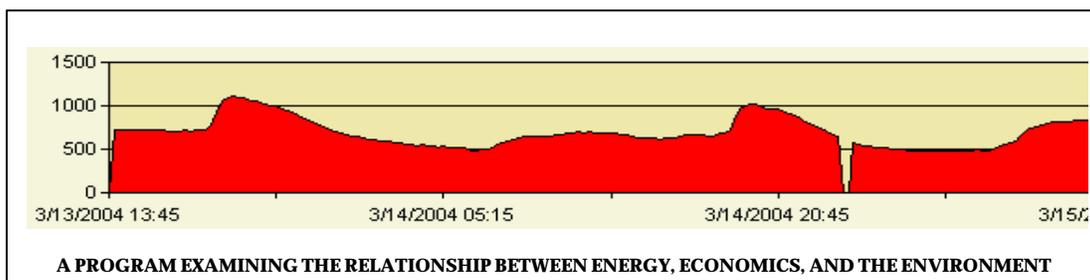




ACTION, COMMUNICATIONS, TECHNOLOGY & SCIENCE
SERVICE-LEARNING IN THE GALAPAGOS ARCHIPELAGO



A MICROSOLAR DISTANCE LEARNING PROGRAM
IN COLLABORATION WITH



PROGRAM SUMMARY

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ACTION, COMMUNICATION, TECHNOLOGY, & SCIENCE (ACTS)

Service-Learning in the Galapagos Archipelago

BACKGROUND AND RATIONAL

The Galapagos Archipelago is the destination for more than 84,000 tourists annually, representing approximately \$250 million in gross revenues. Powering the engines of this economy requires the import of large quantities of fossil fuel--fuel to power the electricity grid on the islands and fuel for the numerous tour boats and transportation services. Dependence on imported fuel is placing the Galapagos Islands at environmental and, consequently, economic risk. And it is gradually destroying unique marine ecosystems with pollution and hazardous waste spills.

Risk turned reality at approximately 2200 local time (UTC-6) on January 16, 2001: the tanker *Jessica*, owned by Acotramar, ran aground and sank at Schiavoni Reef, about 800 meters from Puerto Baquerizo Moreno on San Cristóbal Island. The vessel had just arrived from the port of Guayaquil on the Ecuadorian mainland, carrying 160,000 gallons of diesel fuel destined to be delivered to the dispatch station on Baltra Island, plus 80,000 gallons bunker fuel (IFO), which were to be used to fuel the tourist vessel *Galapagos Explorer II*. A major oil spill occurred which continues to have long-term effects on the health of marine wildlife in the Galapagos.



**REFUELING IN THE GALAPAGOS
SAN CRISTOBAL ISLAND**

In response to this tragic event, the United Nation Foundation (UNF) and the United Nations Development Programme are supporting a Renewable Energy Program for the four inhabited islands in the archipelago. Providing leadership for this program is the e7 Fund for Sustainable Development (e7). The e7 signed a memorandum of understanding in April of 2003 with the government of Ecuador to undertake a wind energy project that will generate approximately 1,800 kilowatts of electricity, displacing more than 50 percent of the electricity presently being produced by diesel-powered generators. In a complementary initiative, e7 companies AEP, Ontario Power Generation and Hydro-Quebec are funding the Galapagos Archipelago's participation in the e7's Micro-Solar Distance Learning Program, where solar panels, or photovoltaic systems, are installed in learning centers to power advanced information and telecommunications technologies. It is in the context of the MicroSolar Distance Learning Program that the ACTS Service-Learning Program has been initiated to improve technology-aided learning in the schools of the Province of the Galapagos.

Solar Quest®, in collaboration with Colegio Tecnico Ignacio Hernandez, will manage ACTS in which 23 students will each provide 200 hours of community service to monitor and analyze characteristics of energy consumption by sector---residential, commercial, and municipal---of electrical grid to determine the potential to reduce electricity demand through energy efficiency. Skills adopted and knowledge transferred with technical assistance from SolarQuest® under ACTS are directly applicable to remote environmental monitoring, data collection and management, and trend analysis required for advanced science research and the development of a global information economy in the Galapagos.

PROGRAM DESCRIPTION

Action, Communications, Technology, and Science (ACTS Service-Learning Program) is an interdisciplinary course of study designed to meet the education requirements for students at Colegio Tecnico Ignacio Hernandez to fulfill education standards under Order No. 2950 of the Government of Ecuador Ministry of Education and Culture (MEC) which requires level-5 students

to perform 200 hours of civil service work and to prepare them to meet the demands of higher education and/or enter into the workforce. ACTS focuses on four areas of competency as follows in Table 1:

TABLE 1: ACTS SERVICE-LEARNING CORE PROGRAM AREAS	
<ul style="list-style-type: none"> - <u>ACTION</u>: Students are required to conduct research and participate in activities that will provide knowledge and exposure of community issues. ACTS students will research the relationship between energy production and its impact on the economy and environment of the Galapagos, and make proposals related to energy management in order to reduce the conflict between development and conservation. 	<ul style="list-style-type: none"> - <u>COMMUNICATIONS</u>: Students are required to be involved in oral and written communications activities that demonstrate their knowledge of community issues. ACTS students will collaborate on an energy conservation master plan, conduct interviews, present results, and propose solutions at community meetings and media presentations.
<ul style="list-style-type: none"> - <u>TECHNOLOGY</u>: Students are required to demonstrate their knowledge of information and communications technology, including the ability to collect data and use the data for analysis. ACTS students will utilize information technologies and monitoring equipment to collect and analyze data, and use electronic communications technologies to disseminate the results to the general public and international community. 	<ul style="list-style-type: none"> - <u>SCIENCE</u>: Students are required to conduct original science research utilizing the scientific method. ACTS students will conduct research on the electric grid in San Cristobal and collaborate with engineers located in the US, Canada, and Italy in order to determine the role of energy conservation in the re-powering of the Galapagos Islands with renewable energy.

BENEFITS TO THE COMMUNITY

The benefit of ACTS Service-Learning Program for the community is a comprehensive understanding of the proposed re-powering of the Island of San Cristobal with the renewable energy systems proposed by the e7 Network for Expertise on the Global Environment, and the potential role of community stakeholders in reducing the demand for energy through consumer participation in energy efficiency programs. Student activities will result in providing community stakeholders with the knowledge to make informed decisions about their energy future in regard to the consumption of energy and protection of the natural environment and economy of the Galapagos Archipelago.

PROGRAM SPONSORS

ACTS Service-Learning Program sponsors and participants include corporate members of the E7 Network for Expertise on the Global Environment (American Electric Power and Enel) and EcoSage Corporation (d.b.a. SolarQuest®). American Electric Power (AEP) and EcoSage are providing financing for program coordination, staff support, technical assistance, travel and per diem, energy monitoring equipment, on-line monitoring of facilities, and demand side management (DSM) interventions totaling an estimated program cost in of USD \$56,400. (See Program Cost Schedule.) EcoSage may elect to increase the project budget depending upon the final determination of the scope of work for DSM interventions and available donor financing.

PRORAM LOCATION

The ACTS Service-learning Program is located at Colegio Tecnico Ignacio Hernandez and is benefiting the students (approximately twenty-three students) eligible for the mandated education standards under Order No. 2950. The program is closed to other students at Colegio Tecnico Ignacio Hernandez and in other schools located on the Island of San Cristobal. Administrators, teachers, and students at Colegio Tecnico Ignacio Hernandez and Colegio Nacional Galapagos (Santa Cruz Island are observing the ACTS program for inclusion into existing programs for the academic 2005 school year under Order No. 2950.

PROGRAM OUTCOMES

The ACTS Service-Learning Program is designed with three learning outcomes for distinct communities with the Galapagos as follows:

1. LEARNING COMMUNITY: Students will obtain knowledge and skills applying information and communications technologies to real-world activities which will prepare them for advancement of the education and/or professional careers while serving the community.

2. EDUCATION COMMUNITY: The education sector in the Galapagos as represented through the participating agencies (Direccion Educacion Provincial Galapagos and Colegio Tecnico Ignacio Hernandez) in planning education reform utilizing information and communications technologies.

3. THE GENERAL PUBLIC: The general public, specifically residential and small commercial electricity consumers, will obtain a better knowledge of their energy consumption patterns, energy conservation opportunities, and associated costs and environmental benefits.

PROGRAM COST SCHEDULE

TABLE 2. PROGRAM COST SCHEDULE			
6.2.1.	Preliminary Audit 2003	3 mo X 1,050 + 2,000 =	+ \$5,150
6.2.2.	Local Coordinator	1/2 time 10 mo X 1,050 =	+ 5,250
6.2.3.	Local Staff Support	10 mos. x 850 =	+ 8,500
6.2.4.	Technical Assistance	10 mos. x 2,000 =	20,000
6.2.5.	Travel and per Diem	estimate 5,000 =	+ 5,000
6.2.6.	Appliance Monitors	30 x 150 =	+ 4,500
6.2.7.	Online Monitoring per Building	2 x 4,000 =	8,000
6.2.8.	DSM Interventions	TBD =	0
6.2.9.	Selected Items (Paid from e7 funds)	indicated by + =	28,400
6.2.10.	Total ACTS Program Cost (Excluding Interventions)		56,400
6.2.11.	e7 Cost Share		25,000
6.2.12.	Other Donor(s) Cost Share		31,400

PROGRAM SCHEDULE

The ACTS Service-Learning Program will be implemented in two phases. Phase One, February 18, 2004 through April 2, 2004, will provide technical assistance to program coordinators, teaching faculty, and peer-learners for the use of distance learning software technology, energy monitoring equipment and software programs, and an introduction to the four key areas of the ACTS program as listed in section 1, above. Phase Two, April 5, 2004 through December 17, 2004, will be implemented in several expanded activity sets in the ACTS program areas. The following table outlines the projected schedule to fulfill each of the four programs areas with subsets of program goals and objectives.

TABLE 3. ACTS PHASE 2 PROGRAM ACTIVITY SCHEDULE	
Apr	Learn key goal (energy conservation) and objectives (human capacity development through distance education). Develop knowledge and skills in basic computer software database programs, including distance learning and energy data management software. Develop an awareness of personal energy consumption and the energy consumption of individual electrical appliances in the home. Submit data to on-line database technology for scientific observation.
May	Expand knowledge of basic computer software database and energy data management to real-world applications by monitoring physical facilities on the energy grid within the Island of San Cristobal. Participate in the auditing and electrical monitoring of public and facilities for the collection of data for use by electrical engineers researching the power service on the Island of San Cristobal. Participate in events informing the general public and electricity consumers about the benefits of energy conservation and the MicroSolar Distance Learning Program as it is demonstrated through the ACTS Service-Learning Program.
Jun	Demonstrate a comprehensive knowledge of software applications, energy data management, and energy consumption analysis by developing energy profiles (Energy Balance Statements) on representative commercial and residential facilities on the Island of San Cristobal utilizing data collected by means of energy data monitoring devices.
Jul	Continuation and completion of May and June activity sets. Testing by ACTS program faculty.
Aug	Complete energy audit certification testing by demonstrating knowledge and skills of distance learning technology, software and database management, energy data management (hardware and software), and energy consumption analysis. Develop knowledge of basic energy conservation interventions through the use of energy efficiency appliances and alternative energy measures. Demonstrate knowledge to general public and electricity consumers through a series of public venues, including radio, television, and public meetings.
Sep	Provide services to electric consumers by conducting energy analysis of major electric appliances. Expand on current energy database of targeted high energy consuming electric appliances. Contribute to the development of an island-wide energy analysis research project and assist in the publication of a report of the ACTS program findings. Participate in regularly schedule community energy conservation workshops. Participate in proposed intervention programs.
Oct	Continuation and completion of September activities with emphasis on community service to household and small commercial electricity consumers.
Nov	Continuation and completion of September activities with emphasis on the publication of the final island-wide energy research analysis and publication of a report on ACTS Service-Learning Program findings.
Dec	Conduct community outreach activities, including radio, television, and a series of community meetings disseminating information about energy conservation opportunities to the general public.

ACTS CURRICULUM FRAMEWORK:

ACTS program managers and faculty will conduct an iterative curriculum framework analysis to support student learning objectives and provide a methodology to assessing key attributes for the development of technology-aided education for replication in schools throughout the Province of the Galapagos. Table 3 is a draft curriculum frame work for ACTS, which shall be revised based on program experience.

TABLE 3.	INFORMATION TECHNOLOGY	SCIENTIFIC METHOD	DATA MANAGEMENT
1. OBJECTIVES	1.1. Provide a working understanding of an outcomes-based learning framework utilizing information technology systems.	1.2. Provide a working understanding of the scientific method, specifically regarding data collection through observation and testing.	1.3. Provide a working understanding of structuring data observation and collection methods.
2. GOALS	2.1. Develop the ability to plan outcomes-based learning activities using Internet-based communications software.	2.2. Develop the ability to diagram logical multiple pathways of the scientific method.	2.3. Develop the ability to organize data collection and presentation methods. Collect data for data entry.
3. CURRICULUM	3.1. Learn principals of Internet-based, database communications software and logic of communications protocol.	2.3. Learn the principles of the scientific method utilizing Internet-based curriculum resources.	3.3. Learning the principals of database organization in table formats, utilizing rows, columns, and cells.
4. ACTIVITIES	4.1. Establish information exchange with international students utilizing database communications software.	4.2. Read on-line materials related to the scientific method. Draw simple diagrams of multiple pathways in graphic software.	4.3. Create Energy Use Log Book, enter observation data in log book, and transfer data to Home Energy Audit Form.
5. PRODUCT	5.1. Written and pictorial presentation of biographical and cultural information on Internet-based, database software.	5.2. Post diagram as a report on Internet-based communications software. Revise reports based on review comments.	5.3. Post completed Home Energy Audit Form with identification of typical household appliances.
6. EVALUATION	6.1. Peer evaluation based upon oral and graphic presentation of web published product utilizing Peer Evaluation methods.	6.2. Self-evaluation of communications software logic and communications protocol. Peer review of methods diagram.	6.3. Parent evaluation of completeness of Energy Use Log Book and Home Energy Audit Form.
7. ASSESSMENT	7.1. Teacher assessment based upon the comprehension and demonstration of Internet-based, database software logic.	7.2. Teacher assessment based upon quality product presentation and oral defense of student self-evaluation.	7.3. Teacher assessment based upon assessment of data entry in Energy Use Log Book and quality product presentation.
8. MATERIALS	8.1. Computer software, Distance learning technology, energy monitoring equipment.	8.2. Science ACT Worksheet 2. Computer software (Excel).	8.3. Science ACT Worksheet 3 & 3a. Energy monitoring hardware and software. Computer software (Excel).

ACTS ACTIVITY WORKSHEETS: (EXAMPLE, ACTIVITY WORKSHEET)

ACTS program managers and faculty will develop a series of curriculum worksheets to support student learning objectives and develop a methodology to assessing key attributes for activity worksheets for technology-aided education for replication in schools throughout the Province of the Galapagos. Below is a sample activity worksheet for ACTS.

OBSERVING ENERGY CONSUMPTION

Where does the energy come from that you use in your home? Where does it go? An energy audit provides the means to observe energy consumption in the household. Energy audits can vary from simple observation methods, such as looking at you energy bills, to measuring energy consumption with an electronic monitoring device. In activities #3 & #4 you will use simple observation methods: Write down your estimated energy consumption in a log book and then transfer that information to an audit form.

ACTIVITY #3: Download and review the Activity #4 Home Energy Audit Form. Identify information to be collected, such as electric fixtures and appliances by type. Now create a daily log similar to the one pictured at right. Talk to your parents or guardians about the household electric bill and ask for the data. Enter your daily use of electric appliances for two weeks. Note the watts for each appliance or light bulb and record time of day and time of use. Note if the appliance remained on without anyone in the room. Compare your log book with your Science ACT Team.

<p>Page 12</p> <p>Home from school (3:30 p.m.)</p> <p>3:30 p.m. - TV (on) 250 watts 9:30 p.m. - (off) (Note: Watched TV for 2 hours after school and half an hour before bed.)</p> <p>5:30 p.m. - Desk Lamp (on) 150 watts 9:30 p.m. - (off)</p> <p>7:30 p.m. - Computer (on) 150 watts 9:00 p.m. - (off)</p> <p>7:30 p.m. - Printer (on) 100 watts 9:00 p.m. - Printer (off) (Note: Used printer .5 hrs.)</p> <p>Went to bed (9:30 a.m.)</p>

ENERGY USE LOG BOOK , ACTIVITY #3

SCIENCE ACT - HOME ENERGY AUDIT FORM						
HOUSEHOLD ELECTRIC CONSUMPTION						
	Kilowatt Hours (KwH)					
Monthly Electric Bill		<input type="checkbox"/> Actual	<input type="checkbox"/> Estimate	Underline if actual or estimated electric bill.		
Annual Electric Bill		<input type="checkbox"/> Actual	<input type="checkbox"/> Estimate			
HOUSEHOLD ELECTRIC APPLIANCES (110 volt only)						
Appliance:	Wattage:	Hrs/Day:	Watts/Day:	KwH/Day:	% Personal	KwH Personal:
Television						
Radio						
Computer						
Play Station						
Hair Dryer						
Toaster						
Coffee maker						
Desk Lamp						
Other						
Other						
Total:						
Note: Record hrs./day to the hundredths. Example: 1.25 hrs. (Remember: 1 KW = 1,000 watts.)						
PERSONAL ELECTRIC APPLIANCES (110 volt only)						
Appliance:	Wattage:	Hrs/Day:	Watts/Day:			KwH Personal:
Television						
Radio						
Computer						
Play Station						
Desk Lamp						
Aquarium						
Alarm Clock						
Other						
Other						
Other						
Total:						
COMBINED PERSONAL ELECTRIC USE:						
Total Combined KwH for Personal Use:						Total:
Enter Total KwH for Personal Use in Carbon Calculator for Total Personal Carbon Footprint.						Total:

SCIENCE ACT HOME ENERGY AUDIT FORM / ACTIVITY #4

ACTIVITY #4: Using the Science ACT Home Energy Audit Form, transfer the data collected from you log book to the Audit Form. Once your basic information has been transferred, complete the calculations to determine the totals for each electric appliance and vehicle as indicated. Obtain your carbon emission data by entering the total KwH for Personal Use in the carbon calculator referenced in the Learning Link below.

When you complete the energy audit, post it as a report to this task. (Use the MS-Word file provided. Make changes to the file as necessary, such as labeling appliances.) Now compare you audit forms with your Science ACT Team members. Submit a report detailing your observations. Do you think that you have enough information to form a hypothesis? Are you ready to conduct a test?

Review Learning Links: Appliance consumption in Watts: <http://ianrpubs.unl.edu/consumered/heg94.htm>

ACTS PROGRAM SUPPORT STAFF

SOLARQUEST®
P.O. Box 274
Chelsea, Vermont USA 05038
802.685.3450
aeb@solarquest.com
<http://www.solarquest.com>

Allan E. Baer, President (EcoSage Corporation)
Academic Programs

Ronald B. Swenson, Chairman (EcoSage Corporation)
Technology Development

Loren Kalevig, (EC Bridge)
Technology Consultant

Alfonso Tovar, (EcoSage Corporation)
Electrical Engineering

Berenice Norris Crespo, (EcoSage Corporation)
Coordinator (San Cristobal)

COLEGIO TECNICO IGNACIO HERNANDEZ
Av. Jaime Roldós Aguilera,
Barrio Las Peñas Altas,
Isla San Cristóbal,
Provincia de Galápagos, Ecuador

Lic. Hermes Fernando Mendoza García, Rector
Program Coordination

Edwin Santana, Professor

Kevin Torres, Professor