Mining Intellectual Gold

Revolutionary not Evolutionary Changes in Education

Partners:

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Overview

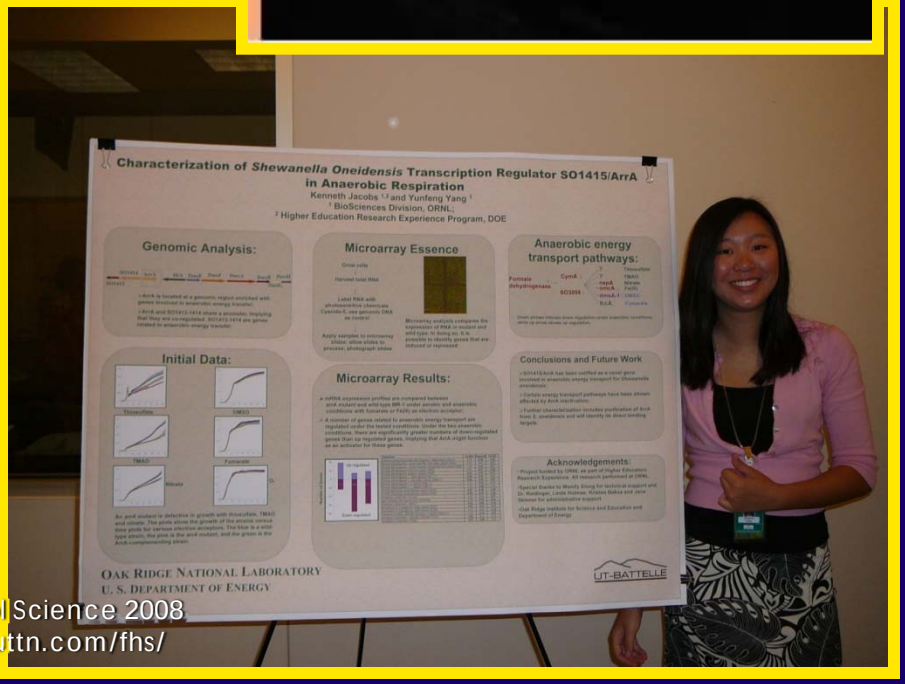
What?

Why?

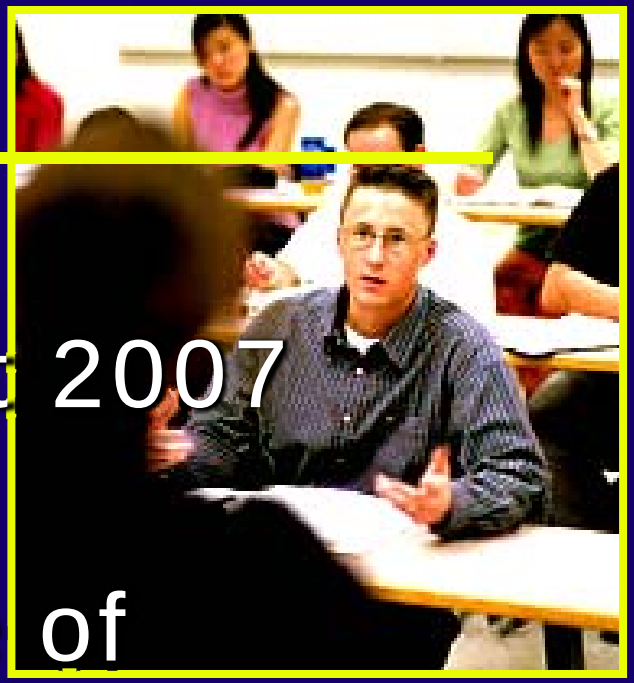
How?

What?

1. Pair high school seniors with top level scientists (mentors)
2. Develop research plan
3. Conduct Research
4. Prepare abstract, poster, paper and present



Why?

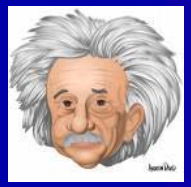


- America Competes Act 2007
- Student's lack of experience/knowledge of research and STEM careers
- Need to hook these students
  - *Keep them in STEM disciplines*
  - *Keep them in geographic location*

Benefits

Students

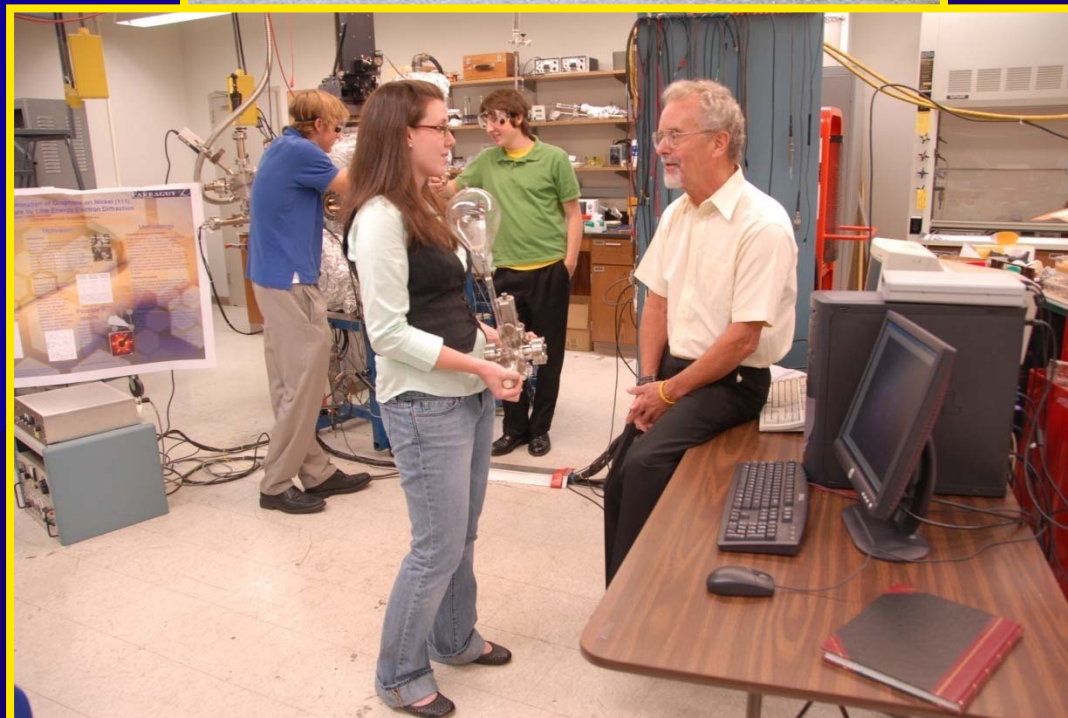
Teachers



Mentors

Student Benefits

- Building self-confidence
- Fostering initiative and independence
- Sparking an interest in STEM careers



Student Benefits

- College opportunities, scholarships, and future employment
- Enhancing science and engineering knowledge via application /real life field experiences
- Strengthening student credentials
- Assisting students in choosing a university program that fits their needs
- Building student's network for summer employment and the future beyond college

Teacher Benefits

- Puts teacher in different role
- Teacher's learn from reading abstracts and poster presentations
- Distinguished lecture series
- Positive teacher/parent/community contacts.
  - —Parents love it
  - —Principal loves it
  - —Positive publicity for the school

Mentor Benefits

- Mentors love to teach
- Young minds provide untainted thinking
- Great publicity—community involvement
- Students may become future researchers or employees
- Builds communication networks

Identification of Motile Soil Microbes

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INTRODUCTION

Some bacteria have the ability to sense nutrient sources in the environment and move towards them. Using a culture dependent approach, motile bacteria can be identified from soil samples and classified according to movement.

Identifying motile soil microbes can aid other research. For example, bacteria can "swim" towards plant roots, they may have a advantage over non-motile species in colonizing plant surfaces. Knowing which species are colonizing the rhizosphere can be important to agricultural enhancement and environmental remediation, because these bacteria may promote or hinder plant growth.

Figure 1. Typical streak (left) and motility plate (right)

QUANTIFICATION AND ISOLATION OF CULTURABLE SOIL MICROBES

The number of soil microbes amenable to culturing was determined by conducting plate counts on two media types. Soil was suspended in basal media, which has minimal nutrients, in order to keep fungus, mold, etc. growth to a minimum.

Serial dilution of the soil samples was made because too many bacteria or any plate can result in misinterpretation of the species present as aggressive bacteria take over less aggressive bacteria as they compete for space and food.

Figure 2. Examples of the soil dilution plates

The soil samples were then cultured on both basal (minimal nutrient) and yeast peptone media, which is nutrient rich. The total number of colony forming units (CFU) as well as the different colony morphologies were counted for each plate (Table 1).

Sixty-five isolates, representing nineteen different morphology types, were selected from these plates and purified by streaking three times on agar plates (Fig. 9).

Motile phenotypes in soil for motility were then chosen off of these plates.

Table 1. Plate and Phenotype Counts

1:1000 dilutions	CFU/gram soil*	Colony Morphotypes Present*
Basal	1.08 x 10^4	2.33
Yeast	1.48 x 10^4	4.67

*Averages from triplicate plate counts

MATERIALS AND METHODS: MOTILITY PLATES

•The collection of 25 isolates were characterized with regards to motility and Gram staining.

•Motility was initially assessed using semi-solid (0.4% agar), nutrient-rich agar plates. An aliquot (5-10 µl) of broth culture was used to inoculate the center of these semi-solid agar plates. Plates were incubated at room temperature (23° C) in a humid container for 48 hours. Growth patterns and distance migrated from the site of inoculation were determined for each isolate every 24 hrs.

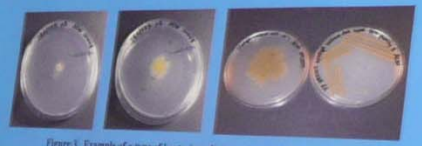

Figure 3. Example of a type of bacterium that swarms rather than swims

•Motility characteristics (movement, type of movement) were observed for bacteria present in the motility "front" by phase contrast microscopy.

•Cellular morphology (shape and size) was also observed and recorded (e.g. Figs. 8 and 10).

•Two types of motility were evident in the isolate collection:

•Swimming: outward movement through motility agar (Fig. 1)

•Swarming: outward growth on top of motility agar; surface-driven motility as opposed to swimming through the agar (Fig. 3)

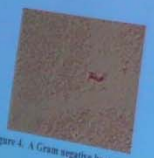

Figure 4. A Gram negative bacterium

Figure 5. A Gram positive bacterium

•Gram staining is a method of determining the characteristics of the bacterial cell wall and was performed on each of the isolates.

•To prepare slides for staining, bacteria are heat fixed to a slide. Cells are then sequentially stained with Crystal Violet and Gram's Iodine, decolorized with ethanol, and counterstained with Safranin. Stained cells are visualized by light microscopy.

•Bacteria staining Gram positive appear purple or blue due to thicker outer walls (Fig. 5). •Gram negative bacteria stain pink due to thinner outer walls that vary in composition from that of Gram positive bacteria (Fig. 4).

RESULTS

Approximately half (56%) of the isolates screened in this study were motile under the conditions tested. Of the 25 isolates screened, 22 demonstrated unique cellular morphologies, suggesting that they are distinct bacterial types. Twelve of these 22 distinct isolates were motile. The motile isolates demonstrated variation in their movement in the semi-solid agar assay (Fig. 6). These differences were also supported by variation evident in microscopic analysis of the strains. Finally, Gram staining revealed that six of the strains were Gram negative, 12 Gram positive, and seven Gram variable.

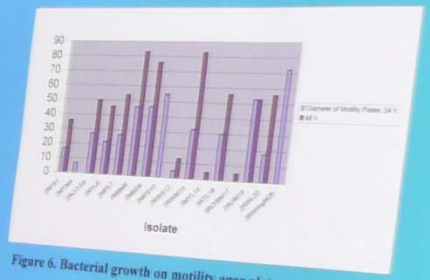

Figure 6. Bacterial growth on motility agar plates.

CONCLUSIONS AND FUTURE DIRECTIONS

Approximately half of the soil isolates examined were motile under the conditions tested. Future studies are aimed at determining whether these isolates are representative of naturally abundant populations in wheat and switchgrass rhizosphere communities by comparing diagnostic gene sequences from these isolates with those obtained from culture-independent approaches.

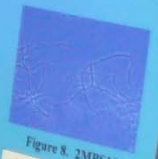

Figure 8. 2MPS10

Figure 9. Purified isolates

Figure 10. 2RWringM26

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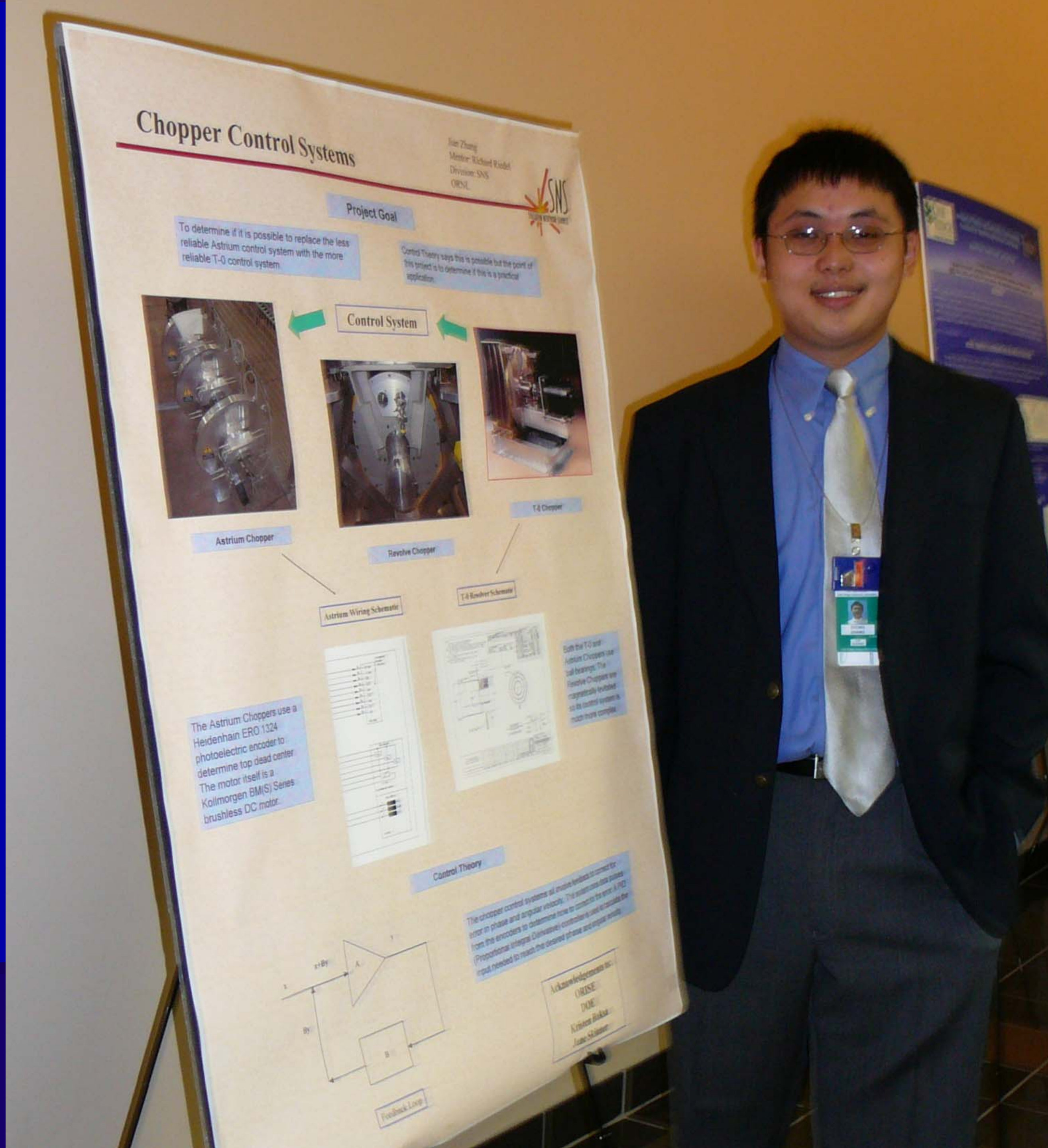
Chopper Control Systems
Project Goal
To determine if it is possible to replace the less reliable Astrium control system with the more reliable T-0 control system
Control System
Astrium Chopper
Revolve Chopper
T-0 Chopper
Astrium Wiring Schematic
T-0 Resolver Schematic
The Astrium Choppers use a Heidenhain ERO 1324 photoelectric encoder to determine top dead center. The motor itself is a Kollmorgen BM(S) Series brushless DC motor.
Control Theory
Feedback Loop
Acknowledgements to:


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SNFUH

OAK RIDGE CENTER FOR AD UDIES

An Analysis of Rhenium 3 Tungsten using X-ray and Electron Diffraction

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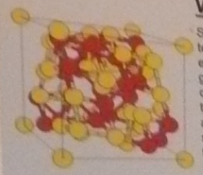
Farragut High School

Claudia Cantoni
Materials Science and Technology Division

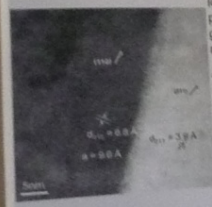


Why Study Rhenium 3 Tungsten?

Superconductors are materials whose resistance is zero at temperatures below a certain critical temperature because the electrons condense into a low energy level that leaves an energy gap above. The presence of this energy gap inhibits the kind of collision interactions which lead to ordinary resistivity. Once these superconductors reach their critical temperature they act as regular conductors. Conventional BCS theory superconductors have electrons coupled in pairs (Cooper pairs) that exhibit a spherical symmetry. However, unconventional superconductors have a non-spherical energy gap which permits electrons to transfer to an energized state at temperatures lower than the critical temperature. There are indications that the unconventional electronic structure of certain superconductors is linked to a lack of symmetry in the crystal lattice. The crystal structure of Re_3W lacks inversion symmetry. Therefore, Re_3W can assists us in understanding why certain superconductors act in this fashion and their behavior is not explained by the BCS theory. Before studying the superconducting properties of a Re_3W sample, the specimen has to be subjected to X-ray and electron diffraction tests to determine whether the prepared sample is free of impurities and suitable for further study.

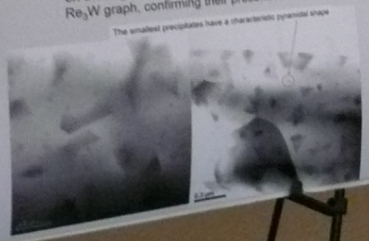
Results of Specimen Analysis

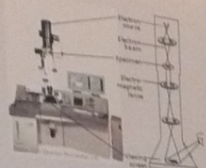
The diffraction tests show two unrecognizable peaks at lower theta values. TEM inspection of the sample shows precipitates homogeneously distributed throughout the grain matrix of Re_3W that might explain the spurious reflections seen in XRD.



As expected the Re_3W matrix is polycrystalline and has a cubic lattice parameter of 9.6 Angstroms. The grain boundary image shows lattice fringes originated by the 110 planes (left side) and from the 211 planes (right side).

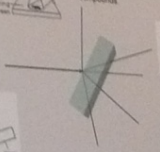
After the chemical analysis tests, the XRD graph was compared to XRD data for ReO_3 and Carbon, the peaks on these graphs corresponded to the peaks on the Re_3W graph, confirming their presence.

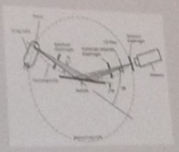


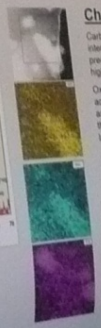


Diffraction

An incident beam of electrons or x-rays (particles or photons) interacts with the sample and emits an elastically scattered beam that is collected by a detector. Using Bragg's Law ($n\lambda = 2d\sin\theta$) and the reciprocal lattice, the planes that scatter the incident beam can be determined. The transmission electron microscope also uses a variety of other scattered beams to collect data. Some of these beams are inelastically scattered electrons and characteristic x-rays. Characteristic x-rays are used in chemical analysis by graphing the x-ray counts versus their energy; the resulting data is characteristic to different elements and compounds.





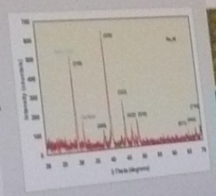


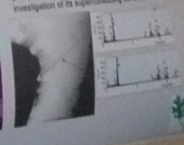
Chemical Analysis Results

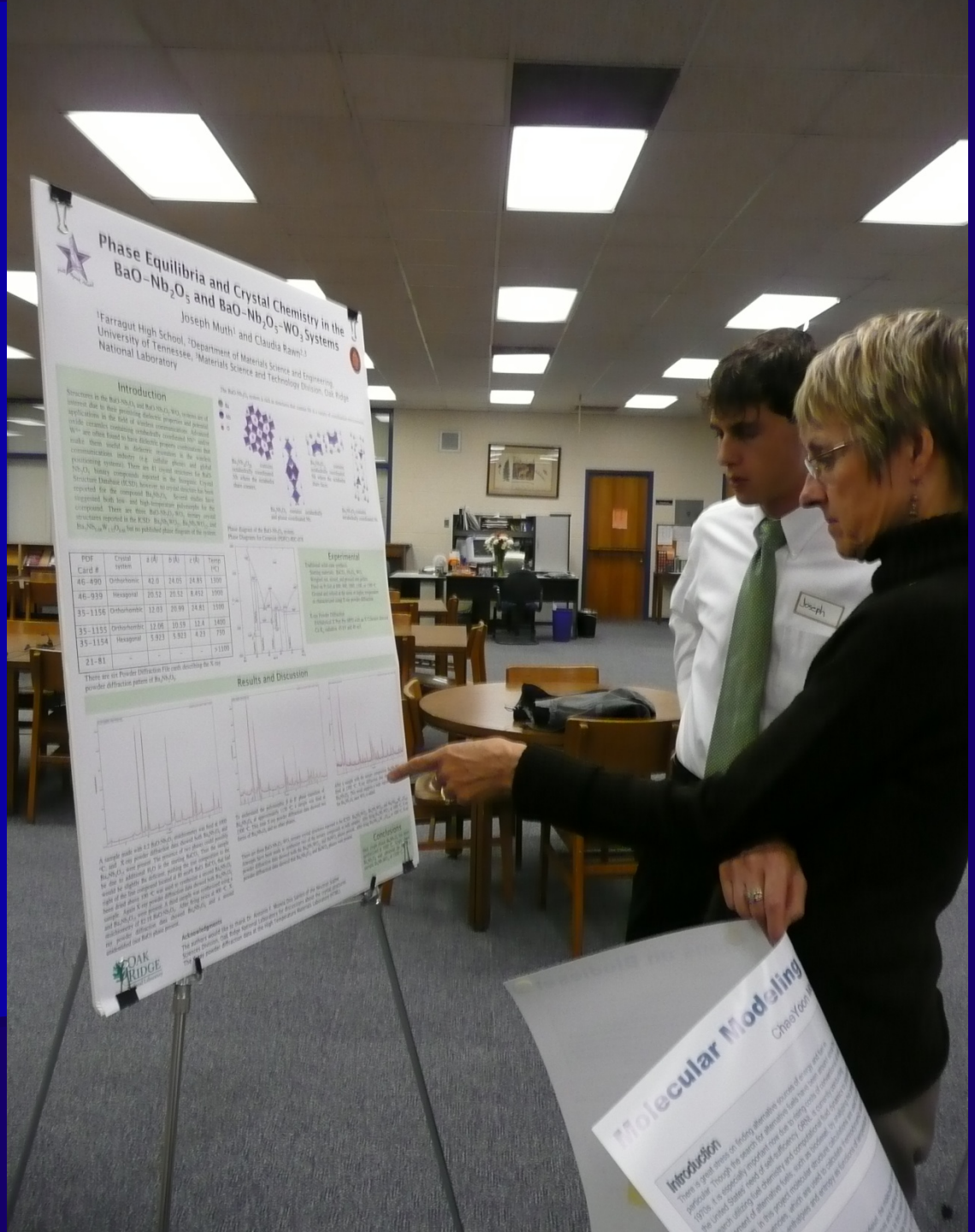
Carbon found within the sample appears either interstitially within the matrix or concentrated in the precipitates, the atomic concentration is 2 to 4% higher in the precipitates.

Oxygen is also present throughout the sample and according to EDS and XRD data, the oxygen formed as ReO_3. As seen in the chemical analysis to the left, the rhenium oxide is usually found adjacent to the larger carbon precipitates.

Although the rhenium to tungsten ratio is 3 to 1, the results conclude that the high concentration of carbon precipitates in the sample may interfere with the investigation of its superconducting behavior.






Phase Equilibria and Crystal Chemistry in the BaO–Nb2O5 and BaO–Nb2O5–WO3 Systems
Joseph Muth[1] and Claudia Rawn[2,3]
[1]Farragut High School, [2]Department of Materials Science and Engineering University of Tennessee, [3]Materials Science and Technology Division, Oak Ridge National Laboratory
Introduction
Results and Discussion
Experimental
Conclusions
Acknowledgments
OAK RIDGE
Molecular Modeling
Introduction

Min Kao Scholarship

Final Thought How do we test this?

- Will this improve our student's test scores?
- Should we stop the program because it will not improve our student's test scores?

- Do we really want to limit what our we teach our children to just what we can measure on a m/c test?

How Can You Help?

- Be a mentor
- Provide expertise for classroom projects and competitions
- Provide real-world applications
- Be a speaker
- Provide field trip opportunities
- Provide equipment/instrumentation

How To Get Involved

- Call a principal
- Call a teacher
- Register on vols4stem.org

What Do Students Have to Say?