Kennedy Space Center
Materials Science Division

Materials Engineering and Failure Analysis

By Katherine Stone

Engineering and Technology Directorate (NE)
Materials Science Division (NE-L)

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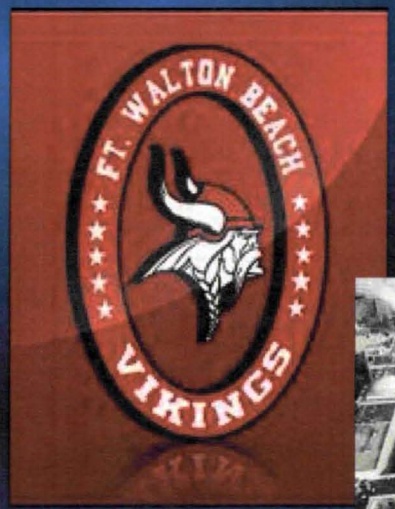
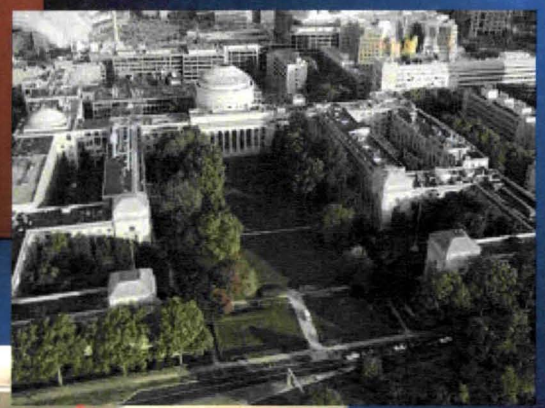
The Basics





- Senior at Fort Walton Beach High School
- Dream School- MIT
- Mentor- Clara Wright
- Materials Engineering- Failure Analysis
  - Engineering and Technology Directorate
  - Materials Science Division

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NE-L Branches

L1: Failure Analysis

L2: Materials Testing and Corrosion Control

L3: Prototype Development

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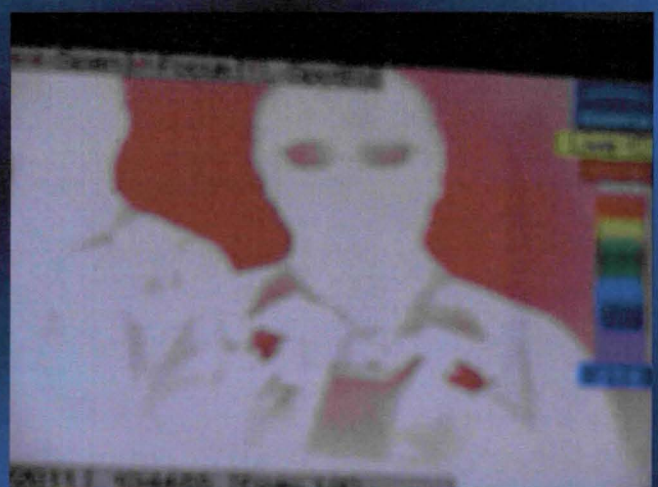
NE-L Branches Continued

L4: Materials Processing and Engineering

L5: Applied Physics



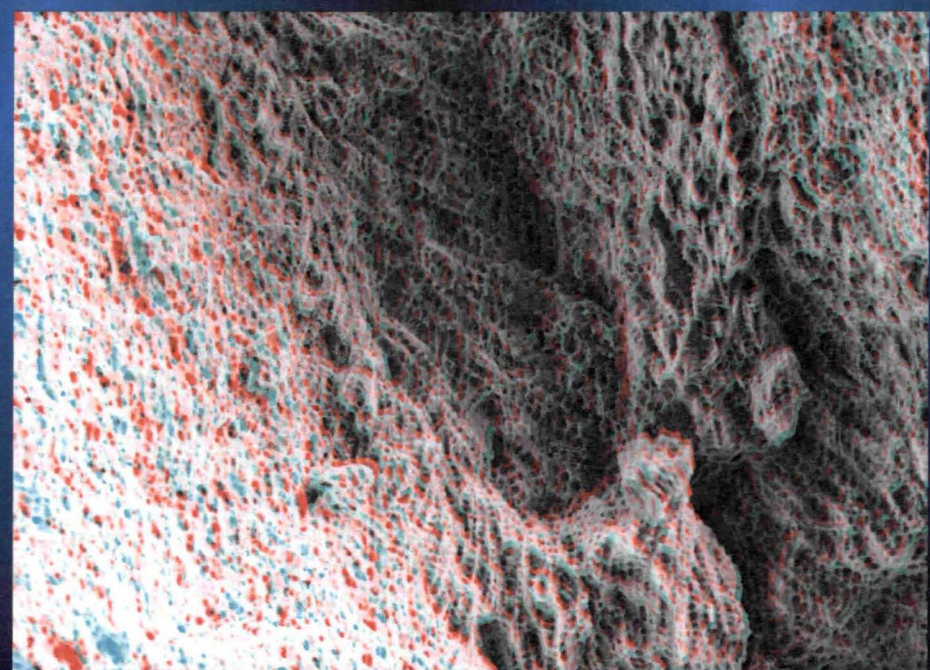
L6: Chemical Analysis

- Gathering
- Uploading and Organizing
- Future Statistical Analysis:
  - Determine common system failures in the shuttle program
  - Use this information to design future safety and inspection criteria


Preserve evidence
Interview witnesses
Take pictures
Use microscopes
Inspect material
Test properties
Discuss with team
Present Results/Write Report

Microscopy

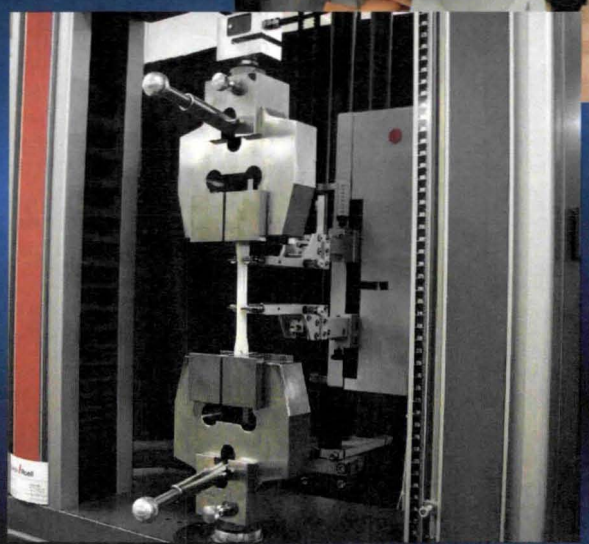
- Keyence Digital Microscope
  - Up to 1,000x magnification
  - Qualitative 3D Imaging
  - View fracture surfaces and any abnormalities
- Laser Confocal Microscope
  - Quantitative 3D Imaging
- Scanning Electron Microscope (SEM)
  - 100,000x Magnification
  - Qualitative 3D imaging
  - Elemental Composition/Distribution
  - Helps determine mode of failure



Metrology

- Dimensional analysis to ensure hardware is fabricated to specifications
- Common Instruments:
  - Coordinate Measuring Machine (CMM)
    - accurate to 2/10,000 in
    - Programmable
    - 3-Dimensional Measurements
  - Keyence
    - Depth/ 3D Measurements
  - Micro-Vu
    - No physical touch
    - Accurate to 8/10,000 in (X-Y plane)
    - Easy to use

Mechanical Testing



- Testing of material properties to ensure a material is processed correctly
- Common Tests:
  - Hardness Testing
  - Conductivity Testing
  - Tensile Testing
    - Determine/confirm ductility and tensile strength of a material using stress-strain curves
    - "Be-all-end-all" strength test

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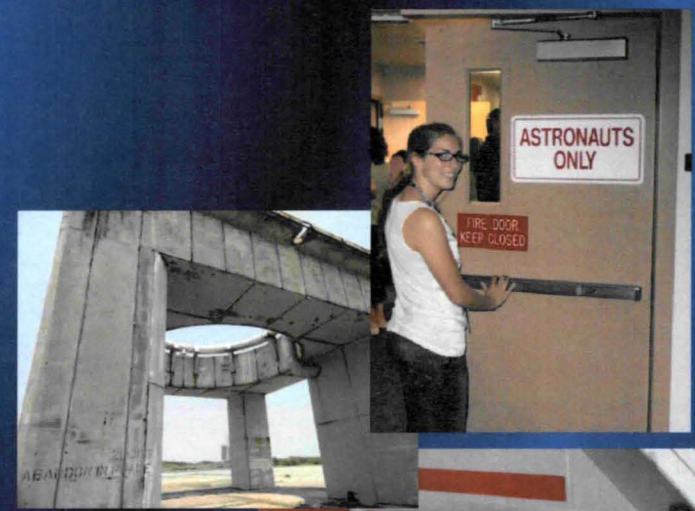
Other Experiences

- NE-L Picnic
  - I am not good at Corn Toss
- Other Tours:
  - Shuttle design and processing facilities (VAB, OPF, Pad 39, etc.)
  - O&C High Bay (Orion Processing)
  - Cape Side/ Apollo, Mercury, and Gemini Facilities
  - Crew Quarters
- The Last Shuttle Launch
  - Pre-Launch Parties
    - Astronauts
    - Charles Bolden (on the dance floor)
  - Astronaut walk out from O&C
  - LCC with Beans and Corn Bread



Influence on the Future

- Reinforced Materials Path
- Introduced me to failure analysis specifically
- Made contacts at MIT (My Dream School)
  - Gave me advice for admissions, course choices

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Special Thanks

- NASA INSPIRE
- Priscilla Moore, Angela Delp, Helen Kane
- Jim Gerard
- Steve Chance
- Samantha Rogers and Karesha Solomon
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- Clara Wright
- Dave Lubas
- Steve McDanels
- The Entire NE-L Division!