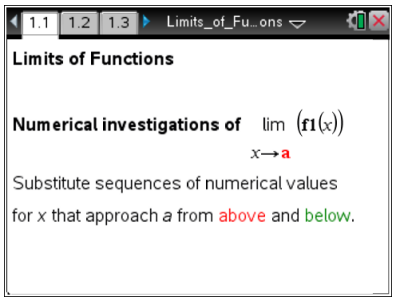
About the Mathematics

The *Limits_of_functions.tns* document provides a simple but powerful tool for investigating limits of functions numerically. The idea is to consider $\lim_{x \to a} f1(x)$ by substituting a sequence of numerical values for x that get closer and closer to a (without actually reaching a). It is important to consider sequences of values that approach a both from above (that is, values that are greater than a) and from below (through values that are less than a).



Objective

- This activity allows students to investigate the limit of a function at a point through numerical evaluation

TI-Nspire™ Navigator™ System

- Send out the *Limits_of_functions.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

- Limits_of_functions.tns

Using the Document

Page 1.1 provides the mathematical setting. On page 1.2, use the setup command **approach(a)** to set the "target" value *a*, and simply define **f1**(*x*) as the function to be investigated. On page 1.3, the limit under investigation is displayed. Two sets of slider arrows have been set up to allow the user to step through the sequence of values approaching *a* from above (using the down arrow since the values are decreasing) and from below (using the up arrow since the values are increasing). The sequences are set to start 1 unit away from *a*, proceed toward *a* in arithmetic steps of 0.1, and then switch to geometric steps when the value is within 0.1 of *a*. To reset or to switch to another function or target value, simply return to page 1.2 and re-enter the **approach(a)** command and redefine the function **f1**(*x*).

Tech Tip: Have students tap the up and down arrows to change the values of *x*. **Longer taps may be necessary.**

Possible Application

Typically, you should investigate a variety of function behaviors, including ones where the right-hand and left-hand limits differ ($\arctan(\frac{1}{x})$ with $a = 0$ is a nice example that avoids the use of split-formula definition) as well as functions that do not show either asymptotic or removable discontinuity behavior (the classic example is $\sin(\frac{1}{x})$ with $a = 0$). Combining the numerical investigation with a look at the graph of **f1** in a window that includes $x = a$ is useful (and the results of the numerical investigation can be compared to the CAS result of evaluating the limit, if TI-Nspire CAS is used).