GLOBAL Challenge:

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Save the World on Your Way to College

By David Gibson and Susan Hull Grasso

While most students stay busy with school, sports, and typical teenage fun, Rudhi and Brian, a pair of students from your neighborhood, are meeting online with Meghna and Pranav from across the world in India to work on an idea and business plan that could save the world from global warming and sustain a future without oil. They've been meeting online for months using Skype (a free voice and file sharing application for synchronous meetings) and eFolio (an electronic portfolio application to create asynchronous collaborative artifacts). Their goal is to produce an innovative idea supported by a global business plan and explorations in science, technology, engineering and mathematics (STEM) content that addresses some aspect of the global warming problem or energy crisis.

Perhaps they'll tackle the problem of CO_2 emissions in transportation and invent a new design for a clean technology car. Maybe they'll link three countries together in a supply chain to manufacture and support an algae-based smokestack scrubber. Or they might develop a method of spraying roofs in the sunny belts of earth with a self-organizing material that settles to form a solar collector and electric grid for the home. It's all up to them.

The Global Challenge Competition

Meghna's participation in The Global Challenge (http://www.globalchallengeaward.org)—funded in part by the National Science Foundation ITEST (Information Technology Experiences for Students and Teachers) Program—begins in her senior chemistry class in Mumbai, India, when her teacher describes the global online competition for high school students. Like Rudhi, a sophomore girl from Boston, Massachusetts, Meghna looks over the Web site and decides to register. She is intrigued by the idea of working on a socially significant issue such as global warming and excited by the prospect of collaborating with other like-minded teens in an online format. She finds a male friend, Pranav, and an adult with whom she wants to work—a parent, teacher or older friend—and forms her Country Team. Through the Global Challenge Web site, her team pairs up with a U.S. team—Rudhi and Brian's—and together they become an International Team.

Formed sometime between September 1 and December 1, her team of four has until April 30 to design a global business plan around an innovative idea that applies science, technology, engineering, and mathematics to the problem of global warming and the future of energy. The team is scored in May based on three kinds of evidence:

- Global Business Plan
- STEM Explorations
- Global Teamwork

Scholarships are announced on June 1, with an average award size of $1,000 per student. More than $60,000 was awarded to 34 students in 2007 and nine of the top 10 teams sent representatives—all expenses paid—to The University of Vermont for an intensive summer Governor's Institute of Vermont (GIV) on Engineering. Meghna, Rudhi, Pranav, and Brian can participate each year they are in high school and can win an award every year, building a college fund while challenging themselves to learn and expand their personal networks.

Global Business Plan

The Global Challenge Business Plan is shaped by a comprehensive rubric—the BP Rubric. Meghna uses the rubric to self-score her sections of the narrative; she leaves comments for her teammates in the eFolio. Her teammates can use the rubric to make independent judgments of Meghna's scores as well as record their own. Rudhi contacts the team's undergraduate STEM Mentor—a Global Challenge alumna a few years older and in college majoring in a STEM discipline—to get some advice. The mentor helps her elaborate her ideas. The adults selected by the students—most often parents, teachers, or working scientists and business leaders—join the students in using IT

The Global Challenge Web site (http://www.globalchallengeaward.org) contains hundreds of searchable links to powerful external collections such as the National Science Digital Library (http://nsdl.org), National Oceanic & Atmospheric Administration (http://www.noaa.gov), National Aeronautics & Space Administration (http://www.nasa.gov), American Association for the Advancement of Science (http://www.aaas.org), and the American Federation of Scientists (http://www.fas.org). Undergraduate STEM students and scientists help collect and curate the collection.

tools to communicate and use the rubric to reflect on the completeness and quality of the team's work.

With help from the BP Rubric, Web site resources, mentors, and advisors, Meghna's team members:

- develop an understanding of the problem
- research the history of solution attempts by others
- analyze effects on industry and environment, and
- estimate how potential customers or clients will value and use their product or service.

Rudhi and Meghna create the first draft of the team's detailed technical description, which explains and documents the underlying STEM content of their innovation. Pranav reads "The World is Flat" by Thomas Friedman and encounters ideas about workflow, open source software, outsourcing, off-shoring, and supply chaining that teach the team how the Internet and new production practices have completely transformed global business. He drafts the team's rationale and business strategy. Brian, who is missing a lot of his regular school due to medical reasons, can still be part of the Global Challenge from home, finding and using Internet resources to research, write, and communicate with the team.

By January, Pranav is ready to register the team's core concept in the Global Challenge "Patent Office." An online form forces the team to summarize their concept to its essence in order to protect and lay claim to the idea in the current year's competition. The summary helps distill the team's claim of innovation and establishes that they understand the basic science and technology of their innovation. The full business plan submitted in April works out the details and provides more in-depth evidence. Once their concept is registered in the Patent Office, no other team can successfully submit the same idea this year.

The team must use solid evidence and effective writing to convince each other—and later, the judges—of the scientific, technical, social, and economic feasibility of their idea. Wherever possible, Rudhi and Meghna incorporate available test data, lab results, and field trials into their technical description. If no data are available, they need to convince the reader that given the current state of technology, results can be obtained in the near future using known science and technology. Together, the team builds a comprehensive business plan that fully describes their promising idea and explains how to implement and sustain it in the world.

STEM Explorations

To scaffold the team's search for the roots of their idea—the STEM underpinnings—The Global Challenge presents a series of "STEM Explorations," mini-challenges that present core content. Teams decide which units of study align best with their solution ideas and how deeply to engage with each exploration, which are offered at three levels. Brian takes the lead on choosing "Sources of Greenhouse Gas Emissions" and works with the team to understand the issues in order to improve the business plan's section on technical feasibility. The team receives one point for documenting the "Basic" level, two points for "Going Beyond" and three points for "Going Crazy." Earning all six points means that team members will spend 4–6 hours on this exploration.

In addition to the undergraduate STEM Mentors and STEM Explorations, students can also access the online Global Resources collection to further their scientific understanding of their business plan idea. Links in the Global Resources encompass a broad range of STEM topics, including scientific tools such as Mathematica's Demonstration Projects (interactive simulations and exploratory mini-applications that help one explore computational ideas) and scientific news and community-building sites such as Cogito (a site that introduces them to the world of science and to peers from around the world).

Global Teamwork

Through e-mail exchanges and Skype conversations, Rudhi learns that Meghna is interested in cell biology and science writing and Pranav enjoys physics. Rudhi herself brings an interest in sustainability while Brian likes working on economic issues. Global

Challenge team members are diverse in gender, nationality, racial and ethnic background, strengths, aspirations, and interests.

The diverse gender-balanced teams are rewarded in several ways. Teams characterized by disparate backgrounds and varied interests tend to bring a broader range of solution ideas to the table than homogenous teams, thereby leading to better final projects. In addition, because team dynamics can be challenged by diversity, Global Challenge participants are offered real-world experiences in coping with substantial differences in knowledge, skills, and life experiences. Successful teams learn that bringing these differences together and working through them strengthens a global team for innovative collaborative work. Finally, Global Challenge teams earn points toward their overall score for meeting the gender and diversity standards set forth in the program, and may be eligible for the Global Challenge Diversity Award.

Globalization is rapidly changing the face of the world economy, and global team-based learning is key to today's marketplace of ideas and commerce. With effective IT resources and a support system, a diverse team accesses a wider more effective "search space" of knowledge, research methods, and potential solutions. Consequently, an increasing number and variety of organizations are seeking people who can contribute effectively to their worldwide teams. The Global Challenge provides students with an opportunity to learn about the world, themselves, and others in the context of real problem-solving global teams.

Formalizing Informal Learning

The Global Challenge takes place outside of school through "informal" learning in science, technology, engineering, and mathematics. Informal in this context means "not in school" and is characterized by high levels of self direction, open-ended challenges, and self-motivated decision making. A student anywhere in the world can undertake the challenge with little support from parents, teachers, or friends by using the Internet and working on her own time. Students access the program from libraries, home, school, churches, and workplaces. Although referred to as informal, the program is actually highly structured and leads to formal recognition of achievement such as college scholarships, letters of recommendation, and commendations from experts.

Another way to formalize the Global Challenge's learning opportunity is for teachers and schools to incorporate the learning design and free materials at one of three levels.

Light: If you don't have much time or energy, you can:

- Recommend that students take a look at this Web site and form a team by individually registering. Your words might encourage them to try, and the project will be there to help them. There is no limit to the number of students you can recommend.
- Use the teaching units in your own classes. We have lessons and challenges in a wide variety of topics in STEM sciences. Your students can work on the same challenges as competing teams, but without the pressure of completion and the rigors of the competition.
- Use the extensive Global Resources in your classes. These are selected articles, Web sites, and interactive STEM teaching materials.

Medium: If you have some time, but not much energy to spare, you can, in addition to the above:

- Help connect students with an advisor, in case a parent or community member is not readily available to the team. The adult should be someone you and the students trust and who will make the commitment to help the team stay on track from October until May.
- Form an after-school club where the students come for ongoing check-ins and help.
- Become an advisor yourself and help one team to succeed.
- Establish direct contact with scientists to do hands-on experiments in your own community. The Global Challenge will provide you with linkages, ideas, research background, protocols, and a telecommunications platform.

Heavy: If you have both time and energy, then in addition to the above, you can:

- Help create Team Challenges that will benefit your students as well as students from around the world.
- Work with scientists and project staff to create an original line of research and action in your community. The Global Challenge will help connect you with people, resources, and assistance while making sure that student efforts stay focused on things that will help them create highly competitive ideas and proposals.

Global Education and the Future

The "big idea" that attracted Meghna and Rudhi and led them to meet and work together via the Internet was the prospect of making a contribution to solving an important global problem—one of the biggest chal-

lenges of their generation. Complex, ill-structured problems such as global warming cannot be solved by conventional thinking and schooling or traditional reductive engineering approaches. By addressing a global issue with an international team using information technology, The Global Challenge encourages creative thinking, improves global communication skills, provides experience in the negotiation of team dynamics, and deepens an understanding of core STEM concepts—skills that are of increasing importance in successfully navigating today's globally flattened world.

On the horizon, an exciting partnership with Microsoft, the Boston Museum of Science, and the Lawrence Hall of Science is leading to the creation of a multi-user virtual environment or MUVE (***Editor's Note:*** See "Get Your MUVE On" in the May 2007 issue of *L&L* for more information on multi-user virtual environments). If funded, this effort will begin to turn the STEM Explorations, LHS's Global Systems Science, and other existing STEM curriculum materials into "game paths" in a new kind of e-learning platform. It is conceivable that in the future, millions of young people could be working to save the earth on their way to college.

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