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**A Word From Our Director
by Patrick Gannon, PhD**



2001: A Space Research Odyssey represents a new approach towards the design and formulation of an educational outreach strategy. A cross-section of teachers and students have been recruited from select New York City high schools. These individuals are commissioned to interact as partners with space biomedicine scientists at Mount Sinai School of Medicine and provide their unique perspectives as high school teachers and students.

Defying Gravity, the three-year educational outreach project of which *2001* is but the first phase, seeks to draw on the expertise of professional educators by considering their perspective on bridging the gap between cutting edge space biomedical science and the first stages of science education.

Questions presented to teachers for consideration have been designed to enable them to guide and advise scientists in the creation of content. These include: "What would you consider appropriate material for classroom lessons with the objective of meeting both grade-level and science education standards," and "what factors would provide compelling incentives for students to better understand the relevance and

The Defying Gravity Educational Outreach Program is funded by the National Space Biomedical Research Institute (NSBRI #).



Inside:
Web Ed, Dr. Martin Weiss, spinning with Dr. Moore

Studying Radiation and Genetic Mutations



Dr. Rosenstein studies the effects of radiation and genetic predisposition to cancer.

Venturing beyond the Earth's protective blanket, the ozone layer, can be pretty dangerous business. This is because the ozone layer shields us from harmful radiation. Those who often travel on airplanes, such as airline crews and frequent fliers, are exposed to greater amounts of radiation. Astronauts on long journeys are at an even greater risk of being exposed to harmful radiation.

"Once one is in space and away from our the protective atmosphere there can be

a much larger exposure to radiation," said Dr. Barry Rosenstein, a radiation biologist in Mount Sinai's radiation oncology department and one of the scientists participating in the Defying Gravity program. These are mostly particulate forms of radiation such as high-energy protons and heavy ions from stars found in space, said Rosenstein, "we're exposed to a little of this type of radiation on Earth but not a whole lot."

The National Space Biomedical Research Institute is especially interested in studying the exposure of astronauts to cancer-causing radiation as it investigates sending a crew on a three year journey to Mars. The NSBRI is looking to the research of scientists like Dr. Rosenstein, who studies the effects of radiation on the human body, and to its own Radiation Effects Team which researches if the forms of radiation in space are critical to the production of cancer. These researchers are trying to learn whether or not its safe to send a crew to Mars and what countermeasures should be taken to protect them.

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Sharing Information Using Web Ed with Merrill Schindler

Web CT is a program that was developed by a math teacher to improve communication with students and to facilitate the dissemination of class materials. The instantaneous communication, eco-friendly electronic hand-outs, and sheer ease of transmission over the electronic waves of the Internet quickly caught on among peers and soon a new company was formed around the novel computer program.

That was several years ago. Now, after eons in cyber-years, various Web CT-like programs exist, all with one objective - to provide an application that aids in building a website, but requires no programming. All the user needs to do is input the desired content. Web CT is a framework; it provides the tools with which to create a comprehensive information system.

Guided by the knowing hand of



The DG website runs on Web Ed software.

Merril Schindler, Assistant Director of Systems, Mount Sinai has taken the Web CT program and put it to good use. Medical students and doctors now have a central forum in which to present class notes, discussions and new information, without having to learn computer programming first.

Web CT, renamed Web Ed at Mount Sinai, allows the user to present content in various formats. The program sustains

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Dr. Barry Rosenstein Studies Radiation Effects at MSSM

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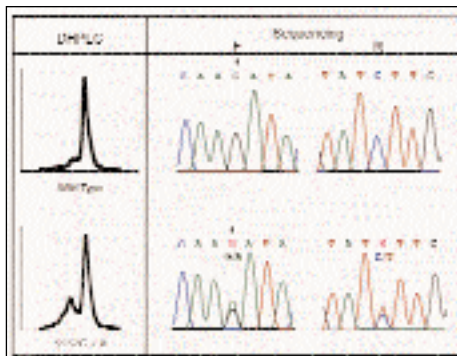
It is estimated that astronauts will be exposed to hundreds of times more radiation than they are exposed to on Earth. This can cause cell death, tissue damage, cancer causing mutations, vision problems and damage to the nervous system. "NASA has said this could potentially be a show stopper if it's felt that this is such a great risk," said Rosenstein.

Some initial research of the Radiation Effects team has been released, and it seems as though its not that dangerous, said Rosenstein. "There are concerns, but I don't think this will preclude any potential mission to Mars."

Possible countermeasures being investigated by NSBRI scientists are creating a shielding device for the space shuttle or an electromagnetic propulsion system which would repel radiation particles. Shielding would probably make the shuttle too heavy for space travel though and the electromagnetic propulsion system is very costly. "One of the issues that NASA is grappling with is how much of a concern is there and is it worth it ...in terms of developing this type of costly procedure," said Rosenstein. The Radiation effects team is also researching possible drug treatments that may reduce the effects of radiation exposure.

The NSBRI must also consider if any of the astronauts are genetically more susceptible to radiation effects. This is where Dr. Rosenstein's research may prove useful to the NSBRI. Currently, Dr. Rosenstein is studying a gene that may make breast cancer patients more susceptible to complications of radiation treatment. A small percentage of breast cancer patients undergoing radiation therapy experience moderate to severe skin redness and irritation. Other breast cancer patients develop cancer in the second breast as a result of the radiation exposure. Dr. Rosenstein thinks these women may be genetically predisposed to developing radiation induced cancer. "Our hypothesis is that patients that have one mutated copy of the gene are mildly radiosensitive."

If Rosenstein's hypothesis is correct, women with breast cancer may eventually be screened prior to radiation treatment to determine if they are particularly sensitive to the effects of radiation. Oncologists would then lower the radiation dose or treat the patient with other therapies.



The graph at top left shows a normal, or "wild type," gene. The graph below it shows a mutant version of the gene, as evidenced by the small peak to the left of the main peak. The mutant gene leads to greater susceptibility to the carcinogenic effects of radiation. The graphs at the right show specific base-pairing.

The NSBRI may also need to consider genetic vulnerabilities to radiation exposure when selecting its crew for the mission to Mars. Overall, the task is large with many variables to consider. However, with efforts of scientists at the NSBRI and other radiation biologists, a long mission to Mars is becoming increasingly feasible.

Using Web Ed to Share Information at MSSM

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Merrill Schindler and her computers

Flash animations, HTML and PDF files. Access to users can be restricted so that no Internet junk mail, or "spam" gets through; all mail is directly related to the course, its participants and materials.

Web Ed is fast. Schindler recalled several examples of curricula, presentations and projects that would have taken months to post without the ease of the program.

Another advantage of Web Ed lies in the ability of users to access the site from anywhere. Information can be shared across the world at the speed of fiber optic transmission. So, for example, a Mount Sinai physician working in Alaska can obtain results from research being conducted in New York in a few seconds.

meaning of the lesson to space and earth issues?"

Likewise, similar questions posed to students, such as: "What hooks within the material would generate your interest," and "how would you design classroom activities related to this material that would allow you to pursue a hands-on or inquiry-based experience?" give the students' perspectives on their own education.

2001: A Space Research Odyssey is combining three essential components of comprehensive science education. The scientists represent the culmination of a science education. The high school teacher represents the avenue for knowledge dissemination, and each has been assigned to devise educational and inspirational curricula for the third part of the equation: the student.

The students involved in *2001* provide feedback through their perspective on the information being designed and presented to them. In the future, curricula will be taken to NYC classrooms and a broader level of perspective will be utilized in creating a final, comprehensive, thoroughly tested science education product.

According to Schindler, "communication is the number one factor in making [web-based education and information sharing] a success." The Defying Gravity program is exemplary in communication among participants. DG is "way ahead" in utilizing the full capabilities of the Web Ed program. Weekly calendars, newsletters, surveys integral to discussing curriculum creation, and projects are posted on the Intranet at Mount Sinai using Web Ed. The result is enhanced communication among teams and between program executives and participants.

The speed and simplicity of posting project results, communiques, group discussions and new curriculum developments is helping Defying Gravity and its summer research institute track and record feedback, evaluation and progress. As Merrill Schindler puts it, "[Web CT] is the first piece of commercial software that really makes life easier."

Next Issue:

Curriculum Development with SauLing Chan and Toby Brandriss. Dr. Mitchel Schaffler and Bone Loss in Space. The Return of "Launch" Column.

An Interview With Martin Weiss, PhD, of the NYHS

Before we begin, tell us about yourself.

I came to the Hall of Science in 1990. Prior to that I did research on human malaria (*Plasmodium falciparum*) for my PhD at NYU Medical School and the biochemistry of the hydrogenosome of *Trichomonas* at Rockefeller University. At the Hall of Science I serve as director of science and as the Principal Investigator for the several of the Hall's exhibits and programs: the Microlab Institute program, designed to provide resources for middle school teachers to supplement classroom presentation of microbiology through hands-on activities; the permanent and traveling version of Hidden Kingdoms-the World of Microbes; a traveling exhibition "What About AIDS?"; "Marvelous Molecules-the Secret of Life and the Biochemistry Discovery Lab. Current projects include Molecules and Health and The Search for Extraterrestrial Life.

What are the responsibilities of your position?

I chair the Program Committee which reviews all exhibitions and programs and makes recommendations to the director; develop exhibitions and programs; review science content for the director.

What criteria must an exhibit meet, in your opinion, in order to be sufficiently educational?

Specific exhibitions need to be judged by established Criteria for exhibitions fall into three categories:

- Are the programs desirable: do they further the public understanding of science; deal with appropriate topics; reach specific audiences; use our best understanding of how people learn; make full use of their medium and the capabilities of new technologies; engage people through a variety of styles;

- Are the programs efficient: are they the best means available or would another medium serve better; is the Hall of Science the best place to carry them out or should they be done cooperation with another institution; do they make good use of the funds available;

- Are the programs feasible: can they be funded; are staff, time and facilities adequate to ensure a high quality product; can they be maintained or sustained after the initial start-up?

Exhibits form a major role at science centers and the New York Hall of

Science. Specifically what qualities make them "good"? At their best exhibits can do the following:

- 1) Arouse interest, which is the starting point for learning;
- 2) Facilitate inquiry, the central process to any learning;
- 3) Provide encouragement, the process that started at the exhibition and will continue beyond the exhibit.

What form of exhibit have you found to be the most effective in teaching science?

Interactive exhibits can provide experiences for visitors that are not available in other ways and lead to learning. Especially when they meet the criteria of "good" exhibits (see previous question and answer). While putting real objects on display has been the traditional offering of traditional museums, science centers add to this by making real phenomena and technologies accessible for visitor interaction.

Briefly explain how you evaluate an exhibit for its educational value.

We evaluate exhibitions, and programs, by using the techniques of front end, formative remedial and summative evaluation. Front end helps us determine the scope of the project by exploring visitors interest, knowledge and misconceptions about the topic; front end or prototype tests the individual exhibits or approaches via exhibits and is designed not only to test the exhibit's safety and functionality but to determine whether the goals of the exhibit are being met. Remedial evaluation is designed to find mistakes in label text and errors in fabrication while summative evaluation tests the success of the overall goals of the exhibition.

How long does it usually take to actually develop and then physically build an exhibit?

Timelines for exhibitions vary but in general we spend about one year on development, a bit longer on prototyping, design and producing the necessary drawings and a bit less than a year on development of computer software and videos, fabrication of the exhibition and summative evaluation.

Why and how are museums beneficial to the conventional learning process?

Students and other visitors see us a non-competitive, non-judgmental arena to learn in where they can get expert information. We don't check homework or give grades. In addition, many of our visitors find



Defying Gravity is Making Great Strides in Utilizing Web Ed to its Full Potential

Defying Gravity is working on the Web Ed system at Mount Sinai School of Medicine to create an innovative website. Using the Web CT technology, DG will use its site to present content in various ways, facilitate communication among participants and post the latest research projects, results and discussions.

The structure of 2001: A Space Research Odyssey places students and teachers in assorted laboratories to gather content for curriculum module production. The DG site on Web Ed allows for cross module communication so that information pertinent to any group may be posted by any other group on the website. Direct links to various educational websites and pages as well as reviews can be shared among all members of the summer research institute. In this fashion, the DG website is a centralized repository for freely shared resources.

Within the site, there is a hierarchy of information access. Currently, this allows program directors to monitor daily e-journal entries, surveys, feedback and curriculum development with a guarantee of security for participants. Students and teachers privately view their own contributions and program faculty are able to retrieve the information they need to monitor, evaluate and adjust the program as they see fit.

The Web CT technology used in Web Ed and the DG website works smoothly with other programs such as Power Point, Excel, Flash animation and audio and video streaming. All the capabilities of the World Wide Web are compacted into this comprehensive website. At Mount Sinai School of Medicine, for

example, surgical video clips are available on Web Ed for Continuing Medical Education. Defying Gravity is collecting content to follow in these footsteps.

One of the goals of the DG site is to provide participants with a method of presenting their contributions in an easy and timely manner. Subsequently, their information can be easily collected and reviewed. Furthermore, important information can be supplied to participants without the inconvenience of photocopying pages of material.

Applications for the classroom abound. The dissemination of information can proceed along electronic lines, cutting out unnecessary wasting of time and materials. Communication among students and between teacher and student will be facilitated. Sharing information will lead to discussion and information updates. Research projects can be presented in multi-media format. Ultimately, the linking of scientists with professional educators and high school students will create an electronic community that will further the development of comprehensive science education.



"One Giant Leap for Mankind"

Many in the DG program have a love of space that comes from watching images of the Apollo missions. Many, however, were simply born too late to watch as these events happened. For those, the 1989 documentary *For All Mankind* uses archival footage shot by the astronauts themselves, and numerous sound bites, and retells with easy grace the story of Apollo 11. This beautiful and surprising film is available on DVD from the Criterion Collection; the DVD includes extras such as audio commentary by Apollo 17 commander Eugene A. Cernan, as well as liftoff footage from Mercury, Gemini and Apollo missions.

Applied Technology and New Research at NSBRI

A recent press release by the National Space Biomedical Research Institute revealed that researchers at the NSBRI are developing a virtual-reality training tool to combat disorientation problems that astronauts face when they are in space. "Our bodies are designed for Earth's gravity, and gravity tells our brain which way we are oriented," said Dr. Charles Oman, head of the NSBRI's Neurovestibular Adaptation Team. Without gravity, the structures in the ear which normally tell the brain which way is up and which way is down are unable to function. This can prove detrimental in the event of an emergency when the crew may have to think and move quickly.

The group of researchers, which includes NSBRI and MIT scientists, are developing a virtual-reality apparatus to teach astronauts techniques and strategies to help them navigate through the many compartments of the International Space Station. The Virtual-Reality Orientation and Navigation Trainer is a device mounted on the user's head that displays virtual-reality scenes. Astronauts travel through various virtual paths and then must figure out how to get home. The apparatus tests how they maintain orientation and find their way in a spacecraft.

"You have to use tricks to learn an area's layout, such as choosing distinguishing landmarks. . . within the station that will help you understand your orientation with respect to each module," said Oman. The efforts of the NSBRI/MIT team combined with Dr. Moore's collaborative research on neurovestibular function will hopefully solve some of the major challenges currently imposed on space explorers.

Source: www.newswise.com



Sarah, DG student participant, experiences the thrill of centrifugation in Dr. Moore's lab.

Dr Martin Weiss *Continued from Page 3*

learning in science centers is enjoyable.

With the increase in science and technology in our culture, where do you see the museum (in general) in five to ten years?

I envision most changes to occur in the technologies used in the exhibitions. For example, I envision more advanced interactive computer simulations; use of high definition video; more effective use of virtual visits because of broader bandwidth available for full motion video; use of handheld computers with which visitors will be able to interact with exhibits and demonstrations.

How, if at all, do the goals of the NYHS match up to the national goals to develop new science education standards?

School standards are developed for schools-for longer-term interactions between students and teachers than occurs in a museum setting. However, we do take into account curricula and national standards when we develop exhibitions and programs. Our exhibitions and programs are often looked upon as enriching experiences for students. Although biochemistry is not taught in middle schools chemistry and biology are. By combining them in the Marvelous Molecules exhibition we offer the student another way of looking at chemistry and living things than they might be offered in school.

What do you enjoy best about your job?

I was a research biologist before I came to work at the New York Hall of Science and I still think of myself as doing research. I just speak to a larger audience that when I did research in the laboratory. Each project has its challenges. How do we present the concept of shared chemistry between living things that look so different-bacteria, fungi, plants elephants and humans? This was not easy and through the process of evaluation-which means working with our visitors- we were able to develop ways of interpreting this concept. I enjoy working with a development team and producing an entertaining an informative product. Developing programs for teachers and visitors is another part of what I do and is somewhat different. It involves developing activities to introduce visitors to science and helping teachers develop programs for their students. What I don't always enjoy is writing grant proposals.