**The Pattern and Relations Strand: Outcome P7.1**

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| **Outcome** | **Indicators** | | |
| P7.1 Demonstrate an understanding of the relationships between oral and written patterns, graphs and linear relations.  [C, CN, R]  *In support of the K-12 Mathematics goals of Number Sense, Spatial Sense, Logical Thinking, and Mathematical Attitude.* | 1. Represent a relationship found within an oral or written pattern using a linear relation. 2. Analyse whether an oral or written pattern is linear in nature. 3. Provide a context for a linear relation. 4. Identify a pattern from the environment that is linear in nature and write a linear relation to describe the pattern. 5. Identify assumptions made when writing a linear relation for a pattern. 6. Create a table of values for a linear relation by evaluating the relation for different variable values. 7. Create a table of values using a linear relation and graph the table of values (limited to discrete points). 8. Sketch the graph from a table of values created for a linear relation and describe the patterns found in the graph. 9. Describe the relationship shown on a graph using everyday language in spoken or written form. 10. Analyze a graph in order to draw a conclusion or solve a problem. 11. Match a set of linear relations to a set of graphs and explain the strategies used. 12. Match a set of graphs to a set of linear relations and justify the selections made. 13. Describe a situation which could result in a graph like one that is shown. | | |
| **Learning Space** [**Top**](#top) | | | |
| In grade 6, the students learned about graphing relations on a Cartesian plane using tables and patterns to define the points to be graphed. In grade 7, the students’ focus moves to representing, describing, and working with relations that are linear in nature.  This outcome is developing understandings that are fundamental to the students’ future study of relations and functions. It is very important that they develop the understanding that different representations (concrete, pictorial or oral patterns, tables, and graphs) of relationships are just different lenses through which relations can be observed and analysed. It is crucial that the students understand that the relationship being represented does not change when different forms of representation are used. Thus, other forms of representations for the same relationship must necessarily support interpretations and analysis done with respect to one form of representation.  For the first time, the students are grouping similar types of relationships. Although they may have thought of grouping patterns into categories such as sound patterns, colour patterns, or shape patterns, in this outcome the students are asked to recognize a pattern based on the relationship rather than the attribute. So, regardless of the context or type of representation, the goal is for students to be able to identify linear relations.  In understanding linear relations, the students also need to firmly grasp the value of one variable in the situation directly and predictably dictates the value of the second variable. Moreover, the relationship they describe concretely, orally, pictorially or symbolically is the key for moving from the value of one variable to the associated value of the other.  Linear relations can emerge in a wide variety of settings and may or may not be directly connected to any particular subject area. The students should be actively engaged in helping identify, as well as describing and representing linear relations. | | | |
| **What Students Should…** [**Top**](#top) | | | |
| **Know**   * The terms linear relationship and linear relation. | | **Understand**   * The type of pattern of change that must occur in order for a relation to be linear. * Not all relations or pattern relationships are linear. * In extending or interpreting within a pattern, assumptions about the pattern are being made. * When writing a linear relation for a pattern, assumptions are being made about the pattern. * The role of the variables in a linear relation. * How one variable influences the other variable. | **Be Able to Do**   * Explain why a given pattern (concrete, oral, physical, pictorial, or in a table) is linear. * Write a linear relation for a pattern that is linear. * Create a table of values from a pattern. * Create a table of values from a linear relation. * Graph the points in a table of values and explain whether or not the graph is linear. * Demonstrate an understanding of the relationships between oral and written patterns and linear relations. * Identify contexts in which a pattern or relation will be linear. * Describe a context that could be represented by a given linear relation. |
| **K****ey Questions** [**Top**](#top) | | | |
| * What makes a relation or pattern linear? * What assumptions are being made when interpreting or extrapolating a pattern to determine values or write a linear relation? * Why are there two variables in a linear relation? * What is the purpose of a linear relation? * What is beyond a linear relation? | | | |

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| **Suggestions for Assessment:** [**Top**](#top) |
| **Big Idea:**  Linear Relationships  **Suggestions for assessment tasks:**   1. Assess the turn-in assignment that the students do in their groups of three (see 8 in **Suggestions for Instructional Activities).** 2. Provide the students with a series of contexts, with and without accompanying representations, and ask them to identify those that involve linear relationships and to explain their reasoning. Have the students select one of the contexts that they identified as involving a linear relationship and ask them to create the four types of representations (pattern, table of values, graph and linear relation) for the linear relationship involved. 3. Provide the students with a linear relation and ask them to describe a context where that linear relation could be used to represent the context. 4. Give the students a linear relation and ask them to graph it. Provide the students with an additional point and ask them to verify whether the point satisfies the linear relation and to justify their reasoning. Ask the students to verify the point in a second way. 5. Ask the students to solve a problem using the graph of a linear relationship. Have the students explain their reasoning.   **What to look for:**   1. See [*Linear Relationships Rubric*](file:///C:\Users\kw426\AppData\Local\Temp\Linear%20Relationships%20Rubric.doc)*.* |
| **Suggestions for Instruction:** [**Top**](#top) |
| **Big Idea:**  Linear Relationships  **Suggestions for instructional activities**   1. The students have already had experience with patterns, tables of values, graphs and relations. In this outcome, there are now focusing on the type of relationship shown in these representations, specifically to recognize linear relationships. Tell the students that you are going to show them a number of examples of patterns, tables of values, graphs and relations, all of which represent a particular type of relationship. Tell the students that you will begin sorting the relationships according to whether or not the relationship is of a particular type. Begin by giving the students examples and non-examples that you categorize as a YES or a NO. Ask the students to not say their ideas out loud during this time period, but rather keep a written record of what they think are the characteristics of the type of relationship that you are focusing on. After a number of examples and non-examples of all four types of representations, have the students pair up and discuss their ideas and hypotheses about the characteristics of the desired type of relationship. 2. Once a pair of students has agreed upon a set of characteristics, provide the students with copies of more representations or relationships and ask them to categorize each representation as a YES or NO using their characteristics. If the students are unsure where a particular representation fits, have them describe to you why they don’t know for sure. Use this description to create either an example or non-example that you identify for the students and that they can use to refine their characteristics. 3. When a pair of students has completely sorted the second set of representations, have them check their results with two other groups (so now in groups of 6). The students must come to consensus on their results, and each student needs to be able to justify the identification of each representation as either a YES or a NO. If they are unable to make a decision on a particular representation, they can either confer with another group, or again describe their point of confusion to you so that they can be given a new example or non-example. 4. Discuss the sorting of the second set of examples, this time having students explain their reasoning for the placement of each representation. If there is disagreement, allow the students time to try to sort it out before providing additional examples or non-examples to clarify the situation. 5. Debrief the activity by having the students summarize the characteristics of the YES representations. Tell the students that all of the characteristics belong to what is called linear relationships. Ask the students if there are any of the representations that make this choice of name appropriate. Also be sure to tell the students that the relations in the YES representations are specifically called linear relations. 6. Have the students form groups of three. Give each student in the group one of three sets of cards for matching. One set should be matching patterns to tables of values, another matching tables of values to graphs, and a third matching tables of values to linear relations. Have the students work independently to match their set of cards. 7. Have each student describe the cards that they were given to match, the matches they made, and the strategies they used. As the students progress, they should see the tables of values in each set of cards are the same. Have the students rematch the cards (keeping only one card for each table of values) to show the different representations for the same relationships. Have the students discuss how each representation is related to the other and how they would translate between each one. 8. In their groups, have each student create one of each of the four different types of representations, each depicting a different linear relationship. Have the students confirm that all of the representations created by their group are linear. Next, have the students pass their set of cards to the student on the right. The students are then to create the remaining three alternate representations for each relationship and turn their work in. 9. As a class, consider a number of different situations and contexts and discuss whether or not each situation or context can be described using a linear relationship. For those that can, ask the students to create one form of representation of the relationship. Ask the students to vary the type or representation that they use. 10. Show the students a linear relation and provide them with three or four contexts involving the numerical constants in the linear relation in different ways. Ask the students to identify the one context which the linear relation could describe and have them explain the reasoning. Repeat this activity using a graph rather than a linear relation. 11. As a homework task, ask the students to do two things: create a list of contexts related to their home life that could be described using a linear relationship and to describe a different context that could be represented by a linear relation that you have provided to them. 12. Give the students a graph and ask them to describe a context which the graph could represent. Have the students share their contexts and discuss their similarities and differences. 13. Provide the students a linear relation and ask them to graph it. Have the students share their strategies and discuss them. Ask the students what is special about the points that they have graphed (in terms of the linear relation). Provide the students with points on the Cartesian plane that are not already plotted and ask the students to determine which points come from the same linear relationship as the linear relation and which ones don’t. Have the students discuss their ideas and strategies. Be sure to emphasize the idea of a point “satisfying” a linear relation. 14. Provide the students with a graph and no linear relation. Give the students possible points that might belong to the same relationship and ask them to determine which points do belong and which do not. Have the students discuss their strategies. If the students are only thinking to use algebraic methods, plot the points as they decide about them and ask the students to reflect on the position of the points and whether or not they belong to the same relationship. 15. Provide the students with a graph of a linear relationship and pose a problem they are to use the properties of the graph to answer. Have the students discuss their strategies. |