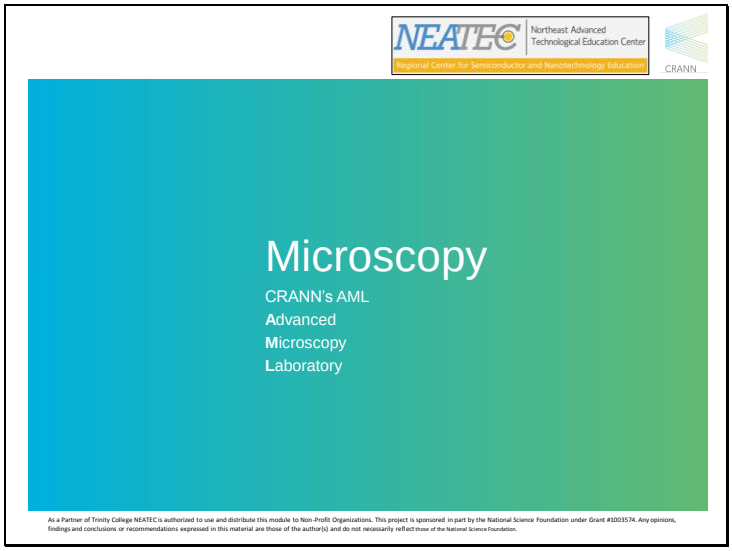
Slide 1


NEATEC
Northeast Advanced Technological Education Center
Regional Center for Semiconductor and Nanotechnology Education
CRANN
Microscopy
CRANN's AML
Advanced
Microscopy
Laboratory
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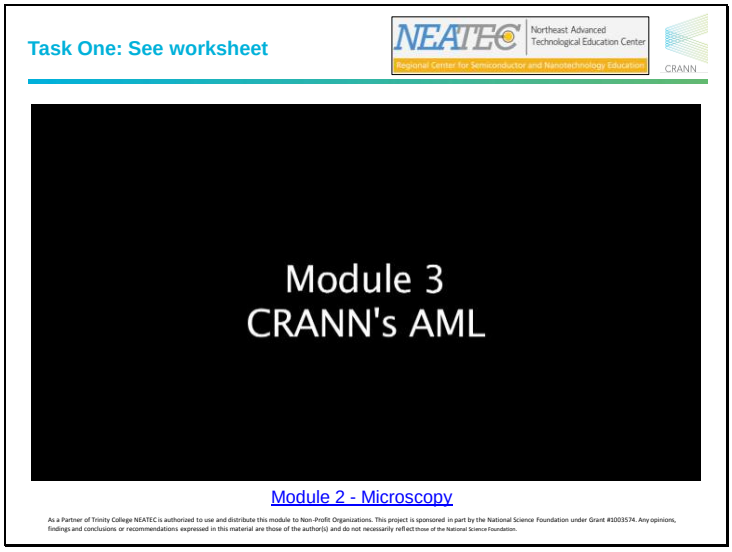
Slide 2


Task One: See worksheet
NEATEC
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CRANN
Module 3
CRANN's AML
Module 2 - Microscopy
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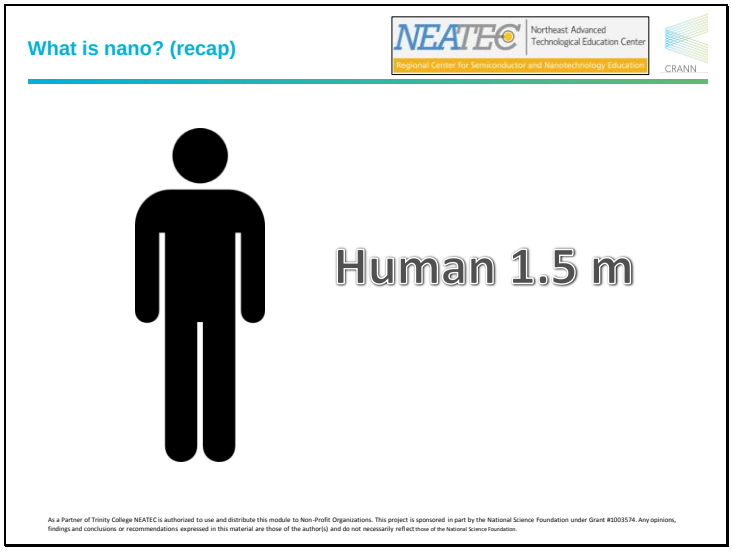
Slide 3


What is nano? (recap)
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Human 1.5 m
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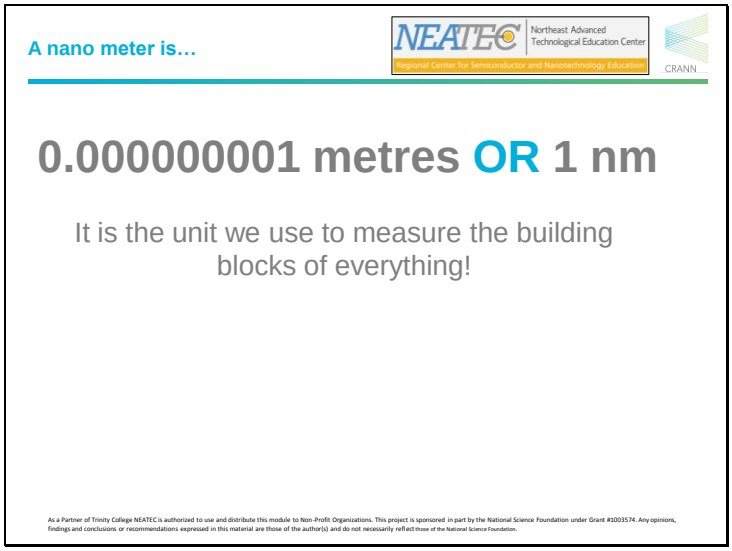
Slide 4


A nano meter is…
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0.000000001 metres OR 1 nm
It is the unit we use to measure the building blocks of everything!
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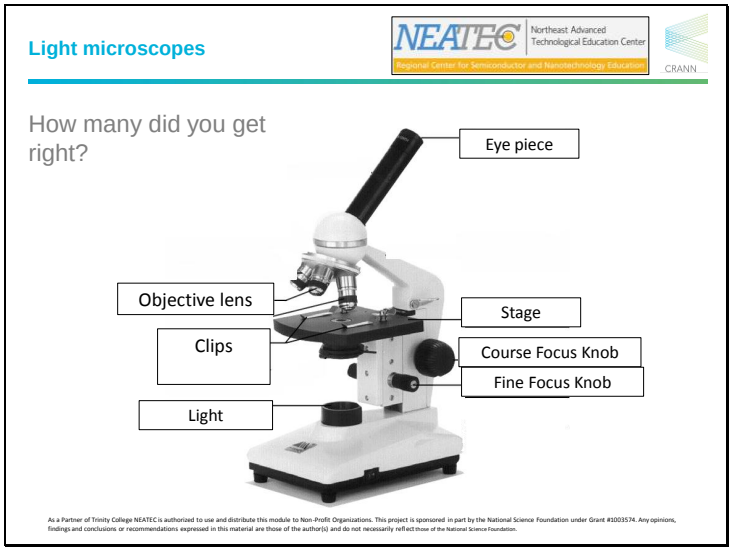
Slide 5


Light microscopes
NEATEC
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How many did you get right?
Eye piece
Objective lens
Stage
Clips
Course Focus Knob
Fine Focus Knob
Light
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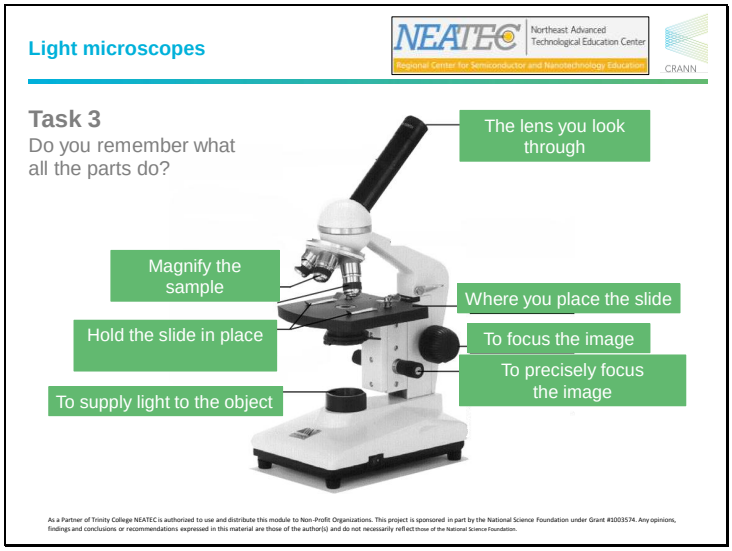
Slide 6


Light microscopes
NEATEC
Northeast Advanced Technological Education Center
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CRANN
Task 3
Do you remember what all the parts do?
The lens you look through
Magnify the sample
Where you place the slide
Hold the slide in place
To focus the image
To precisely focus the image
To supply light to the object
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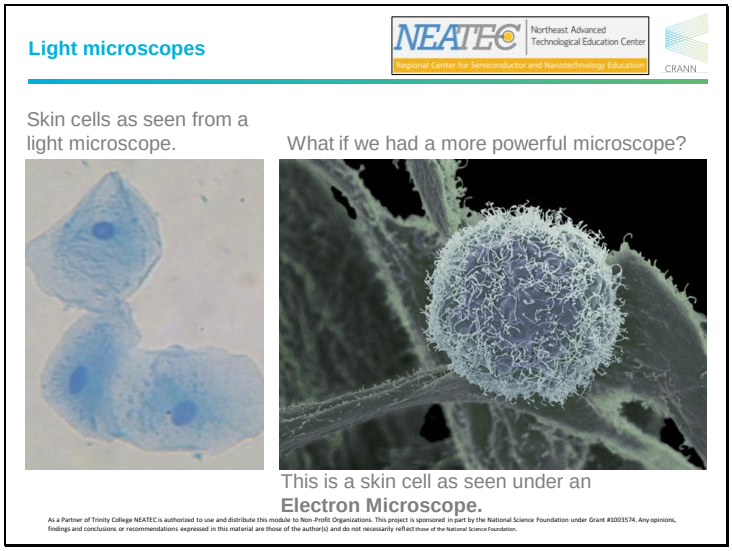
Slide 7


Light microscopes
NEATEC
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Skin cells as seen from a light microscope.
What if we had a more powerful microscope?
This is a skin cell as seen under an
Electron Microscope.
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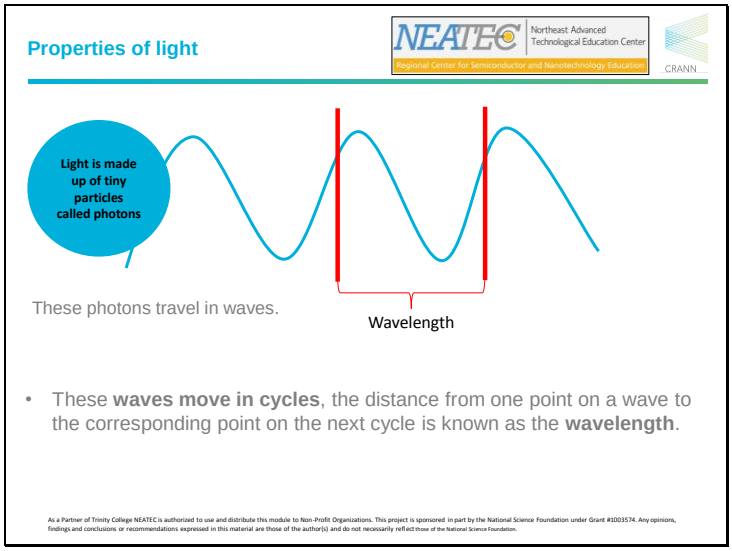
Slide 8


Properties of light
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Light is made up of tiny particles called photons
These photons travel in waves.
Wavelength
• These waves move in cycles, the distance from one point on a wave to the corresponding point on the next cycle is known as the wavelength.
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Slide 9

Properties of Light

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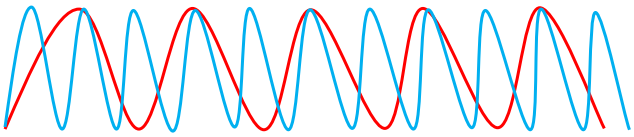
The light we see, **visible light**, is **made up of lots of different colours**.

We can see this when we look at a rainbow.

The colour of light depends on its wavelength.

Red light has a large wavelength (700 nm).



Blue light has a smaller wavelength (450 nm).

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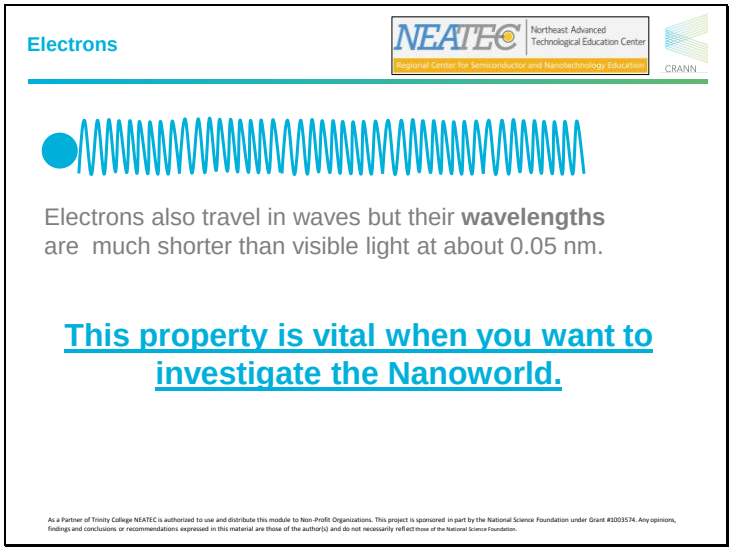
Slide 10


Electrons
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Electrons also travel in waves but their **wavelengths** are much shorter than visible light at about 0.05 nm.
This property is vital when you want to investigate the Nanoworld.
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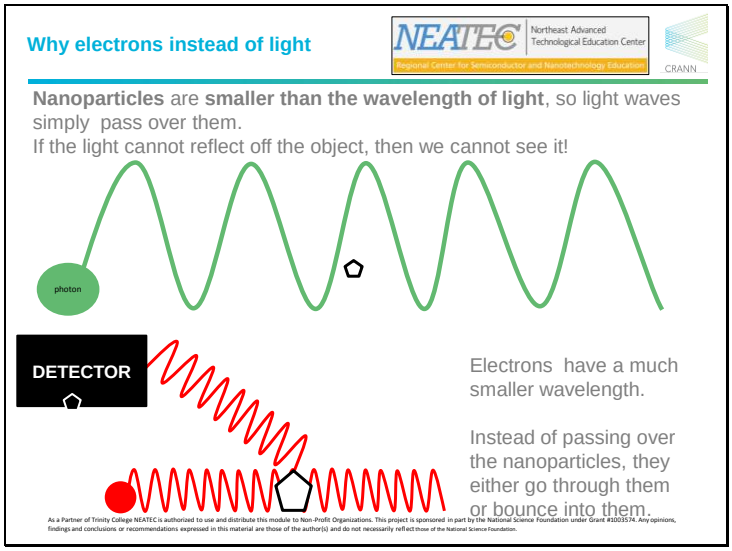
Slide 11


Why electrons instead of light
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Nanoparticles are smaller than the wavelength of light, so light waves simply pass over them.
If the light cannot reflect off the object, then we cannot see it!
photon
DETECTOR
Electrons have a much smaller wavelength.
Instead of passing over the nanoparticles, they either go through them or bounce into them.
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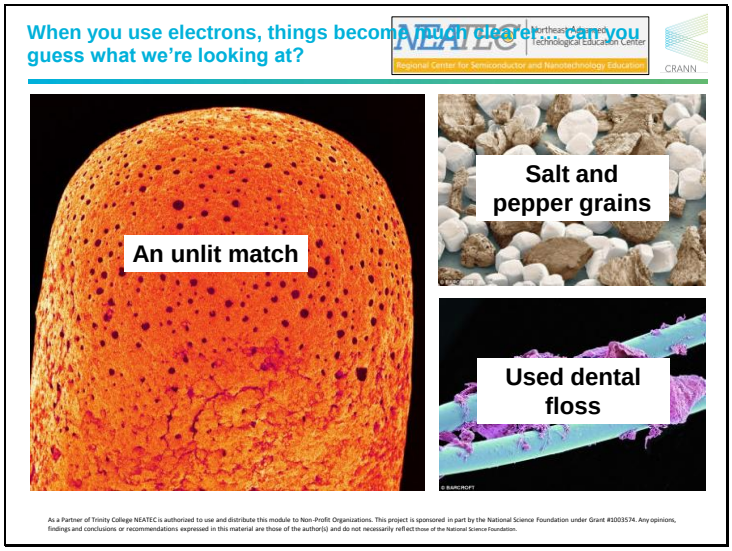
Slide 12


When you use electrons, things become much clearer! Can you guess what we're looking at?
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An unlit match
Salt and pepper grains
Used dental floss
© BARCROFT
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Slide 13

Electrons

So far we have learned that:

- Light has both particle and wave properties.
- Nanomaterials are extremely small (10-9 m).
- Compared to nanostructures light waves are BIG.
- We can use electrons to view nanostructures as they have a smaller wavelength.

Task 4: In your own words explain why we cannot use light microscopes to view nanostructures, you may use diagrams.

Link to quick video tutorial on next topic 'Electron Microscopy'

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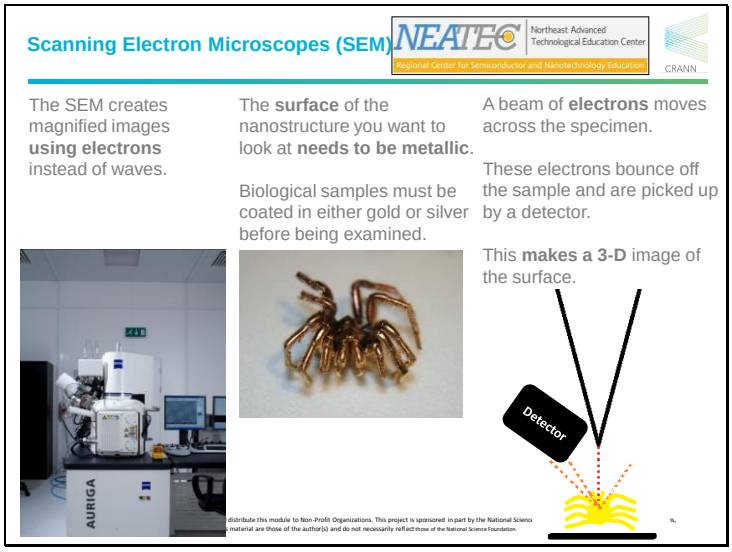
Slide 14


Scanning Electron Microscopes (SEM)
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Regional Center for Semiconductor and Nanotechnology Education
CRANN
The SEM creates magnified images using electrons instead of waves.
The surface of the nanostructure you want to look at needs to be metallic.
Biological samples must be coated in either gold or silver before being examined.
A beam of electrons moves across the specimen.
These electrons bounce off the sample and are picked up by a detector.
This makes a 3-D image of the surface.
AURIGA
Detector

Slide 15

SEM Images: Can you guess what this is?
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Dog Hair
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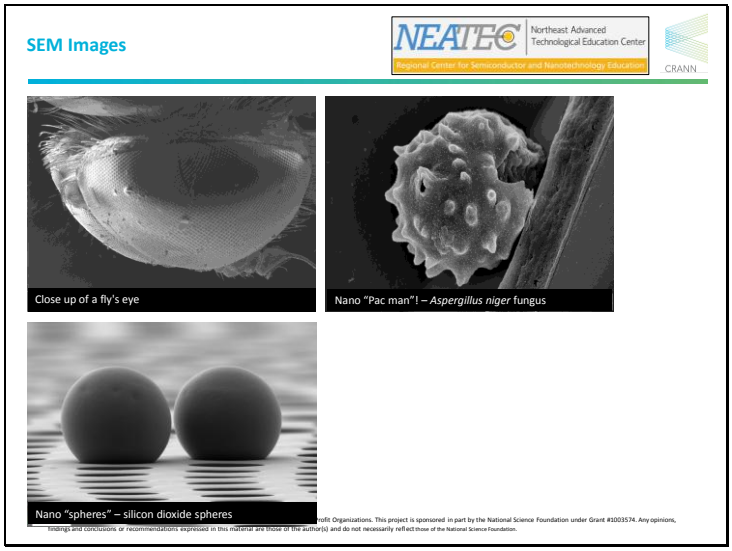
Slide 16


SEM Images
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Close up of a fly's eye
Nano "Pac man"! – *Aspergillus niger* fungus
Nano "spheres" – silicon dioxide spheres
ofit Organizations. This project is sponsored in part by the National Science Foundation under Grant #1003574. Any opinions,
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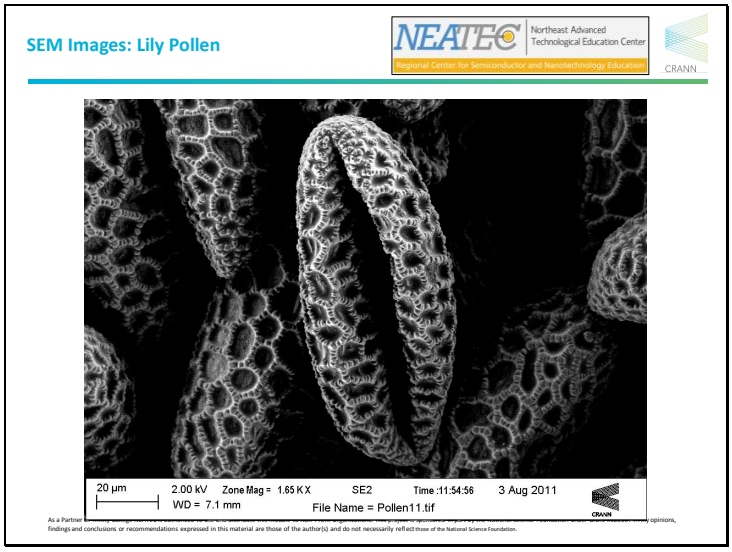
Slide 17


SEM Images: Lily Pollen
NEATEC
Northeast Advanced Technological Education Center
Regional Center for Semiconductor and Nanotechnology Education
CRANN
20 µm
2.00 kV
Zone Mag = 1.65 K X
SE2
Time :11:54:56
3 Aug 2011
WD = 7.1 mm
File Name = Pollen11.tif
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Slide 18

Transmission Electron Microscopes

CRANN's TEM.

Beams of **electrons** are **passed through the sample**.

This creates **dark and light** areas where some electrons have got through and others have not.

These dark areas are used to generate an image of the sample.

Plant cell.

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Slide 19

TEM images

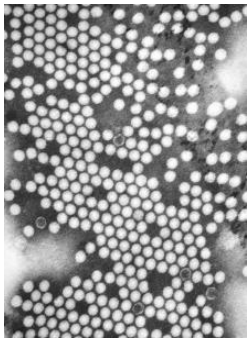

Image of the polio virus taken using a TEM.

Chloroplasts in a leaf.

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Slide 20

Scanning Probe Microscopes

- Scanning Microscopes are also used to **image structures** on a nano scale.
- They work by physically moving a probe back and forth over a surface, 'feeling' the surface and creating an image to represent it.
- Its like running a needle over a record!

Link to quick video tutorial on Scanning Probe Microscopes

Clips 1- 3.

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Slide 21

Scanning Tunneling Microscopes

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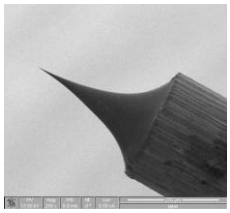
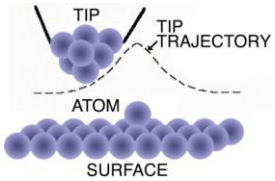
- An **extremely fine probe** with a metal tip the size of a single atom (right) is held extremely close to a metallic surface.
- A voltage is passed between the tip and the surface.
- The probe is moved up and down across the surface creating a contour image.





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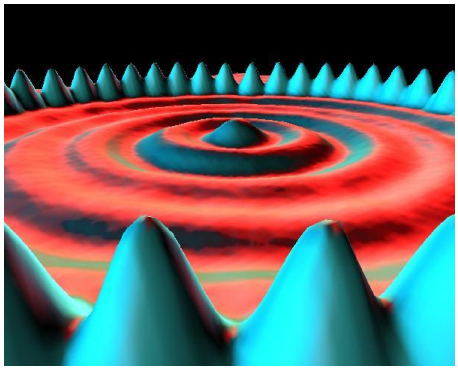
Slide 22

STM images: Quantum Corral



The corral is an artificial structure created from 48 iron atoms (the sharp peaks) on a copper surface.

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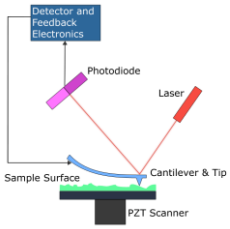
Slide 23

Atomic Force Microscope

- A type of Scanning Probe Microscope.
- "Feels" the surface of a material with a **mechanical probe** (cantilever).
- Tip at the end of the probe is just one atom big!
- **Tip moves up and down** and maps out the contours.
- An image is created.



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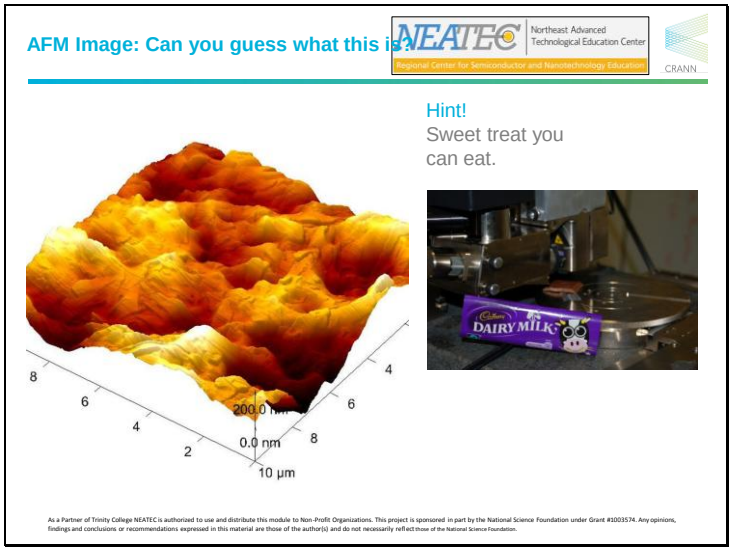
Slide 24


AFM Image: Can you guess what this is?
NEATEC
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CRANN
Hint!
Sweet treat you can eat.
DAIRY MILK
200.0 nm
0.0 nm
10 µm
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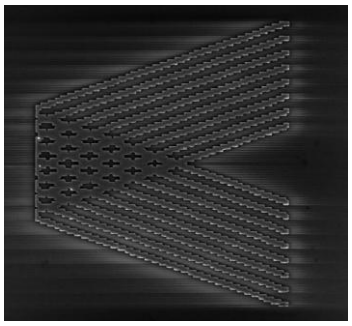
Slide 25

Manipulation of nanomaterials

We can control and manipulate the properties of nanomaterials using a **Focussed Ion Beam (FIB).**

Atoms can be **deposited** (added on) or **etched** (taken away) to manipulate the properties of the substance.



Task 5: Do you remember your abbreviations?

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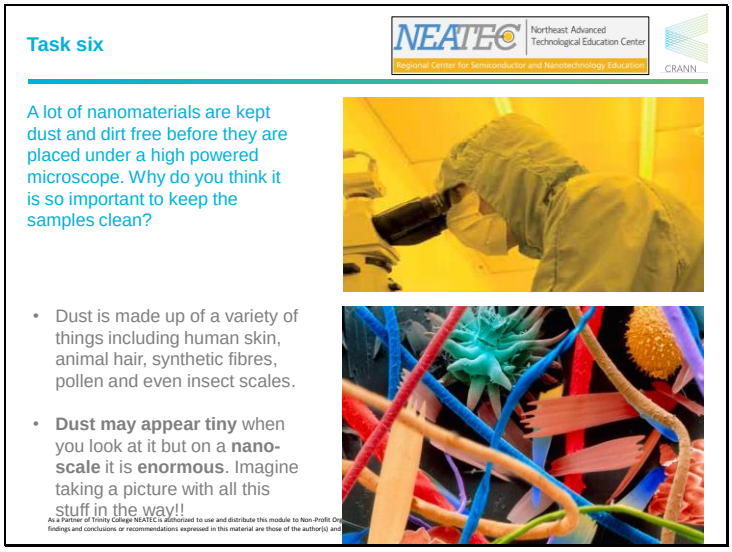
Slide 26


Task six
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Regional Center for Semiconductor and Nanotechnology Education
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A lot of nanomaterials are kept dust and dirt free before they are placed under a high powered microscope. Why do you think it is so important to keep the samples clean?
• Dust is made up of a variety of things including human skin, animal hair, synthetic fibres, pollen and even insect scales.
• Dust may appear tiny when you look at it but on a nano-scale it is enormous. Imagine taking a picture with all this stuff in the way!!

Slide 27

Summary

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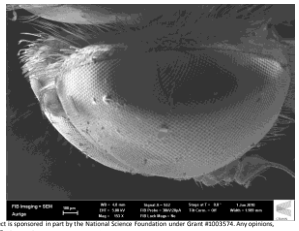
CRANN

- Light microscopes – parts, functions and limitations.
- Electron microscopy – how does it work?
- Scanning probe microscopes – what are they?
- Manipulating nanomaterials.



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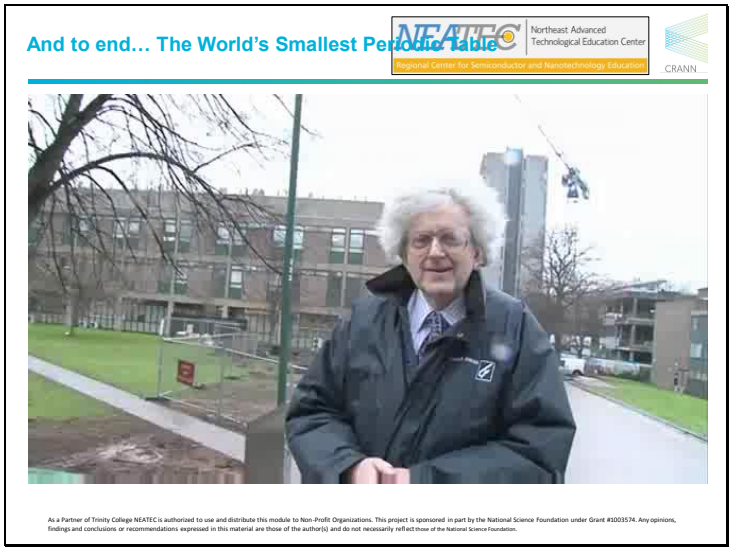
Slide 28


And to end… The World's Smallest Periodic Table
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CRANN
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