

# LINEAR RELATIONSHIPS

## SUMMARY

The intention of this unit was to have students explore the CONCEPT of a linear relationship, not just how to recognize or plot one, which is a very lower order level of thinking. We wanted students to consider the importance of research that reveals relationships and influences amongst variables in real-life issues. This required them to develop the basic skills (differentiate a linear from non-linear relationship, interpret and create graphs, extrapolate patterns for prediction), but the unit does not end there – it goes far deeper into the importance of understanding relationships, correlations, and causation so that they can be critical readers of research and news reports. Mathematical concepts such as constancy, communication, patterns, predictability, and uncertainty are all explored as students learn that while we can make logical predictions (if the rate of obesity continues to rise, health care costs will also increase), we cannot be absolutely sure that this will come true.

**According to math curricula, and the NCTM the main goals of mathematics education are to prepare students to:**

1. Communicate and reason mathematically
2. Use mathematics confidently, accurately, and efficiently to solve problems
3. Appreciate and value mathematics
4. Make connections between mathematical knowledge and skills and their applications
5. Commit themselves to lifelong learning
6. Become mathematically literate citizens, using mathematics to contribute to society and to think critically about the world

**The K-12 Mathematics curriculum is designed to support and promote the understanding that mathematics is:**

1. A way of learning about our world
2. Part of our daily lives
3. Both quantitative and geometric in nature, with both aspects being equally important in the development of mathematical literacy.

**In addition, mathematics and its study encourages the development of:**

1. Creative thinking
2. Logical thinking
3. Problem-solving skills
4. Data analysis skills
5. Co-operative interaction.

***\*If this is our curriculum, there is NO WAY to teach this through rote drill and text books! By definition, creative thinking, co-operative interaction, valuing and appreciating mathematics, and using math to contribute to society have to go beyond turn to page 24 and do the odd numbers!***

## **BIG IDEA**

1. Rate of change is an essential attribute of linear relations, and has meaning in the different representations, including equations

## **ESSENTIAL UNDERSTANDINGS**

1. Algebra is the study of relationships, and the solving of mysteries (e.g. why does variable  $x$  change? What influences it?)
2. Many real world functional relationships can be represented by equations, which in turn can be used to predict/find the solution to given real-world problems.
3. Linear algebra allows us to make predictions based on consistent relationships (concept of constancy in mathematics)
4. Numbers communicate important information about real life phenomena.
5. Linear relationships can be depicted visually, and graphic representations can aid in prediction

## **ESSENTIAL QUESTIONS**

- A. How does recognizing linear relationships in the real world impact our ability to predict outcomes, and make informed decisions regarding social issues?
- B. What do numbers tell us about the magnitude of an issue, and the urgency of problem solving?
- C. How can you represent these linear relationships so it can be understood clearly?

## ASSESSMENT RUBRIC

	Limited	Basic	Good	Excellent
A	Understands that variables can influence each other in predictable ways	Explains how an equation or graph describes a relationship that is constant, with supporting examples	Demonstrates how a real world functional relationship can be represented by an equation,	Proposes solutions based on patterns / predictability
B	Understands that numbers can indicate a “Big problem” or “little problem”	Compares degree of influence, and magnitude of a problem, given examples	Evaluates solutions to problems based on both mathematical and social variables, justifies importance of resolution (i.e. some problems may affect more people, but be of less severity, and vice-versa)	Communicates the urgency of resolving a social issue with power and impact. Uses statistics, equations, and graphs in insightful ways.
C	Identify examples of linear relations	Explain and differentiate between linear and non-linear relations	Analyze real-life data to determine if the pattern or relationship is linear	Critique a local issue that shows a linear pattern and propose a solution to solve it
D	<ul style="list-style-type: none"> <li>- Explain the linear pattern in a graph</li> <li>- List the components of a clearly labelled graph</li> </ul>	<ul style="list-style-type: none"> <li>- Produce a graph that shows a linear relationship</li> <li>- Interpolate and extrapolate values within a graph</li> </ul>	<ul style="list-style-type: none"> <li>- Generate a linear equation from a pattern</li> <li>- Evaluate whether a graph represents a linear situation or equation</li> </ul>	Create an infographic to present data regarding a local issue which includes a linear equation and its graph

## STATIONS & CENTRES (COOPERATIVE WORK)

<b>Verbal Linguistic</b>	<b>Logical Math</b>	<b>Visual Spatial</b>	<b>Body-Kinesthetic</b>	<b>Musical-Rhythmic</b>
Write a news article to explain an equation for a real world problem/issue, what does the future foretell if the pattern continues?	Evaluate the statistical claims of an article reporting influences on a social issue, are the conclusions logical? How urgent is it that society respond?	Create an infographic to represent a linear relationship related to a social issue, persuade people it is important	Construct a model to represent a linear relationship related to a given problem	Create an interpretive dance that demonstrates a linear relationship related to a social issue
<b>Naturalist</b>	<b>Interpersonal</b>	<b>Intrapersonal</b>	<b>Existential</b>	
Illustrate a linear relationship found in nature	Explore the factors contributing to a social issue, and their magnitude – indicate whether there are linear relationships within them	Think about the factors that influence you in your own life - indicate whether there are linear relationships within them. How powerful an influence do they hold? Write an equation to represent their impact.	Look at the data related to spiritual practices (e.g. meditation) and health. Recommend policy for Health Canada	

## EXAMPLES OF SOME SOCIAL ISSUES THAT *MAY* REFLECT A LINEAR RELATIONSHIP

1. Industrialization/Emissions with Global Warming
2. Human population growth with deforestation, endangered species, etc.
3. Socio-Economic status with academic achievement, diabetes, obesity, etc.
4. Poverty with infant mortality rates
5. Rates of gun ownership with mass shootings

## SOME EXAMPLES OF STUDENT PRODUCTS

1. **Musical Rhythmic:** Two students created a dance in which they first portrayed a couple whose movements were gentle and coordinated, and then portrayed the couple drinking alcohol, and movements becoming aggressive and reactive rather than coordinated (depicting relationship between alcohol use/addictions with domestic violence)
2. **Kinesthetic:** One student created a model showing a car accident at lower speeds, and one at higher speeds (depicting the relationship between speeding and fatalities)
3. **Naturalist:** Artistic representation of pesticide use with depletion of bird populations
4. **Verbal Linguistic:** A student wrote an article in response to the equation  $x=2y$  inferring that if X were rate of obesity, y could be the rates of pancreatic cancer, given recent research detailing the increased risk of pancreatic cancers in adults who are obese.
5. **Logical Mathematical:** Students were shown a graph indicating the closer people lived to a landfill, the more likely they were to struggle in school. Students were required to research the concept of a correlation – that is, that causation can't be attributed to a relationship. Do the toxins from a landfill cause learning difficulties, or are landfills placed in more impoverished areas, where a series of factors may be influencing learning? The truth is we don't know, because this is a correlation, not an empirical experiment.