Lab - Atoms in Aluminum Foil

How thick is aluminum foil in centimeters? How many atoms thick is this? The small size an any one atom gives a clue to the relatively large number of atoms in a sample of matter that we can pick up and measure.

Purpose: To relate the size of an aluminum atom to the thickness of a piece of aluminum foil by:
1) determine the density of aluminum
2) indirectly measure the thickness of aluminum foil, and
3) convert units using dimensional analysis.

Materials:

25 to 100-mL graduated cylinder	scissors
water	aluminum cylinder
metric ruler	aluminum foil
electronic balance	

Procedure:
1) Mass the block or cylinder of aluminum. Record the mass in grams in data table shown.
2) Fill a graduated cylinder with water to the 20-mL mark.
3) Gently lower the aluminum cylinder into the water in the graduated cylinder until it is completely immersed. Read and record the volume of water. Compute and record the volume of the aluminum.
4) Remove the aluminum block from the water, dry it, and return it to your teacher.
5) Cut a piece of aluminum foil approximately 12 cm x 12 cm. (there are some already cut for you.)
6) Measure and record the exact length and width of the piece of aluminum foil to the nearest 0.1 cm.
7) Mass the piece of aluminum foil and record your result.

Data and Observations:

Mass of aluminum cylinder (g)	
Volume of water in cylinder (mL)	
Volume of water and aluminum (mL)	
Volume of aluminum (mL)	
Length of aluminum foil (cm)	
Width of aluminum foil (cm)	
Mass of aluminum foil (g)	

Analysis and Conclusions

1. Determine the density of the aluminum cylinder and record it in your data table. (Density = mass/volume)

2. Knowing that all aluminum has the same density, use the density to find the volume of the aluminum foil and record it in cubic centimeters (1 mL = 1 cm^3).

3. What is the purpose of the aluminum cylinder?

4. Find the height (thickness) of the foil, in cm, from the relation
"Volume = l • w • h" and record the result.

5. One aluminum atom is 2.5×10^{-8} cm thick. Use dimensional analysis to find the thickness of the foil in atoms.

6. Using the mass of the aluminum foil, compute the number of moles of aluminum and the total number of atoms of aluminum in your piece of aluminum foil.

Extension and Application

If the population of the world is 5×10^9 individuals, how many atoms of aluminum could you distribute to each person from your sample of aluminum foil?