TKC Leaflet: April 2007 Newsletter
FRONT

Yale Forestry Program

Foresters from the Yale School of Forestry and Environmental Studies (F&ES), the nation's oldest school of forestry, were on island for two weeks in March to work with a landowner to create a forest restoration and management plan and to think through ways that the plan could also be part of community-wide interests in sustainable economic development.

The Kohala Center, through its Executive Director Matt Hamabata, extended an invitation to Yale Professor Mark Ashton, an expert in tropical hardwood forests with extensive experience in Indonesia, to consider working on Hawai`i Island to develop a management plan for a large landholding. Dr. Ashton and David Ellum, a recent Ph.D. graduate, co-instruct Yale University's graduate-level Rapid Assessments in Forest Conservation course. Students in this course learn how to develop a comprehensive management plan for a large-acreage property within a relatively short timeframe. Students work within guidelines established by the landowner to meet the landowner's management and conservation goals, including the production of varied goods and services. The project site encompasses roughly 1,200 acres, extending from the Pacific Ocean into the mountains.

Learn more about this innovative partnership.

Getting into the Field

Photo: Students from Kea`au High school conduct a look-box transect for a biodiversity survey at the Wai Opae tidepools in Puna, Hawai`i. Photo by Steve Coffee.

The Hawai`i Meaningful Environmental Education for Teachers (HI-MEET) project has brought Island teachers and their students outdoors for some excellent scientific fieldwork. This year's projects range from coral reef monitoring in Kohala, to marine debris studies and beach clean-ups in Ka`u, to species diversity transects in the tidepools of Puna. Island school teachers are collaborating within their HI-MEET cohort, with experts in scientific field research methods, and with cultural practitioners island-wide to create and deliver interdisciplinary, project-based curriculum and service-learning opportunities for students in grades K–12. Project planning sessions helped teachers to align their projects to science standards, to measure student evidence of learning, and to master the nuts and bolts of doing science in the field with students.

"These science projects attest to the dedication and creativity of these teachers," says Kohala Center HI-MEET Project Coordinator, Steve Coffee. "It has been an honor to work with these gifted people. Our children are in good hands."

Learn more about this year's science projects, and see what teachers liked best about HI-MEET.

April Deadline Approacheth

"I do hope that young people will take advantage of the opportunity to study at Brown or Cornell this summer. Students will get to meet and work with talented young people like themselves from across the nation and around the world. And they will also get to see what life is like on the campuses of some of the country's best universities. We have generous scholarships available, and so all those who are interested should most definitely apply." - Matt Hamabata, who grew up in Hanapepe on the Island of Kaua'i, earned his undergraduate degree at Cornell, his Ph.D. at Harvard, and first taught at Yale. He always says, "If a *lolo* (a dummy) like me can do it, anybody can!"

The scholarship deadline for Hawai'i Island high school students to apply for the BELL Program at Brown University in Providence, Rhode Island, or for the Curie Academy at Cornell University in Ithaca, New York, is **5 pm on April 16, 2007**. The BELL Program focuses on sustainable environmental practices. The Curie Academy focuses on understanding sports injuries and arthritis. Scholarship applications are available at The Kohala Center's website at www.kohalacenter.org. Generous scholarships and travel support are available to qualified high school sophomores or juniors.

Celebrate Earth Day

Photo: Talking Humu and Friend. Photo by Sara Peck.

Bring your family to the festivities at the 7th Annual Coral Reef Awareness & Earth Day Fair on Saturday, April 21, from 10 am – 2 pm, at the Outrigger Keauhou Beach Resort and Kahalu`u Beach Park. Meet "Humu" the walking, talking fish. Learn about native plants and birds, corals, whales, turtles, and monk seals. Learn from ReefTeachers and "fish" for knowledge about the sea. Enjoy Hawaiian crafts, lei making, weaving, music, and entertainment. Learn how you can support Hawai`i Island's fragile ecosystems and species through resource and habitat management, education, and conservation practices. The latest fishing regulations will be available.

Volunteers are still needed to help with various shifts. If you are able to donate any free time to assist at this event, please contact Sara Peck at 329-2861.

Doing It with Aloha!

Photo: Girls Scouts helped to paint the picnic tables at Kahalu`u Beach Park on March 22, 2007.

"As kama`aina* (natives) *of Kona, Kahalu`u Beach was a very special place for us. I remember going swimming in the Bay and having many, many fish swim with and around me. It was a special time. The corals were beautiful too. Today the University of Hawai`i Sea Grant Program and The Kohala Center are reaching out to our community for volunteers (ReefTeachers) to help educate our visitors on "Reef Etiquette." Our goal is to take care of our reef so our children's children a hundred years from now can say, 'Mahalo kupuna (elders)*, whomever you were, for thinking of us.'"* – Cindi Punihaole, The Kohala Center

Trained ReefTeachers use the main pavilion at Kahalu'u Beach Park as a place to educate visitors on how to take care of Hawai'i Island's precious coral reef environments. To help spruce up the pavilion, the University of

Hawai`i Sea Grant Program and The Kohala Center invited the community to a series of volunteer workdays at Kahalu`u Beach Park in March. Cindi Punihaole of The Kohala Center coordinated the volunteer workdays, including providing delicious free lunches for all the volunteers. Volunteers helped to repaint the main pavilion, tables, and benches at the Park. Fifteen people showed up at the first workday, and over 60 volunteers came to help paint the pavilion on the second workday. When we do things on Hawai`i Island, we do them with aloha!

To volunteer to help with projects at Kahalu`u Bay, contact Cindi Punihaole Kennedy at 895-1010 or via email at cpunihaole@kohalacenter.org.

Reef Etiquette Film Wins International Prize

Photo: Dave, ReefTeacher, teaches *keiki* (children) how to keep the coral alive at the 6th Annual Coral Reef Awareness Day at Kahalu`u Beach Park. Photo by Kirk Shorte, event Marketing & Promotions Manager.

Professional underwater photographer Ziggy Livnat's Reef Etiquette PSA (public service announcement) has won the Best Children's Film category in the Wildlife Asia Film Festival. Livnat's PSA combines beautiful underwater footage with a humorous narrative and original Hawaiian music to engage and educate visitors on how to respect the reef and its creatures. In our community, Livnat has been instrumental in promoting coral reef education at Kahalu`u Bay. He donated his photographs to illustrate the ReefTeach reference books and brochures, as well as photographs to be displayed on buses transporting visitors to Kahalu`u Bay. Bus drivers use Livnat's pictures showing "what to do" and "what not to do," to instruct visitors before they disembark at the Bay. Considering that there are roughly 400,000 visitors annually to this popular snorkeling spot, education efforts like Livnat's are critical to the preservation of the reef ecosytem. Here are some of the big lessons conveyed by the film:

1. Corals are alive and very fragile! By stepping on, kicking, or touching them we harm and may even kill them.
2. Feeding the animals is bad for them and for the reef ecosystem. By feeding them we turn them into beggars and they may turn aggressive.
3. Anything left on the beach will end up in the ocean. Thousands of marine creatures die yearly from plastic litter alone.
4. Keeping a respectful distance from marine mammals and sea turtles is not only wise, but it's also the law.

Recycling for Good

Photo: On March 18, students from The Movement Center helped pick up trash and cigarette butts at Kahalu`u Beach Park. Now that no smoking is allowed at the park, we are picking up the last of the many butts that were there in the past. Mahalo to these special children.)

The Kohala Center is now an approved non-profit organization to receive donations from both the Arc of Hilo Recycling Centers and Atlas Recycling Centers, LLC. Anyone can drop off recycled products and let the workers know that he/she would like to donate the funds to The Kohala Center. Just say, "I want to donate this to the Kohala Center." You will receive a receipt that lists the amount of money that you donated. Recycling redemption centers are located at the following transfer stations: Kealakehe, Kea`au, Hilo, Waiohinu, Pahoa, Waimea, Puako, Keauhou, Hawi, and Honoka`a. The Kohala Center will direct all recycling proceeds to the Kahalu`u Bay Project.

Girl Scout Troop No. 425 of Kailua-Kona is actively engaged in preservation efforts at Kahalu`u Bay – both as ReefTeachers and as recycling advocates. Troop No. 425 is recycling used ink cartridges and cellular phones and encouraging others to do the same. Over 400,000,000 old cell phones and ink cartridges are landfilled in the U.S. each year, when these items could be redeemed and recycled. The Kohala Center is supporting Troop No. 425's recycling project, and in February, the Center mailed out over 1,000 self-addressed, postage-paid recycling envelopes to its members and friends.

The Center has already received over 100 additional requests for envelopes.

Rosanne Shank, Troop Leader, reports that the redemption checks are starting to arrive: "It is fantastic to think that this money is coming from something that people were throwing away! It is awesome how some of our actions just seem to snowball and positively affect so many people. And to think we are helping the environment, too! Thank you so much for your support." Mahalo for spreading the word....

The Value of Divergent Thinking

Photo: Parker Hale shows the rocket model he was inspired to build at home after a Math Explorer's session, working with scale models of real objects. He incorporated juice cans of different diameters, a fruit slicer, and even the miniature (4-inch) crutch he got at Math Explorer's class. Photo by Marie Fellenstein Hale.

As this season's Math Explorers classes draw to a close, instructor Gail Lewis shares some thoughts about the importance of strong math foundations for prospective scientists and engineers. She argues that the U.S. needs to foster divergent, creative problem solvers, in order to make the sorts of significant technological advances that occur at the forefront of a global economy.

Read Developing 'Thinkers,' by Gail Lewis.

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BACK

Planning for Forest Stewardship

Each spring graduate students in the Yale School of Forestry and Environmental Studies travel to a different biogeographic region as part of their Rapid Assessments in Forest Conservation course. This course provides an opportunity for students to conduct case analyses in landscape management in diverse regions of the globe. Students typically travel on extended class trips to the study sites, where they do intensive, team-based field work. In collaboration with the landowner, students assess management options for these complex forest ecosystems, to maximize the landowner's goals for the property. Past projects have focused on regions in the Pacific Northwest, Ecuador, Costa Rica, Venezuela, Belize, central and southern Mexico, and the Panama Canal Watersheds.

This spring, for the first time, the program engaged a Hawai`i Island landscape. Students, led by Professor Mark Ashton and doctoral candidate Dave Ellum, spent several weeks preparing for their two-week rapid assessment on Hawai`i Island. A huge challenge for the Yale students is to incorporate community and cultural values, as well as local environmental conditions, into their assessments, within their short timeframe onsite. The Kohala Center (TKC) provided access to cultural and community leaders and to local environmental experts, in order to appropriately orient the students to Hawai`i Island's cultural, historical, and natural contexts.

As part of their semester-long project, the Yale students conducted intensive research on the project site, based on GIS mapping, satellite imagery, historical references, and intensive environmental research prior to their arrival on the Island. During their onsite field work, the Yale students participated in cultural interviews, consultations with community members, and field surveys to assess current conditions on the site. The Kohala Center

provided access to cultural and environmental expertise both prior to the students' arrival and during their two-week stay on the Island.

TKC arranged for the Yale students to accompany Kanoelehua Wilson, a Hawaiian cultural practitioner, to the AhSam family's taro *lo'i* (terraces). Kanoelehua Wilson, Ashton Dirks, and members of the AhSam

family served as the group's teachers on their first day in the field. They learned about *kalo* (taro) and its importance to the Hawaiian culture. The students had the opportunity to plant taro and clean the *`auwai* (irrigation ditches) supplying the *lo'i*. They learned to recognize the architecture of traditional Hawaiian *lo'i*, so that during their field survey of the project site they were able to recognize an abandoned *lo'i* in one of the gulches. This ancient *lo'i* was previously unsurveyed, and its discovery was an exhilarating moment for the Yale students. The landowner will consider the possible restoration of this abandoned *lo'i* as a resource for the benefit of the surrounding community.

Students toured Ka`upulehu dry forest with Yvonne Yarber-Carter, and a restored rainforest landscape in Volcano with Marilyn Nicholson of the Volcano Art Center. Students also visited a native forest exclosure with natural resource expert Mick Castillo, who introduced the students to native species and common invasive species. Invasive species are a huge challenge in Hawai`i's forests. The Yale students are considering mechanisms to control invasive species without herbicides, as the landowner wishes to minimize use of chemicals on the project site.

Professor Ashton accompanied Kohala Center staff person Greg Smitman to the Kealakekua Heritage Ranch, where Smitman reviewed the forest management plan that he and Mick Castillo prepared for this large tract of land in South Kona. Before coming to Hawai`i Island, Smitman served as Natural Resource Office for the Bureau of Indian Affairs, where he oversaw forest management plans, wildlife management, irrigation, and hydrology for three Indian reservations encompassing over 650,000 acres of land in Montana. Smitman has assisted with the preparation of reservation-based resource management plans for 84 different reservations across the U.S.

Smitman has some ambitious long-term goals for the fledging partnership with Yale's School of Forestry and Environmental Studies:

"We are engaging expertise from Yale to improve natural resources and community assets for the residents of Hawai'i Island. Both current projects include public outreach and public access clauses. We are working with the landowners of both projects to incorporate 'facilitated' access, where the landowner participates in the public access plan to ensure respectful engagement of the landscape. We are also hoping to encourage Yale to consider siting long-term forestry research on Hawai'i Island. We would like them to help gather data and develop meaningful growth-yield tables for koa on this island. Right now we don't know what it will take to restore koa forests on former agricultural land – we don't know how long it will take and what the parameters are. We want to work with institutions like Yale to put an educational process in place to replicate successful restoration efforts in other forests. And we want to work with private landowners to establish research sites around the island which encompass the variety of habitats on the island, so that we can begin to collect data in both wet and dry environments."

The Yale students will turn over their final report to the landowner on June 1, 2007. The report will include recommendations about which areas of the project site should be reforested, suggestions for natural regeneration techniques for native forest species, suggestions for removal of feral ungulates and livestock, advice on where to site trails and recreational uses, suggestions for incorporating self-sufficiency into operations, suggestions for maximizing view planes, and many more specific recommendations which will be incorporated into a Forest Management Plan Pre-proposal for possible submission to the State of Hawai`i's Forest Stewardship Program. The State program provides cost-sharing for forest regeneration projects with a minimum ten-year commitment on the part of the landowner.

Once their report is accepted by the landowner, the students' task will be completed. Only time will tell whether the seeds planted by the Kohala Center will take root and foster additional partnerships with Yale. The Rapid Assessment course exposed Yale professors and students to opportunities to conduct research here on Hawai`i Island. The hope is that this partnership will result in long-term forestry research on the Island, which brings long-term benefits for Island environments and communities.

"It would be wonderful if someday soon, we would be able to build teaching and research programs that connect SFE with outstanding Island institutions and programs, such as Hawai`i Community College's Hawaiian Lifestyles and Forestry programs," said TKC Executive Director Matt Hamabata. "It would be an unusual and lively partnership, through which the field of forestry could be deepened and strengthened by indigenous knowledge and by exposure to our unique natural assets and to our wonderful Island teachers. Through such a partnership, local professionals and students could also participate in research and learning that have global significance and impact - by focusing on challenges and opportunities presented to us right here on

Hawai`i Island. Such a partnership also has the potential to bring new and valuable resources, both financial and intellectual, to Hawai`i."

Hands-on Environmental Education

Story and Photos by Steve Coffee

Photo: A happy HI-MEET teacher (India Young) enjoys hands-on environmental education.

At Connections Public Charter School social studies, fine arts, and marine science teachers are collaborating on a project about marine debris and coastal issues of the Ka`u District. Students have been working with the *kupuna* (elders) of Punalu`u and hauling away marine debris from the coastline of South Point.

Kanu o ka `Aina New Century Public Charter School is bringing science and Hawaiian cultural studies together through an ongoing coral reef monitoring project to track the long-term effects of development at Kawaihae Harbor on near-shore ecosystems. Students have been in the water collecting data on species composition and photographing the reef to monitor changes in biodiversity over time. These students also receive rigorous water safety training and diving skills practice.

Ke Kula o Ehunuikaimalino middle and high school students continue their ongoing survey of human impacts at Honaunau and Kahalu`u, popular South Kona dive spots. Students are using digital eco-probes to measure water-quality parameters and to track water quality changes over time.

And teachers from Kua O Ka La Public Charter School in Puna, Kea`au High School, and Na Wai Ola Public Charter School have been exploring the tidepools and shoreline ecosystems of Kapoho.

Photos: Before **(above right)** and after **(below right)** beach clean-up results in Ka`u.

I think the HI-MEET Program has been an excellent means of providing the critical assistance needed for Hawai`i Island teachers to get out of their classrooms and into the field where some of the best learning takes place. My primary roles have been to assist teachers with project planning, logistics, and the techniques of doing science in the field. Without this kind of assistance, authentic project-based education in the field is just not realistic for most public school teachers.

We have learned over the years that most teachers have the passion and the energy to provide quality curriculum, but many lack the expertise in project planning and field science methods. Even experienced science teachers may lack the knowledge or administrative support needed to coordinate and manage ongoing hands-on environmental education projects and teach real-life environmental monitoring skills.

One of my primary roles has been to meet with teachers in the planning phase of their projects to ensure that field activities will support their project objectives, satisfy state and federal education standards, and will result in concrete evidence of student learning. We sit down with a project planning template and lay out, step by step, the timeline, the project activities, the resources needed, and the assessment strategies to assure that the project progresses smoothly and meets overall project goals, including some real benefit to the community at large. Evidence of student learning might include a collection of photographic transects of a coral reef, calculations of native forest biodiversity, water quality data from a stream or particular shoreline near the school, or concrete plans to mitigate an environmental problem or issue students have identified or studied. Student products may take the form of PowerPoint or video presentations, public speeches, or even visual and performing arts projects.

My other primary role has been to join teachers and their students in the field, to assist with data collection, species identification, and using the complex array of sampling equipment and methodologies commonly used in the field of conservation and resource management. We work together, often with student involvement, to design sampling protocols, to select sample sites or target species, and to decide how to manage a growing body of field data. Sometimes the logistics of transportation, hauling sampling equipment, dive gear, water, first aid kits, food, field guides, etc., as well as coordinating students and chaperones can be overwhelming. For these reasons alone, many teachers opt to stay in the classroom and inside the "box." I have been able to act as a liaison between the teacher participants and The Kohala Center, which through the HI-MEET Program, provides funding and support in these areas as well.

The long-term goal of the HI-MEET Program is to establish a cadre of teachers on the Island who are adept at working in the field with students on environmental and conservation type projects. Over the next few years we hope to attract more teachers to the ranks of those who are intrepidly doing interdisciplinary field science. These kinds of projects can help to facilitate the collection of scientific data needed to make sound policy decisions and maintain a healthy, sustainable environment for all stakeholders. This work also prepares students with the skills they need for employment in the growing fields of conservation and resource management in Hawai`i.

I think we've gotten off to a very strong start and we are looking forward to continuing the program next year, assisting more and more Island teachers to master the skills necessary to do environmental education projects in the

field.

Here is an overview of the many different field projects happening this year at Island schools as a direct consequence of the HI-MEET Program.

HI-MEET PROJECTS 2006-07

Connections Public Charter School - Hilo
Marine debris and coastal issues of the Ka`u District
Grades 7 & 8

Photo: Students from Connections Public Charter School pick up marine debris, mostly plastic, along a remote beach at South Point, Hawai`i Island, as part of their marine debris and coastal issues project.

Students explore the composition and origins of marine debris at South Point through studies of human activities and ocean currents, and site visits, including Hawaiian cultural perspectives and coastal resource management issues.

Teachers:
Eric Bollen - Social Studies
Grace Chao - Art
Bill Ebersol - Marine Science

"The mini-grants made it possible for us to get equipment for the kids to engage in real science. We were able to get good equipment that will last for years." - Science Department, Connections Public Charter School.

"The mini-grants allowed us to take four field trips that would have been otherwise impossible." – Eric Bollen, Social Studies teacher, Connections Public Charter School.

"Starting a project allowed us to branch out and connect to other disciplines. Student artworks have been based on the themes of ocean life and issues surrounding the

destruction and protection of the ocean." - Grace Chu, Art teacher, Connections Public Charter School

Kanu o ka `Aina New Century Public Charter School (NCPCS) - Waimea
Coral reef monitoring of the Kawaihae Harbor area
Grades 6-11

Photo: *Kumu* (teacher) Hadee Sabzalian reviews safe diving techniques before students enter the water to collect data for their coral reef monitoring project at Kawaihae Harbor.

Students collect long-term baseline data of coral reef habitat at three sample sites around Kawaihae Harbor, to monitor impacts of projected harbor development. Students collect data on species biodiversity and photograph the reef to monitor changes over time. Students also learn the Hawaiian cultural protocols and practices appropriate for this area.

Teachers:
Nicole Anakalea - Hawaiian Culture & Language, Social Studies
Hadee Sabzalian - Science & Health
Casey Tiemann - Math

"The HI-MEET Program has been a huge help in our efforts to create an authentic hands-on learning process. The program has given students an opportunity to become experts in the random sampling process. The funds from the grant have supplied us with quality equipment to help ensure the students can conduct their studies in the proper manner. Having Steve Coffee by our side every step of the way has been a huge help. Without his valuable help, we could not have made it this far." - Hadee Sabzalian, Science & Health teacher, Kanu o ka `Aina NCPCS.

Ke Kula o Ehunuikaimalino School - Kealakekua
Monitoring of human impacts and water quality at several high-use shoreline access points along the South Kona Coast.
Grades 6-12

Teacher:
Monica Pilimai Traub - Science, Social Studies
Kea`au High School - Kea`au
Classification and marine species identification
Grades 10 & 11

Photo: Science teacher India Young of Kea`au High School prepares her students for a biodiversity survey at Wai Opae tidepools in Puna.

Students study classification and biodiversity through transects, observation, and research of marine organisms and the coral reef ecosystem both in the Kapoho tidepools and at the library.

Teacher:
India Young - Science

"HI-MEET has allowed me the opportunity and flexibility to enhance my curriculum with hands-on and applicable field trips that engage students in the outdoor classroom, making science come alive." - India Young, Science teacher, Kea`au High School

Na Wai Ola Public Charter School - Kurtistown
Marine species identification
Grades 6-8

Students identify marine tidepool organisms both in the lab and by snorkeling at Wai Opae tidepools in Kapoho.

Teacher:
Carol Gray – Science
Kua O Ka La Public Charter School - Puna
Comparison of tidepool and aquarium marine ecosystems
Grades 9-12

Students measure water quality parameters in both natural and artificial ecosystems to compare and contrast bio-control mechanisms.

Teachers:
Prana Mandoe - Social Studies
Jason Thorpe - Science
Connections Public Charter School - Hilo
Long-term water quality monitoring of Hilo Bay and concurrent watershed river inputs
Grades 2-12

Students measure water quality at selected sites around Hilo Bay and the rivers that flow into the Bay, and correlate effects of currents, tides, and storm activity along the coastline. Middle and high school students mentor elementary students.

Teachers:
Phyllis Cabral – Elementary
Sonya Carvalho - Science
Bill Ebersol - Science
Elsie Miyazuno – Elementary Math & Science
Pam Thatcher – Elementary Math & Science

"You have accomplished your mission. We have incorporated environmental education into all areas of content. Project-based, interdisciplinary learning engages students in all areas of life." - Bill Ebersol, Science teacher, Connections Public Charter School

Developing 'Thinkers'

By Gail Lewis

Photo: Math Explorers students experiment with different bubble shapes. Photo by Michaela Lewis.

"No Child Left Behind" (NCLB) is an education initiative that focuses on convergent thinking: know the pre-determined correct answers and do well on the test. But when you look at recent technological advances - the Internet and its information-finding capability, nano-technology, medical

advances through genetic modifications, hydrogen fuel research, cell phone/camera/PDA/GPS combinations – you find a synergy between knowledge and imagination, between convergent and divergent thinking.

Of course, math learning must include consolidation of skills through frequent practice to facilitate the development of critical neural pathways, to support conceptual understanding, and to increase speed of computational processing.

In elementary math and science education, I also advocate spending some time on divergent or open-ended thinking tasks, in addition to formal, mediated instruction to explain concepts and teach the efficient computational methods children need to learn.

How do we encourage divergent thinking? Provide regular exploration opportunities to nurture problem-solving skills. Let children loose on open-ended tasks which can have a variety of solutions. Their innate creativity will do the rest.

At Math Explorers this past fall, I saw some striking instances of divergent thinking in students – little events with big implications. Mathematical work is based on developing and using algorithms, or sequences of steps designed for the effective solution of a problem, for example, the steps involved in long division.

Parker Hale, a 2nd Grader, probably can't tell you what an algorithm is, but at Math Explorers I saw him come up with an efficient algorithm to deal with the task of shading an 8 x 8-inch square grid to form a checkerboard design. Having noticed a checkerboard's pattern, Parker's method was to draw parallel diagonal lines on the grid and shade every square that had a line in it. Confident in his method, he was done sooner than anyone else and made no errors in shading. Not bad for an 8-year-old beginner in algorithm design! Try his method for yourself! It's very efficient.

Photo: Levitating tetrahedra: an intriguing shot of kites made by students in Math Explorers class. The kites were lightweight, functional, aesthetically pleasing, and fun to fly. Photo by Gail Lewis.

Curious about intriguing patterns in math? Did you know that a feature of square numbers is their ability to be represented by units arranged in equal rows that actually form a square? Seems obvious, but it is still gratifying to see. Using home-made math manipulatives (white polystyrene balls on a black contact paper background), we showed that the number 9 can be represented by 3 rows of 3 balls and that 25 can be made of 5 rows of 5 balls.

While we were playing with these square number representations in Math Explorers class, 4th grader Davy Ragland made an insightful suggestion that I had not considered before. "Hey," he commented, "this would make a good method for finding the square root of a number. Not only that, but you could also find out whether the square root is a whole number or not."

Davy's comment showed that he was extending our exploration by looking at the issue differently. For all of us in the room that day, our mathematical understanding of the relationship between numbers, exponents, roots and patterns was enhanced – first by the 'cool' practical way in which square numbers actually make squares and, secondly, by Davy's insight that this could be a method for finding a square root. He had found in our pattern a powerful way to visually represent the relationship between a number and its root!

Open-ended investigations of math concepts are a rare occurrence in most math classroom settings, especially in the NCLB era of standardized-test-based math instruction. With a little imagination and planning, families can remedy this by enjoying practical math explorations together. Old-fashioned encyclopedias for children always had suggestions for "Things to Make and

Do," puzzle pages, and project ideas. Parents can revive those activities, visit the under-utilized math resource sections in the public libraries, and tinker with open-ended math-linked games like Tinkertoy, pattern blocks, tangrams, geoboards, and marbles - new or second-hand. Your young tinkerers may grow into the skilled divergent thinkers the U.S. needs to solve the complex problems that face our planet!