The Crusty Loaf of Bread—Graphing Guide

To illustrate the hemispherical loaf of bread and the surface area of the upper crust of each slice, please use the **Mathematics Visualization Toolkit** (http://amath.colorado.edu/java/) and take the following steps:

- **Open the MVT software** (you may run this directly on their server or download it to your personal computer and run it from there)
- Use the access path: **Tools/Graphing Tools/Spherical Plotter**

When the Spherical Plotter opens,

- Click on **Show Options**
- Click on **Domain/Range Options** if necessary for access

To display a hemisphere (oriented vertically):

- Enter rho (ρ) = 6, theta (θ) = 0 to pi, and phi (φ) = 0 to pi;
- Click on **Plot.** This will produce a rotatable 3-D graph of a hemisphere (oriented vertically). Select the **Rotate tool** and click and drag on the 3-D graph to rotate it.

To display the surface area of the upper crust of an individual slice:

- enter the indicated parameter values in the **Domain/Range Options** fields
- click on **Plot**

slice #	***θ from, to***	***φ from, to***
1	0 to 0.586	0 to pi
2	0.586 to 0.841	0 to pi
3	0.841 to pi/3	0 to pi
4	pi/3 to 1.231	0 to pi
5	1.231 to 1.403	0 to pi
6	1.403 to pi/2	0 to pi

Note: The values for theta were calculated by finding *arccos*(*n*/6) in radian measure where *n* represents the number of inches from the center of loaf. These values for theta then correspond to the locations of the vertical edges of each one-inch slice of bread.

Displaying each slice individually gives students a better visualization of the effect of curvature on surface area. It is informative to **graph an individual slice,** click on the **Overlay** checkbox, and then **graph a non-adjacent slice.** Afterwards, clicking on the superimposed graphs and rotating them will allow students to see more clearly the differences in shape and the fact that the surface areas of each upper crust have the same value.