Name: _____ Date: _____

Investigate: *The Geometer's Sketchpad*® Method

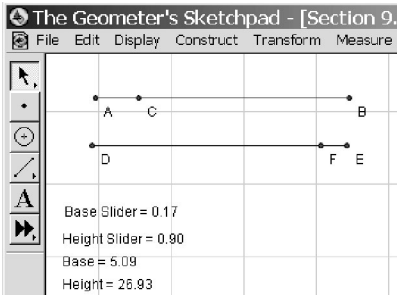
Technology Tools
- *The Geometer's Sketchpad*®
- computers

Use *The Geometer's Sketchpad*® to create a model of a square-based prism and control the dimensions with sliders. Since the base is square, you will need one slider to control the base length, and another slider to control the height.

1. On the **Edit** menu, click **Preferences**. Click the **Text** tab. Ensure that **For All New Points** is checked. Click **OK**.

2. Construct a slider to control the base length.
   - Construct a horizontal line segment AB.
   - Construct a point C on the line between A and B.
   - Select points A, B, and C, in that order. On the **Measure** menu, click **Ratio**. The ratio of AC:AB will appear on the screen.
   - To change the label of AC:AB, select this ratio measurement. Right-click and on the menu click **Label Measurement**. Type in the new label **Base Slider**.
   - Drag the point C back and forth. Note how the ratio changes.

3. Create another slider in the same way. Label this slider **Height Slider**.



4. Select the measurement **Base Slider**. On the **Measure** menu, click **Calculate**. Enter the formula 30*Base Slider, by selecting **Base Slider** from the **Values** menu on the calculator. Change the label to **Base**.

5. Select the measurement **Height Slider**. On the **Measure** menu, click **Calculate**. Enter the formula 30*Height Slider. Change the label to **Height**.

6. Construct a point G in the workspace. Select point G. On the **Measure** menu, click **Abscissa (x)**. Select point G again. Then, on the **Measure** menu click **Ordinate (y)**. These are the coordinates of point G.

7. Select $\mathbf{x_G}$ and **Base**. On the **Measure** menu, click **Calculate**. Enter the formula x_G + Base, by selecting these values from the **Values** menu on the calculator.

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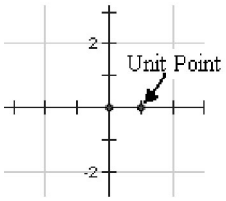
8. Select $\mathbf{y_G}$ and **Height**. On the **Measure** menu, click **Calculate**. Enter the formula y_G + Height.

9. Plot the remaining points to form the vertices of a rectangle GHIJ.
- Select $\mathbf{x_G}$ **+ Base** and $\mathbf{y_G}$, in that order. On the **Graph** menu, click **Plot As (x, y)**. This will be the point H. If point H is not visible on your screen, drag the unit point to adjust the scale of your sketch. Deselect the point.



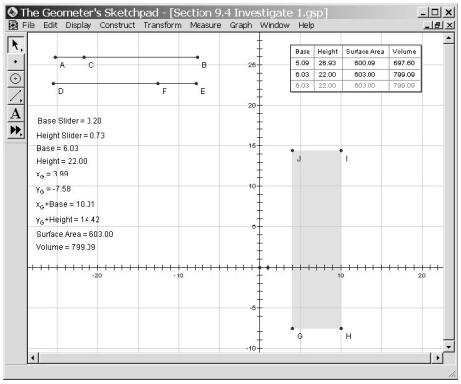
- Select $\mathbf{x_G}$ **+ Base** and $\mathbf{y_G}$ **+ Height**. On the **Graph** menu, click **Plot As (x, y)**.
- Finally, select $\mathbf{x_G}$ and $\mathbf{y_G}$ **+ Height**. On the **Graph** menu, click **Plot As (x, y)**.
- You may need to relocate your rectangle in the workspace by clicking and dragging the rectangle.

10. Select points G, H, I, and J, in that order. On the **Construct** menu, click **Quadrilateral Interior**. Move your sliders. Notice how the dimensions of the rectangle change.

11. Select **Base** and **Height**. On the **Measure** menu, click **Calculate**. Enter the formula 2*Base* Base + 4*Base*Height. Change the label to **Surface Area**.

12. Select **Base** and **Height**. On the **Measure** menu, click **Calculate**. Enter the formula Base*Base*Height. Change the label to **Volume**.

13. Create a table.
- Select, in order, **Base**, **Height**, **Surface Area**, and **Volume**. On the **Graph** menu, click **Tabulate**.
- Adjust **Base** to 5 cm, using the base slider. Adjust the height slider until **Surface Area** is 600 cm^2. Select the table. On the **Graph** menu, click **Add Table Data**…. Click **OK**.
- Adjust **Base** to 6 cm. Adjust the height slider until **Surface Area** is 600 cm^2. Add the data to the table.
- Continue increasing the base by 1 cm each time, until you are sure that you have passed the maximum volume.



14. Next, try to refine the values of the base and the height until you have the maximum volume. What base and height dimensions produce the maximum volume? Describe the shape of this square-based prism.

15. **a)** Predict the dimensions of the square-based prism with maximum volume if the surface area is 384 cm^2.
b) Use the GSP sketch to check your prediction. What shape is this prism?

16. Repeat question 15 for a square-based prism with surface area 864 cm^2.

17. **Reflect** What conclusion can you make about the maximum volume of a square-based prism with a given surface area?

18. Save this sketch for use in future investigations.