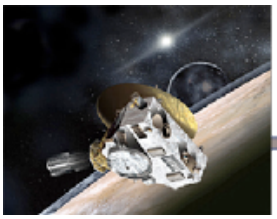


# Speaking Volumes About Dust

## Student Handout

**NAME:**

## Part I

Record your answers on a separate sheet or lab book.

**Density = Mass ÷ Volume**

**1 liter = 1000 $cm^3$**

**1 $m^3$ = 1 x $10^6$ $cm^3$**

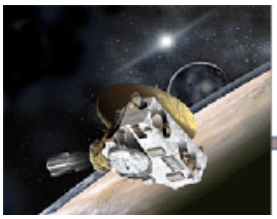
**1 kg = 1000 g**

**Complete the following. Include your units in all answers.**

I.I. Find the density of the block of wood:
Write the procedure below:

I.II. Find the density of the rock:
Write the procedure below:

LASP
LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS
UNIVERSITY OF COLORADO AT BOULDER



# Speaking Volumes About Dust

## Part II

Density is a measurement of the amount of mass that is contained in a specific volume. Consider a solid to be a collection of atoms that are fit into a certain shape and size. The density of an object depends on how many atoms fit into that shape (and the mass of those atoms). This is why a cube of lead is denser than a cube of wood of the exact same size. Even though the two cubes are the same size, lead has a greater mass in the same amount of volume. In this section, instead of a solid, you will be finding the density of peas in a space. The interior of the plastic container with the sealed lid is the space. Assume that the sides are negligible thickness. Record your answers on a separate sheet or lab book.

II.I.

a. After zeroing the mass of the lidded container, add half the bag of peas to the container. Reseal the container and place on the scale. Record your answer.

b. Calculate the volume of the space assuming the walls of the container are negligible thickness. Record your answer.

c. Compute the density of the space using the density equation. Record your answer.

d. Convert the density into $kg/m^3$. Record your answer.

e. Imagine that all sides of the container were doubled. Would the density of the container with peas increase or decrease, and by how much? Show your work.

f. Imagine that all sides of the container were halved. Would the density of the container with peas increase or decrease, and by how much? Show your work.

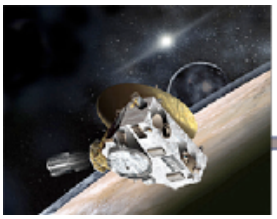
g. If we decreased the total mass of the system, would the density increase or decrease? Explain.

II.II. Extra Credit

a. How could you estimate the number of peas in the container without counting them? Write the procedure.

b. About how many peas are in the container?

c. Are you feeling brave? Using the skills of all of your teammates, count the peas to get the actual number in the container. How good was your estimate?



# Speaking Volumes About Dust

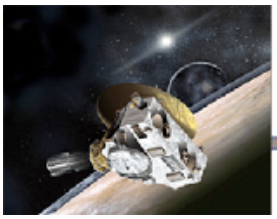
## Part III

Density for SDC is computed by assuming that the volume of dusty space the instrument travels through is similar to the box with peas. The instrument has a specific rectangular area that sweeps through space collecting dust as it travels. If we put an imaginary box around the space the SDC instrument has traveled through, we can determine the volume of space. If we collect all of the dust in that volume of space, we get a density. Record your answers on a separate sheet or lab book.

III. I. Before your group begins, hypothesize about how the density of the dust recorded by SDC will compare to the density of peas recorded in Part II.
**Write out your hypothesis:**

III.II. At a computer, open the Student Dust Counter New Horizons page.
http://lasp.colorado.edu/sdc/

- Conduct research on studying dust and also on the instrument. Pay particular attention to where dust comes from, why it is studied, and the goals and design of the instrument.
- Under "Education" along the top, select "Data Viewer" from the drop-down menu
- In the top box of the SDC Data Viewer, click on "Geography"
- In the bottom box, click on "Density"
- Your group will be assigned a region of space
- Use the arrows to scroll to your region of space and the plus/minus buttons to zoom in and out
- At the bottom of the Data Viewer, enter the Solar System distance range in the "Low AU" and "High AU" boxes
- Click "Calculate"
- Fill in the table that appears on the following page.



# Speaking Volumes About Dust

| Section | Region of the Solar System From AU To AU | Density | Average Mass | # of hits | Total Mass |
|---|---|---|---|---|---|
| 1 | 1.15 to 1.55 | | | | |
| 2 | 1.625 to 1.95 | | | | |
| 3 | 2.65 to 3.25 | | | | |
| 4 | 3.99 to 4.7 | | | | |
| 5 | 5.1 to 6.98 | | | | |
| 6 | 7 to 7.96 | | | | |
| 7 | 8.8 to 9.9 | | | | |
| 8 | 9.9 to 10.96 | | | | |
| 9 | TBD | | | | |

III.III. Share your values with the class, and fill in the chart above.

III.IV. In your group, describe the region of space you were examining. Be specific. *For example: The spacecraft was approximately 1.3 AU away from the Kuiper Belt at the end of our data collection period.*

III.V. Imagine you meet someone who has never heard of dust in space. You want to tell the person exactly what you know without making any assumptions. What true statements can you make about dust in space?

III.VI. As a class, discuss the things that might affect dust in space.

III.VII. Write your concluding remarks and comment on the hypothesis you made.