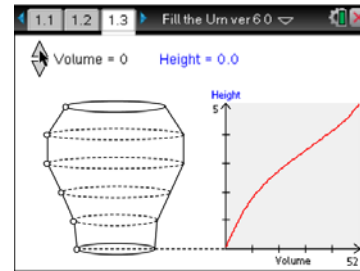




About the Mathematics

The *Filling_the_Urn.tns* document provides for a graphical investigation of related rates. The physical context is the filling of an urn with liquid depicted in a window on the left side of the illustration. The associated graph represents the height of liquid in the urn as a function of the amount of liquid in the urn. The shape of the urn determines the characteristics of this graph.



Math Objective

- Students will have an opportunity to work with linked graphical and physical (in the virtual environment of the .tns document) representations of the related rates of change of volume and height of fluid in a vessel.

Using the Document

Page 1.2 provides the textual description of the physical setting of a urn filling with liquid. Page 1.3 provides the picture of the urn and corresponding graph of fluid level height as a function of volume of liquid in the urn. The slider at the top allows the user to increase the volume of liquid in the urn 1 unit per click. If one assumes that the volume flows into the urn at a constant rate, then the graph could be viewed as a graph of the fluid level as a function of time. Page 2.2 draws the graph of the fluid level as it changes for each unit of volume.

Possible Applications

Relating the calculus characteristics of the graph (slope, concavity) to the shape of the urn is a source of rich questions in both directions. (What does a concave down portion of the graph say about the shape of the urn? At what levels on the urn will the graph have its greatest slope?) This document allows the shape of the urn to be changed by grabbing the “handle” vertices shown on the left side of the urn. The graph of height versus volume will change dynamically with any change in shape. This provides an opportunity to ask questions like, “What shape of urn would have a linear graph of height vs. volume?”

TI-Nspire™ Technology Skills:

- Open a document
- Grab and drag a point
- Move between pages
- Click on a minimized slider

Tech Tips:

- Students will need to “grab” the point, move to the new location, then “click” to drop the point.

Lesson Materials:

Filling_the_Urn.tns

Visit www.mathnspired.com for lesson updates.