

## **STRAND 1: FOUNDATIONS OF FUNCTIONS**

### **TOPIC 1.1: IDENTIFYING PATTERNS**

#### **Topic 1.1 Notes**

##### **Mathematical focus**

The concept of patterns is basic to the development of algebraic thinking. In this topic, students will utilize concrete models to explore the physical development of patterns. Through the use of tables and a process column, students will be able to match the concrete development of patterns to the numerical development, and then expand the numerical to an algebraic generalization.

##### **Topic overview**

There are seven tasks (one is two-part) included in this topic.

Task 1.1.1a: Increasing Patterns with Direct Variation

Task 1.1.1b: Increasing Patterns without Direct Variation

Task 1.1.2: Decreasing Patterns

Task 1.1.3: Area Patterns

Task 1.1.4: Patterns with Negatives

Task 1.1.5: From Graphs to Patterns

Task 1.1.6: From Functions to Graphs

Task 1.1.7: Pattern Application

By using concrete models and a process column, participants model linear patterns and explore the constant rates of change. Participants model both input and output questions with equations and solve them using tables and graphs. Teachers will be presented with an overarching application problem that requires in-depth understanding of the concepts of foundations for functions, specifically including range, domain, proportionality, dilations, independent and dependent variables, and direct variation.

The first tasks in this topic involve patterning. The first is an increasing pattern, the second a decreasing pattern, the third involves geometric concepts of changing dimensions proportionally (area pattern), and the fourth involves graphing in both quadrant 1 and quadrant 2 (patterns with negatives).

Task 5 assesses the participant's understanding of coordinate points and the growth of a pattern from a graphical representation. Task 6 assesses the participant's understanding of a symbolic representation of a pattern. Finally, Task 7 looks at an application problem using a pattern.

Range and domain are introduced in these activities as well as an informal understanding of y-intercept as a starting point, rate of change of a pattern, and x-intercept. The words slope, y-intercept, and x-intercept are not formally introduced until the linear section.

**TEExES standards focus**

**TEExES 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.

**TEExES Standard II.005 Patterns and algebra.** The teacher understands attributes of functions, relations, and their graphs. The beginning teacher:

- (B) Identifies the mathematical domain and range of functions and relations and determines reasonable domains for given situations.
- (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).

**TEKS/TAKS focus**

**TEKS A.1 Foundations for functions.** The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways. The student is expected to:

- (B) gather and record data and use data sets to determine functional relationships between quantities;
- (C) describe functional relationships for given problem situations and write equations or inequalities to answer questions arising from the situations;
- (D) represent relationships among quantities using concrete models, tables, graphs, diagrams, verbal description, equations, and inequalities; and
- (E) interpret and makes decisions, predictions, and critical judgments from functional relationships.

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

**TEKS A.3 Foundations for functions.** The student understands how algebra can be used to express generalizations and recognizes and uses the power of symbols to represent situations. The student is expected to:

- (B) look for patterns and represent generalizations algebraically.

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

**TEKS A.5 Linear functions.** The student understands that linear functions can be represented in different ways and translates among their various representations. The student is expected to:

- (C) use, translate, and make connections among algebraic, tabular, graphical, or verbal descriptions of linear functions.

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

**TEKS A.7 Linear functions.** The student formulates equations and inequalities based on linear functions, uses a variety of methods to solve them, and analyzes the solutions in terms of the situation. The student is expected to:

- (A) analyze situations involving linear functions and formulate linear equations or inequalities to solve problems; and
- (B) investigate methods for solving linear equations and inequalities using concrete models, graphs, and the properties of equality, select a method, and solve the equations and inequalities.

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

**TEKS (8.10) Measurement.** The student describes how changes in dimensions affect linear, area, and volume measures. The student is expected to:

- (A) describe the resulting effects on perimeter and area when dimensions of a shape are changed proportionally

High School TAKS Objective 8: The student will demonstrate an understanding of the concepts and uses of measurement and similarity.

### Materials

Task	ID Patterns #1a and #1b	ID Patterns #2	ID Patterns #3	ID Patterns #4	ID Patterns #5	ID Patterns #6	ID Patterns #7
Color tiles/pattern blocks	x				x		
3 x 5 note cards or 3 x 5 Post-It <sup>®</sup> notes (about 35 note cards per group)			x				
Color pencils / markers	x	x	x	x	x	x	x
Graphing calculator	x		x	x	x	x	x
1-inch grid paper	x	x	x	x			
Chart paper	x	x	x	x	x	x	x
Algebra tiles				x		x	

**Procedure**

The beginning of this unit should start with a brief introduction to the overarching problem Changing Perimeters. This problem represents the teacher assessment for this unit. By presenting the assessment first, we are providing participants a chance to experience the Professional Teaching Model. Discuss with teachers some of the concepts that are included in the assessment (range, domain, independent, dependent, changing dimensions, dilations, proportions, and direct variation). Explain how the assessment was specifically designed to contain certain TEKS. First the assessment was written, then lessons were planned to ensure success on the final assessment.

The TEXTEAMS institute *Algebra I 2000 and Beyond* contains more student activities involving patterning. There are also several problems in the Dana Center publication *Algebra I Assessments* (2002) that are applicable for patterning.

**Summary**

Concrete modeling of patterns provides students a beginning introduction to the foundations of functions. These activities allow students to relate the visual changes in a pattern to a table and to the development of a symbolic rule as an expression of these changes. The use of patterns establishes the connections between tables, algebraic representations, and graphical representations.

**Extensions**

TEXTEAMS *Algebra I 2000 and Beyond* contains several pattern activities that may be used as extensions for this task.

**Assessment/Transition to the Classroom**

*The Mosaic Problem, Bathing the Dog, and Distance and Time* from TEXTEAMS *Algebra I Assessments* institute and the Dana Center publication *Algebra I Assessments* (2002) provide an open-ended assessment for this task.

Participants should complete the Teacher's Journal, recording their responses and making any modifications necessary to make the tasks completely classroom ready.