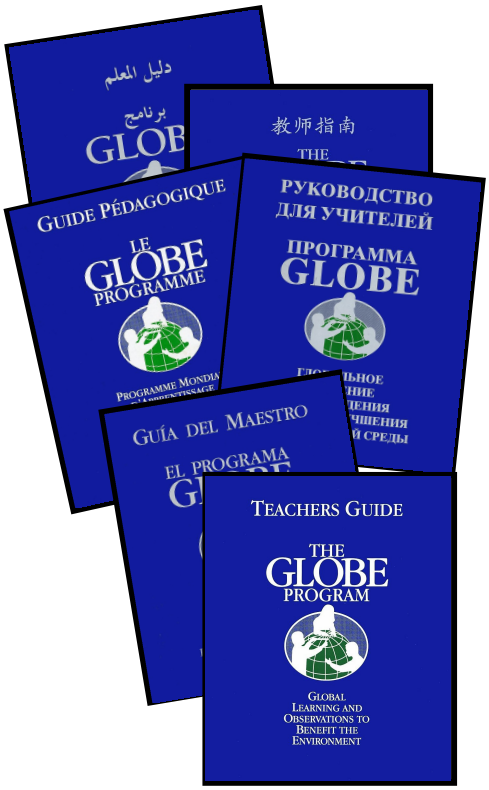
The GLOBE Program: Educational Benefits for Students and Teachers

The GLOBE Program

GLOBE provides a variety of K-12 educational materials, from hands-on inquiry activities for classroom use to online interactive learning experiences and investigations using student-collected data.



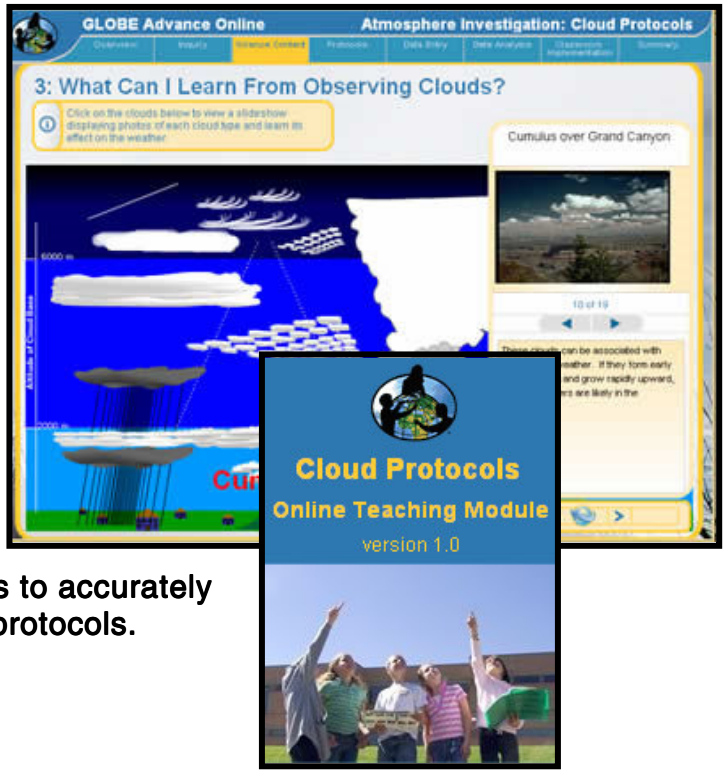
The GLOBE Teacher's

The GLOBE Teacher's Guide provides the scientific and educational foundation for the first generation of GLOBE investigations: Atmosphere, Hydrology, Land Cover, Phenology, and Soil. It includes information necessary for accurate data collection such as measurement procedures, student lab and field guides, instrument specifications, and scientific background information. The Teacher's Guide also includes a variety of Learning Activities that complement data collection and extend student understanding of the Earth as a system through a hands-on and inquiry-based approach.

Elementary GLOBE

GLOBE has developed a suite of storybooks and learning activities specifically designed for grades K-2 that form the Elementary GLOBE Unit. This unit engages the youngest GLOBE students in an age-appropriate fashion. These standards-based and classroom-tested resources include five modules that each address parts of the Earth system while also building literacy skills.

Online Teaching Modules



The GLOBE Program has developed Interactive online resources to promote understanding of GLOBE Program content and scientific protocols. Resources combine graphics and interactivity to promote understanding through a hands-on approach that has been established as a successful model for online learning. The Cloud Protocols module (shown here) promotes scientific understanding of cloud formation, content on identification of cloud types, and interactive features to help online learners to accurately collect data related to the GLOBE Cloud protocols.

Data Use Activities

Educational materials have been designed to encourage student analysis and interpretation of data. The data use activities foster student investigation of environmental data using the GLOBE Web site and its online graphing tools.

GLOBE educational technologists are exploring additional learning models to encourage student interpretation of data in an online and inquiry-based format.

Partner Updates & Highlights

GLOBE International and U.S. Partners all agree that the program serves as an international common ground where educators and youngsters of all backgrounds share the excitement of science and learning. Through GLOBE, children, teachers, community members and scientists from different cultures - in their own countries and from around the world - work together as they gather, report and analyze data. GLOBE provides opportunities for students to experience the excitement, satisfaction and frustrations of working together, getting along, and communicating well. **"The international dimensions of the GLOBE Program provide opportunities for students around the world to collaborate on scientific research projects while at the same time learn about each other's countries, cultures and languages,"** said Dr. Teresa Kennedy, Director of International/U.S. Partnerships. GLOBE organizes International Learning Expeditions and Conferences that provide students with opportunities to discuss their research on a world-wide scale. **"GLOBE allows teachers to put the concepts of authentic learning, student-scientist partnership, scientific inquiry and standards-based pedagogy into practice on an unprecedented scale. GLOBE encourages all students to behave as scientists and mathematicians while promoting collaboration among all content disciplines in the school."** said Dr. Craig Blurton, former Director of GLOBE.

Many organizations are collaborating with GLOBE coordinators to help facilitate program growth. These include the United Nations Environmental Programme, U.S. Peace Corps, the United Nations High Commission on Refugees (UNHCR), Rotary International, The Foundation for the Future of Youth, World Wildlife Fund, Sister Cities International and many other governmental as well as non-governmental organizations (NGOs).

The number of partnerships at **minority serving institutions** has increased significantly. For example, traditional ways of knowing joined with contemporary science research as educators and others from more than a dozen **U.S. Tribal Colleges** met for sessions entitled "Weaving Common Threads" at Northern Arizona University. GLOBE U.S. Partner Coordinator Elena Sparrow, from the University of Alaska in Fairbanks, believes that GLOBE schools can learn from the **Native Americans** who have an intimate knowledge of their environment, as they have historically depended on natural resources to provide shelter, clothing, and food. "Some Native American elders are able to accurately predict weather," Sparrow says. "Their sense of observation is so keen, in a way that we're trying to teach in western science. It's a valuable scientific skill, and something GLOBE students can learn."

Other training sessions designed to focus on the expansion of diversity within the GLOBE program brought together representatives from **Historically Black Colleges and Universities** (HBCU) from around the country at Howard University in Washington D.C. Representatives from 17 HBCU's and 9 African nations were given the opportunity to develop collaborative relationships on many issues such as cross Atlantic scientific research, and ways to empower and engage minority students into the field of science, technology, engineering and mathematics while establishing long-term partnerships at all levels.

Lifelong Learning: Student to Retiree "GLOBE is not only about lifelong learning," said former GLOBE Director Tom Pyke, "but also about lifelong contributions to knowledge of our world." In an extraordinary display of lifelong learning, a handful of seniors in the United States and in Europe have embraced GLOBE long past their retirement from full time jobs. GLOBE participants at three senior institutions in Mobile, AL know very well that neither physical infirmity nor advanced age are obstacles to learning. These seniors say they have enjoyed the opportunity to master GLOBE's scientific protocols, to satisfy their curiosity about the environment and to make a contribution. Perhaps most profoundly, Anne Marshall, a certified therapeutic recreation specialist, found that GLOBE participants showed a measurable improvement in psychological well being compared to a control group. Senior GLOBE enthusiasts in the Netherlands took an entirely different approach. Ten Dutch seniors recently received training in Bennekom so that they can go into classrooms and help GLOBE teachers and students with their research. **GLOBE is an all-inclusive program!**

GLOBE Promotes Curriculum Integration

GLOBE is a means of bringing virtually every classroom in the school together to work on the same mission with other students and scientists world-wide. Students concentrate on protocols in their **science** classrooms and **math** when learning scientific research methodologies and manipulating data sets. **Technology** classrooms utilize GLOBE data sets to create elaborate charts, graphs and maps, comparing their findings with other areas around the world to examine data critically.

Consistent with **Secretary of Education Rod Paige's priorities for international education,** GLOBE is the perfect **standards-based** venue to conducting projects involving comparative studies between the **105** different countries involved in the program. A November 20, 2002 press release stated that the Department's first policy priority is "increasing U.S. knowledge and expertise about other regions, cultures, languages and international issues." GLOBE supports the multicultural study of **geography** by providing students with hands-on experience with basic geographic skills such as understanding latitude, longitude, scale, map elements and spatial analysis.

Additionally, **foreign language classrooms** are provided with authentic opportunities for communication in many languages through GLOBE School-to-School emails (GLOBEmail) and Web chats, which provide interactive ways for students to work on projects with other schools across town or around the world. Because GLOBE is a world-wide program, materials are currently available in all six United Nations' languages (English, Spanish, French, Russian, Mandarin, and Arabic), plus German, and more languages are becoming available all the time through our international partners. GLOBE students are introduced to other languages and cultures as they engage in authentic projects and meaningful discussions with one another, students in other countries, and world experts in the disciplines they are studying

GLOBE provides teachers working with **English Language Learners** (**ELL's)** the opportunity to assist their students to acquire English literacy skills in the regular classroom while learning the curriculum outlined for their grade level. These students also assume leadership positions in their classrooms when the discussions and Internet exchanges occur with other students from their home countries. GLOBE provides these students with access to high-quality science information by communicating in their first language. New figures released in January 2003 by the Census Bureau reported that the **Hispanic population, the nation's largest minority group**, is now roughly at 37 million. GLOBE is the means to create an enrichment program that actively includes the Hispanic student population in the school while enhancing the academic achievements of the entire student body, ultimately integrating **literacy skills in reading and writing** with all disciplines in the school.

Virtually all classrooms in the school can participate in GLOBE activities. Students build weather stations in their **industrial technology** classrooms while students in **agricultural education** classrooms can actively assist scientists and farmers in the field to better track environmental events effecting crop production. It is also possible to incorporate GLOBE into the **arts and humanities** (art, drama, drawing, music, photography), and **language arts** (descriptive and technical writing). For example, students in **art education** classrooms work with contour maps, draw landscape diagrams and study soil colors.

GLOBE provides authentic, life-centered curricula and opportunities for meeting the **special needs** found in inclusive classrooms of students with a broad range of abilities and learning styles. Furthermore, opportunities for **cross-age tutoring** encourage school-wide collaboration, respect for the background and perspectives of all students, and enhanced content learning and cooperation. GLOBE activities are also ideal for **after school clubs** and community **service-learning** projects.

GLOBE allows teachers to collaborate between disciplines, provides students with a more integrated view of their own learning, and enables all students to see the interconnection between the various subjects they study. Student motivation to learning is peaked when they are given a sense of meaningfulness in regard to their studies. Because GLOBE links teachers and students around the world, it fosters alliances among students and increases not only their environmental awareness but also their understanding of other cultures and their sense of a global community. GLOBE allows teachers to put the concepts of authentic learning, student-scientist partnership, scientific inquiry and standards-based pedagogy into practice on an unprecedented scale. **GLOBE encourages all students to behave as scientists and mathematicians while promoting collaboration among all content disciplines in the school.**

GLOBE Helps Teachers Meet Many Standards

The GLOBE Program helps teachers link their work in the classroom and the field with emerging requirements for teaching and testing in science, math, and other subjects. In the U.S., individual states have developed education standards, often building on recommendations provided by the American Association for the Advancement of Science (AAAS) and the National Academy of Sciences (NAS), leaders in science education reform. Internationally, the Third International Mathematics and Science Study (TIMSS) has measured students' science and math performance and effectively defined expectations for student achievement. Although the emerging standards vary somewhat in content and scope, they generally emphasize the hands-on, scientific inquiry-based approach that is a cornerstone of GLOBE.

"Schools embrace GLOBE science because it is authentic, performed as professional scientists perform it," said Dr. Ralph Coppola, former GLOBE Chief Educator and Assistant Director for Education and Training. "States are implementing education reform through standards. We want to make it easier for teachers to meet their state requirements in science, math, geography and other areas of study. We will align GLOBE with standards and help establish professional development networks. GLOBE fits very well with the reform agenda."

SCIENCE EDUCATION "UTOPIA"

In North Carolina, teachers have a clear idea of how GLOBE fits in with their state's newly revised standards because the state education department itself has embraced the GLOBE program. Like many states, North Carolina used AAAS benchmarks. (These benchmarks can be found on the web at www.project2061.org/tools/benchol/bolframe.html.) The goals that permeate the revised standards for science education include the Nature of Science, Science As Inquiry, Science and Technology, and Science and Personal and Social Perspectives.

"GLOBE ties in very nicely in all categories," said Clara Stallings, middle school science consultant for North Carolina's Department of Public Instruction. "When I once described the utopia of what science education should look like, I ended up describing what GLOBE is today. The completeness of it, the materials support, the formalized protocols which really emphasize how all scientists do things. And the students are actually given the structure to do something meaningful with the data. We've spent the last two years getting curricula in place and the past year trying to identify exemplary programs. GLOBE is not the only program but is the one that best fits the competency goals in middle school."

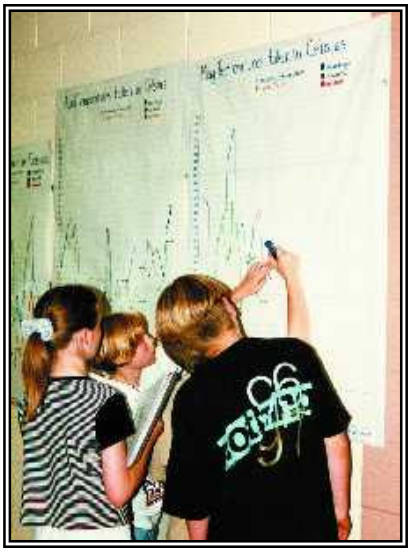
North Carolina sixth graders will focus on soil protocols, seventh graders on atmosphere protocols, and eighth graders on hydrology. In high school, the Earth science course covers all three areas plus land cover. "Everybody wants the training now - whole counties want the training," Stallings said. "It's a nice problem to have." GLOBE conducted a workshop in NC building a cadre of trainers to prepare teachers to implement GLOBE as a component of their implementation of state standards.

The 2003 New Teacher Manual with E-guide is now available! Contact your State Partnership for assistance in training teachers in your school. State Partnership information is listed online at www.globe.gov

GLOBE Aids in Teaching Math

One of the major goals of the GLOBE Program is to enhance student achievement in math. Teachers are reporting that GLOBE can help demonstrate mathematical concepts in a way that makes learning math fun and, best of all, easier to understand. "Math is a worry for a lot of students," says Jeanette Stopher, a GLOBE Teacher at Corbin High School in Kentucky. "We try to show students a continuity between math and science, that math is not just memorization."

Ms. Stopher teaches ninth grade science and works with the school's math teacher to coordinate the mathematical applications addressed by GLOBE into the math curriculum. The teachers have worked together on algebra, geometry, dimensional analysis, measurement skills, and standard equations. Ms. Stopher says such coordination doesn't have to be a lot of extra work for either teacher. "Our math teacher is very innovative, and she wants something from real-life that helps students understand. Getting things together can really mean a five-minute conversation in the hallway," she says.



Using GLOBE to teach math is also useful for younger grades. At the University of Montana in Missoula, Georgia Cobbs works with K-8 pre-service teachers to help them see the links GLOBE offers between science and math. "There's no GLOBE without mathematics," Dr. Cobbs says. "There is a great connection between the math and science methods, and I definitely see GLOBE as a great math foundation."

In Pennsylvania, GLOBE Teacher Gayle Sellers is using GLOBE to help students at Royersford Elementary School understand fractions using decimals and percentages. "In pH, when they decide if it's a 4 or a 5, they use the meter and can see it's a 4.6. Now they understand," Ms. Sellers says.

Nora Ziegler, who teaches students at Hillsdale Elementary School in West Chester, PA, agrees that GLOBE has enabled her students to grasp more advanced math ideas than they otherwise might. Her third-graders are working with percentages, fractions, minimum and maximum temperatures, Fahrenheit to Celsius conversion and some work with spreadsheets. "With GLOBE they can see the math, such as when I demonstrate the cloud cover using strips of blue and white paper. If there are five strips of white and five of blue, they see that it is 50 percent," Ms. Ziegler says.

At the middle school level, GLOBE is also being used to teach percentages, averages, and probabilities. "With the statistics involved in GLOBE, with the information gathering, students are able to use what they've observed in math," says GLOBE Teacher Thomas Ingram from the A.M. Thomas Middle School in Lost Hills, CA.

"We're always looking for things that will take us away from the text book," reports GLOBE Teacher Steve Newman from the Kent Denver School in Englewood, CO. He has used GLOBE to work on averages, mean, median and mode, graphing and other math activities. "It's good when kids have some ownership in the data," Mr. Newman says. "It has also charged up the math people here. GLOBE has a lot of opportunities to do that, using the data and using technology."

Lessons in Geography

From the earliest elementary grades up through the university level, educators are finding that the GLOBE Program can help support the study of geography. In GLOBE, students are getting hands-on experience with basic geographic skills, such as understanding scale, latitude and longitude, map elements, and spatial analysis.
"Geographers have recognized for two millennia that human beings have an impact upon Earth and that it is our responsibility, as geographers, to better understand these impacts," said Alex Philp, Assistant Director of the EOS Education Project at the University of Montana (UMT) in Missoula. "Every single GLOBE protocol -- from water analysis, to atmospherics, to land cover -- is really the stuff of a good physical geography course."

"The GLOBE protocols provide an excellent introduction to biophysical geography for K-12 students. The association of the GLOBE Program with geographic alliances assures a better understanding of environmental interrelationships and their relevance to society," said Jeff Gritzner, Chairman of the Geography Department at UMT.

Given these and other benefits of the GLOBE Program, the University is incorporating GLOBE training into the curriculum for pre-service training of elementary and high school teachers. In addition, the GLOBE U.S. Partner at UMT and the Montana Geographic Alliance have formed the Montana-GLOBE Alliance Partnership to promote geography and environmental science studies in the state's K-12 system.

Geographer and University of Arizona U.S. Partner Coordinator, Cyndy Henzel, also found that GLOBE complements the teaching of geography, providing K-12 students with exposure to college level concepts. "Understanding that certain types of soils, climates, and land cover affect where people live and what they do - that's what really makes it interesting," she added, "Putting the cultural information together with the physical information is a powerful learning tool for us all."

The GLOBE Program is also attractive to educators interested in introducing the technology of Geographic Information Systems (GIS) into the classroom. Through GIS, with its new advances in software technology, geographers are able to take satellite imagery and other information and create detailed data maps more easily than ever before. GIS maps can include a wide variety of information - such as GLOBE student data and be tailored for use in an almost infinite number of scenarios, such as land use planning and business development.

John D. Moore, a GLOBE teacher at the Burlington County Institute of Technology in Medford, New Jersey initiated a collaborative project for GLOBE schools worldwide interested in learning about how to use GIS technology with GLOBE data to study the Earth's environment. "In the environmental field, ultimately, there is no way that one country is going to manage the globe," Mr. Moore said. "It is critical that students get to know each other, because they will be working together in the future, and our GLOBE-GIS project is building those partnerships."

GLOBE in Alabama U.S. Partner Coordinator, Greg Cox, believes that an early introduction to geography concepts and GIS through GLOBE will prepare students to excel in this emerging field of technology. "Here in Alabama, and across the nation, knowledge of GIS technology is becoming a valuable skill for young people entering the workforce, and GLOBE students can become leaders in this field," he said.

GLOBE Offers Lessons in Language

Anyone one who has taken a foreign language class remembers starting with the fundamentals, such as how to talk about the weather. Unfortunately, the conversations were only hypothetical. However, in GLOBE, many educators are finding a valuable opportunity for students to learn to conduct real conversations about the weather, and much more, while also learning a second language. "The GLOBE Program lends itself as a vehicle for learning foreign languages, social studies, and culture," reported GLOBE Teacher Teresa Kennedy of Moscow, Idaho. "This model provides the perfect foundation for interdisciplinary study." Dr. Kennedy, who also teaches at the University of Idaho's College of Education, has already begun to incorporate GLOBE into the curriculum of the Idaho Foreign Language Elementary School Program with great success. She and her colleagues at the University are beginning this initiative at the elementary school level, when students have a greater aptitude for learning a new language.

The students in Kennedy's classrooms are using Spanish versions of the GLOBE printed and online materials. The students are also using GLOBEMail to practice their Spanish by contacting their peers in Spanish-speaking countries. For example, the Idaho elementary school children correspond in Spanish with students in Colegio La Misericordia and Colegio El Buen Aire, GLOBE schools in Argentina. Kennedy emphasizes that, when kids enjoy using a foreign language, they are more likely to learn it. "GLOBE brings everything into perspective. The students are not learning isolated vocabulary words. It's true to life. The kids love it, and I really think they are going to come out with a higher level of proficiency," Kennedy says. "¡GLOBE es divertido. Me gusta el programa de GLOBE!" exclaims Sara, a fourth grade student in Kennedy's classroom.

Tony Magnelli, a GLOBE Teacher in Sewickley, Pennsylvania, describes another example of the interdisciplinary model. At Quaker Valley Middle School, sixth graders study South America in social studies and use GLOBE to study Spanish. They are establishing an information exchange program with South American GLOBE schools that want to use GLOBE in their English studies. The students in Pennsylvania will get online assistance in sharpening their Spanish skills while offering to tutor the South American students in English. Magnelli's students will also be producing email bulletins and weekly videos – in Spanish - to report weather data to their classmates. "GLOBE activities give these students the chance to really put their Spanish lessons to work, not just engage in role play," Magnelli said.

In other classrooms, GLOBE is being used to teach English to students for whom English is not their first language. For example, for many deaf and hard-of-hearing students, American Sign Language (ASL) is their first language. "Deaf students are communicating among themselves in ASL when they're using their hands in sign language, but when it comes to writing or reading, they have to switch over to English," explains Jerry Jones, a GLOBE Teacher at the Mississippi School for the Deaf in Jackson. "There are grammatical differences between the two languages." Jones said her students are using GLOBEMail to help practice English writing skills.

During the summer of 1998, students from the Mississippi School for the Deaf will be presenting the results of research on El Niño at the GLOBE Learning Expedition in Helsinki, Finland. As part of their presentation, the students also hope to teach their peers from other GLOBE schools some important GLOBE words and phrases in ASL.

In Greece, where students are required to learn a second language, schools are using GLOBE materials to improve their English skills. "The students are excited about having a real opportunity to practice their English through communications with GLOBE scientists and students in other countries and by using the GLOBE Web site," reports the Country Coordinator for GLOBE Greece, Costas Cartalis. "Participating in the GLOBE Web chats is particularly exciting as it requires the students to quickly read and respond to messages in English."

GLOBE Aids in Teaching Reading

Although elementary and middle school teachers are accustomed to integrating their teaching, many are under a great deal of pressure to concentrate on reading and writing. "Science, and especially inquiry-based science, often falls by the wayside," reports David LaHart, a professor at Florida State University's Institute of Science and Public Affairs.

Despite this pressure, science need not take a back seat. Educators are finding creative ways to integrate science learning into reading and writing exercises using GLOBE materials. By integrating science and reading through the use of story books and activities, teachers can cover two important subjects areas with substantially less time.

"I participate in GLOBE and language arts because GLOBE requires critical thinking, creative thinking, problem solving, and research." Marcie L. Bosseler, GLOBE Teacher, Miami, FL

Sandra Ivins, a second-grade teacher at Major Edwards Elementary School in West Boylston, MA, has identified a number of storybooks that complement her GLOBE activities, such as Letting Swift River Go and A River Wild. "We can use literature books to teach about the quality of the water," Ms. Ivins says. "People think second-graders can't handle this level of science. But they really rise to the occasion when they've read about the river in books and they've slipped along the river bank to do the tests."

Ms. Ivins also has her children write haiku poems using the scientific terms used in GLOBE. "Haiku is a short, easy form of poetry. We write about water and use words like evaporation and precipitation, and they're no longer difficult words."

Dr. LaHart and his colleagues at Florida State are developing and field-testing a series of storybooks which highlight the GLOBE protocol areas. "We figured that if lower-elementary teachers had one more tool in their box, they could teach some science and the students would learn the `whys' of the protocols," Dr. LaHart said. Check it out online at http://www.globe.fsu.edu/sample.html

Many teachers are incorporating GLOBE in projects that require independent research and writing reports. "I incorporate GLOBE and language arts because GLOBE requires critical thinking, creative thinking, problem solving, and research," says Marcie L. Bosseler, a GLOBE Teacher at Palmetto Elementary School in Miami, FL.

Sue Robinson, who teaches third through sixth grade at Gold Dust Elementary School in Phoenix, AZ, has students gather information about different countries from books and from the Internet and then connect with GLOBE students from those countries by sending letters via GLOBEMail.

"They write and edit very carefully when they know their message is going to another country, when someone other than me is going to be reading it," Ms. Robinson says. "There is often a lot of back and forth between the students as they explain different hobbies and customs. It provides a huge incentive to go into more depth, and there's a lot of research, reading and writing involved."

Gail Fuller, a special education teacher with fifth and sixth-grade students in New York, also finds that GLOBE lends itself well to research projects that require reading and writing skills. Integrating GLOBE into science, language arts and other subjects is allowing her to meet high education standards being set in her state and across the country. "New York State has a lot of standards right now, and they are inquiry-based and integrated. GLOBE is just that," she said.

Meeting the Special Needs of All Students
By Jennifer Locket, GLOBE Trainer, Alabama

With a Masters Degree in Special Education and with a special needs child of my own, I became interested in using GLOBE with special needs students soon after attending my first GLOBE Teacher Training Workshop in 1998. In an inclusive classroom of students with a broad range of abilities and learning styles, educators must find programs that offer integrated curricula, interdisciplinary teaching, multi-cultural curricula, and life-centered curricula. GLOBE provides each of these critical elements!

Some 65 percent of the diagnosed special needs students in the United States are in the regular classroom for all or most the day. GLOBE can help these students achieve success in the classroom, maybe for the first time. With GLOBE, my special students do not have to settle for watered-down curriculum or untested programs. It takes planning and a conscious effort to include these students in GLOBE activities, but I believe teachers will find, like I have, that they do not need to make more than minor adaptions to the GLOBE activities for the program to work successfully with their entire classroom.

We all have had the student who spends much of the day in classes for disruptive behavior. Harmless clowning around develops into more serious behaviors that in turn lead to a diagnosis of a behavior disorder. Often test results will show difficulty with audio and visual processing. I believe GLOBE can help these students feel part of something bigger and something important, and provide them an opportunity to take some personal responsibility.

Educators are also in search of ways to reach students with learning disabilities or those diagnosed with attention deficit disorders. School is a struggle for these young people, even with an above-average ability to learn. They need immediate feedback and meaningful results. The regular teaching styles of the past years do not accommodate these special needs. This is another instance where the hands-on nature of GLOBE can help.

Reflecting on my work with special needs students, I realize that *all* of our young people are "special needs" students. In order for our children to succeed in life, each and everyone one of them has emotional, physical, and academic needs that must be met. Through GLOBE, students can see a bigger picture than what's in their own backyard and can realize their individual responsibilities as a part of humankind. By being members of a team with scientists and other students, GLOBE students learn life lessons such as cooperative learning and productive thinking.

I truly believe that, by its design, the GLOBE Program helps address both the educational concepts and the life values that *all* of our young people need to learn. By being members of a team with scientists and other students, GLOBE students learn life lessons such as cooperative learning and productive thinking.
I am thankful to all I have met in this journey and to the GLOBE Program for being the vehicle that I was able to embrace in teaching my students, including those with special needs.

Jennifer Lockett is a teacher with the Archdiocese of Mobile and a GLOBE Trainer with the GLOBE in Alabama U.S. Partner. She can be reached at ***jlockett@bellsouth.net***.

GLOBE Students Initiate Collaborative Studies

Scientists recognize the importance of collaboration in their quest for knowledge. Through the GLOBE Program, K-12 students are also learning this valuable lesson. Teachers report that, in their classrooms, the GLOBE Program fosters individual and group student research, collaboration among local schools, and cooperation among schools regionally and globally.

As the 1998-99 winter season descended on the Northern Hemisphere, students of GLOBE Teacher Jim Lane at Charles B. Murray Elementary School in Sheridan, Montana, initiated an international research project among GLOBE schools to study snow variation. Using the GLOBE Web site to communicate, schools from throughout the United States and Scandinavia joined together to test and compare the density, hardness, reflectivity, compactibility, crystallization and layers of the snow.

"We added this to our regular GLOBE tests because it's a fun thing to do and because we're able to interact with other GLOBE students and teachers around the world," Mr. Lane says. "We can study whether our snow is different from somebody else's and our students can ask themselves, 'Why?'"

Eighth graders in Michael Cavanaugh's class at Nolan Middle School in Killeen, Texas, use other GLOBE schools' data to sharpen their compare-and-contrast skills. The students use the GLOBE Web site and other resources to identify areas of the country and the world with varying climates for their research. "First, we look for schools that have a lot of data. Then, we use data from other schools to compare the seasons," Mr. Cavanaugh said. "My students understand that when scientists or other GLOBE schools look for useful data the schools with the most consistent data are the most helpful for research purposes." Although Mr. Cavanaugh works hard to be sure his students understand the seriousness of using and reporting high-quality data, that doesn't take away from their enjoyment of their GLOBE studies. "Working with dissolved oxygen and pH was great," says GLOBE Student Jonathan Westerfield. "I felt like I was a real scientist, and I was." Jonathan's classmate, Katie McQuadem added, "I also like the idea that kids all over the world can look at and use the data we have collected."

In Marion, Massachusetts, GLOBE Teacher Richard Harlow requires his students at the Tabor Academy to communicate with other GLOBE schools for a number of projects. For example, Mr. Harlow's students are interested in climate variations. First, they identify GLOBE schools with differing climates from their own. Then, they research historical climatic data for each school's region, and compare it with the current data being reported by GLOBE students, looking for changes in climate over time.

Mr. Harlow's students have found that younger students often provide the best quality data. "My students have learned through GLOBE that all ages contribute equally to the scientific data base," Mr. Harlow said. "These school-to-school projects impress students with the need that working scientists have for cooperation, while also giving students a chance to use the Internet in a meaningful way."

From scientific collaborations, GLOBE students also gain in knowledge and understanding of other cultures. "GLOBE is such a wonderful tool to bring learning into the real lives of the students and to introduce them to others' lives around the world," says Sheila Yule, a junior high science teacher at St. Francis of Assisi School in Louisville, Kentucky. "Our collaboration with our GLOBE partners in Ecuador has been very rewarding for the students. Bertha Aguirre de Calle, a GLOBE teacher from Santo Domingo de los Colorados, actually visited us and our students, who are learning Spanish, enjoyed a chance to practice by talking with her."

GLOBE Student Data Aids Agricultural Research

Farmers in Washington State have observed that, if it rains just before wheat crops are harvested, the seeds on the plant start to germinate, rendering them less useful for planting new wheat crops the following year. Researchers from Washington State University are turning to GLOBE students to help the farmers address this problem.

In beginning this research effort, Dr. Stephen Spaeth from the University's Seed Technology Lab looked for precipitation data from various meteorological stations around the state, but found that such data were not available in the area of concern.

Fortunately, Dr. Spaeth had become familiar with the availability of GLOBE data through his daughter's participation in the program as a student at Sunnyside Elementary School in Pullman, Washington. By visiting the GLOBE website, Dr. Spaeth found the data he needed from St. John Vianney School, a GLOBE school in Spokane, Washington. "You have collected and published one of the most complete public weather records in one area of our interest," Dr. Spaeth told the GLOBE students.

The scientists are using local GLOBE precipitation data to identify when there are harmful rains and to help determine when other water sources may be a cause for early germination of wheat seeds. "Zero or trace readings of precipitation may not be as exciting as huge downpours, but sometimes they are just as important," Dr. Spaeth said. With this data, he and his colleagues will better be able to track precipitation events along with the wheat growing season, and look for relationships between exposure to water and seed germination.

The GLOBE students at St. John Vianney have been collecting atmospheric data consistently since spring 1995. The students, who are also experienced in soil characterization studies, have also been called on to assist the Washington State Soil Conservation Department in other studies of local agricultural field conditions.

GLOBE Allied with "Team Ag-Ed"

In recognition of shared values and approaches, GLOBE is partnering with Team Ag-Ed. The Team includes The National FFA, The National Council for Agricultural Education, and the National Association for Agricultural Educators. “Our mutual goals are to help agricultural education teachers and students learn and benefit from the Program, and to strengthen working relationships among science, agriculture and general education teachers”, says Dr. Carol Conroy, GLOBE Chief Educator and Director for US Partnerships. “A well-designed program integrating the three core areas of agricultural education—classroom instruction, SAE, and FFA leadership—can provide a context for learning necessary content and skills. GLOBE injects local, regional and global relevance into instruction in scientific principles and SAE projects focused on long-term scientific inquiry.”

Students and Satellites Team Up!

A major revolution in satellite observations of Earth is underway. An extraordinary investment in satellites and instrumentation over the last eight years is beginning to pay dividends. This also is a revolutionary time for the involvement of school children in helping all of us to understand the global environment.

Enter The GLOBE Program. Across the planet, students on every continent are taking data that directly relates to satellite observations of Earth from space. For example, GLOBE students take measurements in land cover, phenology, clouds and aerosols – measurements that scientists can compare with their satellite data.

Upcoming NASA Earth Observing System launches and associated small missions, the European Space Agency's ENVISAT, the continuation of Canada's Radarsat and Japanese Earth observing satellites all come together to make this a time ripe with opportunities for gaining a comprehensive understanding of Earth as a system, but remote sensing data can only supply a part of the observations. Ground-based measurements are required and volunteer observers, including GLOBE students, can supply some of these.

GLOBE directly partners with several satellite missions that together cover virtually all aspects of the global environment. For example, in CENA, the GLOBE aerosol investigation at Drexel University has students perform sun photometry measurements to compare with data from the Pathfinder Instruments for Cloud and Aerosols Observations - Climatologie Etendue des Nuages et des Aerosols.

Colorado State University and the Jet Propulsion Laboratory joint CloudSat Mission, to be launched in April 2004, is a satellite experiment designed to measure the vertical structure of clouds. Its goal is to evaluate and improve the way clouds are represented in global models, thus better understanding their role in climate change and weather prediction.

"Student observations of clouds are a unique and important contribution to the CloudSat mission. Even a simple observation of what clouds are present and whether rain or snow is falling at or close to the time that the CloudSat radar flies overhead is a tremendous help," said Graeme Stephens, CloudSat Principal Investigator. "Scientists use such GLOBE data to help determine how well the CloudSat radar can detect and measure precipitation and whiter the radar is missing some clouds, such as low-level clouds."

GLOBE land cover data are used by NASA scientists to ground truth images taken by Terra, the first satellite to monitor daily - and on a global scale - how Earth's atmosphere, lands, oceans, solar radiation and life influence each other. Terra's wide array of measurements will give a comprehensive evaluation of Earth as a system and will establish a new basis for long-term monitoring of changes in Earth's climate for future satellites. Terra was launched in December, 1999.

GLOBE students will be using four-channel sun photometers to measure column water vapor along with aerosol optical thickness in support of the NASA Geosynchronous Infrared Fourier Transform Spectrometer (GIFTS) mission. In the Netherlands, GLOBE student sun photometer measurements will be used by the Dutch Meteorological Institute to validate satellite data from the Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY), which is scheduled to be launched this year. Look up, GLOBE students, you have partners in space.

Informal Education

The GLOBE Learning Community (GLC) concept encourages the participation of a broad range of community members who share a common commitment to supporting teachers and students in the implementation of GLOBE for the benefit of their community. A GLC might begin as a GLOBE Partner based at a university working with teachers and students from primary and secondary schools in the local school district, and then branch out to include parents, youth clubs, scientists, senior citizens, other colleges and universities, daycare centers, museums, businesses, government agencies and more. The following are examples of GLCs.

Eagle Scout Project Leads to Construction of Instrument Shelters

Eagle Scout candidate Greg Colton with Troop 83 from Ft. Collins, Colorado, led the construction effort of building 11 GLOBE instrument shelters which will be donated to local GLOBE schools. Boy Scouts from several Fort Collins troops teamed up on August 21, 2004, at Colorado State University's Atmospheric Science Building on the university's Foothills Campus, to participate in this activity.

The Eagle Rank is the highest rank within Boy Scouts and is awarded to projects demonstrating a dedicated level of leadership and contribution to their community. Less than 2% of all boys involved in the Boy Scouts attain this rank. The event was supported by United Building Centers and Mawson Lumber & Hardware Company, who donated the wood for the instrument shelters, and Brown Enterprises who precut the forms for assembly. The NASA CloudSat mission was also one of the sponsors.

A Desert Also is a Teacher

One doesn't usually think of deserts as "lush". Yet the Sonoran Desert running in the U.S. through Southwest Arizona and part of California into parts of Senora and Baja, Mexico is among the most lush in the world.

Plants such as the agave, coulter's globemallow, creosote bush, desert mariposa lily, mesquite, ocotillo, palo verde and the stately, world-famous saguaro cactus thrive there. Animals such as the raccoon-like coati, javelina, elf owl, gila monster, kangaroo rat, pack rat, roadrunner, sidewinder, and tarantula have found their niches there. And after a good -- if rare -- rain, many of the 2,000 species of flowering plants explode into bloom.

Educators and scientists at the Arizona-Sonora Desert Museum in Tucson are using GLOBE protocols to help them monitor different ecological communities within the desert. The museum's mission is both educational and scientific and staff members there believe GLOBE fits just right.

No Age Limit to Learning, GLOBE Seniors Show

Like any GLOBE student, Florence Martin is trained to read and record measurements from the instrument shelter at her site. Yet unlike most GLOBE students, she turned 90 on the day Mobile, AL, measured a record high of 105 this summer.

Ms. Martin and her fellow GLOBE participants - some in their 70s, 80s and 90s - at three senior institutions in Mobile, AL, know very well that neither physical infirmity nor advanced age are obstacles to lifelong learning. The seniors maintain GLOBE study sites at two residential facilities, the Allen Memorial Home and the Atria Regency residence. A third site is at a non-residential community center, Senior Citizens Services Inc., also known as the Mary Abbie Berg Senior Center.

VISIT THE GLOBE WEB SITE WWW.GLOBE.GOV TO SEE THESE AND MANY MORE EXAMPLES OF GLOBE PARTNER ACTIVITIES

EDUCATORS ARE TALKING ABOUT GLOBE...

GLOBE is a great tool to help teachers meet state and national education goals and standards. ***Richard Dinko, Educator, Canton, OH***

GLOBE brings the concepts of authentic learning, student–scientist partnerships, and inquiry-based education into practice on an unprecedented scale. The results can be seen in young people around the world through an increased understanding of Earth as a system. ***Jennifer Lockett, Teacher, Mobile, AL***

GLOBE is an incredible program, a very exciting opportunity for teachers and students. The key is that the students have ownership of what they are doing -- the taking and reporting of measurements; the analysis of their work and the work of other schools. The materials and instruction that GLOBE supplies are invaluable for the long run and the program's Help Desk gives us constant support. ***Debra Foster, School Board Member, Middlebury, VT***

Not only are my students excited about GLOBE, their parents are. I've had many of the adults tell me we need to do more of this. ***Nancy Dickerson, Teacher, Bristol, TN***

GLOBE combines classroom activities and modern technology and gives kids the chance to work with scientists. This all fits with our goals aimed at using new technology and sharing ideas among educators. ***Linda Clifton, Principal, Booneville, MS***

In my 20-plus years of teaching, I have never seen such positive student reaction to a science program. They like learning because it is hands-on and real life. ***Bob Jost, Teacher, Fresno, CA***

I knew from day one that I wanted GLOBE to be a part of each science class in our high school, and now it is! ***Peggy Foletta, Teacher, Kingsburg, CA***

GLOBE helps students with thinking critically, communicating effectively, developing cross-cultural understanding, demonstrating responsibility, and accessing and using information effectively. ***Diane Duncan, Teacher, St. Charles, IL***

The opportunity for our students to participate in the authentic international scientific endeavors of the GLOBE Program has clearly demonstrated to us that the learning - which correlates to real environmental issues - is rich and lasting, and it is most rewarding. ***Del Clark, Board of Education Los Alamitos, CA***

GLOBE is the best program I've seen for generating a natural student interest in science. ***Diane Wells, Teacher, Glenwood, MD***

The best part of GLOBE is that it lets students take the initiative in learning and the children don't have to be 'A' students. ***Tammy Mauney, Teacher, Booneville, MS***

As educators, we are challenged to make science exciting and relevant for your people. GLOBE, a program appropriate for the third millennium, meets that challenge. ***John Padalino, former chair, National Science Teachers Association's Environment Education Advisory Board***

GLOBE is an opportunity for students to see themselves as possible future scientists because they are actually being encouraged to work like scientists. We are totally committed to this program because of what it does for kids. ***Vicky Christenson, Denton Independent School District, TX***

My students... have really found themselves in this GLOBE. They have been asking questions like "What does it take to be a scientist?" or "I would like to become an environmentalist, what do you think?" This is so great! *They have never thought of this before!* It is all because of the GLOBE Programme. ***Maisa' Haddad, Teacher, Jordan***

I just returned from an excellent GLOBE workshop and I was fascinated by the problem-oriented, *real- life and inquiry- based approaches* used in this course. GLOBE is an ideal content to demonstrate contextual learning and teaching. ***Hossein Divanfard, Chemistry Professor, Toppenish, WA***

GLOBE is fabulous! I can't tell you how excited I am to be involved in such a relevant program to be entering the new millennium! ***Lisa Pitman, K-12 Education Director, Miami, FL***

Our school board knows technology is key for kids whether or not they go on to college and so our schools are interested in programs for improved computer-based learning like GLOBE. ***Jim McCaffery, Principal, Abington, PA***

All of us learn in the GLOBE Program, and the scale of learning is very, very wide. ***Diana Garasic, Educator, Croatia.***

The educational impact of the program is seen today after only four years of operation, as students acquire an excitement in science and a better understanding of how they can interact with the environment. However, possibly the most significant outcome of this program is still decades away in its realization; that is the availability of real-world scientific data which these children are actively recording and reporting to the professional scientific community, through the infrastructure established by GLOBE. ***Richard Erdlac, Educator, Midland, TX***

Parents are immediately excited to have their kids participating in something of this scope. It brings them out to school because they are curious and excited about the great things the kids are doing. ***Susan Mullis, Technology Specialist, Huntsville, TX***

Because of GLOBE, I realized that I came to take a much broader view of what 'local" means to me. Now, my students and I feel just as connected to that rainforest in Central American or the Outback of Australia as to the stream that flows near our school. ***Richard Rosenblum, Teacher, Poway, CA***