The Coach's Corner

Chengde Feng

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VOLUME 5 • NUMBER 5

ImaGiNe...

Opportunities and Resources for Academically Talented Youth

May/June 1998

SPOTLIGHT ON MULTIMEDIA COMMUNICATIONS

Art Gets Animated

Working the Web for Fun and Profit

Inside Immunology

Students Review Northwestern University

Published by the Johns Hopkins University Press for the JHU Institute for the Academic Advancement of Youth

From the Editor

Dear Reader,

This year, we at *Imagine* have created issues exploring various worlds: biology; literature, language, and linguistics; public service and politics; mathematics; and, with this issue, multimedia communications. As always, our publication has illuminated a range of educational opportunities and activities in each field. As always, we have profiled students who have forged new paths of learning and creative activity.

This issue features many exciting examples of young people whose inventiveness has expanded the range of human expression. From developing a Web site (and sowing the seeds of a new business), to spinning CDs on a radio station, to mastering the complexities of television production, students show how school-based activities can lead to new interests, skills, and even careers. A professional computer animator explains how technology has enabled him to translate his visual skills into computer art programs, realistic animated characters, and short films. An amateur teenage historian describes how the medium of film allowed her to create a "permanent visual memory" of heroines from her hometown. Throughout the issue, our contributors demonstrate that personal initiative can ignite the possibilities of technology to create powerful new forms of communication.

Next year, we will continue to inspire you with accounts of student accomplishments as well as information and insights that can guide you toward new challenges and adventures. The next volume of *Imagine* will explore the following focus topics:

- **Environmental Science**
- **The Performing Arts**
- **Engineering**
- **Cross-Cultural Studies**
- **Career Discovery**

Imagine can help you take charge of the coming school year, plan effectively for college, and even shape a career. Where else can you find articles and creative work by students, college reviews, career profiles, reviews of classic novels, puzzles, math challenges, and current information about programs, competitions, internships—all in one publication?

1998–99 promises to be an exciting year for *Imagine* and for you. We hope you'll join us again in September to discover even more ways to make your precollege years challenging, fulfilling, and fun.

Melissa Hartman

Don't miss out on any upcoming issues of *Imagine!*
Call (800) 548-1784 to ensure that you continue to enjoy one of the best resources available to students today.

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*Opportunities and Resources for Academically Talented Youth**

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On the cover:
Chiun Kim, Megan Cooper, and Peter Shanel edit a film they created at the Institute for Television, Film, and Radio Production. Photo by Boston University Photo Services, courtesy of ITRP.

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Art and Craft

by Cassidy Curtis

A lot of people think that because I'm a computer animator, I must be an accomplished artist. But I know some people who are artists, and I'm definitely not that. I'm just a guy who draws.

I was a kid who drew all the time. In high school I took whatever art classes I could, and I later took classes at the Art Students' League in New York. But it was computer graphics, not my background in the visual arts, that got me interested in becoming an animator.

When I was a teenager, I was enthralled by the computer graphics that started to show up on TV and in the movies. At the time, I thought these effects were created by imposing men in suits who worked in skyscrapers in Manhattan. I had no idea that this was something I could do. But eventually I got my own computer, and by the time I got to college, I had done some computer graphics on my own.

In college, I worked with a professor who was interested in mathematical visualization, and he helped me get started doing computer graphics programming. This experience led me into computer animation, which has recently led me into animation in general. That's an unusual route; most of the animators I know went to art school. For some of them, their job was their first brush with computers at all.

The Evolution of Animation

With the growing use of computers in animation, you might think that the processes used to create the old Bugs Bunny cartoons have been discarded. But cel animation, or traditional animation, still exists. An animator creates the key poses, and then people called "in-betweeners" fill in all the in-between frames. These people are really good at interpreting the key poses and creating a natural-looking motion between them. That unique talent has yet to be replaced by computers.

But the computer has been able to speed up many processes, such as the ink-and-paint process. The in-betweeners used to give their pencil drawings to another team responsible for drawing the lines with ink and filling in the colors. Now, a lot of that is done digitally.

But the real changes have taken place in new branches of animation, such as 3D animation. As it's developed over the years, computer animation has drawn a lot not only from cel animation, but also from cinematography, in terms of how to frame a shot, how to place a camera, how to light a scene. You can see the influence of both cinematography and cel animation—particularly in motion and lighting—in movies like *Toy Story*.

Today, animation is infinitely flexible. In fact, I think we're at a point where any image that a director or an artist can conceive of can be created with the help of computer animation. What can be done in the movies is limited only by the amount of time, energy, and money that can be spent on the project.

As a result of this flexibility, animation now serves more purposes than ever. In addition to providing entertainment, computer animation also has scientific, medical, and mathematical applications. For example, computer animators can generate a digital model of an organ, muscle, or bone, allowing doctors to see what they're studying without conducting surgery or dissection.

It also has uses beyond the fields of math and science. In the legal profession, computer animation can be used to reconstruct events. By integrating forensic evidence and witnesses' descriptions of events, computer animators can make a video showing what actually happened, which can be used in the courtroom as evidence. Computer animation can even be used in engineering: there's a company called Failure Analysis that analyzes bridges and large-scale construction projects, visually representing things that can and do go wrong for the purpose of building things more safely.

Watercolor painting? Not exactly: this is a computer-generated image created using a program Cassidy wrote to produce watercolor effects.

All of these applications suggest that if you know computer graphics, you can work in almost any field.

Making Noodles Dance

If you want to work in computer graphics as an animator, you'll need a sense of timing, a sense of motion, and most important, strong visual skills. The ability to see things in your head will take you a long way. I think I was lucky in that regard—I had a hard time with abstract mathematics, but anything that could be

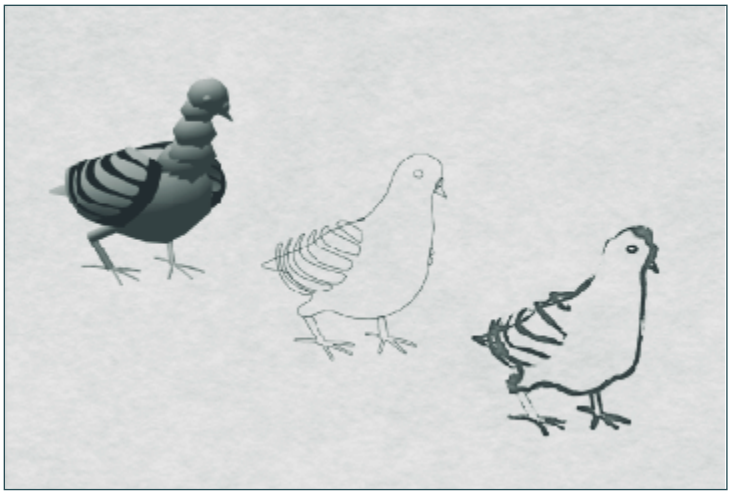
perceived as a shape or a volume or a surface, that I could turn around in my head, I could understand.

While I have relied on my visual skills, pure mathematicians who don't work as visually can do great work in this field. Computer graphics is a part of computer science; it is built on algorithms, and algorithms don't have to be visualized. For example, if you can come up with a really efficient sorting algorithm—sorting has to be done even in computer animation programs—you can be involved in computer graphics as a purely technical person.

I always encourage my students to keep their experience broad: I advise art students to take a programming class so they can see what it's like to build a program that does their work for them. And I recommend that computer science students take a drawing class so they can understand the experience of trying to represent the world on a piece of paper. You don't have to be an expert at both to do well in computer graphics, but you certainly want to have some experience with both.

A typical production environment brings together people with these different skills. I worked on a fun commercial for Kraft Velveeta that involved every aspect of animation production. The premise of the commercial was that macaroni noodles prefer Velveeta to other kinds of cheese because it melts better. The commercial featured a flock of happy, dancing, jumping macaroni noodles and a live-action four-year-old kid who looked on in awe as the noodles danced around. We were given a background plate of a table top, a box of noodles, and a kid looking across the table as if there were noodles there. Our job was to put the noodles into the scene and make them look real, and a lot of details went into making that work.

The process started with a model, a digital representation of a three-dimensional object. A relatively simple object, like a noodle, can be built in one of the many available 3D modeling programs. For a complicated object, like a human face, a traditional sculptor will build a model out of clay. The computer modeler will then scan and digitize that model.



In the short film Brick-a-Brac, *Cassidy began with a three-dimensional model and, with the help of a computer, translated it into what looks like a hand-drawn image.*

In the case of the Velveeta project, the model was built directly in the computer. My job was to put a little skeleton inside the model so that it could be animated, to design the deformations that would enable it to bend, and to make sure that when it did bend it would still look like a noodle. After I put in the skeleton, I handed it off to the character animators. At this point, the model was a lot like a marionette; it was the character animators' job to pull the strings in such a way that the noodles would come to life and act.

In one of his many attempts to use a computer to represent the real world, Cassidy created this animation that simulates the effects of cream poured into coffee.

There was also a lighting person whose job was to give each noodle a realistic texture and to put lights into the virtual world that made the noodles look like they were in the real world. And since the table top was made of tile, this person had to create shadows and reflections of the jumping noodles.

The Computer as Brush and Ink

While I love working in a group of people with all of these distinct talents, one of my favorite projects was actually one in which I performed all of those roles myself. I had just started working at Pacific Data Images, where they had a policy of giving trainees a window of time during which their only task was to create a small project from scratch and see it through to completion. I took advantage of that and started working on trying to make computer animation look like something other than 3D plastic objects moving around.

I wanted to do a short animation that looked like a drawing. But since I didn't have the experience in traditional animation to do hand-drawn animations, I had to write software that would convert a three-dimensional animation into a hand-drawn animation. That was what I did for *Brick-a-Brac*, my short film about a pigeon who likes to hit his head against a brick.

To turn a 3D animation into something that looked hand-drawn, I first built a model of a pigeon in 3D and animated it by moving its joints and changing its positions in 3D space. After creating images of those different poses, I used an automatic tracing program to find the edges of the silhouettes of the pigeon's wings, beak, and body. Then I rendered those edges as if they had been drawn, incorporating the subtle characteristics of a hand-drawn line—the variations in thickness, the textural qualities, and even little splotches of ink. The computer performed that process on every single frame in the animation, and the result is an animation that looks like it was drawn by hand.

Continued on next page

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In the same way that *Brick-a-Brac* looked like it was created with a brush and ink, I wanted to do an animation that looked like it was done with watercolor painting. I love watercolor for its luminous quality, transparency, and wonderful range of textures. In my project on computer-generated watercolor effects, I tried to capture some of that in a computer algorithm that could be used to produce those qualities on demand.

While I was working on the project, I discovered that when you paint with watercolors, the paint continues to move and flow, and the shapes don't stay static. That became part of the project as well—simulating not only the finished painting, but also the process of making the painting.

I was motivated to pursue this project because I found watercolors fascinating to look at. That's where the motivation for a lot of my work comes from. I see something in the real world, like a cloud in the sky, and I wonder, what makes that work? By understanding the way that this thing works, could I make a picture that behaves the same way? Could I make an animation that moves the same way as that cloud or that paint or the cream when I pour it into my coffee?

A large part of work like this is just getting excited about the real thing and then using what you know about math and physics and human perception to control the effect. If you're in production, you need this control because an artistic director tells you what he or she wants the finished product to look like. But this control—the process of interpreting and making sense of the world and then writing a computer program that will do the thing that is so fascinating to you—is completely satisfying in its own right.

After earning a B.A. in mathematics from Brown University, Cassidy Curtis began his career in computer graphics. Now a researcher and instructor at the University of Washington, Cassidy has worked on animation projects including MTV's Top 20 Video Countdown, the 1994 movie The Pagemaster, and commercials for Kodak, Listerine, Capri Sun, Mercedes, and Toyota.

Bringing Teen Voices to the Web

by Daniel Jackson

Attracted to the concept of a high-tech publication written for and by teens, I joined the staff of *In-Site*, an online magazine written, edited, and coded by students at my school, the Academy for the Advancement of Science and Technology in Hackensack, New Jersey. Bringing teenage voices to the Web, *In-Site* broke new ground in the online market. As a staff member, I have learned a lot about writing, about online production, and about teenagers like me.

Not just a news source, but a resource for teens that goes beyond the facts, *In-Site* features editorials and reviews, giving young writers the opportunity to express themselves. Topics range from news to fashion, from music censorship to movie reviews, and from sports predictions to computer technology. Besides featuring the perspectives of staff members, the publication also highlights readers' opinions: young people from across the country and around the world post responses or introduce their own ideas on *In-Site*'s response forms and message boards.

In-Site is joined in a partnership with *The Bergen Record*, an area newspaper that helped us get started. The *Record* now sends reporters to our school to assist in teaching writing and journalism classes. *Record* staff also work with student reporters to write and revise articles, gather information, and maintain the Web site.

The *In-Site* staff works in groups dedicated to topic areas, each headed by an upperclassman who directs and coordinates reporters. I worked on many aspects of the publication, including the computer section; the sports section; and "Real Time," which discusses recent news. I also worked independently to write, design, and code feature stories and editorials.

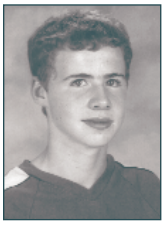
In my feature and editorial writing, I could choose almost any topic. I had fun critiquing the government's attempts to censor music for teenagers and defending Marilyn Manson and Rage Against the Machine for using violent language to express themselves in their own way. My story on this subject was based on a kid who was arrested for wearing an explicit Marilyn Manson t-shirt in a grocery store.

I conducted most of my research for this article by reading *Circus* and *Spin* magazines and by surfing MTV's Web site. Other Web sites are a great source of information, and most will allow you to use their information once you notify them (it is important to quote all sources because of copyright laws). For my article on music censorship, I also conducted a survey at school and compared the results to those of another survey published on the Internet. My purpose was to contrast the views of adults and teenagers on the question of censorship.

The best part about writing freelance for *In-Site* is that the design of the Web page is left completely to the reporter, allowing him or her to integrate graphics and layout, creating a much more powerful article. After writing and checking for grammar, I would code my articles into an HTML template, copying and pasting sections into preset forms of HTML code to make them readable by Internet browsers.

Then, I would work on design, creating graphics from scratch or digitally editing scanned photographs or images provided by *The Bergen Record*, the Associated Press, or other consenting sources. Sometimes students would travel to events and supply us with their own photographs. Once I completed the graphics, I would upload the article to a Silicon Graphics workstation used as the development server, where all articles undergo final adjustments to make sure they work well on a Unix platform. From there they would be moved to the actual server for placement on the site.

In-Site has grown tenfold since its first days, maintaining and strengthening its identity as a teenage publication. I can safely say that my online experience made me more independent, reliable, diligent, and self-motivated. I also enjoyed having an excuse for reading *Spin* magazine and *Rolling Stone* in school—it was research!



Daniel Jackson is a sophomore at AAST, where he is a member of the lacrosse, soccer, and math teams. He and a friend recently started their own Web page design company.

Four Friends and a Home Page

by AJ Shankar

Sometimes the activities we pursue just for fun turn out to be the most rewarding. But when AJ Shankar and three of his friends embarked on an experiment in HTML, they didn't expect the awards—or the business opportunity—that would follow.

Near the end of the summer of 1995, my friend Grant came up with the idea of creating a home page for our high school. The Web, only a few years old, was just getting hot, and we wanted to learn more about it. We convinced our friends Dan and Matt to join us in what began as a summer project but eventually turned into an entrepreneurial adventure.

An Award-Winning Hot Site

By the first week of school, we had a prototype of the page to show the head of our school's science department. Both he and the superintendent of schools, who stopped by on that same day, were impressed by what we had done. Encouraged, we refined the site and had it approved by the school administration. In February of the following year, the Cheshire High School page went online.

That was just the beginning of our work. Like any good news source, home pages require constant updating. We decided that our page should be more than just a mission statement and bunch of pictures; we wanted it to be a site people would have a reason to visit regularly. Seeking ways to interest students, alumni, and the community, we posted school events, student accomplishments, the honor roll, and sports results; we even added an alumni registry. And we modified the site design periodically to keep it fresh and up to the latest Web standards.

However, building an audience for a Web site isn't easy. We needed publicity, so we submitted our site's address to *USA Today Online*. In mid-April we received a *USA Today* Hot Site Award, which recognizes "sites that are likely to be sure hits with readers ... by exhibiting excellence in graphics, content or both." *USA Today Online* posted a description of and a link to our site, which dramatically increased our page's popularity. Shortly after winning this award, Cheshire's home page received favorable reviews by local newspapers, RadioONE, and IBM Internet Connection, giving the site exposure to an even wider audience.

When summer came again, we did not rest. Matt and Dan coded Cheshire's entire Program of Studies, more than 250,000 bytes of text. I entered our site in the Microsoft Schools on the Web competition, and all four of us kept the site looking good throughout the summer. Then, in the first week of the new school year, I was called to the principal's office. The site had won first

The Cheshire High School home page (www.pcnet.com/~ cheshigh), which displays the various awards it has won, was just the beginning of AJs work in Web publishing.

prize out of 2,000 schools in the Microsoft competition, crowning it as the premier high school home page in the country. The award came with a $15,000 grant for the school, which we used to purchase a graphics workstation computer so that future Webmasters could maintain the site at school. Our hundreds of hours of work had paid off.

Webmasters for Hire

With college expenses looming, we decided to try to profit from our new skills. During the summer after our senior year we started a company called Team 7 Web Publishing (named after our gym volleyball team). To find customers, we worked with a local public relations agent who was hired by companies to promote their products with print media. With the help of Team 7, he could now offer to build Web sites for these companies. We were contracted to make Web sites for several businesses through this arrangement.

We also did some advertising and mail promotion on our own to attract clients. We even tried selling business-to-business. Doing our own marketing taught us the importance of projecting confidence when dealing with potential customers. We weren't just a bunch of high school kids, we reminded ourselves: we were skilled professionals.

We soon learned, however, that making Web pages professionally is very different from updating a high school home page as a hobby. Deadlines had to be met and specifications had to be carried out to the pixel. Some of the companies we worked with were large—valued at tens of millions of dollars—and had distinct corporate images they wanted to portray. I was in charge of graphics for Team 7, as I was for our high school site, and I found myself spending many hours redoing images until our clients were completely satisfied. In one instance, we redesigned an entire front page—including graphics—five times before the client, a large networking company, accepted it.

Since we were all going off to different colleges, we decided to disband our business at the end of the summer. But we had profited from Team 7 in many ways: we made some money, improved our Web design skills, and gained valuable experience dealing with companies and managing one of our own. I'm now a coder for Harvard's home page (www.harvard.edu), and I think that my time with Team 7 played a significant role in my obtaining this job. Those two summers spent learning and working in Web publishing became so much more than we expected, bringing a school, several businesses, and four students' skills into the cyber age.

A freshman at Harvard University, AJ Shankar is planning to major in applied math, computer science track. He enjoys listening to music; playing sports, trivia games, and the trumpet; and (of course) working on his home page at www.fas.harvard.edu/~ shankar2/

Photo by Michael Gaffney

A Summer Internship at Bell Labs

by Scott Aaronson

Internships are a good way to discover how academic knowledge is used in the real world. The right internship can also help you focus your career interests. Last summer, for example, I realized during an internship at Lucent Technologies' Bell Labs that I wanted to pursue a Ph.D. and a career in computer science.

For ten weeks I worked in Bell Labs' Database Systems Research Department as part of the six-member technical team for a Web site called Maps On Us (www.MapsOnUs.com). Maps On Us is a free service that allows users to type in any address in the continental United States and get a zoomable map. For example, the service can find the shortest route from Denver to San Francisco that stops in Wichita and Los Angeles along the way, and can list every McDonald's franchise within five miles of the White House. People use Maps On Us in a variety of ways, from planning road trips to creating directions for party invitations; a prosecutor in Tennessee even used it to prove that a defendant was within driving range of a crime scene.

When I began my internship, Maps On Us had been online for five months, and several new ideas were in the works. We created a new feature called SpeakRoute, which uses Bell Labs' patented text-to-speech synthesizer to read directions aloud. My role was to diagnose problems by testing SpeakRoute with a variety of browsers and operating systems. Once everything was working correctly, this multimedia feature became a favorite with users. In addition, our group made it possible for users to email maps to friends, and I wrote a program to manage the several hundred messages Maps On Us receives every day so that the staff could more easily search and respond to them.

With about a million accesses per day, Maps On Us was already one of the most popular sites on the Web, but we wanted to attract even more users. I was involved in the public-relations effort in two ways. First, I wrote an article about the capabilities of Maps On Us for *WebBound* magazine. Second, at the suggestion of the marketing manager, I designed interactive ads that appeared on Yahoo! and Netscape Guide: users could type the names of two cities directly on the ad and get a route between them. Judging from their click-through rate—the portion of users viewing the ad who click on it—these ads were a success. The rate is typically 3–4 percent for Internet ads, but the rate for these ads reached 17 percent, probably because of their interactive component.

Maps On Us plans routes based on user-entered specifications. This map shows the fastest route from Berkeley to Los Angeles.

Projects like these were only part of what made this internship so rewarding. I especially liked the intense intellectual atmosphere of Bell Labs. People often argue about programming semantics in the dimly lit halls, which are lined by canisters of nitrogen (for the chemistry department) and emergency showers (to rinse your eyes if you squirt toxic chemicals in them). The person sitting at the next table in the cafeteria might be the inventor of the Unix operating system or a Nobel laureate. And, if you're not hungry, you can always visit the nearby chess tables, where the challenge is to find not a partner but an unoccupied table. Bell Labs employees can also attend frequent research seminars on everything from the life-on-Mars debate to nanofabrication with buckytubes. I gave a small seminar myself about a paper I published on hypertext system organization.

If you're considering an internship in software or multimedia, my advice is to look for internships that involve a specific product or research area that you can really sink your teeth into. I chose Maps On Us because it was a tangible service to which I felt I could contribute. If a company's brochure drones on about how it "implements high-end relational object servers for distributed applications in blah, blah, blah," and it sounds boring to you, then it probably is.

Once you've found a few internships you want, apply for them! You might be surprised at how marketable you are, especially if you have strong computer skills. Once you have been accepted somewhere, make sure you know what you will be working on. Your boss might not have time to give you much direction, and if your assignment is not clear you could spend the summer floundering. When I began working at Bell Labs, I undertook to redesign the entire Maps On Us user interface. This project was too ambitious: I would have had to spend months familiarizing myself with the huge base of existing computer code. Luckily, the developers at Maps On Us were a pleasure to work with, and they helped me find projects that were both interesting and achievable within ten weeks.

Since they require a lot of technical creativity but not a lot of background knowledge, internships involving Web site design or multimedia applications are especially suitable for high school students. If you want to spend your summer both learning new skills and applying them to actual problems—and you're willing to work hard—an internship could be an excellent choice.

Scott Aaronson spent last year at The Clarkson School, a program that allows high school seniors to live and take courses at Clarkson University. Scott is currently in his first year at Cornell, where he is majoring in computer science. You can contact him at sja8@cornell.edu or visit http://sja8.resnet.cornell.edu

Tuning in to High School Radio

by Jason Weill

Photo by Jeff Kleinman

Jason chooses from the 7,000 CDs available to DJs at WKWZ

It's 2:28 on a Saturday afternoon in Syosset, New York. I'm sitting in front of a mixing board, making sure I'm prepared for everything I'll do in the next 100 seconds: Playlist. Check. Weather report. Check. Tapes and announcements. Check.

The second hand completes a revolution.

First two songs cued up. Check. Sign-on announcement. Check. I focus on the clock.

2:29:57, 2:29:58, 2:29:59 ... CLICK. "WKWZ, Syosset," a baritone voice booms across the airwaves. "At this time, WKWZ, Syosset's community radio station, begins another broadcast day." I sit back and relax, but only briefly: in precisely 55 seconds, I'll take the mike and begin a music show.

Before I started working at my high school's radio station, I might have said that radio broadcasting requires little more than flipping switches and playing tracks off CDs. But as I've learned in my three years at WKWZ, radio involves much more.

WKWZ is completely student-run. Students do everything from planning the programs to providing live play-by-play sports coverage, so each one of us has a responsibility that's vital to running the station. If I'm sick, I *have* to find someone to cover my show. It's not possible for a radio station simply to take a day off, and consistently signing off early because the 9:00 p.m. host doesn't show up could result in a lost license. Like all radio stations, WKWZ is regulated by the Federal Communications Commission. Because the FCC requires us to be on the air at specific times, and because we must depend on each other to meet this requirement, our policy is that three missed absences, unless made up by "subbing" for another host, will result in suspension from the station.

It's not enough just to show up, however. As the enormous one-word signs hanging in the station remind us, we have to "THINK" at all times. We have to know and remember the many FCC rules. If someone slips and uses an obscenity, for example, the FCC can fine the station a *minimum* of $7,000, which is more than our annual operating budget. We also have to watch the time, making sure to run our "legal ID"—failure to identify ourselves as "WKWZ Syosset" at the top of every hour could result in a $5,000 fine.

In addition to knowing general FCC rules, we have to keep in mind the specific requirements of individual shows. On a music show, I need to make sure the songs flow together smoothly and to perform quick time calculations to make sure I don't miss a scheduled break. On a sports or news discussion show, one person has to watch the clock and direct the others so that the show covers all the necessary ground in the allotted time. Always remaining alert and prepared requires concentration, and the students who have stayed on at WKWZ have succeeded because they can maintain focus even in hectic situations.

The students' part in keeping WKWZ running smoothly includes raising money to purchase new, state-of-the-art equipment. Although the station receives some funding from the board of education, we have to find ways to supplement our budget. Since commercials aren't allowed on school radio stations, we've experimented with underwriting, convincing local businesses to pay small sums for announcements that read something like, "Portions of this program were brought to you by J. Smith Clothing, located on 400 Elm Street in Woodbury." More often, however, our director of development coordinates special events—such as our upcoming auction of memorabilia from local and national bands—to help us raise money.

But we don't raise money just for WKWZ. We have donated proceeds from races, bowl-a-thons, and other projects to local causes and charities. These events not only raise awareness of and money for the charities, but also strengthen our ties with the community.

Our commitment to the community also shows in our programming. One of WKWZ's most important missions is to broadcast community news, which it has accomplished since its inception 25 years ago. On our public affairs programs, we've covered school board meetings, local elections, and even the local music scene. With our community focus, we have secured interviews with many local people before they hit the national scene: former New York City Mayor Ed Koch, comedians Jerry Seinfeld and Margaret Cho, football players "Jumbo" Elliott and Drew Bleddsoe, and countless musicians. We've also aired interviews with bands that have loyal followings in their hometowns but that get passed over by more mass-market outlets.

One of the biggest rewards of high school radio is that it allows your voice to extend far beyond the walls of your school. Radio combines a slice of fame with a chance to improve your journalism and people skills, to demonstrate commitment and good judgment, and to have a lot of fun. My experience at WKWZ has given me all of this, and I hope to continue broadcasting through college and beyond.

Jason Weill, a junior at Syosset High School, is the publicity director of WKWZ-FM. He is currently working on a retrospective program about the 25-year history of the station. You can send Jason email at jweill@northeast.net

Out of the Living Room, Into the Control Room

by Melissa Hartman

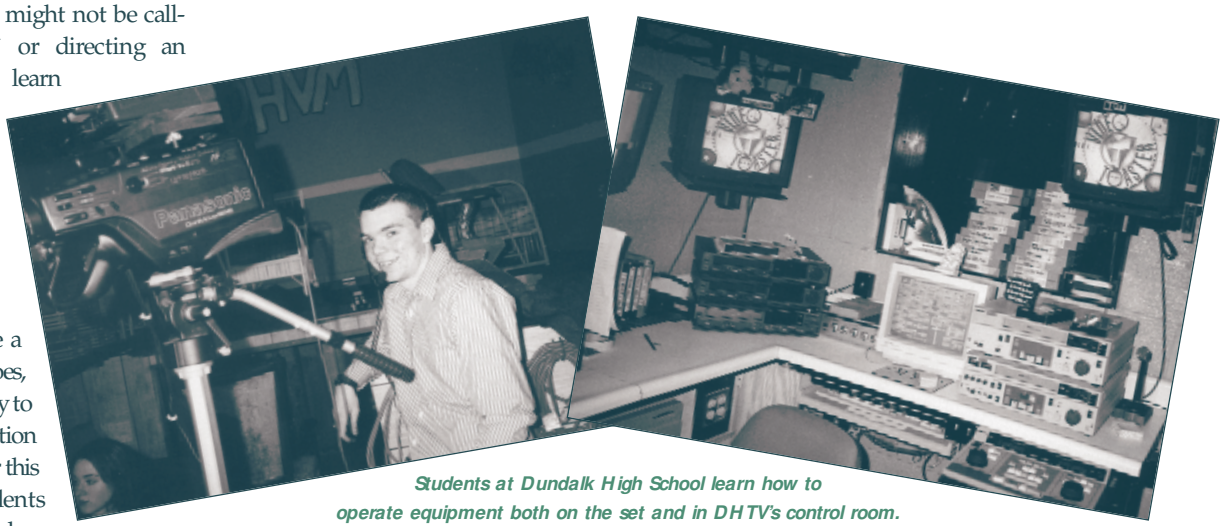
Whether you watch the news every night, *The X-Files* every week, or History Channel documentaries only occasionally, you have seen the product of an extraordinarily collaborative process. Watching a program's closing credits scrolling by, you have probably realized that a television show is the work of many people, most of whom never appear on screen.

It takes a whole team—from camera operator to technical director to film editor—to create a television program. Fortunately, many opportunities exist for you to try your hand at these different production roles. While you might not be calling the shots at CNN or directing an episode of *ER*, you can learn valuable technical skills to take with you to a summer job, to college, and even into a career in television.

School TV

Does your school have a television studio? If it does, you've got a convenient way to start exploring the production process. Some schools offer this opportunity only to students taking a production class, while others allow students to participate as an extracurricular activity. Either way, you can learn how to operate the equipment and help to create programs that might be shown in school or on cable.

For example, at Dundalk High School, a public school in Baltimore, an all-student staff produces three shows that are broadcast on The Education Channel, a local cable channel: *Attic Trax*, a music video program similar to MTV; *What's Goin' On Here*, a show featuring one-on-one interviews with local celebrities and politicians; and *Dundalk High Video Magazine*, a news program that focuses on school and community events. A half-hour each, these programs feature students as hosts, reporters, camera operators, film editors, directors, and producers.

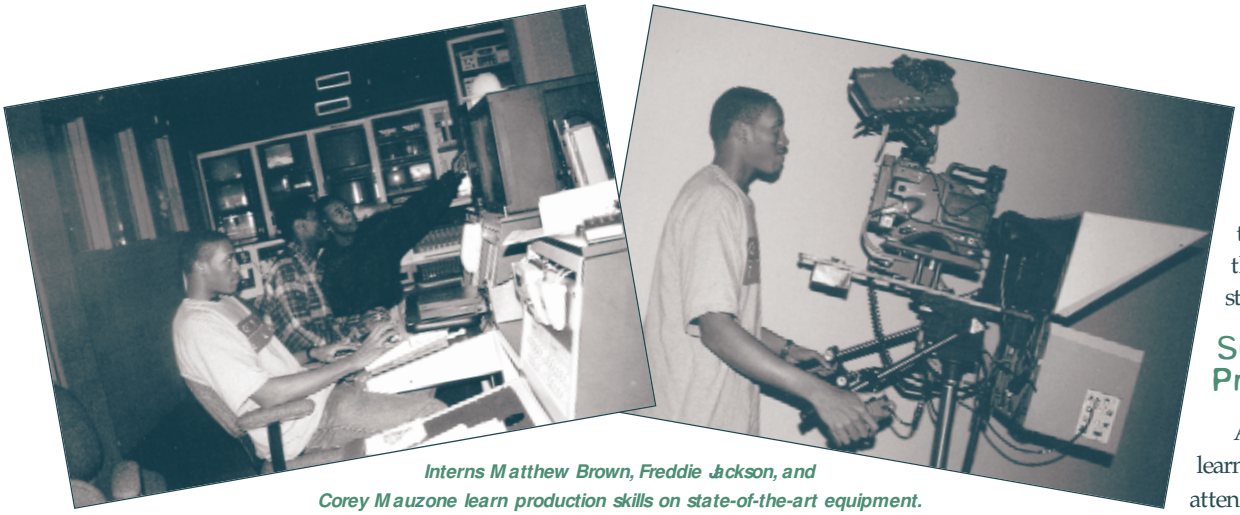


Students at Dundalk High School learn how to operate equipment both on the set and in DHTV's control room.

High school studios like Dundalk's allow students to rotate among jobs on the set and in the control room. Even a very basic studio will give students access to studio cameras, microphones, and lights on the set; and a switcher, a VCR, a video mixer, video monitors, and a sound board in the control room.

But what if your school doesn't have a TV studio? Consider starting a television club. You and other interested students can organize visits to local studios, arrange for guest speakers, and perhaps use equipment from your school's audio/visual department to produce some small projects.

With a lot of work and dedication, your club might be able to establish a studio at your school. Keep in mind, though, that this process may be a long one. After enlisting the support of a faculty advisor and gaining the approval of your school's administration, you may have to organize fund raisers and ask for donated equipment.



Interns Matthew Brown, Freddie Jackson, and Corey Mauzone learn production skills on state-of-the-art equipment.

When all of that is done, you'll need to meet the technical challenges of producing air-quality programs.

Also look beyond your school: you may be fortunate enough to live in the vicinity of a magnet program that offers television production. Intensive coursework and access to high-quality equipment are only part of the benefit of attending these magnet schools: many also offer career shadowing opportunities as well as placement in part-time jobs and internships.

Internships

Even if you don't attend a magnet school, you can take advantage of internship opportunities in your community. While many internships—even in public television and at local stations—are given only to college students, some small stations, especially cable stations, offer internships to high school students.

One major advantage of working at these smaller stations is that you can gain experience in many different production roles. Just ask high school students Corey Mauzone, Matthew Brown, and Freddie Jackson, all interns at Baltimore County's Education Channel. "We're learning how an actual TV station runs, even though it's small," Freddie explains. "And because it's small, it's easy for us to rotate into different positions."

All three students have worked as camera operator and stage manager, and they have begun to explore different positions in the control room, acting as audio technician, character generator operator, teleprompter operator, and even director for portions of some shows. They learn the skills for these positions from professionals on state-of-the-art equipment. And they can practice what they've learned when they're not working: "We can use the equipment here any time we want to, and we can sign some of it out to take home. That's one of the best things about interning."

If you want to find an internship like this one, start with the phone book—call your local television stations as well as your cable provider and ask about opportunities for high school students. Also check with your school's guidance office and audio/visual department or media center. Freddie suggests that you "look everywhere. The opportunities are out there—you just have to call around. It's harder at bigger studios, but there are small stations that give high school students a chance."

Summer Programs

Another great way to learn about production is to attend a summer program. If you have no production experience, a summer program can introduce you to the field and help you decide if it's something you'd like to pursue during the school year. If you already have a production background, a summer program can help you hone your skills as well as develop new ones.

As with programs in other disciplines, summer programs in television and film vary in length and intensity. Students looking for an overview might prefer The Media

ITRP participants spend five weeks immersed in a production environment, working both individually and in groups.

photos by Boston University Photo Services

Continued on next page

Continued from page 11

Workshops, one-week sessions held at UCLA that include visits to major motion picture studios and network production centers. Students desiring a more in-depth study would probably benefit more from the longer programs offered by the Pre-College Summer Institute, the Institute for Television, Film, and Radio Production, or the National High School Institute. Participants in these programs combine what they learn in hands-on exercises, workshops, and lectures to create finished portfolio pieces.

Looking Ahead

Summer programs, internships, and school studio experience can help you make important college and career decisions. If you think you want to pursue a career in television, look for colleges that offer a major in television or film studies. You'll also want to find a school that provides internship opportunities so that you will have experience when you're searching for a job in this competitive industry.

Involvement in production while you're still in high school can also make a difference when you apply to college. While some excellent undergraduate programs in television/film, such as those at Northwestern University and Columbia University, do not require separate applications or previous experience, others do. Both The Film School at Florida State University and The School of Cinema-Television at the University of Southern California require a separate application; USC's program also requires a portfolio, and FSU's program weighs previous filmmaking experience and studies in their admissions process. Applicants to many arts colleges, such as The University of the Arts in Philadelphia and The California Institute of the Arts, can expect to appear in person for a portfolio review.

Clearly, your high school production experience will be helpful to you if you're planning to major in or pursue a career in television or film. Even if you're not, you can learn a lot from the production environment—about teamwork, about media technology, and about the satisfaction of creating a product for others to view and enjoy. So the next time you're watching your favorite show, remember you are seeing only the outcome of a complex process—a process you can learn, and learn from.

Whose Job Is It, Anyway?

These descriptions will give you an idea of what role each member of the production team plays. Of course, responsibilities for production positions depend upon the size of the production and vary among studios.

Producer: The leader of the production team, the producer supervises the entire production process, from planning the budget to hiring other members of the team. In small studios, the producer might also assume the role of director.

Director: The director has responsibilities at all stages in production. He or she arranges the positions of cameras and talent (the people who appear in front of the camera) during preproduction, then selects the camera shots during production. Finally, the director supervises post-production work, such as film editing.

Technical Director: The technical director works in the control room. In addition to operating the switcher (the equipment that switches from one camera to another), this person supervises audio, video, effects, and all other technical aspects of the production.

Audio Director: Also called the audio technician, this person sets up and checks the microphones, and monitors sound quality throughout the production.

Videotape Recorder Operator: In a role similar to that of the audio director, the VTRO performs recording checks and monitors video quality.

Electronic Character Generator Operator: The CG operator designs and types in the closing credits you see at the end of a movie or television show as well as any opening titles and subtitles.

Teleprompter Operator: Integral to the production of live broadcasts, the teleprompter operator makes certain that the script flows properly for the talent to read. In rehearsals, the teleprompter operator may also make changes to the script as specified by the director.

Camera Operators: In addition to performing the actual shooting of a production, camera operators set up, inspect, and maintain the cameras. They may also work with the director in deciding on shots.

Stage Manager: This person coordinates the activities of all of the people who work on the set, including camera operators and talent. The stage manager, with help from stagehands, is also responsible for putting together and breaking down the set.

Editor: Film editors receive the raw tape and may cut segments, arrange segments in a different order, make adjustments in sound or lighting, and add special effects.

For more information about the summer programs mentioned in this article:

Institute for Television, Film, and Radio Production

Boston University
College of Communication
640 Commonwealth Avenue
Boston, MA 02215-2422
(617) 353-5015
itrp@bu.edu
www.bu.edu/COM/itrp

The Media Workshops Foundation

291 S. La Cienega Boulevard, Suite 735
Beverly Hills, CA 90211-3312
(800) 223-4561
mworkshop1@aol.com

National High School Institute

Radio/TV/Film Division
Northwestern University
617 Noyes Street
Evanston, IL 60208-3026
(800) 662-NHSI
nhsi@nwu.edu
www.nwu.edu/nhsi/rtvf.html

Pre-College Summer Institute

The University of the Arts
320 South Broad Street
Philadelphia, PA 19102-4901
(215) 875-3355
(800) 616-ARTS (outside PA)
pcuarts@netaxs.com

Education at a Distance

From traditional intellectual mentorships via correspondence, to CD-ROM-based courses, to interactive virtual classrooms hovering on the Web, distance education is transforming the way we learn. Read on to discover how you can benefit from these countless opportunities.

Do you want to take more advanced courses than those your school offers? Do you yearn to become better versed in literature or to strengthen your writing? Are you ready for college courses but not ready to leave high school to enroll full-time in college? Distance education is one of the most powerful resources at your fingertips if you are ready to expand, deepen, or accelerate your education.

A top-notch distance learning experience replicates the elements of a good classroom experience: curricular materials crafted from a comprehensive knowledge base; intensive contact with an excellent teacher; built-in, periodic assessment to ensure an appropriate degree of academic challenge; and, in some cases, student community facilitated by email.

Learning at a distance also offers unique benefits: Whether you live in New Mexico or Alaska, you can touch down on a virtual campus with the flick of a switch. You don't have to board a plane or catch a bus to take advantage of distance education.

And you don't have to set an alarm clock. Some programs, such as CD-ROM-based courses without a person-to-person tutorial, impose no time constraints; more complex programs mandate scheduled assessment and tutorial feedback, but leave students free to work when they please. Considering the demands of swim practice, theater tryouts, and family activities, some learners judge the freedom to schedule their own learning to be distance education's greatest benefit.

And then there are the educational benefits. Multimedia software, such as CD-ROMs, combined with Internet connections, can open up a whole world of knowledge: a single CD may contain an entire course, integrating images, animation, video, sound, and links to Web resources. Multimedia courseware can also accommodate differences in learning styles. Some learners benefit from visual or aural cues that reinforce material and instructions. And the freedom to navigate a lesson in one's own way—slowly, for example, or over and over again—can strengthen any learner's grasp of new concepts and skills.

Distance education works best for committed learners with time and resources to devote to additional study. So take a look—at yourself—before you leap.

Are you a self-starter? To get the most out of distance learning, you need to be intellectually curious, motivated, and disciplined enough to work consistently on your own. The tendency to procrastinate is natural in most of us; it's how you handle that tendency that makes the difference.

Do you have time? Most academically talented students are already heavily engaged in school and activities. If you are considering a distance education program to supplement your learning, ask yourself one important question: Can you realistically fit extra work into your daily schedule, or are you likely to fall behind, become frustrated, and lose interest?

Can you afford it? At the most basic level, you need to consider the cost of tuition and textbooks/materials. Traditional by-mail correspondence courses may be very reasonable, but high-tech transmission requires sophisticated computer equipment and online time. Having your own system is most convenient, of course, but may not yet be an option for your family.

Once you've considered these questions, if you still want to become a distance learner, all you have to do is decide what kind of program in what subject you want, as well as what kind of delivery system will work best for you. To find a program that accommodates your educational goals, start with the list of distance learning options on the following pages.

Distance education programs, such as IAAY's Math Tutorials, allow you to enjoy the benefits of a classroom experience at home.

Selected Distance Learning Options

IAAY's Distance Learning Programs

Now—without leaving home—students can receive the individualized instruction that is the hallmark of IAAY's programs. The Center for Distance Education offers flexible, self-paced courses in writing and mathematics. Integrating sound pedagogy, solid curricula, and expert, responsive tutors, this program strives to create a community of learners who share common intellectual bonds.

IAAY Math Tutorials

The Math Tutorials are a series of mathematics courses for qualified students in grades K–12. These courses, which range from primary school- to college-level, are offered in a multimedia IBM-compatible format. Students work at their own pace and consult with their tutors on a regular basis. Tutors provide feedback based on weekly reports turned in by their students.

Students establish eligibility by earning a qualifying score in an IAAY Talent Search. K–1 students qualify based on recommendations and above-grade-level scores on a quantitative analysis or mathematical achievement test.

Application deadlines: Tutorials begin on the first of each month. Students should send their applications five weeks in advance of the date they would like to begin.

IAAY Math Tutorials
The Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218-2699
(410) 516-4759, fax (410) 516-0200
math.tutorials@jhu.edu
www.jhu.edu/gifted/cde

IAAY Writing Tutorials

The Center for Distance Education's Writing Tutorials offer courses for students in grades 6–12. Beginning with invention techniques and moving through rhetorical modes of exposition, description, analysis, argumentation, and persuasion, students can participate in a full writing experience that culminates in courses in poetry, fiction, or AP Composition.

IAAY's CD-ROM version of Crafting the Essay combines sound and visuals in a series of short exercises that make up fourteen lessons.

Designed by veteran writing instructors from IAAY's summer programs, courses are geared to the highly motivated writer. During the academic year, a student completes fourteen assignments and receives comprehensive feedback from his or her tutor. In all courses, a heavy emphasis is placed on the writing process: prewriting, drafting, and revision.

Writing courses are conducted via surface mail or email. A multimedia CD-ROM version of Crafting the Essay will be available this fall.

Application Deadline: August 29, 1998.

IAAY Writing Tutorials
The Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218-2699
(410) 516-0277, fax (410) 516-0200
IAAY.EWTinfo@jhu.edu or
IAAY.YWTinfo@jhu.edu
www.jhu.edu/gifted/cde

Additional Distance Learning Options

LetterLinks

Through LetterLinks, students in grades 6–12 may take high school honors-level courses in mathematics, science, social sciences, and the humanities by mail or email. For the duration of each course (about nine months), you and your tutor—a high school teacher experienced in working with academically talented students—correspond on a regular basis.

LetterLinks also offers two computer-based learning programs: WordTeacher, a vocabulary-building program; and math courses on CD-ROM, developed by EPGY.

Eligibility is based on your scores on SAT/ACT exams taken in grades 6–8.

LetterLinks courses begin twice a year.

Next registration deadline: September 15, 1998.

LetterLinks
Center for Talent Development
617 Dartmouth Place
Evanston, IL 60208-4175
(847) 491-3782, fax (847) 467-4283
jar@nwu.edu
www.ctd.nwu.edu

Duke University TIP

Duke University's Talent Identification Program offers three distance learning opportunities: The Learn On Your Own Program, which allows students to work with a mentor of their choice to master materials designed by TIP; Talent On-line, which offers mathematics courses through a TIP partnership with EPGY; and the Graphics Calculator Project, which uses the TI-83 graphics calculator as a tool for analysis and mathematical modeling in mathematics and science coursework.

Registration deadline:
Open enrollment

Duke University/Talent Identification Program (TIP)
P.O. Box 90747
Durham, NC 27708-0747
(919) 684-3847
www.tip.duke.edu

Merlyn's Pen Mentors in Writing Program

This twelve-week, noncredit program for students in grades 6–12 requires no qualifying scores or academic grades and is intended to supplement, not replace, school courses.

Your mentor—a professional writer or editor on the *Merlyn's Pen* staff—sends you personalized assignments, written critiques, and suggestions for revision. Upon successful completion of the semester, you receive a written evaluation from your mentor, along with a Certificate of Achievement in Writing.

The Mentors in Writing Program offers both a three-month and a six-month program. The number of assignments and responses is the same for both programs.

Application deadlines:
July 1 for the three-month program;
October 1 for the six-month program.

Merlyn's Pen Mentors in Writing Program
P.O. Box 1058
East Greenwich, RI 02818-0964
(800) 247-2027
merlynspen@aol.com
www.merlynspen.com

Gelfand Outreach Program in Mathematics

The Gelfand Outreach Program in Mathematics at Rutgers University encourages the development of mathematical ability by using non-standard problem-solving models in algebra, geometry, analytical geometry, and precalculus.

After completing a diagnostic assignment, you work either individually or in groups to complete monthly assignments. The solutions and explanations you submit are reviewed and commented on by faculty members and graduate students in the Department of Mathematics. You receive a certificate for the successful completion of each year/level of the program.

Registration deadline:
Students may enroll at any time during the school year.

Center for Mathematics, Science, and Computer Education
118 Frelinghuysen Road
Piscataway, NJ 08854-8019
(732) 445-3491, fax (732) 445-3477
gopm@math.rutgers.edu

Penn State Independent Learning Program

Penn State uses both traditional and nontraditional methods to bring any subject offered through its colleges directly to you. An academic advisor is available to assist you in choosing from over 300 credit and noncredit courses. Your assigned instructor communicates with you by mail and telephone.

Independent Learning Program
The Pennsylvania State University
207 Mitchell Building
University Park, PA 16802-3601
(800) 252-3592
psude@cde.psu.edu

Texas Tech Guided Study

The Texas Tech University High School offers a complete state-accredited diploma curriculum as well as undergraduate courses from six colleges of this major research university.

Guided Study
Texas Tech University
Box 42191
Lubbock, TX 79409-2191
(800) MY-COURS
www.dce.ttu.edu/

University of Nebraska–Lincoln Independent Study High School

This program offers four online courses (with six more to be added in August) and 125 print-based courses. Students can take either the college prep track or general studies track to earn a fully accredited diploma. UNL also offers high school students approximately 80 print-based college-level courses for college credit.

University of Nebraska
Independent Study High School
Department of Distance Education
Division of Continuing Studies
Clifford Hardin Nebraska Center for Continuing Education, Room 269
33rd and Holdredge Streets
Lincoln, NE 68583-9800
(402) 472-4321, fax (402) 472-1901
unldde@unl.edu
www.unl.edu/conted/disted/index.html

University of California Extension

Through this extensive program, you may correspond with your instructor for high school, university, and professional development courses by mail, email, or fax. Some courses may now be taken via America Online and on the Internet.

Center for Media and Independent Learning
University of California Extension
2000 Center Street, Suite 400
Berkeley, CA 94704
(510) 642-4124
cmil@violet.berkeley.edu

University of Wisconsin Extension

You may choose from hundreds of high school and university correspondence courses and enroll at any time during the year. Keeping in touch with your assigned instructor by mail or email, you work at your own pace, taking up to twelve months to complete coursework and exams.

UW-Extension
Independent Learning
104 Extension Building
432 North Lake Street
Madison, WI 53706-1498
(800) 442-6460, fax (608) 262-4096
ILEARN@ADMIN.UWEX.EDU

Women in the Wings:

Julia Love, Filmmaker, in the Spotlight

by Lesley Mackay

Black-and-white shots of young women ... interviews filmed 50 years later of women in their seventies ... photographs of the industrial city of Pittsburgh in the 1940s ... "Heinz 57" employee newsletters ... government movies urging women to join "the homefront army" ... D-day footage showing the sky over France blackened with American aircraft and parachutists.

Out of these materials, Julia Love, 17, crafted *Women in the Wings: Pittsburgh's World War II Workers*, a 30-minute documentary released this spring. America's D-day invasion of German-held French territory during World War II was accomplished in part by glider pilots who braved enemy fire to transport men and equipment, including Jeeps, into France. Julia's film focuses on a domestic secret behind the invasion: wings for America's glider planes had been painstakingly built by hundreds of female workers in a Pittsburgh processed food plant.

Researching, directing, writing, editing, narrating, and producing her documentary took Julia over three years. Despite setbacks, such as being turned down for funding because of her age, she remained true to her goal. "What motivated me all along," says Julia, "was wanting to make a tribute to the women who made the gliders."

"It started with my history teacher, Susan Schotz Rhodes. Once, out driving, she tailed a man who had a bumper sticker on his car that read, 'World War II Glider Pilots' 50th Reunion.'" In a parking lot, Mrs. Rhodes invited Ed McCague to give a talk about his wartime experience to her students at Pittsburgh's Shady Side Academy.

Then in ninth grade, Julia learned a great deal about World War II from the ex-glider pilot's presentation. His story included a surprising piece of local history: Pittsburgh women had been recruited by the H.J. Heinz Company to build military glider wings in a Heinz building, using plywood normally used to make the food company's crates and boxes. Encouraged by Mrs. Rhodes, Julia started to ask questions. "But no one seemed to know about the glider-making, not even my grandparents, who have lived in Pittsburgh all their lives." The conversion of the Heinz plant into a war materials factory had been top-secret—

"the fear was that if the Nazis found out, they would bomb it," Julia explains. "At the time, people were not allowed to talk about their jobs, and many of them have been silent until recently. The story was untold."

Julia decided to tell the story through the medium of film. "My dad is a producer, and I had been a production assistant for him before," she notes. (Julia's father and a colleague taped the film's interviews, under Julia's direction.) "But mostly I chose film because it was the best way to preserve interviews of the women. They're getting older now—they're all in their seventies." Through film, Julia could create a permanent visual memory of her subjects.

First, she had to find them. "I contacted the Heinz company for employment records, but they had been destroyed. So Mrs. Rhodes and I drove around Pittsburgh, posting flyers in churches and senior citizen centers, asking the women workers to call." For a long time nothing happened. And then something did: "Almost a year later, Big Jean called our school. When Mrs. Rhodes and I went to interview her, she was wearing red cowboy boots, with her fingernails painted to match her sweater. She was animated about her life and remembered a lot about working at the Heinz plant. We knew then that we had a film."

Julia eventually interviewed five women for *Women in the Wings*. "I was 21 years old, and my husband had been drafted," Big Jean testifies. "We were married in March, he was drafted in April, and he went off to the war." Like others back home, she explains, she began to look "for ways and means of surviving." Her search led her to the Heinz plant.

Of Young Women—Past and Present

By following contemporary interviews with old photos and wartime footage, *Women in the Wings* transports its viewers from the present to the past. Julia herself suggests the trip back: today, she is almost the age that her subjects were when they worked in the factory. "I think that the women were so open with me in part because I was even younger than they were during the war," she says.

The Pittsburgh women themselves led diverse lives, and Julia began to put her film together only when she was sure it would speak in a range of voices. After others had already been interviewed, Julia made special appeals on radio and in the *Pittsburgh Post-Gazette*, hoping to hear from African Americans who had been part of the glider-making. Eventually, Kathryn Nolan called to add her testimony: how she had been

rejected from art school because of her race; how she came to the factory to escape having to work in domestic service; how her boyfriend had been a soldier and she had wanted to contribute to the war effort; how she grew to enjoy taping and gluing and nailing the long glider wings, as well as the camaraderie in the plant. "I really believe that common cause was the true meaning of what we did," she attests in the film.

Kathryn Nolan died in the summer of 1997, before seeing herself on film. Her family attended the Pittsburgh première of *Women in the Wings*. "The film preserved the memory of her," says Julia. "I was happy to have been able to do that."

What Is a Glider

What were the special aircraft that Kathryn Nolan and the other women built for almost two years? Gliders are designed to imitate the flight of soaring birds. Their technology is relatively simple, a function mostly of aerodynamic shape—tapered wings and a lightweight body made from wood, metal, or plastic—as well as simple mechanical devices—a steering wheel, a rudder operated by foot pedals, a variometer to measure rates of ascent and descent. Gliders have been used mostly for sport and for meteorological research.

In 1940, the Germans used gliders to invade Belgium. After that, the British and the Americans began to use large gliders to transport troops and equipment in the preliminary stages of an invasion. Towed and then released by small transport planes, the gliders would silently soar toward enemy territory, kept afloat by rising air, thermal currents, and clouds.

While *Women in the Wings* focuses on the workers who made the gliders, it also reveals the experience of the pilots who flew the engineless aircraft during the D-day invasion. Ed McCague, the man Mrs. Rhodes had followed into a parking lot, adds moments of intense emotion to Julia's film, recalling the experience of navigating a descending glider through heavy fire. "It was just something indescribably awful, in my opinion," he says, looking straight into the camera. Mr. McCague's moving testimony is accompanied by war footage of American gliders forced into violent crash-landings.

Making a Film ... and Winning Support

The abundance of voices, diversity of materials, and shifting time-frames of *Women in the Wings* makes the documentary something of a collage. Julia and her editor, Henry Simonds, a recent graduate of Middlebury College, needed to organize the interviews, other footage, and still images Julia had gathered and to compose a narrative that would unify them. "We just sat and tried to fit the story together," Julia says. "We organized all the topics on a big board. It was exciting because Henry and I had complete control of the script."

The excitement of piecing together the film sustained Julia even when she couldn't convince others to support her project. "From the first year," she explains, "I started trying to raise money, but I only got rejection letters. The foundations didn't think that I would finish the film, or they didn't think that it would be of professional quality. I just went on with my work, conducting the interviews and putting the film together as much as I could. Toward the end, though, I really needed money for the sound mix and for the final editing. So I had a meeting at the Heinz Company Foundation and showed them a rough cut. They gave me money, and then I got more from other foundations."

Other times, support came quickly. President Bush, a pilot who had been shot down in World War II, taped an introduction for *Women in the Wings* just days after Julia sent him a copy. "I didn't expect to hear from him, but I got a tape back in a week. I called everyone I knew, and then I ran all over town looking for a machine that could play a professional videotape. When I found one, I played his introduction over and over."

Convincing a President to introduce her film was an amazing achievement. However, for Julia, even that honor could not outshine an earlier triumph: "The best part of making the film," she says, "was when Big Jean called and we went to meet her."

***Women in the Wings** has premièred in Pittsburgh and Los Angeles and at the Schlesinger Library of Radcliffe College. This fall, Julia Love will attend Duke University. She is currently helping her father with his next film.*

Still Life with Movement
Video as Art

by Ted Winstead

With its plush wall-to-wall carpet, the room could almost be in your house. A wooden chest stands alone against the back wall. A vase of flowers, a short table lamp, and a compact digital clock showing real time have been arranged atop the chest. The room is unremarkable but for a small black-and-white monitor on the chest displaying the face of a middle-aged woman sleeping.

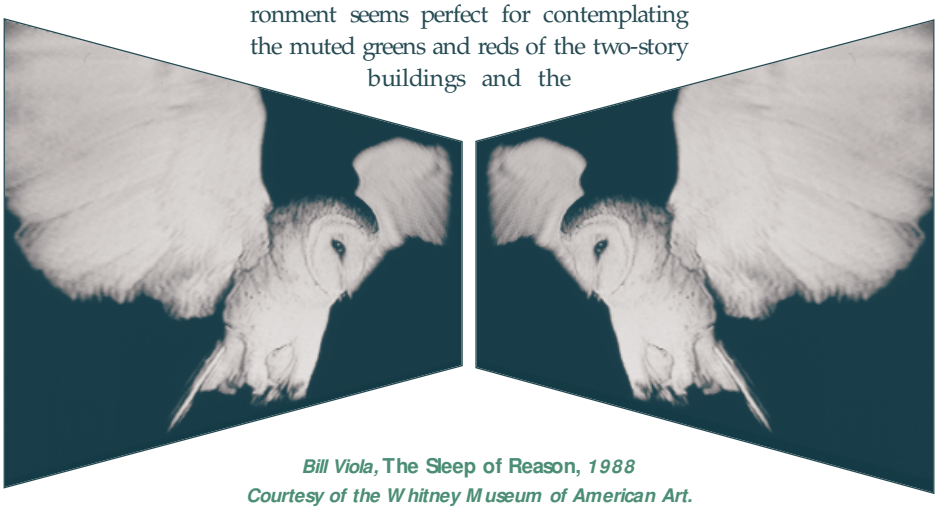
A minute passes, and the woman adjusts her head against the pillow. Then, without warning, the lamp shuts off, and floor-to-ceiling video images appear on three walls. An agitated white owl, filmed close-up at night, flies at the viewer. Loud industrial sounds come from speakers in the ceiling. After a few seconds, the room abruptly returns to normal—the lamp switches on, and the sleeping woman reappears on the monitor.

Bursts of sound and video continue to jolt the room at random intervals, a disconcerting flurry of incoherent sounds and chaotic images—lunging Dobermans, burning buildings. The sleeping woman and the dramatic transformations of the room seem to suggest the mind, with its capacity for wakefulness, sleep, and the heightened realism of dream states.

Media as Art: Video and Oil Paints

This is not a room in your house. It is art, a 1988 video/sound installation called *The Sleep of Reason* created by California-based artist Bill Viola. A retrospective of Viola's work in video occupied two floors of the Whitney Museum of American Art in New York this spring. On a different floor is a popular work from the museum's permanent collection, *Early Sunday Morning,* a 1930 painting by the American artist Edward Hopper. The oil painting depicts a series of storefronts in a small town, as seen from the street in late afternoon sun.

You could visit both works of art in an afternoon. The Hopper painting hangs on a white wall, displayed prominently in a quiet, well-lit room with other paintings. The environment seems perfect for contemplating the muted greens and reds of the two-story buildings and the long shadow from a barber's pole in the foreground. If you went upstairs to the Viola exhibit and came back two hours later, the painting would not have moved, and the room's lighting would be the same. Only the group of people around you might be different.



Bill Viola, **The Sleep of Reason,** *1988*
Courtesy of the Whitney Museum of American Art.
Photograph by Kira Perov

Meanwhile, *The Sleep of Reason* continues to alternate its environments. You could stay for fifteen minutes or so, and a different video clip with its own audio would appear at each interval. But to experience the entire work, you would have to stay for a complete cycle, and there is no way to know up front how long that might take.

We encounter these works of art in very different ways, but ultimately the dissimilar media of oil paints and video technology can accomplish the same thing: they can stir in us responses beyond that of recognition. We react to the media as art. In contrast, we perceive much of the visual stimuli of everyday life, such as traffic lights, merely as information.

The Portapak: A New Technology

Before 1965, only television stations worked in video because the technology necessitated well-lit studios and teams of engineers to operate the heavy equipment. But that year Sony introduced the original portable video camera and recorder, the Portapak. Although cumbersome—a bulky camera, open-reel recording deck, and battery pack—the Portapak could record in relatively low natural light, allowing for spontaneous recording almost anywhere.

Video art has taken many forms since artists began experimenting with video technology in the late 1960s. In video sculpture, artists use TVs and video monitors to create three-dimensional works of art, such as the figure of a person constructed from 1950s TV consoles. A video installation—like *The Sleep of Reason*—is an environment that incorporates video technology.

Today, any work that utilizes television or video technology is considered video art. The scope of the field limits the depth of any introduction to video art, but we can sample the diverse body of works by examining the medium's distinct features.

New Representations of Time and Space

Many video artists exploit the medium's capacity to represent time and space in ways not possible before video. Consider the complexities of time and space in *The Sleep of Reason*: The video clips were filmed in real time at some point in the past. They appear at unpredictable intervals, breaking up the present with startling images from some previous time, leaving the impression, at least for a moment, that past *is* present.

The video images also provide a direct connection to some other location, or space.

As for the sleeping woman, she may be on videotape, or she may actually be sleeping in another place and appear on the monitor as part of a live hook-up. The latter scenario is impractical but possible, and live pictures are common in video art. Either way, the room is connected to another space via the monitor. An element of future time is involved, too, as you instinctively try to anticipate each jolt of image and sound. Finally, the passage of time is marked by the compact digital clock on the chest.

Taking on Television

Another of video's distinct properties is a unique ability to represent television. A defining feature of modern life, television can be a compelling subject for any artist, but particularly for video artists. In Viola's words, video enables us "to speak directly in the language of our time"—the language of television.

Nam June Paik, Video Flag, *1985-1996*
Courtesy of Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Holenia Trust Fund, 1996.
Photograph by Lee Stalsworth/Ricardo Blanc

There is a historical connection between video and television as well. In the late 1960s when artists began experimenting with video, television played a decisive role in shaping public opinion regarding the war in Vietnam. Support for the war diminished sharply after the networks began broadcasting daily body counts and combat footage of U.S. troops on the nightly news. Early video artists were fascinated by this powerful medium, and video artists have glorified, analyzed, and criticized television in their work ever since.

One example of artists taking on television is a July 4, 1975, event staged and videotaped by a group of San Francisco video artists that drew 500 people and was covered by local TV crews. The focus of the event was an elaborate speech in which a man made up as John F. Kennedy critiqued corporate capitalism and television. Later, an artist drove a Cadillac through a wall of old TVs. (The vehicle had been modified to withstand a high-speed crash.) That night the artists taped local TV newscasts, all of which highlighted the crash and ignored the speech. Combining performance art (the crash and the speech) with its TV coverage, the artists created a video documenting what they saw as television's bias toward sensationalism.

Familiar Subjects, with a Twist

The video camera can also function essentially as a high-tech paintbrush, using its distinct properties to convey familiar subject matter in unfamiliar ways. A stunning example of this is Nam June Paik's installation *Video Flag,* on exhibit at the Hirshhorn Museum in Washington, D.C. The seven-by-twelve-foot bank of 70 thirteen-inch monitors is immediately recognizable as an American flag. Its electronic stars and stripes merge with split-second news stills, endless runs of ones and zeros, and the morphing faces of every U.S. president from Truman to Clinton, which appear in place of stars.

Images fly by. Among them we see photographs of Vietnam protesters burning the American flag. By including these stills, Paik honors those who once rejected—in the most defiant way possible—the very icon he recreates. In *Video Flag* we immediately see a fresh interpretation of a classic symbol of patriotism. But it is also an ironic meditation on the meaning of patriotism, made possible by video technology.

The future of video art is wide-open. Judging from recent newspaper articles on video art and from the success of the Viola retrospective, the medium seems healthy and vibrant. Video will surely be combined with new computer-based media in the years to come, creating endless possibilities for artists.

STATES OF THE ART

The Past

The story of video art, according to lore, begins at the Liberty Music Store in Manhattan in 1965, when a Korean-born artist named Nam June Paik purchased a Sony Portapak that had been part of the first shipment to this country from Japan. On his way home, Paik shot scenes of the Pope's visit to New York, and that night he played the videotape for a group of artists. A spontaneous documentary with an artist's sensibility, the videotape is considered by many the first work of video art. Today Paik is frequently referred to as "the father of video art."

The Present

Female artists have been drawn to video in part because it has little history or established bureaucracy. The diverse work of today's female artists is notable for its subjects and innovative points of view. For example, Johnna MacArthur's 1996 *Chalk Confessions* is an intimate and improvisational work in which the viewer engages in someone else's personal ritual. The video shows a close-up of a hand scrawling private thoughts on a small slate in chalk and then crossing them out.

After years of being relegated to out-of-the-way corners of museums, video seems to have achieved parity with other media in the eyes of the art establishment. On the occasion of the Viola retrospective, the *New York Times* declared that "video has become an unavoidable, if not ubiquitous, fact of art-world life." Recent international exhibitions like the Venice Biennale have showcased video art, and major museums like the San Francisco Museum of Modern Art are acquiring it for their permanent collections.

The Future

When the Guggenheim Museum in New York throws a party for the millennium, video will be there. Paik is one of two video artists with shows slated for the millennium. His exhibit will feature the installation *Megatron/Matrix*, which is similar to *Video Flag*. This time, a wall of 215 monitors will display sequences that include documentary images, national flags, and even giant birds that migrate across the screens.

Exploring Career Options: Immunology

Interview with James Hildreth

by Carol Blackburn

James Hildreth, M.D., Ph.D., divides his time between two jobs: As Associate Professor of Pharmacology & Molecular Sciences, he studies the immune system's capacity to fight HIV, while as Associate Dean for Graduate Studies at The Johns Hopkins School of Medicine, he nurtures a new generation of biomedical scientists.

Photograph by Bruce Weller

How did your interest in the world of medicine first develop?

My father died of renal cancer when I was eleven. We were poor, lived in rural Arkansas, and had very limited access to health care. Even though I didn't know what it would entail, I set my sights on becoming a doctor or a scientist who studies cancer, hoping someday to spare another child from having to watch his father die. That was a big dream for an eleven-year-old boy, but that's how it all started for me.

And that youthful dream continued to inspire you throughout school?

Yes. By high school, it was clear that I had a strong affinity for science. In biology class, my mind was always racing ahead, wondering "What are the implications of this? How did they discover that? How do they know this is true?" I loved biology.

For me, though, as I looked ahead, personal considerations were more important than academic ones. I had to become comfortable with the idea that I *could* be a doctor or scientist. Growing up in rural Arkansas, I had never seen a scientist, let alone an African American scientist. Lack of exposure to role models is, I think, a major impediment to minority students' becoming interested in science as a career—it's simply not a lifestyle they're familiar with. One of the great joys of my work now is talking to young people, trying to convey my excitement and enthusiasm about my life as a scientist.

How did you address your own lack of exposure to the world of science?

I read every book I could find about science and scientists, to learn not just about science itself but also about becoming a scientist. If you know what the process is, know the road—where the curves and forks are—you can prepare yourself and take it one step at a time.

To be honest, though, some people were very discouraging about the prospects of someone in my situation becoming a doctor, let alone a scientist. But there were others—my mother and my biology teacher, in particular—who always encouraged me, who never let me take no for an answer. They provided the emotional support I needed to make it to the next step.

And that next step was a big one: Harvard.

Coming from a small town and a high school of 800 students to that unbelievably incredible place was quite something. The intellectual caliber there is so high. I was valedictorian of my high school graduating class, but many of my fellow students at Harvard had done far more exceptional things.

I had a very humbling experience my first year there. Thinking it would give me a nice jump on my premedical education, I took an advanced course in physiology—and got a D on the first exam. After a lifetime of As, a D was quite a shock. "What have I done? I've made a tremendous mistake. How could I possibly have believed that I could be successful here?" I have to credit my mother for helping me put things into perspective. Eventually, I saw that the problem was that I had taken an inappropriate course, not that I shouldn't be at Harvard.

Once I got my feet on the ground, I found the opportunities for personal growth and enrichment just amazing. You come away from Harvard feeling that there's nothing you can't accomplish if you approach it the right way. It was a very empowering four years for me.

Your next step was an unusual one for someone headed for a biomedical career. Why did you pursue a Rhodes scholarship?

As an undergraduate, one of my dreams was to become a doctor, then return to Arkansas and set up a health care center in a medically under-served part of the state. A friend suggested that a Rhodes would help me achieve that goal. Many Rhodes scholars go on to careers in public service or politics, so being a Rhodes scholar would not only be enjoyable and rewarding, but would also enable me to meet people who might be helpful when I was ready to set up that center.

The Rhodes is typically a two-year program in which you complete a master's degree in the field of your choice. However, because I was by that time planning to obtain both an M.D. and a Ph.D., I arranged to spend a third year at Oxford so I could complete a Ph.D. there. I studied with a gifted and inspiring immunologist, then returned to the States and came to Johns Hopkins for medical school.

Did you choose immunology because of your interest in cancer?

Yes. For decades, cancer researchers have believed that if we could just get the immune system's attention and direct it to cancer cells, we could change the

progression of the disease. That now appears to be true, although the molecular tools to pursue that strategy were not available when I was a graduate student in the early '80s.

As I studied the immune system, it became fascinating to me in its own right, not just as a means to help fight disease. I'm biased, of course, but I think the immune system is the most interesting system in the body—so marvelously efficient and potent, with so many levels of regulation. It's amazing.

What have you focused on?

My interest is in molecules that facilitate contact between cells called lymphocytes. The immune system is the only system in the body whose cells are predominantly free-floating, dispersed, and physically unconnected to one another. Cell-cell communication is thus essential to the functioning of the system. Some of the communication is accomplished by soluble molecules that diffuse from cell to cell, but much of it occurs when immune cells come into direct contact with one another. The cell adhesion molecules I study are an essential part of that latter process. Whenever immune cells interact, there always seem to be at least five or six different molecules involved, so teasing out exactly what each one does can be quite challenging.

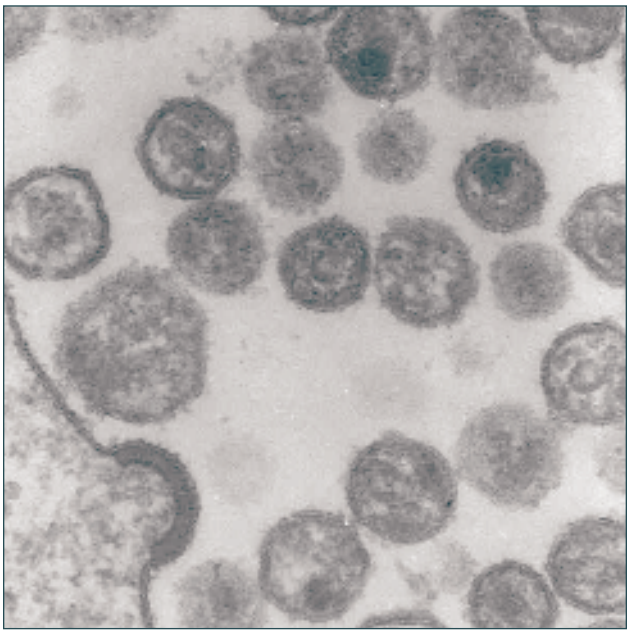
While you were in medical school, AIDS emerged as a serious problem, changing the biomedical landscape. How did AIDS change your research?

When I first became a faculty member in 1987, I felt a little uncomfortable jumping into a field that already had some pretty heavy hitters in it. But I decided to see whether the molecules I was studying might have something to do with the biology of HIV infection. And it turns out that they do.

For some time now, it's been known that HIV binds to cells in the immune system via a particular cell surface protein called CD4. What makes HIV so pernicious is that the subset of immune cells that expresses CD4, called helper T lymphocytes, are sort of the quarterbacks of the immune system. They direct the activity of all the other cells in the system. So if you eliminate helper T cells, as AIDS does, you cripple the immune system.

HIV uses the T cells' own identification markers against them?

Yes. HIV contains only nine genes, but by a stroke of evolutionary bad luck, one of those genes codes for a protein that binds to helper T cells' self-identification protein. Because of that, HIV makes a beeline for the very cells the immune system most needs to fight off viral infections.



Budding Virus: In the final stage of viral replication, a nascent HIV virus buds from its host cell (lower left). Electron micrograph courtesy of the Laboratory for Infectious Diseases, Hvidovre Hospital, Denmark.

All of CD4's normal activities require the cooperation of other proteins, including the adhesion molecules I study. So I thought, "If adhesion molecules are involved when immune cells bind to one other via CD4, maybe they're also involved when HIV binds to CD4." And they are.

How? Does HIV produce a protein that binds to the adhesion molecules, too?

No, it uses a more devious method: it steals cell surface proteins from the cells where it replicates. As a virus particle buds off from a cell, it takes part of the cell membrane with it. Since HIV preferentially infects cells in the immune system, the molecules it absconds with include ones involved in immune cell-cell interactions. These stolen molecules enable HIV to bind to any cell that a T cell can normally bind to.

By blocking cell adhesion molecules, however, we've been able to block HIV infection of T cells—at least, in tissue culture. We hope that understanding this process of viral acquisition of cell surface proteins will enable us to come up with new drugs to treat HIV infection.

Would the treatment you're exploring work the same way as the drugs already in use to treat HIV?

No, it wouldn't. The drugs now in use target the virus's ability to reproduce itself—something that it does only after it has already infected a cell. Our approach targets the virus's ability to latch onto and enter a cell—an intervention that might prevent HIV from infecting a cell in the first place.

In a sense, everything in biology comes down to molecules interacting with other molecules, and the consequences of those interactions. When you know something about a biological interaction, you can look for ways to alter or disrupt it. We'd like to be able to disrupt HIV's life cycle in as many different ways as possible. I am studying one line of attack; other labs are busy exploring others.

The AIDS research community is a busy one.

Yes, and a very competitive one. No matter what you decide to study, you will find many, many other laboratories working on the same thing. There are still some areas of immunology where you can carve out a little niche for yourself and be one of only a few scientists working on a problem, but that's not true of anything in AIDS research.

However, if there is any silver lining to this tragic disease, it's that it has drawn so many talented researchers to immunology and virology. Even when we've been unsuccessful in our efforts to thwart HIV, we've learned a great deal. AIDS research has led to many important discoveries, including some very fundamental ones about the immune system and molecular biology. Progress in these areas has moved ahead more quickly than it would have had we not been racing to understand this complex virus.

Do you use both your graduate and your medical training in your work? What have

you found to be the value of having an M.D./Ph.D.?

My daily life is more like that of a Ph.D. than an M.D.; I work in a lab, not a clinic. But even though I don't actually see patients, my medical training affects the context in which I think about research problems. Knowing about the things that can and do go wrong in the human body makes it easier to sense when a new finding might have clinical implications. And while I work at the molecular level, I always like to keep an organismal or whole-person perspective in mind. I think that having training in medicine as well as basic science encourages you to see the patient as well as the underlying biological puzzle.

What do you see happening in immunology's future?

Many of the fundamental questions about how the immune system works have clearly been answered in a general way, although we are certainly busy trying to fill in the outline. And there always seems to be yet another discovery that represents a breakthrough in our understanding of this complex system.

But there are also many unanswered questions, especially about modulation of the immune system. Even something as essential to our existence as reproduction holds immunological mysteries: we still don't fully understand why a pregnant woman's immune system doesn't reject the fetus, which is, after all, an immunologically foreign body.

Some other big questions have barely been touched. It's now quite clear, for instance, that the immune system is influenced in very profound ways by other systems in the body, especially the nervous system. How these two complex systems relate and how those interrelationships are controlled remains largely uncharted territory. (I always tell my students that everything in biology is connected to everything else—we just don't understand all the connections yet.)

One of the things I find attractive about immunology as a field is that it can accommodate so many kinds of biological curiosity—from the very basic to the very applied, from the genetic to the structural. The immune system can be meaningfully explored at many levels.

These are basic biological matters. Immunologists will also have important roles to play in applied biology, developing new medical technologies such as gene therapy and xenotransplantation.

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Do you have any final words of advice?

Well, I guess I would say that it's a long road from where your readers are now to where I am, and it's important to take advantage of what life offers you at each step along the way. I encourage students to develop a range of interests—not just preprofessional ones—while they have the time and opportunity. We all need outside interests for relaxation, to recharge our batteries, and to turn to in hard times. There is a wholeness to life—family and friends, what we do to earn a living, what we do to enjoy ourselves—and all aspects are important in shaping us and preparing us for what is a lifelong journey of discovery.

If I had it to do over, the one thing I might do differently would be to spend my Rhodes scholarship studying literature. I'm a great fan of Shakespeare, and I gave serious thought to that tempting possibility—what could be better than to study Shakespeare at Oxford? At the time, two years seemed like too much time to give to a non-career-related interest. Now I realize that taking two years out would not have made much difference to my career in the long run. And now that I'm fully engaged in my career, I'll never again have two years to do something like that.

But I really have nothing to complain about. I am tremendously fortunate to have been able to realize my childhood dream. Not many folks can say they are doing what they always wanted to do. What a blessing it is to be able to say that. ■

Selected Resources

Clark, W.R. *At War Within: The Double-Edged Sword of Immunity*. New York: Oxford University Press, 1995.

Cohen, J. "The New Face of AIDS." *Science* 28 June 1996: 1876–1890.

Gorman, C. "Man of the Year: Dr. David Ho, AIDS Researcher." *Time* 30 Dec. 1996: 52–73.

Hall, S.S. *A Commotion in the Blood: Life, Death, and the Immune System*. New York: Henry Holt, 1997.

Nowak, M.A., and A.J. McMichael. "How AIDS Defeats the Immune System." *Scientific American* Aug. 1995: 58–65.

Piel, J., ed. "Life, Death, and the Immune System." (special issue) *Scientific American* Sept. 1993: 52–144.

Related Web Sites

All the Virology on the WWW:
www.tulane.edu/~dmsander/garryfavweb.html

HIV Replication:
www.micro.msb.le.ac.uk/335/335Replication.html

AIDS Pathology:
medstat.med.utah.edu/WebPath/TUTORIAL/AIDS/AIDS.html

For additional related Web sites, see
jhunix.hcf.jhu.edu/~setmentr/links_55.html

The 57th Annual Science Talent Search

Every March the finalists in the nation's most prestigious precollege science competition are invited to Washington, D.C., to be honored for their accomplishments. For two days, the 40 Science Talent Search (STS) finalists exhibit their work to the public, allowing science enthusiasts to talk with young investigators about their projects, passions, and perspectives.

Scan the titles of the STS finalists' projects and you'll sense the range of topics that inspire young scientists. Some are fascinated by the lure of the unknown; others, by a desire to find practical applications of knowledge. This year's top two winners exemplify these two sorts of curiosity.

First-place winner **Christopher Mihelich** studied the behavioral peculiarities of sets of polynomials called quotient rings. Nobel laureate Dudley Herschbach, speaking to *The Washington Post*, likened Chris's work to "stringing together DNA molecules, then studying what kind of critter emerges. It is a subtle kind of a mathematics and quite extraordinary for a high school kid to be doing."

Why was Chris interested in these mathematical exotica? "Such quotient rings have connections to string theory," Chris observes, "but I haven't studied enough physics to understand those applications. I just found the problem an enjoyable challenge. One pleasurable aspect of mathematics is the sense of exploring territory that is at once familiar and unfamiliar. Sometimes as one reads a proof, one feels as if on a wild goose chase, following paths that are going nowhere. Then suddenly the last step makes everything fall into place, and one feels surprised, delighted, and perhaps as mystified as ever."

STS finalist Michael Lee talks to visitors.

Mystified by more pragmatic matters, second-place winner **Ravi Shah** focused on a problem with immediate implications: the means by which some tumor cells elude treatments intended to destroy them. "Even after surgery, radiation, and chemotherapy, some malignant glioma cells survive to launch a second, fatal attack on the patient," Ravi explained. How? In part by activating self-correcting mechanisms built into healthy cells. "Normally, it's advantageous for a cell to have enzymes that find and correct damage to its DNA. But when that damage is intentional—as it is in the case of radiation and chemotherapy—those repair enzymes reduce the effectiveness of the treatment. We wanted to better understand how glioma cells achieve their resistance to such therapies."

Working at the Barrow Neurological Research Institute in Tempe, AZ, Ravi showed that a specific DNA repair system may mend chemotherapy-induced DNA damage, thereby enabling glioma cells to escape destruction. "We are now beginning to test whether chemotherapy is more effective when this DNA repair pathway is inhibited. It's incredibly exciting to know that my research may have a real impact on cancer treatment."

Whether they venture into abstract or applied realms, the STS finalists show just how far curious—and dedicated and resourceful—young investigators can go. ■

This Year's Top Honorees

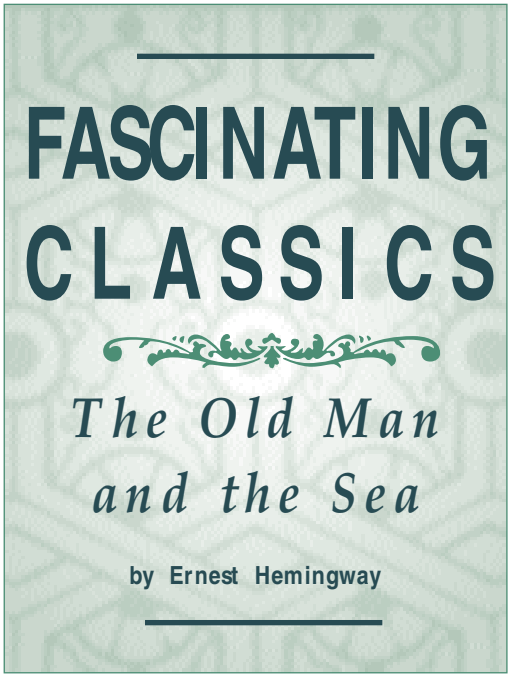
In addition to public recognition, STS finalists win scholarships. First-, second-, and third-place winners receive $40,000, $30,000, and $20,000, respectively. Fourth- through sixth-place winners receive $15,000. Seventh- through tenth-place winners receive $10,000. The remaining 30 finalists each receive $1,000 scholarships.

This year's top winners and their projects were:

1. **Christopher Mihelich**, 16, of Carmel, IN. *Structure of a Polynomial Quotient Ring Involving Symmetric Polynomials.*
2. **Ravi Shah**, 17, of Tempe, AZ. *Nucleotide Excision DNA Repair: Novel Implications in Therapy Resistance in Human Malignant Gliomas.*
3. **Parker Conrad**, 17, of New York, NY. *Changes in Functional Receptors on the Post-Synaptic Neuron During the Maturation of an Identified Synapse.*
4. **Sohini Ramachandran**, 15, of Fair Oaks, CA. Homo sapiens *and* Arabidopsis thaliana: *Mathematical and Computer Intensive Studies of Geographic Molecular Variation.*
5. **Travis Schedler**, 17, of Carbondale, IL. *Construction and Properties of Set-Theoretical Solutions to the Quantum Yang-Baxter Equation.*
6. **William Greenleaf**, 18, of Rochester, MN. *Artificial Cavitation Nuclei Significantly Enhance Acoustically Induced Transfection.*
7. **Ann Kromsky**, 17, of Corona, CA. *Computational Model of Child Memory: Memory Acquisition Without Biological Constraints.*
8. **Jonathan Kelner**, 17, of Old Westbury, NY. *Universality of the Near-Zero Microscopic Eigenvalue Spectrum of Random Matrix Ensembles of Infinite Variance.*
9. **Patrick Goodwill**, 17, of Plano, TX. *Development of a Novel Silicon/Diamond Sensor for Trace Metallic Contaminant Detection in Wafer Processing Chemicals.*
10. **Jesse Anttila-Hughes**, 17, of Bronx, NY. *Computer Model of the Transmission of an Action Potential at the Neuro-Muscular Synapse in a Myasthenia Gravis Patient.*

For more about the STS and all the finalists' projects, see: www.sciserv.org/weststs.htm

Review by
Lesley Mackay & Charles Beckman



Charles: *The Old Man and the Sea* is a great book to discuss because it's quick and accessible. You can read it in just a few hours. Hemingway's two significant characters (not counting fish)—the old man and his former fishing partner, the boy Manolin—meet at the fisherman's shack at the beginning of the novel and reunite there at the end. The heart of the narrative shows the determined old man sailing out into deep seas, where he gives himself entirely to a three-day battle with a huge marlin.

Lesley: The old man, whom Hemingway occasionally refers to by the name of Santiago, used to fish with Manolin. However, he has become so stigmatized in his fishing village by a run of bad luck—84 days without a fish—that Manolin's parents have insisted that their son go out with other fishermen. So Manolin appears in the morning to awaken Santiago, to cheer him, to make sure he has coffee, and to accompany him out to his boat, but Santiago sails alone. The narrative follows the old man's superhuman attempt to reverse his misfortune, to redeem himself by catching a great fish.

Charles: The action unfolds in the waters off Cuba, a setting so stripped down that it barely registers. I think that in this story Hemingway relies very little on traditional devices of fiction like setting, plot, and character.

Lesley: Hemingway's narrative elements can seem pared down and minimalistic. But I think they seem so because they have been inflated so much that they are massive and, at times, hard to see. The book's oceanic setting is perhaps the clearest example of Hemingway's use of outsize story parts. His hypnotic descriptions of the Gulf Stream waters emphasize the sea's power and, by contrast, point to the fragility of man:

> *The water was a dark blue now, so dark that it was almost purple. As he looked down into it he saw the red sifting of the plankton in the dark water and the strange light the sun made now. He watched his lines to see them go straight down out of sight into the water and he was happy to see so much plankton because it meant fish. The strange light the sun made in the water, now that the sun was higher, meant good weather and so did the shape of the clouds over the land. But the bird was almost out of sight now and nothing showed on the surface of the water but some patches of yellow, sun-bleached Sargasso weed and the purple, formalized, iridescent, gelatinous bladder of a Portuguese man-of-war floating close beside the boat.*

The appearance of the word "now" in almost every sentence enhances the lulling effect of this passage, which reads like a series of lapping waves. It also emphasizes that, as the fisherman gets closer to the biggest fish he has ever hooked, he moves into the heart of the present.

Charles: I agree, Lesley, that Hemingway's minimalistic narrative creates a sense of vastness and universality. His elderly fisherman, Santiago, is an epic character like the warriors and kings of classic literature. The old man's vulnerability arouses our compassion, but from the very beginning of the novel, Hemingway hints at his heroic nature:

> *The old man was thin and gaunt with deep wrinkles in the back of his neck. The brown blotches of the benevolent skin cancer the sun brings from its reflection on the tropic sea were on his cheeks. The blotches ran well down the sides of his face and his hands had the deep-creased scars from handling heavy fish on the cords. But none of these scars were fresh. They were as old as erosions in a fishless desert.*
>
> *Everything about him was old except his eyes and they were the same color as the sea and were cheerful and undefeated.*

Lesley: I, too, love that passage, with both its great physical description of a person who is old and its hints of enduring vitality. The passage prepares us for the novel's major confrontation in which the old man takes part in a battle so great that it forces up all the paradoxes of his nature: He finds that he is both aging and ageless, frail and powerful, insecure and confident, humane and destructive, vanquished and triumphant.

Charles: It's interesting to speculate how autobiographical Hemingway's portrait of the fisherman was. The author loved Cuba and the water, and both in life and in his fiction, he returned again and again to scenes in which men struggle for survival and conquest (for example, he was devoted to attending bullfights in Pamplona, Spain, which he wrote about in his novel *The Sun Also Rises*). Furthermore, Hemingway both felt and was interested in the deep tensions within human nature. For example, sketching the characters of men with strong, silent, masculine demeanors, he often shaded sensitive, troubled personalities underneath. As you point out, in Hemingway's portrait of the fisherman, the contradictions become so

Images of Redemption in *The Old Man and the Sea*

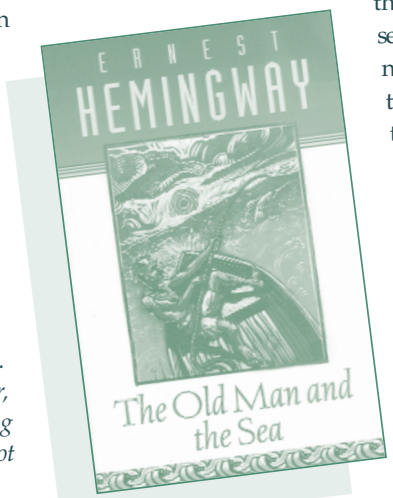
Ernest Hemingway was born in the Midwest in 1898. At 18 he became a volunteer World War I ambulance driver based in Italy; later, he moved to Paris, joining a group of American drifters, a "lost generation" disconcerted by war and unsure of the future.

In Paris, Hemingway wrote short stories and novels that articulated the modernist sense that human life may ultimately lack meaning. However, while exploring and popularizing a bleak sense of "nothingness," Hemingway also brought to his writing more positive values, adopting a sometimes Romantic appreciation of nature and espousing human qualities such as courage, empathy, and "grace under pressure."

After World War II, Hemingway moved to Cuba with his fourth wife. In 1952, two years before he won the Nobel Prize in Literature, he wrote *The Old Man and the Sea*. Into its patterns of light and dark he wove love of nature, dread of solitude and death, and, perhaps surprisingly, a vivid intensity of experience conveyed in part through ideas and images from Roman Catholicism.

strong that they emerge thematically. I think it's safe to say that this novel is the product of a great deal of introspection.

Lesley: The novel gains its introspective quality in part through Hemingway's narrative technique. He tells *The Old Man and the Sea* in the third person, through a narrator who is not a participant in the action. This narrator is partially omniscient—not merely an observer who records what the fisherman does and says, but one with insight into the fisherman's thoughts and feelings. The narrator knows, for example, that Santiago finds the early morning sun painfully bright, that he believes that killing a great fish is unjust, and that in his dreams he returns to an African beach where lions lie about on the shore, a magnificent scene he remembers from an earlier fishing trip.



The narrator keeps us attuned to Santiago's thoughts and feelings by re-creating them in an interior monologue that, intermingling with the plot, ebbs and flows throughout the book. For example, midway through the narrative, Santiago contemplates the amazing marlin he has hooked as it swims alongside the boat, and muses about whether he will ever pull it in:

> *You are killing me fish, the old man thought. But you have a right to. Never have I seen a greater, or more beautiful, or a calmer or more noble thing than you, brother. Come on and kill me. I do not care who kills who.*

Charles: Santiago's fabulous marlin, like Captain Ahab's great whale, Moby Dick, in Melville's novel, is not so much a fish, but a Fish, an animal as replete in symbolic power as it is in natural strength.

Hemingway foreshadows the old man's encounter with this magnificent creature: sailing out, Santiago observes that it is fall, the season of "the truly big fish" that are hardest to reel in, that can bring the greatest glory. Hours later, he hooks an animal that is more fish than he had ever dreamed of. I think the marlin is the perfect expression of the natural world and of its ultimate indifference to human desires.

Lesley: I agree that the fish represents those things. But I believe that the novel offers a more hopeful vision than the fish suggests.

Charles: Really? To me, this novel reflects an uncompromising perspective. I don't want to give away the unexpected resolution of Santiago's struggle with the fish, but I do think that the book suggests that the enormous effort of a human being, in the words of Hemingway's tough-guy contemporary Humphrey Bogart, doesn't amount to a hill of beans.

Lesley: That reading seems stark to me—it fails to account for the important victories won by the protagonist. Santiago is a hero, a man who goes to the limits of his own capacity while facing down the world's indifference. He does this with tremendous grace: instead of regretting his old age, his growing frailty, his long run of bad luck, or his lost reputation, he embraces the perilous and exhausting test that faces him. I think he surpasses the example of his hero, the baseball player Joe DiMaggio, whose strength, craftsmanship, and consistency he praises as he sails out into deep waters.

Hemingway does make it clear that Santiago cannot prevail against all the challenges thrown at him by the ocean. Yet he convinces me of the value of Santiago's attempt to move up the hierarchy of nature by stealing a great fish from the sea. Furthermore, the novel proposes meaningful alternatives to the full victory that Santiago craves: dedication and excellence in one's work; love, even of the terrible beauty of the universe; and human community.

Charles: Community is an important theme in this novel, which offers a rich meditation on the possibilities and problems of solitude. Santiago sails out utterly alone. For just a moment, he imagines how much better it would be to fish with a radio, listening to the baseball games he so loves. But Santiago cannot afford food, let alone a radio, and his poverty both reinforces and represents his alienation from the community. He imagines that this loneliness can never change: "No one should be alone in their old age," he thinks, before adding, "But it is unavoidable."

Lesley: However, in the course of the novel, Santiago's relationship to his community does change. The town searches for him "with coast guard and with planes" when residents realize that he has not returned at night. And when he does return, with remains of the massive marlin on the side of his boat, the community understands that the old man has done well in a monumental battle. Santiago then regains stature and the interest and compassion of others. Best of all, he regains an important partnership when Manolin decides to return to his boat: "We will fish together now for I still have much to learn," the young boy says with kindness and wisdom, in full knowledge of the old man's integrity and greatness. ■

Lesley Mackay

Charles Beckman

Critics have pointed out that Santiago can be compared to Christ or to saints and martyrs in his intense suffering, his alienation from the world, and his faith in the possibility of redemption. He prepares himself for his meeting with the marlin with fervor, starving himself and meditating prayerfully on the beauty around him. During the course of the novel, he sustains wounds that mirror those of Christ. Through his noble fight with the fish, he attains a kind of resurrection, returning to his village with an inspiring story to tell.

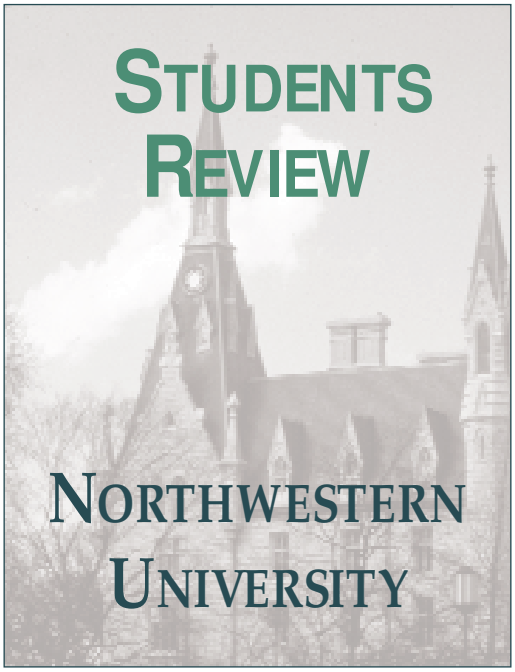
Hemingway was born a Methodist but said that he had been won over to Catholicism when a priest ministered to him after he was wounded in World War I. However, Catholicism was just one of many philosophical and aesthetic sources from which he drew as he gave expression to the meaningful and the meaningless, the possible and the impossible, the bright and the shadowed.

Upcoming Fascinating Classic:

J.R.R. Tolkien, *The Hobbit*.

The College Review Series is intended to aid prospective college students in their search by offering insiders' views of selected colleges and universities, as expressed by current undergraduates or recent graduates who have high academic ability. Note that the number of reviewers is small. Consider their personal perspectives as only one component as you gather information and impressions from many sources.

STUDENTS REVIEW



NORTHWESTERN UNIVERSITY

Our reviewers include eighteen students, who major(ed) in American studies (1), biology (1), biomedical engineering (2), communication studies (1), computer science (2), economics (1), geology (1), integrated sciences (2), international studies (1), journalism (1), materials science (1), math (3), mechanical engineering (1), music composition (1), music theory (1), neurobiology (1), physics (1), political science (1), and sociology (2). (The number of majors exceeds eighteen because several students completed double majors.)

Quality of Academic Instruction for Undergraduates

Northwestern University (NU) houses six undergraduate schools: Arts & Sciences, Journalism, Speech, Music, Engineering, and Education & Social Policy. Students may complete degrees in more than one school. NU also offers a number of prestigious special-focus programs including the Integrated Science Program and the Honors Program in Medical Education.

"NU is large enough to attract some of the best research and teaching professors in the country, but small enough to offer students access to this prestigious faculty. With a minimum of effort, you can regularly find stimulating classes taught by fantastic professors who are accessible and genuinely concerned with undergraduates."

"NU offers a number of exceptional special programs. The Integrated Science Program (ISP) is a carefully constructed curriculum emphasizing the common bases and the interrelationships between the physical sciences and mathematics. Taught by some of NU's best science faculty, ISP courses are extremely rigorous and packed with challenging content. The quality of instruction is, with few exceptions, superb. Classes are small—about thirty students in the first year and no more than fifteen in upper-level classes."

"The Honors Program in Medical Education (HPME) is an accelerated, combined B.A./M.D. program—three years for the B.A., then four years of medical school. Knowing that you have a guaranteed place in med school takes a lot of pressure off, especially in 'weed-out' classes like organic chemistry. One drawback is that the accelerated curriculum affords little choice in major courses and no room to take unrelated courses. You must also be sure of your major when you start; there's no time to dabble."

"NU's Medill School of Journalism has the finest undergraduate journalism program in the country. Every class makes you feel like you have a lot to learn—and you do! But professors are always willing to talk, to offer advice on job or internship searches, or to refer you to others who might be helpful. You really feel like you are in a network at Medill, one that includes not only the faculty, administration, and current students, but also thousands of alumni and professionals in the field—all there to provide help and guidance when needed."

"Medill's program requires its students to diversify; two-thirds of our classes must be taken outside the journalism school. This helps us develop the knowledge base we'll need to be good journalists and also allows us to focus on another subject area that interests us."

"The engineering core curriculum offers a lot of flexibility and allows students to have a liberal arts education as well as a technical one. We must complete a coherent, self-selected group of liberal arts courses. You can design your 'theme' (as this requirement is called) around anything that interests you as long as the courses are demonstrably related."

"In addition to excellent arts & sciences, journalism, and engineering programs, NU has an amazing theater program in the School of Speech. Speech is home to several of NU's strongest programs, including communication studies, radio/television/film, theater, and communication sciences & disorders. We also have one of the top music schools in the country. Many music students complete dual degrees with the other schools; it's not uncommon to meet opera/neuroscience or harp/astrophysics double majors."

"As a student in the Music School, I benefit from having the rest of the university to draw upon. I have many more resources available to me than I would at a conservatory. The opportunity to study art history, drama, literature, poetry, or anything else is a big plus."

"I came here as a music and engineering student. While I have since dropped my computer science major, it got me interested in music technology. This sort of cross-pollination is a great feature of NU. I've found many students who have several divergent interests, which makes the campus population well-rounded and interesting."

"An important fact about NU is that it runs on the quarter system, which is much more intense than a semester system. We have three sets of finals per year. With a normal course load being four courses per quarter, this system helps us cram more courses into our college years."

Social Life

NU's social life reflects the interests of the diverse student body, while nearby Chicago supplements the extracurricular options.

"NU's setting on Lake Michigan is absolutely gorgeous. In warm months, students are found rollerblading, playing volleyball, and relaxing on NU's private beach. In addition, Chicago's glorious, inexhaustible resources are just a train ride away. With everything from world-class museums, music, and sports to ethnic neighborhoods and restaurants, Chicago is a gold mine."

"Basically, if you want it, it's there. The El-train into Chicago is cheap and accessible, and greatly expands the social options. Clubs are widespread in Chicago (although not in Evanston). Evanston, a small, lovely town, is not at all a typical college town. It has a very conservative feel, and it closes at 6–7 pm, so 'late night' (after 8 pm!) opportunities are limited."

"Well, NU is not exactly a party school, although there is definitely fun here if you look for it. The Greek system is huge but not exclusive. Social life is split between two campuses: North Campus has the fraternity quads and the athletic center, so it's very sports- and Greek-oriented, while South Campus is where the more artsy students traditionally live. On weekends, you can definitely find a frat party, but you can probably also see two or three student-produced plays if you want."

"Most students live in dorms their first two years, then off-campus or in Greek housing after that. There are also Residential Colleges (RCs), which provide an important alternative to both dorms and Greek housing. Each RC has an academic theme—science & engineering, public affairs, international studies, performing arts—and sponsors many functions organized around its theme. RCs are exempt from the lottery system that assigns scarce on-campus housing slots to upperclassmen. Instead, housing assignments are based on the number of points an individual accrues for contributing to his or her RC (by organizing an RC-sponsored lecture series, for example). The RC system strives to foster an academic atmosphere in its living units."

"NU's special programs (ISP, HPME, the American Cultures program, and Mathematical Methods in the Social Sciences, to name only a handful) provide close-knit, supportive social communities for program members."

What Do You Like Best about Northwestern?

"The solid career preparation. NU produces really 'together' graduates."

"The opportunity to pursue all my interests. With its six schools, NU makes it easy to pursue diverse interests. A chemical engineering major who plays the piano can take private lessons in the School of Music. A history major who loves to dance can take classes at the School of Speech. At no time does the administration tell students they must make a choice. All doors are open and inviting."

"ISP. It offered me exceptional career opportunities and the chance to meet many stimulating peers and faculty. Through it, I completed bona fide research projects in chemistry, physics, and mathematics—a feat simply not possible outside of ISP."

What Do You Like Least about Northwestern?

"The weather and the endless winters! As I write this, it's May 28th and maybe 40°F outside—definitely something to consider, since students must walk or bike everywhere. Also, the atmosphere sometimes seems too competitive. It feels like no one takes time to just chill out and relax. It's good that everyone's so motivated, but it can be stressful."

NORTHWESTERN UNIVERSITY

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"The quarter system is incredibly demanding. Three weeks into the quarter, midterms begin, and from then until the end of the semester, hardly a week goes by in which you have no exams to take. Although this can be a plus when you consider how many more courses you will take compared to students at semester-system schools, it's a huge negative in terms of the amount of stress you will be under and the amount of work you will have for the majority of the quarter."

Who Would Be Most Compatible with the Academic and Social Atmosphere at Northwestern?

"NU students tend to be highly motivated, extremely career-oriented, slightly conservative, and Midwestern. There are few trendy dressers or people with unfriendly attitudes."

"Most students here are preprofessional and tend to be more pragmatic than deeply curious. Few want to study a subject for its own sake; there's always an ulterior motive. NU is thus a studious but not a highly intellectual campus. Through the RCs and some of the special programs, however, you can find more intellectually inclined peer groups."

"The students likely to get the most out of NU are those in the special programs, which offer exceptional educational opportunities. Their curricula hold their own when compared to those at any university in the U.S."

If You Had It to Do Over Again, Would You Go to Northwestern?

All but one reviewer (who was unhappy with his major department) were very satisfied with NU.

"Absolutely. NU is a tremendous institution to which I owe much of my current success. My years there were a time of intellectual growth, challenge, stimulation, and frustration that defines me more than any other period of my life. And this serves as a perfect definition of a successful undergraduate experience."

"Definitely. You can find excellent academics elsewhere, but the location—on the shore of Lake Michigan and in the shadow of Chicago—is prime. Having grown up in the East, my horizons have been broadened by living in the Midwest, which has its own distinct flavor. I simply love the warm, understated manner so common here."

"Actually, NU was not my first choice. When I came here, I almost had the attitude that NU had something to prove to me. It has impressed me and gone beyond that—I went from a skeptic to an enthusiastic advocate. I feel that NU has been the right place for me because of the wide range of opportunities it offers. And I loved getting to know Chicago."

As you try to find the college or university best suited to you, the views presented above may be helpful. Keep in mind that these students might have had similar positive or negative experiences had they attended a different school. At any college, it is important to seek out challenging academic experiences and to create a social life that fits your personal style. ■

Note: The students quoted in the College Review Series are expressing their own views, which are not necessarily those of JHU or IAAY.

PLANNING AHEAD FOR COLLEGE

Visit Colleges This Summer

by Linda E. Brody, Ed.D.

Virtual college visits have become a reality. Videotapes and the Internet bring images of life on campuses around the country into your home. As you scan the net and view the videos, read about colleges in books and catalogs, and talk to college-aged friends and siblings about their experiences, you will have much of the information you need to decide whether a college is right for you. But a personal visit is the only way to get a real feeling for life on a campus.

It's clearly better to visit colleges when classes are in session than in the summer. Although some colleges offer summer sessions, many empty out so that you are left evaluating the campus facilities rather than students' experiences at the college. But since your school work and activities can make it difficult to get away during the school year, it can be useful to make preliminary visits during the summer to a wide variety of colleges. Then, you can return when classes are in session for a second visit to those that really interest you.

Getting the Most out of Summer Visits

Before you visit a college or university, do your homework. Learn about the school and think about concerns you have about that college. Identify questions you want to ask.

Call the admissions office in advance to find out about scheduled tours and group information sessions. Tours are usually led by students who are very knowledgeable about the facilities as well as about student life on campus. Don't hesitate to ask questions as you tour the campus. Group information sessions are also valuable for learning about the college. Often led by a member of the admissions office staff, these sessions can give you insight into the way admissions and financial aid decisions are made at that college or university.

As you walk around each campus, take in the atmosphere. Also visit the surrounding community. How comfortable do you feel? What characteristics of the college environment contribute to your comfort or lack of comfort? Begin to answer such questions as: Do you prefer a college in an urban or rural area? Do you like a small or large campus? Does the presence of on-campus security make you feel secure or nervous? Do you prefer a particular type of housing? If something affects you in a negative way, evaluate that aspect carefully in the next college you visit.

It's fun to build a summer vacation around college visits. Depending on the college's location, you can enjoy the ambiance of a small town or an urban center as part of your visit and plan activities accordingly. Many colleges have historic buildings and museums on campus, and there may be historic sites nearby. Visit the college bookstore. Explore local shops. Eat in an outdoor café. Investigate local tourist attractions. A tour of colleges can be an excuse to visit a part of the country that you've never seen and can provide for a wonderful vacation for the whole family.

If your summer plans are already made, consider including some college visits in your plans. Even if your first-choice colleges are not located where you will be traveling, visits to any college can help you define aspects of campus life that are important to you.

Because it's summer, you might be tempted to dress very casually for your campus visits, and you will see other prospective students in shorts, t-shirts, and tennis shoes. Nonetheless, it's advisable to dress more appropriately. You want to give the impression that this visit is important to you and that you care what the people you meet think about you.

Interviews

Even if you haven't applied to the college you're visiting, you can arrange to have a personal interview with a member of the admissions office while you're on campus. It's another way to get information about a college, and it is often easier to get an appointment in the summer than during the school year.

Colleges vary in whether they require personal interviews and to what extent interviews affect admissions decisions. Some offer interviews conducted by alumni in your local community. In general, the trend is to offer interviews to help answer students' questions but not to weigh them heavily in the admissions process. An interview may be required and more important for certain applicants such as Early Decision candidates or young applicants.

Return Visits when Classes are in Session

Most campuses look quite different during the school year than in the summer. Students rushing to class, meeting in groups on campus, and hanging out in cafés will make the atmosphere seem much more alive. Once you've narrowed your college choices, a more in-depth look during the school year is important. You should probably stay two days, including an overnight stay in a dorm.

Talk to students. Attend classes. Hang out where students hang out. See what they do in their free time. Schedule appointments with faculty members in your areas of interest. Meet with people who work in activities in which you hope to become involved, such as coaches, newspaper editors, or orchestra leaders.

Visiting colleges requires a serious time commitment. But by scheduling your initial visits during the summer, you can reduce the number of visits you need to make after school begins. ■

THE COACH'S CORNER

by Chengde Feng

Mr. Feng teaches mathematics at the Oklahoma School of Science and Mathematics (OSSM) and has coached many students who have competed successfully in mathematics contests in China and the U.S. In this column, Mr. Feng offers Imagine *readers questions designed to improve their problem-solving skills.*

PROBLEMS

1. Let m, n, p, and q be nonnegative integers such that $\frac{(x+1)^m}{x^n} - 1 = \frac{(x+1)^p}{x^q}$ for all $x > 0$. Find $(m^2 + 2n + p)^{2q}$.

2. Given that $a > 0$, $b > 0$, and $a^3 + b^3 = 2$, find the maximum value of $a + b$.

3. Given that the two distinct positive roots of the equation $ax^2 + bx + 1 = 0$ are both less than 1, where a and b are integers, find the smallest possible value of a.

SOLUTIONS

1. Substituting $x = 1$: $2^m - 1 = 2^p \Rightarrow m = 1, p = 0$

$$\Rightarrow \frac{x+1}{x^n} - 1 = \frac{1}{x^q} \text{ for all } x > 0 \Rightarrow x^q(x + 1 - x^n) = x^n \text{ for all } x > 0$$

Substituting $x = 2$: $2^q(3 - 2^n) = 2^n \Rightarrow n = 1, q = 1$ (why?) $\Rightarrow (m^2 + 2n + p)^{2q} = 3^2 = 9$.

2. Alternative 1: If $a = b$, then $a = b = 1$, and $a + b = 2$. (1)

If $a \neq b$, let $a > b > 0$, since $a^3 + b^3 = 2 \Leftrightarrow 1 - b^3 = a^3 - 1$

$$\Leftrightarrow (1 - b)(b^2 + b + 1) = (a - 1)(a^2 + a + 1)$$

then $\frac{a-1}{1-b} = \frac{b^2+b+1}{a^2+a+1} < 1$ or $a - 1 < 1 - b$ (is $1 - b > 0$?) or $a + b < 2$. (2)

(1) (2) $\Rightarrow$ The maximum value of $a + b$ is 2.

Alternative 2: By the A.M.–G.M. Inequality, $a^2 + b^2 \geq 2ab$

$\Rightarrow (a + b)^2 \geq 4ab$ or $ab \leq (a + b)^2/4 \Rightarrow (a + b)^3 = a^3 + b^3 + 3ab(a + b) \leq 2 + 3(a + b)^3/4$

$\Rightarrow (a + b)^3/4 \leq 2 \Rightarrow a + b \leq 2$, and $a + b = 2$ if and only if $a = b = 1$.

3. Let x_1 and x_2 be the two roots with $0 < x_1 < x_2 < 1$.

$\Rightarrow x_1x_2 = \frac{1}{a} > 0$, $x_1 + x_2 = -\frac{b}{a} > 0$, and $b^2 - 4a > 0 \Rightarrow a > 0$, $b < 0$, and $b < -2\sqrt{a}$ (1)

$0 < x^2 < 1 \Rightarrow 0 < \frac{-b + \sqrt{b^2 - 4a}}{2a} < 1 \Rightarrow 0 < -b + \sqrt{b^2 - 4a} < 2a \Rightarrow b < \sqrt{b^2 - 4a} < 2a + b$

$\Rightarrow b^2 - 4a < 4a^2 + 4ab + b^2 \Rightarrow -4a - 4a^2 < 4ab \Rightarrow -(1 + a) < b \Rightarrow b \geq -a$ (2)

(1) (2) $\Rightarrow -a \leq b < -2\sqrt{a} \Rightarrow -a < -2\sqrt{a} \Rightarrow a > 2\sqrt{a} \Rightarrow a > 4 \Rightarrow a \geq 5$.

When $a = 5$ and $b = -5$, $5x^2 - 5x + 1 = 0$ has two distinct positive roots that are both less than 1.

Therefore the smallest possible value of a is 5.

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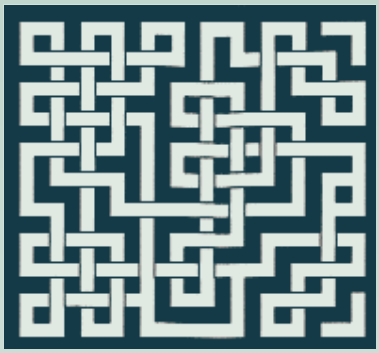
Amanda Brainerd and Janine D'Adamo are students of Lyn Ostrov at Friends School in Baltimore. Next fall, Amanda will attend Carnegie Mellon University, and Janine will attend the Pratt Institute.

Linoleum Block Print by Amanda Brainerd

Ceramic and Photograph by Janine D'Adamo

Ceramic and Photograph by Janine D'Adamo



Knossos Games

by Tim Boester

After completing his undergraduate studies at the University of Chicago this spring, Tim Boester will continue his mathematical pursuits next year as a graduate student at the University of Wisconsin.

Congratulations, *Imagine,* on finishing your 5th year.

The Goal:

Go from **Start** to **Finish** by jumping the number of squares designated within each square on which you **land**.

The Rules:

Each move must travel a straight line horizontally or vertically, not diagonally. Use only the numbers in the squares that you **land on**.

								S→ 3	2	3	1	6	3
2	1	4	6	2	2	2	2	6	2	1	2	2	2
1	7	1	8	1	1	1	1	4	3	5	5	3	4
2	1	5	5	5	5	5	5	5	5	5	5	2	3
2	3	5	5	5	5	5	5	5	5	5	5	6	3
4	3	5	5	5	5	5	5	5	5	5	5	7	6
3	2	6	4	4	5	5	5	5	5	5	5	4	6
F	2	1	6	2	5	5	5	5	5	5	5	1	4
			2	1	5	5	5	5	5	5	1	2	4
			3	6	5	5	5	5	5	6	7	8	2
			8	3	2	3	5	5	5	1	2	7	
			4	1	3	4	5	5	4	2	1		
					1	2	1	1	2	1	2		
					2	1	2	2	1	2			

Solution to Knossos Games in our March/April issue:

The numbers show the order in which the rooms are visited in the solution path.