

## STRAND 2: LINEAR FUNCTIONS

### TOPIC 2.1: LINEAR PATTERNS

#### Topic Notes

##### **Mathematical focus**

This topic emphasizes building linear functions from linear patterns. The concept of linear functions is developed from a concrete level to develop mathematical understanding of rate and how it plays a role in linear patterns and functions.

##### **Topic overview**

This topic contains two tasks:

Task 2.1.1: Generating patterns

Task 2.1.2: Finite differences

Participants explore and describe the connections between a geometric pattern's representation and its algebraic representation through modeling, table building, graphing, symbolic representation, and function notation. The functions are graphed and used to model a situation. Participants also apply the method of finite differences to analyze different types of functions.

##### **TE<sub>x</sub>ES standards focus**

**TE<sub>x</sub>ES Standard II.004 Patterns and algebra.** The teacher uses patterns to model and solve problems and formulate conjectures. The beginning teacher:

- (A) Recognizes and extends patterns and relationships in data presented in tables, sequences, or graphs.
- (B) Uses methods of recursion and iteration to model and solve problems.

**TE<sub>x</sub>ES Standard II.005 Patterns and algebra.** The teacher understands attributes of functions, relations, and their graphs. The beginning teacher:

- (C) Understands that a function represents a dependence of one quantity on another and can be represented in a variety of ways (e.g., concrete models, tables, graphs, diagrams, verbal descriptions, symbols).

**TE<sub>x</sub>ES Standard II.006 Patterns and algebra.** The teacher understands linear and quadratic functions, analyzes their algebraic and graphical properties, and uses them to model and solve problems. The beginning teacher:

- (A) Understands the concept of slope as a rate of change and interprets the meaning of slope and intercept in a variety of situations.

**TE<sub>x</sub>ES Standard V.019 Mathematical processes and perspectives.** The teacher understands mathematical connections both within and outside of mathematics and how to communicate mathematical ideas and concepts.

- (C) Translates mathematical ideas between verbal and symbolic forms.
- (F) Uses appropriate mathematical terminology to express mathematical ideas.

**TEKS Standard VI.020 Mathematical learning, instruction and assessment.** The teacher understands how children learn mathematics and plans, organizes and implements instruction using knowledge of students, subject matter, and statewide curriculum (Texas Essential Knowledge and Skills [TEKS]). The beginning teacher:

(F) Understands a variety of instructional strategies and tasks that promote students' abilities to do the mathematics described in the TEKS.

### TEKS, TAKS focus

**TEKS 2A.1 Foundations for functions.** The student uses properties and attributes of functions and applies functions to problem situations. The student is expected to:  
(B) collect and organize data, make and interpret scatterplots, fit the graph of a function to the data, interpret the results, and proceed to model, predict, and make decisions and critical judgments.

**TEKS 2A.4 Algebra and geometry.** The student connects algebraic and geometric representations of function. The student is expected to:

(A) identify and sketch graphs of parent functions, including linear ( $f(x) = x$ ), quadratic ( $f(x) = x^2$ ), exponential ( $f(x) = a^x$ ), and logarithmic ( $f(x) = \log_a x$ ) functions, absolute value of  $x$  ( $f(x) = |x|$ ), square root of  $x$  ( $f(x) = \sqrt{x}$ ), and reciprocal of  $x$  ( $f(x) = 1/x$ ); and

(B) extend parent functions with parameters such as  $a$  in  $f(x) = a/x$  and describe the effects of the parameter changes on the graph of parent functions.

**High School TAKS Objective 1:** The student will describe functional relationships in a variety of ways.

**High School TAKS Objective 2:** The student will demonstrate an understanding of the properties and attributes of functions.

**High School TAKS Objective 3:** The student will demonstrate an understanding of linear functions.

**High School TAKS Objective 4:** The student will formulate and use linear equations and inequalities.

**High School TAKS Objective 10:** The student will demonstrate an understanding of mathematical processes and tools used in problem solving.

### Materials

Task	Task 2.1.1 Generating Patterns	Task 2.1.2 Finite Differences
Graphing Calculators	*	*
Pattern blocks	*	

### Procedure

Participants should work on the tasks in groups. Pacing is important in these tasks, so encourage participants to use the pattern blocks in investigating patterns rather than skipping to the generalized formulas. The primary focus is to have the participants experience the tasks as students would in their classrooms. Different groups can be assigned to work on distinct train patterns if pressed for time. It is important to bring the participants together for summary discussions on their group findings.

### Summary

Teachers of Algebra II often do not know the vertical connections that build toward the function concept or linear functions prior to Algebra II, in particular at the middle school level. Having them experience these tasks promotes their understanding of the kinds of experiences students may have had prior to Algebra II and the foundations from which they can continue to build robust ideas about linear functions and a conceptual understanding of functions.

Transitions to the classroom—which of the tasks are appropriate only for teachers? Which for students? How would we modify a teacher-task to make it student appropriate?

	Teacher use only	Modify for students	Ready for students
Task 2.1.1			*
Task 2.1.2		*	