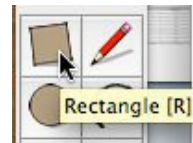


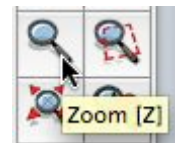
5. Next, let's use Microsoft Excel to mirror this data table.
 - a. Open Excel and create a New Workbook.
 - b. Label column A "Length" in cell A1, and label column B "Width" in cell B1.
 - c. Make column C your perimeter column.
 - d. Enter in the dimensions from the above table into your Excel workbook.
 - e. We will come back to this table in a moment...

6. Now using Google SketchUp, let's draw these rectangles. Once you open SketchUp, select the Rectangle tool.



7. Draw any rectangle shape in the window. Once you do, enter your first length, then a comma, then your first width with the keyboard, and hit Return (Enter).

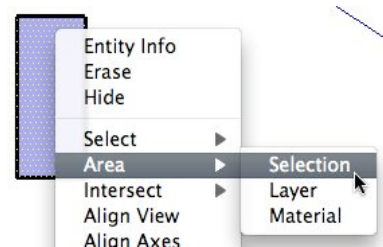
8. SketchUp will redraw your rectangle with the dimensions that you have just entered. If the shapes are too small to see, use the Zoom tool.



9. Continue to draw all of the rest of your rectangles, entering in the dimensions, until you have drawn at least 8 length/width variations for your perimeter.

10. How do they look? Do any seem larger or smaller in area than the others?

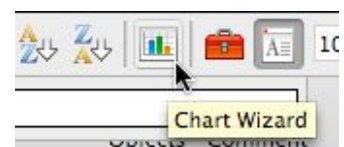
11. Now, let's see if there really is a difference or not in the area of these rectangles. Using SketchUp, right-click or control-click inside one of the rectangles that you have drawn. In the menu that appears, select Area --> Selection (see the image). SketchUp will calculate the area of the rectangle for you.



12. Repeat this for all of the rectangles that you have drawn. After each area calculation, enter the value into your Excel workbook next to the corresponding length/width in a new "Area" column.

13. Now that we have some numbers, let's use Excel to make a graph to compare the area & perimeter measurements. Working as a team, figure out how to make this graph. Let us know if you need help with this, but here are some hints & considerations:

- i) How do you "tell" Excel what information you want to graph?
- ii) What type of graph will be most helpful?
- iii) The "Chart Wizard" is your friend...



14. What did you find? Is there a relationship between perimeter and area? What was the shape of the Area graph & the Perimeter graph? Generalize what you have discovered below.

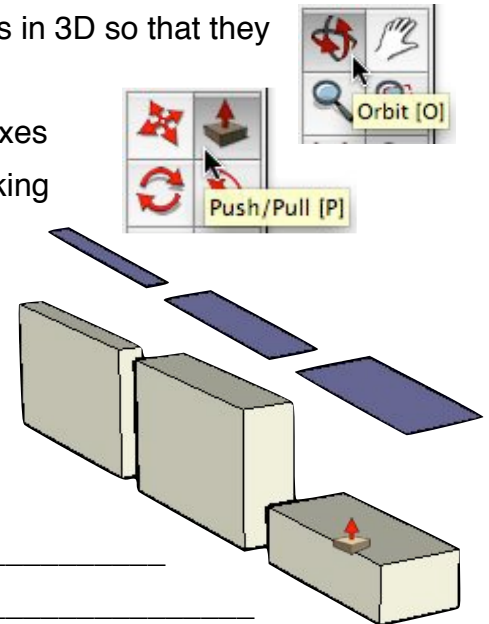
15. Look back at your guess/hypothesis that you made on step 2. Were you right or wrong?

16. **BONUS!** Looking at the Length, Width, and Area numbers for your rectangles, can you come up with the relationship between the length & width of a rectangle and the corresponding area measurement? Can you generalize this relationship as an equation? If so, please write it below.

17. **EXTENSION:** Let's go back to SketchUp and enter the world of 3D! Using the Orbit Tool, click and drag the SketchUp window to see your rectangles in 3D so that they look like the blue rectangles at right:

18. Now, grab the Push/Pull tool and pull your rectangles up into boxes with volume! After you set the height of the first box, double clicking with the Push/Pull tool will make each box the same height. Please make all of your boxes the same height.

19. Go back to the Orbit tool and move around your boxes. Do any of these boxes look like they are larger or smaller than the others? Based on the Area calculations, which boxes do you think will be the largest or have the greatest volume?



20. Back in Excel, let's make another column for Height. Enter in the height of each box (which should be the same measurement for each box) in this new column for each box.

21. Let's label one more column in your Excel workbook, this time for Volume. We will use Excel to make the volume calculations for us, much like plugging numbers into a calculator. The formula for volume is Length x Width x Height.

- In the cell under Volume, hit the equals key (=) on the keyboard. This tells Excel that we are going to do a calculation.
- Now, click on your first length measurement. This will put the cell number of that measurement next to your equal sign. Follow that with a * (Shift+8) for multiply. Repeat

- c. by clicking on the width, enter a *, then click on the height. You should have an equation that looks like this: =A2*B2*E2 or something similar.
- d. Once you hit enter (return) on the keyboard, Excel will calculate the volume of that box. Repeat for each of your rectangles, calculating the volume of all of your boxes. If you know how to drag & fill the equations down, share this knowledge with your group!

22. Look at the new volume calculations and compare these with the areas of each rectangle. Do the volume calculations behave or look more like the area calculations, or the perimeter & height measurements? _____

23. **SUPER BONUS!!!** Using Excel, can you make a graph that compares the perimeter, area, *AND* volume of all of these rectangles/boxes? If so, please show your graph to one of your instructors and have them initial this paper here: _____. Please sketch what this graph looks like in the space below.

