How big is small
Fatty Film
By Eric Muller

Estimate the length of a molecule by floating a fatty acid (oleic acid) on water.

An oleic acid molecule is a reasonably straight organic molecule only a couple of nanometers long. One end of the molecule is attracted to water (hydrophilic: the other end is repelled by water (hydrophobic). This attraction and repulsion allows the oleic acid to spread out on the water's surface as a monolayer film that is one molecule thick.

This is a classic hands-on activity. There are many resources on-line for this lab.
Go to Google and type "monolayer" "oleic acid."
This document and some on-line videos are on my website at: www.exo.net/~emuller

Below is the teacher/example worksheet for this lab. On the back, is the student version.

Data and calculations:

1. Number of drops of isopropyl to reach 5ml in a graduated cylinder= __249____
   - Add one drop of oleic acid to the isopropyl and mix thoroughly.
2. Total number of drops in the graduated cylinder= __250__
3. Calculate the volume of a single drop from the graduated cylinder = __.020___cm^3

   Example: 5 cm^3/250 total drops = .020 cm^3/drop
4. Calculate the volume of oleic acid in the single drop = __.00008__ cm^3

   Example: 1/250 th of the solution is oleic acid so: .02 cm^3 x 1/250 = .00008ml
   - Place a single drop of the isopropyl / oleic acid in the center of the tray.
5. Measure the diameter of the disk that forms = ___20___ cm
6. What is the radius of the disk that forms = 10 cm

   Diameter/ 2 = radius Example: 20cm / 2= 10cm
7. What is the area of the disk that forms = ___314cm^2

   Area = πr^2 Example: 3.14 x (10cm) ^{2} = 314cm^2
8. What is the thickness or height of the monolayer = __2.5x10^{-7}cm ___

   (Although the drop forms a disk, it is a cylinder….a very thin cylinder)
   Vol. of a cylinder = πr^2x height
   Example: .00008 cm^3 = 314cm^2 x height Height = .00000025 cm or 2.5x10^{-7}cm
9. Convert the thickness into meters = ____2.5x10^{-9}m__ (remember: 1m = 100cm)
10. Also, Convert the thickness into nanometers= __2.5___nm

    One nanometer = 1x10^{-9} meters
    Example: 2.5 x10^{-9}m x 1 nanometer/1x10^{-9} meters = 2.5 nm

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Student Worksheet:

Data and calculations:

1. Number of drops of isopropyl to reach 5ml in a graduated cylinder= _____
   - Add one drop of oleic acid to the isopropyl and mix thoroughly.
2. Total number of drops in the graduated cylinder= _____
3. Calculate the volume of a single drop from the graduated cylinder = _____cm^3
4. Calculate the volume of oleic acid in the single drop = _____ cm^3
   - Place a single drop of the isopropyl / oleic acid in the center of the tray.
5. Measure the diameter of the disk that forms = _____ cm
6. What is the radius of the disk that forms = _____cm

   Diameter/ 2 = radius

7. What is the area of the disk that forms = _____cm^2

   Area = πr^2

8. What is the thickness or height of the monolayer = _____cm

   Volume of a cylinder = πr^2 x height
   (in cm^3) (in cm^2) (in cm)

8. Convert the thickness into meters = _____ m (remember: 1m = 100cm)
9. Also, Convert the thickness into nanometers= _____nm

   One nanometer = 10^{-9} meters