Teaching STEM Through an Indoor Skydiving Experience (Curriculum Exchange)

Dr. Philip S. Schmidt, University of Texas, Austin

Philip Schmidt is the Donald J. Douglass Centennial Professor, Emeritus and University Distinguished Teaching Professor, Emeritus at the University of Texas at Austin, where he recently retired after 43 years on the faculty in Mechanical Engineering. He is a Fellow of the American Society of Mechanical Engineers and a registered professional engineer. Dr. Schmidt received a BS in Aeronautics and Astronautics from MIT and MS and PhD in Mechanical Engineering from Stanford, the latter in 1968. Prior to coming to UT in 1970 he taught for two years at Prairie View A&M as a Woodrow Wilson Teaching Fellow. In 1994 he was named Texas Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and in 1995 he was selected as one of the 10 inaugural members of the Academy of Distinguished Teachers at UT Austin. Dr. Schmidt received ASEE's Ralph Coats Roe Award in 1992, and the Chester F. Carlson Award in 2010 for his contributions to development of project-based engineering education and promotion of educational and professional opportunities for women and minorities. During the past 10 years he has worked actively with the Austin Children's Museum to encourage children's interest in STEM. In 2013 Dr. Schmidt was retained as a consultant by iFLY Corporation to develop programs which utilize the company's unique indoor sky-diving facilities and expert flight instruction with a hands-on science/math curriculum to produce exciting and memorable STEM educational experiences for K-12 students.

Christina Soontornvat, iFLY

Christina Soontornvat holds a B.S. in Mechanical Engineering (Trinity University) and a M.S. in Science Education (UT Austin). She has worked in the science center field for eight years, including as the Science Content Developer for the Austin Children's Museum. During this time she oversaw all STEM content in exhibits and programs, delivered STEM trainings for staff and teachers, and served as museum liaison to UT Austin's Science and Engineering departments and the local STEM professional community. She received training in inquiry-based learning from the Institute for Inquiry at the Exploratorium in San Francisco, CA. She is currently the Education Director for Phoenix Arising Aviation Academy and the Program Director for STEM Education programs with iFLY.

Mr. Stuart B Wallock

Stuart Wallock has spent the last 20 years involved with the convergence of technology, ecommerce, media and entertainment industries in various online and retail capacities. He holds a BA in Liberal Arts from UT Austin. Stuart joined SkyVenture/iFLY Indoor Skydiving from Dell, Inc., in October of 2011. As Chief Marketing Officer, he oversees the company's corporate and product marketing, franchisee and consumer marketing, social media, communications, brand strategy and application development. At Dell, Stuart was Director of Site Innovation and Social Commerce. Previously, he was Director of Marketing at Newegg.com, overseeing all marketing and web development programs. Before Newegg, he was Director of Business Planning at Sony Electronics. Since assuming his present role with SkyVenture/iFLY, one of Stuart's major objectives has been the development of the team building and education programs at iFLY– from concept through implementation–with the goal of making physics, math, technology, the science of human interaction, and entertainment all come together.

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Overview: This presentation describes a curriculum and delivery strategy for teaching scientific and mathematical principles of fluid dynamics through a unique indoor skydiving experience in a vertical wind tunnel facility. iFLY Corporation operates a number of such facilities throughout the US and abroad and makes them available at discounted rates to K-12 groups for educational purposes. The program is designed to enhance students' understanding of how fluids produce forces on moving objects and how these forces are influenced by the shape and size of an object and the velocity of the fluid stream. The science of fluid dynamics is critically important in engineering of aircraft, ships, cars, bridges, and buildings, in sports such as swimming, running, cycling, and skiing, and in earth sciences such as meteorology and oceanography.

Targeted grade levels: The curriculum is primarily targeted at grade levels 5-7 to reinforce force and motion science objectives and transition-to-algebra math objectives. It has also been piloted at lower and higher grade levels with appropriate adjustments to the technical and mathematical content. All elements are keyed to state and national math and science grade-level curriculum standards.

Curriculum description: The curriculum is designed to teach the fundamentals of fluid science and engineering through a combination of three basic elements: visual presentation of fundamental principles with live demonstrations, quantitative experimentation integrated with an individual flight experience, and data analysis. These elements focus on the following topics:

- ***Visual presentation with real-time demonstrations***
  - Wind tunnels: what they are, how they work, and what they are used for. Explanation of energy conversion from electrical (to drive the fans) to potential (compression of the air by the fans) to kinetic energy of the airstream.
  - Distinction between fluids and solids, types of fluids
  - Pressure and friction forces in fluids: viscosity, static and dynamic pressure
  - Aerodynamic drag as a combination of friction and pressure forces
  - Equilibrium of forces for an object in free flight: gravitational force vs. drag force
  - Measurement of air velocity

- ***Real-time wind tunnel experiment/individual flight experience***
  - Measurement of each student's "terminal" air velocity and recording of data on worksheets for subsequent analysis.
  - Training in proper safety procedures and flight techniques and suiting up for flight
  - Two individual flights in the vertical tunnel under direct supervision of a certified flight instructor.

- ***Data analysis activity encompassing practice in application of science and math skills:***
  - Measurement of body dimensions and weight using tape measures and electronic balance.
  - Relating mass to weight using gravitational acceleration.
  - Calculating areas of various body elements represented as geometric shapes and converting area units in the metric system (cm^2 to m^2)
  - Conversion of tunnel terminal velocity in miles/hr to metric units (m/s)
  - Using algebraic equations to relate a predicted quantity to measured variables
  - Carrying out mathematical operations using scientific notation to represent decimal numbers of varying magnitudes.
  - Comparing predicted vs. measured results and rationalizing discrepancies.
  - Using simple statistical measures to assess the validity of alternative hypotheses, and accounting for uncertainty and error in measured quantities.

Teaching resources and supplemental materials: Information on iFLY locations and scheduling may be found at https://www.iflyworld.com. The following teaching resources are available for download from a secure website. For authorization to access this site, please contact **pschmidt@mail.utexas.edu.**

- Teacher guide, including mapping of activities to state and national curriculum standards.
- PPT presentation to introduce concepts and motivate students
- Sample student worksheets and instructions
- Excel spreadsheets for compiling experiment data for the group and computing results for verification of student calculations and subsequent statistical analysis
- Links to helpful files and supplemental websites for follow-up activities