OTHER NEW AND EXPANDED VSGC PROGRAMS

Virginia STEM Collaborative Nurturing Network to Enhance Content-focused Teaching (VA STEM CoNNECT)

FAA Design Competition

Mary Sandy, Director
Chris Carter, Deputy Director
Virginia Math/Science Partnership

- *No Child Left Behind* authorized a Mathematics and Science Partnership (MSP) competitive grant program.
- Higher education and schools provide teacher professional development.
- In Virginia, administered by Virginia Department of Education (VDOE).

Virginia MSP -- Three Priority Areas:
- Math Standards of Learning (SOL); Science SOL; Integrated STEM
- One statewide grant ‘to provide professional development focusing on engineering design process’
VA STEM CoNNECT

- **Va STEM CoNNECT project awarded**
  - Teacher professional development for K-12 vertical integration of STEM and engineering design process
  - Follow-up support for teachers
  - 6 regional Institutes and a one-day Conference
  - External Evaluation Study with Control Group.

- **Led by Longwood University**
  - VSGC, Old Dominion University, James Madison University, College of William and Mary, University of Virginia, Math Science Innovation Center, George Mason University.
VA STEM CoNNECT

► VSGC regional partner to coordinate and provide a 5-day workshop and follow-up support
  → Partnering with six divisions participating in Governor’s Academy for Innovation, Technology, Engineering (GAITE)
  → Follow-up led by two Master Teachers.

► Research-based best practices in using engineering design in the classroom.

► Hands-on instruction and practice in using exemplar lessons.

► *Integrating Science and Math Through Engineering Design.*
VA STEM CoNNECT

Institute Goals, the teachers will learn:
- Characteristics of STEM including differences and interactions
- The practices used by scientists (inquiry), engineers (design and build), and mathematicians (problem-solving)
- Using engineering to show relevance of math and science
- How one prepares to become an engineer
- Key resources for incorporating engineering into classroom.

Lead Facilitator, Patty Watson - Manager of STEM Collaboratory at Virginia Tech, and current Ph.D. student in Integrative STEM Education.

23 teachers – $600 stipend ($400 participation/$200 deliverable); 30 total contact hours.
VA STEM CoNNECT

- ‘Farm the Wind’
  - Students use wind generators as a context for exploring electrical circuits, map reading, and renewable energy.

- Guest Speakers From Various STEM Organizations:
  Old Dominion University; Hampton University; National Institute of Aerospace (NIA); NASA Langley Research Center; NASA Digital Learning Network (DLN); Huntington Ingalls Industries-Newport News Shipyard; The Structures Group; Thomas Nelson Community College

- Teachers provided with 3 exemplar lessons
'Farm the Wind'

- Newspaper Article: ‘Virginia makes bid for offshore wind energy test sites’
  - Is wind power a good source of renewable energy in Virginia?
  - Advantages/Disadvantages
  - What makes a good design of a wind turbine?
  - What design generates the most power?
  - How do you measure power?

- The Challenge: Your team has been hired to create an onshore wind farm in Virginia.
‘Farm the Wind’

- Design and build a model wind turbine for the wind farm.
  - It must lift 5 Tootsie Rolls as quickly as possible over a distance of 3 feet using the provided materials.
  - Fan speed is determined by “site” choice.
- Location
- Blade Design
  - Number, size, shape, angle
‘Farm the Wind’

Assessment

3. Find $x$.

Here it is

Ocular Trauma - by Wade Clarke ©2005
‘Farm the Wind’

Assessment of Engineering Design Projects

▶ Multiple Right Answers!!

▶ Multiple Correct Designs Will Accomplish the Mission
‘Farm the Wind’

**Science Extensions**

- **Physics**—force (friction), ways of doing work, velocity, gravity, resistance,
- **Bio**—human impact on environment
- **Earth Science**—Wind, where it would be more/less effective, mapping, weather patterns, onshore/offshore flow, collect local weather data
- **Chemistry**—electricity, materials, redox reactions, rust
‘Farm the Wind’

Math Extensions

• Gear ratios
• 3D objects, 2D objects
  – Relationship of angles in trapezoids
  – Geometry (tripod)
  – Circles—radius, circumference
  – Distance
• Economics—cost/benefit analysis, linear programming models
• Statistics
• Graphs—predict performance
‘Farm the Wind’

**Other Extensions**

- History of windmills
- Architecture/visual impact
- Political/social impact
- Migratory birds
- Letter to congress
- Field trip/guest speaker
- Journal/Written peer evaluation/Process essay
- Team building skills
- Career exploration
What is Engineering Design?
Why is Engineering Design a Good Pedagogy for Integrative STEM Education?
Getting to Know Each Other’s Disciplines
A Day in the Life of an Engineer

Technological Challenges of the Future

- Physical Infrastructures in Urban Settings
  - Buildings, Transportation, Sanitation, Water
- Information and Communications Infrastructure
Engineering Design as a Student
Engineering Design as a Student
Testing and Presentation of Engineering Design
Testing and Presentation of Engineering Design Challenge
Differentiating Engineering Education

NASA’S DIGITAL LEARNING NETWORK
VA STEM CONNECT

“This information has reignited that flame of love for education that has been dwindling due to day-in and day-out doing the same old thing and being frustrated with the results.”

“I am confident that what I have learned, once incorporated into my classroom, will remind my students of the days when they loved school too!

Extremely valuable experience especially writing and seeing lessons.

Guest speakers were all excellent with diverse knowledge base. I am very glad I attended this conference.

I enjoyed learning about what NASA has as far as educational tools.
On Campus Residential STEM Experience

- Three-day on-campus motivational residential programs for rising ninth and tenth graders.
- $218,000 per year award: Year one at UVa (summer 2013) and year two at Virginia Tech (summer 2014).
- Two programs each summer for 60 students each; total of 120 students each summer; no cost to students.
- Open application for qualified students with teacher recommendation.
- Seeking students with STEM aptitudes for whom this program might be the spark for STEM studies and career planning.
- Cross disciplinary across STEM departments.
FAA recently selected winners for its fifth annual Design Competition for Universities. Binghamton University - State University of New York, University of Southern California, Embry-Riddle Aeronautical University Daytona Beach and University of California at Berkeley captured first place awards; eight other submissions also received awards…

Read More

FAA Design Competition for Universities
Winners 2011

FAA Design Competition for Universities
2012 – 2013 Academic Year
VSGC manages the Competition for the FAA, now in its seventh year.
FAA Competition Goals

- *Raise awareness of the importance of airports to the National Airspace System infrastructure.*

- *Increase the involvement of the academic community* in addressing airport operations and infrastructure issues and needs.

- *Engage U.S. students* in the conceptualization of applications, systems and equipment capable of addressing related challenges in a robust, reliable and comprehensive manner.

- *Encourage U.S. undergraduate and graduate students to contribute innovative ideas and solutions* to airport and runway safety issues.

- Provide the framework and incentives for *quality educational experiences* for university students.

- Develop an awareness of and an interest in airports as a vital and interesting area for engineering and technology *careers*.
FAA Competition Partners

- University Aviation Association
- The American Association of Airport Executives
- The Airport Consultants Council
- The Airports Council International
- The National Association of State Aviation Officials

All are providing advice, expert links for teams, assistance in dissemination of the Competition opportunity to its members, and participation in design reviews.
Competition Elements

- Individuals or teams.
- Undergraduates and Graduates eligible.
- Multidisciplinary, multi-departmental or multi-institutional teams an option.
- Good vehicle for collaboration among institutions.
- A worthwhile aeronautics project for design courses or independent study.
- Allows for interdisciplinary approach and solutions.
- Real world applications.
Connections with Airport Operators

- Linkage with an airport operator is required to obtain expert advise and ensure the viability of the proposed approach.
- Competition website has links to experts with FAA, Partner Organizations and connecting students to airport operators.
Awards

First place: $2500; Second place: $1,500; Third place: $1,000

- Prizes are awarded to individuals or divided equally among team members.
- Team representatives for first place awards will be invited to accept their award and present their design at the FAA Headquarters in Washington, DC.
- A travel allowance of up to $3,000 per award will be provided for two individuals (two students or one faculty advisor and one student) from each first place award winning team.
Topical Meetings 2012

**October 10-12** - Columbus, OH
AAAE Airport Pavement Workshop. One student and Professor Bill Ziegler from Binghamton University will attend.

**October 21-23** - New Orleans, LA
AAAE National Airport Conference. One student and Professor Seth Young from The Ohio State University will attend.

**November 4-7** - Chicago, IL
AAAE Airports Going Green Conference. One student and Professor Eirik Hole from Stevens Institute of Technology will attend.
Competition Website

http://faadesigncompetition.odu.edu

- Detailed competition background and guidelines.
- Links to publications and resource documents in each of the broad challenge areas -- a starting point for students and faculty.
- Venue for submitting questions and required Notice of Intent to propose.
- Final proposals submitted electronically through the website.
- Detailed evaluation criteria.
- Links to expert resources and airport operators.
FAA Competition Design Challenge Categories

- Airport Operation and Maintenance
- Runway Safety/Runway Incursions/Runway Excursions
- Airport Environmental Interactions
- Airport Management and Planning

Note: Safety risk assessment is an element in each challenge
New FAA Competition Design Challenge
Categories

- Electric/Hybrid-Electric Aircraft Technology
- Innovative Application of FAA Data

Note: Safety risk assessment is an element in each challenge
Airport Operation and Maintenance Challenge

- Exploring new methods for design and maintenance of pavement surfaces.
- Methods for innovative pavement repair.
- Innovative pavement materials, installation and maintenance techniques, including non-destructive evaluation methodologies.
- Improved approaches to rubber removal/surface restoration due to aircraft tire friction.
- New or improved techniques for ice removal from runways.
Airport Operation and Maintenance Challenge

- Improved methods for foreign object detection and removal from runway surfaces.
- Innovative approaches to address wildlife issues at airports including bird strikes.
- Improved tug systems for aircraft.
- Innovative applications, including web-based solutions, for airport operations and maintenance.
- Improved methods for ground traffic flow scheduling.
Runway Safety/Runway Incursions/Runway Excursions Design Challenge

- **Expanding situational awareness of pilots and ground operators on the airfield. Ideas include, but are not limited to:**
  - Direct warning systems to alert pilots they are approaching a runway and if the runway is occupied.
  - Direct warning systems to alert air traffic controllers for situations leading to runway incursion.
  - Direct warning systems to alert airfield drivers that they are approaching a runway they are not authorized to cross.
  - Development of innovative techniques to record, analyze and display annotated spatial data for improved situational awareness of ground operations.
  - Methods for aircraft/runway interface that address issues caused by new energy efficient lighting not being visible to heat sensing, enhanced flight vision systems.
Runway Safety/Runway Incursions/Runway Excursions Design Challenge

- **Enhancing Airport Visual Aids**
  - Improved lighting, marking, and signage for runways, taxiways and the airport apron.
  - Lighting other than traditional incandescent.
  - Providing surface navigation guidance to pilots in the cockpit via electronic alternatives in limited visibility conditions (in lieu of outside visual cues).

- **Runway Excursions**
  - Identification of major causal/contributory/contextual factors leading to runway excursions.
  - Risk analysis of runway excursions due to overrun/undershoot/veer-offs.
  - Innovative approaches to reducing runway excursions and associated risks.

- **Safety Assessment Tools**
  - Mobile tools to support assessments conducted by runway safety action teams that aid in compliance evaluation as well as hazard identification and correction.
  - Systems analysis to determine areas of greatest risk for runway incursions and excursions in the National Airspace and proposing corrective action plans.
Airport Environmental Interactions Design Challenge

- Making snow and ice removal more environmentally friendly. Both chemical and non-chemical options can be considered.
- Improving methods for containment and cleanup of fuel spills.
- Increasing energy efficiency in the management of airfields.
- Innovative methods for stormwater management at airports.
- New tools and approaches to noise reduction at airports.
- System level methodologies for strategic assessment of environmental interactions beginning at the airport planning phase.
Airport Management and Planning Design Challenge

- **Maximizing Airport Capability**
  - Strategies for accommodating aircraft that experience extended delays on the tarmac and in line for take off, including dealing with human needs and airport and airline capabilities.
  - Innovative approaches to demand forecasting and management for airports.
  - Innovative strategies for reducing airline fuel consumption, such as new ways to reduce gate-to-gate time or revise procedures.
  - Effective alternatives to current ramp and gate controls.
  - Creative approaches to airport revenue generation for general aviation airports.
  - Models for collaborative decision making and data sharing at airports.
  - **Methods for aircraft/runway interface that address issues caused by new energy efficient lighting not being visible to heat sensing, enhanced flight vision systems.**
Electric/Hybrid-Electric Aircraft Technology Challenge

- Electric/Hybrid Electric Aircraft Technology challenges students to design a regional transport aircraft that will use electric or hybrid electric propulsion and to consider the impact on airports. This is the first aircraft design challenge for the FAA design competition.
Innovative Application of FAA Data Challenge

- Innovative Application of FAA Data challenges students to use FAA, industry, travel and airport-relevant data to develop a mobile application for use with smartphones and tables that is innovative and commercially viable.
FAA Design Competition for Universities

Key Dates

- **Competition Announcement:** August 2012
- **Notice of Intent:**
  - NOI strongly suggested and anticipated prior to start of design process
  - Fall semester deadline - September 28, 2012
  - Note: NOI’s involving fall work will still be accepted through the Spring semester deadline of February 1, 2013
- **Design Submittal Deadline:** 5 p.m. Eastern Daylight Time, April 19, 2013
- **Winners Announced:** by June 7, 2013
- **Award Ceremony and Presentations:** Summer 2013
- **Competition web site:** [http://faadesigncompetition.odu.edu](http://faadesigncompetition.odu.edu)
Learning Venues for the Competition

- 208 proposals for first six years of the Competition
- 22 individuals (20 graduate students; 2 undergraduate) – two seconds, third and two honorable mentions
- 182 teams (undergraduate-150; graduate-13; both-19)
- Teams ranged from 2 to 28 students
- Venues
  - Design Class
  - Course Project
  - Student Chapter
  - Independent Study
  - Proposal Focus:
    - Airport Operations and Maintenance - 45
    - Runway Safety/Runway Incursions - 85
    - Environmental Interactions of Airports - 53
    - Airport Management and Planning - 25
University Participants from Mid-Atlantic Region

Stevens Institute of Technology
Rowan University
Rutgers University
University of Virginia
George Mason University
Old Dominion University
Hampton University
The College of William and Mary
Disciplines

Aerospace, Aviation, Business, Computer Science, Engineering-Civil, Mechanical, Industrial, Environmental, Systems, Electrical, Operations, Human Factors, Management, Physics, Psychology, Technology, Transportation
Competition Statistics 2007-2012

208 design proposals
1046 student participants
1024 student participants on teams
22 individual participants
59 participating universities
86 participating faculty members
2012 First Place Winners


- A team of three undergraduates from The Ohio State University, Advisor, Seth Young, Airport Management and Planning, “Terminal Buddy.”

- A team of six graduates and one undergraduate from Embry-Riddle Aeronautical University, Daytona Beach, Advisor, Kelly Neville, Runway Safety/Runway Incursions/Runway Excursions, “iTAXI – Total Runway Awareness.”

- A team of four undergraduates from Stevens Institute of Technology, Advisor, Eirik Hole, Airport Environmental Interactions, “Green Gates Locally Powered Gate Electrification System.”
“…we find it difficult to imagine a project that could be better suited for or do a better job of preparing our students for careers involving research, problem solving, design, and engineering. The students learn to work as a team over an extended period of time, experience multiple phases of a project, and importantly, don’t just develop a solution that’s been handed to them.”

Professors Kelly Neville and Marty Lauth
“…this competition is an excellent forum to allow students to investigate a challenge faced by an external client. It is one of the few competitions that doesn’t define the problem for the students.”

Professor Linda Riley
“...The FAA competition is by far the best-organized competition I have seen in my 34 years in higher education the educational value and experiences presented by participating in the competition is simply unmatched anywhere else.”

Professor William Ziegler