Student Instruction Sheet

Seeing Nano: Using Scanning Electron Microscopy (SEM) to View Nano-size Objects

Introduction: You are probably familiar with using a magnifying glass or a microscope to enlarge objects so you can see them better. But how do we see really small objects such as those on the nanoscale which are less than 400 nanometers? Nano-size objects are smaller than the wavelength of light and because of this they cannot be viewed with a light microscope. You need special tools to see nanoscale objects, one of which is the scanning electron microscope. This activity will have you explore the types of images we can obtain using an SEM.

Make a Prediction: How does a scanning electron microscope (SEM) image nano-size objects?

Materials Needed:

- Magnifying glass
- USB digital scope (optional)
- Hitachi TM3000 Tabletop SEM (recommended but not required)
- SEM images of common objects (recommended objects include feathers, Styrofoam, seashells)
- Actual objects used for the SEM images for students to match to the images

Procedural Steps: Complete Parts 1 and 2 of the activity. Your teacher will tell you if you are doing both parts of this activity.

Directions for the Activity:

Part I: Using the SEM

1. Prepare an appropriate specimen to image by adhering it to specimen holder using carbon tape which allows for conduction. Ask your teacher about the type of specimens that can be imaged in the SEM. They need to be conductive. The preparation for the specimen will be dependent on the type of device that is used.

Developed by Samantha Andrews
*Development and distribution partially funded by the **National Science Foundation***

NNIN Document: NNIN-1385
Rev: 08/2014

2. After loading your specimen into the SEM. Look at the projected SEM image at three magnifications (suggested magnifications 40X, 400X, and 4000X) and draw the images below. Label the magnification and the scale bar.

3. How does the magnified image differ than the macro-size image?

4. What are some unique features of the item that you can see with SEM that is not visible with the unaided eye?

Developed by Samantha Andrews
Development and distribution partially funded by the ***National Science Foundation***

NNIN Document: NNIN-1385

Rev: 08/2014

Part II: Identifying SEM Images

For this activity you will identify objects that have been magnified using a SEM. Use the magnifying glass and objects to identify the images.

1.

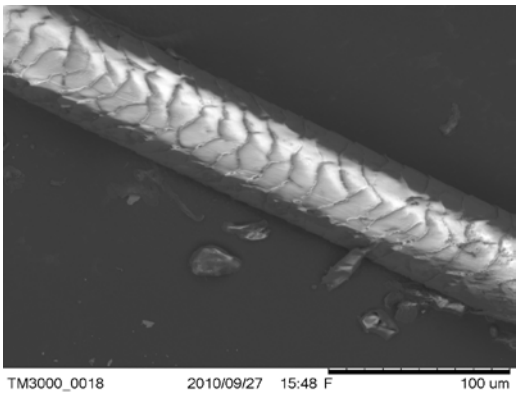

Image Name_____

2.

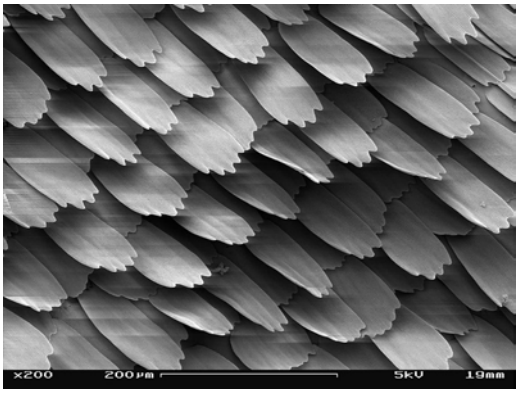

Image Name_____

3.

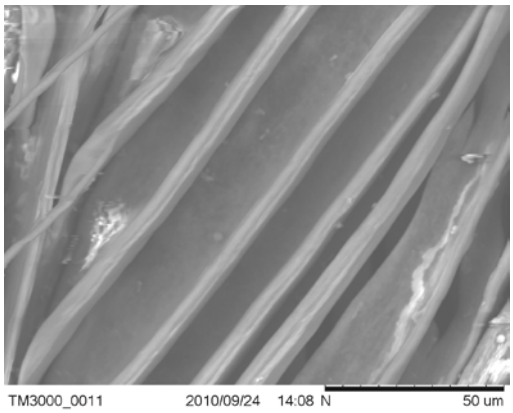

Image Name_____

NNIN Document: NNIN-1385

Rev: 08/2014

4.

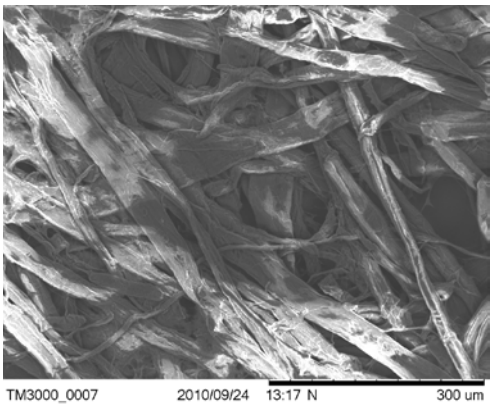

Image Name_____

5.

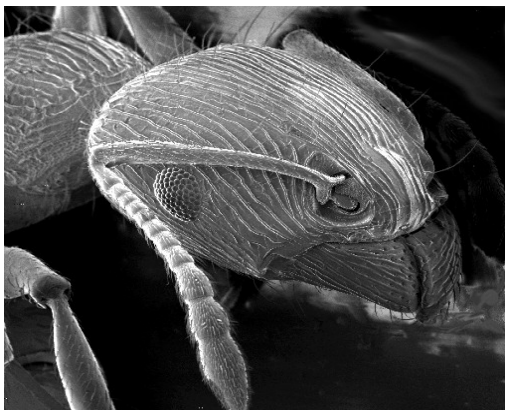

Image Name_____

6.

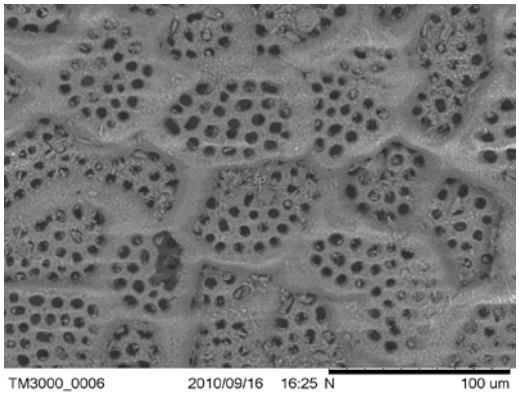

Image Name_____

Developed by Samantha Andrews
*Development and distribution partially funded by the **National Science Foundation***

NNIN Document: NNIN-1385

Rev: 08/2014

7.

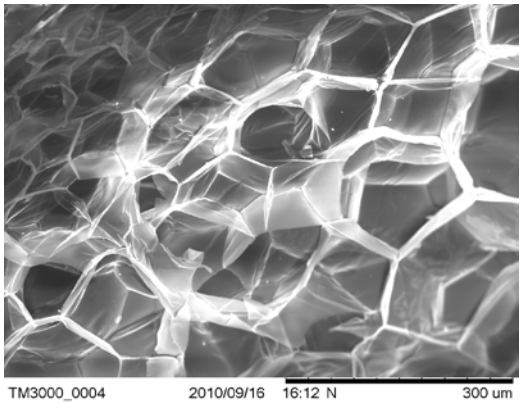

Image Name_____

8.

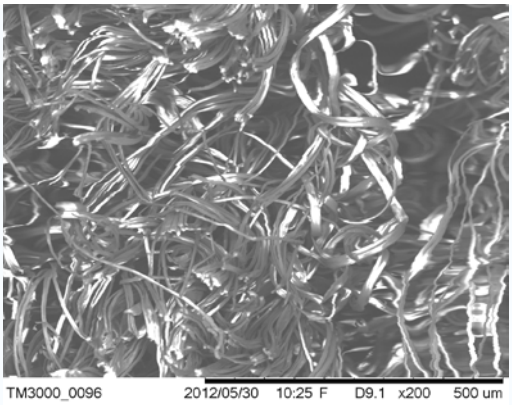

Image Name _____

9.

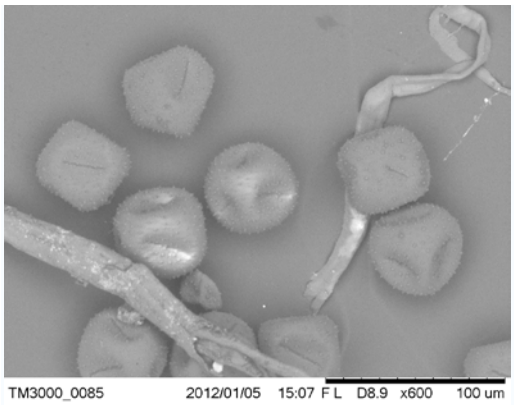

Image Name _____

Developed by Samantha Andrews
*Development and distribution partially funded by the **National Science Foundation***

NNIN Document: NNIN-1385

Rev: 08/2014

10.

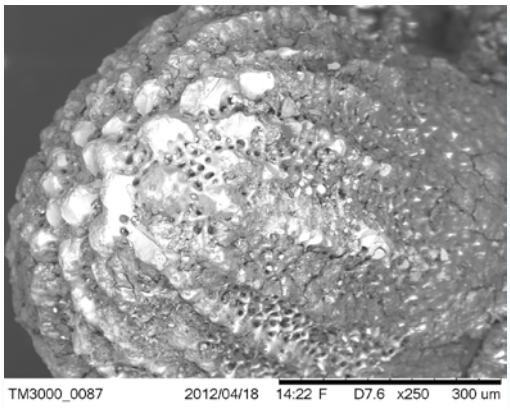

Image Name _____

11.

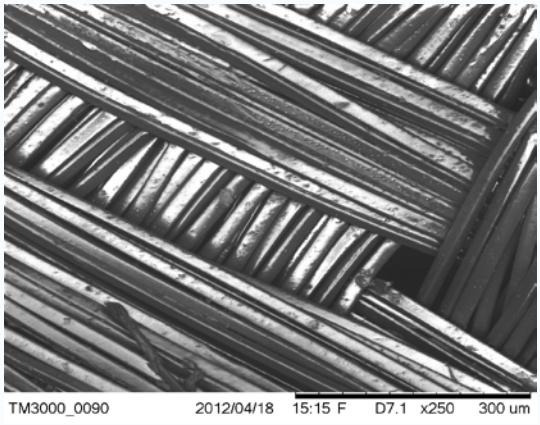

Image Name _____

12.

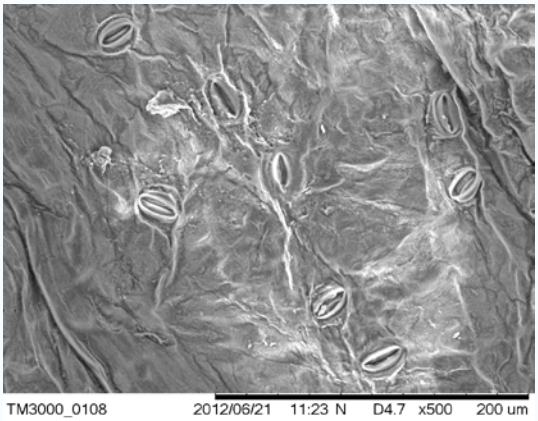

Image Name _____

Draw Conclusions:

1. What does SEM stand for and what does it use to image objects?

2. How does SEM compare to the light microscope?

3. In a typical SEM, samples must be coated with carbon or metal, why is this?

4. What are some of the limitations of using SEM for imaging?

5. What features are visible on objects when viewed under SEM as compared in their macroscopic state (ex: pollen)?

Developed by Samantha Andrews
Development and distribution partially funded by the ***National Science Foundation***

NNIN Document: NNIN-1385

Rev: 08/2014