IES Newsletter

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Director's Note

The recognition and nurturing of scientific ability is important for school children as well as for university students and those beyond the doctorate. The Institute offers an environment for the development of scientific talent at many levels. Through guidance and support from role models, exposure to new ideas and technologies and opportunities to share ideas and experiences with others, grade school students, college undergraduates and young scientists develop their strengths in the sciences.

In Eco-Inquiry, a curriculum developed by Kathleen Hogan, 5th and 6th grade students learn how to focus natural curiosity through the structure and discipline of scientific inquiry. In the Research Experiences for Undergraduates program, college students design projects and do research with Institute scientists over the summer and present their fundings in a public seminar.

This issue features the work of Ms. Hogan as well as that of Dr. Vera Krischik, an established scientist who received a grant through a National Science Foundation program designed to advance the careers of women scientists.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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The Care and Feeding of a Curriculum: Eco-Inquiry Grows

The serene surroundings of the stately brick Gifford House Visitor and Education Center belie high levels of activity within. Five educators, committed to a project that will contribute to shaping an ecologically literate society, bring creative energy and enthusiasm to their upstairs offices. The object of their attention is not the ecosystems of nearby fields and forests nor the Perennial Garden outside their windows, but an innovative curriculum called Eco-Inquiry. Over the past five years, IES Educational Research and Development Specialist Kathleen Hogan has been developing this curriculum, a school science program that transforms 5th and 6th grade classrooms into centers of ecological research. On January 1, 1991, the Institute of Ecosystem Studies received a National Science Foundation (NSF) grant supporting expansion of Eco-Inquiry and its dissemination throughout the United States.

Eco-Inquiry* had its roots in the interests and strengths of the Institute, and in national goals for science education. As she developed the program, Ms. Hogan had three objectives. First, students would learn how an ecosystem works: how are the parts interrelated through nutrient cycling and energy flow? Second, they would learn to view science as a human endeavor: who are scientists? what do they do? why do they do what they do? Finally, the students would learn to do what scientists do: make descriptions and predictions that lead to a better understanding of the workings of the natural world. Through Eco-Inquiry they would learn how to create knowledge about these phenomena and then apply their inquiry skills to other subject areas as well as to problems in everyday life. From the start Ms. Hogan believed that a curriculum aimed at developing inquiring minds would become a valuable nationwide educational tool.

Initial classroom pilot programs were run during spring and fall 1986. Five years, several revisions, three teacher workshops and many classroom pilot programs later, Eco-Inquiry has been introduced into all Dutchess County (N.Y.) School Districts. Now, thanks to the 2½ year NSF grant, national dissemination can begin.

New Directions

The grant has made it possible to work on new fronts as well. One recent addition to the curriculum, "Mysteries in Ecosystem Science Activities," or MESAs, uses stories, dialogue and hands-on problem solving to communicate the approach, content and spirit of ecological research:

Picture a children's clubhouse, in a small woodlot in the suburbs. The 11- and 12-year-olds playing nearby discover a piece of intriguing equipment and overhear people talking in the woods. They return to the clubhouse to discuss what they saw and heard.

Click. In a city classroom, 5th and 6th graders turn off a tape recorder and discuss what they saw in their mind's eye, and what they heard while "eavesdropping." "What's going on?" they're urged to discover. Their inquiry is helped along with props that relate to the taped story, and they turn the tape recorder on again to listen to more of what's going on at the clubhouse and to try to figure out what the group in the woods is up to.

The group setting up intriguing equipment in the woods is, of course, a team of ecologists collecting samples and data in

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** For more information on the background of Eco-Inquiry, see the November-December 1986 and September-October 1988 issues of the IES NEWSLETTER.*

TOM TAFT

Kathleen Hogan, originator of Eco-Inquiry, visited Mr. Joe Phaneuf's 5th grade class at the Alden Place School in Millbrook during the curriculum's "Dress the Scientist" session. Left to right: Marshall Heilman, Ms. Hogan and Beth Madsen.

their search for answers to a scientific question. The children who are characters on the audiotape try to figure out what the ecologists are doing and discovering, while the students in the classroom think and work right along with them. MESAs serve a central goal of Eco-Inquiry by giving students insight into the thoughts and actions of scientists as regular people, not unlike the students themselves, who use scientific thinking and methods to build an understanding of nature. In the nationally disseminated curriculum, MESA audiotapes and kits will provide an alternative to the personal contact with scientists that was a part of local pilot programs when IES scientists visited classrooms.

On another front, research assistant Erik Lilleskov, under the direction of IES Head of Education Dr. Alan Berkowitz, is refining and adding to the classroom experiments that are a major component of Eco-Inquiry. Among the experiments that he is designing are some to demonstrate the effects of nutrients on plant growth. The students will plant seeds, make compost and compost "tea" (a solution of compost in water), and then compare growth rates of plants with and without the tea. Mr. Lilleskov's task is to determine what the best compost material is — what mixtures decompose to release the highest amounts of nutrients (without smelling up the classroom!) — and which seedlings will respond best in a classroom situation. Other new developments include the design and production of educational computer software, and a videotape to familiarize teachers and school administrators with the Eco-Inquiry program.

A major challenge in the expansion of Eco-Inquiry is to make it applicable to a wide range of educational settings. A first step in this process is adapting it to an urban environment. Twelve teachers from two school districts in the Bronx, New York will be introduced to the curriculum this summer by Lisa Morganstern, Eco-Inquiry project coordinator. Their 5th and 6th grade classes will do the 10 - 12 week program in the fall term. During this period a variety of innovative assessment tools and techniques, developed by Ms. Hogan in cooperation with research assistant JoEllen Fisherkeller and a group of national advisors, will be used to measure growth in students' understanding of ecology, perception of scientists and their ability to inquire. The Eco-Inquiry team will use these evaluation results to revise the curriculum, particularly to improve its suitability for use in urban settings.


TOM TAFT

Part of the Eco-Inquiry team: l. to r. Lisa Morganstern, Kathleen Hogan, Erik Lilleskov and Alan Berkowitz.

Spreading the Seeds of Inquiry

During summer 1992 the Eco-Inquiry curriculum will be published and the dissemination process will begin. IES educators will hold a workshop for the New York State Elementary Science Mentors, teachers and science coordinators from across the state who are "turn-key trainers" for their regions, funneling new skills, techniques and curricula to their peers. At the IES workshop the participants will be introduced to Eco-Inquiry so that they can bring it home and train colleagues in its use. Ms. Hogan and Ms. Morganstern will also train teacher-trainers at other sites in the United States. Five informal science centers have been selected as hubs for this dissemination process: Fernbank Science Center, Atlanta, Georgia; Cranbrook Institute of Science, Bloomfield Hills, Michigan; Missouri Botanical Garden, St. Louis, Missouri; Desert Botanical Garden, Phoenix, Arizona; and Oregon Museum of Science and Industry, Portland. From these sites, the new trainers will begin introducing the curriculum to local school districts.

During the first half of 1993, a final evaluation of the Eco-Inquiry curriculum will be made and long-term planning for future dissemination will begin. With documented successes behind them, Ms. Hogan, Dr. Berkowitz and the others on the Eco-Inquiry team are very optimistic about the role of this innovative curriculum in improving the quality of elementary science education in the United States and in providing children with the knowledge and wherewithal to be responsible citizens of Planet Earth.

* * * * *

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IES Award

Are We Really Making Products That Are Better for the Earth? Sixteen months ago, Heather M. Hicks, now a 6th grader at North Park Elementary School in Hyde Park, N.Y., began an experiment to test whether or not plastic bags degrade as their manufacturers claim; soon after that she began a similar study of disposable diapers. Her project took first place at both the North Park Science Fair and the District Science Fair, and two special awards at the Dutchess County Regional Science Fair on April 6.

A number of IES scientists and educators were judges at the regional fair, and


TOM TAFT

Drs. Alan Berkowitz, Gary Lovett and Kim Medley evaluated each entry to select one for an IES award. All three were impressed by Heather's research — her creative approach, long-term observations and careful attention to detail were qualities they looked for in a winning project. As recipient of this first annual IES award, Heather received $25 and a Certificate of Recognition presented at the Institute (left) by Director Dr. Gene E. Likens.

Heather's research is continuing, and her project will be entered in the Dutchess County Fair this August.

VPW Grant Supports Plant-Insect Research

Beetles have led her to rainforests, savannahs and deserts from Costa Rica to Tierra del Fuego, Argentina. Now they bring Vera Krischik to the Institute of Ecosystem Studies.

As one of 23 women scientists receiving a 1990 National Science Foundation Visiting Professorship for Women (VPW) Dr. Vera A. Krischik recently began two years of research at the Institute. While in residence, she will study plant resistance to insects and pathogens and at the same time develop programs to increase the visibility of women scientists and encourage women to pursue a career in science.

Dr. Krischik comes to IES from Washington D.C. where she was a research ecologist. As a coleopterist at the Smithsonian Institution, her specialty was beetles; her work on tropical species diversity was what took her to the field sites in Central and South America. She then worked as a research associate in the Department of Entomology at the University of Maryland, studying the effects of plant chemicals on the virulence of an insect-killing bacterium called *Bacillus thuringiensis* — the same species that is formulated for use as a natural insecticide for the garden. Dr. Krischik found that insects have more resistance to the bacterium after eating certain plants containing chemicals to protect themselves from disease and predators. She discovered a similar phenomenon with insects benefiting from the nicotine in tobacco.

Dr. Krischik also looked further into the effects of plant chemicals on the host plants — are these chemicals deterrents to insect herbivory and diseases? Her work showed that the same naturally occurring chemicals in plants could reduce both these threats. She believes that plant chemicals with a general toxicity to many pests (likened to a broad-spectrum antibiotic) may offer plants the best protection from leaf loss.

In addition to pursuing this research, Dr. Krischik has been a science administrator with the U.S. Department of Agriculture (USDA). Working part-time at this post while at the University of Maryland, Dr. Krischik has instituted practices based on the principles of integrated pest management (IPM) for grain and food storage. (IPM is a multi-disciplinary approach that combines tactics such as biological control, insect pheromone traps to monitor pest populations, population modeling, good sanitation and good management practices, e.g., grain silo aeration fans to cool grain below the temperatures at which insects are active. The IPM approach can reduce the use of costly and dangerous pesticides.)

By her efforts, Dr. Krischik has changed federal policy on integrated pest management. She convinced the Environmental Protection Agency (EPA) and the Federal Drug Administration (FDA) to approve the use of biological control agents such as parasitoids and predators in grain and food storage. She won approval from the FDA to allow insect pheromone traps in storage facilities. Through the USDA grant program, she obtained funds to help the University of Texas and the University of Wisconsin develop an immunoassay system to detect insect parts in processed food to enforce sanitary regulations. Also as a result of her initiatives, the USDA in Manhattan, Kansas and Gainesville, Florida is working on a way to determine the presence of insects in stored grain by the sounds they make when chewing on kernels. Such techniques enable early detection of grain pests so that timely control measures can be taken.

TOM TAFT

Dr. Krischik will be doing much of her research in the IES greenhouse.

One of Dr. Krischik's major research interests continues to be the question of defensive chemicals in plants. There are a number of plant groups that have distinctive defensive chemicals in their leaves: tannins in oaks (which have been shown to reduce the virulence of a gypsy moth virus on gypsy moths), phenolic glycosides in willow and cottonwood, mustard oils in broccoli and cabbage. Throughout evolutionary time, has damage from insects and disease — biotic damage — had an influence on the development of these chemicals? What does influence plants to produce these chemicals? She will study these questions with IES chemical ecologist Dr. Clive Jones, who has studied cottonwood response to ground-level ozone, an abiotic (non-living) source of damage. Together they are investigating the defenses of plants to insects and diseases and comparing their findings with plant responses to abiotic sources of damage. They hope to learn if different types of leaf damage lead to the same type of plant response, and whether plants have a general response to multiple damaging agents, whether biotic or abiotic.

The two scientists have collaborated on an edited book to be published later this year (*Microbial Mediation of Plant-Herbivore Interactions*, Barbosa, Krischik and Jones, editors; John Wiley and Sons, Inc., 1991). The VPW grant proposal was born out of the discussions and debate on plant-herbivore interactions that went on while the two scientists edited the book. "Dr. Jones gave generously of his time while we wrote the proposal and I am pleased that our creative efforts were rewarded," said Dr. Krischik.

In addition to doing her research, Dr. Krischik is developing a Women in Science seminar program. The program will open in mid-October 1991 when Dr. Jean Langenheim, past president of the Ecological Society of America, presents a research seminar on the chemistry of tropical forests and a seminar on the role of women in ecology. Dr. Krischik said "I met Jean at an open air cafeteria at a research site in the middle of the Amazon Basin, where she was studying the effects of plant resins on insect population dynamics . . . . It means a lot to me that she will begin the seminar program."

Progress in Dr. Krischik's work at IES will be described in the Institute's annual publication *Discoveries in Ecology.*

Eco-Inquiry, *from page 2*

Kathleen "Kass" Hogan joined the IES Education Program in fall 1985. She began working immediately with local schools, creating schools' programs at the Institute (including "Ecology of the Sugar Maple" for 3rd, 4th and 5th grade classes) and laying the groundwork for Eco-Inquiry. Later, as program leader in ecology education, she worked with other IES educators in expanding on-site programs for elementary and high school students. Recently she received a promotion to her current position, and in recognition of her work in advancing ecology education was named to the Institute's scientific staff as assistant educator.

Calendar

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted.*
Call (914) 677-5359 to confirm the day's topic:
(July 7: Independence Day weekend, no program)
July 21: **An Oldfield Stroll**, a walk led by Dr. Steward Pickett. (*Meet at the Greenhouse on Route 82.)
Aug. 4: **Air Pollution and the Forest**, a walk led by Dr. Gary Lovett.

For outdoor programs, wear long pants and sturdy shoes with socks.
In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.

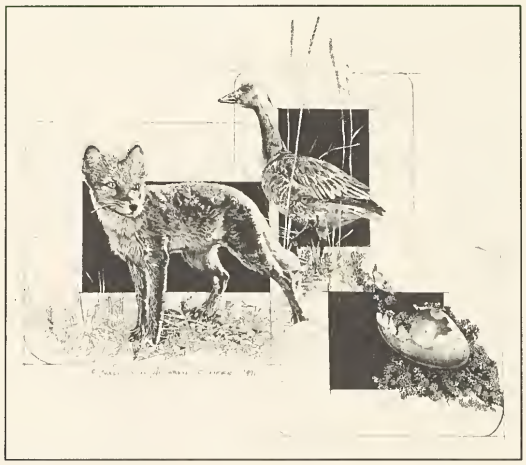
OUTDOOR SCIENCE CENTER

The walk-through pond, ecology discovery tanks and pollution garden comprise the Institute's Outdoor Science Center, located behind the Gifford House. These exhibits are open during Arboretum hours.

PERENNIAL GARDEN

Highlights for early summer include:
Campanula (Bellflower)
Rodgersia (Roger's Flower)
Geranium (Cranesbill)
Clematis (Clematis)
Delphinium (Larkspur)
Digitalis (Foxglove)
Gaillardia (Blanket Flower)
Yucca (Adam's Needle)

ART EXHIBIT



"A Fox, a Goose, a Broken Egg," by Karen L. Allaben-Confer

Impressions of Living Beings, an exhibit of paintings by wildlife artist Karen L. Allaben-Confer, is on display in the lobby of the Plant Science Building. (Ms. Allaben-Confer's previous show, *To Catch the Wind*, was at IES in fall 1988.) Most of the works in the current show result from recent trips by the artist to the Canadian wilderness. The exhibit is open weekdays from 9 - 4 through the end of July. Admission is free.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).
Divisions from the Perennial Garden, while supplies last

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

ARBORETUM HOURS
(Summer Hours: May 1 - September 30; closed on public holidays)

The **Arboretum** grounds are open Monday through Saturday, 9 a.m. to 6 p.m.; Sunday 1 - 6 p.m. The Greenhouse and the Plant Science Building close at 4 p.m.

The **Gift and Plant Shop** is open Tuesday through Saturday 11 a.m. to 5 p.m. and Sunday 1 - 5 p.m. (closed weekdays from 1 - 1:30 p.m.).

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, a free subscription to the IES NEWSLETTER, and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is $30; family membership is $40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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