Student Worksheet

CDs and DVDs as Diffraction Gratings
Optional Activity: Using Scion Software

Step 1: Downloading the software
Go to http://www.scioncorp.com/ and download Scion Imaging software. This is free software, but you might be required to fill in a form requesting basic information about the user. After you have downloaded the software, download the AFM scan images for a blank CD, blank DVD and blank Blu-ray disc from the NNIN website to your computer.
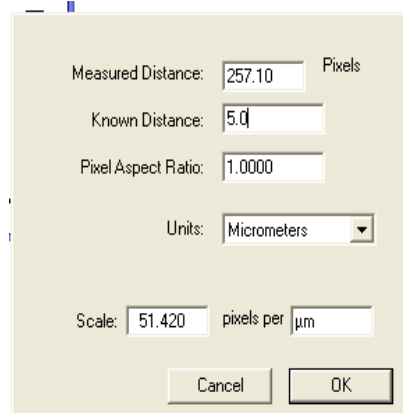
Step 2: Using the software

1) Open the Scion software. Use the **File →Open** option to open the file (BlankCD5.bmp) from your computer.
2) This is the image of a blank CD obtained by using an atomic force microscope.   Each pixel in the image represents the height (z-value) of the coordinate in the sample.

3) Go to **Options →Color** tables and select the desired option to view the color profile of the image.

4) Move the cursor horizontally and then vertically to see how the numbers under **x, y and value** change in the **Info chart**. Explain the meaning of **the x, y and value** data. (x, y and value represent the x, y and z values of the points being scanned on the sample)

5) Use the **Profile Plot tool** ⌇ from the **tool bar** (pictured on the right) to drag a line perpendicular to the tracks visible on the CD. The **plot** window opens up showing the surface profile along the line. The vertical scale is in nanometers while the horizontal scale is in micrometers. Notice that the plot shows raised portions separated by the same distance.

6) Use the **rectangular selection tool** ⌐ from the **tool bar** to select a region or the full image. Click on the **Analyze tab** on the main tool bar and select **Surface Plot** and then click **OK** to view a 3-D surface image.

7) **Making Measurements:**

a) Set Scale: (conversion of pixels to micrometers)

Use the **straight line selection tool** in the **Tool bar** window. Draw a line along either axis of the image. Choose **Analyze→ Set Scale** option. The window shown to the right displays the measured distance in pixels. Set **Units** as **Micrometers** and set **Known Distance** to   the image scale (**5.0 micrometers**). Click OK to continue. This automatically calibrates your future line measurements

Measured Distance:	257.10 Pixels
Known Distance:	5.0
Pixel Aspect Ratio:	1.0000
Units:	Micrometers
Scale:	51.420 pixels per μm
	Cancel OK

b) Measuring Track Separation:

Select the **straight line selection tool** to draw a line perpendicular to the tracks and spanning about 5 tracks. Choose **Analyze → Measure**. The measured length will be displayed as length in micrometers in the **Info window**. Every time you make a repeat measurement using the straight line
selection tool, choose **Analyze → Measure** to indicate the new measurement. You can average your
measurements of the separation of adjacent tracks to determine the average track pitch of a CD.

8) **Use the toolbar and the Main Menu to explore other options**. If your image is messed up close the file without saving and reopen the file again to work on it.

Image Analysis Questions

1. **Determine the average track pitch of a CD and compare it to that of a DVD and a Blu-ray disc.**

2. **What is the depth of the track in a CD?**

3. **How is the image of the recorded CD any different from the blank CD ?**

4. **How is the information on a CD or DVD read by the CD /DVD player ?**

5. **Compare and contrast the images of a DVD to Blu -ray DVD.**