

STRAND 4: SQUARE ROOT FUNCTIONS

TOPIC 4.2: APPLICATIONS

Topic Notes

Mathematical focus

The topic focuses on applications of square root functions, fitting data to square root models, and understanding the validity of equations with square roots.

Topic overview

This topic includes 3 tasks:

Task 4.2.1: I Can See Forever ...

Task 4.2.2: The Pendulum Swings

Task 4.2.3: Truth or Consequences

In these tasks, participants experience square root functions through applications and equations. In Tasks 4.2.1 and 4.2.2 students model situations using square root functions. Students collect length and period data from a pendulum and then find a radical function model to fit the data. Students then use graphing calculators to model the solutions to equations graphically and make connections between transformations of functions, inverse functions, and algebraic solutions. In Task 4.2.3, students investigate the square root function by investigating the validity of equations.

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.

(E) Applies basic transformations [e.g., $k f(x)$, $f(x) + k$, $f(x - k)$, $f(kx)$, $|f(x)|$] to a parent function, f , and describes the effects on the graph of $y = f(x)$.

TEExES Standard II.007 Patterns and algebra. The teacher understands polynomial, rational, radical, absolute value, and piecewise functions, analyzes their algebraic and graphical properties, and uses them to model and solve problems. The beginning teacher:

(A) Recognizes and translates among various representations (e.g., written, tabular, graphical, algebraic) of polynomial, rational, radical, absolute value, and piecewise functions.

(B) Describes restrictions on the domains and ranges of polynomial, rational, radical, absolute value, and piecewise functions.

(C) Makes and uses connections among the significant points (e.g., zeros, local extrema, points where a function is not continuous or not differentiable) of a function, the graph of the function, and the function's symbolic representation.

(F) Solves equations and inequalities involving polynomial, rational, radical, absolute value, and piecewise functions using a variety of methods (e.g., tables, algebraic methods, graphs, use of a graphing calculator), and evaluates the reasonableness of solutions.

(G) Models situations using polynomial, rational, radical, absolute value, and piecewise functions and solves problems using a variety of methods, including technology.

TEExES Standard V.018 Mathematical processes and perspectives. The teacher understands mathematical reasoning and problem solving. The beginning teacher:
(E) Understands the problem-solving process (i.e., recognizing that a mathematical problem can be solved in a variety of ways, selecting an appropriate strategy, evaluating the reasonableness of a solution).

TEExES 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.

(B) Understands how mathematics is used to model and solve problems in other disciplines (e.g., art, music, science, social science, business).

(D) Communicates mathematical ideas using a variety of representations (e.g., numeric, verbal, graphical, pictorial, symbolic, concrete).

(F) Uses appropriate mathematical terminology to express mathematical ideas.

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 scatter plots, fit the graph of function to the data, interpret the results, and proceed to model, predict, and make decisions and critical judgments.

TEKS 2A.9 Quadratic and square root functions. The student formulates equations and inequalities based on square root functions, uses a variety of methods to solve them, and analyzes the solutions in terms of the situation. The student is expected to:

(A) use the parent function to investigate, describe, and predict the effects of parameter changes on the graphs of square root functions and describe limitations on the domains and ranges;

(B) relate representations of square root functions, such as algebraic, tabular, graphical, and verbal descriptions;

(C) determine the reasonable domain and range values of square root functions, as well as interpret and determine the reasonableness of solutions to square root equations and inequalities;

(D) determine solutions of square root equations using graphs, tables, and algebraic methods; and

(F) analyze situations modeled by square root functions, formulate equations or inequalities, select a method, and solve problems.

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 5: The student will demonstrate an understanding of quadratic and other nonlinear functions.

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

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

Materials

Task	Task 4.2.1 I Can See Forever	Task 4.2.2 The Pendulum Swings	Task 4.2.3 Truth or Consequences
Graphing calculator	x	x	x
String		x	
Washers		x	
Timers		x	
Tape measures or meter sticks		x	
Compasses		x	
Big grid paper		x	

Procedure

Task 4.2.1 serves as an introduction to fitting square root functions to data. Ask participants to work in groups for this task. Before moving on to Task 4.2.2 pose the additional extension questions found in the teaching notes for 4.2.2 for homework. It is important to have participants do the experiment in Task 4.2.2 in class (to save time, you could assign construction of the pendulum for homework the day before the task is to be completed in class). Participants need to get a feel for how this kind of activity works in a classroom—what the classroom management issues may be, etc. Task 4.2.3 can be assigned for homework, but participants should discuss their findings in groups at the following session. An additional assessment (either take-home or in-class) included in below is an excellent way to see if participants are able to translate the task into their classroom practice.

Summary

When appropriate assumptions are made, square root functions have real world applications as models of many situations.

Assessment

It would be most appropriate to use the student journals for Tasks 1 and 3, and the teacher journal for Task 2.

	Teacher use only	Modify for students	Ready for students
Task 4.2.1			*
Task 4.2.2		*	
Task 4.2.3			*