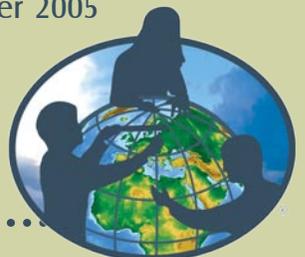


The GLOBE Program

Global Learning and Observations to Benefit the Environment (GLOBE) Integrated Earth Systems Science Program (IESSP)

The purpose of this briefing packet is to provide information to interested organizations about Next Generation GLOBE and the types of education and science products and services the GLOBE Program Office can provide. This information was developed in December 2005 in reference to NSF Program Solicitation 06-515 (www.nsf.gov/pubs/2006/nsf06515/nsf06515.htm).

An online version of this GLOBE briefing packet is available at: www.globe.gov/iessp_info



Next Generation GLOBE



The GLOBE Program
www.globe.gov/iessp_info

The GLOBE Program is a hands-on international education and science program that joins students, educators, and scientists from around the world in studying Earth Systems Science. The core objectives of GLOBE are to improve science education, enhance environmental awareness, and increase understanding of Earth as a System. GLOBE is a cooperative effort of schools in partnership with colleges and universities, state and local school systems, and non-government organizations. Internationally, GLOBE is a partnership between the United States and over 100 countries.

Recently, the GLOBE Program office completed a new ten-year plan presented in: The Next Generation GLOBE (https://globe1.globe.gov/webarchs/all/NGG_WhitePaper_9_291.pdf). While the core objectives of the GLOBE Program will remain unchanged, the NGG plan describes several new approaches to program implementation that are intended to improve overall program effectiveness and strengthen connections between the existing GLOBE community and scientists engaged in cutting-edge Earth Systems Science research.

The National Science Foundation (NSF) is seeking to establish new partnerships between the GLOBE Program and scientists associated with Integrated Earth System Science Programs (IESSP), defined as major NSF- or NASA-funded research programs related to Earth System Science. The purpose of this briefing packet is to provide information about Next Generation GLOBE to those interested in responding to the NSF Program Solicitation (06-151).

Included in this Briefing Packet:

Next Generation GLOBE
The GLOBE Community
GLOBE Education and Science Products and Services

- GLOBE Educational Materials
- GLOBE Science Measurements
- GLOBE Web Site
- GLOBE Professional Development

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GLOBE is managed by University Corporation for Atmospheric Research in collaboration with Colorado State University, with support from NASA, NSF, the U.S. Department of State.





In order to link the resources of NSF- or NASA-funded Earth Systems Science research to student learning and inquiry, NSF has described the role of IESSPs in the program solicitation as working collaboratively with the GLOBE community. For example, the funded IESSP teams and/or coordinating organizations will work closely with the **GLOBE Program Office** to meet the needs of the evolving GLOBE Program. IESSP teams may also work with **U.S. partners and international country coordinators** to facilitate implementation, and will actively participate with **schools** to continue to encourage student observations of environmental parameters. These parts of the GLOBE community are described below.

GLOBE Program Office (GPO)

GPO staff members have expertise in education, science, educational technology, and international relations. Of the 28 GPO staff, fifteen hold graduate degrees including ten doctorate degrees in a variety of fields including, science education, curriculum and instruction, and several disciplines within the geosciences including atmospheric science, geology, geography, and marine science. GPO staff members have experience and expertise in K-12 classroom teaching, facilitation of student research, student assessment, higher education, informal education, professional development, international relations, education technology, distance learning, database management, Web design, program evaluation, and development of data analysis and visualization tools for the classroom.

U.S. Partners and International Country Coordinators

Currently, GLOBE Partners and Country Coordinators facilitate interaction between schools and other groups. They recruit GLOBE schools as well as train and mentor GLOBE teachers. Internationally, GLOBE is being implemented through bilateral agreements between the U.S. government and governments of over 100 nations. Within the U.S., GLOBE collaborates with organizations that recruit GLOBE schools, train teachers, and mentor students. A full list of current GLOBE countries is available at (www.globe.gov/countries).

GLOBE Schools

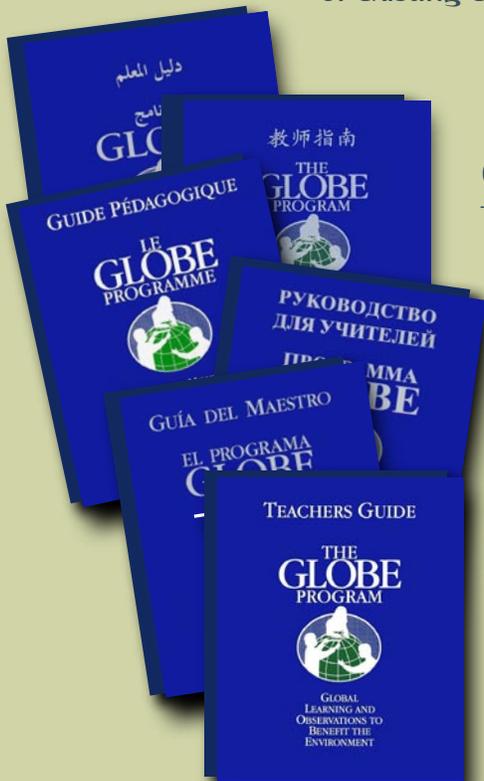
Through the GLOBE Program, students, teachers, and scientists from round the world have been linked together in the pursuit of observing and understanding the Earth as a System. During NGG, networks of schools will participate with the NSF- or NASA-funded Earth Systems Science research programs of IESSP teams via data collection and student research in order to facilitate a worldwide conversation about Earth processes among students, teachers, and scientists.

The University Corporation for Atmospheric Research (UCAR)

UCAR manages the GLOBE Program in collaboration with Colorado State University. UCAR, a nonprofit consortium of over 87 U.S. and international universities, is based in Boulder, Colorado and manages the National Center for Atmospheric Research.



GLOBE has the capacity to develop innovative, creative, and multi-media educational materials in alignment with national education standards. Existing GLOBE educational materials are available for use in IESSP projects and can be repurposed if necessary. Working in close collaboration with IESSP teams, new educational materials can be developed. A brief overview of existing educational materials is included below.



GLOBE Teacher's Guide

The GLOBE Teacher's Guide provided the scientific and educational foundation for the first generation of GLOBE investigations. It includes information necessary for accurate data collection such as measurement procedures, student guides, instrument specifications, and scientific background information. The Teacher's Guide includes a variety of Learning Activities that complement data collection and extend student understanding of 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.



Science Education Research Modules

Science research by students has been a foundation of GLOBE. Building on this tradition, the promotion and facilitation of student research in the classroom is at the heart of Next Generation GLOBE (NGG). Three Science Education Research Modules are currently under development (Student Research Module, Teacher/Facilitator Research Module, and Scientist/Student Research Module). All modules will be accessible through the GLOBE Web site.

"To raise new questions, new possibilities, to regard old possibilities, and to regard old problems from a new angle requires creative imagination and marks new advances in science."

- Albert Einstein

The Science Education Research Modules may be useful as GLOBE and IESSP teams work together to develop geoscience educational materials that are age-appropriate, aligned to national education standards, and supported by research-based pedagogy to enhance science in the classroom through student research. If appropriate, GLOBE will encourage partnerships between students and IESSP team scientists.



The Student Research Module will:

- Provide instruction to students on how to collect, analyze, and display data to investigate their research questions
- Guide students to data sources (including those external to GLOBE)
- Provide hands-on, inquiry-based learning experiences that are reflective of research in the geosciences
- Infuse all of the features of inquiry in the classroom that support student research including questioning, collecting data, creating explanations based on evidence, connecting explanations to scientific truths and communicating results of investigations



Teacher/Facilitator Research Module will:

- Provide a step-by-step guide to support student research in the classroom
- Create content specific research examples that can be used in the classroom
- Provide guidance in research question selection and project implementation
- Include tools to evaluate student research projects



Scientist-Student Research Module will:

- Provide strategies for effective communication to scientists who will be interacting directly with students at a variety of grade levels
- Provide connections between IESSP research, national science standards and local curriculum
- Suggest hands-on, inquiry-based science content enrichment activities in the geosciences
- Guide scientists in classroom visits and presentations



GLOBE Science PIs have developed scientifically rigorous measurements and protocols for use by students and teachers. The measurements are available for use by IESSP teams. GLOBE will provide assistance to IESSP teams who wish to develop new measurements and protocols. More detailed information on current measurements and protocols is available at (www.globe.gov/protocols).

Atmosphere (10 measurement types, 15 Protocols)

Measurement	Protocol(s) and comments
Cloud type and cover (includes contrails)	Cloud Protocols
Aerosols	Aerosols Protocol
Water vapor	Water Vapor Protocol
Relative humidity	Relative Humidity Protocol
Precipitation	Precipitation Protocols (Based on local precipitation)
Maximum, minimum, and current air temperature	Maximum, Minimum and Current Temperature Protocol, Digital Multi-Day Max/Min/Current Air and Soil Temperatures Protocol, and Automated Air and Soil Temperature Monitoring Protocol
Air pressure	Optional Barometric Pressure Protocol
Automated weather stations	Davis Weather Station Protocol, RainWise Weather Station Protocol, WeatherHawk Weather Station Protocol, and AWS WeatherNet Protocol.
Surface temperature	Surface Temperature Protocol
Surface ozone	Surface Ozone Protocol

Hydrology (9 measurement types, 10 Protocols*)

Measurement	Protocol(s) and comments
Water transparency	Water Transparency Protocol
Water temperature	Water Temperature Protocol
Dissolved oxygen	Dissolved Oxygen Protocol
Electrical conductivity	Electrical Conductivity Protocol
Salinity	Salinity Protocol, and Optional Salinity Titration Protocol
Water pH	pH Protocol
Alkalinity	Alkalinity Protocol
Nitrate	Nitrate Protocol
Freshwater macroinvertebrates	Freshwater Macroinvertebrates Protocol

* NOTE: Marine Invertebrate Protocol is currently being field tested.

GPS (1 measurement type, 1 Protocol)

Measurement	Protocol(s) and comments
Latitude, longitude, elevation	GPS Measurement Protocol

Measurements *(cont.)*



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Soil (11 measurement types, 14 Protocols)

Measurement	Protocol(s) and comments
Soil characterization	Soil Characterization Protocol
Soil temperature	Soil Temperature Protocol, Digital Multi-Day Soil Temperatures Protocol
Soil temperature and air temperature	Digital Multi-Day Max/Min/Current Air and Soil Temperatures Protocol, Automated Soil and Air Temperature Monitoring Protocol
Soil moisture	Gravimetric Soil Moisture Protocols, and Optional Soil Moisture Sensor Protocol
Bulk density	Bulk Density Protocol
Soil particle density	Soil Particle Density Protocol
Particle size distribution	Particle Size Distribution Protocol
Soil pH	Soil pH Protocol
Soil fertility	Soil Fertility Protocol (Includes Nitrogen, Phosphate, and Potassium.)
Water infiltration	Optional Infiltration Protocol
Automated soil moisture and temperature	Davis Soil Moisture and Temperature Station Protocol (Connects with a Davis weather station and logs soil moisture and temperature every 15 minutes.)

Land Cover (5 measurement types, 6 Protocols)

Measurement	Protocol(s) and comments
Land cover sample site classification	Land Cover Sample Site Protocol
Biometry (Canopy cover, ground cover, tree, shrub and graminoid height, tree circumference, graminoid biomass)	Biometry Protocol
Land cover mapping	Manual Land Cover Mapping Protocol and Computer-aided Land Cover Mapping Protocol
Land cover change detection	Land Cover Change Detection Protocol
Fire fuel ecology	Fire Fuel Protocol

Earth as a System (8 measurement types, 8 Protocols)

Measurement	Protocol(s) and comments
Budburst	Budburst Protocol
Green-up	Green-Up Protocol
Green-down	Green-Down Protocol
Ruby-throated hummingbird	Operation Ruby Throat: The Hummingbird Project Protocol
Arctic bird migration	Arctic Bird Migration Monitoring Protocol
Lilac phenology	Clonal and Common and Lilac Protocol
Phenological gardens	Phenological Gardens
Seaweed reproduction	Seaweed Reproductive Phenology Protocol



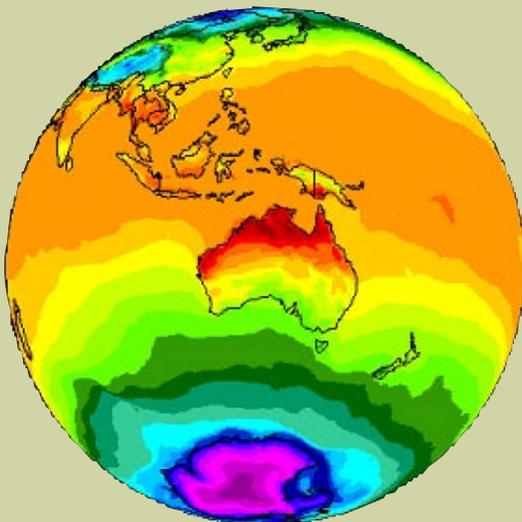
The high caliber science education output of collaborative efforts between IESSPs and GLOBE will require a world-class geoscience education Web site supporting student research and student-oriented data access and analysis. It will also require mechanisms for schools to communicate and collaborate with other schools and scientists on research projects.

A bold and forward-thinking decision was made at GLOBE's inception in 1994 – GLOBE would be an Internet based education and science program. As a result, the GLOBE Web site offers a menu of educational materials, data entry, data analysis, and communication tools for the GLOBE community. Building on this foundation, Next Generation GLOBE will utilize cutting edge technologies to promote student-centered research.



At the heart of the GLOBE Web site are over 13 million student-collected data points accessible in a variety of visual and export formats. This unique collection of internationally collaborative data is accessible through a powerful database that assists students conducting inquiry-based investigations. Additionally, GLOBE offers online professional development experiences for educators to increase the capacity to teach high quality geoscience content. The use of technology tools for working with and understanding geoscience data is a key component to future student research and learning experiences on the GLOBE Web site.

Currently, the GLOBE Web site is being updated to incorporate the latest cutting-edge education technology products and approaches to student learning. The intent is to better serve students, teachers, and the IESSP teams.



IESSP teams may consider interactive Web-based projects that include but are not limited to:

- Student collected data activities
- Analysis of published data sets (non-GLOBE data)
- Interactive collaborations and communications between project schools/students
- Inquiry-based student research projects
- Interactive instructional materials
- Online professional development for educators
- Interactive video/audio communication between scientists and students

Professional Development



The GLOBE Program
www.globe.gov/iessp_info

Professional development can be defined as a process of gaining knowledge and keeping current in one's area of expertise. The GLOBE Professional Development Institute (GPDI) was created to promote effective strategies for providing professional development to GLOBE trainers and teachers. The GPDI (<http://gpdi.globe.gov/>) supports several approaches to professional development (described at right) that may be used by NSF- and NASA-funded IESSP teams and/or coordinating organizations. It is anticipated that K-12 classroom teachers will be a key audience for GLOBE/IESSP team professional development efforts. Other potential audiences for professional development activities include IESSP team members and/or staff of coordinating organizations, GLOBE partners, and trainers of classroom teachers. The needs of the target audiences and the scientific content will drive the professional development design.

The GPDI is founded on the strong research base of best practices associated with professional development programs for educators. The National Science Education Standards (NSES) outline approaches for professional development for teachers of science. The GPDI will continue to use the NSES approaches to professional development as a framework.

It is recognized that a challenge of professional development for science teachers is linking sources of high quality scientific research with the needs of classroom teachers. Working together, GLOBE and IESSP teams will create professional development opportunities for educators based on the educational relevance of IESSP science content areas. Significant attention will be given to instruction and practice in student research and inquiry.



GPDI Workshops

Traditional, face-to-face workshops can be designed to fit the research topics of IESSP teams. Strengths of face-to-face workshops include:

- Hands-on instruction
- Guided practice
- Immediate feedback
- Community building

GPDI Online Instruction

Online instruction can take several forms including: 1) stand-alone, self-paced instructional modules; 2) instructional modules facilitated by a dedicated instructor; 3) fully interactive course with a dedicated instructor. Strengths of online instruction include:

- In-depth science content coverage
- Reflective discussion
- Ability to provide up-to-date resources

GPDI Mixed Design

The mixed design approach to professional development combines the strengths of face-to-face workshops and online instruction. Multiple workshops can be interspersed with online instruction. There are many combinations of approaches to mixed design professional development that can be customized to match the appropriate audience and content focus of IESSP teams.