

Building “Macro” Atomic Force Microscopy For High School Class Room : Magnetic Mode

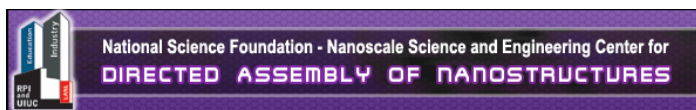
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This report includes (1) a list of parts and (2) step-by-step instructions to build a Macro-Atomic Force Microscopy (“Macro-AFM”). In addition, (3) data analysis using the “Macro-AFM” is shown as an example to demonstrate. By using the components and apparatus commonly available in high school physics laboratory, we have developed a teaching module that could be used in high school physics and technology classrooms.

Upon building the Macro-AFM, high students taking “Technology” class will strengthen their skills in using technical tools and building an integrated technological apparatus. Upon utilizing the Magnetic “Macro-AFM”, high school students taking “Physics” class will enhance their understanding on magnetic forces and fields and light reflection. Team-work by 2-4 high school students will be promoted for designing experiments, recording and analyzing data using the “Macro-AFM.”.



Magnetic Mode

Number of High School Students: 2 – 4

Concepts:

Physics (all levels)

Magnetic Forces and Fields
Light Reflection

Technology (Principles of Engineering)

Utilizing technological systems
Use of real world tools

General

Collaboration and group work
Data Collection and Analysis
Measurement and scale
Instrument Limitations

(1) Parts List

1. Strong Magnets

(Neodymium Magnets – PASCO Catalog #EM-8648 - \$23)

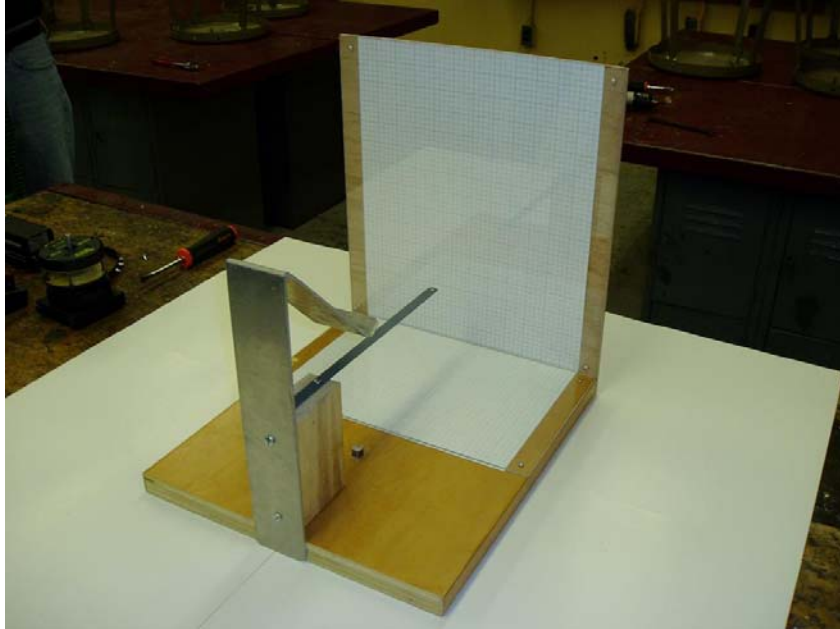


2. LASER source

(PASCO Catalog #OS-8514 - \$549)



3. AFM Simulator with samples

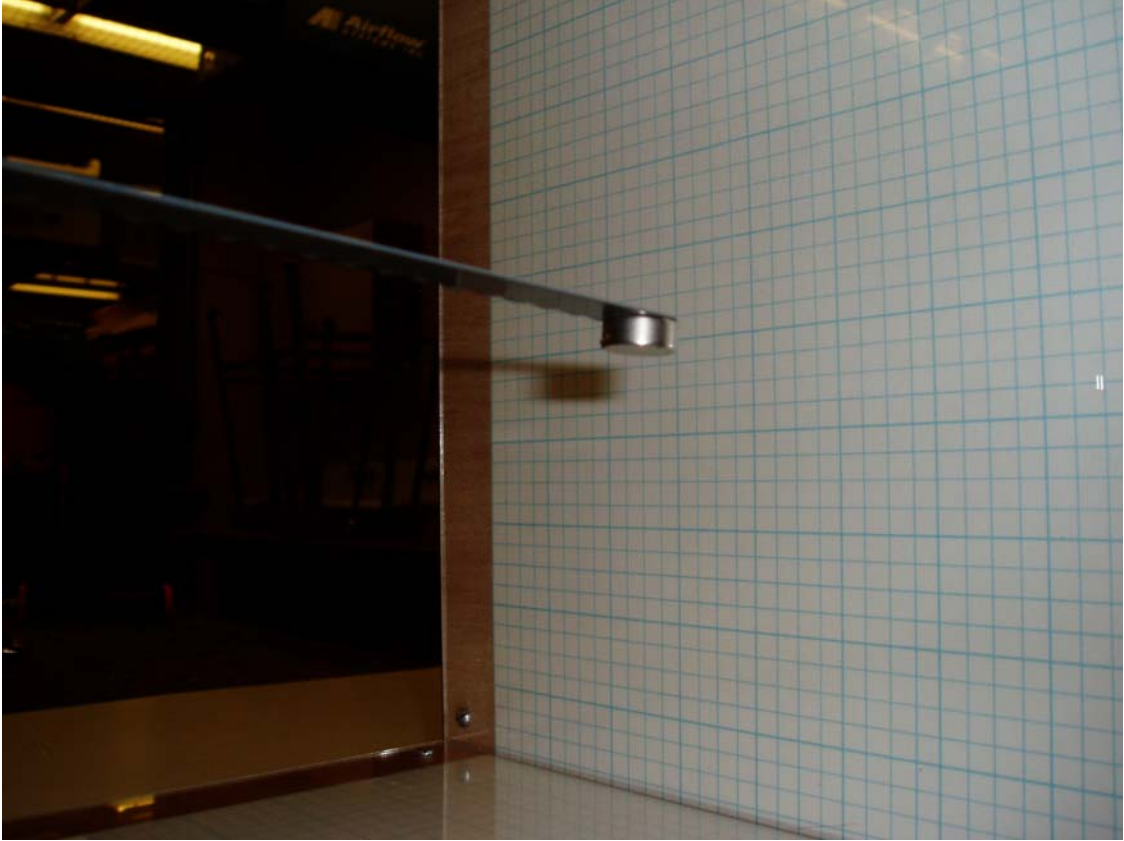


(2) Instruction to build Magnetic Mode “Macro-AFM”

Install LASER

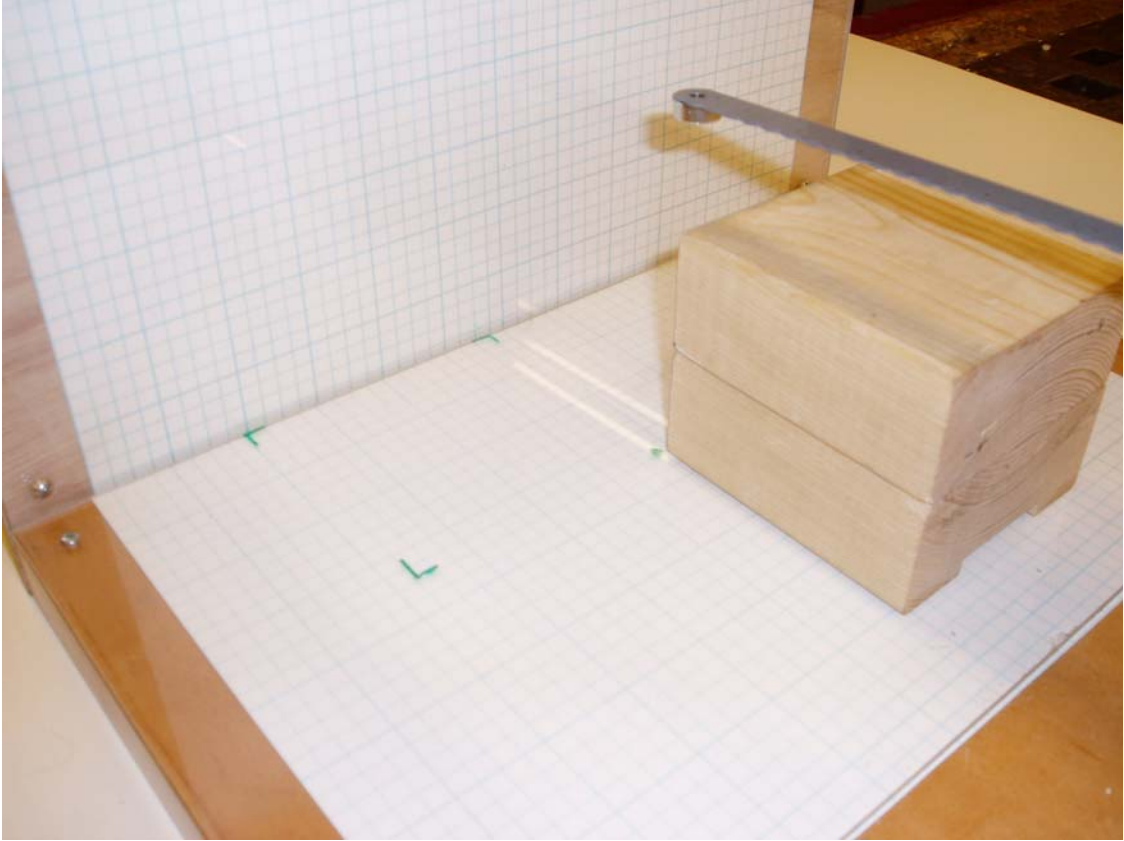


Attach Tip



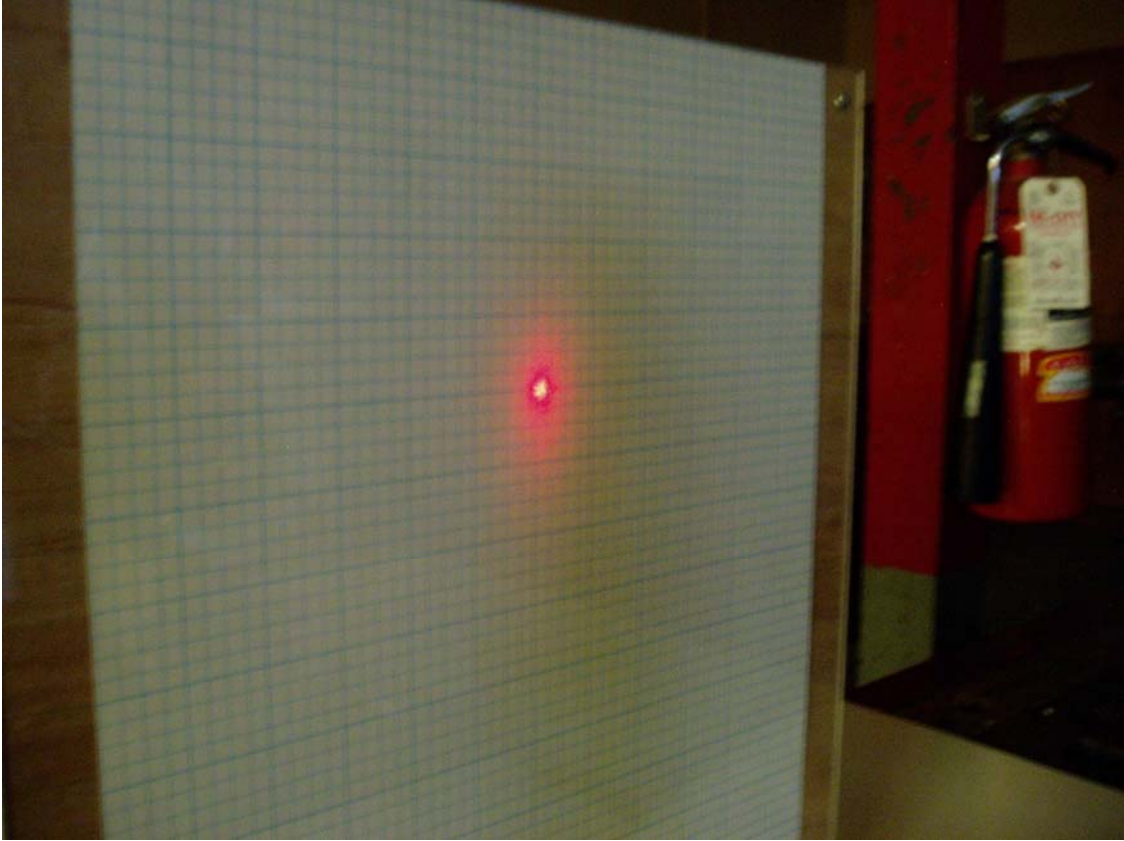
1. Attach the magnet to the end of the hacksaw blade

Sample Alignment



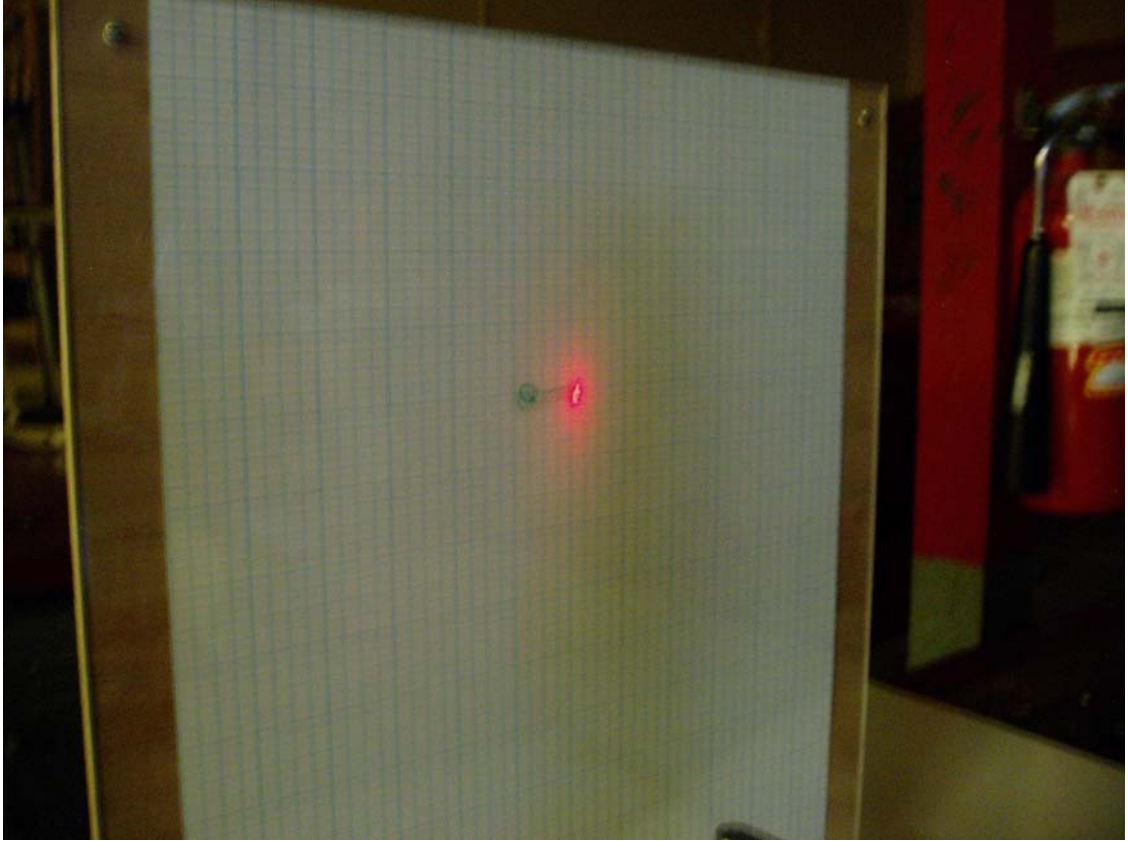
1. Position the sample so the tip is at the left rear corner
2. Put a mark at the starting position
3. Mark 3 1/2" square behind and to the left of the starting position

Zero Line



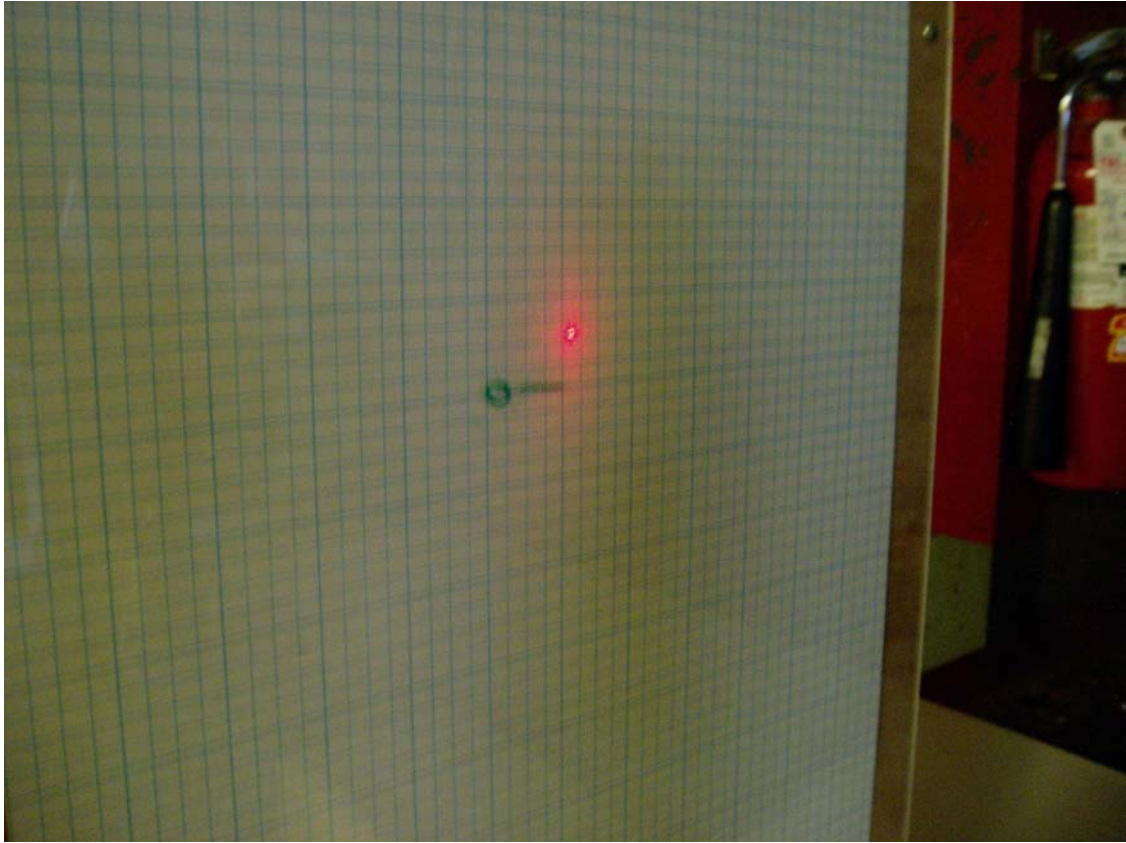
1. Dim lights and turn on LASER
2. LASER reflection will be the zero point

Amplitude Chart



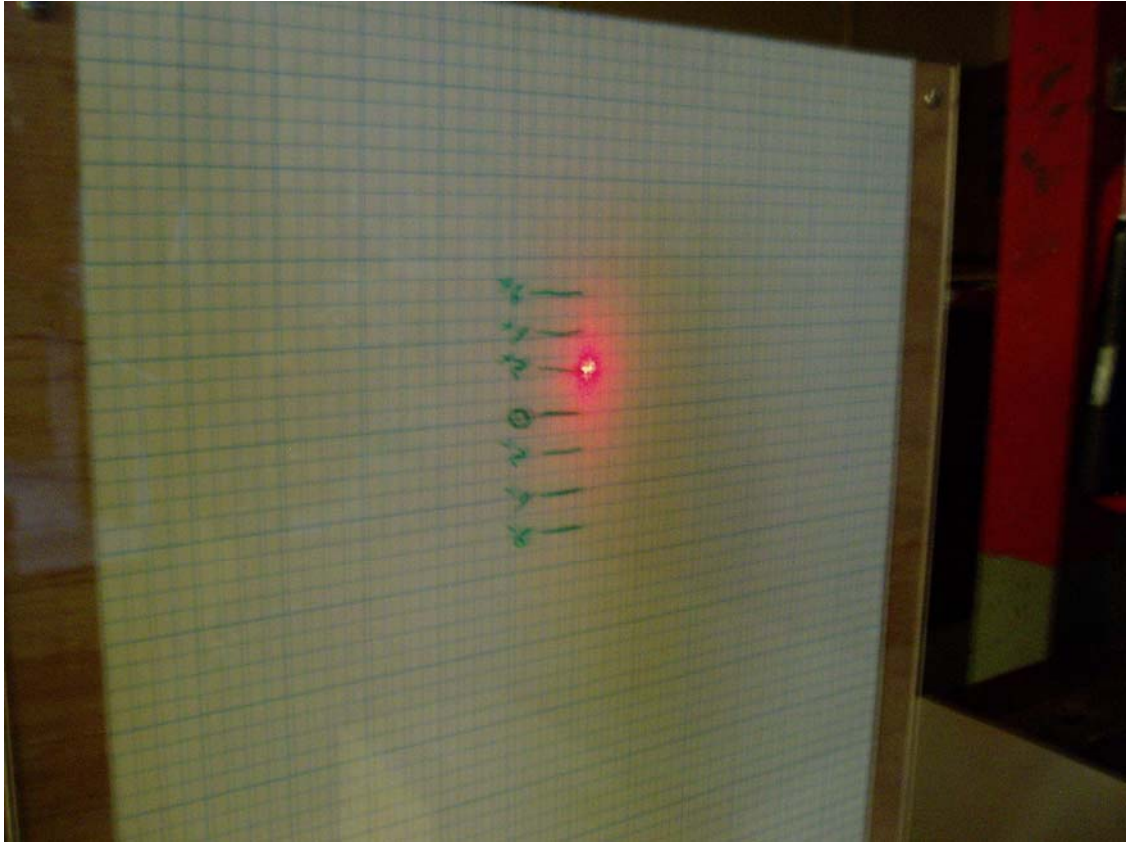
1. Mark the zero point with an overhead marker

Data Collection

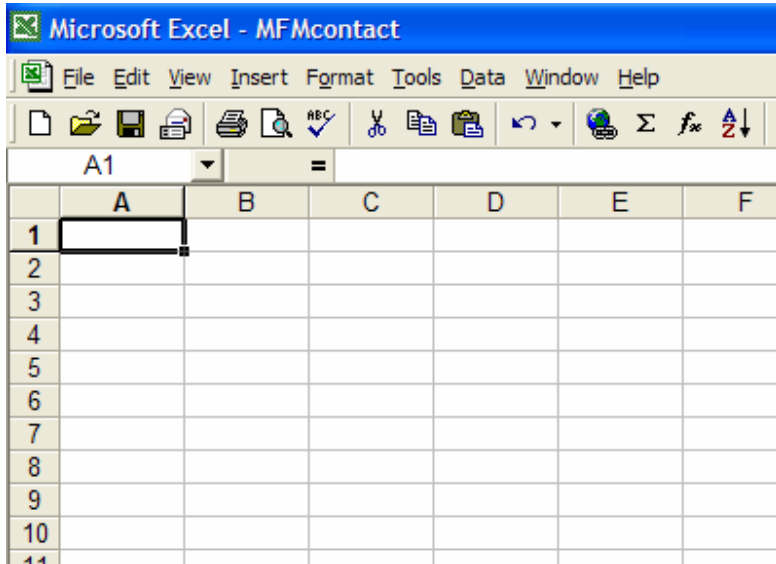


1. Move the sample one space to the left and observe any change in the LASER reflection. (for example, the picture above is from a repulsion from the sample)
2. Record the LASER position, using the graph paper. The more precisely you estimate the LASER position, the more accurate your surface analysis will be. It is recommended that positions be estimated to one tenth of a box.

It might be helpful to make a scale for quicker and easier data collection



3. Input this amplitude reading into cell A1 of the spreadsheet



4. Continue moving sample left in $\frac{1}{4}$ " increments, repeating the above procedure and recording the data in Row 1 of the spreadsheet.

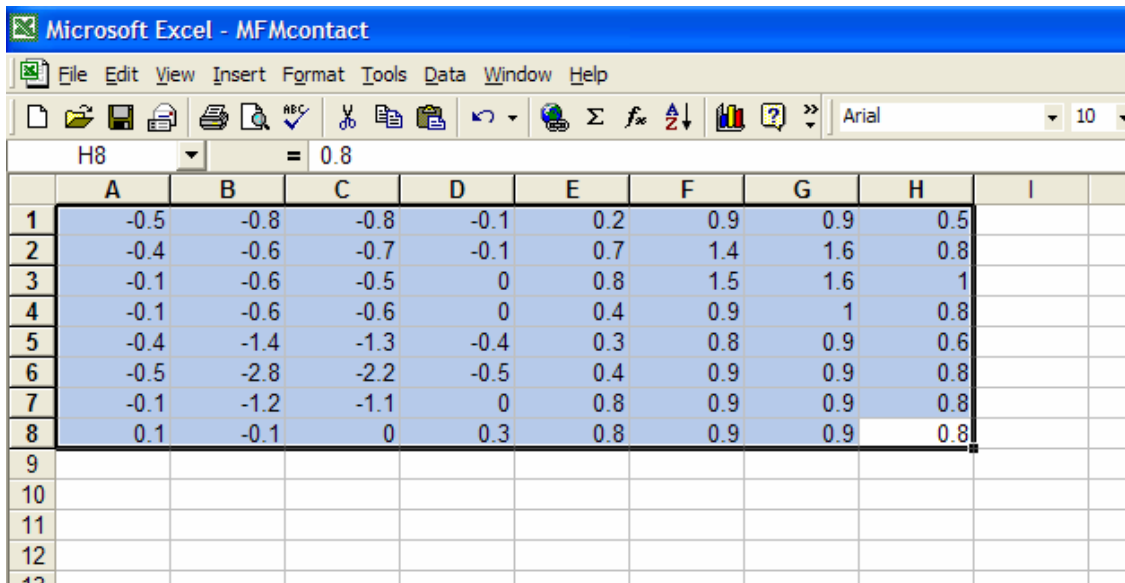
5. At the end of row one, move the sample towards the backboard $\frac{1}{4}$ "

6. Repeat the above procedure, now sweeping back to the right and filling in Row 2 on the spreadsheet from right to left.

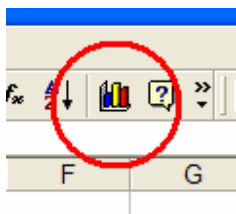
7. Continue moving sample and recording data until the entire block has been scanned.

(3) Data Analysis

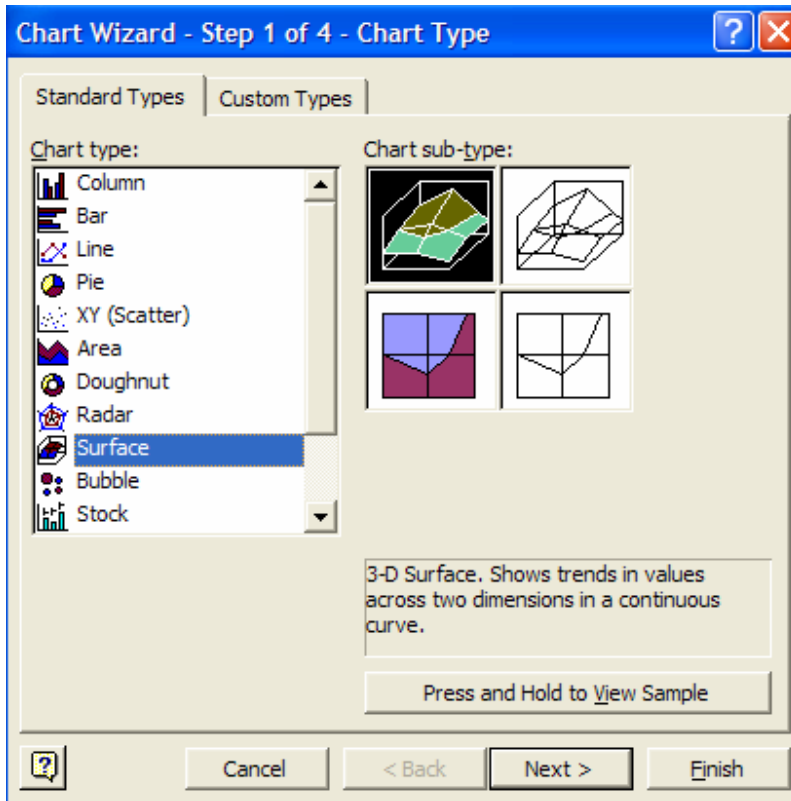
1. Highlight the cells



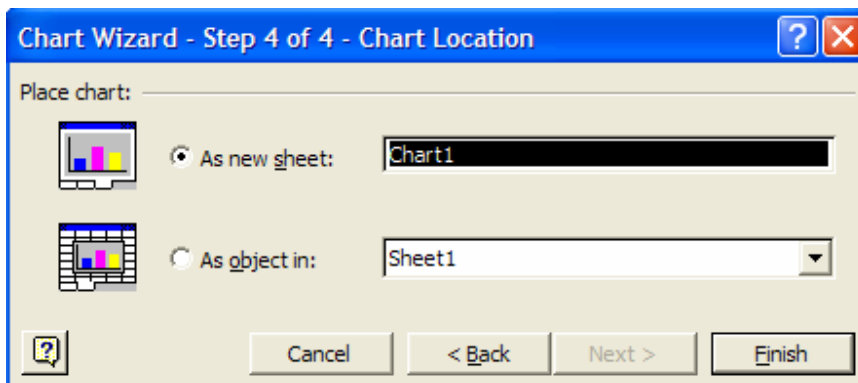
2. Open Chart Wizard



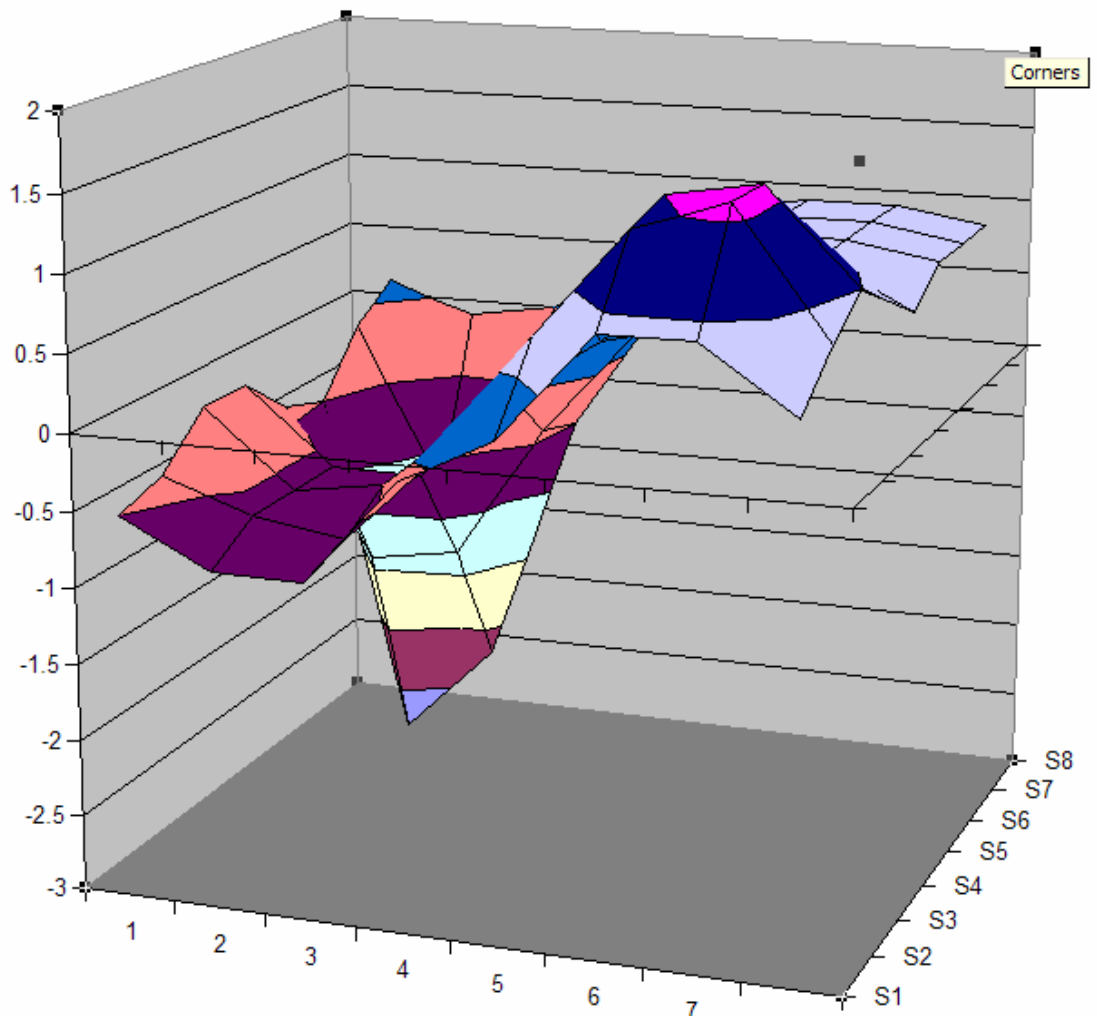
3. Select Surface Plot



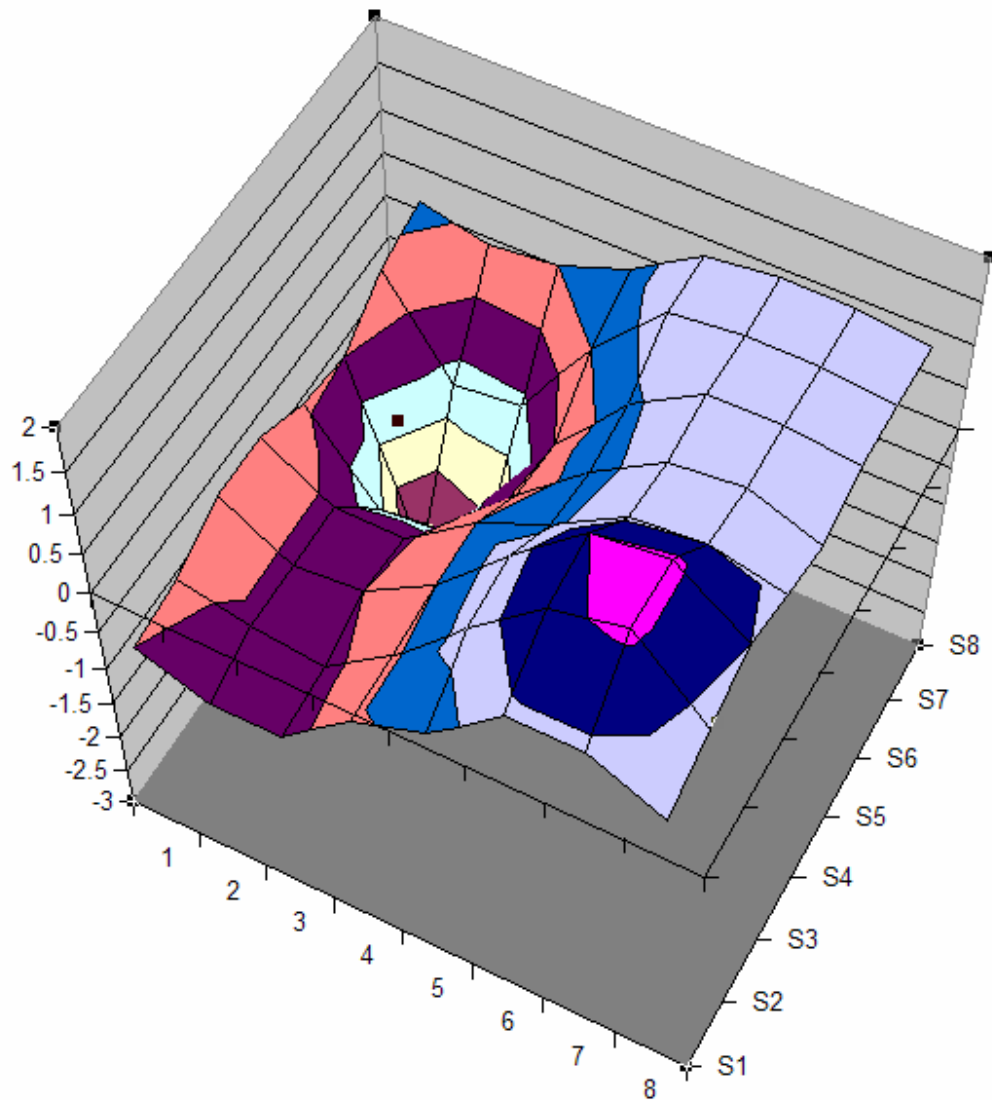
4. Save as New Sheet called Chart1



5. Click the corner of the 3D box



6. Once the corner is selected, you can manipulate the orientation of the graph



7. If desired, you can double click the legend and make the major unit smaller