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The Collaborative Ukrainian Experiment

A Report on The Collaborative Ukrainian Experiment-Teachers and Students Investigating Plants in Space.

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Abstract

The Collaborative Ukrainian Experiment (CUE) flew aboard the Space Shuttle Columbia on Mission STS-87. The educational component, entitled “Teachers and Students Investigating Plants in Space” (TSIPS), involved students and teachers in the U.S. and Ukraine performing ground controls for the “*Brassica rapa*-Seed Terminal growth In Chamber” (B-STIC) experiment. Teachers in both countries were trained in the experimental protocols for culturing and pollinating *Brassica rapa* plants in simulated flight hardware. Teachers and students in the two countries have been exchanging letters which has resulted in a rich exchange of culture and science.

For the mission, an Ukrainian Payload Specialist (PS) performed pollination in space while an alternate Ukrainian PS and hundreds of thousands of students in the U.S. and Ukraine performed the same tasks on Earth. Two communication downlink sessions were held so that students asked the PS about the experiments taking place on orbit. Participating students submitted the results of their ground control studies which are being compared to the plants pollinated on orbit.

The enthusiasm observed from the teachers and students from both countries indicate there is great hope that the collaborations established during this mission will continue in other collaborative areas into the future.

CUE Mission Background

President Clinton of the United States met with President Kuchma of Ukraine to develop collaborative efforts between the two countries. In the Joint Statement on Future Aerospace Cooperation Between the United States and Ukraine, National Aeronautics and Space Administration (NASA) and the National Space Agency-Ukraine (NSAU) agreed to collaborate on experiments and payloads which could qualify for flight on the Space Shuttle and provide an opportunity for a Ukrainian Payload Specialist to fly on the Space Shuttle.

The joint U.S. and Ukrainian Payload consisted of experiments to study the effects of microgravity on plant reproduction and photosynthesis, plant physiology and pathology, and moss gravitropism (Dreschel, 1997).

Preparation for the Collaborative Ukrainian Experiment science experiments began in November of 1995 with a meeting of scientists, engineers, and management at Kennedy Space Center. During this meeting, collaborations were established between Ukraine and U.S. scientists and the initial definitions of the experiments as well as the education component were established. During the following months, Ukrainian scientists visited the U.S. scientists’ laboratories and the U.S. scientists visited the Ukrainian scientists’ laboratories.

CUE Education Program Background

In January of 1996, a meeting of the two education component Principal Investigators, Professor Paul H. Williams of the University of Wisconsin-Madison and Dr. Volodimir I. Nazarenko was held at Kennedy Space Center. This meeting included a workshop with local school teachers and meetings with NASA life sciences and education programs representatives. This meeting served to establish the education component collaboration and initiated the design of the education program which would come to be known as the Collaborative Ukrainian Experiment-Teachers and Students Investigating Plants in Space or CUE-TSIPS (Dreschel, 1997).

CUE-TSIPS Teachers Guide

The development of the material for the CUE-TSIPS came as an extension of Wisconsin Fast Plants activities and NASA education office materials. The CUE-TSIPS Teacher's Guide was developed during 1996 and included detailed instructions on building simulated flight hardware and conducting the B-STIC experiment under classroom conditions. In addition, discussions of the space (microgravity) environment and plant research in space were included as well as additional activities to demonstrate plant response to the environment.

The guide, titled "Teachers and Students Investigating Plants in Space: A Teacher's Guide with Activities for Life Sciences" (Williams, 1997) contains a detailed description of the construction of classroom CUE hardware from readily available, inexpensive materials, as well as procedures for planting, culturing, pollinating, and measuring development in the *Brassica rapa*. In addition, the activities which are centered on plant responses to gravity and light are described and utilize 35 mm film cans and soda bottle caps.

The guide (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) was translated into Ukrainian and distributed there. The Ukrainian education component also developed an abbreviated version for students, also in Ukrainian. The U.S. version of the teachers guide is available at NASA education centers and on the Spacelink Life Sciences Web Site at http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Materials/Sciences /Life.Sciences/.
Additional information is available on the KSC Biomedical Office CUE Web Site: http:// atlas.ksc.nasa.gov/education/general/cue.htm.

CUE-TSIPS Teacher Training

The first CUE-TSIPS master teacher training workshop was held in Kiev, Ukraine in October of 1996. Professor Williams and two Kennedy Space Center life sciences programs representatives, Peter Chetirkin (Russian interpreter) and Dr. Thomas Dreschel (education programs coordinator), conducted a three-day workshop with nineteen Ukraine teachers and Dr. Nazarenko. The workshop was received with great enthusiasm and established the CUE-TSIPS program in Ukraine. Subsequent to this initial workshop, the Ukraine teachers held a number of teacher workshops resulting in the training of over 500 teachers in the 25 regions of Ukraine.

Students from U.S. and Ukraine schools have been exchanging letters as a result of participation in CUE. The U.S. Embassy in Ukraine and NASA Headquarters have assisted in this exchange by providing an inexpensive way for mail from Kiev to reach the students in the U.S. via pouch-mail. This mail is carried from Kiev to Washington D. C., sent to Kennedy Space Center, and placed into the U.S. Postal System. In addition, The Coca Cola™ Foundation-Ukraine has provided a grant to the Ukraine Junior Academy of Science. This grant will support the establishment of student email sites in each of the regions of Ukraine and has facilitated the sending of select Ukraine students and teachers to Kennedy Space Center for the STS-87 launch.

In the U.S., the initial master teacher workshop was conducted at the University of Wisconsin-Madison by Professor Williams and the Wisconsin Fast Plants Office staff in March of 1997. Twenty U.S. master teachers were trained during the workshop and went on to conduct additional workshops to train thousands of other teachers.

The master teachers were all experienced Fast Plants middle school and 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 good socio-economic/cultural diversity. In addition, there was at least one teacher in proximity to NASA centers: Kennedy Space Center (Florida); Johnson Spaceflight Center (Texas), and Ames Research Center (California). Teachers in the U.S. and Ukraine have been paired for continued interactions. The schools that have been designated with their 'partner' school are presented in Table 1.

The National Science Teachers Association and National Association for Biology Teachers Annual Meetings

Demonstrations were conducted, workshops held, and approximately 5,000 CUE-TSIPS Teacher's Guides were distributed during the National Science Teachers Association and the National Association of Biology Teachers annual meetings. A workshop was conducted at NASA's Classroom of the Future and Internet chats were set up between students and CUE-TSIPS experts. During the fall semester of 1997, it is estimated that tens of thousands of students in Ukraine and hundreds of thousands of students in the U.S. participated in the CUE-TSIPS experiment.

The STS-87 Mission

On November 19, 1997, STS-87 was launched into orbit from Kennedy Space Center with an international crew and the hearts and minds of teachers and students in the U.S. and Ukraine. The crew for STS-87 consisted of: Commander Kevin Kregel; Pilot Steven Lindsey; Mission Specialist (MS) Kalpana Chawla, Ph.D.; and Mission Specialist Takao Doi, Ph.D. The Ukrainian Payload Specialist (PS) for CUE was Colonel Leonid Kadenyuk with Dr. Yaroslav Pustovyi acting as the PS mission back-up.

Table 1. CUE-TSIPS School Partners in the United States and Ukraine

U.S. Schools	Ukraine Schools
1. Stellar Secondary Alternative School Anchorage, Alaska	a. The City Children's Ecological Center, Ivano- Frankivsk b. Regional State Ecologic- Naturalistic Center, Ivano-Frankivsk c. The District Ecologic-Naturalistic Center, Ivano-Frankivsk Region, Nadvirna
2. LA Center for Enriched Studies Los Angeles, California	a. School N 155, Kiev b. Khmelnitsky Regional Ecologic-Naturalistic Centre, Khmelnitsky
3. Roosevelt High School Los Angeles, California	a. The Chernigivsky Regional Ecologic-Naturalistic Centre, Chernigiv b. The Laboratory of Ecology and Aero space Monitoring, Simferopol, Crimea
4. Leland High School San Jose, California	a. Regional Ecologic-Naturalistic Centre, Dnipropetrovsk b. Dnipropetrovsk Ecologic-Industrial Association of Children and Students, Dnipropetrovsk
5. Del Mar High School San Jose, California	a. Volynsky Regional Ecologic-Naturalistic Centre, Volynsky Region
6. Wilton High School (two teachers) Wilton, Connecticut	a. Crimean Scientific Research Centre of Students, Simferopol, Crimea b. Khersonsky State Pedagogical Institute, Kherson c. Chernivitsky Regional Ecologic-Naturalistic Centre, Chernivtsy d. Kirovogradsky Regional State Ecologic-Naturalistic Centre, Kirovograd

Table 1. (Continued)

U.S. Schools	Ukraine Schools
7. Cocoa High School Cocoa, Florida	a. Solonyanska Secondary School, Dnipropetrovsky Region, Solone b. Ecological Center, Dnipropetrovsky Region, Nikopol
8. Lake Brantley High School Altamonte Springs, Florida	a. Myrgorodska Centre of Juniors, Poltavsky Region b. Pyryatinska Regional Centre of Juniors, Poltavsky Region
9. Parkview High School Lilburn, Georgia	a. Lugansky Regional Ecologic-Naturalistic Centre, Lugansk b. School N 57, Lugansky Medical University, Lugansk
10. Grissom School Tinley Park, Illinois	a. Ukraine State Ecologic-Naturalistic Centre, Kiev b. Regional Ecologic- Naturalistic Centre, Zhytomyr c. Volovetska Secondary School, Zakarpatsky Region, Volovetsk
11. Olathe East High School Olathe, Kansas	a. Cherkasska Regional Centre of Juniors, Cherkassy
12. Central City High School Central City, Nebraska	a. Institute of Plant Physiology and Genetics, Kiev b. Palace of Children and Juniors, The Centre of Junior Naturalists, Gorodenko, Ivano-Grankivsky Region c. Rivenska Center of the Juniors, Rivensky Region, Riven
13. The Lawrenceville School Lawrenceville, New Jersey	a. Fomin Botanical Garden, Kiev b. National University, Physico-Mathematical College, Kiev

Table 1. (Continued)

U.S. Schools	Ukraine Schools
14. Logan High School East Bellefontaine, Ohio	a. Kiyiv Palace of Children and Juniors, Kiev b. Kiev Regional Ecologic-Naturalistic Centre, Kiev c. Mykolayivsky Regional Ecologic-Naturalistic Centre, Mykolayiv
15. Gervais High School Gervais, Oregon	a. Ukrainian State Ecologic-Naturalistic Centre, Kiev b. Vinnitskaya Regional Centre of Junior Naturalists, Vinnitsia
16. Dent Middle School Columbia, South Carolina	a. Secondary School N 71, Kiev b. Balakleysska Regional Centre of the Juniors, Kharkivsky Region, Balakleya
17. Moises Molina High School Dallas, Texas	a. Ukrainian State Ecologic-Naturalistic Centre, Kiev b. Kiev Regional Ecologic-Naturalistic Centre, Kiyivsky Region, Boyarka
18. Augusta High School Augusta, Wisconsin	a. Kiev Regional Ecologic-Naturalistic Centre, Kiyivsky Region, Boyarka b. Kovisky Ecologic Centre Ivano-Frankivsky Region, Kosiv c. Odessky Regional Ecologic-Naturalistic Centre, Odessa
19. Westby High School Westby, Wisconsin	a. L'vivsky Regional State Ecologic-Naturalistic Centre, L'viv b. Ternopilsky Regional Ecologic-Naturalistic Centre, Ternopil

CUE-TSIP Student and Teacher Presence at Launch

Prior to lift-off, Ukraine students and teachers visiting Kennedy Space Center had the opportunity to meet and talk with Ukraine President Kuchma. Shortly after these students and teachers along with some of their counterparts from the U.S. watched as Space Shuttle Columbia rose into orbit carrying the Ukrainian Payload Specialist, Colonel Kadenyuk and the Collaborative Ukrainian Experiment payload.

Student Downlink Sessions with Colonel Kadenyuk

On December 1, 1997, Colonel Kadenyuk talked with and answered questions from students in the Ukraine and the United States participating in the CUE-TSIPS project. Two separate downlink sessions were held from Space Shuttle Columbia while on orbit, one in Ukrainian and one in English. The Payload Specialist discussed such topics as the different experiments that he was performing, his impressions of living and training in the United States and how it feels to be in space. Students in Ukraine questioned Colonel Kadenyuk from a television station in Kiev, and students in the U. S. asked their questions from either Kennedy Space Center in Florida or Johnson Space Center in Houston, Texas. Each session lasted approximately one-half hour and about thirty questions were discussed during each session.

Experiment completion and data collection

Upon finishing their data collection, students submitted their results to become part of a large data-base. The data-base includes the results of student investigations in the United States and Ukraine, the scientists' ground control and spaceflight data. Follow-up studies will be up to the individual students to develop.

In summary, the CUE has answered questions about plant responses to the space environment and the CUE-TSIPS has involved hundreds of thousands of teachers and students in space life sciences research. The scientific and cultural exchange between scientists, teachers, and students in the U. S. and Ukraine has lead to a greater understanding both of the effects of the space environment on plants and of the two countries involved. The CUE has been received with a high degree of enthusiasm by both countries. Because of the dedication and hard work by many individuals in both countries, it has been a highly successful mission both for science and for cultural exchange, with high hopes of further collaboration in the near future.

Literature Cited

Dreschel, T. W., P. H. Williams, V. I. Nazarenko, and P. V. Chetirkin. 1997. The Collaborative Ukrainian Experiment (CUE): Opportunities for collaboration in Science Education and Research. Proceedings of The 34th Annual Space Congress, Cocoa Beach, Florida, Session 2D, Paper #6.

Williams, P. H. 1997. Teachers and Students Investigating Plants in Space: A Teacher's Guide with Activities for Life Sciences. National Aeronautics and Space Administration, U. S. Government Printing Office: 1997-417-772/76126, 106 pp.