What's My Rule?
ID: 13293

Activity Overview
*This activity is similar to the idea of a function machine. There are two levels of the manipulative (called a **nomograph**). The first is comprised of two vertical number lines, input on the left and output on the right. The second has three number lines to accommodate displaying the composition of two functions. At the first level, students enter domain values and observe how they are transformed to new (range) values.*

Topic: Sequences, Series, & Functions
- *Calculate the value of a function f(x) defined by an algebraic expression at any real value of x.*

Teacher Preparation and Notes
- *Prerequisites are: an introduction to functions (including the terms domain and range), function notation ("y=" and "f(x)="), and experience graphing linear functions using slope and y-intercept. It is important that the model be demonstrated to students prior to them exploring the .tns file on their own. (Perhaps work through Problem 1 as a class.)*

- *The activity can be customized by changing some of the functions and cutting and pasting selected problems into a separate TI-Nspire document.*

- *User-input nomographs are implemented on a split-screen: Graphs on the left and Lists & Spreadsheet on the right. Calculations that drive the implementations are hidden in the spreadsheet; the "split" is designed to expose only Column A. Caution students to leave the rest of the spreadsheet alone. Additionally, all inputs into cell A1 need to be in decimal form.*

- *In the Graphs work areas, instruct students that they are **not** to unhide the Function Entry Line.*

- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "13293" in the keyword search box.***

Associated Materials
- *WhatsMyRule_Student.doc*
- *WhatsMyRule.tns*

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

- *Radical Functions (TI-Nspire technology) — 8978*
- *Compositions Graphically (TI-Nspire technology) — 9990*
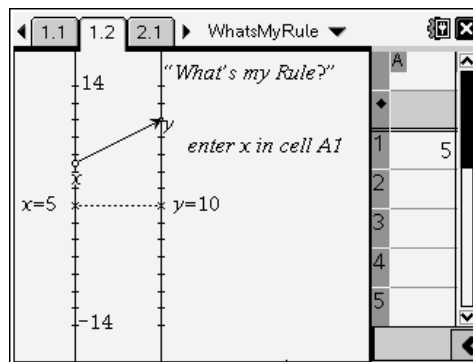- *Inverses of Functions (TI-Nspire technology) — 11404*

Introduction

A ***nomograph*** is similar to a function machine in that it relates a number from one set (the domain) to a number in a second set (the range). Each set of numbers is represented in a pair of vertical number lines; the domain is on the left, and the range is on the right. According to the function rule, an element of the domain is mapped to its corresponding range element, and this mapping is depicted by an arrow.

Prior to beginning Problem 1, review domain and range, and ensure that students understand how to use the model.

Problem 1 – "What's my Rule?"

The first several problems are "What's my Rule?" activities. Input values are entered, one at a time, into cell A1 of the spreadsheet on the right side of the screen. The nomograph on the left side of the screen displays the input and its corresponding output. By repeatedly entering different inputs, the student should be able to discover the function's rule.

For example, if domain values 1, 2, 5, and 7 and their respective range values 3, 5, 11, and 15 are observed, the rule $f(x) = 2x + 1$ should be identified. When students have conjectured a rule, they should record it on their worksheets and check it. The rule is checked by selecting an input number, applying the rule, and predicting the output number.
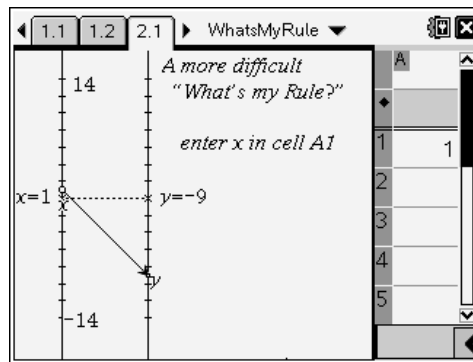
Solution

- **f1**$(x) = 3x - 5$

Problem 2 – A more difficult "What's my Rule?"

This nomograph follows a quadratic rule. Students are guided through the same steps to determine the rule. Encourage students to record several of the ordered pairs they observed on their worksheets. This will help them in determining the function's rule.
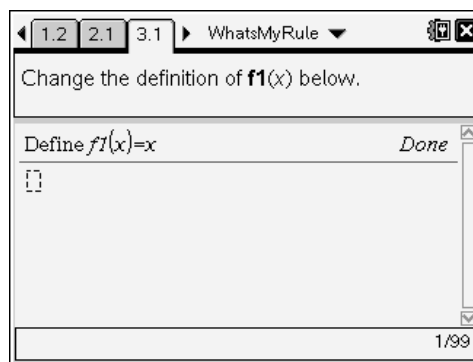
Solution

- **f1**$(x) = x^2 - 10$

Problem 3 – The "What's my Rule?" Challenge

Instruct students to create their own functions of the form $y = ax + b$ or $y = ax^2 + b$ (where a and b are integers). Each student should use the *Calculator* work area on page 3.1 and redefine **f1** to their own function by using the Recall Function Definition command. Students should then proceed to page 3.2 (to display the nomograph) and exchange handhelds with a partner. It is the partner's task to use the nomograph to identify the mystery function. Encourage students to repeat this activity several times.
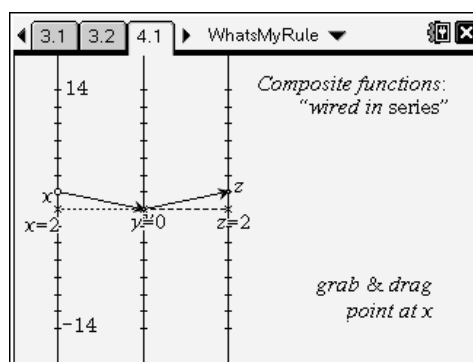
Solutions

- Functions will vary.

Problem 4 (Extension) – Composite functions: "wired in series"

The nomograph in Problem 4 enables students to explore the meaning of the composition of functions. Be sure students are familiar with both notations for composite functions: **f2 ∘ f1** and **f2(f1(x))**. The input for the first function is controlled by grabbing and dragging the point at *x* (it will jump in discrete steps of 2), and an arrow connects *x* to its output, *y*. The point *y* is used as input for a second function, and connected by a second arrow to its corresponding output, *z*.

Solutions

- **f3**(x) = –6x + 14
- **f2**(**f1**(3)) = –4   **f1**(**f2**(3)) = –18
- **f2**(**f1**(x)) = 2(x – 1)^2 + 3   **f1**(**f2**(x)) = (2x + 2)^2