

Name _____ Date _____ Per. _____

CHAPTER 8 VOLUME ACTIVITY

CALC

Objective: Gain visual/conceptual understanding of methods of integrating to find volume.

Go to a craft store (or look around your house, grandma's house, etc.) and get material to construct a 3D shape in "layers." These shapes will then be saved and used for demos in future generations of calc classes.

Each person will make **TWO** shapes. One shape will be **EASY** and the other **MORE CHALLENGING**.

Get approval for your design/idea/EQUATION from your instructor. Email your equation, limits of integration, and means of forming the solid (e.g. rotating about x -axis, etc) for your easy & more challenging as soon as possible. First come first serve. Reserve your idea before someone else takes it. seanbird@covenantchristian.org

EASY ideas: *No calculating or slicing is necessary for this.* Find a shape that will help others get the idea of how a 2 dimensional shape can be rotated to form a solid. Give an approximate equation and how the volume was formed. Be prepared to show the class and explain. Try to have your name and integral written on the creation.

- table/party/wedding decorations that fan out in various shapes is an excellent way to do this. You could cut your shape so as to get a unique shape with an identifiable equation.
- Bundt cake (This is an inverted parabola shift up and to the right rotated about the y -axis. And it tastes good)
- To get the idea about how a 2-dimensional shape can be rotated to form a solid, you may cut and staple old magazines. They make forms similar to the party decorations... like wedding bells

MORE CHALLENGING:

For the more challenging you must model it based on some equation and do the following:

1. Pick a function to model and a "method." You can use either the "cylindrical shells" method of 8.6 or "plane slicing" (a.k.a. washers) of 8.5.
2. Note the Δx (or Δy in some cases). Delta- x is the thickness of the "foam board" (or whatever the material is).
3. Cut out all the sample figures.
4. Make a table that indicates the actual volumes and sum these values to calculate approximate volume.
5. Do the integral to get the exact value.
6. And then do a "percent error" calculation. $|\text{Experimental} - \text{Standard}| / \text{Standard} \times 100\%$

Some possible ideas or materials to use:

- a disk, a washer (a disk with a smaller removable disc in the center of the larger disc), and a known cross section model with Styrofoam.- this can be messy
- You can purchase "art boards" at an art supply store. These look like a centimeter-thick piece of foam sandwiched between two poster boards. They are easy to cut into "slices" of volume which can then be stacked together to form a nice approximation of a solid.
- A candle can be sliced. A round candle is very easy to carve and fashion into a solid. They also make square candles and elliptical candles.
- For solids of revolutions you can take a small bundt cake pan and filled it with layers of a very thick felt like material. You could also take the same pan and make shells that fill it using the same material.
- foam
- clay
- plaster of Paris
- felt
- Balsa wood
- cardboard from boxes (potentially kind of ugly)
- One of the most clever ideas was a kid who hooked a cut-out version of the graph of a function to an electric motor. The graph spun so fast, that the 3D shape amazingly appeared in the air! She had also drawn the "representative rectangle" in a contrasting color so that the shape generated was also visible.
Note: be sure to wear eye-protection with a model like this!!!!

See more examples at <http://www.dade.k12.fl.us/msprings/skoski/CALC/index.htm> On this website, students have chosen rotation about an axis of known cross sections. There is also an example of "work." This year bonus points will go to digital camera person and website assistant. Let's record our achievement for the benefit of others.

Volume Project Grading Form

200 points

We see shapes everywhere. Often the cost is associated with how much volume (material) is required to construct that object.

One goal or motivation for this project is to be able to have a visual/conceptual understanding of volumes created by various integration methods. Students often have difficulty “seeing” the shape that is formed. A recommendation for a source of ideas for equations is the homework problems that will be assigned in section 8.5 & 8.6 or old AP problems. Making models for these problems may prove to be helpful in explaining these problems to future students.

Due dates:

Tuesday, January 24 Email equations deadline.

Tuesday, February 6 “Easy” creation due.

Day before chapter 8 test Project and paper due.

Plan ahead. There will continue to be daily homework.

Please make this paper the last page of your project for ease in grading.

A

- Go above and beyond: Possible ways you may do this is by
 - drawing impressive sketches.
 - Write a paragraph about what you have learned and why this was a worthwhile project - tell your story.
 - Impressive volume creation - e.g. you win the class competition of “Best of Show”
 - Your presentation is something special
- You email your project and turn in a hard copy on or before the due date. (If you make a sketch for any part of the project, scanners are available to merge this electronically into your paper.)

B

- Do all of the requirements for a C and do it correctly and neatly and on time.

C

- On your paper remind me of your **EASY** project by writing its equation and showing what it looked like. (A digital picture of this could be nice.) Label clearly “Easy Volume”.
- Show equation and how your volume was created
- Show data: Δx or Δy , “R”, cross sectional area, volume of slice. Total the volumes
- Show work for integration. If you can not integrate it by the fundamental theorem of calculus, state that you numerically integrated.
- Compare integral with approximation method. I.e. find percent error.
- Draw at least the graph of your equation

D

- Not doing part or all of the above bullets, turning it in late, or not doing it right the first time

F

- do it again until it is passing