How big is an atom?

GOAL: experimentally estimate atomic size + calculate an estimate of Avagadro's number.

PROCEDURE: use oleic acid (C_18H_34_O_2) dropped in a pan filled with distilled water, and look at the size of the slick it makes. Here's the recipe in more detail.

#A: Fill a water tank with enough distilled water to make a good sized surface. Make a 1:500 solution of olieic acid in denatured alchohol. Put a bit of lycodium (spore) powder on the surface of the water tank. Now pipette a drop of the oleic acid + alchohol solution onto the surface. The film of Oleic acid pushes the spores out of the way. Determine the number of drops per square centimeter spread.

#B: Then do the procedure again BUT first add 20mL concentrated HCl to the water. A single drop now covers much greater area

IDEA IS: since Oleic acid has a hydrophobic end, in the first case the oleic acid molecules (think of it as a cylinder) are upright and close-packed in a vertically stacked film on top of the water. Then the strong acid makes it easier to solvate the hydrophobic end...so now the molecules are laying long-axis across the top of the water..like a log jam.

Calculation #1:

Then compute the volume of oleic acid (1:500...remember) in a drop and use geometry of a cylinder on end or laying down like a log jam to solve for d the diameter of the cylinder and l the length of the cylinders. Since it is a long, (almost) straight molecule, d should be roughly the diameter of an atom. Does l=19d (as a long chain 18 C and one O)? Is it close?

Calculations #2, and #3.

Since the molar mass of Oleic acid is 282g and it has a density of 0.895g/cc you could also use Avagadro's number to compute the "size" of an atom. Do that naively, then do it again assuming that the CH_2 are one volume and nearly equal to that of the OH on the end (and the extra O)..that is, assume the H's get buried in the larger atom and don't count them as separate "atoms" for the volume computation. Compare them to the d in Calculation #1.

NOTE: You may want to perform the parts #A and #B of the procedure multiple times to get a measure of the random errors involved in the experiment.

Is this atomic size reasonable? Compute Avagadro's number from the 'd' you computed in Calculation #1.