Prior projects: Prior to doing this project, students should have done these project:

- Introduction to Mathematica and Graping Project

Philosophy behind this project:
This project asks students to develop a flexibility for interpreting and applying integrals in a variety of contexts. One application that is often lost on students is the integration of the constant 1 can have multiple interpretations, such as $\iint_D 1\,dA$ can give as mass of a lamina or the area of a lamina.

Learning Goals:

1. Review of application of integrals to calculate mass
2. Review of application of integrals to calculate area
3. Review of polar coordinates
4. Review of applications of integrals to calculate total charge of a solid
5. Review of applications of integrals to calculate volume

Implementation Notes:

1. Discuss the need for students to be flexible applying concepts they learn in class since these are just a sampling.

2. Page 1 has students consider the meaning of a double integral involving density times the area dA.

   (a) Reiterate to students the idea of that integration is an infinite sum of the product of two quantities, and the context for these two quantities is not limited to area.

   (b) If you see individuals within a group using different refinements for their mesh and the students seem ready, the introducing the idea of the norm of a partition may be useful.

   (c) Problem 5 allows for the opportunity to review the idea of iterated integrals and Fubini's Theorem.

   (d) Problem 6, note that order matters for Mathematica input. Bounds for x must appear before y, even if y is bounded by a function dependent on x.

   (e) It may be worth having a student draw the polar mesh for the lamina on the board. This can be used by the instructor or student to explain how to calculate the area of an individual partition.

   (f) One of the big punch lines for this activity is in the box at the bottom of the page. Take time to emphasize integrating the constant 1 can represent multiple contexts. This can be connected to single integrals to get the length of an interval and to the line integral of having a fence that has a height of 1 from an earlier project.

3. Page 2 focuses on students understanding that double integrals can represent both area and triple integrals can represent volume.

   (a) Problem 12 encourage students to draw both a solid and an area to emphasize the multiple representations for the double integral.

   (b) Connect Problem 13 and 15 by explaining to students that the triple integral in Problem 15 could represent the volume function $V(S)$ for the solid.

Wrap-Up:

1. The wrap-up for this project should include mentioning the scope of applications for integrals and emphasizing the value of an integral can represent multiple contexts (especially if we integrate the constant 1).