Radical Functions

ID: 8978

Activity Overview

To help students explore radical functions (specifically, functions involving a square root), this activity employs a model similar to the idea of a function machine. The manipulative (called a **nomograph***) is comprised of two vertical number lines, input on the left and output on the right. The transformation of a input via the radical function is illustrated dynamically by an arrow that connects the domain entry to its range value. Students use these nomographs to examine input-output pairs and to find the rule of a "mystery" radical function.*

Topic: Rational and Radical Functions

- *Evaluate a radical function for any real value of its variable.*
- *Graph radical functions and inequalities.*

Teacher Preparation and Notes

- *This investigation could be used as an introduction to radical functions. Students should be able to evaluate a function for a given input and should understand the concept of the square root of a number. They are led to discover the domain of a simple radical function (Problem 1) and a more complex one (Problem 3), involving a quadratic under the radical sign.*
- *This activity is designed to be used in Algebra 2 or Precalculus as an introduction to functions defined using radicals.*
- *It is important that the nomograph model be demonstrated to students prior to exploring it on their own. (Perhaps work through Problem 1 as a class.)*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student TI-Nspire document (.tns file), go to education.ti.com/exchange and enter "8978" in the keyword search box.***

Associated Materials

- *RadicalFunctions_Student.doc*
- *RadicalFunctions.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *It's a Radical Universe (TI-Nspire technology) — 12177*
- *Introduction to Radicals (TI-Nspire technology) — 9636*
- *Roots of Radical Equations (TI-Nspire technology) — 12213*
- *Radical Transformations(TI-Nspire technology) — 11575*

Problem 1 – Domain of a Simple Radical Function

In this problem, students get acquainted with the idea of a nomograph by investigating a simple radical function, $f1(x) = \sqrt{x-4}$.

On page 1.4, have students observe the mapping when they enter the different values for x from the worksheet in cell A1 of the spreadsheet. This will change the input of the function. For each change in input, have students record the corresponding output.
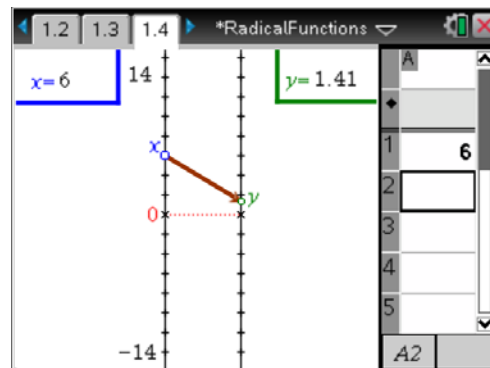
After entering values in the spreadsheet, have students grab and drag point x along the first vertical number line. At a certain point, they will see the mapping vanish. This is likely to initially surprise students, but it provides an illustration of what it means for a value to be outside the domain of a function.

Questions that follow will lead students to state the domain of the function $f1(x) = \sqrt{x-4}$.
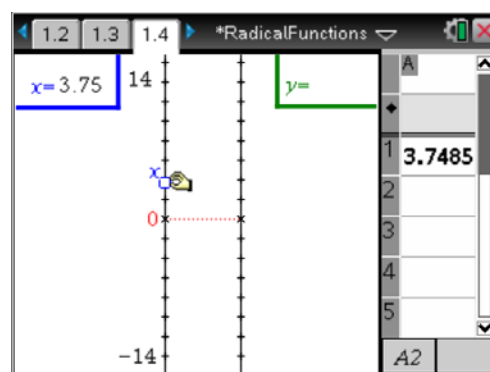
TI-Nspire Navigator Opportunity: *Live Presenter*

See Note 1 at the end of this lesson.

Problem 2 – Guess the Radical

Direct students to read the information on page 2.1 and then advance to the nomograph on page 2.2. Their goal is to identify the function rule by determining several input/output pairs and the domain of the function. Allow students ample time to answer the questions on their worksheet, providing assistance as needed.
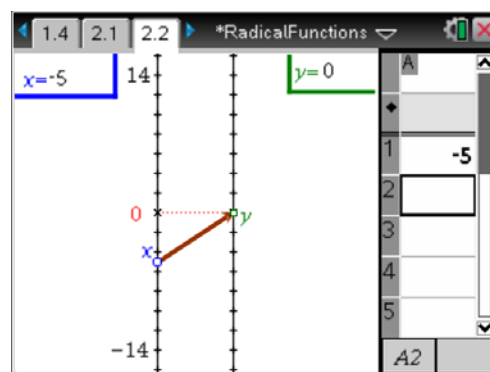
TI-Nspire Navigator Opportunity: *Quick Poll, Screen Capture*

See Note 2 at the end of this lesson.

### Problem 3 – A More Complicated Radical Function

On page 3.2, students investigate a function with a quadratic expression under the radical sign $f(x) = \sqrt{(x-1)(x+4)}$. There are now <u>two</u> points at which the arrow showing the mapping from inputs to outputs disappears. As before, students determine the domain of the function after evaluating the function and observing the mapping.
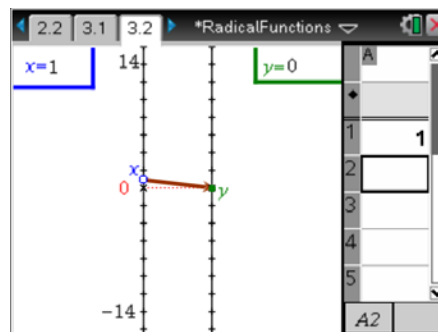
A Radical Extension

On page 4.2, students will find a nomograph for the function $\mathbf{f1}(x) = \sqrt{x-4}$. Students are instructed to drag point *x* upwards, pressing [ctrl] + [.] along the way to capture data values into the spreadsheet.

Note: Caution students not to capture data values such that $x < 4$. When the input is out of the domain of the function, an error will occur in Column B (the outputs) of the spreadsheet. If this happens, instruct students to reset the data capture by navigating to the spreadsheet and pressing [enter] two times on each of the formula cells (in gray) for Columns A and B.
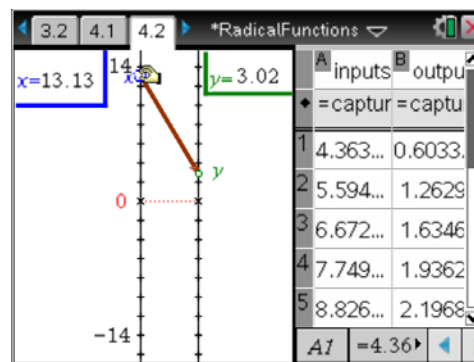
After collecting at least 10 input-output pairs, students should move to page 4.4 to view a scatter plot of their collected data. They should find that the all of the displayed points have an *x*-coordinate greater than or equal to 4 and a *y*-coordinate greater than or equal to 0.

Direct students to press [ctrl]+[G] to show the function Entry Line, arrow up to access the definition of $\mathbf{f1}(x)$, arrow over to the Hide/Show icon, and press [enter] to display the graph of the function. As the graph appears, students will find that it passes through the points in the scatter plot.
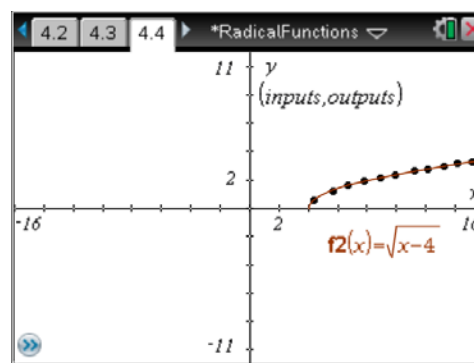
Student Worksheet Solutions

1.

Input		Output
4	→	0
6	→	1.41
8	→	2
13	→	3
20	→	4
29	→	5

2. near $x = 4$

3. The function is undefined when $x < 4$. When point x is dragged to a value less than 4, there is no output from the function, so the arrow that shows the mapping from input to output disappears.

4. $\{x \mid x \geq 4\}$

5. $x = -5$

6.

Input		Output
−4	→	1
−1	→	2
4	→	3

7. $f(x) = \sqrt{x + 5}$

8. $\{x \mid x \geq -5\}$

9. **a.** $g(x) = \sqrt{x - 10}$

b. $h(x) = \sqrt{x - 13}$

c. $j(x) = \sqrt{29 - x}$

d. $k(x) = \dfrac{1}{\sqrt{10 - x}}$

10.

Input		Output
1	→	0
−4	→	0
5	→	6
−8	→	6
−2	→	does not exist

11. $x = 1$ and $x = -4$

12.a. yes

b. 0 for both

13. $\{x \mid x \geq 1 \text{ or } x \leq -4\}$

14. The domain of this function includes only values of x that are greater than or equal to 4.

15. The square root of a number is always greater than or equal to 0. The outputs from this function are the *y*-coordinates on its Cartesian graph.

TI-Nspire Navigator Opportunities

Note 1
Problem 1, *Live Presenter*

It may be helpful to students if *Live Presenter* is used it help demonstrate how to drag the point *x*, as well as how to input values into cell A1.

Note 2
Problem 2, *Quick Poll, Screen Capture*

Use *Screen Capture* to monitor student progress as they go through problems 2, 3, and the extension. When students seem to be ready, send the following Q*uick Polls* that correspond to questions 7 and 8 from the Student Worksheet.

7. This function rule involves a square root. What is the rule?

8. What is the domain of the function defined in this problem?