MOUNT SINAI SCHOOL OF MEDICINE

DEFYING GRAVITY

ENDURING LIFE IN SPACE

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A Note From Our Co-Director

Nancy Kheck, PhD

As we near the end of our summer institute, the Defying Gravity program faculty are immersed in assessment and evaluation of a creative process and its product. Both are the result of an intensive 5-week push to devise a unique research-based approach to learning science and math at the high school level. The novelty of DG's approach to curriculum development lies in the configuration of the scientist-teacher-student partnership - an experimental formula that hasn't been formally tested. *2001: A Space Research Odyssey* represents the primary interface for this partnership and the design of the individual curriculum modules. While the scientists are contributing content (research data and fundamental background), students function as learning models, provide feedback, and alpha-test the inquiry-based small-group classroom activities.

Teachers play a pivotal role in *translating* these modules into an educational format that is familiar and accessible to other educators (e.g. detailed lesson plans annotated with links to state and national standards, in-class lab and extension activities, discussion guides, etc). The DG program emphasizes that professional educators formulate the strategies for how this research-based material can be successfully imported into the high school classroom and integrated into existing curricula. This partnership and the underlying theme of involving end-users into the design phase may be the key to a successful curriculum.

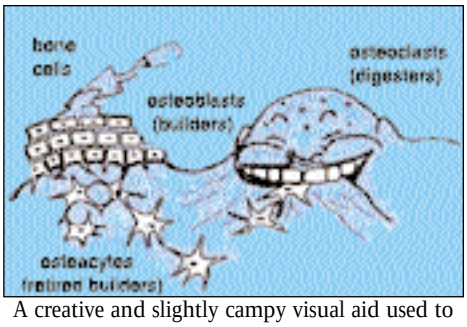
Inside:
Lab Photo Series, Dr. Bernard Cohen, Applied Tech.

The Defying Gravity Educational Outreach Program is funded by the National Space Biomedical Research Institute (NSBRI #00-02-013).

Curriculum Development Speeds Ahead

Tobie Brandriss and SauLing Chan have made exceptional advancements in the development of their curriculum modules. The two educators are from Hunter College High School and the Manhattan Center for Math and Science, respectively. Ms. Brandriss is working with Dr. Mitchell Schaffler, using his bone density research to formulate her curriculum content. Ms. Chan is working with Dr. Patrick Gannon, utilizing his research on taste and smell in space for her content.

To teach her students about the qualities of living bone, Ms. Brandriss asks them to conduct an overnight experiment that compares subject height just before sleep with subject height upon waking. As a body remains upright throughout the day, cartilaginous discs between vertebrae lose fluid due to gravitational force. The result is a slight decrease in height. As a body rests horizontally, the effects of gravity are spread over the entire body and the discs decompress; in the morning, the subject will be taller. This simple experiment shows the students how gravity is constantly working on the human skeleton.



A creative and slightly campy visual aid used to teach students about different bone cells.

Ms. Brandriss continues from this initial experiment, showing X-rays of child and adult hands to show that bone is a living and growing tissue. She uses X-rays of fractured hands to discuss the three basic types of bone cells. Finally, she has her students work in the laboratory with real bone making slides and viewing bone cells to prove that bone is living tissue. Beginning with the inquiry-based experiment measuring height, and accelerating to hands-on lab research, Ms. Brandriss is making impressive headway in developing a curriculum that stimulates students' thought

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Students Adding Their Own Perspective to Curriculum

As the Defying Gravity summer institute draws to a close, Sarah Walters and Adelina Hung, two student participants, are beginning to see their hard work pay off. The two girls are working with teacher Tobie Brandriss and scientist Mitchell Schaffler, who studies bone loss in patients with spinal cord injuries.

Sarah and Adelina said the first couple of weeks were a bit overwhelming and confusing because there was so much information to absorb. "The beginning of the program was a bit tedious because we had to do a lot of background research, but after we finished the grunt work it became more interesting," said Sarah. Both girls agreed that this week was much more enjoyable. The group did hands on research in the lab with Dr. Schaffler.

Their action packed week began when Tobie bought a veal bone from a local butcher. The team then sawed off a thin slice of the bone. Next, Dr. Schaffler demonstrated how the bone is sanded down to a 100 micrometer thick section. Tobie and the students were then able to sand-down their own piece of veal bone. The students said this was the best part of the entire experiment. "Its amazing how you start with something so big and get it down to the width of a piece of paper," Sarah said.

In the next part of the experiment, the team allowed some of the bone sections to dry over night while the other sections were kept in water. The following day the group made slides. The sections that had been soaked in water were stained and viewed under a microscope while the dried bone sections were viewed

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Curriculum Progress Being Made by Teachers and Students

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via action and discovery.

To simulate the effects of microgravity on perceptions of taste and smell, Ms. SauLing Chan and student Nelson Shih have devised an experiment using flavored candies in conjunction with a blocked sense of smell. Subjects close their eyes, hold their nose and try to distinguish flavors. With a decreased sense of smell, such as occurs in microgravity, the sense of taste is distorted or diminished. One experiment participant, for example, could not distinguish between orange-flavored and cherry-flavored candy, whereas another, with sense of smell intact, easily picked out the citrus flavor. The experiment is a hands-on method of teaching the concepts involved in sensory perception and the effect on taste and smell in space.

Using an Acoustic Rhinometer to measure nasal obstruction, Ms. Chan's students have been working in Dr. Gannon's Rhinology laboratory to test their exhalation through nasal passages. Nelson Shih has been the prime subject. He works with the Rhinometer to measure his nasal air flow. In the coming days, Nelson will be placed in a reverse incline of 15^{o}. This simulates the effects of microgravity on blood flow and insterstitial fluids. After remaining in the position for the specified time, Nelson will again measure his nasal exhalation. Through this hands-on comparison, the student will learn the effects of microgravity on the fluids of the human body and the subsequent effects on the nasal passageways.

Ms. Chan is adding to her curriculum module content with a video presentation of comparative skeletal anatomy. A video series was taken showing the nasal bone structure of a deer; another series was taken using a dog skull; and finally, a human skull was featured. This series will be used to show the differences in olfactory sensory capability among herbivores, carnivores and omnivores.

Toby Brandriss and SauLing Chan are exemplary of fulfilled expectations placed on all DG participants. Their development of hands-on and inquiry-based curricula is still in progress. In coming weeks, more teachers will be showcased. For now, the teachers and students continue working to devise better methods of teaching the principles of science using novel space biomed-

Toby Brandriss and Students Create Curriculum Module in Dr. Mitchell Schaffler's Bone Research Laboratory

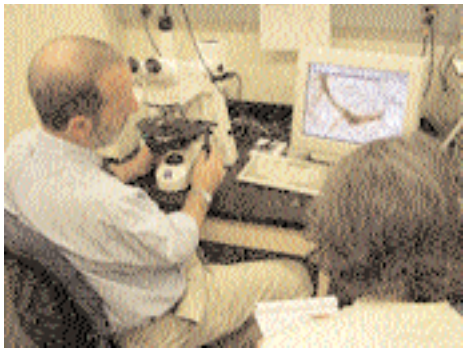
1. DG Participant Sarah Walter looks on as histologist Damien Laudier saws a cow hip bone into thin slices. The bone was procured from a butcher.

2. The bone slice is sanded between two pieces of wet-dry sandpaper until it is only 100 micrometers thick. Dr. Schaffler demonstrates. The students will continue the process until enough sections are sanded to make several slides.

3. Some of the sections are left to dry overnight. Others are viewed fresh from cutting. The dried sections will be stained to see detail under the microscope.

4. Laudier removes a section from eosin, a

5. The eosin-stained bone section is then affixed to a slide.



6. Dr. Schaffler works with a microscope that uses polarized light to see individual bone cells in the prepared sections. The computer is connected to the microscope and provides a detailed visual display.

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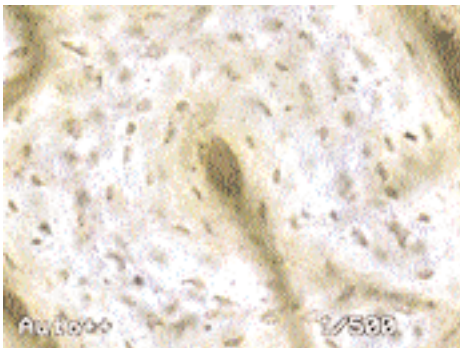
Curriculum Module Development in Progress Using High-Tech Laboratory Equipment and Help From Professionals



7. A picture taken by the computer of a sliver of bone, at 100x magnification, stained with eosin.

8. Ms. Brandriss, Sarah Walter, and Adelina Hung all get a chance to use the microscope. See the front page article for students' reactions to this hands-on education.

SauLing Chan and Students Create Visual Presentation of Comparative Anatomy of Nasal Bone Structure Using Specimens Provided By Dr. Jeffrey Laitman's Laboratory

1. The skull of a wild deer; this side view clearly shows the "scrolling" of the "turbinates". Scrolling is the term for the curling of turbinates, thin layer of bone. When the animal is alive, the bone is covered by olfactory mucosa; the many scrolls allow a heightened sense of smell.

2. Close up view of turbinates. This type of scrolling occurs only in terrestrial mammals. Most primates do not have this type of bone growth. Increased surface area for sensory neurons in the mucosa leads to greater sensitivity to the presence of food and dangerous predators.

3. A a young adolescent human skull. In the nasal cavity are the 3 layers of turbinates present in the human nose. As in other mammals, these are covered by the olfactory mucosa.

4. A close up front view of the nasal cavity. Human turbinates are considerably less complex than those found in other terrestrial mammals. There are 3 distinct layers. The top layer leads to the olfactory mucosa; the middle and inferior layers lead to the lower respiratory tract.

An Interview With Dr. Bernard Cohen.

Dr. Bernard Cohen M.D., is the Dr. Morris B. Bender Professor of Neurology at the Mount Sinai School of Medicine. Dr. Cohen focuses his research on vestibular neurophysiology. His laboratory studies how signals from the sensory organs are interpreted by the brain to produce compensatory visual movements when the body is in motion. He has been involved in space biomedical research for many years using microgravity as a tool to change spatial orientation in monkeys and humans. He is responsible for Mount Sinai earning consortium status with the National Space Biomedical Research Institute.

Dr. Cohen has been studying the effects of microgravity since about 1985 when he received a call from Washington asking him if he would be interested in flying monkeys in space. Since then, Dr. Cohen has worked both with Russians cosmonauts and NASA. In 1987 he worked on a project with the Russians on a cosmos bion-capsule. The project involved flying monkeys in space and monitoring their eye movements. In 1992 Dr. Cohen and his team flew to Russia again. The researchers recorded the monkey's eye movements before and after the flight. In 1993 NASA announced a mission to study brain function in space. Dr. Cohen and his team were selected to be part of the research and they flew a centrifuge in space. A great deal of information was gained from the centrifuge experiment. "One of the most interesting things seemed to be that astronauts who had been centrifuged did not have as many changes in their eye reactions as some of the astronauts had had before," said Cohen. It seemed as if the centrifuge had acted as a countermeasure to maintain their eye ear reflexes.

Dr. Cohen served as the chair of the external advisory council of the NSBRI for three years beginning in 1997. Dr. Cohen

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The Gateway to Higher Education Program

The Sophie Davis School of Biomedical Education was created in 1973 with a mission to "recruit and train physicians from underserved minority populations and then encourage new doctors to deliver services to the communities most in need." The Gateway to Higher Education Program was launched by Sophie Davis in 1986 with Morton Slater and Elizabeth Iler as co-directors.

The program opened with 100 ninth graders in four New York City public high schools. By the 1999-2000 school year, Gateway had enrolled 800 students across the five boroughs. In the fall of 2000, CUNY and Gateway established the Gateway Institute for Pre-College Education of the City University of New York. The program also maintains a close relationship with the Mount Sinai School of Medicine.

Gateway accepts students who show average or greater performance. There is no test for admission such as those administered by New York's specialized high schools. Gateway seeks to develop students' potential through challenging work and professional support. More than 97 percent of students go on to four-year colleges. Fifteen percent go on to pursue careers in medicine, a much higher rate than the general average.

The Gateway Institute runs programs for selected students in nine public high schools. Class size is smaller, teachers have been specially trained and students have access to cutting edge technology such as DNA laboratories.

Schools involved with gateway are: Jamaica High School, Brooklyn Tech, John F. Kennedy High School, Port Richmond, Erasmus Hall, Bayard Rustin High School for Humanities and Adlai Stevenson High School, Science Skills Center and Lafayette High School.

Gateway also runs two schools comprised solely of participants. Life Sciences in Manhattan (6th-12th grades) and Queens Gateway (7th to 12th grades). The focus of education is on the sciences, particularly biology. As in the other programs, nearly all students continue to a four-year college and many go on to careers in medicine.

Morton Slater, PhD will be featured in an interview in next week's issue of the newsletter.

Students Add Perspective to Curriculum Development

Continued from page 1

without staining. Adelina and Sarah agreed that it was "cool" to see the different parts of the bone that they had learned about in books under the microscope.

Overall, the students said they have enjoyed the summer institute so far. The girls liked working with Dr. Schaffler. "He has been very helpful and dropped everything for us to explain the project," said Sarah. It's nice that we get to call Tobie "Tobie" because we feel like we're all part of a team, Sarah added. "We get to help her with computers and she helps us with the teacher side of things," Sarah said. Tobie always asks our opinions and we have group meetings and we all give feedback, said Adelina.

The students commented that the summer institute has been very educational. "I feel like I improved my computer and lab skills," said Adelina. Both girls said they made a lot of friends at the DG summer institute and had a good time learning. "The best way to learn is to have fun," said Adelina.

NASA Funded Program Develops New Machine to Aid in Astronaut Health Maintenance

A group of students at Colorado State University have invented an exercise machine that they hope will prevent bone and muscle loss in microgravity. Thanks to NASA's Reduced Gravity Student Flight Opportunities Program, the students were able to test the device aboard a KC135 aircraft. The aircraft which is used to train astronauts flies in parabolic arcs. The aircraft provided the Colorado State students 30-second periods of microgravity 26 times a day to test out their exercise machine. The device attempts to recreate a dead lift, an exercise commonly done by weight lifters to strengthen leg and back muscles. The machine works by using constant torque springs to provide constant resistance. Results of the experiment have not yet been released.

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Next Issue:
Drs. Mitchell Schaffler and Morton Slater, and Dr. Patricia McArdle. Profile of ENT researchers.

Dr. Bernard Cohen, *continued from page*

believes Mount Sinai was selected to be part of the NSBRI consortium because Mount Sinai has both the technology and the experience to perform space biomedical research. "We have had a long history of close to 20 years of experience doing space projects and understanding some of the problems of microgravity," he said. Dr. Cohen said it is unfortunate that the Russians are not flying monkeys in space anymore (probably do to pressure from animal activists) because as Cohen's work demonstrates a good deal of information can be learned from this type of research.

Robotic Secretaries in Space

Wouldn't it be nice to have someone pick-up after you? Wouldn't it be even nicer if you had your own personal robot to assist you with your chores? Well some lucky astronauts aboard the international space station will have the chance to see what it's like to have a Personal Satellite Assistant or PSA to help them with routine tasks. These grapefruit-sized robots were inspired by science fiction and are intended to fly around the international space station recording ambient pressure, temperature and gas concentrations. PSA's may also be used as life saving devices venturing into questionable or dangerous situations before astronauts. They will also be able to understand questions and commands. "I looked a little bit at the light sabre training remote in Star Wars. That was part of the inspiration for [the PSA]," says Yuri Gawdiak, who came up with the idea. The PSA's have a small LCD screen that displays important information to the astronauts such as lists and status information. The PSA will also have a wireless network connection to the computers of the shuttle or space station, enabling it to access information about hardware, inventory, crew schedules or science experiments -- then transmit that information to astronauts as needed. PSA development is underway at NASA's Ames Research Center. Researchers have already designed prototypes and next year the PSA team plans to fly one on a KC-135 airplane.

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The Personal Satellite Assistant is a space-bound secretary.