

P1.2 Providing Informal Geoscience Education for Upward Bound Students: Integrated Design for Geoscience Education (IDGE)

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1. INTRODUCTION

Integrated Design for Geoscience Education (IDGE) is an NSF-funded project which utilizes The GLOBE Program to increase scientific knowledge and to promote careers in the geosciences for at-risk students involved in the Upward Bound program at West Virginia State University. The Upward Bound (UB) program serves high school students from low-income families in which neither parent holds a bachelor's degree and first-generation military veterans who are preparing to enter postsecondary education. Students who are most under-prepared in math and science are often from low-income families without college-educated parents.

IDGE is based at West Virginia State University (WVSU) but is delivered through a partnership between the NASA IV&V Facility Educator Resource Center and Fairmont State University's Geoscience Education department. An inquiry-based laboratory science course based on NASA's GLOBE Program protocols and learning activities was developed and infused in the 6-week summer UB program. This field-based course involves UB students in the active collection and analysis of

environmental data and promotes a multi-disciplinary integrated approach to geoscience instruction.

IDGE will:

- Encourage underprivileged students to investigate science and scientific careers
- Utilize an integrated teaching method crossing the traditional boundaries of science, technology, and mathematics.

2. BACKGROUND

2.1 GLOBE PROGRAM

The GLOBE Program is a world-wide hands-on inquiry-based education and science program where students and teachers take scientifically valid measurements in the fields of atmosphere, hydrology, soils, land cover and phenology (seasons).

The GLOBE Program in West Virginia serves to promote contemporary geoscience education in rural Appalachia and was initiated through a memorandum of understanding between the local NASA Educator Resource Center and GLOBE head quarters. In less than four years time since the first workshop, GLOBE in WV has evolved into a learning community which includes 450+ certified teachers in over 250

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schools, and includes partnerships with six institutions of higher education, several non-profit scientific institutions, multiple state agencies and has received funding from a variety of state education grants. The momentum behind this geoscience program is strong and growing. IDGE builds on this success by recruiting geoscience experts from the WV GLOBE training team which include state geologists and soil scientists, professors of geology, biology, forestry, meteorology, geography, and science education and master K-12 teachers who are implementing GLOBE in their classrooms.

2.2 UPWARD BOUND

In an effort to address the war on poverty, the UB program at WVSU was instituted in 1968 to assist low income first generation students to be the first in their families to not only attend, but to graduate from college. WVSU's UB serves 120 students from the poverty stricken counties of Kanawha, Fayette, Lincoln, Boone and Putnam in rural West Virginia. Two-thirds of the participants meet the first generation and low income criteria.

Ms. Barbara Cary, the program's director since 1991 has facilitated an 85% college enrollment rate for UB students. UB students graduate from the college or university of their choice at a rate of approximately 77% and have joined the workforce as lawyers, pilots, teachers, social workers, chemists, bankers, and vice principals while many have pursued post baccalaureate degrees. UB courses are taught by college and secondary teachers permitting participants in the program to receive high school credits for their participation.

The UB program assists first-generation and low-income students by continuing their

education during the summer months and ensuring their graduates are receiving a post-secondary degree or certification. UB commits itself to providing equal access and treatment to eligible students who are members of groups that have been traditionally underrepresented in secondary education, such as members of racial or ethnic minorities, women, and the physically challenged.

The program provides activities and services that generate the skills and motivation in its participants necessary to complete secondary and postsecondary education successfully. This valuable program reaches students when they are making educational decisions which will either prepare them for science education in college or leave them without the necessary skills for higher level science coursework.



Figure 1: Students routinely integrate on-line GLOBE data analysis into environmental investigations.

3. PROGRAM OVERVIEW

3.1 STUDENT PROGRAM

IDGE significantly increases the inclusion of inquiry-based science methods in WVSU's UB program. In order to prepare UB students for careers in science, they must develop the skills of "making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results." (NRC 2000) The GLOBE Program is built on the philosophy of teaching science through doing science, and IDGE instructors will receive training in best practices of developing and delivering inquiry-based lessons.



Figure 3: Students conduct GLOBE hydrology measurements at a nearby lake and stream.

In Year 1 IDGE will:

- develop and deliver a 6-week Introduction to Environmental Inquiry for selected UB students;
- produce a series of interactive online learning modules to engage participants in data analysis through their required UB monthly follow-up meetings.

In Year 2 IDGE will:

- develop and deliver an advanced International Environmental Inquiry course for 2nd year students who are interested in expanding their geoscience knowledge, while repeating the Introduction to Environmental Inquiry course at WVSU and a partner UB program at another WV institution;
- engage local K-12 educators of UB students through professional development in Earth System Science which will provide the motivation and enthusiasm to incorporate GLOBE into their classrooms year round; and
- provide a capstone experience for advanced UB students and educators to participate in an international learning expedition to Costa Rica where they will meet with GLOBE students, experience the local culture and ecology, and conduct scientific measurements side by side with Costa Rican students.

With the demands of No Child Left Behind, K-12 science instructional time is very limited. IDGE will excite, inspire, support academic achievements and expand regular school time learning experiences. IDGE will also provide professional development and observational equipment to local educators which will disseminate IDGE activities to other students in their classrooms. Earth Science instruction offers the unique opportunity for students to engage in the

active scientific process where they can engage, explore, elaborate, and explain the environment around them.



Figure 2: Students conduct a Measurement Mission where they create their own weather-sensing equipment and calibrate them.

IDGE better prepares UB students to succeed in post-secondary laboratory sciences, increase students' critical thinking skills, and promotes positive attitudes towards careers in science. The program also strives to increase student's critical thinking skills and to promote positive attitudes towards careers in science.

IDGE activities will take place over a two year program and include the course development, online learning module creation, professional development for K-12 educators, facilitation of the 6 week Environmental Inquiry and International Environmental Inquiry course, and a capstone experience.

3.2 EDUCATIONAL MATERIALS

IDGE will develop environmental educational materials that can be used in other informal secondary science programs. The materials will be available on-line at the WV Science website:

<http://www.wvscience.org>

Instead of providing students a series of inadequate black/white copies and presenting information from a far removed overhead projector, IDGE will develop student-driven on-line learning modules which incorporate the needed skills to “think like a geoscientist” (Manduca 2002). These learning modules will be incorporated into the Environmental Inquiry courses and will increase student use of technology to analyze scientific data.

The learning activities will focus on the geosciences and GLOBE-centered learning. Topics will include the following: landcover, soils, hydrology, phenology, and meteorology. The activities will be inquiry-based projects utilizing international student data. IDGE will concentrate on modifying existing curriculum for UB participants in a very well-defined student-driven learning environment.

3.3 CAPSTONE PROGRAM

The culmination of this project will be an educational expedition where selected UB students and facilitators will travel to Costa Rica, with the Holbrook Travel program, in order to complete ecological studies in the field. Holbrook Travel is the premier youth education and conservation expedition organization. This expedition will allow them to gain first-hand knowledge of the international responsibility we have as scientists and citizens of our planet.

This opportunity for successful students and dedicated educators will foster collaborative partnerships with Costa Rican students and educators and facilitate an improved appreciation for the geoscience.

4. CONCLUSIONS

After the initial academic period, IDGE has identified those students with a particular

interest and aptitude for geoscience. A second geoscience course, International Environmental Inquiry, continues their learning in an increasingly advanced/rigorous learning environment and will be provided at WVSU. To further interest and involve these more advanced students, educational curriculum from Holbrook Travel will be included to increase their environmental knowledge on the ecology of Costa Rica. Collaborative partnerships will be fostered among UB students and educators here in West Virginia with GLOBE students with educators and students in Costa Rica to promote an international comparison of our physical environments.



Figure 4: Students participated in a GPS scavenger hunt to become acquainted with the GPS units.

In 2007, simultaneous programs will take place at WVSU UB and a partner UB at a second WV university. The introductory Environmental Inquiry course will be taught at both facilities utilizing the IDGE on-line learning modules by GLOBE-certified and IDGE-trained UB faculty while highly

interested and motivated UB students from year one will be selected to participate in International Environmental Inquiry at WVSU. This advanced course will build on students' knowledge from year one by introducing comparative research and inquiry and will require IDGE students to collaborate with GLOBE students from Costa Rica.

Ultimately and independent of future financial support, the UB program at West Virginia State University and our partner UB programs have agreed to continue offering the Environmental Inquiry courses by their trained faculty to future students thus ensuring the sustainability of the program at the local level. Additionally, the widely available on-line activity modules will guarantee that significant aspects of the IDGE program will continue to serve our West Virginia students well beyond the initial funding period.

5. REFERENCES

Manduca, C. (2002) *Bringing Research on Learning to the Geosciences*. Written in preparation for the NST conference: Bringing Research on Learning to the Geosciences, Racine, Wisconsin 2002.

National Research Council (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. Washington, DC: National Academy Press.