

# ***Archimedes' Challenge***

## ***Day 1 – The Setup***



Your group must develop a procedure to accurately determine the density of a human subject using standard laboratory techniques. We will be following the best procedure from today's group discussions during class on Wednesday.

### **Guiding Questions:**

- How is density calculated?
- What must be measured in order to calculate density?
- What is an acceptable range for the density of a human?
- How will the safety of our "volunteers" be guaranteed?
- What are some possible sources of error in our procedure? How can they be minimized?

# ***Archimedes' Challenge***

## ***Day 1 – Data Collection/Presentation***



Data Collection Worksheet:

What data needs to be calculated to determine density?

What factors control the density of a human being?

What data is relevant to answer this question?

How will the data be presented (table, graph, both)?

What are the advantages/disadvantages of each?

# ***Archimedes' Challenge***

## ***Day 2 – Data Collection Procedure***



### Procedure One:

1. Measure the mass of each subject on a bathroom scale.
2. Fill the overflow container until water spills out the spigot.
3. Have the subject get into the overflow container.
4. Collect the water that comes out of the overflow spigot and measure its volume.
5. Calculate the density of the subject using the formula  $D = m/v$
6. Record data

# ***Archimedes' Challenge***

## ***Day 2 – Data Collection Procedure***



### Procedure Two:

1. Measure the mass of each subject on a bathroom scale.
2. Mark the inside of the barrel to show the original water height.
3. Have the subject get into the overflow container.
4. Mark the new water level.
5. Measure the difference between the two water level marks. Calculate volume using the formula:  
$$V_{\text{cylinder}} = \pi r^2 h$$
6. Calculate the density of the subject using the formula:  $D = m/v$
7. Record data

# ***Archimedes' Challenge***

## ***Day 2 – Data Collection Procedure***



### Procedure Three:

1. Measure the mass of each subject on a bathroom scale.
2. Fill the overflow container until water spills out the spigot.
3. Have the subject get into the overflow container.
4. Collect the water that comes out of the overflow spigot and measure its mass.
5. Use the formula:  $v = m/D$  to determine the volume of the subject.
6. Calculate the density of the subject using the formula  $D = m/v$
7. Record data

# ***Archimedes' Challenge***

## ***Day 4 – The Analysis***



Data Presentation:

Group	Mass	Volume	Notes (error):
1			
2			
3			
4			
5			
6			

Calculations:

Density (1)	Density (4)
Density (2)	Density (5)
Density (3)	Density (6)

## Analysis of Data based on Predictions

- How do the density values for each trial compare to our expectations?
- What variables (other than error) may have influenced the values for density?

## Error Analysis

- What are some potential sources of error for this experiment?
- How would each source of error affect the density calculations (i.e. if water spilled out of the measuring bucket . . .)?
- Which method worked best for determining the density of a human subject (support your answer with “data”)?