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Cover Sheet

Science Communication for the Life Sciences at Kennedy Space Center

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Science Communication for the Life Sciences at Kennedy Space Center

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The Science Communication Process

In the Aeronautics and Space Act of 1958, the National Aeronautics and Space Administration (NASA) was created and directed to: .Provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof..

Horack and Treise (1998) define science communication as: .the process through which a message of new knowledge or technology is delivered to a particular customer, in a way that adds value to the research itself, because knowledge has been shared with someone who wants or needs it for some use.. They go on to state: *.It is not correct to think of science communications as synonymous with public affairs. Science communications is not education. It is not outreach. Nor is it technology transfer. Within an integrated science communications process, each of these are customer-specific tasks to be done well as part of a larger process.* Customers of science communications even include the traditional science information generator – the scientists themselves. Indeed at some level we all are users of scientific information. Science communications therefore addresses how scientific knowledge is communicated, how consumers of that knowledge use it, and how this communication of knowledge adds value to the research. Because some customers of science communications processes also are decision makers within science, effective science communications may significantly foster a more vibrant and flourishing science research activity.. (emphasis added). In other words, any effort such as outreach or education do not fulfill the complete scope of science communications but serve as a part of the whole effort. Science communications does not target one specific group, but outreach or education would. To have a .true. science communications effort, the must focus on communicating with all customers using various methods.

Science Communication, Knowledge, and the NASA Strategic Plan

The Framework of the NASA Strategic Plan for 1998, referring to external customers, states: .The NASA Strategic Plan is based on a commitment to satisfy our external customers. Our performance in carrying out our programs, and our success as an Agency, will be judged by our customers, based on our ability to meet their requirements.

We (NASA) have identified the following groups as our external customers and stakeholders:

- The Administration and Congress, our primary stakeholders, provide us with policy direction and financial resources to conduct the Nation's aeronautics and space programs.
- The science and education communities, aerospace and nonaerospace industries, Federal agencies, and other primary customers receive our products directly and use them for purposes that yield public benefit.
- The public is both the ultimate resource provider and the ultimate beneficiary of our products..

The NASA Strategic Plan for 1998 makes a strong point that science communication activities within the agency are of primary importance. An important directive is stated under the title of .Generate Knowledge.: .This is the process by which NASA provides new scientific and technological knowledge from exploring Earth, the solar system, and the universe and from researching the space environment, aeronautics, and astronautics. This knowledge is provided to scientists, engineers, and technologists in industry, academia,

and other organizations, as well as to natural resource managers, policymakers, educators and other NASA customers. This process reflects the first and most basic part of NASA's mission statement and plays a major role in seeking answers to fundamental questions of science and research..

The directive continues under the title of .Communicate Knowledge. and is stated thusly: .The process objectives are as follows:

- Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in the space research and discovery experience; and
- Improve the external constituent communities' knowledge, understanding, and the use of the results and opportunities associated with NASA's Programs.

To achieve the goal and objectives for this process:

- We will foster partnerships with teachers and students.

We will work with teachers and others in the academic community to inspire America's students and increase learning opportunities. We will help enlighten inquisitive minds and involve teachers and students in our endeavors to seek answers to fundamental questions of research and science.. An important aspect of the effort to generate and communicate knowledge is to continue to nurture and generate new .external partnerships and cooperation.:

.To encourage improved efficiencies for our human and capital resources, we are also developing synergies between the programs of the Enterprises and the capabilities of other partners in Government, industry, academia, and other nations..

.International cooperation is a key element of the strategies for all four Strategic Enterprises..

The Definition of Knowledge and NASA's Communicate Knowledge Process

Because of the critical role that communicating knowledge plays in everything that NASA is tasked to do, NASA Administrator Dan Goldin assigned his Associate Administrator for Human Resources and Education at the time, Mr. Spence M. Armstrong, the duty of documenting the .communicate knowledge process. within NASA and making recommendations as to improving the knowledge communication effort within the Agency. For this purpose, the Communicate Knowledge Process Team was established and visited the ten NASA installations, talked to other government agencies, and evaluated communication initiatives at NASA Headquarters. The team defined knowledge as .a resulting product of a NASA–conducted or NASA–funded research, development, or operational effort.. In addition, they distinguished between .disseminating knowledge. (defined as a NASA function by the Space Act) and .communicating knowledge. which implies that both the customer and NASA are involved in an exchange of information. They defined .communication. as distributing knowledge and the collection of feedback information in a complete loop.

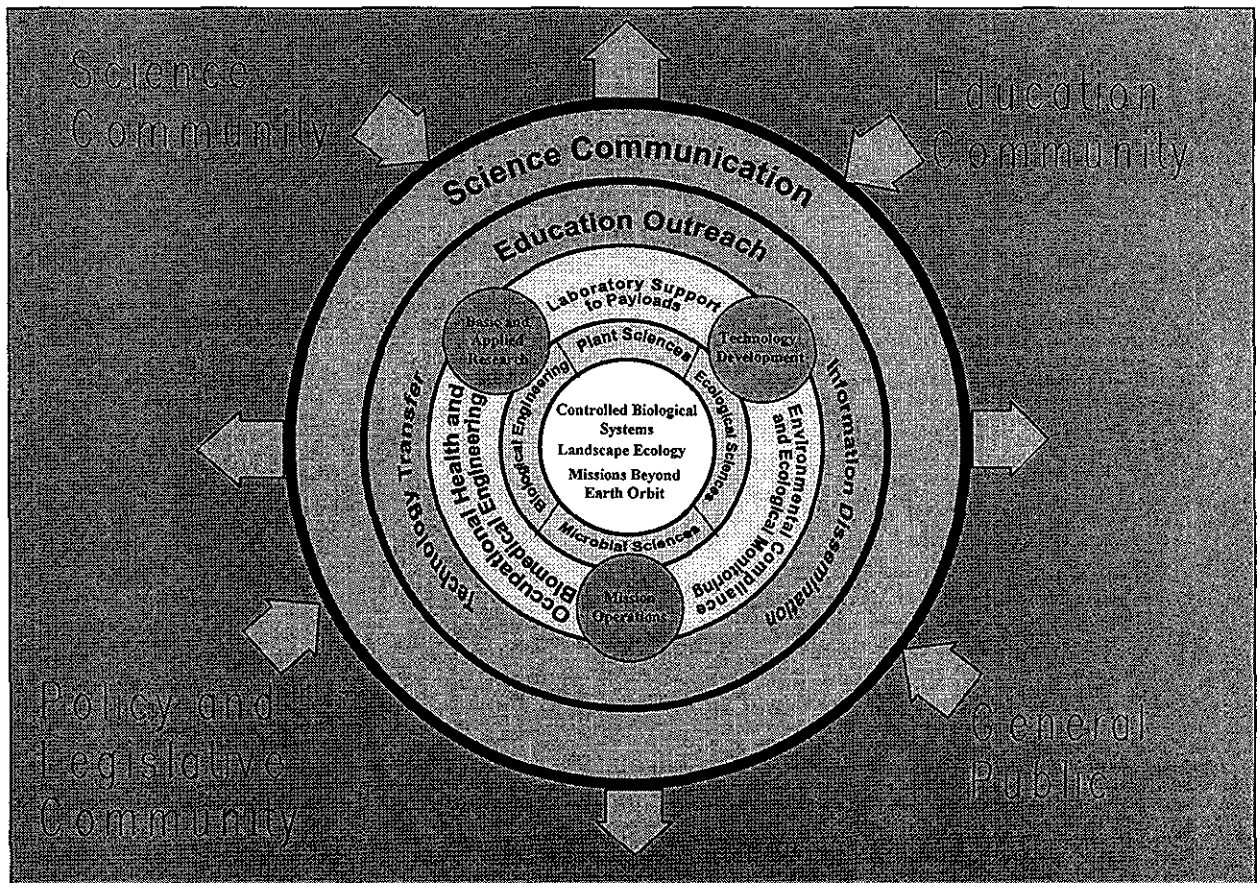
The team found a consensus among employees that communicating knowledge is a critical function of NASA to .expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.. They also found a .potential for NASA to do significantly better in providing a process, monitoring the output, examining the outcome, and widely publicizing the results. of the knowledge that they generate. In addition, they determined that .there are perceived and real impediments, including inadequate funding and travel budget, as well as a lack of management support, guidance, time or incentive for accomplishment. of communicating knowledge. They recommended that a formal process be developed and improved. They did, however, find .some exemplary Communicate Knowledge activities already taking place within NASA and some of the other Agencies visited. which were .driven by professional incentives, contractual obligations, official policies, or personal commitments that are frequently carried out on personal time.. They also stated that .exemplary practices were observed at every site visited..

Some of the recommendations that were made were that: A Headquarters Communicate Knowledge working group be formed; Center–base Integrated Communications Teams be created to advise scientists or

technologists in effective communication; every research, development, or operational effort have a Communications Plan; a NASA Policy Directive and a NASA Policy Guide be created to document the recommendations; NASA provide guidance in the use of archives, data bases, and web information; and an information process for communicating knowledge to the public be developed.

The Kennedy Space Center Life Sciences Science Communication Effort

Kennedy Space Center (KSC) Life Sciences workforce generates and communicates knowledge as an integral part of the research, development, and operational activities that are conducted. This process is depicted in the diagram shown below which represents the integration of programs and capabilities in science and engineering that support the KSC mission along with select programs within the Human Exploration and Development of Space (HEDS) enterprise and provide extensive opportunities for science communication.



Modified from Knott, W. M. 1998.

The personnel of the NASA-KSC Biomedical Office and Payload Processing Office have a long history in support of science communication activities. These include publishing reports and peer-reviewed journal articles and making presentations at professional meetings. In addition they are involved in collaborative ventures with other researchers in their field and participate in other programs, both within and outside of formal NASA education programs. Researchers, educators, and students of all ages and backgrounds have interacted, interned or collaborated with the civil service and contractor staff under the two NASA offices and the Life Sciences Support Contract (LSSC). During the period of January through December of 1998, personnel reported contact time with over 8,000 individuals and logged nearly 5,000 hours (during work and

after hours) interacting with the public in one form or another. Although KSC Life Sciences is a small group within the KSC family, the group has a reputation for strong science communication support by the administrators, scientists, and engineers at KSC.

The KSC Life Sciences–Science Communication efforts encompass all areas of professional and public communication including publishing in reports and in the peer-reviewed literature. Examples of journals and other publications are listed below:

Acta Horticulturae	Journal of Experimental Botany
Advances in Space Biology and Medicine	Journal of Florida Medical Association
Advances in Space Research.	Journal of Geophysical Research
Agricultural Engineering	Journal of Gravitational Physiology
Agronomy Journal	Journal of Herpetology
Air, Water and Soil Pollution	Journal of Plant Nutrition
American Midland Naturalist	Journal of Plant Physiology
American Potato Journal.	Journal of the Tennessee Academy of Science
American Society of Agricultural Engineers	Life Support and Biosphere Science
Mimeograph Paper	Marine Mammal Science
Annals of Botany	Microbial Ecology
Applied Environmental Microbiology	Microgravity Science and Technology
Applied Micro Gravity Technology	NASA Technical Memorandum
American Society of Biologists Bulletin	NASA Tech Briefs
BioCycle	PGRSA Quarterly
BioScience	Photochemical Photobiology
Canadian Journal Zoology	Photogrammetric Engineering and Remote Sensing
Castanea	Physiologie Plantarum
Chemical Propulsion Information Agency Publication	Phytochemistry
Crop Science	Phytopathology
Environmental Biology of Fishes Environmental	Plant, Cell and Environment
Management	Plant Cell Physiology
Environmental Toxicology and Chemistry. FEMS	Plant Cell, Tissue and Organ Culture
Microbiological Ecology	Plant Physiology
Florida Field Naturalist	SAE Technical Paper Series
Florida Scientist	Sea Frontiers Underwater Naturalist
Geo Info Systems	Soil Biology & Biochemistry
Gulf Research Reports	Soil Science
HortScience	Society of Automotive Engineers Technical Paper
HortTechnology	Today's Aquaculturist
Invertebrate Biology.	Upland Terrestrial Communities
In Vitro Cellular Developmental Biology	Water, Air, and Soil Pollution
Journal of the American Society of Horticultural	Water Resources Bulletin
Science	Wetlands
Journal of Biotechnology	Wildlife Society Bulletin

The KSC Life Sciences also support established NASA education programs such as the Summer High School Apprenticeship Research Program (SHARP), NASA's Unique Resident Training for Up-and-coming Replacement Engineers and scientists (NURTURE), Summer Teacher Enhancement Program (STEP), NASA's Education Workshop for Math and Science Teachers (NEWMASST), NASA's Education Workshop for Elementary School Teachers (NEWEST), and NASA Student Involvement Project (NSIP). During 1998, 11 SHARP students

were mentored, four NURTURE student visits were supported with job shadowing, presentations were made for the NEWMAST and STEP Teacher programs, and a visit to KSC by the NSIP winners was supported.

A significant effort by the KSC Life Sciences research and support staff involves implementing the Space Life Sciences Training Program (SLSTP) for college undergraduates. During each summer since 1984, KSC Life Sciences has hosted from 25 to 45 SLSTP students in collaboration with Florida A&M University. These students spent six weeks at KSC involved in life science research and attending lectures and field trips. Two presentations and a final report on their research are required from each student to earn five credit hours from Florida A&M University.

In addition, the staff is committed to developing and nurturing collaborations with educators and students from pre-kindergarten through graduate/medical school. During 1998, KSC Life Sciences developed the Life Sciences Educator Network (LSEN) with 23 teachers participating. The Life Sciences have also provided judges for four regional science fairs, sponsored a number of Graduate Student Research Program scholarships and undergraduate interns, hosted medical interns and nurses, participated in the Virtual Science Mentorship program, and provided tours and lectures to various school groups. KSC Life Sciences assisted the NASA Classroom of the Future in the development of BioBLAST (Biology-Better Learning through Adventure, Simulation, and Telecommunication), a multimedia curriculum project (<http://www.cotf.edu/BioBLAST/>) and coordinated the participation of students and teachers from the U. S. and Ukraine in the Collaborative Ukrainian Experiment-Teachers and Students Investigating Plants in Space (<http://atlas.ksc.nasa.gov/education/general/cue.htm>).

Staff members continually participate in public outreach activities with local community groups, advisory councils, etc. They serve as volunteers for the Summer Industrial Fellowship for Teachers Board of Directors, Environmentally Endangered Lands Selection and Management Committee, the Brevard School Science Advisory Council, The Brevard Museum of Art and Science advisory committee, and Friends of the Enchanted Forest. In addition, they meet with and present to various groups such as Keep Brevard Beautiful.

Information on programs, research, and links to additional resources both within and outside NASA are made available to the public on the World Wide Web:

<http://atlas.ksc.nasa.gov/education/general/educate.html>

<http://atlas.ksc.nasa.gov/env.html>

<http://www-jj.ksc.nasa.gov/jj-d/env.htm>

<http://atlas.ksc.nasa.gov/celss/INTRO.HTM>

<http://ohp.ksc.nasa.gov/>

Establishing and participating in collaborative programs with schools (K-12, colleges, and universities), museums, commercial groups, other NASA directorates and centers, and other federal, state, and local agencies has become a high priority. Staff also serve as adjuncts to colleges and universities and serve on graduate student committees. Examples of current or past partner organizations are listed below:

Baruch College

Brevard Community College

Coca Cola Foundation

Coca Cola-Ukraine

Commonwealth Scientific and
Industrial Research Organization

Delaware North

Department of Energy

Desert Research Institute

Disney Corporation

Duke University

Florida A&M University

Florida Institute of Technology

Hubbs-Sea World Research Institute

Institute of Biochemistry-Kiev, Ukraine

Institute of Botany-Kiev, Ukraine

Kansas State University

Louisiana State University

National Academy of Science–Ukraine National
Park Service
National Space Agency–Ukraine
North Carolina State University Northwestern
University
Ohio State University
Old Dominion University
Sea World of Florida
Smithsonian Environmental Research Center
Texas A&M University
University of Central Florida

University of Essex
University of Florida
University of North Carolina
University of South Carolina
University of Wisconsin
U.S. Air Force
U.S. Fish and Wildlife Service
U.S. Forest Service
Wake Forest University
Wheeling Jesuit University

The Future of Life Sciences–Science Communication at Kennedy Space Center.

With the successful deployment and assembly of the first sections of the International Space Station (ISS), a new era of science research on orbit has been instituted. Over the next several years, the ISS will become fully functional and provide a platform for science research in low–earth orbit.

As stated in the Overview of the NASA Research Plan for ISS: .Whether through improving industrial processes, advancing the state of scientific knowledge, looking after our health, enabling a vigorous program of space exploration, or researching tomorrow’s products today, work performed on board the ISS will benefit the citizens of the United States and our global partners by taking full advantage of the unique environment of space. Ultimately, our experiences, research results, and technology validation efforts on the ISS will be put to use as our Nation and its partners take the next steps in the human exploration of the solar system.. (<http://spaceflight.nasa.gov/station/science/index.html>). The potential exists then for .generating knowledge. at an increasing rate and the need for .communicating this knowledge. will increase also.

The Overview also contained this reflection on ISS educational benefits: .The ISS will provide a .window of opportunity. for assisting educators in promoting academic scholarship and in achieving systemic reform in science classrooms. Educators will utilize the ISS as a relevant, real–time learning tool that demonstrates the essential role of science in daily life. Through the use of telescience capabilities, the ISS promises to be the ultimate field trip, experiential lab tour, and research demonstration of scientific processes and concepts. Investigations performed aboard the ISS in the microgravity environment of space will enable educators to engage students in a fresh approach to discovering science facts, becoming acquainted with what scientists and engineers do, and experiencing the interdependency of science and technology necessary for communicating potential solutions to complex problems. The ISS will exemplify science as collaborative research efforts dedicated to examining current issues and problems familiar to many students..

The continuation of the Space Shuttle program, the construction and operation of the ISS, and the development of missions beyond Earth orbit will continue to provide knowledge that will need to be communicated to NASA’s customers in a timely manner and in an understandable fashion. Continued support of current NASA life science research and education programs and additional requirements for ISS and future exploration all point toward the need for a robust science communication program.

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