NASA PROMOTES STEM PROFESSIONAL ACTIVITIES FOR EDUCATORS

Amidst resurging emphasis on STEM-related fields of study, career opportunities, and K-12 student performance, NASA launched its Summer of Innovation with a number of partnerships and professional development opportunities for teachers. NASA was tasked by the President to play a significant national role in stimulating interest in STEM and to use its vast resources and capabilities to inspire a new generation of scientists, engineers, and mathematicians.

Among a number of Summer of Innovation activities, NASA established a partnership with RTI International to involve teachers in cutting edge technologies that they could use in developing engaging and exciting lessons for their students. NASA plans to offer the program again in Summer 2011, and RTI proposes using NCSM as one of the dissemination outlets for notifying teachers across the country about the opportunity. The mathematics education leaders that NCSM reaches are ideal candidates for this unique NASA experience, and NCSM will be notified when the application process opens.

STEM-AERO at Langley and Ames

NASA sought assistance from RTI International in Research Triangle Park, NC, in piloting an intensive, two-week summer STEM-AERO internship opportunity for sixteen mathematics and science, middle and high school teachers from Boston, Miami, Colorado Springs, and Tucson. RTI managed the solicitation and selection process and coordinated the travel and workshop development processes for this project. Eight teachers attended the NASA Ames facility in California and eight attended NASA Langley in Virginia during the last two weeks of July.

Unique to this opportunity was the requirement that teachers seek to engage business, industry, and/or academic partners which would be willing to support the growth of STEM-AERO interest in their communities. As part of the application process, teachers contacted local agencies and universities to solicit classroom support during the school year. RTI augmented the teachers' efforts by contacting other companies and academic organizations to develop sustaining relationships.

The focus of this professional development experience was the role of modeling and simulation in aerospace engineering, and teachers were required to develop a mod-sim lesson for their students by the end of the experience. Throughout the two-week internship, teachers benefited from presentations from engineers and astronauts, met and worked with mentors to learn what engineers do and how modeling and simulation are integral parts of their work, and worked collaboratively to pool their ideas and develop lessons for their students. NASA anticipates that by engaging teachers and ultimately their students in the real work of aerospace engineers, the STEM-AERO program will contribute to the industry workforce pipeline with skilled engineers, mathematicians, scientists, and aerospace enthusiasts.

Teachers explored and adapted a number of online simulations for their lessons and found ways to embed their mentor's research into their activities. Teacher teams at both Langley and Ames developed lessons that met the requirements and expectations of the workshop and shared their lessons live across the two sites via NASA's Distance Learning Network. Teams have posted their lesson plans on NEON – NASA Educators' Online Network – for easy sharing within the

science community. It is the intent of the project that the STEM-AERO teachers continue to use NEON as they pilot their lessons in their classrooms.

The lesson plans focused on the use of simulation technology for analysis of real-world problems, use of mathematics and science within the engineering design process, and collaboration within teams to solve problems. Some teacher teams paired middle school and high school teachers; therefore, lesson plans covered the topic in a manner that allowed for experimentation at several grade levels. For example, in the *Newton's Law of Motion Lesson,* students must predict and test factors which may increase or decrease an aircraft's speed to demonstrate the relationship between force and motion. This lesson provides middle school students with an opportunity to collect and analyze data, and compute the average speed of an airplane. At the high school level, the students learn to calculate rotational and linear speed and investigate the effect of independent variables, such as weight, drag, center of gravity, or potential energy, on the rate of speed of the airplane.

The students will use simulations to solve problems within the lessons. Much of the simulation software incorporated into the lessons is freely distributed and available on educational web-sites. For example, the *FLY:Flight sim Life application for Youth Lesson Plan* for 6th-8th grade, uses four different simulations and real world air traffic control problems to demonstrate how human choices affect publicly shared natural resources. The *Human Factors Labs Ames Lesson Plan* uses air traffic control methods to collect data and analyze traffic problems within a school parking lot at the middle school level and air traffic control simulations to understand efficient optimization at the high school level.

Another aspect of the lesson plans is the alignment of NASA research focus areas to grade level appropriate content. *The iRobot's Roomba: Exploring Trajectory Optimization Using Simulation* focuses on trajectory optimization for students taking 8th grade Physical Science and 9th grade Introduction to Physics. The lesson is based on NASA's trajectory optimization in the design of helicopters, airplanes, and space machinery and requires the students to use simulation to design an optimized trajectory for the iRobot's Roomba autonomous robotic vacuum cleaner. NASA's Orion's heat shield re-entry research was incorporated into the *Arc Jet Simulation Lesson Plan* for grades 9-12. The anticipated outcomes of the lesson are that the student will design and simulate an Arc Jet test, measure surface temperature, interpret and graph temperatures of various insulation materials and identify the most efficient material.

The STEM-AERO teachers left the workshop eager to pilot their lessons in the classrooms and develop new ones using the mod-sim skills they developed at NASA. In post-workshop evaluations, they commented that the experience was "amazing," "phenomenal," and "fulfilling." In one teacher's words, "This experience was priceless and I hope that it continues to reach other educators." In fact, NCSM will help disseminate information about the Summer 2011 opportunity as soon as it is available.

You are invited to access, review, and try these lessons in your own classroom by joining NEON at http://neon.intronetworks.com/#Groups. After you sign in, look under 'other groups' for the Simulation-Based Aerospace Engineering Teacher Professional Development group and click on the resources. This should lead you to some of the lessons.