ILLUSTRATION BY BRAD YEO

Life is richest at the juncture where worlds meet. Where theory meets tangibles—on the mountain top, at the potter's wheel, in the living room hearing children laugh—is where the student evolves from learner to discoverer, from discoverer to expert. That's what it means to be an undergraduate doing research.

The Quantum Leap

By Mary A. Durlak

"I DIDN'T KNOW YOU COULD DO THIS IN COLLEGE," said Stan Skotnicki, '06. He gestured to the garnet-studded rocks on the tables, the saws for cutting granite and quartz, and the microscope designed to reveal the minerals in a paper-thin slice of rock.

But he was referring to much more than the petrology lab. He also meant the field trip to the site of an ancient continental collision in what's now western Connecticut, and another trip to Hawaii with the Geology Club, where he saw firsthand the rocks of the volcanic island chain. Ultimately, he took on his own research project at the abandoned Hooper Garnet Mine in the Adirondack Mountains.

For 12 hours a day, for days at a stretch, Skotnicki walked the perimeter of the old mine. "The mine is about 150 meters by 100 meters, and 60 meters high," he said. "I hiked at different elevations, taking measurements every two or three meters." All in all, Skotnicki took more than 700 measurements.

The funny thing is that geology wasn't part of Skotnicki's plan until he took a course from Gary Solar, assistant professor of geology. Solar researches the mountain-building process, and much of his work focuses on the Adirondacks. "The Adirondacks were once like the Andes are now," said Solar. "Rocks are the record of the process."

Skotnicki's study of the Hooper Garnet Mine resulted in a three-dimensional geological map of the mine. Such a map shows not only the topography but also the orientation of the rocks caused billions—yes, that's a *b*—billions of years ago when the mountains were formed. Until Skotnicki created it, no such geological map of the area existed. The map contributes to the scientific body of knowledge about the formation of the surface of the earth.

Skotnicki, an earth sciences and science education major, has presented his findings to other geologists. "Going to conferences is exciting," he said, "because you talk to other people who understand your passion." He also was selected to present a poster showing his project at an annual event in Washington, D.C., called "Posters on the Hill." The Council on Undergraduate Research (CUR), a national organization that advocates undergraduate participation in scholarly research under the guidance of a faculty mentor, sponsors the event.

Participating in research as an undergraduate himself made all the difference to Solar. "I was a civil engineering major," he said, "but I wasn't particularly enthusiastic about it. It wasn't until I did research myself that college came alive for me." In geology, Solar found the unique blend of theory and field study that became his life's work. As a professor, he seeks to provide his own undergraduate students with a similar experience.

GARY SOLAR, ASSISTANT PROFESSOR OF GEOLOGY (LEFT), IS COMMITTED TO SHARING HIS OWN EXPERIENCE OF UNDERGRADUATE RESEARCH WITH HIS STUDENTS. HE INTRODUCED STAN SKOTNICKI, '06, AN EARTH SCIENCES AND SCIENCE EDUCATION MAJOR, TO THE THRILL OF READING THE PLANET'S HISTORY DIRECTLY FROM THE ROCKS THAT TELL THE TALE.

PHOTOGRAPH BY TOM WOLF

Experiments for Art

"Ceramics involves so much chemistry it's ridiculous," said Jonathan Matecki, '05, a ceramic artist and design major. "Glazes alone can have seven different ingredients. Iron-based colorants can go green or red, depending on how much you use and what the other ingredients are."

Ceramic artists use clay to create vessels, sculpture, and forms embodying both. Sometimes extensive experimentation is necessary to achieve a particular artistic objective.

"I have boxes of things that didn't work out," said Matecki. One of his interests is to reveal the properties of clay by using pestles to stretch and distort the vessels as he shapes them on the potter's wheel. He had to formulate a clay body that withstands such manipulation.

"I'm also trying to create something like geodes," said Matecki. He forms a hollow clay ball, texturizes the outside to resemble the unremarkable rocks that contain crystal formations, and injects a glaze into the ball's hollow center.

"I need to find glazes that crystallize," he explained. "Most glazes just pool and flatten out." So far, he has experimented with more than 500 glazes, including glazes he himself has developed.

Added to the challenge is the kiln temperature at which Matecki fires his work. A lower temperature range, called cone 04, is commonly used to fire pottery; Matecki uses cone 10, which indicates a temperature as high as 2,381 degrees Fahrenheit. Matecki uses gas kilns because they require time and watchfulness, imbuing the process with a certain reverence. "Clay's precious," he said. "It comes out of our earth."

PHOTOGRAPH BY TOM WOLF

WHEN ROBERT WOOD, PROFESSOR OF DESIGN (LEFT), ISN'T BUSY CREATING AND EXHIBITING HIS OWN WORK, OR COORDINATING BUFFALO STATE'S CERAMIC DESIGN PROGRAM, HE IS HELPING STUDENTS DISCOVER THEIR CREATIVITY AND EXPRESS IT THROUGH CLAY. UNDER HIS GUIDANCE, JONATHAN MATECKI, '05, LEARNED TECHNICAL EXPERIMENTATION.

Matecki exhibited his work at the regional conference of the National Council on Education for the Ceramic Arts (NCECA) last year. He was one of just 40 students whose work was selected from hundreds of submissions. "The Undergraduate Research Office helped me apply to enter the NCECA exhibition," said Matecki. "And when my work was accepted, they helped me pay for my hotel and conference registration."

Robert Wood, professor of design and well-known ceramic artist, has been important in guiding Matecki's progress. "Bob has done a lot," said Matecki. "He works with large-scale pieces, and he knows about all the different materials. He'll suggest a direction, but he won't give you the answer."

"Students have to be able to make and defend their own decisions," said Wood. "My students start with visual research in their introductory courses to find objects to draw from—a milkweed pod, for example. As we go on, the research becomes more technical: What's the right clay body? What firing process will work best? What glaze will express an idea best?"

OWNING INFORMATION IS EMPOWERING. THAT'S WHY AMITRA HODGE, ASSISTANT PROFESSOR OF SOCIOLOGY (LEFT), REQUIRES HER STUDENTS TO DO RESEARCH. DISCOVERING NEW INFORMATION LEADS TO CONFIDENCE AND CRITICAL THINKING SKILLS. ANGELA CENTENO, '05, EXPLORED DIFFERENCES OF PERCEPTION.

PHOTOGRAPH BY KC KRATT

Demystifying Research

"Knowing how to get knowledge is power," said Amitra Hodge, assistant professor of sociology. That's why she requires research in every class she teaches.

Hodge investigates gender and Internet usage, but she encourages students to find their own areas of interest. "You can't sustain in-depth research if you're not interested in the subject," she said. "Research is too demanding, too rigorous. Without a personal, vested interest, it's hard for students to sustain the energy necessary to come to a finding."

Hodge said many students believe they can't do research. So she starts by demystifying the process.

"We are all consumers of research," she tells her students. Whenever a person relies on a doctor's advice, chooses a new car, or plans for the future, he or she is relying on information created by research. The research method may be good or flawed, producing information that is reliable or misleading. That's why it's so important to know how to evaluate the research before relying on the information.

"Dr. Hodge helped me very much," said Angela Centeno, '05, who participated in last spring's Student Research and Creativity Celebration. Centeno, a sociology major, became interested in the perceptions her fellow students have of Puerto Rican culture. She devised a questionnaire to examine those perceptions, distributed it, and compiled the findings.

"I learned that doing research takes time and patience," said Centeno. After collecting the data, she used a statistical software package to analyze the results. Because participants identified themselves by their majors, she was able to look for differences among students of art, natural science, and social science.

"I hope that this experience will help me get into graduate school," said Centeno. "Understanding the research process is important for future learning."

Prescription: Food

The first time Veronica Smith heard her son belly-laugh, he was 14 years old. It was a joyful moment, yet Smith pointed out that the breakthrough came after she had learned about a special diet designed for children with attention-deficit disorder (ADD). "He'd been on the diet for just one month," she said, "and we'd been trying to treat his ADD for years with medication and school interventions. If I had known more about nutrition sooner, it would have been much easier for our entire family."

Smith had become interested in nutrition earlier, when another son underwent chemotherapy. She asked his doctors if there were any foods that could aid his recovery. "Their answer," she said, "was, 'Give him a vitamin pill.'"

Not satisfied, Smith began to study nutrition at the library, on the Web, and at the nearest bookstore. When she decided to return to college, the obvious major for her was dietetics—the science of applying the principles of nutrition to the diet to maintain, improve, or restore health.

DIETETICS MAJOR VERONICA SMITH, '06 (LEFT), HAS MASTERED BIOLOGY, CHEMISTRY, AND ANATOMY COURSES SO SHE CAN USE NUTRITION TO HELP HER FUTURE CLIENTS IMPROVE THEIR HEALTH. TINA COLAIZZO-ANAS, ASSISTANT PROFESSOR OF DIETETICS AND NUTRITION, IS STUDYING FACTORS LINKING OBESITY, CANCER, AND DIET.

PHOTOGRAPH BY BRUCE A. FOX

But she wasn't confident about her abilities; at first, she thought the program required too much science for her to succeed. Course requirements include biology, chemistry, anatomy, and statistics in addition to courses in nutrition and supervised clinical practice. Nonetheless, she decided to pursue the discipline because she felt called to it. Today, she's maintaining a grade point average of 3.8.

Tina Colaizzo-Anas, assistant professor of dietetics and nutrition, interviewed Smith for admission into the coordinated dietetics program. Graduates of this program can take the exam to become a registered dietitian, the field's most prestigious certification.

Colaizzo-Anas is a registered dietitian who has extensive experience developing disease-specific nutrition plans for patients in intensive care. Her interest in the link between diet and cancer led her to study obesity, because obesity is related to increased incidences of certain cancers. She encouraged Smith to apply for an Undergraduate Research Fellowship in 2004 (see sidebar) so they could conduct research together.

"It's important for dietitians to understand scientific research," said Colaizzo-Anas, "because they rely on research to design nutrition therapies for individual patients. And the easiest way to understand research concepts is to do research yourself."

"I didn't have a clue about research before working with Tina," said Smith. But with Colaizzo-Anas, Smith designed the project's methodology. They investigated some of the questions of why so many people are unable to lose weight despite sincere efforts. Smith focused specifically on determining if overweight women knew how many calories they should consume daily to lose one pound a week. She also asked participants to estimate portion size.

The study's methodology considered many variables besides weight, age, and gender, such as health, menstrual cycles, and "resting energy expenditure" or REE—how many calories a person consumes when at rest or sedentary. Smith pre-screened participants, interviewed them, and used a calorimeter to determine individual REE.

"I gained a lot of confidence by working with Tina," said Smith. "And you have to understand research because there's so much conflicting information about what foods are good for you."

Smith also discovered she has a gift for determining her patients' needs through careful questioning. "People have different layers of knowledge, and knowing how to pull information out of people is critical when you want to help them get better and stay better," she said.

The initial findings were paradoxical: People generally overestimate the number of calories they need to eliminate from their diets in order to lose weight, but they routinely underestimate the number of calories they actually consume. The final results will be submitted for publication to the *Journal of the American Dietetics Association.*

PHOTOGRAPH BY TOM WOLF

"BECAUSE THE CLASSROOM JUST ISN'T ENOUGH," SAID AMY MCMILLAN, ASSISTANT PROFESSOR OF BIOLOGY, EXPLAINING WHY RESEARCH IS SO IMPORTANT TO UNDERGRADUATES. THROUGH FIELD AND LAB RESEARCH, KEN BRAUN, '05, STUDIED THE DNA OF LOONS.

Hunter Tracks DNA Markers

Ken Braun, '05, spent much of his senior year as a biology major in the "loon lab." Ironically, what landed Braun in the lab is his love of the outdoors, a love that began when he started hunting at 12. Eventually he hopes to become a wildlife biologist, maybe specializing in field management of large predators.

For now, though, his work is with DNA samples drawn from loons. Under the guidance of Assistant Professor Amy McMillan, he has been looking for a genetic marker differentiating the common loons of eastern North America from their West Coast cousins.

"Evolution is all about genetics," said McMillan, an evolutionary biologist. Understanding loon genetics is a way to read the history of loons and related loons within the species. One of McMillan's research objectives is to be able to identify where a specific loon returns annually to breed. That knowledge will help wildlife biologists understand puzzling health and mortality issues among this fascinating but vulnerable species.

For his piece of the puzzle, Braun tried to find a distinguishing genetic marker by using AFLP genotyping. AFLP stands for "amplified fragment length polymorphism"; it's a way of analyzing DNA that enables the researcher to look for genetic markers on a section of DNA.

Braun pointed to small, dark shadows—genetic markers—at certain places along parallel green lines on a computer monitor. He had hoped to find one marker consistently absent or present among the birds from one of the two coasts, so they could be distinguished.

A Leader in Undergraduate Research

The Undergraduate Research Office was formally established on campus in 2003, but many undergraduate research activities existed long before then. For example, the annual Student Research and Creativity Celebration, which showcases students' original work, was first held in 1999. Summer research fellowships have been awarded to students since 2000. And faculty have been mentoring undergraduates conducting research, scholarly, and creative activities for decades. Just ask Jill Singer–a 1979 Buffalo State alum. "My experience doing research as an undergraduate transformed my education," she said. "That's why I became such an advocate for it."

JILL SINGER, PH.D., DIRECTOR, UNDERGRADUATE RESEARCH OFFICE

Singer's advocacy for expanding undergraduate research opportunities for Buffalo State students began when she joined the faculty in 1986. Besides incorporating research into her own classes, she has mentored more than 30 students in undergraduate research projects, often addressing local environmental problems. In the early 1990s, Singer became involved in the national movement to provide undergraduate research opportunities. She became active in the Council on Undergraduate Research (CUR), whose institutional and individual members believe that students learn best when engaged in the process of discovery, making research one of the most effective ways of teaching. Singer served as CUR's president in 2003–2004, bringing her experience at Buffalo State to a national audience. Today, the college serves as a model for institutionalizing undergraduate research, not only in the natural and social sciences, but also in the arts and humanities.

Singer, who also served as a program director in the National Science Foundation Division of Undergraduate Education in Washington, D.C., from 2001 to 2003, was appointed director of the Undergraduate Research Office upon its creation. But despite her administrative work and her teaching (she is a professor in the Earth Sciences and Science Education Department), she continues to mentor undergraduate researchers for the enormous satisfaction of seeing students learn, gain confidence, and solve challenging problems.

GARY JONES, INTERIM DEAN OF THE SCHOOL OF THE PROFESSIONS AND ASSOCIATE PROFESSOR OF SPEECH-LANGUAGE PATHOLOGY, HELPS JILL ODROBINA, '05, SET UP DIAGNOSTIC EQUIPMENT. THE RESEARCH CONDUCTED BY ODROBINA AND JONES DEMONSTRATED THAT RESULTS ARE ONLY AS RELIABLE AS THE INSTRUMENTS USED TO MEASURE THEM.

PHOTOGRAPH BY TOM WOLF

"I've gained a ton of knowledge," he said. "For one thing, I found out I have the patience to do lab work." While as of this writing he had not found the marker he sought, he's pleased that he has been able to adapt an AFLP protocol for upcoming students. "Somebody else will benefit from what I learned about running gels," he said, referring to one process of translating raw DNA into data scientists can analyze.

"Doing science takes years," said McMillan. "But a student can usually find out enough to develop a meaningful presentation in one or two semesters." Some students publish their findings, often as coauthors with their faculty mentors. Others turn their work into the focus of their graduate studies.

Research, in McMillan's experience, is especially valuable for students who otherwise struggle to connect textbook information with the physical world around them. "When a student is part of trapping loons so scientists can draw blood samples," she said, "they understand what's going on when they use blood as a DNA source in the lab."

Braun's lab experience gave him a behind-the-scenes understanding of the inner workings of research, from following precise steps in rigid sequences to keeping copious, detailed notes of each step. Still, he's ready for the great outdoors again: he's looking forward to working for the Loon Preservation Committee, studying loons on Lake Umbagog in Maine.

Undergraduate Sounds an Alarm

"I found it amazing to discover knowledge that I didn't have...that nobody has," said Jill Odrobina, '05. "I never imagined myself doing this back in high school."

Back then, Odrobina hadn't even considered becoming a speech-language pathologist. She wanted to work with people, and an aptitude test suggested she consider the field.

Gary Jones, associate professor of speech-language pathology and Odrobina's mentor, said that students who do research learn how to solve problems. "Doing research forces you to think something through," he said. "Students learn how to do a research project—define the goals, state the problem, develop a methodology, collect the data, analyze the results, and present the findings."

Odrobina recruited 46 college students between the ages of 18 and 40 for her study. She used two different measurement systems to compare their evaluation of the same voices making the same sound. Both systems are used as diagnostic tools by speech-language pathologists.

The first research objective was to update the characteristics of normal speech, because the norms in use are becoming outdated. The second objective was to compare the measurements obtained by the two different systems.

"The findings were scary," said Odrobina. "The devices didn't give the same results, even though they were supposed to be evaluating the exact same thing." When she presented her findings at the New York State Speech-Language-Hearing Association convention in April, speech-language pathologists who use the equipment were concerned. If further investigation bears out the initial findings, the implications for speech-language clinicians are significant, because the devices in question help diagnose not only speech problems but also underlying physical problems such as growths on the vocal cords.

The experience of explaining new information to her senior colleagues increased Odrobina's self-confidence enormously. "Everybody was interested," said Odrobina, "and I learned about new therapies and adaptive technologies." She plans to pursue her research as part of her master's degree.

KNOWLEDGE IS POWER only if the knowledge is reliable. As the global economy continues to develop, those who can pan good information from the nonstop flow of available information will become more and more influential. Professors are the scholars, scientists, and artists who create new knowledge, interpret old knowledge in the light of new information, and pass those skills on to their students. Students who have been initiated into the rites of research—framing a question, assessing available data, and finding the path that leads to new facts—will own the future. ◉

To hear students discuss their research, visit www.buffalostate.edu/podcasts.xml.