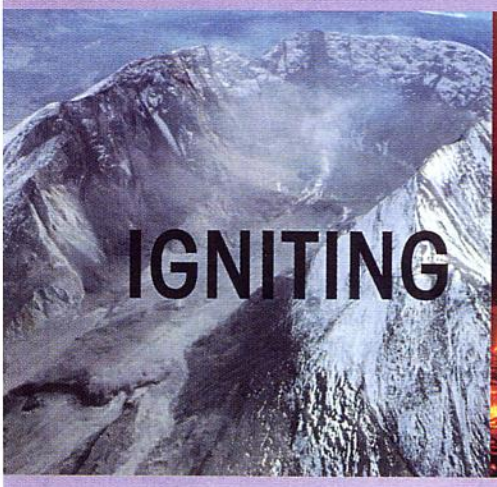
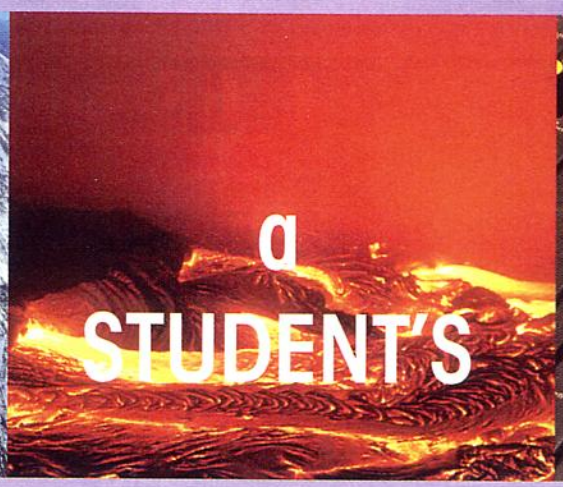


# IGNITING a STUDENT'S



**THE BIG ISLAND, HAWAII — MARCH 1995**

Katie Inderbitzen is a modern day fire walker. Protected only by heat resistant hiking boots, long sleeved clothing, and thick gloves, the fourteen-year-old marine geology student from Hudson, New Hampshire walks with her mentor, Dr. Steven Mattox, across a shiny metallic lava field on Mt. Kilowea in Hawaii. The molten lava flowing below the crust registers over 1000 degrees C. on a thermal probe.

"This is one of the hottest lava fields I've walked across with an Argonaut," says Mattox, a science writer and teacher at the University of Hawaii. "This crust is barely five hours old. The flow was created by a lava tube breakout about 100 feet away. How does that make you feel Katie?"

"Well, it's a bit nerve-wracking but the crust feels thick and hopefully it will hold our weight," says Inderbitzen as she gingerly steps across the lava field, sidestepping glowing red fissures. Mattox explains that hardened lava has a shiny metallic surface, while the molten lava has a reddish glow. She remembers not to stand in one place too long lest her soles start smoking. On primeval soil, Katie quickly learns to rely on all her senses.

"It sounds like popcorn popping or throwing water onto an open fire," Inderbitzen observes. "And it smells like rotten eggs." Mattox explains that the popping sound occurs when flowing hot lava meets up with the cooled crust, while the odor is sulfur dioxide, a gas commonly released by an active volcano.

As Mattox and Inderbitzen continue their stroll, they are followed by a man carrying a portable boom microphone. Camera crews are stationed strategically around the lava field. As the two scientists speak, satellites and microwave links relay their chat back to twenty-six interactive theaters or PIN sites—universities, museums, and research facilities—in the United States, Canada, the Caribbean, and Great Britain, where almost a half million students will have the opportunity to watch Katie and her fellow Argonauts in six daily broadcasts over a two-week period. PIN sites include: National Geographic in Washington, DC; the National Museum & Galleries Meyerside in Liverpool, England; and the Goddard Space Center in Maryland. During this broadcast, Katie's classmates watch her from the New England Science Center in Worcester, Massachusetts.

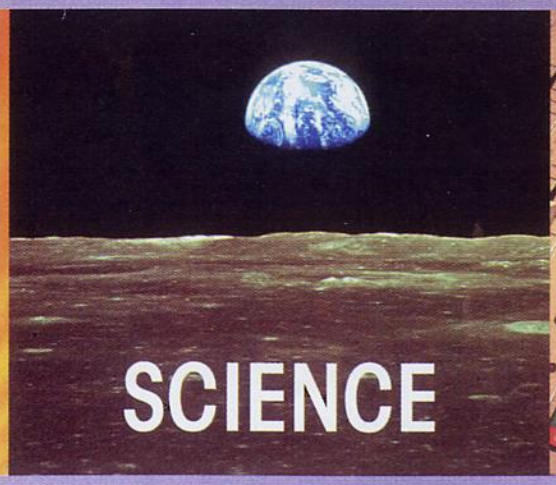
* * *

Back at the Science Center, students from Alvirne High School and Jaffrey-Rindge Middle School in Hudson, New Hampshire are crammed together on bleacher seats watching Mattox and Inderbitzen on a large movie screen. Katie's classmates can follow her when she takes a helicopter ride over the breathtaking lava flows at Pu'u O'o (pu-oo-oh-oh) vent. They can also join her atop the Mauna Kea observatory, where they can learn about the forces that have shaped volcanoes and volcanic activity throughout the solar system. And they can take part in a study on spider adaptation in Hawaii. Students at selected PIN sites will remotely operate a lava crane or drive the Marsokhod remotely operated vehicle (ROV), which is being developed for future exploration of the Martian landscape. Today, Katie's best friend Gena Hill sits at the controls.

Gena sits at the far end of a high tech console below the big screen, which looks like a command center at a NASA space launch. The panel stretches across the entire front stage. Samantha Marxer commands the communications center. Dressed in a dark blue jumpsuit with a JASON logo on the back, the EDS technician intently watches twelve tiny monitors. The screen directly in front of her shows the broadcast from Hawaii. The other miniature televisions are "cued" with short taped highlights from previous JASON shows. Marxer will project the edited scenes on two smaller screens flanking the main screen throughout the broadcast.

For example, while students watch the main screen and listen to the young Argonaut talk about lava flows, Marxer runs a clip from the Mauna Kea observatory on one screen and an insect experiment on the other screen. The segments are produced by the New England Science Center in late night sessions after the previous day's programs are complete.

# PASSION for SCIENCE



BY JOHN OST

"We spent an extra $50,000 on tape editing equipment," says Jesse Anderson, chief technologist at the museum. "The equipment is not included with the standard JASON console. Throughout the year, we plan to use the editing equipment to produce science programs for the classrooms in the Worcester area."

At the opposite end of the stage from Anderson's editing tools, Gena Hill grips her computer joy stick. She takes control of the Marsokhod ROV—remote operating vehicle—resting on the metallic surface 5000 miles away. Above her head on the main screen, the audience sees a desolate picture, a barren landscape. The camera does not move.

From Hawaii, Dr. Ballard asks the young pilot to move forward on the surface. Bob Ballard is the Woods Hole Oceanographic Institute scientist whose underwater research team discovered the wreckage of the Titanic. He is the founder of the JASON Project. Tentatively, Gena pushes forward on the stick and then turns the handle left. On the main screen, reddish fissures become visible in the seemingly endless shiny gray metal rock. Flat landscape takes on definition. Quickly the youngster becomes adroit with the controls and soon guides the camera expertly around the volcanic surface. Students at every site on three continents experience each twist and turn of the ROV.

"The kids enjoy the JASON Project because it gives them a chance to see scientists working on the same projects that the kids worked on at school," says John Stone, a sixth grade teacher at the Jaffrey-Rindge Middle School. Mr. Stone has taught at the school for nineteen years. "The kids are excited because the JASON Project is live—anything could happen at any time."

Throughout the broadcast, the two-way video screens and communications links function like giant video telephones. The technology allows the students to question Dr. Ballard and his fellow scientists during the broadcasts. Video cameras connected to the PIN site computers also transmit the students' pictures back to Hawaii. At the same time that a student asks a question, his or her photo is flashed across two continents inside a small window on the main screen. During the interactive sessions, the students literally sit on the edge of their seats. All eyes collectively "lock-on" the screen. A pin could drop in the auditorium. Telepresence has transported them.

* * *

The JASON Project was born during a lecture at Southern Methodist University in 1987, when Dr. Robert Ballard told the audience how amazed he was that thousands of children had written to him about his recent discovery.

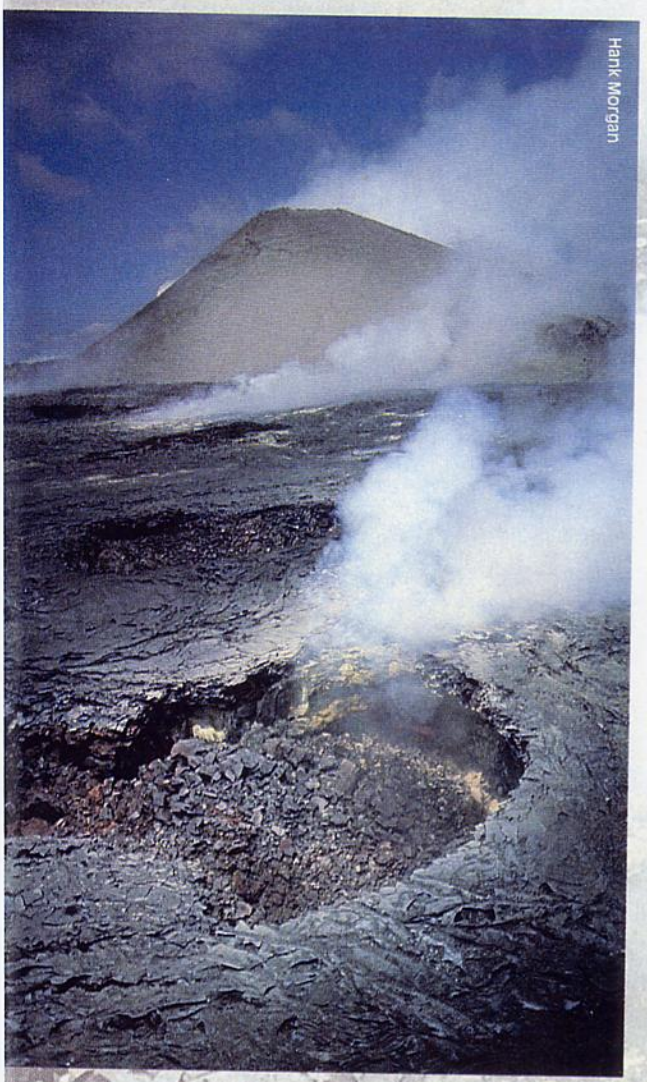
"Wouldn't it be great if we could take all these students on an expedition and get them turned on to science?" said Ballard.

Listening to his speech that night was Diane Spradlin and several other executives from the EDS Corporation. They took up Ballard's challenge. For the past six years, EDS has provided the critical technical support that allows over 300,000 young scientists to follow the oceanographer to research sites around the world. An additional thirty-three million students had the opportunity to watch rebroadcasts of the expeditions from their classrooms. The edited classroom segments are produced by the Mind Extension University (MEU)—an educational cable network in Denver, Colorado. Time Warner cable in Claremont feeds MEU to classrooms in the North Country, while local carriers in southern New Hampshire have not picked up the network—effectively reducing the interactive JASON experience for students in Nashua and Manchester to a one-day field trip.

* * *

For one southern New Hampshire resident, however, the JASON Project was far more than a field trip. Katie Inderbitzen sought out the JASON program because she says she didn't want to just sit in a class and take notes and a test. "I want to go out [in the field] and do it. I want to work with my hands, see the volcano and stick the probe in the lava and measure how hot [the lava] really is."

Ms. Inderbitzen and twenty-four other students were selected from an international pool of outstanding high




JASON VI PROJECT SITE:
PU'U O'O VOLCANO IN HAWAII

school applicants by the JASON Foundation to take part in JASON VI: Island Earth. Each year, these "Argonauts" have followed scientists to remote research sites such as the Galapagos Islands and hyperthermal vents on the ocean floor near the Baja peninsula coast. Last year, Argonauts went to Belize.

## WEAVING TECHNOLOGY INTO THE RAIN FOREST: BELIZE — MARCH, 1994

Dr. Robert Ballard climbs a series of rope ladders and cautiously walks across a 100-foot long footbridge toward a rectangular wooden platform. From Ballard's vantage point, the structure nestled between several trees on the opposite side of the bridge appears suspended in midair, nearly camouflaged by leaves and vines. The wobbly slat bridge stretches across a portion of the Belize rain forest canopy and spans Blue Creek, seventy-five feet below. With every step, the footbridge sways laterally. It almost appears that the seaman has temporarily lost his sea legs.

A cameraman standing on the stage tapes Ballard's arrival. Two shorter bridges fork at the platform and lead to other work areas in the canopy. In a "crow's nest" twenty-five feet above the bridges, a second cameraman takes wide-angle shots of the activities on the deck below or provides the viewer with a panoramic sweep of the Central American rain forest. Engineers built the bridges on the ground and hoisted them into the canopy with pulleys. The stages were fastened, sculptured, and carved into the available space between the trees. The man-made artifacts did not damage a single limb.

As they watched Dr. Ballard cross the footbridge, none of the students could possibly appreciate how the JASON Project had woven modern technology so very gently into the fabric of the rain forest. So that the platform photographer could film Dr. Ballard's footbridge walk, technicians had strung thousands of feet of cable, which stretched from the canopy to the forest floor, linked the cave systems and the Maya ruins, and served as the electronic highway connecting the Blue Creek production studios with the uplink trucks. Like a giant umbilical cord, the fiber optic line delivered digital nourishment throughout Belize. Unlike an umbilical cord, the information flowed both ways.

At the Blue Creek campsite, cottages were built out of lumber imported from the mills and palm leaves. All the buildings had windows except for one totally enclosed, air-conditioned, humidity-controlled hut, which housed a complete New York production studio. Everything inside the building—computers, video equipment, sound equipment, air conditioning, and generators for electricity—was carried to the clearing on a single gravel path, which minimized the damage to the fragile rain forest floor.

A fiber conduit and telephone line snaked alongside the stone path from the studio to the uplink truck parked 1/8 of a mile downstream in a clearing. The cable was carefully threaded through thick vegetation and bypassed twenty-five year old saplings patiently waiting for an old tree to die so that a shaft of light might set chemical processes in motion which would transform the sapling into a hundred foot tall tree.

For five hours each day, producers sped their digital bits down this narrow data highway to the transponder and dish antenna perched atop the van. Oblivious to the high tech highway tem-

porarily constructed in their rain forest, Maya women washed their clothes on the stones in the stream next to the truck.

The Maya live in small rural villages populated by 150 to 1000 people, says Dr. Richard Leventhal, director of the Xunantunich Archaeological Project of Belize. Many of the Maya are farmers. Their children speak a Maya language—usually Kecchi or Mopan—at home and English at school. Maya children are required to have at least three years of schooling. Many times, teachers come to the villages and teach in one-room schoolhouses, according to Leventhal.

Curious about their new neighbor, some of the Maya children at Blue Creek camped outside the truck and watched a television monitor, which intercepted the live broadcasts a nanosecond before the signals reached the PIN sites around the globe. Some of the Maya children had never seen a television screen, let alone a broadcast truck before JASON, says Diane Spradlin of EDS.

Not only did the Maya children see Dr. Ballard and the other scientists at work, they saw their culture and their habitat flick by on the screen from vantages points they had never experienced.

The brightly lit televised caves probably offered the youngsters a much clearer view than at any time they may have explored the tunnels with their naked eyes. The broadcast probably transported many of the children to the canopy for the first time. And each day they listened as people spoke an unfamiliar language and tried to interpret the hieroglyphics that only the Maya ancestors truly understood.

Each evening, the young explorers watched the Olympics on the local cable broadcasts with the JASON staff. No matter how hard they tried, the staff could not explain ice skating to the Maya children. And when the broadcasts were over, the kids became angry as the television screen darkened and the generators went silent. One can't help but wonder why the children came and sat in front of the television each day or what they felt and thought as this strange technology whisked glimpses of their life and culture by them in just the blink of an eye.

* * *

Upstream from the uplink van, Arthur Desrosiers also explored an unfamiliar world and culture. Desrosiers, 15, was an Argonaut from Barnstable High School in Massachusetts. He said that his soul was touched by the country's beauty and his experience at the research sites. Like all the Argonauts, Arthur has benefited from many mentor relationships.

Back at his school in Massachusetts, Arthur's science teacher, Dr. Peter Auger, helped the young researcher design pit traps—small beer mugs with a triangular Dixie cup in their lids—for his experiment in Belize. Arthur wanted to find out whether bugs that devoured rotting plants (plant decomposers) or insects that gorged themselves on animal carrion (animal decomposers) were more prevalent in various parts of Belize. So, the young researcher baited his traps with pineapples for the plant eaters and tuna fish for flesh munchers—food unrelated to the region. Curious bugs attracted by the bait tumbled to the bottom of the mugs.

In addition to his experiment, Arthur worked at all of the research sites. At the Maya ruins, Arthur watched Dr. Richard Leventhal, chief archaeologist on the JASON V Project, operate a computer simulation, or graphics program, which visualizes or "reconstructs" ancient ruins buried beneath the current excavation site without disturbing the fragile setting.

Despite its interpretive powers, the computer holds out little mystery for Arthur and the other young Argonauts weaned on silicon. Instead, Arthur reported that he was most fascinated by the Maya ruins and lifestyle. He loved the Maya food. He says he especially enjoyed the Maya legends that Dr. Leventhal told the Argonauts each night before bed. Just like the Maya children huddled down the road, part of the magic for Arthur was trying to learn about something he hardly understood.

"When youngsters become involved in serious projects and learn to work as part of a team with scientists and teachers," says Dr. Ballard, "the importance of that

experience could not possibly be lost on the kids—whether they come from a large urban city or a small midwestern town with a population of 100 people."

And there is little doubt that the JASON experience is changing Arthur Desrosiers' and Katie Inderbitzen's life by exposing them to the mysteries and excitement of pursuing a career in science. At the same time, one can't help but wonder if the paths of a few Maya children may also have been altered because they were befriended by strangers who possessed a technology that was gently woven into the fabric of the children's souls.

## BRINGING JASON INTO THE CLASSROOM

Entering Regan Tiliakos's fifth grade classroom during JASON V in Belize was a bit like entering a simulated rain forest laboratory. Tiliakos teaches at the Burnell Laboratory School in Bridgewater, Massachusetts.

At a long table, three students huddle around Kate Krappe as she delicately presses a pentometer into a leaf, measuring its thickness. Her nose nearly touches the table and her long black hair nearly hides her Mickey Mouse sweatshirt as she leans close to the table and takes her reading. Kate uses the same tool that helped ecologist Meg Lowman determine whether insects were seriously defoliating vegetation in the canopy. Once Kate and her colleagues complete their measurements, they move to another table where they are constructing a miniature ecosystem in a bottle.

At the opposite end of the room from Kate's table, Matt busily types his weekly report about the JASON Project into the computer. Reporting on the JASON Project helps Matt hone his craft.

Later in the day, Tiliakos will send his report to the JASON bulletin board on the Internet, where his summary of the week's events can be read by students in 50 countries. Because the school is at a PIN site, Tiliakos's class watched several JASON broadcasts.

"I like science, especially oceanography," says Matt. "I liked learning about the coral reefs, Maya civilization, and especially doing a lot of experiments. I liked Dr. Ballard because he was the first person to find the Titanic. But I'd rather be a writer than a scientist."

Hand-drawn Belize cave maps covered the back walls of the Bridgewater classroom. Most of the students said that they enjoyed watching Dr. Tom Miller, a speleologist, rappel down cave cliffs and crawl through tunnels during the broadcast. Over the past twenty years, Miller and other researchers have mapped about 50 percent of Belize's extensive limestone cave system. Students not only learned how caves were formed, they also found out that the caves played an important role in Maya religion.

"The Maya believed that the caves were the opening to the underworld," says Dr. Leventhal. The Maya believed the caves linked them with their ancestors. Because the caves were so sacred, Maya offerings and artifacts are frequently found at the cave openings. In addition to mapping the caves, Burnell students also spent a considerable amount of time studying the Maya ruins. One of the most innovative curriculums involved hieroglyphics.

Theresa Payer teaches social studies at Burnell. She split her class into several work groups. Each group was given a set of Maya hieroglyphics—pictures that represent both words and stories—but they were not told the meaning of the symbols. Payer then asked the children to make up a meaning for each picture. She only described in broad strokes the legend upon which the symbols were based. She then asked each work group to write a story based upon the language symbols they had created. Later, Payer asked teachers at a JASON training workshop to decipher the children's stories.

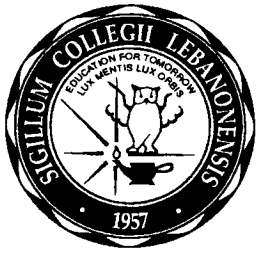
Like the Argonauts in Belize, the Bridgewater students collected data about the different species of plants and insects that lived on a small land plot near their school. They then tabulated their information and entered their results on the PIN

site computer during their visit. The information was transmitted to Belize over the Internet, where it was added to reports from other schools. The resulting database was given to teachers participating in JASON V and also became part of future interactive teaching materials developed by the JASON Foundation.

### BRINGING THE CLASSROOM TO JASON

Over the past year, the Jason Project scientists and teachers have sought to integrate their interactive technology and curriculum more tightly so every student can "experience science" like the Argonauts. This year, the curriculum was placed on the Internet and the World Wide Web. The JASON homepage linked students worldwide with scientists in Hawaii and on-line information resources that complemented the JASON curriculum. For example, teachers and students interested in the solar system and volcanoes on Io, Mars, and Venus could explore several NASA links and an extensive multimedia presentation of the nine planets over the Internet. Teachers and students use the information highway to exchange ideas and information, link electronic penpals, talk with Argonauts, ask Jason scientists questions, upload classroom data about spiders to Hawaii, and take part in collaborative projects.

At the Atholton Elementary School in Columbia, Maryland, five fourth grade students created the JASON Broadcast Reporters project. The JASON Five, as they became known at Atholton, didn't want to miss any of the sixty broadcasts, so they formed a "reporters' network." Forty students at twenty-five schools throughout the U.S. sent news reports about the broadcasts back to the "editors" at Atholton, who then filed the news reports on the JASON bulletin board. The Atholton network kept the entire JASON community abreast of late breaking events, such as a fierce storm that blew down antennas and knocked JASON off the air halfway through the two-week project. The student editors are now compiling their reports into an on-line book.






"We converted our classroom into JASON VI," explain Michael Hynes and Jarrid Freeman, fourth grade students at Gates Elementary School in Davison, Michigan. Hynes' cooperative group—four or five students working together as a team—built a scale model of the Mauna Kea Observatory. The students also made a 3-D model of Io and its volcanoes—huge cinder cones and shield volcanoes complete with lava flows—a bird sanctuary where they could emulate the scientists studying DNA matching, and a walk-in Hawaiian center where visitors could study Hawaiian culture and learn the Hawaiian language. Each cooperative group conducted research on a JASON scientist and wrote a first-person biography about the scientist. They then simulated a broadcast, dressed like their scientific heroes, and presented their show to classmates throughout their school. The students' sketches of the scientists are posted on the JASON bulletin board on the Internet.

"At the beginning of each year students think scientists are 'geeks' and 'nerds,'" says Ann Broaddus, the fourth grade teacher whose students transformed the classroom into Hawaii. "At year end, more than three-quarters of them think scientists are 'way cool' and want to pursue a scientific career." Broaddus is a member of the JASON Project curriculum team and also trains other teachers in Michigan interested in integrating JASON into their curriculum.

## TRAINING TEACHERS IN SCIENCE

The JASON curriculum has inspired teachers as well students. "The Jason Project has changed the way I teach," says Broaddus, who has made science education a core area in her doctorate program. And the JASON Program also provides teachers with science materials outside their formal training. "Science is advancing at a high rate and it is hard for anyone, especially someone as overworked as a teacher, to keep up with advances throughout the scientific community," says Steve Mattox. "The JASON Project allows us to provide teachers with detailed information, which they can share with their students."

"Raising money for the project has been extremely difficult," says Ballard. "It's easier to procure money [for] the Department of Defense than [to get] money for young people. Adults readily give money to their [college] alma mater, but not to their sixth grade science class."

Still, the JASON Project has become the largest interactive science program of its kind. While EDS is the JASON Project's chief source for money and resources, the JASON Foundation also receives generous support from The National Geographic Society, the United States Department of Education, and the Bechtel Group. The two-week JASON V broadcast costs the JASON Foundation $2.5 million. EDS staff, science teachers, and the scientists involved in JASON V developed a 250-page curriculum for the classroom. PIN site trainers then held training sessions for classroom teachers last November where teachers experimented with the curriculum.

"It is important to train the teachers, because over 85 percent of the science teachers in the United States have very little background in physics, chemistry, or mathematics," says Ballard. Most of their training has been in biology and zoology. Last year, the PIN sites trained almost 10,000 teachers. And teacher training is only the beginning of the PIN sites' investments. Each organization pays the JASON Foundation an annual $60,000 fee to cover the costs of the broadcasts and materials. They must also pay JASON Foundation a fee for designing a JASON console.

"EDS builds and supports all of the interactive consoles at each PIN site," says Spradlin. "We take whatever equipment is already available at the site and then enhance the equipment so that the university or museum can receive the program and interact with the expedition."

## IMPROVING SCIENCE EDUCATION

According to a 1989 Educational Testing Service report, 13-year-old American students ranked near the bottom in science scores among youngsters in industrial-

ized countries. Each year fewer American students make it into graduate science programs.

"I have been with the Woods Hole Oceanographic Institute for 25 years," says Ballard. "We train many physics, chemistry, and engineering students from M.I.T. in a joint program. At times, I feel like I'm training the competition because the number of American students has dropped off so dramatically. Scientists in America, Canada, and England are all worried that they are not reaching their young people. We have to be proactive and go after the students."

The potential of a program like JASON is limited only by the imagination, says Diane Spradlin. "Kids live in a global environment. Just as the JASON Project has taken advantage of kids' curiosity and eagerness for exploration, we should design programs that lead them into these new communication technologies."

* * *

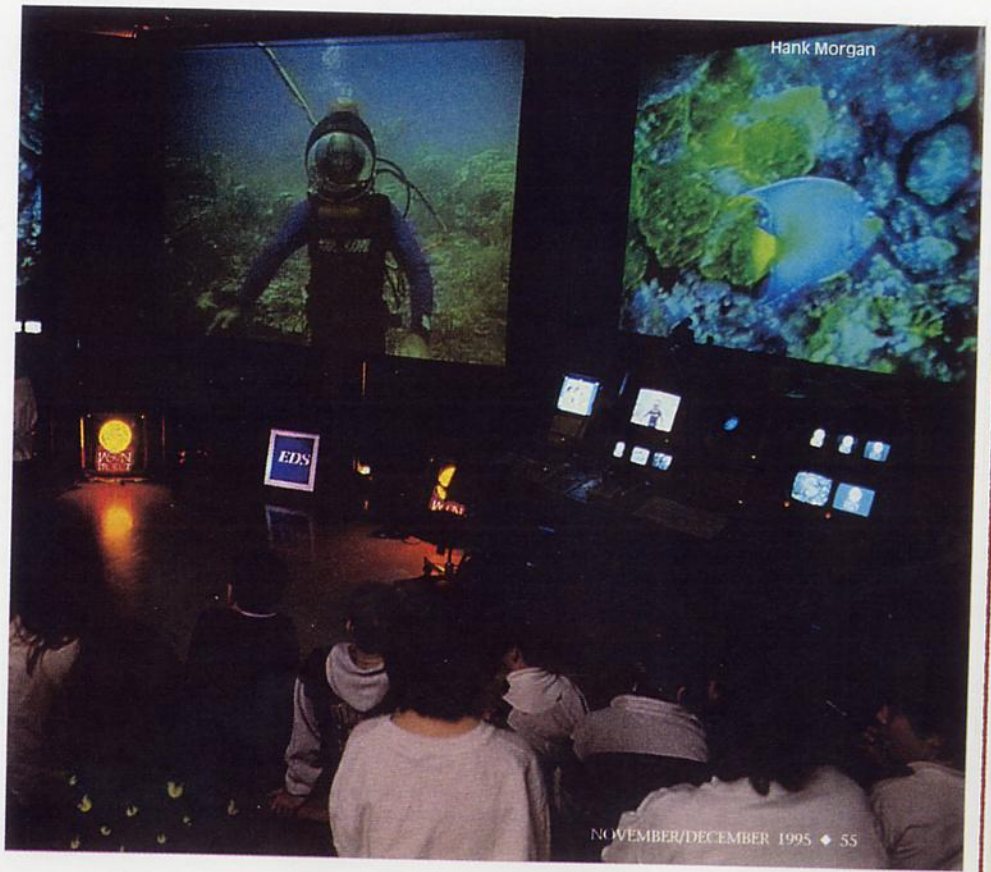
By reaching out to the brightest young science students throughout the United States, Ballard and the other scientists hope to inspire each Argonaut to become an "ambassador for science" who will encourage their peers to study science and perhaps consider scientific careers.

Hudson, New Hampshire's Katie Inderbitzen certainly fits the mold of one of the nation's brightest young students. She takes all honors courses in high school, and, like fellow Argonaut Arthur Desrosiers, she conducts independent research and works on projects seemingly beyond her years. For example, in the seventh grade she designed a science fair project about hydrothermal vents. She sings, acts, and is one of only a handful of young women in her region about to achieve the Girl Scout's Gold Award, the highest honor a young woman can receive. Katie's science teacher, James Dillon, described her as the "most enthusiastic science student I've ever encountered."

"All of the Argonauts are impressive individuals," says Mattox. "I was particularly impressed with Katie's


**STUDENT MANEUVERS MARSOKHOD ROBOT**
**BRIDGEWATER STATE COLLEGE**

**PIN SITE FOR JASON V PROJECT**
**NEW ENGLAND SCIENCE CENTER**



maturity and her ability to discuss scientific issues."

In part, Katie's deep understanding of marine geology comes from the year-long curriculum the JASON Project provided each Argonaut. Her knowledge also comes from personal study and fascination with marine exploration first ignited by Dr. Ballard's book, *The Discovery of the Titanic*. She wrote Ballard when she was eleven after she read about the accidental sinking of the JASON ROV on a barge off the Galapagos Islands. When Ballard replied to her letter and later to a poem she had written about the Titanic, he became a significant science role model in Katie's life.

"I never thought she'd get a reply when she wrote her first letters," says Marge Inderbitzen, Katie's mother, who teaches chemistry at Alvirne High School in Hudson. "He treated her as someone who is enthusiastic and interested in science." Katie returned from Hawaii with even more respect for Ballard, enthusiasm for marine geology, and Ballard's autograph on her copy of *The Discovery of the Titanic*.

Weaving high technology with an interactive science curriculum has allowed JASON scientists to "reach out to a large number of students with a wide range of interests in science," says Mattox. "It's exciting to see a young student scoop lava or fly over an active vent." At a deeper level, says Mattox, the JASON curriculum uses a wide range of multimedia techniques to show students how volcanoes work.

Telepresence offers many students the opportunity to visit exotic places like Hawaii and Belize while accompanying scientists on a research expedition. Just as Bob Ballard's book and personal attention in a letter ignited Katie Inderbitzen's passion for marine geology, Mattox and the other scientists hope that this new technology will allow them to touch the souls of many more students through the JASON Project. ▲

*John Ost is a science writer who lives in Nashua, New Hampshire.*