2010

Math: When are we ever going to use this stuff anyway?

WiSTEM

Annual Report
The 17th annual Women in Science, Technology, Engineering and Mathematics (WiSTEM) Institute was held June 14-25, 2010 at Sinclair Community College. The Institute is designed to allow young women to explore career opportunities in science, technology, engineering and mathematics.

The Women in Engineering Technology (WIET) institute was established in 1993 under the direction of Dr. George Selt, former SME Dean, when a grant was acquired to enable females in grades 10-12 to explore the different areas of engineering technologies. In 2008, the Institute was re-named WiSTEM and focused on being more academically-oriented and assessment-driven, while the topics were expanded to include all areas of STEM that are represented at Sinclair.

Since the grant’s inception, the summer institute has been directed by the following SME faculty and staff:

• 1994: Harmit Kaur, Professor, Electronics Engineering Technology
• 1995-2007: Natalie Royer, Adjunct Faculty & CNC Machine Lab Technician, Computer Aided Manufacturing
• 2008-2009: Larraine Kapka, Associate Professor, Engineering Technology Design
• 2010: Kay Cornelius, Associate Professor, Mathematics

The 2010 program used the theme “Math! When Are We Ever Going to Use This Stuff Anyway? (Anytime, Everywhere).” Fourteen different technical blocks of instruction explored many of the ways that math is important throughout the various STEM-related career fields such as aviation, biology, chemistry, engineering, physics, psychology, and others. This year, for the first time, the Institute included an all-day field trip to the National Museum of the United States Air Force.

Funding for the 2010 WiSTEM Institute was provided by a Sinclair Board Designated Endowment Fund and the Science, Mathematics and Engineering division. A $25,000 budget allowed Sinclair to offer the two-week program at no cost to this underrepresented group of students. An additional $1000 was contributed by the Vectren Foundation.

The budget covered lab materials, the all-day field trip, food, and general supplies and services. Compensation for faculty, staff, and student counselors also came from this budget.

Planning & Recruiting

The WiSTEM Committee consists of female faculty and staff drawn from all areas of the SME division, as well as Computer Information Systems, Academic Foundations, and Psychology. Committee members determine the Institute theme and structure, conduct the marketing and recruitment campaign, develop the Institute activities and implement the program.

For 2010 recruitment, the target student population was restricted to young women entering the 10th, 11th and 12th grades. High school teachers received packets of information inviting them to nominate students who would be open to considering a career in a STEM field. A total of 26 applicants were accepted, with 23 completing the program.

The participants were divided into two groups, with each group assigned a full-time counselor who was a Sinclair student with a STEM major who also had experience working with teenagers. Counselors kept track of their students and made sure they moved safely around campus between activities. Participants filled out a detailed survey at the end of the program, which included questions on what they thought of the Institute in general as well as specific activities.

Marketing

Starting in late 2009, WiSTEM flyers and applications were distributed at various community high school and college events, such as the Women in STEM high school visitation program through Sinclair and the Miami Valley Tech Prep Consortium, and the Summer Camp Fair at PACE (Parents Advancing Choice in Education, Inc.). Informational letters describing WiSTEM and encouraging nominations of interested students were sent to approximately 350 individual teachers at 45 high schools in the Dayton area. Follow up calls were made and emails sent to the 20 teachers who indicated they planned to nominate students. A number of school principals and district superintendents were contacted directly to further encourage participation.
The Institute opened with a keynote address (see “Other Activities” page 7), which was followed by a campus tour led by Admissions office staff. For the 2010 program, 14 different labs explored the importance of mathematics throughout the many areas of STEM. Each block of instruction had a lesson plan designed to ensure that key concepts were covered. Associated labs allowed the participants to better appreciate the principles covered in the lecture material. A copy of the lesson plan format is included in Attachment A.

Each instructional block included a five question written assessment of the main points covered in the instructional block. Awards were given at the end of the Institute to the young women with the highest total assessment scores. Sinclair faculty and staff were responsible for conducting all of the sessions. Youth counselors were Nariman Issa, a Sinclair Aviation major and former WIET participant, and Suzanne Long, a Sinclair Mathematics major. They served as guides and mentors, took the participants to each activity, chaperoned the off-site field trip, and completed various other duties as necessary.

Lab Activities

Alternative and Renewable Energy

Instructor: Dr. Robert Gilbert
Participants examined watts, voltage and amperage, and how mathematic operations are required for determining watts produced by a light bulb. The lab also included an introduction to energy conservation through a comparison of incandescent and fluorescent light bulbs, as well as an introduction to the capability of solar PV for powering these light bulbs.

Architectural Design

Instructor: Mark Wiley
Working in teams, the students learned about building measurements leading to code analysis. They measured the area of the classroom they were in and discussed how they would measure an entire school with drawings provided. They then formulated their own questions concerning observations they made regarding the size of the classroom and school. Those questions were compared to real Building Code issues, such as size versus fire safety, and reasonable structure span, depth, and floor height.

Astronomy

Instructor: Lori Cutright
The participants used a celestial globe to see the way the sky looks from Dayton. They discussed changes due to the Earth’s rotation on its axis and its orbit around the sun. They also discussed constellations, rising and setting, and seasons. Half-painted ping pong balls were used to illustrate when phases of the moon are visible. The group also explored images online to better understand both lunar and solar eclipses and why eclipses do not occur every month.

Aviation Technology

Instructor: Donna Hanshew
Students were introduced to aerial navigation, including how pilots use compasses and account for Earth’s magnetic field. They each constructed a basic compass and experimented with it to understand how the compass rotates to align with Earth’s magnetic field. They were able to practice aerial navigation using a Personal Computer Aviation Training Device (PCATD) flight simulator.

Biology and Biotechnology

Instructors: Norma Hollebeke and Susan Luken
Participants were engaged in learning the ways in which ecologists collect and analyze data focusing on populations and communities of organisms. A planned outing to the Great Miami River to collect field data had to be cancelled due to thunderstorms. Instead, students were able to simulate the adventure in the lab, where they recreated a process known as “mark-recapture” used to estimate the size of large animal populations. They also collected data within a simulated community and learned how to determine species diversity, which is among the most calculated and cited of all ecological variables.

Chemistry

Instructor: Jane Myong
Working in groups, students mixed two different solutions at various concentrations, temperatures, and in the presence of catalysts to study the effects of these three variables on reaction rates. They graphed each of the data categories versus reaction time to better understand and visualize the relationships. Enzymes acting as catalysts in the human body were then discussed, as well as what food manufacturers might do to prevent food spoilage.
Physics

Instructor: Lalitha Locker

Students determined the net upward force necessary to make a helium balloon rise a specific distance. They made several calculations involving a balloon with an attached string and paper clip, and found the mass of a known object as well as the mass of the balloon. They also found the area density of construction paper to be added in order to have a slow rise of the balloon. The students finished by racing the balloons to determine whose would win by being the slowest.

Psychology

Instructors: Jennifer King-Cooper and Anne McCrea

Participants were exposed to various concepts of descriptive statistics, including sample distribution, mean, standard deviation, and z score. While working with a real sample of M&M candies, they constructed a frequency histogram by color using their sample, and then collectively calculated the z score for determining the population parameters of M&M colors. A second activity touched on inferential statistics and introduced the concept of comparing means for significance by using height in inches as a comparison between 9th and 10th graders versus 11th and 12th graders. The hypothesis was identified, data was collected, and the t ratios were collectively calculated. The critical t value was then used to determine the significance of the outcome.

Instructor: Bill Krebs

Students learned about several surveying principles of leveling, such as calculating the height and elevation of benchmarks and turning points. They also learned the importance of recording data and calculations in a field book. Each student then had the experience of rotating positions in the field and leveling the instrument within two minutes, being the rod person, sighting the rod and reading the numerical value, and keeping their own field book.

Computer Aided Manufacturing

Instructor: Natalie Royer

Students learned that defining points for computer numerical control (CNC) machines are based on the Cartesian coordinate system. They looked at X, Y, and Z axis polarities and locations. They also learned about lab safety, tooling used in the machines, and how cutting speeds (spindle RPM’s) and feed rates are calculated. Each student machined a personalized nameplate from aluminum, which they took home with them.

Cryptology/Graph Theory

Instructors: Najat Baji, Ed Gallo, Kinga Oliver, Marie Stroh

This lab involved the participants in exploring two important applications of mathematics not commonly considered: cryptology and graph theory. Students particularly enjoyed the cryptology portion where they used matrices introduced with a graphing calculator to both encode and decode mystery messages. They also solved various graph theory problems including the Konigsberg Bridge problem, the traveling salesman problem, and various Euler paths and circuits, while learning how such concepts can be applied to modern real world problems.

Electronics

Instructors: Lynden McIntyre and Tillie Watts

Students learned the basics of soldering, including component placement and recognition, and schematic symbols. They were given a printed circuit board and the parts for the designated activity. After a short overview of soldering and electronic parts recognition, they placed the parts on the board correctly and soldered everything into place to create a working project. This project was then used to assemble data for finding probabilities and percentages. It was also a great game which they were able to take home.

Mathematics in Art

Instructors: Diana Leakis and Marie Stroh

After an introduction of each topic, participants created art projects representing the Golden Ratio, modular arithmetic, and tessellations. Tessellations in particular proved to be popular with the group.

Instructors: Jennifer King-Cooper and Anne McCrea

Participants were exposed to various concepts of descriptive statistics, including sample distribution, mean, standard deviation, and z score. While working with a real sample of M&M candies, they constructed a frequency histogram by color using their sample, and then collectively calculated the z score for determining the population parameters of M&M colors. A second activity touched on inferential statistics and introduced the concept of comparing means for significance by using height in inches as a comparison between 9th and 10th graders versus 11th and 12th graders. The hypothesis was identified, data was collected, and the t ratios were collectively calculated. The critical t value was then used to determine the significance of the outcome.

Instructor: Bill Krebs

Students learned about several surveying principles of leveling, such as calculating the height and elevation of benchmarks and turning points. They also learned the importance of recording data and calculations in a field book. Each student then had the experience of rotating positions in the field and leveling the instrument within two minutes, being the rod person, sighting the rod and reading the numerical value, and keeping their own field book.
Opening Address

Presenter: Sandy Feola
The Institute opened with a brief talk by Sandy Feola, Customer Engagement Manager at the National Center for Manufacturing Education (NCME). Sandy has been an independent professional quality engineer in the Dayton region since 2004, providing consultation and training to a variety of manufacturing and service organizations, with a focus on performance improvement initiatives in their quality systems. Over the past 25 years, she has held engineering, contract support, and management roles with various companies. After her introduction, Sandy encouraged student participation and team building by weaving into her program current topics in the news to which students could relate.

Field Trip

Organizer: Shan Huang
New to the program this year was a full day field trip to the National Museum of the United States Air Force. The morning started with group photos at Sinclair with all participants wearing their WiSTEM 2010 t-shirts, after which the group departed by bus for the museum. Once on the museum grounds, a guide on the bus gave an overview of the museum and discussed the importance of a solid background in mathematics and the sciences when considering a career in aviation. The group was then able to explore the Presidential and Research & Development galleries on the controlled-access portion of Wright-Patterson Air Force Base. After lunch, the participants toured the Early Years and Modern Flight galleries with guides who were aware of WiSTEM 2010’s focus on mathematics. Everyone then saw the impressive IMAX film about the Hubble space telescope, after which they returned to Sinclair.

Panel on College Success

Panelists: Nariman Issa, Amity Jetton, and Suzanne Long
During the first Friday of the Institute, Amity Jetton from Academic Foundations, and Nariman Issa and Suzanne Long, who were both college students and WiSTEM 2010 counselors, formed a panel with the goal of increasing the participants’ awareness of what it takes to prepare for and be successful at college. Each panelist gave an individual presentation including tips, and afterward took questions from the audience. A variety of college level texts, syllabi, and homework was on display for participants to examine.

Professional Presentation

Presenter: Linda Moore
Also on the first Friday, Linda Moore of the Air Force Research Laboratory at Wright-Patterson Air Force Base came to Sinclair to speak to the group. She is currently working toward her Ph.D. in electrical engineering and her research interests include radar signal and image processing. Her PowerPoint presentation covered many fields of engineering and areas of academic study, their impact on our lives (past, present, and future), and income ranges.

Financial Aid Presentation

Organizer: Amity Jetton
On the last day of the Institute, Sinclair’s Financial Aid office provided interested parents with a presentation.
Hands-on experiments and projects, some made to take home, provided the students a multifaceted opportunity to learn about the importance of mathematics and many nontraditional career opportunities. The program typically attracts two kinds of students: those who know that they want to enter a STEM field, but are not sure what discipline they would enjoy, and others who are not sure what STEM entails. Whether or not a student chooses a STEM field as a career, the Institute participants gained an understanding of careers and terminology that will help them throughout their lives. Students also increased their confidence in their ability to solve problems and learn new things.

**Poster Presentations**

**Presenters:** Institute Participants

The participants were divided into four groups during the last morning of the Institute and given time to look through all the photos taken during the two-week event. Each group then selected their favorite and most representative images of their total WiSTEM experience. Using these images, markers, colored paper, and other craft supplies, each group created a unique and colorful poster for display during the closing luncheon.

**Closing Program**

Parents, faculty, staff, and Sinclair administrators were invited to a luncheon on the last day of the Institute. Dr. Helen Grove, Senior Vice President and Provost of Sinclair, spoke to the group about keeping their career options open by continuing to take mathematics and science courses in high school. Kay Cornelius, WiSTEM 2010 Director, presented awards to young women who excelled during the week in assessments. All students received certificates of participation, and faculty and staff participants were recognized with certificates of appreciation. During the luncheon, the posters created by the participants were on display for all to admire. Before leaving, the students were asked to complete an evaluation questionnaire (see Attachment C).

**Thank You!**

The dedication of many people is required in order to make the WiSTEM Institute happen. Department chairs, faculty, staff, administrators, Sinclair students, parents, and the high school students themselves all strive to make the two-week program an enjoyable and rewarding event. Many thanks are extended to the Sinclair Board of Trustees; the Science, Mathematics and Engineering division; Dr. George H. Sehi, former dean of the Science, Mathematics and Engineering division; the WiSTEM committee; faculty and staff who facilitated the laboratory workshops and experiments, as well as those who worked behind the scenes before, during, and after the Institute; and the youth counselors and the volunteers who chaperoned our off-campus field trip. Thanks are also extended to the high school teachers and counselors who participated in recruitment. Sinclair Publications, Campus Police, and Aramark Food Service. A special thanks to Karen Butcher of the Physics department who provided significant administrative support.

**Future Recommendations**

The WiSTEM committee recognizes that during the 17 years this program has been in existence, the Dayton area’s demographics and summer opportunities for high school students have changed significantly. Efficient and effective marketing has become a major challenge. The committee is now in the process of exploring other promising ways to reach and recruit our target audience, as well as more effective formats for the Institute itself.
Lesson Objectives:
The objective is showing how Mathematics is used in the fields of Architecture and Engineering.

Outline of Lesson Topics:
1. Introduce instructor(s) and background
2. Introduce topic and tie to mathematics theme
   - The topic will be Building Measurement and how it leads to Code Analysis (Architecturally) and Systems Analysis (Mechanically and Structurally)
3. List main ideas to be covered
   a. How do you measure (area wise) the classroom we are in? Teams
   b. What observations do you have about this classroom? Do they lead to mathematical type questions? Teams
   c. How do you measure an entire School? (Drawings Provided)? Teams
   d. What questions do you have relative to the size of the subject school? Teams
   e. The Building Code lends answers to the mathematical questions (Sections Provided)
   f. Revit Program will be introduced as a tool for Codes (Architectural) and Systems (Mechanical and Structural) mathematics issues.
4. Students will work in teams to measure and do Building area calculations. Then they will formulate their OWN questions. Then these questions will be compared to real Code and Systems issues. For instance, when does a Building start to get too big for its own safety (fire)? What is a reasonable span for structure? What is a rule of thumb for structure depth? How does that affect floor height?
5. The Building Code and Revit will be used as tools in considering these issues. Additionally, what abstract ways can you think of to measure a building. For instance, how can you determine a façade width with only a photo. How can you measure a Building or room without tools? What new tools are available to do the task?
6. Summarize main points of lesson, again weaving in the mathematics
7. Complete assessment tool

Hands-on Activities:
Building measurements and observation (volumetrically)
<table>
<thead>
<tr>
<th>Statement</th>
<th>Definitely disagree</th>
<th>Somewhat disagree</th>
<th>Undecided</th>
<th>Somewhat agree</th>
<th>Definitely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>After attending this institute, I feel I know more about the importance of mathematics and how it is valuable in many different careers.</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After attending this institute, I am more confident that I can handle college</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am planning on attending college</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am interested in earning a 2-year degree</td>
<td>4 1 4 2</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>I want to earn a 4-year degree</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am interested in a career in a STEM field</td>
<td>1 3 6 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am familiar with Sinclair Community College</td>
<td>2 9</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to live on campus during college experience</td>
<td>6</td>
<td>8</td>
<td>2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I expect to pay for most or all of my college education myself</td>
<td>4 5</td>
<td>4 4 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I already know where I want to go to college</td>
<td>1 5</td>
<td>9 6 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will require substantial financial aid and student loans to be able to afford to go to college</td>
<td>3 4 1 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial considerations will require me to attend a community college for my first two years of college</td>
<td>5 3 7 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am considering attending Sinclair Community College for my first year or two of college</td>
<td>4 7</td>
<td>4 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please rate the sessions listed below:

- Opening Speaker
- Team Building Activity first morning
- Quality of Field Trip to Air Force Museum
- Friday Speaker and Panel
- Quality of Faculty and Staff Labs
- Overall Institute

Select the best answers for this question (all that apply):

- Nominated by a teacher
- Heard about it from a friend
- Parent heard about it
- I wanted to attend
- Parent made me attend

How did you find out about this program? (Select all that apply):

Feel free to write any additional comments here: