

**Testimony to the Kansas Senate Ways and Means Committee**  
**Submitted by Zulma Toro-Ramos**  
**Dean College of Engineering, Wichita State University**  
**1/24/2012**

Good morning Madame Chair and honorable members of the Kansas Senate Ways and Means Committee.

**Introduction**

Thank you for the opportunity to testify and share with you the progress achieved by Wichita State University (WSU) College of Engineering (CoE) on the implementation of Senate Substitute for House Bill No. 2014, the Engineering Expansion Grants (EEG), and the House Substitute for Substitute Senate Bill No. 127, the University Engineering Initiative Act (UEIA).

I would like to express my appreciation to this committee for your support of the Engineering Expansion Grants which provide \$333,333 to each of the three Kansas colleges of engineering for fiscal year (FY) 2012 and the University Engineering Initiative Act that allocates \$3.5 M per college per year for ten years starting in FY 2013. Your leadership and vision have set an example in our nation. Our industry partners in the state shared the imperative of growing the engineering workforce in Kansas. Your response, in collaboration with Governor Sam Brownback, to the industry's message was to develop and fund legislation to grow the engineering talent needed by the state of Kansas. The University Engineering Initiative Act will provide our state with 1,365 engineering graduates per year by 2021. Research shows that the availability of the required engineering workforce by industry is not only a key factor in keeping companies in the state and maintaining their competitiveness in today's global economy; but it is a determining factor in attracting new companies to the state.

I would like to thank you as well for enabling the WSU College of Engineering to transform itself into a leader in Experience-based engineering education. This work started over six years ago, however, the approval of House Substitute for Substitute Senate Bill No. 127, the University Engineering Initiative Act, motivated us to go through an accelerated self-assessment and comprehensive planning process to increase by 60 percent the number of engineering degrees awarded by our college. Furthermore, these graduates should be productive engineers the first day they start working.

It is important to note that working with the Kansas Department of Commerce Secretary, Pat George, his team and the Kansas Board of Regents in the implementation of the Engineering Expansion Grants and the University Engineering Initiative Act has been a very positive experience and productive process. It has allowed us, at WSU, to understand how we can better and more effectively impact economic growth and wealth creation and how we can leverage the College of Engineering resources to support these activities beyond the University Engineering Initiative Act.

The WSU College of Engineering has a strong tradition of supporting business and industry needs for learning, exploration and research. Beginning in 1928, the first degree program of the CoE was established in response to the local aviation industry needs. Today, the CoE has a systematic corporate engagement program that is rooted in the College's Vision Statement that follows.

*The College of Engineering at Wichita State University will be recognized nationally and internationally for its:*

**Senate Ways and Means**  
**Date: January 24, 2012**  
**Attachment: 1**

- *Experience-based undergraduate and graduate degree programs;*
- *collaborative efforts with industry;*
- *and research programs to support the economic development and global competitiveness of the Wichita metropolitan area, the state of Kansas, and the nation.*

In response to the Engineering Expansion Grants and the University Engineering Initiative Act, WSU CoE plans to address the need for engineers in Kansas industries through effective programs that recruit, retain and place engineering students in Kansas companies. The College will use the once in a lifetime engineering education investment provided in the University Engineering Initiative Act strategically over the ten-year funding horizon. In FY 2012, the College has been simultaneously planning, beginning and expanding implementation of identified best practices to address the workforce needs of Kansas companies.

This testimony outlines WSU CoE strategies to achieve the proposed increase in number of degrees awarded while elevating WSU to be a Center for Excellence in Experience-Based Engineering Education and Research through an Integrated Engineering Education Model. In this model, research and discovery inform teaching; teaching involves service or community/industry engagement; and service shapes and informs research and discovery. The planning process used by the College which involves a diverse group of stakeholders with the goal of achieving the organizational transformation required in this case will be described. Further, the specific activities under implementation for FY 2012 along with some preliminary results will be presented. A description of the road ahead for FY 2013 and beyond will also be described.

### **Planning Process**

In FY 2006, the CoE began a strategic planning process with all constituent groups, intending to transform the WSU CoE to become the program of choice for students who are serious about engineering education and interested in taking advantage of the College's model for an integrated Experience-based education program of study. The strategic planning process resulted in the development of Strategic Objectives for the College which were approved by faculty and the Industry Advisory Board.

In FY 2011, the progress made toward Strategic Objectives goals was assessed. The program metrics demonstrated that significant progress toward accomplishing the goals had been made, and the analysis confirmed that the strategic goals remain relevant.

In FY 2012, the CoE extended its strategic initiatives to examine the feasibility of meeting the University Engineering Initiative Act objectives and Foresight 2020, the Kansas Board of Regents Strategic Plan. A data-based model with reference to national statistics and evaluation of peer institutions was developed. As a result of this analysis, it was determined that the WSU CoE can, with sufficient resources, accomplish the goals of the University Engineering Initiative Act.

Site visits have been conducted, with interdisciplinary faculty delegations visiting engineering colleges recognized for significant development and or institutions that have recently transitioned to new pedagogical models.

An accelerated self-assessment and comprehensive planning process involving Strategic Action Teams was established and empowered to evaluate evidence-based dynamic designs that provide multiple alternatives and scenarios to achieve the required increases in engineering degrees while transforming WSU College of Engineering into a leader in Experience-based engineering education. A multi-team strategy has involved more than 45 percent of the faculty, multiple staff members, industry representatives, as well as five student volunteers. The action teams include: 1) Curriculum/pedagogy, 2) Student recruiting/retention, 3) Undergraduate student advising, 4) Recruiting, Retaining, and Developing effective faculty, and 5) Organizational structure.

The action teams have completed the Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis of the College to achieve the University Engineering Initiative Act goal. Along with this analysis, faculty and staff productivity has been reviewed and teaching laboratory facilities utilization has been examined. The technology infrastructure has been assessed. Strategies for shared laboratory space have been developed, and proposals for additional teaching laboratory space short and long-term were made to the University. Also, success indicators and milestones have been established using baseline data and the required data collection systems have been identified and defined.

A new Center for Student Success has been established that integrates multiple student support systems. Furthermore, a student-centered college structure is being implemented.

Additional findings of the Strategic Action Teams will inform and determine the strategic initiatives and activities to be implemented in FY 2013 with the goal of achieving the established milestones.

### **Strategies and Activities**

The CoE at WSU has been involved in two main strategies to increase the number of domestic students pursuing engineering degrees, namely, exciting more elementary, middle and high school students performing well in math and science to select engineering as their career choice and to better prepare students who are not doing well in math and science so they can also opt for engineering as a career choice. An array of programs has been employed by the College in the implementation of these strategies to broaden participation in engineering including: **Project Lead the Way (PLTW)**, **Science and Engineering Educational Development for Students (SEEDS)**, **Boosting Engineering, Science & Technology (BEST)**, **SHOCKER MINDSTORMS**, **Engineering Summer Camps**, and **Changing Faces**. This array of programs has been highly effective for WSU College of Engineering which has experienced a 59 percent increase in undergraduate enrollment between Fall 2005 and Fall 2011.

According to the engineering education literature, engineering students tend to drop out of college primarily in the first two years due to: 1) limited engineering involvement in the first two years and 2) student difficulty with calculus and physics. Based on these facts, the CoE at WSU has implemented the **Great Expectations: Engineering Kansas Scholars (GEEKS)** and **Engineer 2020** programs to address the student-retention issue.

With the goal of increasing the number of degrees awarded by nearly 60 percent by the year 2021 and building on the foundations in place as described above, WSU CoE will implement a plan based on the following three strategies:

1. Engineering the engineers of tomorrow - - Expand efforts and programs to build and strengthen the pipeline or supply chain of students interested in pursuing engineering careers, this will involve motivating and preparing them for the rigor of an engineering academic program.

Three activities are being implemented in FY 2012 as part of this strategy, namely, revision and development of new articulation agreements with area and state community colleges, expansion of programs aimed at broadening participation in engineering and implementation of new scholarships programs with support from individual donors, private industry, Sedgwick County, and the federal government.

I am pleased to inform that by the end of the Spring semester we will have completed the revision or the development of at least four articulation agreements. As part of the expansion of the programs to broaden participation, in Summer 2011, seven camps were offered including a residential camp for middle school students from Western Kansas. Since 2007, almost 1,000 students have participated in the engineering summer camps. In Fall 2011, 150 students attended free workshops that included building and programming robots; designing video games; creating computer animations, and designing and building roller coasters. This year the pre-Engineering program, PLTW, is being offered in 28 high schools, 30 middle schools and one elementary school in Kansas. Teachers receive two weeks of training during the summer on the WSU campus. The USD 259 School District Career and Technical Education Newsletter, included as Exhibit I in this testimony, is evidence of the success of the PLTW program. As part of the Fall 2011 BEST competition and the SHOCKER MINDSTORMS pre-competition, over 500 high school students, and 300 middle and elementary school students, respectively, were hosted by the College. Additionally, over 2,000 students were hosted on campus and at school sites with hands-on demonstrations to stimulate interest in STEM as part of other programs to broaden participation offered by the College. College staff has visited twelve targeted high schools across the state meeting with near 1,200 students. In terms of scholarship programs, ten new programs have been established since the approval of the University Engineering Initiative Act by the Kansas Legislature.

2. Augment the student success programs aimed at retaining and graduating the students in a timely manner.

As part of this strategy the College is implementing seven activities during FY 2012 which include expanding the GEEKS program, growing the Persistence in Engineering program, the implementation of a new bridge program for first-year freshmen, redesigning the first-year engineering course to include more experience-based learning activities, implementing a new program aimed at engaging freshmen with engineering early in their academic program, requiring the Certificate in Engineering Education for graduate teaching assistants, and restructuring the student advising system.

In Fall 2011 participants in the GEEKS program received over 400 hours of free tutoring in courses ranging from chemistry and calculus to statics and thermodynamics; students learned from individual and group settings or in open study sessions in the tutoring lab. In addition, 60 engineering students are now part of an engineering community as a result of an "engineering floor" that was established in the residence hall. This has increased opportunities for students to socialize and study with other engineering students. All at-risk freshmen in the College are participating in the Persistence in Engineering Program this semester.

Funding has been secured from the Federal Government for the College to offer in August 2012 the first summer bridge program. Thirty first-semester freshmen will move into the university residence hall 10 days before other students arrive. They will get a jump start on their education at WSU by participating in activities including academic refresher sessions in key subject areas, study skills workshops, team building

exercises, hands-on engineering projects, and many opportunities for building networks and relationships with peers, faculty, and staff. The redesign of the first-year engineering course has been completed and now it includes more hands-on components where students work in teams to design, build, test and demonstrate their project. These projects are demonstrated to the public at science museums and other public events. Furthermore, this academic year the College is running a pilot program in which the two physics courses required in the engineering curriculum are been offered by engineering practitioners. As it was mentioned before, a Center for Student Success has been established and the student advising process is now a shared responsibility between the center and the faculty.

3. Expand our Engineer 2020 program and experience-based education approach with the objective of developing in all of our students the knowledge and skills that will prepare them to be productive engineers the first day they start working.

Eight activities are under implementation in FY 2012 as part of this strategy including launching the new Engineering Technology program, strengthening the College technical support, increasing co-op and internship opportunities, growing student curricular and extra-curricular leadership opportunities, expanding the Global Design Challenge, implementation of an undergraduate research program for both at-risk and high performing students, implementation of curriculum revisions based on industry needs and allocating faculty fellowships to increase and accelerate the integration of experience-based pedagogical approaches into the curriculum.

The first group of students has been admitted to the Engineering Technology program. Work is underway with multiple new industry partners to offer co-op or internships opportunities to our students starting this semester. New programs in partnership with the National Institute for Aviation Research (NIAR) and the WSU Cisco Support Center have been established. Over \$1.8M has been secured in federal funds to support experience-based learning or co-op and internships opportunities for our students. Additional physical infrastructure is under development to expand the extra-curricular leadership opportunities associated with the Mini-Baja and Formula SAE car groups. In terms of curriculum revisions inspired by industry needs, work is in progress with an aviation company in town to identify the competencies and body of knowledge required for graduates to have a successful long-term engineering career with that organization.

The cost of implementing the FY 2012 plan presented above is over \$2M; \$333,333 of this cost will be funded by the Engineering Expansion grant awarded to the WSU College of Engineering.

### **Partnerships for Resource Leveraging**

Since the approval of University Engineering Initiative Act, less than a year ago, the WSU College of Engineering has been able to secure over \$9M in matching funds for this initiative. Individual donors, industry partners and private foundations have contributed near \$2M, Federal Government grants are the source of \$6.28M, and new tuition dollars account for over a \$1M. This speaks to the power of the strategy that the Kansas Legislature is using in the University Engineering Initiative Act, leveraging state dollars with private, federal and new tuition dollars.

Over \$800,000 of near \$2M from donors, industry partners and private foundations will go to student scholarships; the balance will support programmatic initiatives. The Federal Government grants sponsored by the Department of Commerce Economic Development Administration (EDA), the Employment and Training Administration (ETA) of the Department of Labor, and the Small Business Administration (SBA) will support student tuition, scholarships, industry internships or experience-based



learning positions for students, articulation agreements with community colleges, curriculum development, faculty fellowships for industry collaboration, student involvement in technology transfer from the research laboratory to the market, among others. The new tuition dollars will be used for physical infrastructure improvements and faculty capacity expansion.

We are confident that WSU College of Engineering will be able to raise the \$36M in matching required for the eleven-year initiative.

### **The Road Ahead**

Based on the data-based mathematical model developed by the Strategic Action Teams to reach the goal of the University Engineering Initiative Act, a 10 percent increase in student participation in the College main recruitment event, the Wallace Invitational Scholarship Event, seven percent increase per year in the number of new freshman engineering students and 20 additional new students per year are required. I am happy to inform that the attendance to the Fall 2011 Wallace Invitational was up 33 percent from last year, an increase of 70 new admits for Fall 2012 as compared to Fall 2011 has been reported and for the first time in the history of our College, 100 percent of the elite students offered the most prestigious scholarship in the College, the Wallace Scholarship, for Fall 2012 have accepted.

It is evident that the preliminary indicators show that the programs in place to attract students to our College are working. However, the effectiveness of every program in place, and implemented in the future, to build and strengthen the pipeline and supply chain of students as well as the programs for student success will be assessed as part of a continuous improvement process used in the College.

Metrics such as number of co-op and internships opportunities offered to our students as well as how many of these are converted to permanent jobs with Kansas companies are among the metrics we will be using to assess the effectiveness of our experience-based engineering education approach. Further, companies will be asked to provide information regarding the length of time our graduates require to become "productive engineers."

The planning process described earlier shows that WSU College of Engineering is using the opportunity provided by the University Engineering Initiative Act to transform itself and develop an organization in which student success is the guiding principle of everything we do. This principle will determine the type of faculty hires to be made when adding capacity to the College. The outcome of the assessment process along with the strategic directives and responses developed by the Strategic Actions Teams will determine the path of the road ahead in our journey to achieve the goals of the University Engineering Initiative Act.

### **Closing**

In closing, I would like to once again thank this committee for the support of the Engineering Expansion Grants and the University Engineering Initiative Act. I would also like to leave you with a simple message, the Wichita State University College of Engineering in collaboration with the Kansas Department of Commerce, the Board of Regents, the Kansas State University College of Engineering and the University of Kansas School of Engineering, supported by your committee, the Kansas Legislature and Governor Brownback, will help Kansas to meet key challenges of the new KNOWLEDGE economy by developing the engineering talent and connecting higher education more closely to industry needs and economic development. Research has shown that engineering creates wealth and is a DRIVER for

economic development; Wichita State College of Engineering will focus our efforts to grow and strengthen the engineering workforce in Kansas.

Thank you.

# EXHIBIT I





Featuring...  
**the ENGINEERING &  
APPLIED MATHEMATICS  
career pathway, offered at  
five Wichita high schools.**

## CTE Staff

### Jim Means, Executive Director

- Carl Perkins Grant
- New Pathway Development
- Emergency & Fire Management Services
- Health Science

### Eldon Chlumsky, Teaching Specialist

- Construction
- Design & Preconstruction
- Engineering & Applied Mathematics
- Manufacturing Production
- Mobile Equipment Maintenance
- Visual Arts: Graphic Design

### Marla Hayden, Teaching Specialist

- A/V Communications
- Business Entrepreneurship & Management
- Business Finance
- Marketing
- Network Systems
- Programming & Software Development
- Web & Digital Communications

### Cathy Mong, Teaching Specialist

- Consumer Services
- Early Childhood Development & Services
- Family & Community Services
- Restaurant & Event Management
- Teaching/Training
- Visual Arts: Interior & Textile Design

### Diann Fassick, Career Facilitator

- Rigorous Programs of Study Partnerships
- College Career Readiness Standards
- Credit Transfer Agreements
- Guidance, Counseling & Academic Advisement

## Partnerships strengthen CTE engineering

Strong partnerships with postsecondary institutions, and business and industry are critical in making CTE programs relevant and powerful experiences for students. The Engineering and Applied Mathematics pathways in USD 259 have definitely benefited from strong partnerships with the Wichita State University (WSU) College of Engineering, the Wichita Society of Professional Engineers, and the John S. and James L. Knight Foundation.

### WSU's College of Engineering

Dr. Zulma Toro-Ramos, WSU's dean of the College of Engineering, has been an advocate for secondary engineering education in Kansas and USD 259. With the support of Dr. Larry Whitman, WSU director of engineering education, USD 259 has become a state leader in Project Lead the Way (PLTW), a nationally recognized engineering curriculum for middle and high school students. WSU functions as the affiliate university for Kansas and provides the intensive training that teachers must successfully complete before delivering the PLTW curriculum.

On Monday, April 23, 2012, WSU's College of Engineering will host the sixth annual Engineering Design and Development (EDD) Scholarship Competition for PLTW students. The competition is part of the engineering capstone course, "Engineering Design and Development," in which students work in teams to develop a solution to an open-ended engineering problem. WSU will offer renewable scholarships to members of the first, second and third place teams who enter one of WSU's College of Engineering programs in Fall 2012. The scholarships are in addition to other scholarship offers a student might receive from WSU.

At the same time as the EDD competition, middle and high school students from other PLTW classes will exhibit their engineering projects to be judged by a panel of industry professionals and engineering educators.

### Wichita Society of Professional Engineers

The Wichita Society of Professional Engineers (WSPE) has been an avid supporter of PLTW in USD 259 over the years. Members include consultants, professors, former University Deans, and government engineers.

WSPE members were involved when the program advisory committee for engineering education in USD 259 was created and their support continues to help strengthen the program. Presentations by PLTW students at WSPE chapter meetings are hosted annually, members visit classrooms to talk to students about the field of engineering, and the organization participates in the annual high school career fairs.

Members of WSPE have also served on the South Central Kansas PLTW Committee and served as judges for engineering design competitions.

### John S. and James L. Knight Foundation

The computer technology and equipment used in delivering engineering education is expensive and during a time of declining educational budgets, the costs to expand the engineering program in USD 259 were prohibitive. In 2008, the John S. and James L. Knight Foundation awarded a \$2 million grant to WSU to help expand engineering education in Sedgwick County.

"Knight Foundation is investing in PLTW for its proven approach to help schools and teachers have the tools needed for students to succeed in science, technology, engineering and math courses," said Anne Corriston, Knight Foundation program director when the financial award to WSU was announced.

The financial support of the Knight Foundation

See **PARTNERSHIPS**, page 2

Get in Middle Schools, p.2  
Courses, Curriculum, p.4  
Student Feature, p.5



### Did You Know?

Preparation in early grades followed by a high school curriculum of high academic rigor is crucial to ensuring equal opportunity in the sciences at the college level and beyond.

American Association of University Women, 2007

### CTE Update

The CTE Update is a monthly publication of the Wichita Public Schools' Career and Technical Education office.

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Jim Means ..... Executive Director  
Carla Davison ..... Editor

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## PARTNERSHIPS, from page 1

and other grant dollars from the U.S. Department of Labor, also managed by Wichita State University, provided the significant funding needed to bring engineering education in USD 259 to its current level.

PLTW is now offered in every Wichita middle school and at five high schools. Literally

thousands of students are benefiting every year from these partnerships through courses that offer active and hands-on learning about engineering.

## CTE sparks early interest in STEM through GTT curriculum in middle schools

Gateway to Technology (GTT) is a Project Lead the Way (PLTW) program which features curriculum designed to challenge and engage the natural curiosity and imagination of middle school students.

in the Science, Technology, Engineering and Mathematics (STEM) field in high school and beyond.

### GTT curriculum

The GTT curriculum is taught in the Explorations in Technology 2 and 3 classes in all Wichita middle schools and includes four nine-week modules—The Science of Technology, Design and Modeling, The Magic of Electrons, and Automation and Robotics. Students envision, design and test their ideas with the same advanced modeling software used by companies like Lockheed Martin, Intel and Sprint. They study mechanical and computer control systems, and think robotics and animation. Students also explore the importance of energy, including innovative ways to reduce, conserve and produce it using solar, thermal and wind power. The knowledge that students gain and the skills they build from GTT create a strong foundation for further learning

### USD 259 implementation

The Wichita school district first implemented GTT at seven middle schools in the fall of 2009, expanding to all middle schools in the fall of 2010. The project has been funded by the John S. and James L. Knight Foundation, a U.S. Department of Labor grant, and Kansas State Department of Education school intervention funds.

"GTT curriculum is designed to appeal to all students," said Eldon Chlumsky, teaching specialist for the STEM career cluster. "Research shows that the hands-on, project-based curriculum reaches students who already have an interest in STEM-related fields, as well as those who are uninterested in traditional science and math classes."

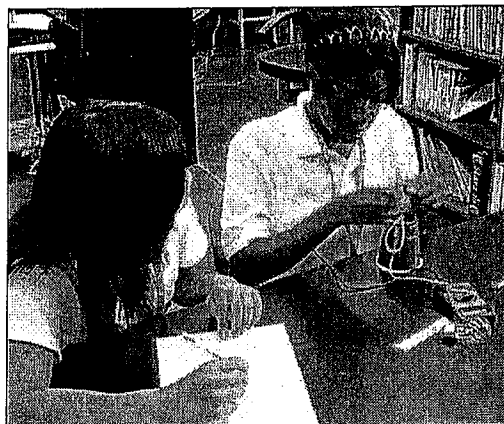
Before teachers can deliver the GTT curriculum, they must become certified by completing two weeks of rigorous and intensive training.

### Encouraging a non-traditional path

"Engineering is considered a non-traditional field for women, so part of the GTT goal is to help middle school girls get excited about the STEM fields and to expand their awareness of the career opportunities that exist for them," said Jim Means, CTE executive director.

Last year, Sherri Molde, who teaches Explorations in Technology classes at Hadley Middle School, was able to work with WSU's Society of Women Engineers to coordinate visits of an MIT team of female engineering students to several middle schools. "It seemed to really open the eyes of a lot of girls," said Shane Koranda, technology teacher at John Marshall Middle School.

(source: PLTW website)



Middle school girls in the Explorations in Technology 3 class learn about electrical resistance using a digital multi-meter. (Photo by Jim Means)

Choose Your Pathway  
Choose Your Future  
Choose CTE



# Engineering and Applied Mathematics courses

**E**ngineering and Applied Mathematics courses utilize Project Lead the Way (PLTW) curriculum which applies and concurrently develops secondary level knowledge and skills in biology, physics, technology, and mathematics.

## ► Introductory Level

### Explorations in Technology 3 (8th grade)

Students work with cutting edge technologies to familiarize themselves with concepts, tools, and technologies that improve the quality of life, environment and society.

## ► Technical Level

### Principles of Engineering

Principles of Engineering is a broad-based survey course to help students understand engineering and engineering technology, and to explore career options. Theoretical and hands-on problem solving are emphasized.

### Introduction to Engineering Design

Introduction to Engineering Design is designed to develop students' problem solving skills, with emphasis on visualization and communication skills using a computer and 3-D solid modeling software.



## ► Application Level

### Digital Electronics

Digital Electronics is a course of study in applied digital logic, using electronic logic circuits that first are designed and then tested using the latest computer digital-logic modeling technology.

### Computer Integrated Manufacturing

Computer Integrated Manufacturing builds on skills in computer modeling design and exposes students to fundamentals of computerized manufacturing technology. The course covers prototyping, CNC equipment, CAM software, robotics, and flexible manufacturing systems.

### Civil Engineering & Architecture

Civil Engineering and Architecture is an overview of the fields of civil engineering and architecture, the course emphasizes the interrelationship and dependence of both fields. Topics include the roles of civil engineers and architects, project planning, site planning, building design, and project documentation. values, and goals. Other units cover contracts, housing, commercial paper, property and bailment.

### Aerospace Engineering

Aerospace Engineering students apply math, reading and writing skills by using engineering principles that apply to aeronautics, flight, and engineering. This is a specialization course that involves the use of technology to solve engineering problems.

### Biotechnical Engineering

The major focus of Biotechnical Engineering is to expose students to the diverse fields of biotechnology including biomedical engineering, and bio-molecular genetics, bio-process engineering, agricultural and environmental engineering. Lessons engage students in engineering design problems that can be accomplished in a high school setting related to bio-mechanics, cardiovascular engineering, genetic engineering, agricultural biotechnology, tissue engineering, biomedical devices, human interface bio-processes, forensics, and bioethics.

### Engineering Design & Development

Engineering Design and Development involves two- to four-person teams that research an open-ended problem and then design and construct a solution to it. Each team must submit progress reports and a final research paper. The team members then defend the solution with an oral presentation before an outside review panel.

# Engineering & Applied Mathematics

## Offered at:

Heights, Northeast Magnet, Northwest, Southeast, and West

## Sample Occupations:

- Aeronautical Engineer ► Architectural Engineer
- Materials Lab and Supply Technician ► Industrial Engineer
- Biotechnical Engineer ► Civil Engineer
- Technical Writer ► Quality Technician ► Product Safety Engineer
- Mechanical Drafter ► Atmospheric & Space Scientist
- Architectural Drafter ► Mechanical Engineer

## 2011-12 Engineering and Applied Mathematics Advisory Committee

- Herb Coin, The Murdock Companies, Inc.
- Samantha Corcoran, Wichita State University
- Ken Lee, Ruggles & Bohm, P.A.
- Jessica Rhein, Parsons Brinckerhoff
- Paul Taylor, Sedgwick County Public Works
- Larry Whitman, Wichita State University

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## PLTW curriculum at heart of local engineering pathways

CTE students in Wichita high school Engineering and Applied Mathematics pathways are engaged in the learning process through the Project Lead the Way (PLTW) Pathway to Engineering curriculum, which facilitates learning about math and science through group and individual projects specifically designed to promote critical thinking, creativity, innovation and real-world problem-solving skills in students. The curriculum is collaboratively developed by teachers, university educators, engineering professionals and school administrators.

All schools using the curriculum are required to offer two foundation courses – Introduction to Engineering Design (IED) and Principles of Engineering (POE), which expose students to the design process, its application and the major concepts encountered in a postsecondary engineering course of study. Beyond



Biotechnical engineering students (right, l to r) Sharmini Lawless, Jeena Elahi, and Hana Alsoudi visit with a fellow student about their "Redefining Crutches" project at the Kansas PLTW Showcase held each year at WSU. (Photo by Jim Means)

*"The ability for a school to become specialized in a particular area is somewhat dependent upon staffing, facilities and other resources."*

*Jim Means, CTE Executive Director*

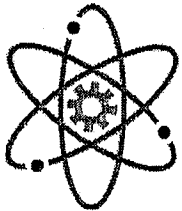
the foundations, schools may choose to focus on one or more of five specialized areas— aerospace engineering, biotechnical engineering, civil engineering and architecture, computer integrated manufacturing, and digital electronics.

"The ability for a school to become specialized in a particular area is somewhat dependent upon staffing, facilities and other resources," said Jim Means, CTE executive director. "Two schools, Northeast Magnet and West High, have long established programs and have been able to carve out a solid niche in their engineering course offerings."

At Northeast Magnet, the emphasis is on biotechnical engineering and aerospace engineering. Biotechnical engineering students are challenged by engineering design problems related to biomechanics, cardiovascular engineering, genetic engineering,

tissue engineering, biomedical devices, forensics and bioethics. Aerospace engineering students explore the evolution of flight, navigation and control, flight fundamentals, aerospace materials, propulsion, space travel, and orbital mechanics, and are presented with alternative applications for aerospace engineering concepts.

At West High, the emphasis is on civil engineering and architecture, and computer integrated manufacturing. Civil engineering students apply their knowledge to design and development of residential and commercial properties and structures, while computer integrated manufacturing students focus on robotics and automation, manufacturing processes, computer modeling, manufacturing equipment and flexible manufacturing systems. (source: PLTW website)



PROJECT LEAD THE WAY

**PLTW**

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## NE senior on his way to owning rocket design firm

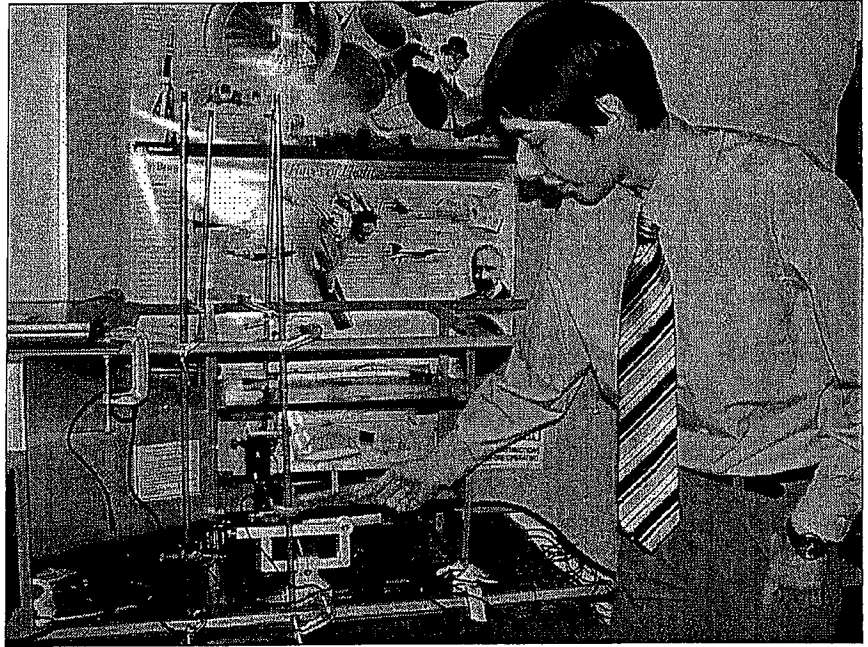
Andrew Holup, a senior at Northeast Magnet High School, is on his way to owning a space travel and rocket design firm. Along the way, he will graduate high school as a CTE concentrator in the Engineering and Applied Mathematics pathway, attend college to get his degree in aerospace engineering, and gain a little experience working for others.

It's important to know, however, that his mission doesn't end there. Before he retires, he also plans to spend a little time teaching in a college or university setting. "I feel like you have to give back to the next generation—share what you've learned and give them the tools they need to carry on after this generation," Holup said.

The 18-year-old's unique passion about engineering started with toys—Holup said he loved building things with Legos® and K'NEX while he was growing up. "It's just kind of natural for me to be innovative and to think outside the box," he said. "Engineering is an art guided by science. You have to follow the rules of science but you get to be creative in the process."

When it came time to enter high school, Holup selected Northeast Magnet because of its science department. He is a big fan of the Project Lead the Way (PLTW) curriculum used in the CTE engineering program. "The hands-on projects create an environment where students are more likely to ask questions and explore solutions, which mean they are more inclined to learn," he said. "Instead of being overwhelmed by repetitive practice and standardized tests, students learn math and engineering as they participate in projects and activities. At times, it doesn't even feel like learning—it is more natural and innate."

Holup has taken engineering classes each of his four years of high school and said that he found each class an exciting combination of structure and a wide open door. He learned the terms and boundaries associated with the science at each level, and then within those boundaries, was free to take his learning in the direction his passion led him. "The



Northeast Magnet High School's Andrew Holup, a CTE concentrator in the Engineering & Applied Mathematics pathway, explains the improvements he made on the wind tunnel used for testing in the classroom. (Photo by Carla Davison)

*"Engineering is an art guided by science. You have to follow the rules of science but you get to be creative in the process."*

*Andrew Holup, Senior engineering student*

Aerospace Engineering class is what really solidified my interest in the field—especially the rocket studies," he said. "It basically gave me a taste of my future."

"Andrew truly has a love for engineering," said Alan Schmidt, engineering teacher at Northeast Magnet. "He's very curious and creative in his approach to solving problems."

During his sophomore year, Schmidt introduced Holup to the Kansas Junior Academy of Science, where he presented "The Effects of Propeller Shape on Power Generation," an engineering project that was awarded Best of State in the small high school division, and prompted an invitation for him to present his project at the American Junior Academy of Science conference in Washington, D.C.

Since June of 2011, Holup has been working part-time as a research assistant at WSU's National Institute for Aviation Research (NIAR)—a paid internship he says he "definitely" got because of the tools he acquired in his engineering classes. He works in

the Walter H. Beech Wind Tunnel and is the youngest intern on the NIAR staff. He looks to the graduate students, professors and other NIAR staff as mentors, along with the professionals from domestic and international companies that he encounters as they use the tunnel for testing.

Working at NIAR is an extension of his education. He uses what he learns in the classroom at work and what he learns at work in the classroom. His Engineering Design and Development course project this year focused on improving the classroom wind tunnel based on what he learned working at NIAR. The project improved the way students collect data through the wind tunnel, and the quality of data they collect.

"Andrew is a very unique student and we're very fortunate to have him in Wichita Public Schools and in our CTE engineering program," Schmidt said. "He's taken full advantage of the engineering courses we offer and will use them well."

## Articulated credit gives CTE students head start on college, careers

The RPOS grant is helping create new opportunities for Career and Technical Education students to earn college credit while still in high school. CTE students are eligible to receive college credit for courses within their chosen career pathways through "articulated credit" agreements negotiated by CTE staff with various postsecondary institutions. Articulation agreements are an important goal of RPOS and a required element of having a state-approved pathway.

Two courses are said to be "articulated" when the high school course has the same content and outcomes as the college course. Although taught in the high school, the course materials, content, and instructional quality are consistent with courses offered by the community college or technical college. An added benefit is that students are not charged tuition or fees for the articulated credit.

Articulated credit agreements help ensure that CTE students within a particular career pathway make a smooth transition from high school coursework to



postsecondary coursework without duplicating classes. The courses that articulate also prepare CTE students with the academic and technical skills necessary to be competitive, give them a head start on postsecondary education, and save both time and money.

While each agreement is unique, articulated credit for CTE coursework may be applied toward an associate's degree, a bachelor's degree or a technical certificate, depending upon the options offered by the postsecondary institution.

Because articulated credit agreements apply to specific courses, not all CTE courses are eligible. Students need to check with their high school counselor to find out which courses are eligible for articulated credit at which institutions to get a head start on college and career readiness. Information about articulated CTE courses can also be found at [www.cte.usd259.org](http://www.cte.usd259.org).

## Workshop helps educators address gender barriers

Wichita High school counselors, administrators, and college and career coordinators gathered Nov. 30 to learn about issues and influences that often impact career choices, specifically the role of gender. Marie Hall, CTE coordinator from the Southeast Kansas Education Service Center – Greenbush and former KSDE consultant for non-traditional programs, lead the workshop.

The information presented by Hall showed that gender roles begin to shape society expectations from a very early age. Young girls typically play with dolls and young boys typically play with trucks because society has established those as the expected and normal behaviors. As children grow, leaving behind dolls and trucks, they may not leave behind expectations that limit their exploration of the world beyond those gender norms.

Workshop participants were given time to develop a plan to eliminate or minimize gender limitations and encourage students to consider all career options that align with their unique skills and interests. Some of the activities being considered include:

- Emphasize non-traditional careers with salary expectations and scholarship opportunities during pre enrollment
- Invite members from the community as class speakers, particularly those that are non-traditional role models themselves



- Utilize school publications and video productions to share information about CTE opportunities
- Provide opportunities for students to connect with postsecondary institutions that offer training or degrees in areas that are non-traditional for their gender

"This workshop and these plans won't completely override the messages that bombard students," said Jim Means, CTE executive director, "but it is a place to begin and just might free some students to explore a career that they otherwise may have not considered."