Strategic Education Plan
Increasing Awareness and Inspiring Stewardship of Caves and Karst

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“In the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught.”

- Baba Dioum

Preface

The National Cave and Karst Research Institute’s (NCKRI) Strategic Education Plan considers NCKRI’s congressional mandates, history, vision, and information gathered from other cave and karst education programs, resource managers, and educators. Additional guidance was derived from directives and recommendations of recent reports and United States (US) legislation (see bottom left), which demonstrate the need for science education reform, environmental literacy, a world-class workforce, and the advancement of lifelong learning opportunities.

The goals, outcomes, and strategies of this plan provide a framework to focus and coordinate NCKRI’s education efforts. Partnerships with other cave, karst, science, and environmental education programs will establish a foundation to accomplish this work. Development and implementation of short-term activities, targeting immediate needs, opportunities, and resources in support of strategic goals, will accelerate the execution of this plan.

- America COMPETES Act 2007
- BEST: What It Takes 2004
- Blue Ridge Parkway Protection Act 2010
- Drinking Water Adaptation, Technology, Education, and Research (WATER) Act 2009
- Federal Cave Resources Protection Act of 1988
- National Academies Report: Rising Above the Gathering Storm 2005
- National Environmental Education Act of 1990
- No Child Left Behind Act of 2001
- No Child Left Inside Act of 2009
- Omnibus Public Land Management Act of 2009
- STEM Education Coordination Act of 2009
- Workforce Investment Act of 1988
Dear Partners and Friends of NCKRI Education,

In June 2009, I began a fact-finding and partnership-building expedition across the US to establish a foundation on which to build NCKRI’s Education Program. I found many great cave and karst educational programs, some active, but some failing due to lack of funding and support. In short, by the end of my research expedition, I became keenly aware of the effects that US economic and educational issues have had on existing programs, as well as the challenges and opportunities they present in developing new ones.

Caves are resources that provide natural drainage, water, valuable scientific information, and recreation for humans, as well as habitat for unusual, rare, and endangered species. Yet these complex systems are misunderstood, fragile, and not resilient to disruption. Water supports life, influences where and how people live, and shapes karst landscapes. Karst makes up roughly a quarter of the landscapes on Earth, with millions of US citizens depending on karst aquifers for drinking water. Yet only cave and karst researchers, educators, managers, or explorers generally understand karst.

With significant impacts on the global environment from population increases and economic development, scientists have come to recognize a new epoch in the Earth’s history, the “Anthropocene.” Humans are now primarily interconnected with urban artificial environments, not the natural world. This makes cave and karst systems and resources particularly vulnerable because they are “out of sight, out of mind” to most people. Science and environmental literacy gaps, human actions, global climate change, and habitat losses are real threats to cave and karst resources. As a world leader in understanding caves and karst, and the effect of their resources on our health, economy, and future, NCKRI embraces the opportunity to increase the public’s awareness and inspire stewardship of these complex systems.

This document outlines our approach to developing programs that will educate the public on caves and karst by increasing both scientific and environmental literacy, as well as promote international cooperation for the protection of caves and karst. It presents strategies to motivate a fondness for science by our nation’s citizens, and provides opportunities to pursue careers related to NCKRI’s mission.

Through periodic evaluations, as well as reviews by our partners, this document will evolve to ensure effective and sustainable programs. Critical to the success of this plan are ongoing and growing partnerships with formal and informal educational institutions, businesses, governmental and non-governmental organizations, and concerned individuals who share in our mission. NCKRI will work collaboratively on programs at scales great enough to influence national and international audiences.

I thank you for your interest in NCKRI’s Education Program and look forward to working with you to improve the world’s understanding of caves and karst.

Kindest regards,
Dianne Gillespie
NCKRI Associate Director of Education
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Map courtesy of Circle of Blue
NCKRI’s Vision

NCKRI will be the world’s premier cave and karst research organization, facilitating and conducting programs in research, education, data management, and stewardship in all fields of speleology through its own efforts and by establishing an international consortium of partners whose individual efforts will be supported to promote cooperation, synergy, flexibility, and creativity.

NCKRI’s Education Mission

NCKRI will provide cutting-edge academic and education programs and work in collaboration with others to elevate the world’s knowledge of caves and karst.

NCKRI’s Congressional Mandates

Public Law 105-325 of the 105th US Congress established NCKRI to:

1. further the science of speleology;
2. centralize and standardize speleological information;
3. foster interdisciplinary cooperation in cave and karst research programs;
4. promote public education;
5. promote national and international cooperation in protection of the environment for the benefit of cave and karst landforms; and
6. promote and develop environmentally sound and sustainable resource management practices.
Foundation for NCKRI’s Education

Maintaining or restoring the integrity of cave and karst systems depends upon public understanding of their importance both to people’s daily lives and as repositories of significant biological, geological, hydrological, paleoclimatological, and cultural resources. Research, education, and stewardship are imperative components of NCKRI’s vision. NCKRI has a direct mandate to educate the public. However, an analysis of all of NCKRI’s mandates reveals the broad spectrum of educational programs needed.
In accordance with NCKRI’s mandates and vision,

NCKRI’s educational efforts will:

1. **Further the science of speleology by:**
   - Promoting the integration of speleology and related topics within the framework of the sciences and standardized curriculum.
   - Contributing to the development of the nation’s science, technology, engineering and math (STEM) workforce, at all levels.
   - Contributing to the development of students in cave and karst sciences.

2. **Centralize and standardize speleological information by:**
   - Developing a physical and virtual cave and karst educational library.

3. **Foster interdisciplinary cooperation in cave and karst research by:**
   - Developing and facilitating cave and karst research and stewardship projects.
   - Developing world-class, cave and karst research facilities.

4. **Promote public education by:**
   - Developing an interactive and engaging cave and karst museum.
   - Developing and facilitating formal, non-formal, and informal educational programs.
   - Developing and utilizing mass communication media, products and programs.
   - Building strategic partnerships with other educational institutions and programs to promote/integrate cave and karst sciences and topics.

5. **Promote national and international cooperation in the protection of the environment for the benefit of caves and karst by:**
   - Engaging national and international audiences in NCKRI’s vision and mission.
   - Developing and facilitating educational and outreach products and programs for national and international cave and karst audiences.
   - Utilizing mass communication media to disseminate information, policies and best practices for cave and karst environmental protection.

6. **Promote and develop environmentally sound and sustainable resource management practices by:**
   - Developing, conducting, facilitating, or supporting cave and karst symposia.
   - Developing, conducting, facilitating, or supporting trainings, workshops to disseminate best practices for cave and karst management.
   - Contributing to the development of the cave and karst workforce.
NCKRI Education Council
The Education Council members listed below represent all education programs across NCKRI. Through their signature, each commits to supporting and enabling the goals and methods of this education plan.

Dianne Gillespie
NCKRI Associate Director
Education Program

Dr. Robert Brinkmann
Chairman
NCKRI Education Committee

Dr. George Veni
NCKRI Executive Director

Hazel Medville
Chairman
NCKRI Board of Directors

Dr. Penelope Boston
NCKRI Associate Director
Academic Program

Ann Dowdy
NCKRI Associate Director
Advancement Program
NCKRI will continue to conduct its two major programs, the Academic Program and the Education Program to facilitate its educational and outreach work.

NCKRI’s Academic Program conducts the Cave and Karst Studies (CKS) program through New Mexico Tech (NMT). CKS-NMT targets graduate and doctoral students and focuses on the many aspects of speleological science and the development of karst terrains.

NCKRI’s Education Program conducts two major projects, i-CAVER (International Cave/Karst Awareness via Education and Research) and the National Cave and Karst Museum (NCKM). i-CAVER is building a series of international curricula and programs to bring about an awareness and understanding of cave and karst resources. NCKRI Headquarters in Carlsbad, New Mexico, will contain NCKM, which will develop exciting state-of-the-art exhibits, a bookstore, and on-site education programs through work with federal land management agencies, the state of New Mexico, the City of Carlsbad, university partners, cave and karst organizations, and local school districts.

NCKRI’s Academic and Education programs will collaborate with other cave and karst studies programs to expand and develop programs and curricula targeting higher education students and pre- and in-service cave and karst professionals. Within the curricula, short-courses and field courses will be developed for adults with varying degrees of cave and karst knowledge, adult students with previous subject knowledge, and professionals for academic and continuing education credits. Programs, curricula, and courses developed in this manner, would be conducted through Cave and Karst Studies at NCKM (CKS-NCKM).
Academic Program Goals

Cave and Karst Studies at NMT

Mission Statement:

Cave and Karst Studies at New Mexico Tech (NMT) is the academic program associated with NCKRI and is housed primarily within NMT’s Earth and Environmental Sciences Department. It is a growing program of cave and karst research, and teaching excellence, drawing attention to the unparalleled cave and karst resources of New Mexico and the American southwest, while also helping to build the National Institute.

Academic Program’s goals and special objectives:

1. Provide training for undergraduate and graduate students in cave and karst science. The academic scope includes geology, mineralogy, karst hydrology, microbiology, soils, environmental geochemistry, and modeling of karst systems including micrometerology, karst water resources, karst-related geohazards, and the potential for karst and cave features on other planetary bodies including the moon.

2. Develop world-class research facilities in support of this academic effort at NMT and with partners around the nation.

3. Promote the recruitment and development of students seeking careers dealing with karst and cave topics.

4. Promote integration and greater awareness of cave and karst sciences within the greater framework of the Earth sciences.

5. Promote awareness of the unique nature of karst aquifers and their role in providing groundwater resources.

6. Provide cave and karst educational experiences to interns from other agencies and organizations.

7. Build upon existing relationships with the US National Park Service, Forest Service, Bureau of Land Management, and the cave resources that they manage.

8. Provide an academic resource in cave and karst expertise for other state and federal agencies, educational entities, and the public.

9. Participate in media coverage of cave and karst issues for print and broadcast venues locally, nationally, and internationally.

10. Bring the precious and often fragile cave and karst environments to the attention of K-12 educators and students, and to the public.
Education Program Goals

Education Program Mission:
NCKRI’s Education Program encompasses two major projects, i-CAVER (International Cave/Karst Awareness Via Education and Research) and the National Cave and Karst Museum (NCKM). We are building a program that will increase the perception, awareness, and knowledge of caves and karst by developing high-quality educational products and programs and through strategic collaborations and partnerships.

NCKRI’s Education Program goals and special objectives include:

1. Provide a lifelong continuum of informal educational opportunities by developing inspiring events, exhibits, expeditions, curricula, tours, and publications to engage the public in NCKRI’s vision as well as cave and karst topics, facilitated through mass communication, seminars, symposia, and NCKM.

2. Develop a Cave and Karst Studies program facilitated through NCKM (CKS-NCKM) for cave and karst hobbyists, citizen scientists, educators, students, and managers.

3. Develop and facilitate cave and karst related stewardship and citizen science projects.

4. Provide continuing education and training experiences for pre-service and in-service cave and karst educators and managers.

5. Build strategic partnerships with agencies and organizations conducting educational programs in topics such as, climatology, environmental ethics, environmental sciences, geography, geology, hydrology, paleontology, and speleology.

6. Promote the development of middle and high school students who seek careers in the STEM fields, particularly in cave and karst related disciplines.

7. Develop high-quality educational curricula for international distribution through NCKRI’s consortium of partners.

8. Promote the integration of cave and karst topics into international and national educational standards.

9. Develop and facilitate informal and formal curricula, products, and programs that elevate the public’s perception of caves and karst.

10. Become a clearinghouse for cave and karst educational products, develop and acquire educational resources for NCKRI’s physical library and the Karst Information Portal.
Education Program Projects

i-CAVER
i-CAVER (International Cave/karst Awareness Via Education and Research) will be NCKRI’s primary vehicle for international and national educational and outreach curricula, programs and products (publications, maps, videos, teaching aids, etc.). Project CAVERN, CAVER and Expedition Caver materials will be developed and refined, then modified linguistically and culturally for international audiences; multiple versions will be created. i-CAVER will be developed after modules in the other series are established.

Project CAVERN
Cave/karst Awareness Via Education and Research Network will be the institute’s primary vehicle for products, programs and resources distributed through mass communication. The global popularity of the Internet makes NCKRI’s website a particularly effective vehicle for informal education, outreach, and networking. Mass communication channels such as publications, cable programming, and internet social networking sites offer tremendous potential for raising awareness of caves and karst resources. Through Project CAVERN, NCKRI’s will build a web presence and effective educational and outreach media.

Project CAVER
Project CAVER curricula and programs will be developed targeting K-12 audiences for instruction in scientific and environmental literacy topics using caves and karst as the learning objects; modules and units will be easily adaptable for use by informal educators. NCKRI will also collaborate with informal educators to develop educational curricula for informal educational institutions, like show caves, museums, and science centers. These curricula and programs will be developed utilizing research-based methods for effective curriculum development and will be linked with international, national, and state education standards. Caves and karst provide excellent “living classrooms,” applying real-world contexts for learning and stimulating “hands-on/minds-on” educational opportunities. Learners will develop answers to real world issues and research questions.

Expedition CAVER
Programs developed through this project will be expeditionary in nature, actively engaging and teaching learners. Expedition Caver curricula and programs will mentor youths and adults in cave and karst related scientific studies, and mentor educators to develop a deeper understanding of the topic. Experiential education methodologies will be used to develop programs that promote learning through activities that require teamwork and direct interface with cave and karst resources. Experiential education programs engage learners by using real-world issues and interaction with natural phenomena, known as learning expeditions. Potential learning expeditions include karst walks, karst geology field trips, educational cave tours, volunteer training programs, citizen science training programs, and cave and karst research projects.

Photo courtesy of Ken Storey
National Cave and Karst Museum

NCKRI Headquarters in Carlsbad, New Mexico, will contain the National Cave and Karst Museum (NCKM). NCKRI will develop exciting, state-of-the-art exhibits, a bookstore, and on-site education programs through work with federal land-management agencies, the state of New Mexico, the City of Carlsbad, university partners, cave and karst organizations, and local school districts.

Exhibits and educational programs will be developed primarily through inspirational and mentoring levels of instruction. Their caliber will attract visitors and effectively inform them about key cave and karst issues. Exhibits and programs at NCKRI Headquarters will complement, rather than compete with, those at the Carlsbad Caverns National Park Visitor Center. Space will be available for temporary exhibits on current research and for traveling exhibits.

The programs developed for K-12 students and their teachers will be aligned with international, national, regional, state, and local educational standards and benchmarks. Classroom space will be used to host small conferences, symposia, workshops, meetings, and guest speakers.

The NCKRI bookstore will distribute educational materials and products developed by NCKRI, in addition to a variety of retail items related to caves and karst. As with the exhibits, bookstore materials will generally not duplicate items sold at Carlsbad Caverns National Park, but will include a diverse and international array of products that showcase the wonder of caves and karst around the world. Bookstore items will be available through NCKRI’s website as well as at the NCKRI Headquarters bookstore.

A separate time-line and strategic plan will be developed for the NCKM, to include interpretation, education, outreach, research, marketing, retail, and fundraising strategies.
References


US Laws and Bills

America Competes Act (20 U.S.C. 9801)
American Recovery and Reinvestment of 2009 (26 U.S.C. 1)
Blue Ridge Parkway Protection Act 2010 (16 U.S.C. 461)
Drinking Water Adaptation, Technology, Education, and Research (WATER) Act 2009 (H.R. 3727-111th Congress)
Federal Cave Resources Protection Act (16 U.S.C. 63)
National Cave and Karst Research Institute Act (16 U.S.C. 4310)

Photography and Graphics

Page 1. Dianne Gillespie, NCKRI. Cave draperies in Carlsbad Cavern, New Mexico.
Page 3. Hanna Nester, Circle of Blue. Karst Regions of the World. Only carbonate karst is shown; with evaporite karst, about a quarter of the world’s land surface is karst.
Page 4. George Veni, NCKRI. Stream disappearing into Gouffre Balaa, a hydrologically important cave in Lebanon.
Page 8. Dan Silvestre, Impact Photography. Royal Palm Springs. The water that flows through this cave is the source of a spring commercially used for drinking water.
Pages 9 & 10. Dianne Gillespie, NCKRI. Alley Spring discharges 84 million gallons of water per day.
Page 11. Kenneth Storey, Cave Research Foundation Gap Cave Project. Karen On Station. A caver uses a compass to survey a cave; she holds her helmet, temporarily off her head, to light the compass.
Page 12. George Veni, NCKRI. NCKRI Headquarters, Summer 2010; construction was ongoing inside.
Back Cover. Dianne Gillespie and George Veni, NCKRI. Caves with archeological resources.
Glossary

**Anthropocene** Term coined in 2002 to denote the most recent period of Earth’s history, generally referring to the past two centuries, characterized by human activities having a substantial impact on global ecosystems and climate.

**Cave** A natural underground open space, generally with a connection to the surface and large enough for a person to enter. Caves in karst areas are dissolved out of soluble rock, such as limestone, dolomite, marble, gypsum, or halite (Veni et al. 2001).

**Citizen Science** Projects in which volunteers partner with scientists to answer real-world questions (Citizen Science Central 2007).

**Complex System** A set of multiple, diverse, and interacting components whose overall (system level) behavior is not predictable from measurement of the components alone. Complexity arises due to nonlinear responses and feedbacks among the system components. Complex systems are typically also complicated systems in that a large number of different components may be involved and operate over a range of different spatial, temporal, and organizational scales (AC-ERE, 2009).

**Education** NCKRI defines cave and karst education as the process of recognizing concepts and values to develop skills and attitudes necessary to effectively understand, study, appreciate, and manage caves and karst areas.

**Environmental Literacy** A fundamental understanding of the systems of the natural world, their relationships, and interactions between the living and non-living environments, and the ability to understand and utilize scientific evidence to make informed decisions regarding environmental problems.

**Expedition Learning** Student learning through rigorous academic content and service to the community. Interdisciplinary units are experiential, project-based, and involve students in original research—with experts—to create high-quality products for audiences beyond the classroom (Expeditionary Learning Schools 2010).

**Experiential Learning** Education programs that engage learners in constructing meaning by immersing them in direct and meaningful hands-on experiences. This approach incorporates learning using real-world problems and interaction with natural phenomena (Association for Experiential Education 2007-2010).

**Formal Education** Learning within a structured education system in which children or adults are required to demonstrate proficiency.

**Informal Education** The lifelong process whereby every individual acquires attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment—from family and neighbors, from work and play, from the market place, the library and the mass media (Coombs et al. 1973).

**Karst** A type of topography or landscape in which the dominant features, sinkholes, caves, and underground streams are formed primarily by the dissolution of bedrock (Veni et al. 2001).

**Lifelong Learning** All learning activity, formal and informal, undertaken throughout life, with the aim of enhancing knowledge, skills, and competencies from a personal, civic, social, and/or employment-related perspective.

**Non-Formal Education** Any organized educational activity outside the formal system intended to serve targeted audiences, and learning objectives (Coombs et al. 1973).

**Outreach Education** Opportunities designed to build awareness, develop relationships, and inspire action. Involves information exchange between the provider and target audience. Frequently designed to reach diverse audiences, but can be personal and interactive, it is designed to identify and appeal to an individual’s personal interest or motivation for information. Learning activities often extend to and compliment organizational missions.

**STEM** An acronym for science, technology, engineering, and mathematics—disciplines that are crucial to maintaining America’s competitiveness in a rapidly changing global society (NAS 2005).

**STEM Education Program** Primarily intended to provide support for or to strengthen, science, technology, engineering, or mathematics education at the elementary and secondary through postgraduate levels, including adult education (USDE, 2007).

**Student Opportunities** Internships, grants, scholarships, fellowships, and educational programs provided to students on a competitive basis for introducing them to careers and/or to support their pursuit of higher education in mission-critical disciplines.

**Training** A process of transferring knowledge and skills using standardized instructional methods and techniques to targeted professional audiences for the purpose of developing and enhancing professional competencies.