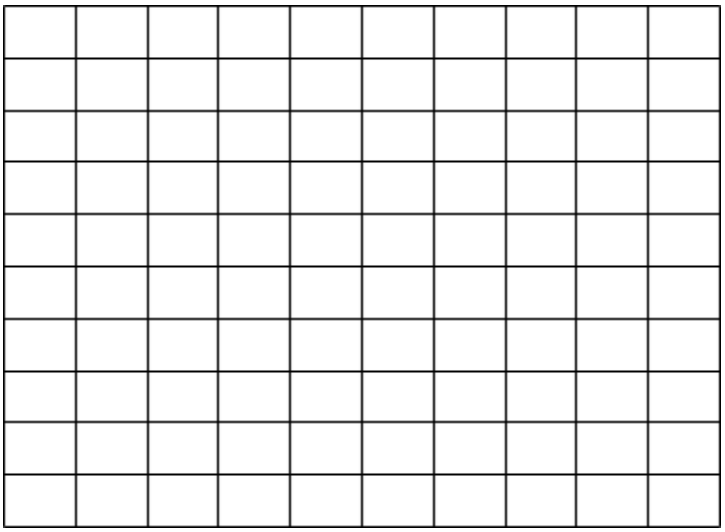
C) Dani's best-fit curve produced the mathematical model $Pressure = \frac{100}{Volume}$. Predict the pressure using the model for a volume of 20 cm^3.

D) Compare your prediction for the pressure using the graph in question B) to the prediction you got from using the mathematical model in question C) and explain why the comparison came out as it did.

10. Phenomenon — Mia runs high school track and while volunteering at her former middle school decides to run in a 50 meter dash. In this race, Briana, the 7th grade student, gets some special treatment as seen in the data table below.

A) Use the data table to create a graph of position versus time for Mia and Briana and include uncertainty boxes and a sketch of a best-fit line for each runner.

Time (s) ± 1	Position on Track (m)	
	Mia ± 3	Briana ±1
0	0	25
2	10	30
4	20	35
6	30	40
8	40	45
10	50	50



B) Estimate and write the mathematical model for your sketched best-fit line for Mia below.

Position = _____ * Time

C) What is the real world meaning of the constant you wrote in?

D) What special treatment did Briana, the 7th grader, get?

E) How is it represented in the graph?

F) Write out the mathematical model for your sketched best-fit line for Briana below.

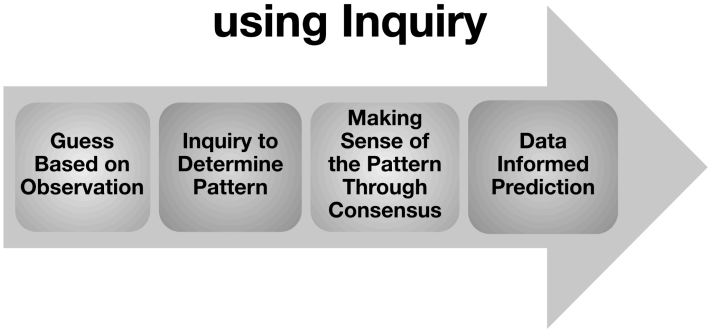
Position = _____ * Time + _____

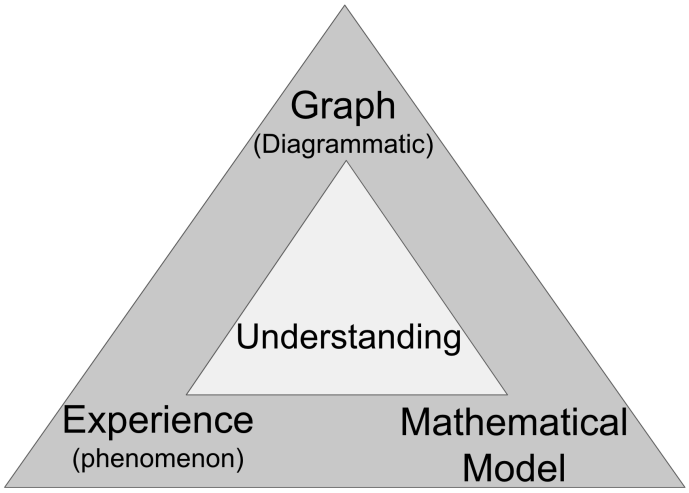
G) The mathematical model above is a combination of what two patterns we studied in this unit?

H) If the race was 100 meters long predict Mia's time and include your reasoning below.

Helpful Posters

Making Better Predictions using Inquiry





Math Equation

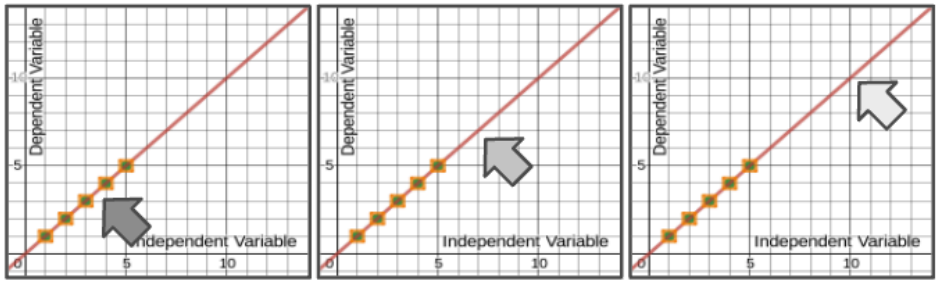
Emphasizes that both sides are equal and is generalized to apply to all similar functions.

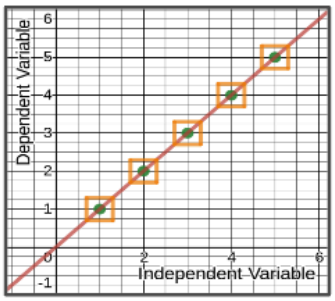
$$Y = mX + b$$

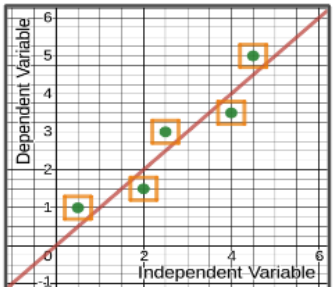
Mathematical Model

Emphasizes that the equation models a system in the real world and that each component maps on to something measurable in the world.

Miles Driven = 40 * Gas Burned + 80$_{\text{on electric}}$







Determining Confidence in a Prediction

Considerations	Predicted Value Within the Data Range	Predicted Value is Near the Data Range	Predicted Value is Far from the Data Range
The best-fit line is near the center of nearly all the data points.	High	Medium-High	Medium
The best fit line is near the edges of many of the data points	Medium-High	Medium	Medium-Low
The best fit line may not apply to the predicted scenario	Low	Very Low	Extremely Low