Transcript – Slope

Let's take a moment and look at how the concept of "slope" is built and applied. You may record any thoughts or questions you have in your journal on the page titled *A Vertical Look at Key Concepts and Procedures*.

Students look for relationships between pairs of numbers, and often they first consider these as additive relationships. Students believe that, given an x value, there is a number you can add to x in order to determine the corresponding y value. These types of relationships can be expressed algebraically as $y = x + b$. As sixth grade students gain more experience with relationships between numbers, they are asked to make distinctions between additive relationships and multiplicative relationships. In student expectation 6(4)(A), students represent a given situation using verbal descriptions, tables, graphs, and equations in the form $y = kx$ or $y = x + b$. Let's look at activities from the Introduction to the Revised TEKS, Grades 6–8 professional development.

Transcript – Grade 6 Example

What do you notice about this activity from grade 6?

In this activity, students are asked to work together to determine the relationship between the width and the length of the given "family" of rectangles.

Students are also given a second "family" of rectangles and are asked to find the relationship between the length and width of these rectangles.

What do you notice?

As students work through the task and generate multiple representations, they will see that activity A represents a multiplicative relationship where the length of each rectangle is two times its width.

They will also see that activity B represents an additive relationship where the length of each rectangle is two more than its width.

Students are also asked to compare the two relationships using the graphs, tables, and equations. The sixth grade activity provides the opportunity for students to explore a multiplicative relationship and begin to think about the concept of a slope before the formal definitions for the constant of proportionality and slope are introduced.

Transcript – Grade 7 Example

In seventh grade, students look at the concept of proportionality both numerically and geometrically. The seventh grade student expectation 7(5)(A) expects students to generalize the critical attributes of similarity, including ratios within and between similar shapes, and 7(4)(C) expects students to determine the constant of proportionality ($k=y/x$) within mathematical and real-world problems. Both of these student expectations build students' conceptual understanding of a rate of change, which will help with the understanding of slope. Let's look at an activity that students may be asked to do to learn each of these standards.

One activity from the Introduction to the Revised TEKS, Grades 6–8 professional development asks students to look at the base-to-height ratio of two sets of triangles. The activity then asks students to consider whether all of the triangles are similar. This not only builds the concept of a ratio in a geometric context, but also leads students to a conceptual understanding of similar figures, which will be used in grade 8 to help build the concept of slope.

Transcript – Grade 7 and 8 Examples

Student expectation 7(4)(C) expects students to determine k, the constant of proportionality. In this example, we can see that the students are given a verbal description and a partially completed table. With that information, they are expected to calculate the constant of proportionality, or cost per piece of chocolate. The cost per piece of chocolate will relate directly to the slope of the linear function, which models this situation.

As students explore proportionality in seventh grade through similarity, unit rates, and real-world situations, they are building the foundation for understanding the concept of slope.

In grade 8, students are expected to use similar right triangles to develop an understanding that slope, m, given as the rate comparing the change in y-values to the change in x-values, $(y_2 - y_1) / (x_2 - x_1)$, is the same for any two points (x_1, y_1) and (x_2, y_2) on the same line.

We will look at an activity from the Introduction to the Revised Mathematics TEKS, Grades 6–8 professional development that addresses this student expectation.

Students combine the concepts of similar right triangles and proportionality to develop their conceptual understanding of slope. In this example, students are calculating slope as the rate comparing the change in y-values to the change in x-values. Using similar triangles, they are expected to generalize that this rate is the same for any two points on a given line.

This idea is a major development in understanding slope, so it is important to note that it has moved from Algebra I to eighth grade. Previously, middle school grades addressed only rate of change. With the revised TEKS, the concept of slope is introduced and developed in grade 8. During Algebra, students continue to use and apply slope with linear functions. During Geometry, students apply slope when they write the equations of lines that are parallel or perpendicular to given lines, and when asked to use

slope verify the parallelism or perpendicularity of pairs of lines. During Algebra II, students continue to apply slope when determining if relationships are linear. They may also apply slope when graphing systems of equations.

Transcript – Slope in Algebra I

As students enter Algebra I, they have an understanding of slope as the rate comparing the change in *y*-values to the change in *x*-values. They have had experience determining slope from tabular, graphical, and verbal representations of linear situations.

In Algebra I, students will extend their understanding of slope and use it to write linear equations. In the linear functions, equations, and inequalities strand of the revised Algebra I TEKS, students are expected to write a linear equation in various forms—from different representations and with given characteristics.

For example, students may be asked to write the equation of a line, given two points. They may also be asked to write the equation of a line parallel or perpendicular to a given line. When this expectation is combined with student expectation A(2)(B), the equation may be written in standard form, slope-intercept form, or point-slope form. When these standards are paired with mathematical process standards, students may be expected to determine slope from real-world situations in order to write the equation of the line.

These are not the only instances in Algebra I where students will be using the concept of slope. The revised Algebra I TEKS expect students to use and apply what they have learned about slope in the middle grades.

Transcript – Slope in Geometry

When students continue their study of mathematics in Geometry, they are extending their use of equations and slope to draw, verify, and prove geometric properties.

For example, students may be asked to write the equation that represents the perpendicular bisector of a segment. Understanding what a perpendicular bisector is adds a geometric context to the question. In this problem, students are expected to determine the coordinates of the midpoint of segment *SR* so that they are able to write an equation of the line that passes through that point. Students must also determine the slope of segment *SR* and the slope that is perpendicular to it before writing the equation of that perpendicular line that passes through a given point.

Students will apply their understanding of the relationships between the slopes of parallel lines, perpendicular lines, and linear functions as tools to explore geometric figures through coordinate geometry.

Transcript – Slope in Algebra II

When students continue their study of mathematics in Algebra II, they are expected to be able to analyze data and determine an appropriate linear, quadratic, or exponential model with and without technology. Students may use the attribute of a constant slope to determine if a set of data can be modeled by a linear relationship.

For example, the data strand of Algebra II expects students to analyze data sets and determine if they are linear, quadratic, or exponential. In the example, students can apply their understanding of slope as a constant rate to analyze the data provided and determine if the data set is linear. They can also apply their understanding of rates of change to determine if non-linear data sets can be modeled with a quadratic or exponential relationship.

As we look at the progression of the concept of slope and the concept of rate of change in the revised TEKS, we see that students begin the conceptual development of slope in the middle grades, and continue to develop and use that understanding into Algebra II to explore linear and non-linear relationships.