EPS 200 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Evaluating Hot Air Balloon Shapes

Formulas:

$Density= \frac{mass}{volume}$ or $D= \frac{m}{v}$

**Mass of Plastic Object** = Surface Area X 0.007 or $M=A×0.007$*[1 in2 of plastic sheet has a mass of about 0.007g.]*

**What’s the purpose of this worksheet?**

Eventually, you will be given a sheet of plastic that is about 72” (72 inches) wide and 108” long. That plastic has a total area of $72"×108" = 7,776 in^{2}$. Of that 7,776 in2, you can use 4,000 in2 to make a hot air balloon. One goal for this assignment is to evaluate some shapes and find the one that will have the lowest density if you use approximately 4,000 in2 of plastic. At the end, you will be asked to tell which shape is *best* for making a hot air balloon, and you will have to explain why.

1. Open up Rhino. Choose the template that says “small objects – inches.”
2. In Rhino, create a simple 3-D shape that might make a good hot air balloon. Some choices of shapes are Box, Cylinder, Pyramid, Truncated Cone, and Truncated Pyramid. **Do not** “unroll” the shape.
3. Save your file on your F:drive
4. Measure the shape’s area by following these steps…
	1. Select the shape
	2. Click the **Analyze** tab at the top of your screen
	3. In the drop down menu, select **Mass Properties.**
	4. Select **Area**.
	5. On the top left of your screen, look at the “cumulative area.” If it’s lower than 3,500, increase your scale. If it is higher than 4,500, decrease your scale. If it’s between 3,500 and 4,500, move on to step # 5
5. Rescale your shape by following these steps…
	1. Select the shape
	2. Click the **Transform** tab at the top of your screen
	3. In the drop down menu, select **Scale.**
	4. Select **3-D.** Then change the size of your shape in one of these two ways…
		1. Option 1 -- Click somewhere on your shape. Then click somewhere outside your shape. Then move your mouse until you like the size of your shape. Then click one last time.
		2. Option 2 -- Click somewhere on your shape and type in a number that will multiply your object’s size. Then click enter. If you want to make it twice as tall, type “2.” If you want to make it three times as big, type “3.”
6. Go back to step 2. Measure the shape’s area to see if it’s in the right range (3,500 in2 – 4,500 in2).
7. If your shape’s area is in the right range, write down the area in the appropriate space on the back of this sheet.
8. Measure the shape’s volume by following these steps…
	1. Select the shape
	2. Click the **Analyze** tab at the top of your screen
	3. In the drop down menu, select **Mass Properties.**
	4. Select **Volume**.
	5. On the top left of your screen, look at the “volume.” Write down that volume in the appropriate space on the back of this sheet.
9. Save your file again.
10. Repeat this for at least one more shape. For 90%, do two shapes. For 100%, do three shapes.
11. Calculate the mass and density for each shape.

**Shape 1:**

A. Describe the shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. Shape Area = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in2

C. Shape Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_ in3

D. Use the formula $M=A×0.007$ to calculate the shape’s mass (if it were made from plastic sheet).

 Shape Mass = \_\_\_\_\_\_\_\_\_\_\_\_\_ g

E. Use the density formula to calculate the shape’s density.

 Shape density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/in3

**Shape 2:**

A. Describe the shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. Shape Area = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in2

C. Shape Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_ in3

D. Use the formula $M=A×0.007$ to calculate the shape’s mass (if it were made from plastic sheet).

 Shape Mass = \_\_\_\_\_\_\_\_\_\_\_\_\_ g

E. Use the density formula to calculate the shape’s density.

 Shape density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/in3

**Shape 3:**

A. Describe the shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. Shape Area = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in2

C. Shape Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_ in3

D. Use the formula $M=A×0.007$ to calculate the shape’s mass (if it were made from plastic sheet).

 Shape Mass = \_\_\_\_\_\_\_\_\_\_\_\_\_ g

E. Use the density formula to calculate the shape’s density.

 Shape density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/in3

**Final Question:** Which of these shapes is the best for making a hot air balloon? Explain why.