

Introducing Aerospace Engineering to High and Middle Schools

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Abstract

In the past there was a common belief that research should only be introduced at the graduate level or at least the senior undergraduate year. Research in the freshman year was not even a topic for discussion. Today, throughout CUNY, colleges are stepping forward and conducting research at all undergraduate levels and achieving good results. One of the more effective ways to enhance the skills of the students in STEM is conducting research as part of an internship or with a faculty member, Boyd and Wesemann (2009). Recent surveys and studies predicts that over the next ten years half of the new jobs will require education that goes beyond high school degree and 25% of our students aren't finishing high school. A clear warning was stated in the report of Rising above the Gathering Storm (RGS) in 2007 about the relative decline of the United States in the science and technology market place and that the competitive nations had increased public funding for research and development and made significant investments in higher education. According to the RGS, Youths between the ages of 8 and 18 average seven-and-a-half hours a day in front of video games, television and computers. The report also stated that 93% of students in 5th through 8th grades are taught the physical sciences by a teacher without a degree or certificate in the physical sciences.

The department of Mechanical Engineering and Industrial Design Technology at New York City College of Technology is currently focusing on aerospace industry. Receiving funding from NASA was one of the main factors motivating this focus. The plan is to involve undergraduate students in designing and teaching a curriculum in aerospace for high school and middle school students who will attend the Proyectoaccess summer program in Hostos Community College in New York. This six weeks program is designed for high achieving minority high school and middle school students. The program extends over six weeks period and its goal is to encourage those students to pursue careers in engineering and science when they go to college. The curriculum is designed to be introductory to engineering and science. This is well aligned with the goals of NASA CIPAIR funding that our Mechanical Engineering Dept. has received. Another partner in this project is Louis Stokes for Minority Participation in Science and Engineering (LSAMP) who supported the undergraduate students for two full academic semesters, spring and fall of 2011, in their effort to design a curriculum in aerospace to be taught in Proyectoaccess summer program.

Involvement of undergraduate students in the curriculum design was a major part of this project. Undergraduate students will benefit from doing such research work they can approach the way high school and middle school students think in a better way. The purpose of this curriculum is to familiarize students with a different kind of science. The students are introduced to theory of flight, and projectile motion. Also we added experiments so that the students could get a better understanding on what they are learning. We included the students

thinking of their own model of a rocket where there is a program to which they could test their ideas on, also a bottle rocket where they view pressure in a bottler and lastly launching a model rocket to record and view velocity, thrust, drag, gravity and lift, then put it at an angle so that a projectile motion can be viewed and calculated. The curriculum includes presentations, animations, applied and theoretical projects and using of computer software “Rocket Sims”. Also, it challenges their science and math skills, and strengthens their analytical skills. An example of *one of the three* curriculums that have been designed is:

Week 1 Newton’s First Law (*An object in motion stays in motion and a object at rest stays at rest*)

- Have students research the topic after a short introduction
- A detailed lesson followed by questions (*include real world applications*)
- An activity concerning the lesson
- A quiz on the lesson
- A project (*hands on and productive*)

Week 2 Newton’s Second Law ($F=ma$)

- Have students research the topic after a short introduction
- A detailed lesson followed by questions (*include real world applicants*)
- An activity concerning the lesson
- A quiz on the lesson
- A project (*hands on and productive*)

Week 3 Newton’s Third Law (*For every action there is an opposite reaction*)

- Have students research the topic after a short introduction
- A detailed lesson followed by questions (*include real world applicants*)
- An activity concerning the lesson
- A quiz on the lesson
- A project (*hands on and productive*)

Week 4 The Lift Equation/ Theory of Flight

- Have students research the topic after a short introduction
- A detailed lesson followed by questions (*include real world applicants*)
- An activity concerning the lesson
- A quiz on the lesson
- A project (*hands on and productive*)

Week 5 The Parts of an Aircraft/Rocket

- A detailed lesson followed by questions
- An activity concerning the lesson
- A quiz on the lesson
- A project (*hands on and productive*)
- Introduce the bottle rocket, also the RocketSim

Week 6 The Continuation of Rockets

- Advance with RocketSim

- Think of their own creation

This project responds to the industry need, NASA and aerospace, of more employees. One of the strategic plans of NASA is to increase the minority students in aerospace industry and to make today's students the future workforce of NASA. Statistics of NASA are showing that 65% of NASA employees are eligible for retirement. Manufacturing industry is suffering from some level of skills shortages, Deloitte et al. (2009). Aerospace and defense is suffering the most as shown in Figure 1 below. Conducting research that is relevant to NASA and improving curriculum with NASA relevant materials will lead to a better preparation of students to be the future work force for NASA and aerospace industry. Students will realize the opportunities that are available to them in aerospace and will be prepared to take the necessary steps toward pursuing them.

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References:

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