



## Socially-based Curriculum Unit: Linear Relationships in the Real World

**Unit Title:** Linear Relationships in the Real World

**Time Frame** Approximately 12 full class periods (2.5 weeks)

**Unit Developer(s):** T. Nicitopoulos

**Developed for Course Name and Course Code:** Principles of Mathematics, Grade 9 Academic, MPM1D

**Strand(s) and Curriculum Learning Expectations Addressed:**

### Linear Relations Strand

**LR1.01** – interpret the meanings of points on scatter plots or graphs that represent linear relations, including scatter plots or graphs in more than one quadrant [e.g., on a scatter plot of height versus age, interpret the point (13, 150) as representing a student who is 13 years old and 150 cm tall; identify points on the graph that represent students who are taller and younger than this student] (Sample problem: Given a graph that represents the relationship of the Celsius scale and the Fahrenheit scale, determine the Celsius equivalent of  $-5^{\circ}\text{F}$ .);

**LR1.02** – pose problems, identify variables, and formulate hypotheses associated with relationships between two variables (Sample problem: Does the rebound height of a ball depend on the height from which it was dropped?);

**LR1.03** – design and carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Sample problem: Design and perform an experiment to measure and record the temperature of ice water in a plastic cup and ice water in a thermal mug over a 30 min period, for the purpose of comparison. What factors might affect the outcome of this experiment? How could you design the experiment to account for them?);

**LR1.04** – describe trends and relationships observed in data, make inferences from data, compare the inferences with hypotheses about the data, and explain any differences between the inferences and the hypotheses (e.g., describe the trend observed in the data. Does a relationship seem to exist? Of what sort? Is the outcome consistent with your hypothesis? Identify and explain any outlying pieces of data. Suggest a formula that relates the variables. How might you vary this experiment to examine other relationships?) (Sample problem: Hypothesize the effect of the length of a pendulum on the time required for the pendulum to make five full swings. Use data to make an inference. Compare the inference with the hypothesis. Are there other relationships you might investigate involving pendulums?).



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**LR2.02** – construct tables of values, scatter plots, and lines or curves of best fit as appropriate, using a variety of tools (e.g., spreadsheets, graphing software, graphing calculators, paper and pencil), for linearly related and non-linearly related data collected from a variety of sources (e.g., experiments, electronic secondary sources, patterning with concrete materials) (Sample problem: Collect data, using concrete materials or dynamic geometry software, and construct a table of values, a scatter plot, and a line or curve of best fit to represent the following relationships: the volume and the height for a square-based prism with a fixed base; the volume and the side length of the base for a square-based prism with a fixed height.)

### Desired Results

#### **Unit Description:**

Relationships exist in the world all around us and it is useful to be able to represent them in a variety of ways including verbal and written descriptions, table of values, and graphs. Students will not only gain experience identifying and forming opinions about relationships between two variables, they will gain that analytical skills to discuss cause and effect and learn how to quantify such using data. Students will use line graphs and scatter plots to explore real world relationships related to contemporary social issues and make future predictions based on overall trends in the data.

#### **Enduring Understandings / Learning:**

Students will be able to...

- identify real world relationships between two variables and analyze which variable is the cause (independent) and which is the effect (dependent)
- develop a personal opinion (hypothesis) regarding cause and effect relationships
- organize data in a table and make inferences based on the data table to evaluate their hypothesis
- plot the data from a table of values to create a line graph to determine overall trends in data
- to interpret the overall relationship between two variables plotted on a scatter plot
- plot data from a table of values on any of the quadrants of a scatter plot and use it to identify the overall relationship
- identify hidden factors that affect the dependent variable other than the independent variable when evaluating the overall relationship
- make meaningful conclusions regarding cause and effect relationships using scatter plots and offer reasons why the relationship exists
- fit a trend-line or line of best fit through a set of data plotted on a scatter plot to identify the direction of the overall trend with and without using technology



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- see the interconnectedness of ordered pairs, table of values, and scatter plots and all as valid tools for working with relationships
- understand the value of a trend-line in terms of interpolating and extrapolating to make future predictions concerning the relationship

### Assessment Tasks

**Performance Tasks and Other Evidence That Will Demonstrate the Knowledge and Skills Acquired:**

Quizzes, Unit Project (Appendix D and E), Unit test

**Assessment Criteria:**

Rubric attached for Unit Project (Appendix E)

### Unit Planning Notes

**Prior Learning Necessary (if any):**

None

**Preparation Notes (if any):**

1. Class set of graphing calculators are available for use by students
2. For the Activity “Is the Earth really getting warmer...” (Appendix A), the teacher needs to retrieve data for the activity from the following sources and organize it in a table to accompany the activity  
Temperature data from the National Climatic Data Center <http://www.ncdc.noaa.gov/oa/ncdc.html>  
Carbon dioxide data from the Scripps Institution of Oceanography <http://sio.ucsd.edu/>
3. Access (login/password) to E-Stat
4. Access to a computer lab / library for students to work on the unit project



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### **Learning Plan**

#### **Lesson 1**

1. Introduce the idea of what a relationship is using a variety of examples from the real world
2. Students work in pairs to brainstorm other ideas of real world relationships between two variables
3. Each group writes their relationship on chart paper and posts it on the board / wall in classroom
4. Class discusses relationships and which can be quantified with real world data and which can't
5. Modify relationships that can't be quantified by replacing the variables with ones that can be measured
6. Define cause and effect and ensure students understand dependent vs. independent variables
7. Formally define "hypothesis" and the role it plays when examining relationships

#### **Lesson 2**

1. Present data in the form of a table of values concerning a real world relationship and ask students what the relationship is between the variables (it helps if the data is not sorted in any order)
2. Provoke students to find an alternative manner to present the data so that the relationship that exists is clear.  
Note: some students will offer the idea of sorting the data or even graphing it!
3. Formal lesson on how to plot data from a table onto a scatter plot (first quadrant only)
4. Handout activity "Is the Earth Really Getting Warmer" (see Appendix A)
5. Students use the remainder of the class to work through the first few questions .

#### **Lesson 3**

1. Introduce the concept of a trend-line or line of best fit as a valuable tool in focusing on the big picture or overall relationship
2. Ensure students are able to make meaningful conclusions based on relationships communicated via scatter plots by focusing on the big picture
3. Ensure students are able to state accurate conclusions by adding qualifiers where necessary (eg. as the price of a sports car increases, so does the horsepower, "most of the time")
4. Students continue working on Activity "Is the Earth really getting warmer?" (see Appendix A)
5. Students should be able to finish the activity during class or for homework if necessary



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### Lesson 4

1. Take up activity “Is the Earth really getting warmer?” ensuring that students understand the social implications of their results from the data
2. Distribute new activity “Do songbirds prefer larger forests...” (see Appendix B) so that students can apply what they learned from the previous activity
3. Allow students to work on this activity for the remainder of the period and assign the rest for homework

### Lesson 5

1. Take up the activity “Do songbirds prefer larger forests...”
2. Formal lesson on plotting data from tables on all four quadrants of the scatter plot. Include an explanation of the term “ordered pair” and have students work from their textbook to practice plotting ordered pairs

### Lesson 6

1. Distribute the activity “Can the Earth sustain itself...” (see Appendix C) and have students work on the activity for the entire period
2. Halfway through the period, demonstrate to the students using the TI-84 view screen how to enter a table of values into the calculator and create a scatter plot. Note: this is a good time to do this because students have gained experience creating scatter plots by hand

### Lesson 7

1. Quiz topics covered to date
2. Introduce the Unit Project (see Appendix D and E)
3. Notify students that topics are on a first come first serve basis and signup is required
4. Allow students time to brainstorm ideas

### Lesson 8

In class work period for Unit Project. It is recommended that you work in a computer lab or library where students have access to a computer and the Internet.

Also, it would be a great idea to have the Librarian do a lesson / activity on using ESTAT and on-line databases, and the Internet to search for data for the project



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### **Lesson 9**

Students continue to work on unit project

### **Lesson 10**

Students continue to work on unit project

### **Lesson 11**

1. Unit Project due beginning of class
2. Review for the major unit test

### **Lesson 12**

1. Students write major unit test

## **Attachments**

Appendix A: Is the Earth really getting warmer?

Appendix B: Do songbirds prefer larger forests?

Appendix C: Can the Earth sustain itself?

Appendix D: Choose your own social issue...

Appendix E: Rubric: Choose your own social issue

## **Other Possible Course Applications**

Geography teachers will find the activities useful in terms of topics covered in their respective courses. Students should have no trouble with the Mathematics related components.