

Bridging K–12 and Informal Science Institutions

The Center for Informal Learning and Schools (CILS) investigates out-of-school learning and learning contexts and explores ways to use what is learned to strengthen K-12 science and mathematics education. Much of CILS research examines learning in cultural institutions (e.g., science museums, botanic gardens, zoos, and aquaria), including structured learning programs such as teacher professional development, field trips, and online learning.

A major goal of CILS is to build the capacity of cultural institutions and schools to form strategic alliances to improve K-12 science learning. These institutions bring to schools a wealth of content knowledge, pedagogical expertise, and authentic artifacts and phenomena that relate to the K-12 curriculum. They also provide unique environments for learning that can complement classroom instruction, as well as shed light on how to motivate and engage learners.

In particular, CILS investigates how cultural institutions can provide learning experiences for both adults and youth who are not typically motivated to learn and do science. They can also support advanced programs and explorations for adults and youth who are deeply engaged in science.

Underutilized resources

As places designed to serve novices as well as experts, cultural institutions are particularly well suited to serve urban teachers, who are more likely to be new or out-of-field teachers, and urban students who are more likely to come from families with little formal educational background. They thus provide a powerful but underutilized resource for under-resourced urban school systems.

Through engaging curiosity, providing experience with doing and knowing science, science museums and learning institutions can change dispositions and readiness for school science (both in teachers and in students).

In addition, through internships, residencies, and advanced coursework, science learning institutions such as museums can support advanced study and conceptual development of both teachers and students.

Learning in cultural institutions

Learning in cultural institutions—whether during casual visits or through structured museum classes or programs—is fundamentally learner-driven. Through encounters with original objects, artifacts, or (in the case of science learning institutions) natural phenomena, museums¹ carefully curate, facilitate, and set the context

CILS Research on Learning

Research studies sponsored by CILS examine the nature of learning in a variety of informal contexts—including homes, community settings, and cultural institutions.

CILS research examines how these environments are structured to allow forms of participation and conversation not usually found in classrooms, and how these differences may lead to or enhance learning designs and outcomes.

The research and graduate programs of CILS draw upon work in developmental psychology, science education, the natural sciences, and museum studies.

These research and graduate programs seek to strengthen academic and theoretical understanding across the disciplines, as well as to directly engage with, learn from, and contribute to the work of practitioners in schools and cultural institutions.

¹ The word “museum” is used in this document to denote a broad array of cultural institutions focusing primarily on science—such as botanical gardens, natural history museums, science centers, zoos, aquaria, and science museums. We chose to use the short word “museums” instead of the even shorter acronym “ISI” (for informal science institution) in an attempt to avoid the inadequate term “informal” to describe what are (like schools) highly structured, curated, programmed, and formalized environments.

for engaging visitor interest and providing tools for further learning. Like many teachers, museum-based educators aim to build on this curiosity and engagement to propel students to develop conceptual understanding.

But unlike most schools, many museums also house disciplinary experts who research, collect, or curate the learning environments. There is also a rich array of objects, and opportunities for visitors to immerse themselves in the subject matter and to make the historical or conceptual linkages between one set of objects and another. In most cases, museums have designed multiple ways into the subject matter, through multiple media, exhibits, and presentations. The best museums design for redundancy not only to reach a broad array of learners, but also to reinforce the visitor's experience of learning as multidimensional and iterative.

In addition, the social contexts of cultural institutions—where even the lone visitor is surrounded by other visitors and groups of visitors—provide opportunities for varying kinds of participation: Visitors are sometimes experimenters, and sometimes explainers; they are sometimes observers and sometimes reflectors. Expert teachers often structure their classrooms in similar ways, but cultural institutions have the additional feature of having a staff of sometimes scores of people who are fully devoted to the subject matter and may spend months designing specific learning opportunities.

Learning in these environments can support not only conceptual development, but also insight into the process of the discipline under investigation. In science centers, for example, teachers and students can not only observe and experience resonance and vibration, they can also engage in the processes of observing, hypothesizing, experimenting, analyzing, and communicating. And, through careful facilitation, they can experience the tentative and iterative nature of developing conceptual understanding in the sciences.

Strengthening the alliance between cultural institutions and schools

A major priority of CILS is to support and build the capacity of cultural institutions to strengthen K-12 science and mathematics education². To this end, CILS focuses on three areas:

1. Developing leaders in the field who can strengthen practices and programs bridging schools and cultural institutions
2. Drawing on and contributing to relevant learning and learning design research and theoretical perspectives
3. Building communities that cross boundaries among disciplines, institutions, professions, and constituencies

Developing leadership for the field

Graduate programs at King's College London and UC Santa Cruz are designed to develop leaders whose career trajectories will take them into academia, research, or museum-based/community-based research or practice. These programs build on the disciplinary strengths of the departmental programs sponsoring the graduate work, yet seek—through CILS activities—to broaden the tools and conversations of the students to include perspectives and understanding from across the many disciplines and types of institutions participating in CILS.

Graduate students are part of regular conversations with museum practitioners. They conduct apprenticeships and research studies in local cultural institutions, learning firsthand about the pressing problems confronting practice, the constraints in real-life settings, and the goals for learning held by the practitioners. They also meet in CILS teleseminars and symposia designed to connect faculty, students, and researchers from all three CILS institutions to engage in questions and problems around methods, meaning, and practice. These young scholars are being prepared to inhabit worlds that blur boundaries and theoretical perspectives, and will be

² Museums are institutions of public learning, and the majority of their work is with the community at large: primarily family and peer groups who visit cultural institutions on weekends and holidays. Yet an important part of most museums' mission is to work with local community groups including schools. Indeed, work with schools is one of the major ways in which museums can address issues of equity and access by reaching community members who may not regularly visit museums as part of the general public. It is also where they can begin to shift the ways in which their respective disciplines are perceived and approached by their communities.

able to connect research and practice in ways that are mutually beneficial, building knowledge and theory as well as practice and outcomes.

A postdoctoral research program, based at all three institutions, is similarly designed to include multiple perspectives, opportunities to cross into new territory, and connect research in practical settings in ways that address practical problems in the field.

Another mechanism for building capacity in the field is the CILS *Informal Learning Certificate* (ILC) program, a leadership development program for museum-based teacher educators.

Many cultural institutions offer teacher professional development programs, ranging from half-day workshops to multiweek summer institutes. These programs generally focus on science content and hands-on science activities designed to spark student interest and develop conceptual understanding. Most programs are conducted through formal arrangements with local schools and districts. Some are grant-funded, many are fee-for-service. Many provide academic or professional credit to participating teachers, who usually come from elementary and middle schools.

The ILC program occurs over a two-year period and includes four multiday institutes and quarterly online discussions. The focus of the ILC is on inquiry, school policy, learning theory and design, and engagement with the research community. The purpose of the program is to support deeper understanding of the inquiry-based environments in which the museum-based teacher educators work, the needs of the schools and teachers they serve, and what research says about learning and teaching for understanding. In addition, the program inducts participants into a cadre of leaders in the museum field, as well as into a broader community (of researchers, formal educators, policymakers, and others) concerned with strengthening K-12 science education.

Each year 30 educators from zoos, botanical gardens, science centers, and aquaria are admitted to the program. Faculty from King's College London and UC Santa Cruz contribute to the curriculum and experience of the ILC, which is based at the Exploratorium.

Drawing on and contributing to theoretical perspectives

CILS programs build on three research traditions. The first, located primarily at UC Santa Cruz, examines the social contexts for learning and development, and in particular how creating and building on these contexts may support learners who come from families with little history of formal education. The second tradition, primarily located at King's College London, examines the nature of science, science education, and knowing science, and considers how to make K-12 science engaging and illuminating for all students—not just for future scientists. These research trajectories, and the researchers engaged in the work, infuse the CILS work and dialogue with the field.

A third research trajectory, based at the Exploratorium, focuses on understanding how schools and cultural institutions can work together to support stronger science learning. In particular, this work examines the role of museums in supporting teacher practice and knowledge, rich science curriculum, and extended student learning opportunities beyond the classroom.

CILS pursues a field capacity-building and dissemination strategy that involves research presentations at the major international conferences for cultural institutions (such as the American Association of Museums, the Association of Science-Technology Centers, and the European Collaborative for Science, Industry and Technology Exhibits). CILS has sponsored one- and two-day events, as well as numerous panels, at these and other conferences in an effort to connect the questions and findings of the research community with the questions and work of the practitioner community at cultural institutions.

CILS also works to develop annotated resources, bibliographies, and research syntheses for practitioners involved with designing and implementing programmatic alliances between schools and cultural institutions.

Crossing boundaries and building new communities of practice

A major purpose of CILS is to broaden and enrich the dialogue of educators concerned with K-12 science learning by breaking down barriers around various fields of practice. To this end, CILS sponsors a variety of meetings that include academics, school practitioners, museum practitioners, district leaders, scientists, researchers, and policymakers. The goal of these meetings is for the participants to learn from one another

and contribute to the development of a more integrated approach to improving K-12 science education. The work of the participants in these meetings will be stronger as a result of these boundary crossings, and the work of CILS will be stronger for the contributions of these varied voices.

In May 2004, CILS gathered 40 school and museum leaders together to identify research questions that could inform alliances between schools and museums, practices that could be shared and scaled up, and next steps for CILS to support work in the field. A meeting convening museum leaders and policy experts will address policy issues related to funding of science museums as key to improved K-12 science.

CILS also hosts an annual research conference called the Bay Area Institute, where current studies, practices, and approaches are explored by a broad array of participants over three days. Sessions consist of panels, workshops, and project reviews, and are convened by practitioners, researchers, and CILS graduate students.

Questions and future directions

There are many questions concerning how to strengthen the alliance between schools and cultural institutions. These include questions related to practices, outcomes, policy, and scale. Strengthening the alliance also requires more deeply engaging the K-12 community in the potential and promise of integrating the resources of cultural institutions to better meet the goals of schools for their students. CILS is beginning the process of answering these questions by first exploring and charting the territory. Who is doing what, what are the conditions and contexts for their work, and what are the outcomes of the work? Through its many meetings, CILS surfaces new questions and trajectories for both research and practice. CILS commissions studies to answer specific questions about how systems and institutions actually work together. It builds on studies of learning to strengthen learning designs and programs that interface the two systems.

As CILS matures, it seeks to go deeper both into questions about learning and into questions about practice. For example, in what ways can learning outside the classroom complement K-12 curricula without compromising the extreme constraints that schools are operating within (in terms of time and tests)? How can we contribute to efforts to strengthen science and mathematics learning in underserved communities? What differences in student learning occur when their teachers are participants in a professional community based at a museum and steeped in science content? What aspects of science knowledge and learning are museums particularly well poised to support—and does this differ for teachers and students, novices and experts? What policy and funding contexts are needed to enable schools to deeply draw on the underutilized cultural resources in their community? How are the learning goals and intended outcomes of schools enhanced through inclusion of those of cultural institutions? What are the overlaps and what are the differences in these goals and intended outcomes? What are the outcomes? How can technologies be used to mediate the environments?

CILS will sponsor research and practice that address these and other questions, but what is clear is that the knowledge and means to address these questions is distributed in a wide array of settings, institutions, and academic disciplines. It is by bringing together the different communities of practice, of fostering dialogue and pushing for recommendations for action, and supporting the intellectual growth and practical efforts of leaders in the field that CILS can effectively serve as a catalyst to strengthen alliances between schools and museums.