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Paper Session II-C - Collaborative Ukrainian Experiment - Science and Technology Exchange Program for Students (Cue-Steps)

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Collaborative Ukrainian Experiment-Science and Technology Exchange Program for Students (CUE-STEPS)

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Abstract

An educational program was initiated during the Collaborative Ukrainian Experiment (CUE) in 1997. The CUE project was a series of plant experiments performed by Ukrainian cosmonaut, Leonid Kadenyuk, on Mission STS-87. A collaborative educational program was developed which was called "CUE-Teachers and Students Investigating Plants in Space (TSIPS)" in which students from both the U.S. and Ukraine conducted ground controls for the space experiments. The educational collaboration established during this project has continued with the development of other programs. These programs included the NASA SEEDS II project, the NASA Farming in Space Project, the International Water Institute, and most recently, the Daphnia project. The purpose of the recent trip was to participate in a teacher symposium and to initiate a student-exchange program. Eight students from Lake Brantley High School with a teacher and a parent chaperone accompanied the KSC representatives. In addition, a reporter and cameraman from a local television station went along to cover the student experiences. Colleagues from the Junior Academy of Sciences in Kiev hosted the group with meetings, tours, and field trips. Lake Brantley has formed a follow-up program, which they call CUE-STEPS (CUE-Science, and Technology Exchange Program for Students). The students hope to collaborate on research in space life sciences and ecology. A visit to central Florida by a Ukraine student and teacher delegation is planned for spring of 2001.

CUE-TSIPS

Research and education personnel at Kennedy Space Center have maintained communications with research and education personnel associated with programs initiated during the Collaborative Ukrainian Experiment (CUE) in 1997. The CUE project was a series of plant experiments performed by Ukrainian Cosmonaut Leonid Kadenyuk on Mission STS-87. Principal Investigators from the U.S. and Ukraine designed and implemented experiments with *Brassica rapa* and other plant species. A significant educational component was developed and carried out by the Wisconsin Fast Plants program at the University of Wisconsin-Madison, under the direction of Professor Paul Williams. On the Ukraine side, Dr. Volodymyr Nazarenko, who is the vice president of the Ukraine Junior Academy of Sciences, implemented the education program. Kennedy Space Center provided support both for the science and the education program (Dreschel et al., 1997, 1998).

The CUE TSIPS education program was based on a pollination, fertilization and embryogenesis investigation with Fast Plants, replicating the B-STIC flight experiment

A group of master teachers in both countries were trained in the CUE exercises and techniques and acted as lead teachers for other colleagues. They and their students ran simulated ground-based control experiments and shared their data with other teachers, students, and the CUE scientists. The instructional materials were also shared through teacher training at the NASA centers and across the Internet, e.g., on the Fast Plants WWW and gopher servers, for any other teachers who wished to participate.

In the United States, master teachers were all experienced Fast Plants secondary teachers who were selected from a pool of applicants. They were already into the experimental "process science" mode with their students and had committed to having their students carry out a subsequent "research" project, based on questions that arose from the real time experiment. The Fast Plants Program designated these teachers so that there was a good geographical distribution and also so that there was at least one teacher in proximity to NASA centers: Kennedy Space Center (KSC); Johnson Space flight Center (JSC); and Ames Research Center (ARC). In Ukraine, the master teachers were select representatives of each of the twenty-five geographical regions. Teacher training workshops for the CUE-TSIPS program were implemented by the WFP program both in Ukraine and in the U.S. Students from U.S. and Ukraine schools exchanged letters as a result of participation in CUE. The U.S. Embassy in Ukraine and NASA Headquarters assisted in this exchange by providing an inexpensive way for mail from Kiev to reach the students in the U.S. via pouch-mail carried from Kiev to Washington D. C. and placed into the U.S. Postal System.

Instructional materials were developed during the late 1996-early 1997. CUE experiments were demonstrated to the 1996 Summer Teacher Enhancement Program (STEP) participants at Kennedy Space Center (Dreschel et al., 1995, 1996). The experiments were also presented in CUE workshops implemented in Kiev, Ukraine (October, 1996), and Madison, Wisconsin (March, 1997).

A CUE TSIPS teachers guide became available in early 1997 for participant use. This guide was developed by the WFP program and published by the NASA Office of Human Resources and Education, in cooperation with the NASA Space Life Sciences Division. The guide, titled "Teachers and Students Investigating Plants in Space: A Teacher's Guide with Activities for Life Sciences" contains a detailed description of the construction of "classroom" CUE hardware, as well as procedures for planting, culturing, pollinating, and measuring development in the *Brassica rapa*. In addition, activities centered on plant responses to gravity and light are described which utilize 35 mm film cans and soda bottle caps. There are also activities described which demonstrate the physics of gravity and microgravity (Vogt and Wargo,

1992). A translated version was produced in Ukraine and distributed during teacher workshops in Kiev.

The materials for constructing the plant growth hardware are readily available and inexpensive or cost-free. Seeds are planted in the wick-pots and in about 12 days, the *Brassica rapa* will be hand-pollinated using a bee-stick, constructed from the thorax of a honeybee and a toothpick. This is the same activity that was performed by the Ukrainian Payload Specialist during the mission. The result of this education component is that the 20 master teachers that were trained each held one or more workshops in which at least other 20 teachers were trained (level 2). In more than 840 classes, over 20,000 students participated in the CUE in the U.S. Thousands of students in Ukraine also participated.

SEEDS II

SEEDS II is a joint effort between the National Aeronautics and Space Administration (NASA) Life Sciences Outreach program, the NASA Glenn Research Center, the NASA Kennedy Space Center Biomedical Office and the George W. Park Seed Company of Greenwood, South Carolina (Dreschel et al., 2000).

For this project, tomato seeds were exposed to the vacuum of space for a period of nine days, aboard STS-86 mission of the Space Shuttle Atlantis. Identical seeds were exposed to the increased pressure of an underwater environment aboard NASA's underwater habitat, the Scott Carpenter Space Analog Station during a mission in the waters near Key Largo, Florida for an identical time period. Seeds also were stored at the Park Seed Company as a control.

The SEEDS II kits that are distributed contain packets of ground control, underwater habitat, and space shuttle exposed seed. Each packet contains approximately 20 seeds. In addition, each kit contains a poster and guide describing methods for developing an experiment and growing the tomatoes. The Educator's Guide contains detailed information on the scientific process, explanations about the history of the seeds within each of the three foil packets, and suggestions for designing, preparing, and conducting a plant biology experiment. In addition, there is a listing of print and web-based resources. The full-color, SEEDS II poster illustrates the parts of a growing tomato plant and the steps of the scientific process. The back of the poster is formatted for ease of reproduction. Educators or group leaders may wish to produce additional resource copies of the articles The Importance of Plants in Space and "Grow" and Experiment. NASA Life Sciences Outreach began distribution in October of 1999.

Eighty thousand kits were assembled by the Brevard Achievement Center in Rockledge, Florida. This is a non-profit organization, which combines employment and training for challenged individuals. The distribution of the kits is being implemented by a number of partner organizations including The Ukraine Junior Academy of Sciences.

The International Water Institute

The concept of the International Water Institute (IWI) stemmed from previously successful collaborative educational programs between Ukraine and the United States. Successful collaborative programs are a demonstration of the positive changes that Ukraine as a country and society are undergoing. As extensions of their CUE plant experiments, the students in Ukraine began to use *Brassica rapa* plants to examine specific components of their local environment, namely soil and water. One of the more important parameters in question was drinking water and how contamination, if any, would affect these plants. One Ukrainian teacher that was involved in the Fast Plants program discussed issues concerning water quality in her region of Ukraine. She explained that the water quality in her region was below standard,

stating, "Some of our children are suffering from nephritis. By the age of ten these children show symptoms of kidney damage. It is our water that we are concerned about."

Because of a grant from Coca Cola, ten students and three teachers were able to travel to Kennedy Space Center in Florida, U.S.A. to witness the launch of their Ukrainian Cosmonaut on Space Shuttle Columbia in late 1997. Now the science learned by students in that experiment is being applied to environmental issues and concerns in the communities. Ukrainian students met with US students and interacted on an academic level as well as on a social-cultural level.

During the visit by the Ukrainian CUE-TSIPS contingent, Brevard Community College, Florida provided them with Water Quality Test Kits, which provided the necessary material for water analysis. Brevard Community College is local to Kennedy Space Center and offers classes at three campuses nearby and also on the Center. These kits were taken to Ukraine when the group returned and within months a water quality seminar was conducted in Kiev, Ukraine, and teachers from various regions of Ukraine began to get involved in this new program. Since then, Brevard Community college has provided approximately 45 test kits to students and teachers in Ukraine. This was the informal basis for the initiation of the International Water Institute.

To fund the institute, a democracy grant was requested and received from the Public Affairs section of the U.S. Embassy in Kiev, Ukraine in order to fund the implementation of water quality workshops and the purchase of water analysis kits and dissolved oxygen meters. This program is training teachers to satisfy student need for knowledge and increasing their awareness towards community development by implementing the IWI program in each of the 25 Ukrainian territories. In accomplishing this program, communities in various territories are able to organize and structure projects that will be effective for them in monitoring their environment. This will also help establish and coordinate a center in Kiev as a clearinghouse for science and environmental information, provide educational materials, train teachers and facilitate collaborations between the teachers and students in U.S. and Ukraine. Continued exchanges, by mail and email communication and reciprocal trips by both sides, will help to encourage Ukraine to stay on a course leading to a permanent democracy.

Recently a letter of agreement was signed between the Ukrainian Land Resources and Management Center (ULRMC) and the Junior Academy of Sciences, Kiev indicating that students would collect and provide water quality data and in turn, the ULRMC would educate students in other ecological monitoring systems such as Geographic Information Systems.

CUE-STEPS

Since the Space Shuttle Mission that contained the Collaborative Ukrainian Experiment, collaboration has continued with the education program including the development of "Farming in Space" by the Wisconsin Fast Plants program and presented in both the U.S. and Ukraine. In addition, the SEEDS II project and the International Water Institute have been introduced and continue to be embraced in Ukraine.

The purpose of the year 2000 trip was to participate in a teacher symposium and to initiate a student-exchange program. Eight students from Lake Brantley High School with a teacher and parent chaperone accompanied two Kennedy Space Center representatives. The students and chaperones were financially supported by grants and with their own funds. In addition, a reporter from an Orlando television station and a cameraman went along to cover the student experiences. Dr. Nazarenko and his colleagues with the Junior Academy of Sciences hosted the group. The Lake Brantley contingent formed a follow-up program to the CUE-TSIPS for the trip, which they called CUE-STEPS (CUE-Science, and Technology Exchange Program for Students). They raised funds to help defer the cost for students and teachers from Ukraine to visit Lake Brantley students and teachers in the spring of 2001.

Visit to Kiev

On arriving at the airport in Kiev, the CUE-STEPS group was greeted by youth in traditional Ukraine costume with bread and salt. This is a traditional greeting and was the U.S. students' first interaction with students in Ukraine. During the initial days, the CUE-STEPS group visited the Kiev Palace of Children and Youth and joined in discussions and tours with their counterparts in Ukraine. The group also visited an orphanage, Internat, which is really a second grade through high school campus. The U. S. students discussed their schooling with the older students there and discovered that the schooling is very similar to that in the U.S. The Internat prepares the students either for college or a trade.

Other events during the first few days included a visit to a planetarium in Kiev for a tour and a musical star show and a visit to the town of Zhytomyr, which is the birthplace of S. P. Korolyov, the chief rocket designer of the former Soviet Union. While in Zhytomyr the students visited Korolyov's birthplace and a space museum. Inside the museum are Soviet space capsules and equipment, historic information, and an exhibit of the STS-87 mission with memorabilia from the CUE mission. While in Zhytomyr, a natural history museum was toured that has a very moving Chernobyl exhibit. The final stop was at the local Ecological Center and the group was again welcomed with bread and salt. During the visit to the Center, an animal show was held with iguanas, parrots, boas, and monkeys. Then the students toured the classrooms and discussed their science research. The Ukraine students showed us their continuing research with the CUE-TSIPS project and their research with the space tomato seeds from SEEDS II.



The next day, the CUE-STEPS group visited with the Vice-Mayor of Kiev and the city's Education Director. The group was then taken to a school called a gymnasium (European high school) and was again welcomed with bread and salt. Nadia Adamchuk, a Ukrainian Cosmonaut candidate was there to visit as well. The children of the gymnasium put on several dancing skits and the U.S. students toured the school that had been completed last September. The U. S. students joined with the Ukrainian students in presenting a few Ukrainian dances.

The next day, a contingent of CUE-STEP and Ukraine students and teachers took a boat trip on the Dneiper River to a picnic spot. Local naturalists took the students and teachers on field trips and the students also tested the river water using portable water test kits. Then the group was treated to a traditional lunch including borscht and other local cuisine. Following lunch, the students continued their ecological studies until the group returned later that evening.

The following day an Architectural Museum was attended. This is an outdoor museum which highlights the architecture of buildings from previous centuries and represents the various regions of Ukraine.



On one occasion, the group visited the O. V. Fomin Botanical Garden in Kiev. During the latter part of the trip, other schools in close proximity to Kiev were visited and, in addition, a cathedral under reconstruction that had been destroyed by the Nazis, a museum on the WW II battle for Kiev. The group also visited a site in Kiev called the Monastery of Caves and climbed the bell tower (higher than the Tower of Pisa).

On the last full day, a press conference was held for the group and hosted by Monsanto. National Space Agency of Ukraine Deputy Administrator, Dr. Edvard Kuznetsov, Cosmonauts General Leonid Kadenyuk and Dr. Nadia Adamchuk, and a number of the CUE researchers (including Drs. Elisabeth Kordyum, Antonina Popova and Svetlana Kochube) were there as well as Dr. Nazarenko, teachers, and students. The press conference appeared on television in Kiev that evening. The KSC representatives and Dr. Nazarenko later visited with representatives at the USAID about possible collaborative programs.

On the final day, the students visited the U. S. Embassy in Kiev to meet with Ambassador Steven Pfeifer, Deputy Chief, David Hess, and Embassy Officer Nancy Heingarter. After one final trip to the Hotel Ukraine, the group returned to the Kiev airport to begin the journey home after saying goodbye to the Ukrainian hosts.



Each visit has been a more enriching experience and increases belief that both countries can benefit from collaborative research and educational programs. Dr. Nazarenko and the Junior Academy of Sciences have recently received funding from both private sources and the government to continue his programs, due in part, to our collaboration. On the U.S. side, students and teachers have been excited and motivated relative to this collaboration. Continued relationships between other countries are critical both for NASA and for global welfare. This program should be expanded to other countries, particularly International Space Station partners. It is hoped that the trip will have been the first step in a continued series of student and teacher exchanges between the U. S. and Ukraine and in developing similar relationships with other countries.

The Daphnia Project

During 2000, a proposal was submitted by three Ukrainian scientists entitled: "The Use of Daphnia as a Biological Indicator Species for the Detection of Hazardous Chemicals in a Spacecraft Environment". The funding for proposals of this nature come from money set aside to support scientists in Ukraine following nuclear weapon disarmament. The purpose of this project is to develop the use of a system for biological monitoring of total toxicity and mutagenicity of aspects of spacecraft environment surrounding astronauts.

The researchers will develop and apply a semi-automated system for estimating total toxicity and mutagenicity of the components of the spacecraft environment under investigation, including the effects of microgravity and ionizing radiation. This monitoring technique will be utilized on drinking and domestic water, food, beverages, and biologically active substances, which are reproduced and manufactured under conditions of microgravity and radiation in the space environment.

The method proposed incorporates the use of a biological indicator species (Daphnia, the water-flea) and an instrument for determining the response of the indicator species to components of the spacecraft environment, specifically for estimating the total toxicity of that component. This will be determined through the change in the measured chemiluminescence of

the daphnia's medium. The nature and degree of this change relates to the change of daphnia metabolism in response to the environmental component under investigation, dissolved in water. Students in Ukraine and the U.S. are collaborating on this project and have joined the scientists in developing protocols and testing various water sources in both countries. Data will be exchange and compared as part of the CUE-STEPSS program.

CUE STEPSS

A new organization called the Sciences at Lake Brantley with Lake Brantley High School are planning a thirteen-day science and technology education exchange between the United States and Ukraine. The Student/Teacher Exchange Program in Space Sciences 2001, or STEPSS 2001, will take place from March 19, 2001 through April 1, 2001. The planned program will feature: (a) a VIP tour of The University of Florida's science research laboratories and discussions with researchers; (b) a VIP tour of Kennedy Space Center and visits with space science investigators; (c) a Plant Molecular Biology Workshop and seminars hosted by The University of Florida's Central Florida Research Laboratories; (d) scientific field trips to Seminole County's Environmental Center, the coral reefs off the coast of southern Florida, and the Everglades; (e) a VIP tour of the Walt Disney Memorial Cancer Institute hosted by its Director, Dr. John Francis; (f) collegial exchanges among Ukrainian and American teachers at elementary, middle, and high schools and discussions with both school and district administrators; and (g) numerous cultural field trips and activities. The highlight of STEPSS 2001 is a Welcome Celebration Dinner at Orlando Science Center. The keynote speaker for the Dinner is Dr. Lawrence DeLucas, astronaut and former scientific director of the International Space Station. Numerous NASA officials and VIP guests will be in attendance.

Conclusions

When the Collaborative Ukrainian Experiment was being planned and implemented, there was little thought to what this collaboration might become. Due to the enthusiasm of our colleagues in Ukraine, and teachers and students in the U. S., this program continues to live on and enrich those involved with science and cultural exchange. Programs such as this have a high potential of making a positive impact on many generations to come.

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