OER In Mathematics Professional Development Project

Lesson Plan

Topic of the lesson:	Standard(s)/Learning Result(s):
Linear Functions – Tables and Equations Lesson	**ALGEBRA: Symbols and Expressions** Students understand and interpret the characteristics of functions using graphs, tables, and algebraic techniques. (including y = kx + b)

Goal(s) of the Lesson:

What do you want the students to know and be able to do? What overarching questions do you want them to be able to answer?

Students should be able to recognize when a relationship shown in a table or equation is linear, including if an equation or table appears on first glance to NOT be linear or fails incomplete tests of linearity (e.g. "no exponent higher than 1" -- so $x*y = 2x^2 + 6x$ would be classified as non-linear when it is linear). When analyzing a table to determine whether it represents a linear relationship, the rate of change between two sets of related X Y pairs is important (the ratio of change in y values divided by the change in X values), not necessarily whether the X values (or Y values) by themselves change by a consistent amount. Also, we want students to understand the distinction between linear relationships and linear functions (as a subset of linear relationships which must be a function and have only one distinct Y value for each X value; e.g. x=4 is a linear relationship but not a linear function).

- Students should be able to accurately identify linear relationships (including relationships that are not functions) from a table or an equation.
- Optional: Students should understand that linear relationships include any function with direct proportionality, even relationships in the form x=4 or a vertical line on a coordinate graph (slope is undefined), although these are not linear functions.

Context

What should students know to engage in the lesson?

Students should have an understanding of variables (as representing a range of unspecified values, not just as a specific but unknown number of "container") and equations, tables of two values (X-Y tables), graphing ordered pairs, and graphing equations using substitution. Students should be able to determine the (X,Y) ordered pair of a point on a coordinate graph. Students should have a basic understanding of a function as a relationship that has a distinct dependent variable value for each independent variable value (every X value has only one Y value). Students should be able to simplify and solve basic equations, including with exponents greater than one.

Associated Student Difficulties

Describe known misconceptions (overgeneralizations, common errors, and misunderstandings) associated with the content in this lesson?

Sometimes students think a relationship is linear if the table of values has X-values increasing at a constant rate, or if the Y-values increase at a constant rate, and may not look closely at either (1) the relationship between each X value and Y value in a pair, and see whether this relationship is the same for all pairs of values in the table, or (2) the rate of change (as the quotient of the differences between X and Y values) between each of the pairs in a table. When looking at equations, students may not recognize equations as linear if they are not in the standard form or slope-intercept form of a line, for example if one or more variables appear on both sides of the

equation (e.g. y+x = 2x + 6) or if an exponent is higher than 1 (e.g. $y + x^2 = x^2 – x – 9$), when in fact these equations can represent linear relationships. Students may think a linear relationship that is not a function (e.g. a vertical line on a coordiante graph) is not linear. When reading graphs, students may also think that a graph that is composed of straight lines, such as the graph of y =|x|, is a linear relationship.

Planning for Differentiation

Describe how the lesson design incorporates a plan for differentiation.

This lesson calls for customizing instruction at the class level based on the results of a pre-assessment.

Pre/Post Assessment

Review what you want students to know and be able to do. How will you determine what they know and don't know? How will you determine that they have met the target? (Describe the pre/post assessment)

Pre Lesson Assessment (Probe): Administer one or more of the Are They Linear? (Tables, Equations, Graphs, or all) assessments to determine if students can recognize linear relationships from the given examples.

- Review results to determine specific instructional interventions.

Post Lesson Assessment: Re-administer the same assessment or the Are They Linear? (all) assessment to determine any learning.

Materials & Resources

Describe any tools and resources that are needed to support the lesson.

- Student Exploration(s) for Are The Linear (1, 2, 2a, or 3 applets)

Technology Tools / Applets

What technology tools, applets, and/or resources you will use for this lesson?

- Are They Linear? applets:
  - (1) http://maine.edc.org/file.php/1/tools/AreTheyLinear1.html
  - (2) http://maine.edc.org/file.php/1/tools/AreTheyLinear2.html
  - (2a) http://maine.edc.org/file.php/1/tools/AreTheyLinear2a.html
  - (3) http://maine.edc.org/file.php/1/tools/AreTheyLinear3.html
  - (4) http://maine.edc.org/file.php/1/tools/AreTheyLinear4.html
- Projector
- Laptops
- Smartboard (optional)

What management strategies will you utilize during the lesson?

- Load the applet(s) and starting configuration on the teacher computer before having students launch the applet
- Put the link on the classroom wiki (or blog, online bookmarks, or other management site)

Teacher Notes:

Lesson Description

Preparation

What resources will you need? What type of preparation is needed before you can begin the lesson?

- Laptops
- Print Pre and Post Lesson Probes (Or make sure the probes are in an online administration site such as ThatQuiz.org)
- Print Exploration(s) for Are They Linear? tool(s) planning to use
- Approximate Time: 15-30 minutes one class, 45-60 minutes the second class

	Lesson	Questions for Learners	Notes / Reflections
Introduction	The day before the main part of the lesson (so you can analyze the pre-assessment data, plan instruction, and copy appropriate explorations as needed) • Introduce the idea focusing on recognizing linear relationships from tables and equations (as opposed to graping linear equations or plotting points in a table) (5 min.) • Students complete one or more of the Are They Linear? pre-assessment(s) (5-15 min). • Engage students in responding to the pre-assessment questions and results without sharind definitive "answers." Show and analyze electronic results (if using clickers, ThatQuiz, Google Forms, etc.) and/or elicit example responses and student opinions. (5-10 min.)	Possible questions to pose but not clearly answer before the assessment are: - How can you tell from a table of values if the relationship represented is linear? - How can you decide from an equaiton if the relationship represented is linear? - What is a linear relationship and how is this different from a linear function?	1) Review probe prior to instruction, make observations about misconceptions and determine accurate responses 2) After the introduction, determine instructional strategy and materials to best address any misconceptions or gaps in understanding shown in the pre-assessment results. If all students answered all questions accurately and the subsequent class discussion showed clear understanding, determine if you will probe more deeply or move to a more advanced topic or different topic.

	Lesson	Questions for Learners	Notes / Reflections
Core Instruction	• Use a combination of guided instruction and student exploration throughout the lesson, pausing as appropriate to engage small groups or the entire class in discussion. • Students engage in 1 or more Are The Linear? applet explorations, either individually or in pairs. (15-20 min.) • Pause to explore applet features and functions as appropriate to promote deeper understanding of why the applet functions a certain way. • Ask questions or individuals to promote thinking related to misconceptions or gaps in understanding related to the pre-assessment, such as variables on both sides of the equation. • Select students to report out about their findings using the applet by demonstrating with the projector or interactive whiteboard. (5-10 min.) • Discuss and review stratgies for determining if a given relationship is linear; and [if appropriate] the difference between a linear relationship and a linear function. (5 – 10 min.)	What have you learned about deciding if a [table or equation] is representing a linear relationship by using this applet? What happens when you move this slider on the applet? Why does the [table of values or graph or point] change that way? What are some strategies to determine from a table if a relationship is linear? What are some strategies to determine from an equation if a relationship is linear? Are there some strategies for determining whether a relationship shown in a table or an equation is linear that you thought worked, but you realize now do not always work? What do you think of the strategy, "if all the exponents in an equation are 1, it is linear." [and other similar questions] Optional: How are the ideas of "linear relationship" and "linear function" related to each other? Is there any different between them?	
Closure	Students will retake the pre-assesment(s), either the same as the pre-assessment(s) or the Are They Linear? (all) assessment. (5-15 min.) Share the results with students and ask them to help interpret the results in light of both accurate responses and the pre-assessment results. (5-10 min)	What does the data from the post assessment tell us about the current understanding of our class on this topic?	Review data Reflect on remaining areas of difficulty Determine next instructional steps