

*Koshland Youth Research Lab: Interact with the Issues*  
**Pilot Program on the Science of Sleep**  
**Summative Evaluation**



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## EXECUTIVE SUMMARY

The Koshland Youth Research Lab<sup>1</sup> (Research Lab) began as an eight-month pilot program funded by the DEK Family Fund at the San Francisco Foundation. The project (initially implemented in 2011) used front-end and formative evaluation to develop the program in line with the needs and interests of its target audience of Hispanic youth. The summative evaluation took place in the last month of the program (December 2011). Researchers from UXR Consulting, Inc. were engaged to conduct all phases of the evaluation.

This summary contains a brief description of the program, key findings, and recommendations. Please refer to the full report for a more detailed account.

### ***Program Description***

The Research Lab was developed by the Marian Koshland Science Museum of the National Academy of Sciences (hereafter, “the Koshland” or “the museum”) in partnership with the Hispanic College Fund (HCF). The program’s target audiences were high school-aged, science-interested, pre-college student participants of the HCF’s summer programs in Maryland and Virginia, known as Hispanic Youth Institutes (HYIs). HCF identifies these students as “college material”, who lack the support structure and resources to achieve high school graduation and college admission on their own. As rising 10<sup>th</sup>-graders, they are at a critical junction when many underserved students elect to drop out of school (EPE Research Center, 2009; Hammond et al., 2007).

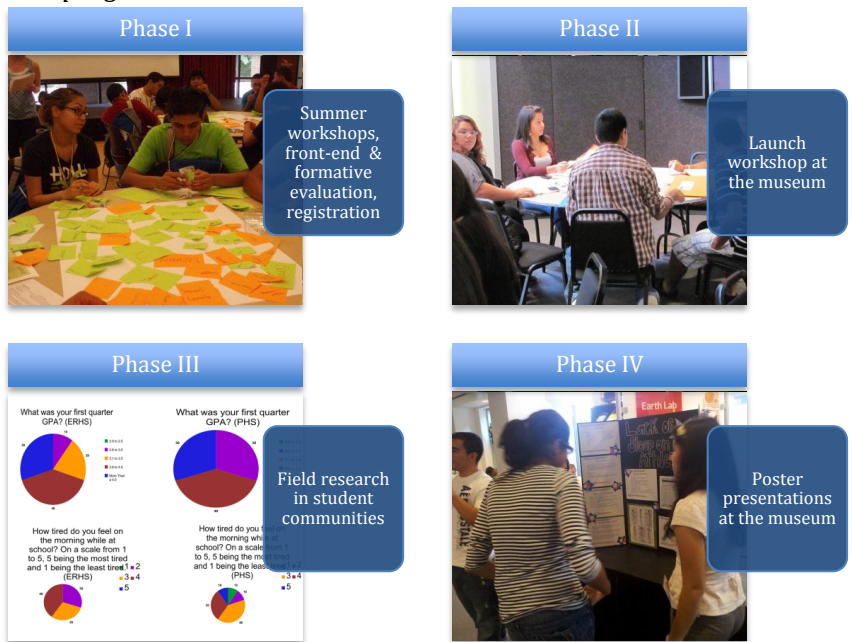
The fall research activities addressed an issue that students perceived as a barrier to their academic achievement. Students were given a number of options that represented issues identified as concerns by HCF that could be supported by a body of work of the National Research Council or the Institute of Medicine. The science of sleep was the topic chosen by students, which served as the focal point for their research activities conducted during the fall of 2011.

The program evolved in four stages (see figure below), which engaged students in all aspects of the research process from developing research questions and hypotheses to interpreting and presenting their findings to their peers and other community members.

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<sup>1</sup> The Research Lab began with a gift from the DEK Family Fund to develop a *Hispanic Youth Initiative* to be tested as a pilot project as a part of the Koshland’s community outreach efforts. When implemented, the program was referred to as the “Koshland Youth Research Lab” to help interested students make the connection between the program and the Koshland Science Museum. The program is now referred to with the broader title of *Issues Research Lab*, so that the program model can be expanded to other audiences, such as adults.

Research Lab program model



The museum identified outcomes and associated indicators to assess the effectiveness of the pilot program in four impact categories: 21<sup>st</sup> century literacies, critical thinking, decision-making, and problem solving (see program logic model on page 15). In addition, HCF stresses “college, career, and community” as its main objectives for Hispanic youth. Thus, the evaluation also sought to uncover how the program might have prepared students for college, future interests in science, and how they built community through their team collaborations and community research efforts.

**Evaluation Questions**

The evaluation was guided by the following questions:

1. To what extent did the program achieve the intended outcomes?
2. What unintended, or unanticipated, outcomes occurred?
3. What are the transferable elements of the program that can be scaled up or replicated for next year?
4. What are the lessons learned and best practices that emerged from the pilot program?

The study used three primary data sources to address these questions: 1) poster assessments (including the poster itself and student presentations of their research process and findings); 2) group interviews at the end-of-program event reflecting on the program structure and the process of conducting a research study; and, 3) a post-program survey, which focused on students’ attitudes and perceptions related to science and research.

## Key findings

UXR used a combination of interviews, surveys, artifact analyses, and observations to address the evaluation questions. The key findings are organized by the evaluation question.

### **1. To what extent did the program achieve the intended outcomes?**

The interviews, surveys, artifact analyses, and observations provided evidence for successful outcomes in most of the program's intended impact categories.

#### *Impact category: 21<sup>st</sup> century literacies*

Outcome: Participants will practice and improve their scientific literacy.

- ✓ We found evidence that this outcome was achieved. Students demonstrated the ability to collect, analyze, and interpret quantitative and qualitative data through their field research, posters, and presentations. Their posters as well as their scores on the pre-then-post scales related to the research process showed that they were able to move through the scientific research process.

Outcome: Participants will practice and improve their information literacy.

- We did not find evidence that this outcome was achieved. The posters and presentations, which provided summaries of the research process as conducted by students throughout the fall, showed that most students primarily used the resources that were shared with them in the launch workshop as their background research on the topic. Students were also unclear about the limitations of their studies, the generalizability of their findings, and the reliability and validity of their research instruments. Students also reported the lowest average score on the Evaluating Information Resources scale in the post-program survey.

Outcome: Participants will practice and improve their health (i.e. sleep) literacy.

- ✓ We found evidence that this outcome was achieved. Students demonstrated through their field research and research planning noted in reflections during interviews that they could conduct a research study on the impacts of sleep on teens and interpret the results of those findings. In some cases students felt confident providing recommendations based on their findings. Students also indicated strong agreement with items on scales related to Attitudes towards Studying Sleep and Perceived Knowledge of the Science of Sleep, producing the highest average scores of all the scales in the post-program survey.

#### *Impact category: Critical thinking*

Outcome: Participants will use various types of reasoning (inductive, deductive) as appropriate to the situation.

- ✓ We found evidence that this outcome was achieved. Students demonstrated an ability to analyze qualitative and quantitative data and to draw conclusions based on those results through their posters, presentations, and group interviews.

Outcome: Participants will analyze how parts of a whole interact with each other to produce overall outcomes in complex situations.

- ✓ We found partial evidence that this outcome was achieved. Students demonstrated an understanding of the impacts of sleep on outcomes like student achievement and athlete

performance. One group showed how use of technology impacts the quality of sleep. In interviews, several students made connections between the results of their study and the results of the other groups' studies.

- We did not, however, find evidence of students demonstrating an understanding of the limitations of their findings, which was a second indicator for this outcome.

## *Impact category: Decision-making*

Outcome: Participants will effectively analyze and evaluate evidence, arguments, claims, and beliefs.

- ✓ We found partial evidence that this outcome was achieved. Students effectively analyzed evidence and claims and worked in groups to determine conclusions and recommendations from their analyses.
- We did not, however, find evidence of students evaluating arguments or alternative claims from the literature or generating alternative explanations to challenge their own interpretations of their results.

Outcome: Participants will interpret information and draw conclusions based on the best analysis.

- ✓ We found evidence that this outcome was achieved. The high quality of the student posters and students' abilities to speak about their process of analyzing their data showed that students were able to interpret their findings and draw group conclusions based on their individual analyses.

Outcome: Participants will reflect critically on learning experiences and processes.

- ✓ We found evidence that this outcome was achieved. Students reflected on their experiences going through each stage of the research process and working together in their teams. Students reflected particularly on the challenges they faced with time management and working with team members outside of the school day. In open-ended survey questions, students were able to provide reflective advice for future students who might participate in the program.

## *Impact category: Problem solving*

Outcome: Participants will identify and ask questions that clarify various points of view and lead to better solutions.

- ✓ We found evidence that this outcome was achieved. This outcome was assessed in terms of students' abilities to ask meaningful questions at face-to-face meetings, to develop research questions and design a research study to answer those questions, and to ask questions that were relevant to their personal lives and community. The student posters and interviews showed that students did all of these. They also asked clarifying questions of Dr. Owens after her presentation during the launch workshop.

## *HCF Impact category: College*

Outcome: Program elements will provide students with experiences that will prepare them for college.

- ✓ We found evidence that this outcome was achieved. Students commented in group interviews that the Research Lab prepared them for college in terms of getting enough sleep (science content), learning the research process (process), and managing their time (life skills). Students also used the Research Lab experience as a building block to apply to additional museum-related

programs or to join honor societies, which will be beneficial items to have on their resume when they apply to college.

*HCF Impact category: Career*

Outcome: Participation in a personally relevant, science-related topic will encourage student interest in science in the future.

- ✓ We found partial evidence that this outcome was achieved. Students who completed the program reported higher average scores on the Intentions to Participate in Science in the Future scale than students who did not complete the program. Students also described ways in which this program would help them participate in science fairs and/or pursue their interests in other science topics.
- These results were not statistically significant, so we cannot be sure whether these group differences were due to the program's impact or if they happened by chance.

*HCF Impact category: Community*

Outcome: Participants will work with each other, family, and friends/peers in their community to complete the program.

- ✓ We found evidence that this outcome was achieved. Students reported high average scores on the Reported Teamwork Behaviors scale and described how they worked with friends, parents, teachers, and other community members to complete their projects.

**2. What unintended, or unanticipated, outcomes occurred?**

The interviews and open-ended survey questions pointed to other outcomes that occurred as a result of the program. Most notably, students reported learning about life skills such as:

- time management,
- group communication, and
- staying on task.

Students also reported:

- having fun and
- making new friends.

**3. What are the transferable elements of the program that can be scaled up or replicated for next year?**

Reflections from Jeanne Troy (Koshland) and Daniel Sarmiento (HCF), as well as the student comments in interviews and surveys, highlighted several aspects of the program that worked well and could be considered transferable elements for the program as it scales up or is replicated in the future.

- Narrowing down the science topics based on the Koshland's and the HCF's organizational missions ensured that the program was a good fit for the partnership.
- Allowing students to vote on the topic from the narrowed-down list of four helped ensure that the science topic was relevant to their personal lives and communities and gave them agency in the process.



- Connecting students with scientific research mentors during the launch workshop guided students through the research process and provided them with a sense for how research is really done.
- The end-of-program poster presentations empowered students to share their findings with peers, community members, and other key stakeholders.
- Having the posters as a tangible deliverable gave students a sense of accomplishment and pride.
- Using Facebook as a group communication tool was effective for the majority of the students who noted that it was often faster than email. Students commented that using email as well as Facebook guaranteed that they did not miss any important information.
- Having consistent contact with the program officer helped to keep students on task. Supportive communication from HCF helped give credibility to the work the museum was doing and held the students accountable.
- Recruiting students during the summer HYIs and then holding the program in the fall capitalized on student enthusiasm and motivation.
- Offering service hours through the program and providing travel compensation were good incentives for the students who completed the program.

#### ***4. What are the lessons learned and best practices that emerged from the pilot program?***

Reflections from Jeanne Troy (Koshland) and Daniel Sarmiento (HCF), as well as the student comments in interviews and surveys, also highlighted opportunities for improvement for the program.

- Everyone felt that more opportunities for face-to-face interactions would have helped students stay on task and work more effectively in their groups, as well as increase opportunities for discussing important concepts like conducting literature reviews, reliability vs. validity, and identifying limitations of a study.
- Setting expectations was also an important theme that emerged. Since this was a pilot study, one of its purposes was to identify what those expectations would be for future programs, however several students dropped out of the program because of this issue.
- Program attrition was a challenge in particular due to the issue of setting expectations, but also due to logistical challenges. Some group members simply lived too far away from each other to allow for effective collaboration.

## **Recommendations**

Based on these findings, the research team proposes a number of recommendations and lessons learned, which can be used to inform the program as it evolves. These recommendations were developed and refined in consultation with Koshland staff to ensure they reflected the realities and constraints of the program's context.

**Continue to give students agency.** The approach to topic selection and planning logistics for the program worked well. Using a series of surveys and conversations with the students, the museum was able to tailor the program to a science topic of interest and to incorporate communication tools like Facebook into the structure of the program. Continue to use these strategies and to find others, which will give students agency and voice in the program development process.

**Clarify expectations.** With the inaugural deployment complete, the museum has the data it needs to improve recruitment and retention strategies for future programs by making program expectations clear to students from the outset. This should be relatively easy to accomplish now that the museum and HCF have a better sense for what the program is and how much time it takes students to accomplish research-related tasks.

**Increase recruitment.** Engaging with students at the summer HYIs was an effective strategy for recruiting students to the program. The workshop model used at the Maryland HYI was particularly effective. That model allowed for small group interaction between the museum and students on the same day that they participated in the Issues to Action workshops. Unlike the Virginia workshop, there were no other competing events at the Maryland workshop, which allowed the museum to reach more students in one day. Using the Maryland workshop model in subsequent HYIs has the potential to increase overall program recruitment.

**Improve the screening process.** Clarifying expectations and increasing recruitment will hopefully allow for a more selective process for program participation. Consider selecting participants not only based on science knowledge/interest or research skills, but also on commitment to the program. One opportunity for improving the screening process would be through the pre-launch activity (i.e. the photo-collection and sharing activity). Use such an activity to filter out students who are less committed, or simply too busy, out of the program before they become part of student groups.

**Engage students as mentors.** Students who completed the program showed a high level of dedication and enthusiasm towards the research process. Students also reported a genuine interest in “paying it forward” and helping future cohorts better prepare themselves for the final poster presentations and manage their time along the way. These program alumni can help fill in the gaps where program personnel or budget constraints restrict time for one-on-one attention.

**Tackle information literacy explicitly.** The evaluation showed several areas in which students could benefit from explicit information literacy training. The museum might consider providing additional assigned readings to students, such as a journal article, which students could use as a model for their research. There might also be a way to build in a group-based literature review effort in which each group reads and reports on one or two articles to share back with the group. While students are designing their studies and developing their research instruments, the museum might consider having group conference calls (or hiring an additional contract educator) to help students think through the limitations of their study as well as issues related to reliability and validity of their instruments.

**Provide more detailed examples.** Although Jeanne provided the students with a field journal to help them move through the research process and a poster template to help them present their findings, students still felt like they needed more direction. Future programs can use the pilot program materials as examples of what students should or should not do. The launch workshop could be expanded slightly to allow time for defining and describing the program’s key deliverables to help students build a mental model for the program and its main components.

**Increase face-to-face interactions.** Students requested additional opportunities to meet as a large group at the museum. Originally, it was thought that getting to the museum would be a logistical challenge for

students, but the students indicated that as long as they knew about the events ahead of time they would have been able to attend. Adding in one additional museum meeting plus hiring a contract educator who can visit with the students in their communities at times convenient to them (i.e. outside of the 9am-5pm work day) might help to fill this gap and ensure students have the support they need to complete their projects in a timely and efficient manner.

**Build on these evaluation results and instruments.** This evaluation provides baseline scores that the museum can use as benchmarks for assessing future programs. Several of the scales used were effective in measuring the intended outcomes. A few scales (i.e. Evaluating Information Resources and Attitudes towards Studying Sleep) need additional development and scale testing. The museum might also consider working with HCF to track student outcomes longitudinally and to follow up with students once they are graduating from college or in high school.

**Raise awareness about the program to the general public.** The work that the students produced in the pilot project was admirable and the poster presentation was an opportunity to showcase that hard work. Consider raising awareness about the work that these youth are doing as well as the outreach efforts of the museum and the HCF by marketing the end-of-program to a wider audience and provided reduced admission or other incentive to encourage greater attendance. This approach might allow students to network with a broader community of individuals and feel further empowered by the importance of their research.

**Develop tools or partnerships to help students take action.** To parallel the Issues to Action exercise, students should be encouraged to act on their evidence-based recommendations. A partnership with a group that does work in this arena could help students after the poster session.

[End of executive summary. This page intentionally left blank]

## INTRODUCTION

This document contains the summative evaluation report for the *Koshland Youth Research Lab: Interact with the Issues* (hereafter, “Research Lab” or “the program”)<sup>2</sup> pilot program. The program was developed by the Marian Koshland Science Museum of the National Academy of Sciences (hereafter, “the Koshland” or “the museum”) in partnership with the Hispanic College Fund (HCF). The museum contracted UXR Consulting, Inc. to conduct front-end<sup>3</sup>, formative, and summative evaluations of the program.

The Research Lab was an eight-month pilot program funded by the DEK Family Fund at the San Francisco Foundation. The front-end evaluation took place from May-August 2011. The formative and summative evaluation took place once the program began in September 2011 and ended one month after the completion of the program in December 2011. The program’s target audiences were high school-aged, science-interested, pre-college student participants of the HCF’s summer events in Maryland and Virginia known as Hispanic Youth Institutes (HYIs). The Koshland obtained parental permission for each student to participate in the HYI as well as the programs and evaluations associated with it.

Traditional summative evaluation is often conducted when an organization wishes to assess the short-term outcomes and long-term impacts of a project that has been in place for some period of time. For pilot projects like this one, there is a shorter timeframe for assessing these outcomes and impacts so that the results of the study can be incorporated into a new program that might be scaled up or replicated in the future. The evaluation was guided by the following questions:

5. To what extent did the program achieve the intended outcomes?
6. What unintended, or unanticipated, outcomes occurred?
7. What are the transferable elements of the program that can be scaled up or replicated for next year?
8. What are the lessons learned and best practices that emerged from the pilot program?

This report contains a description of the program, the methods used to conduct the summative evaluation, results for each evaluation question, conclusions organized by the evaluation questions and the intended outcomes, and recommendations developed in consultation with the museum.

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<sup>2</sup> The next iteration of the program will be called the *Issues Research Lab* to broaden its scope and allow the model to be applied to other age demographics.

<sup>3</sup> The front-end report is available online: Koepfler, J. A. (2011). User-centered program development of the Koshland Youth Research Lab. UXR Consulting, Philadelphia, PA. <http://informalscience.org/evaluation/show/482> . There were no formal reports written for the formative evaluation of the program.

## BACKGROUND

### ***Program partners***

The Koshland Science Museum of the National Academy of Sciences is a non-profit science museum located in Washington, DC. The mission of the museum is to help people use science to solve problems. To advance this mission, the museum's goal is to create tools that build 21st century literacy and skills for students and young adults<sup>4</sup>. As a test-bed for tool development, the museum prioritizes user-centered practices, scientifically rigorous content creation, a holistic approach to programs, and partnerships to ensure sustainability. The museum has made a commitment to the audiences it serves and to itself to measure and share the results of these efforts through research and evaluation. The museum is a unit of the National Academy of Sciences. The National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council are private, nonprofit institutions that provide expert advice on some of the most pressing challenges facing the nation and the world.

The Hispanic College Fund is a national non-profit organization based in Washington, D.C., with a mission to develop the next generation of Hispanic professionals. They seek to accomplish this mission by providing Hispanic high school and college-aged students with the vision, resources, and mentorship needed to become community leaders and achieve successful careers in business, science, technology, engineering, and math.

Prior to launching the pilot program, Koshland staff convened several local organizations, including the HCF, for a scoping meeting. Based on overlapping missions with regard to STEM<sup>5</sup> content and shared target audiences (teens and adults), HCF emerged as the most logical partner to collaborate with them on a pilot program. The Koshland believed that this relationship could provide a path for ongoing exploration of the role of research in students' personal, academic, and professional lives.

The museum contracted UXR Consulting, Inc. ([www.uxrconsulting.com](http://www.uxrconsulting.com)) to conduct front-end, formative, and summative evaluations of the program. UXR offers experimental and mixed-methods research approaches to understanding the needs, values, attitudes, and behaviors of a project's target audiences and key stakeholders during the front-end and formative evaluation stages, and for assessing project outcomes in the summative evaluation stage. Jes A. Koepfler, Principal, has worked with the Koshland over the last three years, evaluating exhibits, programs, and the museum's website, as well as supporting a strategic planning effort.

### ***Program Theory of Change***

A program's theory of change describes the assumptions made about how the resources and activities used to implement the program will lead to intended outcomes for the program's target audience(s) (McLaughlin & Jordan, 2004). The museum worked with UXR to identify outcomes and associated indicators to assess the effectiveness of the pilot program in four impact categories: 21<sup>st</sup> century literacies, critical thinking, decision-making, and problem solving (see

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<sup>4</sup> See <http://www.imls.gov/about/21stcskills.aspx> and <http://www.p21.org/>

<sup>5</sup> STEM = science, technology, engineering, and math

Table 1). These impact categories align with the 21<sup>st</sup> century skills framework, which was developed by the Partnership for 21<sup>st</sup> Century Skills and adapted by the Institute of Museum and Library Services (IMLS, 2009).

**Table 1. Research Lab impact categories, outcomes, and indicators for museum goals**

Impact Category	Outcome	Indicator (data sources)
<b>21<sup>st</sup> century literacies (scientific, information, health)</b>	Participants will practice and improve their scientific literacy.	<ul style="list-style-type: none"> <li>Collect, analyze, and interpret quantitative and qualitative data (poster assessment)</li> <li>Move through the scientific research process (poster assessment, post-program survey)</li> </ul>
	Participants will practice and improve their information literacy.	<ul style="list-style-type: none"> <li>Demonstrate knowledge of how to appraise resources (post-program survey)</li> </ul>
	Participants will practice and improve their health (i.e. sleep) literacy.	<ul style="list-style-type: none"> <li>Conduct a research study on the impacts of sleep on teens (poster assessment)</li> <li>Demonstrate understanding of the impacts of sleep on teens (poster assessment, post-program survey)</li> </ul>
<b>Critical thinking</b>	Participants will use various types of reasoning (inductive, deductive) as appropriate to the situation.	<ul style="list-style-type: none"> <li>Analyze qualitative and quantitative data (poster assessment, interviews)</li> <li>Draw conclusions based on results (poster assessment, interviews)</li> </ul>
	Participants will analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.	<ul style="list-style-type: none"> <li>Demonstrate understanding of impacts of sleep on outcomes like student achievement, community impacts, and other aspects of their personal lives. (poster assessment, post-program survey)</li> <li>Demonstrate understanding of limitations of their findings (interviews)</li> </ul>
<b>Decision making</b>	Participants will effectively analyze and evaluate evidence, arguments, claims, and beliefs.	<ul style="list-style-type: none"> <li>Analysis of data and interpretation of findings (poster assessment, interviews)</li> <li>Work in groups to evaluate sources of evidence and analyze the relevance of various research sources. (poster assessment, interviews)</li> </ul>
	Participants will interpret information and draw conclusions based on the best analysis.	<ul style="list-style-type: none"> <li>Interpretation of findings (poster assessment)</li> </ul>
	Participants will reflect critically on learning experiences and processes.	<ul style="list-style-type: none"> <li>Students reflect on their experiences going through each stage of the research process and working with others (interviews, post-program survey, poster assessment)</li> </ul>
<b>Problem solving</b>	Participants will identify and ask questions that clarify various points of view and lead to better solutions.	<ul style="list-style-type: none"> <li>Students ask meaningful questions (poster assessment)</li> <li>Students develop research questions and then design a research study to answer them (poster assessment)</li> <li>Students develop a research study that asks questions relevant to their personal lives and community (poster assessment, interviews)</li> </ul>

In addition, HCF stresses “college, career, and community” as its main objectives for Hispanic youth. Thus, the evaluation also sought to uncover how the program might have prepared students for college, future interests in science, and how they built community through their team collaborations and community research efforts.

**Table 2. Research Lab impact categories, outcomes, and indicators for HCF goals**

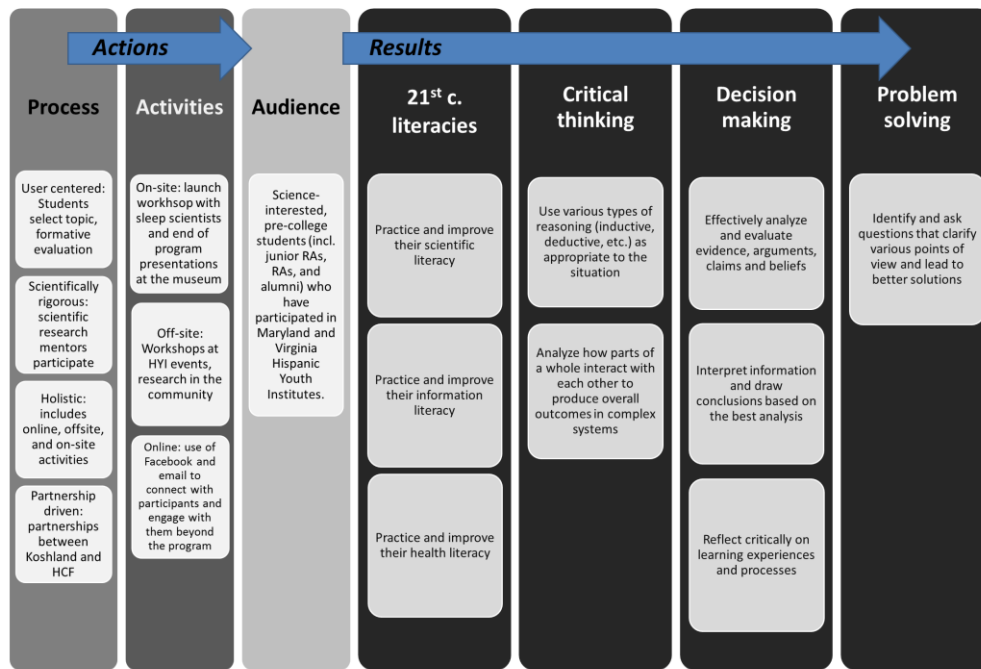
Impact Category	Outcome	Indicator (data sources)
<b>College</b>	Program elements will provide students with experiences that will prepare them for college.	<ul style="list-style-type: none"> <li>Students describe ways in which the program has prepared them for college (interviews)</li> </ul>
<b>Career</b>	Participation in a personally relevant, science-related topic will encourage student interest in science in the future.	<ul style="list-style-type: none"> <li>Self-reported increased interest in pursuing science from students who completed the program than those who did not (post-program survey)</li> </ul>
<b>Community</b>	Participants will work with each other, family, and friends/peers in their community to complete the program.	<ul style="list-style-type: none"> <li>Self-reported team work behavior (post-program survey)</li> <li>Reference roles that teachers, parents, and friends/peers played in the process (interviews)</li> </ul>

A logic model graphically represents a program’s theory of change, illustrating the actions-to-results relationships among program components, activities, and outcomes from key stakeholder perspectives (Love, 2004). Figure 1 contains the logic model depicting the program theory for the Research Lab.

**Figure 1. Koshland Youth Research Lab Pilot Program Logic Model**

Koshland Youth Research Lab: Interact with the Issues (Pilot Program)

Mission: to help participants of the Hispanic Youth Institutes use research to solve problems





## **Program description**

### *Phase I: Summer workshops, front-end evaluation, and registration (May-September 2011)*

The first phase of the pilot program was a series of summer workshops. The museum worked with HCF to connect with students at two Hispanic Youth Institute (HYI) Kickoffs in the summer of 2011.

Prior to the HYIs, Koshland staff met with HCF staff to coordinate plans for the workshops. Together they generated a list of social and community issues for which science could be used to solve or understand them. These topics aligned with the Issues to Action workshops, which are integral to the HYI curriculum. Issues to Action workshops are intended to stimulate Hispanic youth to solve problems in their communities and address barriers to academic advancement.<sup>6</sup>

Koshland staff reviewed the topics for connections to the work of the National Research Council or Institutes of Medicine in order to align the program with their institutional mission. Four topics were selected for feedback from the students: adolescent sleep needs (referred to as sleep throughout this report), teen sexuality and risky behaviors (referred to as sexuality), water quality (referred to as water quality), and adolescent health and nutrition (referred to as nutrition). The final decision on the topic was given to students (primarily 10<sup>th</sup> graders), *familia* leaders (RAs), and junior leaders (junior RAs) during the HYIs to ensure the program topic would be as relevant and engaging to the participants as possible. The first Kickoff was held in Towson, MD at Towson University in June 2011, and the second was held in Petersburg, VA at Virginia State University in July 2011.

The Maryland HYI workshop took place on June 22, 2011, the second day of the HYI symposium, at Towson University in four, 45-minute increments from 3:00 PM to 6:00 PM. All students had participated in an Issues to Action workshop earlier that day and topics described in that workshop were used as a jumping off point for discussion in the Koshland workshops.

The Koshland workshop included a focus-group-like discussion format along with some individual sticky note-based activities. The primary research and evaluation objectives for the focus groups conducted in MD were to better understand workshop participants' attitudes, awareness, and skills with regard to information and research. More specifically, Koshland staff was interested in understanding how participants accessed and verified information to assess information literacy and critical thinking skills. Another goal of the workshop was to gauge student interest in the four pre-selected topics.

The Virginia HYI workshop took place on the second to last day of the four-day HYI symposium at Virginia State University on July 22, 2011 in an auditorium setting from 4:30 PM to 5:15 PM. The students participated in the Koshland workshop all at one time in an auditorium setting rather than in a more intimate workshop setting like that of the event in Maryland. The workshop was scheduled at the same time as the Issues to Action finals event, so many students were unable to attend. Only students who did not make it to the finals were able to join the museum workshop.

The workshop included both individual- and group-guided worksheet activities. The goal of the workshop in Virginia was to narrow the topic selection based on findings from the Maryland HYI and to understand better students' knowledge and skills with regard to designing and conducting research.

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<sup>6</sup> See <http://www.hispanicfund.org/programs/hyi/about-the-program/action> for more details.

These workshops were conducted to help students consider the role of research in their lives and to understand the importance of scientific inquiry and discovery for the purposes of civic and community participation.

Both sets of workshops used the results of the focus-group-type conversations as well as the individual and group activities to identify students' baseline knowledge and awareness related to information literacy and research skills. The workshops were also used to select the final research topic – sleep – and to identify student interest in participating in a research-based program. The Koshland used the results from these front-end evaluation efforts to inform the development and implementation of the fall Research Lab program. See the front-end evaluation report for more details on the workshop and the evaluation findings<sup>7</sup>.

After the summer workshops, the museum sent a call for participation to the students for the fall program related to the most popular topic among students, the science of sleep. See Appendix A for the recruitment emails. Interested students were asked to complete a pre-registration form and describe why they were interested in participating in the program.

A follow-up survey was sent to these students who pre-registered inquiring about logistics related to travel needs, technology and Internet access, communication preferences, and possible incentives. Students were encouraged, though not required, to complete this survey.

#### *Phase II: Program Launch Workshop (October 2011)*

The second phase of the program was a program launch workshop in which the final group of registered students came to the museum on a Saturday morning to learn about sleep research, to practice the scientific process, and to develop their research plans in teams. Prior to the workshop, the HCF helped recruit and encourage students to participate in the program; helped determine the best date and timing for the workshop; assisted with obtaining permission for student participation; and recommended the best ways for students to form research teams.

Jeanne Troy, Program Officer at the museum, worked with the Committee on Sleep Medicine and Research and the Board on Children, Youth, and Families of the Institute of Medicine (IOM) to identify scientific research mentors for the project. The scientific research mentors for the pilot study were Dr. Jennifer Gootman, Program Officer at IOM, and Dr. Judith Owens, director of sleep research at Children's National Medical Center. Sharon Bergquist, the Christine Mirzayan Science and Technology Policy Graduate fellow for the Koshland during fall 2011, also participated in the launch workshop by leading the research methods portion of the event. As a recent graduate of a doctoral program, Sharon served as a bridge between the students and the established scientific researchers in terms of age and experience.

From the outset, the museum hoped that RAs and junior RAs would provide near-peer mentoring for the student groups in the Research Lab. RAs are group leaders from the *familias* formed in the HYIs. They were often already attending college and typically shared a strong connection with the students from

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<sup>7</sup> The front-end report is available online: Koepfler, J. A. (2011). User-centered program development of the Koshland Youth Research Lab. UXR Consulting, Philadelphia, PA. <http://informal.science.org/evaluation/show/482>. There were no written formal reports written for the formative evaluation of the program.

their summer cohort. The original program plan sought to have at least one RA per research group, but this posed a logistical challenge because the location and scheduling of the program for high school students did not align well with college student schedules. Although no RAs were able to participate, two junior RAs and four HYI program alumni signed up to participate. The final research groups were comprised mainly of students in the 10<sup>th</sup> grade with some groups having a junior RA or program alumni from the 11<sup>th</sup> or 12<sup>th</sup> grades as part of their group as well.

## Pre-workshop photo-collection activity

Prior to the workshop, Jeanne asked participants to make observations in their community, taking or collecting at least 10 photos that demonstrated how sleep was an issue in their community (i.e. at home, at their school, or among their group of friends). Nine students uploaded their photos to a photo-sharing site Flickr (<http://www.flickr.com/>). This activity builds from the Photovoice technique, which was designed to give voice to marginalized individuals' understanding of their own communities (Wang & Burris, 1997). For the Research Lab, it was intended to encourage students to observe how the issue impacts their community, and to provide the foundation for the first step of the research process.

By collecting these photos, participants engaged in the first steps of a community assessment. The activity also provided Jeanne with insights into students' personal perspectives on sleep as a community issue.

## In-museum workshop on the science of sleep and conducting research

On the day of the program launch in October, students met at the museum for a hands-on, facilitated workshop from 9am-12noon. The workshop started with introductions and a slide show of the community photos about sleep that students had collected. Next, Dr. Owens gave a one-hour talk about sleep research while students took notes. At the end of her talk, students asked questions.

In the second half of the workshop, students practiced their research skills. Sharon Bergquist introduced the concept of hypothesis building and walked students through their research packets and field journals, which Jeanne had developed for the program. Students then brainstormed research questions related to sleep based on what they had learned in Dr. Owens' talk and from Sharon's tutorial.

After the brainstorming session, Jeanne led a hands-on research activity to help students practice the research process, including asking preliminary questions about the problem, forming hypotheses, and thinking about how to test the hypotheses. Jeanne posed the following problem to the students:

*On several Easter mornings, Jeanne awakes to her basket filled with Peeps and other candies. She loves Peeps but finds that on Easter morning they always seem different from when she buys them in the store. She doesn't know why this is.*

Students asked clarifying questions about the nature of the problem and then developed hypotheses. Jeanne gave the students both a stale and fresh Peep and encouraged them to identify the independent and dependent variables while making observations about the differences between the two Peeps.

In the last portion of the workshop, students worked in groups to discuss their research questions related to sleep and determined how they would work together in their groups to complete the research project.

### *Phase III: Field Research (November 2011)*

During the third phase of the pilot project, students worked in research groups to conduct field research. The students used their research packets (to varying degrees) to develop a research plan that would answer the questions they identified in the launch workshop. Jeanne provided feedback on their research designs, confirmed their plans for data collection, and ensured students had obtained the proper institutional permissions to begin data collection.

Once the groups collected their data, they then worked together to analyze and interpret their findings and present their research on a poster. Jeanne sent instructions and a template for developing the research posters and students presented these at the museum in an end-of-program poster presentation event.

### *Phase IV: Student Analysis and Actions (December 2011)*

During Phase IV of the pilot project, the students returned to the museum on a Saturday afternoon to share their research findings and experiences with each other and with other stakeholders. Visitors to the event included Dr. Owens, Dr. Gootman, Sharon Bergquist, Daniel Sarmiento, Benjamin Thorpe (also from HCF), and friends and family members, including an Intel Science Fair trainee being mentored by Dr. Owens.

During the event, students stood by their posters in groups and gave short five-minute presentations in an informal setting as visitors walked around the displays and asked questions. Visitors listened carefully to student presentations, asked clarifying questions of the students, and provided advice on outcomes and solutions.

The 1.5-hour event concluded with pizza and snacks in the museum's lobby.

### *Communication and Collaboration*

Based on student feedback from the logistics survey, Jeanne created a Facebook group and invited all members of the Research Lab to join it. Daniel Sarmiento of HCF also joined the group. Throughout the program Jeanne posted updates to the page, reminding students of upcoming due dates, organizing the meetings at the museum, and sharing related news articles about sleep issues for teens.

To a lesser degree, students also used the Facebook group and Facebook messaging system to ask questions. Students were able to determine the modes of communication that worked best for their intra-group collaboration. Two groups developed separate Facebook groups to communicate and share documents, while other groups relied more heavily on email and phone calls.

### *Incentives and Compensation*

To encourage participation throughout the program, the museum subsidized student expenses by giving the students a choice of Amazon or Target gift cards in the amount \$25.00. They also provided food at the onsite events, and provided access to a web-based survey tool called Survey Monkey

([www.surveymonkey.com](http://www.surveymonkey.com)), to support their data collection efforts. Jeanne from the Koshland and Daniel from HCF checked on the students regularly to ensure they were on the right track with their research projects and to answer any questions that the students had.

Figure 2 summarizes the four phases of the Research Lab’s program model.

**Figure 2. Research Lab program model**



Table 3 summarizes student participation during each phase of the pilot program.

**Table 3. Summary of student participation in each phase of the pilot program**

Program Phase	Student Participation
<b>Phase I: May-September 2011</b>	
Summer workshops and front-end evaluation	243 students from Maryland (n=132) and Virginia (n=121) participated in the summer workshops.
Pre-registration	52 students from the Maryland HYI (n=35) and Virginia HYI (n=17) completed the pre-registration survey
Logistics survey	14 students completed the optional logistics survey.
<b>Phase II: October 2011</b>	
Program Launch Workshop	30 students were registered to participate in the program. 22 students attended the launch workshop. Several students who had registered were unable to attend due to injury, illness, and/or transportation constraints.
<b>Phase III: November 2011</b>	
Field Research	15 students participated in field research in their communities.
<b>Phase IV: December 2011</b>	
Student presentations at end-of-program poster session	13 students participated in the end-of-program workshop to present their work. The two students who could not attend had prior school-related commitments.

## METHODS

The research design called for a multiple-method approach to answer the overarching evaluation questions. In this way, the assumptions and purposes of one method could be balanced and accounted for by triangulation with another method (Chen, 1997; Creswell, 2009). Whenever possible, we embedded evaluation into the program to maximize resources, to be unobtrusive, and to prevent oversampling of participants. As shown in Figure 3 below, there were seven different combinations of qualitative and quantitative data sources and methods used to evaluate the program.

**Figure 3. Data sources and methods for the program evaluation.**



We used all of these data sources to evaluate the program as it evolved. In particular, the focus groups and research proposals from the summer HYIs became an integral part of the front-end evaluation. Observations at the launch workshop and the backchannel communication were useful for formatively assessing the progress of students and ensuring the program was on track to attain its goals.

We used three data sources in particular for the summative evaluation: poster assessments, group interviews at the end-of-program event, and a post-program survey. Because students used their field journals inconsistently, we were not able to analyze them systematically and we did not include them in the final analysis of this program. We have included an example of a completed field journal in Appendix B and the research instruments for the interviews and survey in Appendix C.

In the sections that follow, we describe the research instruments and protocols, their intended purposes for the evaluation, and their limitations.

**Poster Assessment**

Two researchers attended the end-of-program poster presentation held at the museum on Saturday, December 3, 2011. While one researcher conducted interviews, a second researcher assessed each poster (including the poster itself and student presentations of their research process and findings) using a scoring rubric. This researcher was external to the program (i.e. he was not part of planning calls or otherwise biased through participation) and was the same individual who developed the rubric and assessed the research proposals during the front-end evaluation in the Virginia HYI museum workshop. His participation in this phase of the evaluation helped to ensure consistency in applying the rubric.

The rubric assessed four key components each group’s research project:

- 1) Appropriateness: the research design was appropriate to the research question (3 points)
- 2) Realistic: the study was realistic and doable within the timeframe of the program (3 points)
- 3) Comprehension: the poster demonstrated an understanding of the research process (3 points)
- 4) Creativity: the study was creative (e.g. unique methods or combination of methods, unique resources, or creative data gathering techniques) (4 points)

The researcher assigned each poster a score for each category, provided a description justifying his scores, and then summed the scores (out of a possible 13 points). One poster for each group was assessed. There were four group posters covering four different topics:

*Group A: The effects of sleep on Grade Point Average*

### Sleeping vs. GPA's

<p><b>What's the Problem?</b></p> <p>The problem that we have seen in our community is that the amount of sleep you get affects your overall performance in school. We started noticing this based on our own experiences. Whenever we got good nights of sleep we seemed to focus better in school, leading to better grades.</p> <p><b>Our Research About the Problem</b></p> <p>Our team learned about the different stages of sleep and how long each one takes with Dr. Owen's previous research on sleep. Based on our own results, at least 70% of students that we surveyed agreed that lack of sleep does affect their school performances.</p>	<p><b>What's Your Question</b></p> <p>How does the early beginning of school affect the performance of students during school hours?</p> <p><b>Research Methods</b></p> <p>To research this issue in the community, we created an online survey that asked students specific questions about their sleeping habits. For example: "What time they go to sleep?" and "what time they wake up?" The online survey was taken by students in both Parkdale High school and Eleanor Roosevelt High School.</p>	<p><b>Conclusion</b></p> <p>Based on our results, we found out that school start times do have an affect on the performances during school. Many teenagers do not get the opportunity to experience REM sleep due to the short hours of sleep they get each night, which would result in lower performances.</p> <p><b>So Now What?</b></p> <p>Based on our research, we would suggest to all students that getting a goodnight's sleep (8-9 1/2 hours) will benefit you the most, for people who sleep more tend to get higher academic performance rates.</p>
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**Acknowledgments:**  
We would like to thank Ms. Troy, Ms. Sharon Berquist, and Dr. Owens for all the help that they contributed to us.

**References:**  
Dr. Judith Owens, "The ABCs of ZZZs: The Impact of Insufficient Sleep on Adolescents." Presented at the Koshland Science Museum on October 8, 2011.

*Notes.* This poster also had a second poster associated with it with descriptive statistics in the form of pie charts and bar graphs.




Group B: Effect of sleep deprivation on academic achievement

## Effect of Sleep Deprivation on Academic Achievement

**What is it we are faced against?**  
Under the pressure of intense competition in the labour market and the access to college, members of the community are suffering from lack of sleep.

**Our question**  
Since individuals who lack sleep are less likely to retain information and tend to seek for the missed sleep, the lack of sleep will then worsen academic achievement

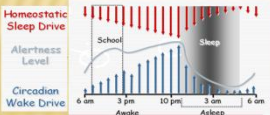
**Conclusions**  
The highest scores were achieved by the members with most hours of bed time. There was a 9.1% grade increase between those who "slept enough", and those who didn't. This suggests that sleeping for around average amount of hours tends to improve scholastic results. Still, test results could be involved with time of day that the person wakes up and goes to bed.



**Our Research About the Problem**  
Sleep is an essential ingredient for the process of learning. Without sleep students are less capable of retaining information. Sadly, 80+% of adolescents get less than recommended 9 hours of sleep, and as the individuals age, these numbers go worse. Questions that exist are, what are the real effects of such behaviour?

**Research Methods**  
The hypothesis was tested by surveying a mass of 63 students from three different schools, and was taken care of by 3 of the members of the group. The questionnaire consisted of 2 parts, one that asked about sleep data, and an extract from and SAT test.

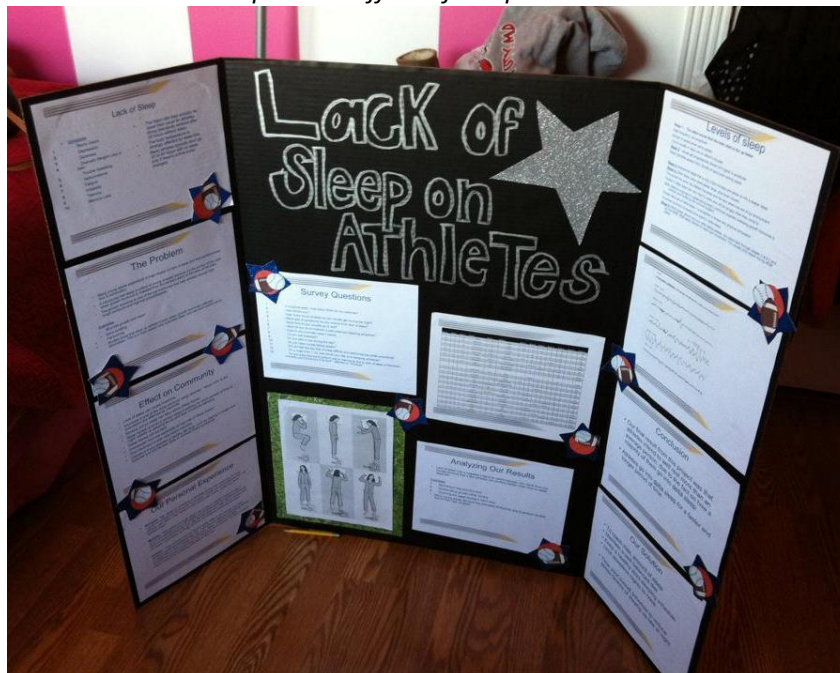
**If academic success is what you're looking for..**  
Sleep more! It is for you to set on a balance, sleep and remember more to the drawback of partially studying, or fully studying and remembering a fraction of it. Out of our researched 63 students, roughly 30% slept appropriately and those were the best averages.



**Acknowledgements:**  
We want to thank the Koshland Museum, and all of its staff for all the support.

**References:**  
"Male Tired From Reading" Stock Photos and Royalty Free Image Subscription from 123RF Stock Photography. Web. 29 Nov. 2011  
Owen, Judith. "The ABCs to ZZZs Presentation." Koshland Science Museum. Washington, DC. 8 Oct 2011. Lecture

Group C: The effect of sleep on athletes





Group D: The effects of technology on sleep

**Technology and It's Affect on Sleep**

<p><b>Sleep Deprivation Due to Technology</b></p> <p>Teens in the community are constantly being affected by sleep deprivation, experiencing both minor and major consequences. The lack of sleep results in many different outcomes, from moodiness and lack of attention to more dangerous and deadly outcomes such as car accidents and falling asleep at the wheel. Technology plays a big role in the cause for sleep deprivation in teens; with today's frequent use of cell phones, laptops, iPods, tablets, etc. it is rare to find a teen that doesn't use technology before bed. The distraction of said items cause the teen to stay up longer, the time going unnoticed, resulting in lack of sleep and its side effects.</p> <p><b>Prior Research</b></p> <p>We researched many topics, including basic knowledge about sleep. Learning how the Circadian timing System works, the sleep stages and their importance, and basic sleep regulation. We then researched more in depth about sleep and adolescents; learning the average hours of sleep needed and the ideal environment for sleep.</p> <p><small>We would like to acknowledge Jeanne Troy for her dedication to helping us through this research, and for supplying helpful advice and tips along the way.</small></p>	<p><b>Question</b></p> <p>Based on our research we first want to confirmed that technology does indeed affect sleep, or more accurately the ability to fall asleep. Once this was confirmed we brought up the question: "Does limiting technology use for at least two hours before bed affect the ability to fall asleep and any side effects associated with sleep deprivation?"</p> <p><b>Method</b></p> <p>Our research plan was to first identify a group of teens in each of our high schools who would be willing to complete an intervention style program with two surveys; a "before" survey to be completed before the intervention and an "after" survey to be completed afterwards. Our sample size was found to be very diverse and consisted of approximately 75 students from each school, covering grades 9-12 and all course levels. Each students completed the intervention program along with both surveys. Then we compared and grouped together the results.</p> <p><small>* To be able to personally experience the effects of the technology we underwent the intervention program ourselves.</small></p>	<p><b>Conclusion</b></p> <p>Limiting the use of technology for two hours before bed greatly impacted the test subjects in a positive manner. Most test subjects found it easier to fall asleep and experienced a more "deep" and peaceful sleep. Many stated that they had better attitudes and more interest in school on the days they completed the intervention. Virtually all participants felt more alert and "awake" as a result of the intervention. This confirms that technology is a big cause for lack of sleep, which over time leads to all the side effects (fatigue, stress, poor grades, etc.)</p> <p><small>*This was confirmed by our personal experience with the intervention</small></p> <p><b>Recommendations</b></p> <p>Based on our findings we recommend to limit use of all technology such as cellphones, TV's, laptops, and MP3's at least 2 hours before average personal "bed time". Also sleeping environment should be dark, and quiet to promote a relaxing and peaceful sleep. If both recommendations are followed one is more likely to fall asleep easier and quicker, which well then lead to an improvement in all side effects associated with sleep deprivation.</p>
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Notes. This poster also had a second poster associated with it with descriptive statistics in the form of pie charts and bar graphs.

Dr. Gootman also shared her thoughts with the evaluation team and the program officer on the student projects overall.

**Interviews**

One researcher conducted face-to-face small group interviews with students, lasting approximately 15 minutes. These interviews were digitally recorded.

The interviews were semi-structured and addressed five main topics:

- 1) Collaboration and Communication
  - a. How did your team work together?
  - b. What tools did you use to communicate with your group members?
  - c. How effective was the use of the Facebook group for communication with the museum?
- 2) Research Process
  - a. Now that you have completed this program, what new research questions do you have related to the topic of sleep, if any?
  - b. How did you arrive at the conclusions that you came up with for your study?
- 3) Recommendations
  - a. What was the most/least interesting thing you did during the Research Lab experience?
  - b. What would you do differently next time or how would you change the program, if at all?
- 4) Support
  - a. What role did your parents or teachers have in your research process, if any?

- b. What role did your friends and family members (non-parents) have in your research process, if any?
- 5) Future Experiences
- a. How has this experience prepared you for the types of challenges you think you might face in college, if at all?
  - b. How has it prepared you for the next few years of high school, if at all?
  - c. What could we do to make the process more beneficial to you for preparing you for college?

There were four groups:

- Group A had five students (3 females, 2 males) including one alumni.
- Group B had four students (2 females, 2 males).
- Group C had four students (three female, one male), including an alumni and a junior RA. Two of the team members were unable to attend to the event, so only 2 students participated in the interview.
- Group D had two students, both female, including one alumni.

We also conducted interviews with the program's two key stakeholders, Daniel Sarmiento of HCF and Jeanne Troy of the Koshland, to assess their perceptions of the program's overall effectiveness.

Once all of the interviews were transcribed, we conducted thematic analysis using the program goals and outcomes as a conceptual guide for emerging themes. Thematic analysis offers "an accessible and theoretically-flexible approach to analyzing qualitative data" (Braun & Clark, 2006, p. 77), which is appropriate for semi-structured interview data and the dynamic nature of a pilot program.

### **Survey**

A few weeks after the end-of-program event in the museum, we developed a questionnaire in consultation with Jeanne to measure the anticipated outcomes. We sent a full version of the questionnaire via a web-based survey tool (Survey Gizmo, [www.surveygizmo.com](http://www.surveygizmo.com)) to all of the students who completed the program. Once students completed the survey, Jeanne sent them their final compensation gift card. Throughout the rest of the paper this group is referred to as Group 1.

We also created a modified version of the survey for students who did not complete the program. We offered these students a \$5.00 Amazon.com gift card as an incentive to complete the questionnaire. Throughout the rest of the paper this group is referred to as Group 2. The primary goal of the survey for the Group 2 students was to find out why they dropped out of the program, so that the program might be better designed in the future to reduce attrition. As a result, there was not much room in the survey to duplicate questions from the Group 1 survey for extensive group comparisons, though the survey did ask a few of the same questions (i.e. Intention to Participate in Science in the Future scale). In any event, testing most of the other scales on Group 2 would not have been logical, because some of the students did participate in some of the program activities - just not all of them. This inherent variance in the data would have made the results difficult to interpret. Thus, beyond the comparison made in this report, there are no additional comparisons that can be made between the two groups.

The questionnaire sent to Group 1 contained six quantitative, summated scales with the following labels: Evaluating Information Sources, Attitudes towards Doing Research, Attitudes towards Studying Sleep, Perceived Knowledge of the Science of Sleep, Intentions to Participate in Science in the Future, and Reported Team Work Behaviors. The Intention to Participate in Science in the Future scale was also included in the questionnaire for Group 2. We adapted and modified the scales from similar scales used by Norland and colleagues to evaluate the Youth Astronomy Apprenticeship pilot program (2009). The scale modifications and changes were necessary due to the change in science topic from astronomy in the Norland study to the science of sleep for this study, as well as slightly different program goals.

We calculated internal consistency measures for each scale using Cronbach’s Alpha. The results appear in Table 4 below and show that the scales were acceptable for the early stages of instrument development, but not all were optimal (i.e. the Attitudes towards Studying Sleep and Evaluation Information Resources scales; Nunnally & Bernstein, 1994). Overall, alphas ranged from 0.55 to 0.96.

**Table 4. Internal consistency measures for scales (agreement scale from 1 to 5)**

Scale Name	Items	Cronbach’s Alpha for original scale
<b>Evaluating Information Resources</b>	4 items	0.62 (n=15)
<b>Attitudes towards Doing Research</b>	3 items	0.73 (n=15)
<b>Attitudes towards Studying Sleep</b>	5 items	0.55 (n=15) (0.73 when reverse-worded item is removed)
<b>Perceived Knowledge of the Science of Sleep</b>	4 items	0.78 (n=15)
<b>Intention to Participate in Science in the Future</b>	5 items	0.96 (n=23) <sup>1</sup>
<b>Reported Team Work Behaviors</b>	5 items	0.82 (n=15)

*Notes.* Agreement scales from 1=strongly disagree to 5=strongly agree. <sup>1</sup>The Intention to Participate in Science in the Future scale was included in the survey to Group 1 and Group 2 for a total n=23.

Based on these analyses, we omitted one item from the Attitudes towards Studying Sleep scale due to poor functioning, most likely due to the reverse-wording of the item (see Appendix C). The final scale used for analysis was comprised of the remaining 4 items raising the internal consistency measure to  $\alpha=0.73$ .

The questionnaire also contained single items asking students to rate their confidence (scale 1-5) in the research process before the program and after the program. We described the steps of the research process as follows:

- Generating research questions
- Developing hypotheses
- Reviewing prior scientific research related to my research question
- Creating a research tool like a survey or interview
- Collecting data from human subjects using a tool like a survey or interview
- Analyzing data (either quantitative data like calculating percentages from numbers or qualitative data like open-ended responses or comments)
- Interpreting the results of a study to draw conclusions

- Writing up the results of a research study (e.g. completing a field journal, creating a poster)

We asked students in Group 1 if they would be interested in taking a leadership role in the next iteration of the Research Lab and to describe any advice that they had to offer future students of the program.

We asked students in Group 2 about how confident they were in each step of the research process. We also asked them a different set of items about how interested they were in some of the main components of the program model, including:

- Learning about the scientific research process.
- Meeting new people.
- Learning about the topic of sleep.
- Participating in workshops and meetings at the Koshland Museum in Washington, DC.
- Working in groups.
- Presenting your findings to your peers and others.
- Conducting a research project.

We also asked Group 2 students to list the key reasons that they were unable to complete the program, what suggestions they had for improving the program, and what incentives could be offered to help motivate continued participation.

We asked both groups to list any advice or suggestions that they had for future students interested in the program.

All 15 students in Group 1 completed the survey. Of the 15 students in Group 2, 8 students responded to the survey. Table 5 summarizes the descriptive statistics for all of the students in this study (Group 1 + Group 2 respondents). The data was compiled and managed using *SPSS 17.0*, a statistical software program.

**Table 5. Demographic characteristics of the survey sample (n=23)**

Characteristics	Survey Participants % (#)
<b>Gender</b>	
Female	70% (16)
Male	30% (7)
<b>HYI State</b>	
Maryland	57% (13)
Virginia	44% (10)
<b>Age</b>	
15	30% (7)
16	39% (9)
17	22% (5)
18	9% (2)

(Table 5 cont'd)

<i>Characteristics</i>	<i>Survey Participants % (#)</i>
<b><i>HYI Role</i></b>	
Student	83% (19)
Alumni	13% (3)
Junior RA	4% (1)
RA	0% (0)

***Analysis***

To test the hypothesis that the program had a positive impact on intended outcomes from the beginning to end of the program, we conducted a within-groups, one-tailed t-test comparing Group 1’s retrospective pre-program scores to their post-program scores on scaled items for the research process. We also conducted a between-groups, one-tailed t-test comparing post-program scores for the summated scales from students in Group 1 to scores from students in Group 2.

***Limitations***

The summative evaluation occurred approximately one month after the end of the program. Even though the research design was appropriate for testing program impact, the data were limited by the short amount of time that had elapsed after the program. Studying the impact of the program on students over time would be recommended for interpreting impact in terms of changed behaviors and actions. The museum might be able to coordinate such longitudinal tracking efforts through their collaboration with the HCF, which tracks students in terms of their high school graduation and college acceptance rates.

We also did not capture independent variables beyond students’ participation in the program. Larger studies in the future could consider demographics such as family income, student GPA, and student access to transportation or technology as possible factors accounting for differences among the students or groups.

Lastly, this study highlights a specific set of experiences that represent a range of student personalities, group types, and stakeholder interactions. Due to the use of small samples and self-report data methods, the results from this study cannot be generalized to high school students in general or HYI participants more broadly. The findings do, however, point to lessons learned and potential best practices that may be transferable across institutions and in other program settings.

**RESULTS & DISCUSSION**

**Student Outcomes**

***Defining Measures***

The project hypothesis was that students who completed the program would experience gains or report positive average scores for outcomes related to 21<sup>st</sup> century literacies, critical thinking, decision-making, and problem solving vis-à-vis learning and applying the scientific research process to a scientific topic

chosen by the students, in this case, the science of sleep. We hypothesized that students who participated in the program would also report ways in which the program prepared them for college, inspired them for a future in science, and connected them with their community. To assess these outcomes, we conducted a poster assessment, interviews, and post-program survey.

For this study, average scores for most quantitative scales were based on a 5-point scale with 1=lowest end of the scale and 5=highest end of the scale. Because the average scores (i.e. mean) typically fell within a small range (3.0 – 4.0), we considered mean scores below 3.0 to be ‘lower’ than the majority of scores and those above 4.0 to be ‘higher’ than the majority of scores. For posters, the scale was a 3- or 4-point scale for each scoring criteria with 1=lowest and 3 or 4=highest. For these scales, we considered 2-2.5 or higher to indicate success.

Standard deviation is a measure of the spread or variance of a set of scores. The standard deviations are listed in parentheses following the mean scores. For a 5-point scale, we considered standard deviations below 0.70 to represent a small spread of scores around the average (respondents reported similar scores) and those 1.0 or higher a large spread.

For measures that had a comparison group (i.e. both retrospective pre- and post-scores, or group comparisons between Group 1 and Group 2), we conducted paired-samples and independent samples t-tests with an alpha-level of 0.05 to test the research hypothesis. For measures that did not have a comparison group (i.e. post-only scores that had no pre-score to match them with), we considered scores indicative of program success if they had high average scores on the 1-5 scale (4.5) with relatively small standard deviations ( $SD < 0.70$ ).

When there was qualitative data associated with the quantitative scores, it was used to help explain the phenomenon that was occurring in the numerical scores. In cases where qualitative data was the only data source, we identified themes and patterns that emerged from the data. These are described in the report along with illustrative examples of the range of response types when possible.

In the sections that follow, the results from each data source are reported along with the impact category they were intended to assess. Each method and data source was intended to capture different aspects of the program and to assess different impact categories, so each method section only covers certain categories as described in earlier tables (reference Table 1 and Table 2). A summary of these results, organized by evaluation question, impact category, and outcomes follows in the Conclusion section.

## ***Poster Assessment***

Table 6 highlights the scores given to each poster in the categories of Appropriateness (App.), Realistic (Real.), Comprehension (Comp.), and Creativity (Creat.).

**Table 6. Poster assessment scores (k=4 groups)**

Poster Title	App. (of 3)	Real. (of 3)	Comp. (of 3)	Creat. (of 4)	Total (of 13)
The effects of technology on sleep [Group D]	2	3	2.5	4	11.5
Sleep deprivation and academic achievement [Group B]	3	3	2.5	4	11.5
The effects of sleep on Grade Point Average [Group A]	1.5	2	2	4	9.5
Athletes and sleep [Group C]	1.5	2	2	4	9.5

*Notes.* Scoring rubric goes from 1=lowest score to 3= highest score for Appropriateness, Realistic, and Comprehension; to 4=highest score for Creativity.

In the impact category of *21<sup>st</sup> century literacies*, the posters showed students’ abilities to collect, analyze and interpret data and move through the scientific research process by conducting a research study on the impacts of sleep on teens. In general, the students included most of the key elements of a research project on their posters. Although Jeanne provided the students with a poster template during the pilot program, a more detailed and explanatory poster example may have helped them improve the content and design of their posters. Future iterations of the program will have the posters from the pilot program as examples to model and build from with additional guidance from Koshland staff.

The moderate to high scores for Comprehension indicate that students understood the research process and understood the science content related to sleep. Dr. Gootman noted that the students “did a really nice job in presenting their topics and there was at least one person in each group that was very articulate in presenting them. They fielded questions well and were fairly clear on how they came up with their research idea, the process they used to collect their data, and what the results showed.”

Lower scores in the category of Appropriateness suggest that the students had issues regarding the reliability and validity of the studies. Reliability means that the instruments or interventions in the study would yield consistent results if conducted again. Validity means that the instruments were measuring the things they were intended to measure. Though Jeanne had intended to introduce these concepts during the program, they simply ran out of time. For example, one group used an intervention technique, but had no way of verifying participants’ adherence to the intervention. Another group used a rigorous instrument (SAT questions) as a proxy for academic achievement, but that instrument may only have tested how well someone does on SAT questions. Further, students often did not consider alternative explanations for their findings (such as confounding variables) or address the limitations of their studies in conjunction with their conclusions. These are minor issues within the overall scope of the student projects, but they point to a key opportunity for developing greater information literacy and research practice in future iterations of the program.

In all cases, the student projects showed excellent Creativity – every group received the highest rating in this category (4). Creativity is a critical skill to apply to the research process (Heinze et al., 2009), and supports *critical thinking* and innovative *problem solving* (see P21, “Creativity and Innovation”, <http://www.p21.org/overview/skills-framework/262>). Examples of creativity in the student projects included:



- unique research design (e.g. the use of an intervention in which the researchers also did a self-test to better understand the experiences of their participants)
- clever use of an existing instrument (e.g. the use of a set of standardized test questions)
- creative data collection strategies (e.g. collecting data from athletes at a gym as well as athletes on high school sports teams).

Students demonstrated their *decision-making* skills by interpreting their findings and drawing reasonable conclusions. Two groups took this a step further and made recommendations for what people should do in light of their findings. For example, the group who studied technology and its effect on sleep said:

“Based on our findings we recommend to limit use of all technology such as cellphones, TV’s, laptops, and MP3’s at least 2 hours before average personal ‘bed time’. Also, sleeping environment should be dark, and quiet to promote a relaxing and peaceful sleep. If both recommendations are followed one is more likely to fall asleep easier and quicker; which will then lead to an improvement in all side effects associated with sleep deprivation.” [Group D]

This example shows that students connected the foundation of the research that Dr. Owens shared in the launch workshop to their own research studies and were able to make recommendations to their friends, peers, and family members. In the interviews, described below, several students noted that they were going to take their own advice and begin to apply these recommendations to their own sleep habits, following the model of the HYI’s Issues to Action initiative.

In the impact category of *problem-solving*, the posters showed students’ ability to ask meaningful scientific research questions and develop studies that were relevant to their personal lives and communities. The interviews showed several ways in which these projects related directly to their family or school environments.

## ***Interviews***

In the category of *critical thinking*, the students reported ways in which they saw their project’s findings connecting to or supporting the findings of some of the other groups’ projects. One student commented that the group that studied different school start times in relation to GPAs demonstrated another variable that might have accounted for some of his own group’s findings. He then said: “What would it look like if we controlled for some of the individual factors?” He wanted to know if they would have the same results if they took into account an individual’s average amount of sleep and average success on the SAT questions instead of the point-in-time estimate they used. Another student commented on how all of the research questions in each study were different but that they all painted a bigger picture of what impacts sleep had on teens.

Students were able to connect the project to their personal lives. One student consulted her family physician to discuss her sister’s and mother’s sleep issues. Another student was taking an AP Psychology class in school, and she pulled resources from her class notes. Yet another student was going to use this project as part of a biology class assignment. A fourth student said that now that she had completed the Research Lab, she had new ideas for her upcoming science fair:

“This is my first year doing a science fair. This gave me an idea of what it would be like. And gave me some ideas for what I could do.” [Group A, female]

Students worked in groups to evaluate sources of evidence and analyze relevant research sources demonstrating their *decision-making* skills. One group mentioned that they had to collect data twice to feel confident about their data analysis:

“The data came out wrong – our first survey came out wrong. We had five schools to begin with and we had all different sample sizes from each school. So we did it over and got 10 students from two different high schools that have different start times and made sure we could ask the same questions of the same types of students (science and tech students).” [Group A, female]

Students also noted ways in which their data led to changed behaviors in their own sleep habits, demonstrating gains in their *decision-making* and *problem solving* skills. One student described how her research findings influenced her:

“I used to always be on Facebook on my phone in bed. Now I don’t do that anymore. I put it far away from me, so that I have to get up to turn off the alarm and don’t use it as much [when I should be sleeping]” [Group C, Female]

Nearly all of the students mentioned at some point that they were more aware of their poor sleep habits and felt more confident that they had the skills and knowledge to make adjustments. Some jokingly commented on how they had stayed up late the night before to finish their posters, thus losing sleep in order to present their findings about the impacts of poor sleep, indicating awareness of the problems and their mixed progress towards solutions.

In the impact category of *college preparation*, when asked how the Research Lab had prepared them for the types of challenges they thought they might face, student comments ranged from new insights on time management and reflections on the research process to the need for more sleep. The examples below highlight these themes:

“This gave me a sense for when in college you have to do research papers...this gave me a sense for how it might be like. What it’s like to do research.” [Group A, male]

“[It made me realize] it’s a lot of work. A lot of planning. You have to be very organized. You have to meet certain deadlines.” [Group A, male]

“I know that I’ll need more sleep!” [Group B, female]

“Learning where to get information from. What sites to go to.” [Group B, female]

“With this project we got to learn how to do our time management. That’s really, really important.” [Group C, female]

“Most of the people we interviewed at the gym were in college. They had to balance work, school, and exercise. It gives you an idea of how that is.” [Group C, female]

“I would like to pursue a science major in college. Maybe biology with a focus on genetics. A lot of research goes into that. This gave me a peek into how research works, what the process is. And it’s nice to gain connections to people in the medical field. I think this is great.” [Group D, female]

“This was really great. A lot of kids don’t know how to do research or run a study. This was really great to learn about and to learn the process of it and how you have to be on time, you can’t procrastinate.” [Group D, female]

*Community* is a concept that is built into both the structure and core message of the HYIs. During the summer, students were organized into *familias* to help them develop a sense of community within the program. The Research Lab continued that model by placing students in groups and encouraging them to engage with their parents, friends, peers, and other community members to complete their research projects. Through interviews with the students, it became clear that parents played an integral role in student success by providing transportation and other logistical support. Parents were also a primary source of inspiration for the photo-sharing activity that students completed prior to the launch workshop.

Several students noted that their friends played the most important role in the project for them because they were the primary source of data for their field research activities:

“Friends played the biggest role. They took their time to participate in our study. I mean, who wants to take SAT questions?” [Group B, male]

“At school, friends and peers helped us compile our data...I gave surveys to my friends and had them give it to their friends so that we could branch out a bit...Eventually we found participants that were dedicated enough to try the intervention.” [Group D, female]

## **Post-Program Survey**

Retrospective pre-then-post testing asked students to consider how confident they were in each component of the research process *before* the program and then asked them to consider how confident they were in each component *after* completing the program. This approach has shown to be effective for measuring impact and change. It may allow for more accurate self-reporting than traditional pre/post testing because the pre-questions can be answered in the same psychological frame of reference as the post-questions (Rockwell & Kohn, 1989). When given an opportunity to learn how much respondents know about a subject prior to responding to a questionnaire, they can more accurately report on changes in knowledge, interest, and attitudes (Davis 2003).

Traditional pre/post measures can be considered for use in the future using the scales that we developed and tested in this summative evaluation. Traditional pre/post approaches have the benefit of being able to be used at multiple time points over the duration of a program or when following program participants longitudinally over time. This within-subjects research design approach, whether traditional or pre-then-post methods are used, is preferred over a between-subjects design (e.g. program

participants compared to a control group of students from the HYI who did not participate) because there are so many external factors that can affect a student’s perceptions and attitudes towards a topic or process. Simply choosing to participate in a program like this may indicate a different type of student (e.g. highly motivated) than those who did not choose to participate in the program.

As Table 8 shows, on average students reported positive increases in their confidence in all of the research component categories ranging from a 0.33-point increase to 0.94-point increase. At the start of the program, students felt least confident in generating research questions; by the end of the program, it was one of the components in which they were most confident. It is important to note that for the pre-then-post Research Process items, we used a confidence scale rather than an agreement or frequency scale, which were used for other items throughout the survey. Confidence, often linked with agency and self-efficacy, is one of five characteristics for positively developing young people (Lerner et al., 2005; Luke et al., 2007) and has been shown to contribute to one’s path into the STEM career pipeline (Brody, 2006; IMLS, 2007). There may be discrepancies between students’ reported confidence in a task, like interpreting the results of a study and drawing conclusions, and their demonstrated ability to do that task as exhibited by their posters. In keeping with this example, student posters showed that they were capable of interpreting and drawing conclusions, but that they need more work on concepts such as reliability, validity, and generalizability.

From a one-tailed, paired-samples t-test between the retrospective pre- and post-program scores, five out of eight of these components showed statistically significant increases, and no decreases.

**Table 7. Statistics for pre/post Confidence in the Research Process items for students who Completed the Program (n=15)**

Item	Pre Mean (SD)	Post Mean (SD)	Mean Score Change
Generating research questions	3.13 (0.92)	4.07 (0.70)	+0.94**
Developing hypotheses	3.67 (0.72)	4.00 (0.54)	+0.33
Reviewing prior scientific research related to my research question	3.40 (0.83)	3.93 (0.80)	+0.53*
Creating a research tool like a survey or interview	3.20 (1.21)	4.07 (1.10)	+0.87**
Collecting data from human subjects using a tool like a survey or interview	3.40 (0.91)	3.87 (0.74)	+0.47*
Analyzing data (either quantitative data like calculating percentages from numbers or qualitative data like open-ended responses or comments)	3.13 (0.92)	3.60 (0.74)	+0.47
Interpreting the results of my study to draw conclusions	3.40 (0.91)	4.00 (0.66)	+0.60*
Writing up the results of a research study (e.g. completing a field journal, creating a poster)	3.33 (1.23)	3.67 (0.82)	+0.34

Notes. Confidence scale from 1=not very confident to 5=extremely confident. One-tailed, paired-samples t-test. \*p<.05, \*\*p<.01

Table 8

Table 8 shows the descriptive statistics for the summated scales used in the post-program survey to assess *information literacy* and *health literacy*. The relatively low average score for the Evaluating Information Resources scale (M=3.10) suggests that there is room for improvement in the program for practicing and improving *information literacy*. The pilot program did not have structured time to help students examine other literature and resources beyond those that were given to them in the launch workshop or to practice evaluating those resources. Students’ self-proclaimed procrastination also prevented the group from engaging in discussions around the reliability and validity of their research designs and findings, which also would have provided opportunities for practicing and improving information literacy. This is an opportunity area for future versions of the program that might best be addressed by the addition of another face-to-face event, a longer launch workshop, and/or the addition of a program staff member who could help students specifically in this area at times convenient to the students (student schedules and the traditional workday often conflict).

The high average scores for Perceived Knowledge about the Science of Sleep (M=4.43) and positive Attitudes towards Studying Sleep (M=4.35) with very small standard deviations, indicate that the program allowed students to practice and improve their *health literacy* with regard to sleep practices. These averages provide a useful diagnostic for future iterations of the program and the tested scales will be useful measurement tools at the start of the program in the future.

**Table 8. Descriptive statistics for scales**

Scale Name	Group 1 (n=15) Mean (SD)
Perceived knowledge of the science of sleep	4.43 (0.37)
Attitudes towards studying sleep	4.35 (0.46)
Attitudes towards doing research	3.87 (0.63)
Evaluating information resources	3.10 (0.64)

Notes. Agreement scale from 1=strongly disagree to 5=strongly agree.

Preparing students for a career or college major in science is a goal held by many museums like the Koshland and *career/college*-oriented organizations like the HCF. It is typically hoped that programs like the Research Lab will help to generate a larger pool of science-interested individuals to begin the career pipeline in science, technology, engineering, or math (National Academy of Sciences, 2011). Table 9 displays the average scores for students’ Intention to Participate in Science in the Future and compares the average group score for the students who completed the program to the students who did not complete the program. Conducting a one-tailed, independent-samples t-test revealed no significant differences on this scale between the two groups. The large standard deviations (more than 1 SD in each group) suggest that other factors outside of the Research Lab program might be affecting students’ scores on this scale. Some possible factors might be level of interest in science (broadly defined), school requirements related to science classes, or other demographic factors.

**Table 9. Intentions to participate in science in the future**

Scale Name	Group 1 (n=15)	Group 2 (n=8)
Intentions to participate in science in the future	3.61 (1.03)	3.28 (1.55)

Notes. Agreement scale from 1=strongly disagree to 5=strongly agree.

In the impact category of *community*, the post-program survey was used to assess how students built community within the program through teamwork, and to determine whether or not students would be interested in extending their participation in the program by taking on a leadership or mentorship role in future years. The high average score for the students’ Reported Team Work Behaviors scale with the relatively small standard deviation, indicates that students typically worked well with others in their group, had a positive influence on group outcomes, and enjoyed working with each other (see Table 10, see Appendix C for scale items).

**Table 10. Reported team work behaviors**

Scale Name	Group 1 (n=15)
Reported teamwork behaviors	4.09 (0.70)

Notes. Frequency scale from 1=never to 5=always.

This sentiment was reinforced by the number of students who indicated that they would be interested in taking a leadership role in the Research Lab next year by mentoring a group, speaking at a workshop, or answering questions online for new student participants, among other potential activities. Table 11 shows that three-quarters of the students who completed the program were interested in continuing their participation in the program through such a role.

**Table 11. Willingness to take on a leadership role next year**

Scale Name	Group 1 (n=15)
Yes	73% (11)
No	13% (2)
I’m not sure	13% (2)

The survey gave students the opportunity to explain their responses to this question. The majority of responses expressed an interest in helping others to not make the same mistakes that they felt they might have made and to otherwise “pay it forward” by augmenting the same type of unique experience that they had in the Research Lab. Comments representing these two themes are highlighted below:

“I feel like in my experience as a first-timer, I believe that there should be someone looking over their shoulder to help when they need it 24/7, not just have one meeting and not get back together at the end of the program. It would help the adults if the veterans from the previous years help out the new students coming in the [program].” [Group A, female]

“I find it to be an amazing opportunity to learn more about the topic, get to know more students from the [H]ispanic community, stimulate science and give a hand to [K]oshland, who, two months ago gave me one.” [Group B, male]

“I would be able to help other participants of the program and help them with their projects I would like the leadership role because I enjoy helping others and because the science field is something I’m interested in.” [Group C, female]

“I would like to tell them about my experience. Tell them ways to make their experience easier.” [Group 1, male]

“It would be a great opportunity for me to give information about the do's and don'ts of this research investigation.” [Group D, female]

## ***Unanticipated outcomes***

Students had plenty of advice to pass along to future cohorts of the program, whether they completed the program or not. Their survey responses highlight unanticipated outcomes related to life skills such as time management, group communication, and staying focused. These comments, coupled with general student interest in acting as mentors in future years, suggest that former program participants can be resources for future programs. The following comments emerged in response to the open-ended survey question, “If you had one piece of advice to give to future students who might participate in the Koshland Youth Research Lab, what would it be?”

“DON'T Procrastinate. Keep your head in the game. This isn't a school assignment where you can BS it to get a barely passing grade. DO THE WORK. Your teammates aren't to be taken advantage of. DO your part. Have fun. It's not supposed to be stressful.” [Group A, female]

“[My advice] would be that they need to have determination and organization since it is the key to success towards your goal.” [Group A, male]

“Communication is important for a group project, ESPECIALLY a project like this. So always stay in touch with your group” [Group B, male]

“Don't procrastinate, be very scheduled and organized from the beginning. Communication is vital! Don't procrastinate.” [Group D, female]

“I would tell them to pay close attention to all the details, don't waste time, and get together with the group they were assigned.” [Female, did not complete program]

“Make sure that you have the time to do this so you won't miss out like I did.” [Female, did not complete program]

“Make sure to dedicate the same amount of time to this program as if it were a club at your school. Also don't let your group fall behind, meet the required dates to stay on track and make it easier.” [Male, did not complete program]

“Understand the commitment you're making to the [Research Lab] and have the motivation to complete the tasks.” [Female, did not complete program]

## **Program Assessment**

In addition to assessing to what extent the program achieved its intended (and any unanticipated) outcomes for the student participants, the evaluation aimed to identify the transferable elements of the program as well as lessons learned and best practices that could be used to improve the program moving forward. The primary data sources for the program assessment were interviews and open-ended questions in the post-program survey to solicit feedback from the students, and interviews with



the program's key stakeholders – Jeanne Troy, Program Officer at the Koshland and Daniel Sarmiento, Director of the Hispanic Youth Institutes of Maryland & Virginia from the Hispanic College Fund. We have presented their responses thematically within the two report sections that follow.

## ***Program Strengths***

In addition to the positive results related to student outcomes, program participants highlighted how much they truly enjoyed the program in an open-ended question at the end of the post-program survey:

“...this experience was really amazing and I enjoy being part of this program.” [Group A, male]

“I actually had fun during this project despite the [...] stress with it. I had to balance school work, and social life with the project, but overall I enjoyed it. It helped me learn about teamwork and that procrastinating is a bad thing” [Group A, female]

“I really enjoyed The Lab. I had thought I knew the scientific method pretty well but I was wrong. I learned much more. The demonstration with the [P]eeps [candy] on the first day helped as well as the availability Jeanne offered. Thanks for everything!” [Group B, female]

The program and its deliverables led several students to continue their learning through other outlets:

- Two students were accepted to another museum-based program.
- One student intended to use the service hours earned through the Research Lab for applications to some honor societies to which he was nominated [Group B, male].
- Another student asked Jeanne to be a reference on an application to another museum program that he was applying to [Group A, male].
- One student mentioned on the Facebook group that her New Year's resolution was to sleep earlier and finish her homework on time. She said that she had been going to sleep at 9pm recently and noticed that she had more energy [Group C, female].
- One student requested to have her field journal back so that she could use the resources for a biology project she was working on at school [Group B, female].

Daniel Sarmiento highlighted elements of the program that he felt were most successful in a phone interview on December 13, 2011, ten days after the final program event. He noted that meeting with the scientific research mentors during the launch workshop was an invaluable experience for the students. He also pointed to the opportunities students had to present their work in the museum at the end of the program.

“The meeting with the researchers [in the Museum] was really beneficial. Talking with someone else who is doing research and learning how to get the most out of research – I think that's huge. That's sort of a mentor/mentee relationship and kids don't often have access to that resource. They are basically being guided into how to do [research]. Also the presentation portion of it [at the end] – making sure that they get to present what they find. There was a lot of pride in telling others what they learned and how they implemented it with their friends and



family. I think being connected to Jeanne, that constant support, was crucial, and I actually think the structure of the program worked really well.” [DS interview, 12/13/2011]

The timing of the program also seemed to work out well, harnessing the energy from the HYI events and carrying that through into post-HYI programming during the school year:

“I think the timing of the program was perfect. It leverages the enthusiasm from the summer and coming back to school they are still very excited and motivated. To do it right around this time was perfect.” [DS interview, 12/13/2011]

Daniel also saw the partnership between the museum and the HCF to be a positive one that could be replicated in future iterations of the program and as the program tries to scale up to regional and national levels:

“There’s definitely strength in numbers in this economy. One of the things I’ve heard going to sponsors is that they want to see folks leverage partnerships and see people working together instead of coming in individually and asking for funding. I think the more people we can involve and the stronger partnership we can create, gives us a better chance to get that funding. Once you add people you might be dealing with different agendas or different perspectives on how something should be done, but that comes with any partnership. I think that coming together is something that really would strengthen any funding pitch that we have.” [DS interview, 12/13/2011]

When asked if there was anything else he would like to add, Daniel noted the positive relationships students were building with science, technology, engineering, and math content/experiences.

“Another success [...] is the STEM aspect of it. To get our kids involved in something STEM-related and it being very successful, I think is a huge win to get these students excited about science and getting their hands dirty in it around something science related. I think it’s a big victory. And just the quality of these kids, I feel that some of them will do something science related in their careers. They were just so excited about their projects. It was so great to see these kids so excited about a science project. I think Jeanne did a fantastic job of keeping the kids engaged and motivated.” [DS interview, 12/13/2011]

### ***Opportunities for Improvement***

The pilot program was a success from the perspective of achieving most of the intended student outcomes and building a structure that was in line with student needs and interests. Moving forward, there are a number of ways that the museum can build on the success of this new program and the partnership with HCF including increased face-to-face interaction between the students and the museum, better preparing the students for the anticipated workload and setting group expectations, and dealing with program attrition.

#### *Increased face-to-face time in the museum*

In interviews and in open-ended survey questions, students indicated that one of the greatest areas of improvement for the program would be through increased face-to-face opportunities. The in-museum experiences seemed to have a positive impact on the students and were some of the fondest memories

they had about the program. Students felt that meeting in person more regularly would have helped them manage their time better and keep them on task:

“Have more meetings than just the one. They could help keep them on their toes, because for us, we got a little bit off schedule. We felt rushed at the end.” [Group A, female]

“More face-to-face meetings at the museum that would make people have to come here. I mean, sometimes it was just hard to communicate. We were only 4 people so I could only imagine the bigger groups.” [Group A, female]

“I actually didn’t know half of the students here and then after the meeting we all explored DC afterwards. And I feel like we couldn’t have done that without the HYI. HYI breaks your boundaries for meeting new people. It’s like everybody is your *familia*.” [Group C, female]

“The structure [of the program] worked pretty well, but I would have liked more...more meetings in DC to come in on different stages of our project and that could have helped us connect the results of our different projects together better. Ours is how technology affects sleep and ultimately that would affect academic achievement [Group B’s topic].” [Group D, female]

## *Setting expectations*

The students commented on time management and group communication being two of the biggest challenges in the program. In the formal call for participation (see Appendix A), the program description describes the program as an opportunity to earn up to 20 hours of volunteer service. For many students, the program took up more than 20 hours of their time. For example:

“Need a head’s up on time management – to know what’s coming up and how much time it will take.” [Group A, male]

“When we first started the program we didn’t really know what we were supposed to do. We weren’t clear on what the assignment was...as time went by we got a better idea of it.” [Group C, female]

Some of the students who completed the program were frustrated by group members who dropped out of the program part of the way through and wanted a more selective process to ensure that all of the individuals enrolled in the program are dedicated to the seeing the project through to the end.

“...get students who are really dedicated to it. Our group started out with six, but it ended up only being 2 of us. They just dropped and we never really heard from them again.” [Group C, female]

These comments highlight the first iteration status of the program. The program evolved in response to the student needs as they went along, leaving some deliverables vague or undefined. Future iterations of the program will not have this issue. Now that the pilot program has been conducted and students completed field journals listing how much time they spent on the project throughout the semester, the

Research Lab is in a good position to address the issue of setting expectations by laying out the requirements prior to students registering for the program. The museum can now do a better job of promoting the program at the summer HYIs, which will prevent students who simply do not have the time from applying in the first place, hopefully reducing overall program attrition (see next section).

### *Dealing with program attrition*

Program attrition is a common occurrence in all programs. For the pilot program, 50% of the registered students completed the program and 50% did not. Because this was the first program of its kind for the Koshland, there was no pre-set benchmark or expectation for how many students would start and complete the program. Daniel from HCF felt that the number of kids who enrolled and saw the project through to completion was actually impressive from his experience. In his interview, he explained how pleased he was with the turn out for the pilot program and how envisioned the program scaling up:

*DS:* Student participation is always an indication of success especially amongst high school-aged kids. To take on an additional task like this – some of these kids are taking AP (Advanced Placement)/IB (International Baccalaureate classes – for them to take on an additional project and see it through to the end [is success]. When I went on Saturday [to the poster presentations], I didn't expect to see that many kids.

### *Interviewer: Why not?*

*DS:* We have a high attrition rate [in our post-HYI programs] typically. The kids that do attend the [HYI] program are these really motivated kids [in the summer]. .... I think it speaks highly about the [Research Lab] program – the way it was structured, the quality of it – that it kept these kids engaged. And it helped them understand how important it was for them. That was a big indicator of success – the fact that they saw it through.

### *Interviewer: What would you like to see if the program scales up?*

*DS:* This was a great size for the initial project. I think I'd love to see more kids, at least 60 per region. I think that's a doable number. I was really surprised by the number of kids who saw it through, and I think that speaks to Jeanne's ability to keep the kids motivated. I think it's doable to raise it up by 20 students or so. Now that we have a year under our belt and have seen such great results, it will be much easier to sell and get kids excited. Integration into the summer events again would be great."

The post-program survey tried to uncover some of the issues students had with completing the program.

Table **12** highlights average group interest for each of the main program components, rated by students who did not complete the program. Overall, the scores were moderate to high indicating that interest in the program and its structure was not the primary challenge students faced.

**Table 12. Descriptive statistics for single-item Interest in Program Components**

Program Component	Group 2 (n=7) Mean (SD)
Learning about the topic of sleep.	4.42 (1.13)
Learning about the scientific research process.	4.29 (0.76)
Meeting new people.	4.29 (0.95)
Conducting a research project.	4.00 (1.15)
Participating in workshops and meetings at the Koshland Museum in Washington, DC.	4.00 (1.15)
Working in groups.	3.86 (1.21)
Presenting your findings to your peers and others.	3.43 (1.40)

Notes. Interest scale from 1=not very interesting to 5=very interesting.

When asked to describe the main reasons that they were unable to complete the program, a couple students identified logistical issues with transportation and location, several students mentioned time management as a challenge, and a few had issues with their groups.

*Logistical issues*

“I wasn't able to get the address on the 1st day of the lab because I did not have internet [at] home. Therefore, I could not attend the 1st meeting. And since I wasn't allowed to attend the meetings without attending the first one I decided not continue the program.” [female, did not complete program]

“For one, I live in Virginia Beach so that made it difficult b/c a lot of group members lived closer to DC.” [male, did not complete program]

*Time management*

“I got a job and it was hard to manage my time.” [female, did not complete program]

“It was mostly my school work, which I could not have expected to have been so much. But also that whenever I did have free time, it would be taken away by a club or a sport.” [male, did not complete program]

“I was unable to complete the program because I was busy with school and personal problems at home. It was just bad timing. I was also in many clubs at school that Interfered with the meetings.” [female, did not complete program]

“...it seemed more intense than what I thought it would be and my school and sports were demanding enough.” [male, did not complete program]

*Group issues*

“I had no way of getting there and also the people in my group stop[ped] having communication towards our project.” [female, did not complete program]

“I was unable to keep up with this program because I was not in a group where I had people close to me and work with them.” [female, did not complete program]

“If people aren't as productive towards the project then they shouldn't be in the program, also people should work alone if possible.” [female, did not complete program]

“Maybe allow bringing a friend who could go to a Hispanic Youth institute kickoff so that they can work together more frequently and can be like partners so that if one can't meet with the rest of the team, at least the other can. Also creating smaller groups who live closer to each other would be more efficient.” [male, did not complete program]

For students who *did* complete the program, program attrition also affected them. Some students thought that it was unfair for students who were not fully committed to the program to participate in the first place. One student made the following suggestion:

“What I would say is to make sort of a pre-lab assignment that participants should do with certain constancy. This will allow you to discard a big chunk of people who don't have the maturity or responsibility to be part of a group. [Another option] would be to cut down some restrictions, force them to do the steps by a certain day. You ensure that everyone is going at a great pace and in the end, they will probably have more valuable time to develop real important conclusions that could have been faulty.” [Group 2, male]

The photo-collection activity did not serve as a useful predictor for student participation. Only nine students of the 30 who registered completed the activity. Of those nine students, six completed the program and three did not. Either the activity needed to be perceived as a requirement for the program, or a different activity may need to be developed to more effectively screen students. In addition to developing a rigorous pre-launch workshop activity to help screen student commitment to the program, staff can also make very clear which students receive the incentives for participation, which would demonstrate that lack of participation is not rewarded.

Immediately following the final program event on December 3, 2011, Jeanne reflected on the pieces of the program that she felt worked well and what she saw as necessities for scaling the program up in the future. Her comments seem to support the comments that the students made in their final assessments of the program and suggested that the program was poised to address the issues that emerged from this pilot.

Jeanne noted that there were opportunities for additional teaching moments regarding explaining the concept of “generalizability” and the notion of using convenience samples, which all of the students used, but might not have realized. She had also hoped to include discussions related to reliability vs. validity of research design and results, but the students had not progressed far enough along in the research process to incorporate it. These two points likely prevented students from expressing the limitations of their own studies, one of the outcomes related to critical thinking that was not fully demonstrated.

Jeanne also mentioned that she hoped to provide more structure for the students in future programs now that she had a better sense for student knowledge and practice related to research. She intends to provide more examples of what a research poster should look like and explain how it will support them in future academic conferences.

The students needed more foreshadowing of the process and the key deliverables that would be expected of them along the way. She hopes to describe what a field journal is and what it should look like so that students have a sense for what the task was that they were going to complete before they completed it.

With increased funding, Jeanne hopes to offer more face-to-face meetings in DC and at the museum in order for students to connect with their group, get help from museum staff and scientists, and make more efficient and effective progress on their projects.

The Conclusions section that follows provides a summary of evaluation results by research question and outcome. After the Conclusions, we provide a full list of Recommendations, which emerge from the results, which were developed in consultation with museum staff.

## CONCLUSIONS

### ***1. To what extent did the program achieve the intended outcomes?***

The interviews, surveys, artifact analyses, and observations provided evidence for successful outcomes in most of the program's intended impact categories.

#### *Impact category: 21<sup>st</sup> century literacies*

Outcome: Participants will practice and improve their scientific literacy.

- ✓ We found evidence that this outcome was achieved. Students demonstrated the ability to collect, analyze, and interpret quantitative and qualitative data through their field research, posters, and presentations. Their posters as well as their scores on the pre-then-post scales related to the research process showed that they were able to move through the scientific research process.

Outcome: Participants will practice and improve their information literacy.

- We did not find evidence that this outcome was achieved. The posters and presentations, which provided summaries of the research process as conducted by students throughout the fall, showed that most students primarily used the resources that were shared with them in the launch workshop as their background research on the topic. Students were also unclear about the limitations of their studies, the generalizability of their findings, and the reliability and validity of their research instruments. Students also reported the lowest average score on the Evaluating Information Resources scale in the post-program survey.

Outcome: Participants will practice and improve their health (i.e. sleep) literacy.

- ✓ We found evidence that this outcome was achieved. Students demonstrated through their field research and research planning noted in reflections during interviews that they could conduct a research study on the impacts of sleep on teens and interpret the results of those findings. In some cases students felt confident providing recommendations based on their findings. Students also indicated strong agreement with items on scales related to Attitudes towards



Studying Sleep and Perceived Knowledge of the Science of Sleep, producing the highest average scores of all the scales in the post-program survey.

## *Impact category: Critical thinking*

Outcome: Participants will use various types of reasoning (inductive, deductive) as appropriate to the situation.

- ✓ We found evidence that this outcome was achieved. Students demonstrated an ability to analyze qualitative and quantitative data and to draw conclusions based on those results through their posters, presentations, and group interviews.

Outcome: Participants will analyze how parts of a whole interact with each other to produce overall outcomes in complex situations.

- ✓ We found partial evidence that this outcome was achieved. Students demonstrated an understanding of the impacts of sleep on outcomes like student achievement and athlete performance. One group showed how use of technology impacts the quality of sleep. In interviews, several students made connections between the results of their study and the results of the other groups' studies.
- We did not, however, find evidence of students demonstrating an understanding of the limitations of their findings, which was a second indicator for this outcome.

## *Impact category: Decision-making*

Outcome: Participants will effectively analyze and evaluate evidence, arguments, claims, and beliefs.

- ✓ We found partial evidence that this outcome was achieved. Students effectively analyzed evidence and claims and worked in groups to determine conclusions and recommendations from their analyses.
- We did not, however, find evidence of students evaluating arguments or alternative claims from the literature or generating alternative explanations to challenge their own interpretations of their results.

Outcome: Participants will interpret information and draw conclusions based on the best analysis.

- ✓ We found evidence that this outcome was achieved. The high quality of the student posters and students' abilities to speak about their process of analyzing their data showed that students were able to interpret their findings and draw group conclusions based on their individual analyses.

Outcome: Participants will reflect critically on learning experiences and processes.

- ✓ We found evidence that this outcome was achieved. Students reflected on their experiences going through each stage of the research process and working together in their teams. Students reflected particularly on the challenges they faced with time management and working with team members outside of the school day. In open-ended survey questions, students were able to provide reflective advice for future students who might participate in the program.

## *Impact category: Problem solving*

Outcome: Participants will identify and ask questions that clarify various points of view and lead to better solutions.

- ✓ We found evidence that this outcome was achieved. This outcome was assessed in terms of students' abilities to ask meaningful questions at face-to-face meetings, to develop research questions and design a research study to answer those questions, and to ask questions that were relevant to their personal lives and community. The student posters and interviews showed that students did all of these. They also asked clarifying questions of Dr. Owens after her presentation during the launch workshop.

## *HCF Impact category: College*

Outcome: Program elements will provide students with experiences that will prepare them for college.

- ✓ We found evidence that this outcome was achieved. Students commented in group interviews that the Research Lab prepared them for college in terms of getting enough sleep (science content), learning the research process (process), and managing their time (life skills). Students also used the Research Lab experience as a building block to apply to additional museum-related programs or to join honor societies, which will be beneficial items to have on their resume when they apply to college.

## *HCF Impact category: Career*

Outcome: Participation in a personally relevant, science-related topic will encourage student interest in science in the future.

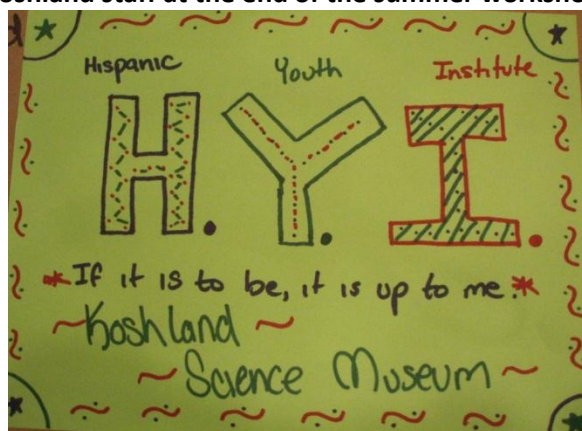
- ✓ We found partial evidence that this outcome was achieved. Students who completed the program reported higher average scores on the Intentions to Participate in Science in the Future scale than students who did not complete the program. Students also described ways in which this program would help them participate in science fairs and/or pursue their interests in other science topics.
- These results were not statistically significant, so we cannot be sure whether these group differences were due to the program's impact or if they happened by chance.

## *HCF Impact category: Community*

Outcome: Participants will work with each other, family, and friends/peers in their community to complete the program.

- ✓ We found evidence that this outcome was achieved. Students reported high average scores on the Reported Teamwork Behaviors scale and described how they worked with friends, parents, teachers, and other community members to complete their projects.

Figure 4. Drawing created by HYI MD student with the HYI motto. Student gave the picture to Koshland staff at the end of the summer workshop.



## 2. What unintended, or unanticipated, outcomes occurred?

The interviews and open-ended survey questions pointed to other outcomes that occurred as a result of the program. Most notably, students reported learning about life skills such as:

- time management,
- group communication, and
- staying on task.

Students also reported:

- having fun and
- making new friends.

## 3. What are the transferable elements of the program that can be scaled up or replicated for next year?

Reflections from Jeanne Troy (Koshland) and Daniel Sarmiento (HCF), as well as the student comments in interviews and surveys, highlighted several aspects of the program that worked well and could be considered transferable elements for the program as it scales up or is replicated in the future.

- Narrowing down the science topics based on the Koshland's and the HCF's organizational missions ensured that the program was a good fit for the partnership.
- Allowing students to vote on the topic from the narrowed-down list of four helped ensure that the science topic was relevant to their personal lives and communities and gave them agency in the process.
- Connecting students with scientific research mentors during the launch workshop guided students through the research process and provided them with a sense for how research is really done.
- The end-of-program poster presentations empowered students to share their findings with peers, community members, and other key stakeholders.
- Having the posters as a tangible deliverable gave students a sense of accomplishment and pride.

- Using Facebook as a group communication tool was effective for the majority of the students who noted that it was often faster than email. Students commented that using email as well as Facebook guaranteed that they did not miss any important information.
- Having consistent contact with the program officer helped to keep students on task. Supportive communication from HCF helped give credibility to the work the museum was doing and held the students accountable.
- Recruiting students during the summer HYIs and then holding the program in the fall capitalized on student enthusiasm and motivation.
- Offering service hours through the program and providing travel compensation were good incentives for the students who completed the program.

#### ***4. What are the lessons learned and best practices that emerged from the pilot program?***

Reflections from Jeanne Troy (Koshland) and Daniel Sarmiento (HCF), as well as the student comments in interviews and surveys, also highlighted opportunities for improvement for the program.

- Everyone felt that more opportunities for face-to-face interactions would have helped students stay on task and work more effectively in their groups, as well as increase opportunities for discussing important concepts like conducting literature reviews, reliability vs. validity, and identifying limitations of a study.
- Setting expectations was also an important theme that emerged. Since this was a pilot study, one of its purposes was to identify what those expectations would be for future programs, however several students dropped out of the program because of this issue.
- Program attrition was a challenge in particular due to the issue of setting expectations, but also due to logistical challenges. Some group members simply lived too far away from each other to allow for effective collaboration.

## RECOMMENDATIONS

This section contains the recommendations for future iterations of the program based on the results of this evaluation study. These recommendations have been developed and refined in consultation with Koshland staff to ensure they reflect the realities and constraints of the program's context.

**Continue to give students agency.** The approach to topic selection and planning logistics for the program worked well. Using a series of surveys and conversations with the students, the museum was able to tailor the program to a science topic of interest and to incorporate communication tools like Facebook into the structure of the program. Continue to use these strategies and to find others, which will give students agency and voice in the program development process.

**Clarify expectations.** With the inaugural deployment complete, the museum has the data it needs to improve recruitment and retention strategies for future programs by making program expectations clear to students from the outset. This should be relatively easy to accomplish now that the museum and HCF have a better sense for what the program is and how much time it takes students to accomplish research-related tasks.

**Increase recruitment.** Engaging with students at the summer HYIs was an effective strategy for recruiting students to the program. The workshop model used at the Maryland HYI was particularly effective. That model allowed for small group interaction between the museum and students on the same day that they participated in the Issues to Action workshops. Unlike the Virginia workshop, there were no other competing events at the Maryland workshop, which allowed the museum to reach more students in one day. Using the Maryland workshop model in subsequent HYIs has the potential to increase overall program recruitment.

**Improve the screening process.** Clarifying expectations and increasing recruitment will hopefully allow for a more selective process for program participation. Consider selecting participants not only based on science knowledge/interest or research skills, but also on commitment to the program. One opportunity for improving the screening process would be through the pre-launch activity (i.e. the photo-collection and sharing activity). Use such an activity to filter out students who are less committed, or simply too busy, out of the program before they become part of student groups.

**Engage students as mentors.** Students who completed the program showed a high level of dedication and enthusiasm towards the research process. Students also reported a genuine interest in “paying it forward” and helping future cohorts better prepare themselves for the final poster presentations and manage their time along the way. These program alumni can help fill in the gaps where program personnel or budget constraints restrict time for one-on-one attention.

**Tackle information literacy explicitly.** The evaluation showed several areas in which students could benefit from explicit information literacy training. The museum might consider providing additional assigned readings to students, such as a journal article, which students could use as a model for their research. There might also be a way to build in a group-based literature review effort in which each group reads and reports on one or two articles to share back with the group. While students are designing their studies and developing their research instruments, the museum might consider having group conference calls (or hiring an additional contract educator) to help students think through the limitations of their study as well as issues related to reliability and validity of their instruments.

**Provide more detailed examples.** Although Jeanne provided the students with a field journal to help them move through the research process and a poster template to help them present their findings, students still felt like they needed more direction. Future programs can use the pilot program materials as examples of what students should or should not do. The launch workshop could be expanded slightly to allow time for defining and describing the program’s key deliverables to help students build a mental model for the program and its main components.

**Increase face-to-face interactions.** Students requested additional opportunities to meet as a large group at the museum. Originally, it was thought that getting to the museum would be a logistical challenge for students, but the students indicated that as long as they knew about the events ahead of time they would have been able to attend. Adding in one additional museum meeting plus hiring a contract educator who can visit with the students in their communities at times convenient to them (i.e. outside of the 9am-5pm work day) might help to fill this gap and ensure students have the support they need to complete their projects in a timely and efficient manner.

**Build on these evaluation results and instruments.** This evaluation provides baseline scores that the museum can use as benchmarks for assessing future programs. Several of the scales used were effective in measuring the intended outcomes. A few scales (i.e. Evaluating Information Resources and Attitudes towards Studying Sleep) need additional development and scale testing. The museum might also consider working with HCF to track student outcomes longitudinally and to follow up with students once they are graduating from college or in high school.

**Raise awareness about the program to the general public.** The work that the students produced in the pilot project was admirable and the poster presentation was an opportunity to showcase that hard work. Consider raising awareness about the work that these youth are doing as well as the outreach efforts of the museum and the HCF by marketing the end-of-program to a wider audience and provided reduced admission or other incentive to encourage greater attendance. This approach might allow students to network with a broader community of individuals and feel further empowered by the importance of their research.

**Develop tools or partnerships to help students take action.** To parallel the Issues to Action exercise, students should be encouraged to act on their evidence-based recommendations. A partnership with a group that does work in this arena could help students after the poster session.

In order to scale up the program and address several of these recommendations, the museum will need a structure of human capital to pull from. Additional scientists and researchers would be necessary to accommodate more students, more teams of students, and the potential diversity of research topics that could emerge. Providing additional face-to-face meetings with these individuals would be an asset to the program and a benefit to the students. These individuals could potentially come from the National Academy of Sciences and/or from local graduate school programs in the sciences, social sciences, and other fields.

A scaled up model for the program with additional partner organizations and more HYI participants (either nationally or in other HYI regions) would require a minimum of the following:

- One program-wide officer/director (the role that Jeanne Troy played in the pilot program).
- Embedded relationship with HCF and the summer HYI programs (similar to what happened during the pilot program) or a similar relationship with other partner organizations.
- Regional-level contacts with HCF (the role that Daniel Sarmiento played in the pilot program).
- Regional-level contract educators or information literacy specialists with ability to travel to student communities and/or connect with students via phone during nights and on weekends.
- Group-level project mentors (this is an opportunity for student alumni from the pilot program and may be a better approach than trying to work with RAs due to the mismatch in high school and college schedules). Note: this will take at least one additional year if the model is expanded to other regions, so that a first group of students will be able to complete the program and become alums.
- Student groups of 3-5 individuals with 4-5 groups per region.
- Funding for incentives, travel compensation, and recruitment/marketing.
- Local science experts and mentors for each region/area (the role that Dr. Owens played in the pilot program).

- Some way (Facebook, Flickr, etc might be sufficient) to connect the different groups or locations, so they develop a sense of community and larger purpose. This connection to a larger group/purpose would help continue to empower the students, and to give them some additional excitement/motivation.



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## APPENDIX A: Recruitment

Formal call for participation:

Participate in the Oct. 8<sup>th</sup> Koshland Youth Research Lab in Washington, DC

Feeling tired?! Join the Koshland Science Museum, scientists, and researchers to explore the issue of sleep—and what happens when we get so little—with your friends from the Hispanic Youth Institute (HYI). Students and RAs from the Maryland and Virginia HYIs are invited to participate in this exciting new program that will help you develop an evidence-based strategy to a local problem.

Koshland Youth Research Lab: Interact with the Issues  
Opening Workshop

Saturday, October 8<sup>th</sup>, 9:30 am – 12:30 pm

Koshland Science Museum

525 E Street, NW, Washington, DC 20001

Directions: <http://www.koshland-science-museum.org/visitor/dandp.jsp>

During the research lab, you will:

- Learn how to develop a research project
- Gain practical skills, such as using online survey tools
- Visit the Koshland Science Museum at the National Academy of Sciences
- Conduct research in your community with friends and other HYI participants
- Present your findings and recommendations to your peers and experts in the field
- Receive a certificate of completion
- Be part of the first annual Koshland Youth Research Lab
- Earn up to 20 hours of volunteer service
- Have fun!

Note:

Small travel stipends are available to cover the cost of Metro, car mileage, or other transportation to and from the museum

A date for the final presentations will be set in mid-November based on students' input from the opening workshop.

**To apply**, please complete an application at <http://www.surveygizmo.com/s3/629436/Koshland-Youth-Research-Lab-Registration> by September 23<sup>rd</sup>.

**Questions?** Contact Jeanne Troy, Program Officer, Koshland Science Museum, [jtroy@nas.edu](mailto:jtroy@nas.edu) or 202.334.1841.

Students were asked to indicate their interest in the program after the HYI workshops. For students who opted in, they were sent the following email in August 2011:

Hi there!

It was great to meet you at the Maryland and Virginia Hispanic Youth Institute workshops that took place earlier this summer. At that workshop, we talked with you and your peers about the role of research in our everyday lives. We also discussed scientific topics ranging from sleep to water quality.

At the end of that workshop, you provided us with your email address to let us know that you were interested in learning more about a fall program with the Koshland Science Museum, and that's why we're writing to you today.

If you're still interested in participating in a program with the museum this fall, please take this [survey](#) and let us know a little bit more about you. If you have any trouble opening the link, please copy and paste

<https://spreadsheets.google.com/spreadsheet/viewform?formkey=dER2eUZ3RFdIYTNWNnBfcmlJcGl1Snc6MQ> into a new browser.

We're trying to figure out what kind of transportation and technology we might need to provide, along with some other things. It should only take about 5 minutes to complete. You have until Monday, August 15, 2011, to complete this survey and have the chance to participate in our fall program. We'll tell you more about the program once we've heard back from you on the survey.

Thanks for your help and we look forward to seeing you again soon!

Sincerely,

Jeanne Braha Troy  
Program Officer  
Koshland Science Museum: Interact with the Issues  
National Academy of Sciences  
525 E Street, NW, Washington, DC 20001  
Tel.: 202-334-1841 | [jtroy@nas.edu](mailto:jtroy@nas.edu) | [www.koshland-dc.org](http://www.koshland-dc.org)

## APPENDIX B: Excerpts from a Field Journal

### Research Log

**Purpose:** The purpose of this document is for you to track the amount of time you spend on your research and determine which activities you have completed as you move through your Koshland Youth Research Lab research project. At the end of the project, the program director from the Koshland will review and approve your hours and activities.

This is also an opportunity for you to reflect on the process. You're doing real scientific research. Sometimes research can be exciting and sometimes it can be very challenging. Scientists often keep journals to note their progress, write down hypotheses as they are going along, and to document their experiences.

**Directions:** Every time you work on something for the Koshland Youth Research Lab project, log the following items in your field journal:

- 1) What aspect of the research process did you work on?
  - a. Examples: team meeting, phone call, instrument development, data collection, data analysis, write up, presentation
- 2) How much time did you spend on the activity?
  - a. Examples: 30 minutes or 0.5 hours
- 3) What are your thoughts and feelings about the part of research you just spent time on?
  - a. Consider any challenges you faced
  - b. New things you learned
  - c. Guesses about what might happen next

Use the form below to capture each of these aspects of your research. Some examples have been provided for you.

Date	Research task	Time spent on task	Reflection
10/8/2011	Team meeting at the Koshland	3 hrs + 2 hrs travel time	Today we met a pediatrician who talked to us about current sleep research. I thought it was very interesting. She gave me some good ideas on ways that I could study sleep. I think I might use a survey and do some interviews with people in my family.
10/9/2011	Research planning	2 hrs	I spent some time reviewing my notes from the meeting yesterday. I started sketching out my project. I think I will participate in a phone call with the museum staff to think through the development of my survey.
10/12/2011	Phone call	30 mins	I talked with Jeanne from the museum today about how to design my survey. She helped me think about how I would recruit participants. I should be ready to start collecting data by the end of the week.



Date	Research task	Time spent on task	Reflection
11-11-11	Research ↓ Planning	12:30 p.m. ↓ 2:10 p.m.	Today we met to talk about interview people on our surveys at the Dallas Mall. (conference)
11-12-11	Interview Ppl at Gym L.A. Fitness	2:00 p.m. ↓ 5:00 p.m.	Today we went to the gym to get feedback on order get young adults
11-21-11	Organized questions for students (Nathaniel's house)	1:00 p.m. ↓ 6:00 p.m.	We came up with a powerpoint and maybe do a model for an example
11-27-11	Met up at Cascade Library for Presentation	2:00 p.m. ↓ 5:00 p.m.	We discussed how to make our presentation
11-16-11	Txted each other	30 min	We discussed what we were planning on doing.
11-24-11	Talked on the phone	2 hours	We decided to gather up our info/data to create our presentation
12/2/11	<del>We went to Michaels,</del> We went to Michaels bought the poster and finish our powerpoint		went over Johana's house 6:00 p.m. ↓ 11:00 p.m.
12/3/11	Assembled our poster together	8:00 a.m. ↓ 9:00 a.m.	We applied our powerpoint to the poster and decorated it

1. In a typical week, how many times do you exercise	2. How old are you?	3. How many hours of sleep do you usually get	4. What type of symptoms do you receive from lack of sleep?	5. What time do you usually go to bed?	6. What do you do to maintain a well balanced sleeping schedule?	7. How do you normally sleep? (chart)	8. Do you eat breakfast?	9. Do you take a nap during the day?	10. Do you have trouble falling asleep?	
1	3	25	7-8	Irritation	12	Massages	5	Yes	no	No
2	2-3	21	3-4	Stiffness fatigues	1	Don't have one	1-6	yes	No	Yes
3	2-3	25	7	Tired laziness	12	Bed early	1-5	No	No	No
4	6-7	24	7-8	Not work out as well	11	Strict sleep schedule. Go to bed when tired	1	Yes	No	No
5	4	19	7	Tired, lack of energy	1-2	Don't have one	1	Yes	One	No
6	4-5	21	6-7	Tired, no focus	11:30-12	Sleep on time	1-6	Yes	Yes	Sometimes
7	5	16	6-7	Exhausted	12	Same thing every day	5	Yes	Yes	No
8	5-6	18	6-9	Not enough energy during the day	11:30-12	Eat 5 meals	6	Yes	Yes	yes
9	6	40	7	Agitated, tired	11:30	Workout. Don't over eat at night	3-6	Yes	Weekends	No
10	3	28	5-6	Irritably	1:30	Try to get everything done	1	Sometimes	No	No
11	5	16	6	Laziness, moody	11	Make sure to get everything done	1	No	No	No



11. do you feel like the lack of sleep affects your performances		12. On a scale from 1-10, how would you rate your sleeping schedule?	13. Do you think that you'll perform bad due to lack of sleep or because mentally you know you'll do badly? Mental vs. physical
1	Yes	5	LOS
2	Yes	2	LOS
3	Yes	3	LOS
4	Yes	8	Both
5	Yes	7	LOS
6	Yes	5	Los
7	Yes	5	Mentally
8	Yes	8	Both
9	Yes	7.5	Los
10	Yes	1	Mentally
11	Yes	5	Mentally
12	Yes	1	Mentally
13	No	1	LOS
14	No	6	None
15	no	6	Los
16	Yes	6	Los
17	Yes	7	Los
18	Yes	8	LOS
19	Yes	9	Mentally
20	yes	8	los
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			

# Athletic Sleep Questions.

1. In a typical week, how many times do you exercise?
2. How old are you?
3. How many hours of sleep do you usually get during the night?
4. What type of symptoms do you receive from lack of sleep?
5. What time do you usually go to bed?
6. What do you do to maintain a well balanced sleeping schedule?
7. How do you normally sleep? (chart)
8. Do you eat breakfast?
9. Do you take a nap during the day?
10. Do you have trouble falling asleep?
11. Do you feel like the lack of sleep affects your performances while exercising?
12. On a scale from 1-10, how would you rate your sleeping schedule?
13. Do you think that you'll perform bad due to lack of sleep or because mentally you'll know you'll do bad?

## APPENDIX C: Instruments

### Interview Questions

Semi-structured, small groups by posters

Group name

Group members' names

### Collaboration

How did your team work together? Did you assign team leaders or roles? Did these form naturally?

What tools did you use to connect with your group members?

What did you think about the different modes of communication and collaboration with the Koshland folks? (e.g. Facebook page, face-to-face kick off meeting, follow-up emails, Basecamp site (?), phone calls (?), etc.)

- What worked best? Why?
- What didn't work so well? Why?

### Research Process

Now that you have completed this program, what new research questions do you have related to the topic of sleep?

How did you arrive at the conclusions you that you came up with for your study? What might be some of the limitations of your findings?

### Attitudes and Opinions

What was the most/least interesting thing you did during the Research Lab experience?

What kept you motivated throughout the semester to work on Research Lab activities in addition to school, work, and afterschool activities?

What was the most influential person/event/or aspect of the project?

What would you do differently next time or how would you change the program?

### Relationships

What role did your parents or teachers have in your research process if any?

What role did you friends and family members (non-parents) have in your research process?

### Future

How has this experience prepared you for the types of challenges you think you might face in college, if at all?

How has it prepared you for the next few years of high school?

What could we do to make the process more beneficial to you for preparing you for college?

How does an activity like this make you think about future careers in science and research?

## Koshland Youth Research Lab - End of program survey

(for students who completed the program)

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### Koshland Youth Research Lab

Congratulations! You've completed the very first Koshland Youth Research Lab program on the science of sleep and helped to make it a huge success! We're extremely proud of all the hard work you have put in over the last few months.

For the very last part of the program, we need you to take 5-10 minutes to fill out this survey as honestly as possible. There are no right or wrong answers to any of the questions we're asking - we just want to know what you think about certain things now that the program is over.

Once you've completed the survey, your tasks for the Research Lab will be complete and you will receive your gift card from Ms. Jeanne Troy. If you have any questions about this survey, please email Ms. Troy: jtroy@nas.edu

You have until Sunday, December 11th at midnight to complete the survey.

Thank you very much!

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### A bit about you

We need this information to match up your survey responses to other data that we have collected over the semester. Your name will be kept confidential and will not be shared directly with the Hispanic College Fund staff, the Museum staff, or anyone else. We promise. Once we've matched up the data, we'll delete this information.

### Please fill out the following pieces of information:\*

First name:: \_\_\_\_\_

Last name:: \_\_\_\_\_

Age (in years):: \_\_\_\_\_

### In which state did you attend your most recent Hispanic Youth Institute?\*

Maryland

Virginia

### In what year did you attend your most recent Hispanic Youth Institute?\*

2011 (this past summer)

2010

2009

2008

2007

2006

**Evaluating information sources**

**How much do you agree or disagree with each of the following statements about INFORMATION SOURCES?\*** [reverse-scored]

	1- Strongly disagree	2- Disagree	3- Neither agree nor disagree	4- Agree	5- Strongly agree
If one important source says an idea is true, then I should believe it. (reverse scored)	( )	( )	( )	( )	( )
When I Google something, the first search result will always have the most accurate information. (reverse scored)	( )	( )	( )	( )	( )
I can trust all information that comes from a .gov or .edu website. (reverse-scored)	( )	( )	( )	( )	( )
If there are statistics associated with a research finding, I can always trust it. Reverse scored)	( )	( )	( )	( )	( )

**Doing research**

**How much do you agree or disagree with each of the following statements about DOING RESEARCH IN GENERAL?\***

	1- Strongly disagree	2- Disagree	3- Neither agree nor disagree	4- Agree	5- Strongly agree
I am pretty good at doing research.	( )	( )	( )	( )	( )
I might not make great discoveries, but I think doing research is pretty interesting.	( )	( )	( )	( )	( )
I enjoy doing research very much.	( )	( )	( )	( )	( )

**How much do you agree or disagree with each of the following statements about DOING RESEARCH ON SLEEP?\***

	1- Strongly disagree	2- Disagree	3- Neither agree nor disagree	4- Agree	5- Strongly agree
I think studying the topic of sleep is interesting.	( )	( )	( )	( )	( )
I see how research related to sleep is important to my life.	( )	( )	( )	( )	( )

It would be fun to share what I know about sleep with my family/friends.	( )	( )	( )	( )	( )
Studying sleep is really only important to someone who wants to be a neuroscientist. (reverse-scored)	( )	( )	( )	( )	( )
I think most people could benefit from research related to sleep.	( )	( )	( )	( )	( )

**Learning about sleep**

**How much do you agree or disagree with each of the following statements about your KNOWLEDGE OF SLEEP?\***

	<b>1- Strongly disagree</b>	<b>2- Disagree</b>	<b>3- Neither agree nor disagree</b>	<b>4- Agree</b>	<b>5- Strongly agree</b>
I can explain the effects of poor sleep to my peers.	( )	( )	( )	( )	( )
I understand the impacts that sleep has on my daily life.	( )	( )	( )	( )	( )
I can explain ways to improve sleep habits to my peers.	( )	( )	( )	( )	( )
I understand the impacts that sleep habits have on academic achievement.	( )	( )	( )	( )	( )

**Science and your future**

**How much do you agree or disagree with each of the following statements about SCIENCE IN YOUR FUTURE?\***

	<b>1- Strongly disagree</b>	<b>2- Disagree</b>	<b>3- Neither agree nor disagree</b>	<b>4- Agree</b>	<b>5- Strongly agree</b>
I would consider taking more science classes in high school if I could.	( )	( )	( )	( )	( )
I do not plan to do any more science unless I have to. (reverse-scored)	( )	( )	( )	( )	( )
If I go to college, I will probably major in a science field.	( )	( )	( )	( )	( )
I plan to work in a science field as a career.	( )	( )	( )	( )	( )
I can see myself maybe getting a graduate degree in a science field.	( )	( )	( )	( )	( )

**Thoughts on the research process BEFORE participating in the Koshland Youth Research Lab**  
**Think back to this past summer, before you participated in this program with the Museum.**  
**How CONFIDENT were you in conducting each of the steps of the research process BEFORE you participated in the Koshland Youth Research Lab?\***

	<b>1-Not at all confident</b>	<b>2-Not very confident</b>	<b>3-Somewhat confident</b>	<b>4-Very confident</b>	<b>5-Extremely confident</b>
Generating research questions	( )	( )	( )	( )	( )
Developing hypotheses	( )	( )	( )	( )	( )
Reviewing prior scientific research related to my research question	( )	( )	( )	( )	( )
Creating a research tool like a survey or interview	( )	( )	( )	( )	( )
Collecting data from human subjects using a research tool like a survey or interview	( )	( )	( )	( )	( )
Analyzing data (either quantitative data like calculating percentages from numbers or qualitative data like open-ended responses or comments)	( )	( )	( )	( )	( )
Interpreting the results of my study to draw conclusions	( )	( )	( )	( )	( )
Writing up the results of a research study (e.g. completing a field journal, creating a poster)	( )	( )	( )	( )	( )

**If you would like to explain any of your responses about the research process BEFORE you participated in the Koshland Youth Research Lab, please elaborate here:**

**Thoughts on the research process AFTER participating in the Koshland Youth Research Lab**  
**Now that you've completed the Koshland Youth Research Lab, think about the research process. You may feel like you're more confident, less confident, or about the same for each of the different steps in the process.**

**How CONFIDENT are you in conducting each of the steps of the research process NOW that you have completed the Koshland Youth Research Lab?\***

	<b>1-Not at all confident</b>	<b>2-Not very confident</b>	<b>3-Somewhat confident</b>	<b>4-Very confident</b>	<b>5-Extremely confident</b>
Generating research questions	( )	( )	( )	( )	( )
Developing hypotheses	( )	( )	( )	( )	( )
Reviewing prior scientific research related	( )	( )	( )	( )	( )

to my research question					
Creating a research tool like a survey or interview	( )	( )	( )	( )	( )
Collecting data from human subjects using a research tool like a survey or interview	( )	( )	( )	( )	( )
Analyzing data (either quantitative data like calculating percentages from numbers or qualitative data like open-ended responses or comments)	( )	( )	( )	( )	( )
Interpreting the results of my study to draw conclusions	( )	( )	( )	( )	( )
Writing up the results of a research study (e.g. completing a field journal, creating a poster)	( )	( )	( )	( )	( )

**If you would like to explain any of your responses about the research process NOW that you HAVE participated in the Koshland Youth Research Lab, please elaborate here:**

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**Working in groups**

Working in groups is really hard, especially if you go to different schools. For these next statements, reflect on the process of doing research with your group.

**When working with your group, how often did you...\***

	1-Never	2-Rarely	3-Sometimes	4-Most of the time	5-Always
Work comfortably with others in the group.	( )	( )	( )	( )	( )
Have a positive influence on other group members.	( )	( )	( )	( )	( )
Feel like you were someone others could count on in the group.	( )	( )	( )	( )	( )
Enjoy working with others in the group.	( )	( )	( )	( )	( )
Think to yourself that it was important to be able to work well in a group.	( )	( )	( )	( )	( )

**Assuming you had the time, would you be interested in taking a leadership role in the Koshland Youth Research Lab next year? This could include mentoring a group, speaking at a workshop, or answering questions online for new student participants, among other activities.\***

- ( ) No
- ( ) Yes
- ( ) I'm not sure



Why or why not?

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**Final thoughts**

If you had one piece of advice to give to future students who might participate in the Koshland Youth Research Lab, what would it be?

**We've asked a lot of questions, but maybe there's something we've left out. Please use the space provided to tell us anything else you would like about the Koshland Youth Research Lab experience.**

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**Thank You!**

**Thank you for taking part in the Koshland Youth Research Lab. We hope you'll keep in touch and come back and visit the Museum again soon.**

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## Help us improve the Koshland Youth Research Lab! Survey

(Survey for Students who did not complete the program)

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### Koshland Youth Research Lab

We're planning another round of the Research Lab program for next year and we want to make it bigger and better. We know how busy school and life can be, so we want to know what we could have done that would have made it easier for you to complete the program. Please respond to the following questions in as much detail as possible.

It should only take about 5-10 minutes to complete the survey.

As a thank you for completing the survey and helping us develop an even better program for next year, we will send you a \$5 amazon.com gift card via email.

If you have any questions about this survey, please email Ms. Troy: jtroy@nas.edu. You have until Tuesday, January 24th at 5pm to complete the survey.

Thank you very much!

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### A bit about you

We need this information to match up your survey responses to other data that we have collected over the semester. Your name will be kept confidential and will not be shared directly with the Hispanic College Fund staff, the Museum staff, or anyone else. We promise. Once we've matched up the data, we'll delete this information.

### Please fill out the following pieces of information:\*

First name: \_\_\_\_\_

Last name: \_\_\_\_\_

Age (in years):: \_\_\_\_\_

### In which state did you attend your most recent Hispanic Youth Institute?\*

Maryland

Virginia

### In what year did you attend your most recent Hispanic Youth Institute?\*

2011 (this past summer)

2010

2009

2008

2007

2006

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## Barriers to Completing the Program

What were some of the key reasons that you were unable to complete the program? Please be as honest as possible. We want to make sure that we create a program that overcomes some of these challenges in the future.

### Interest in Program Components

To what extent were each of the following program components interesting to you or not on a scale from 1-5 (1=not interesting, 5=extremely interesting)?\*

	1-Not very interesting	2	3	4	5-Extremely interesting
Learning about the topic of sleep.	( )	( )	( )	( )	( )
Learning about the scientific research process.	( )	( )	( )	( )	( )
Conducting a research project.	( )	( )	( )	( )	( )
Presenting your findings to your peers and others.	( )	( )	( )	( )	( )
Working in groups.	( )	( )	( )	( )	( )
Meeting new people.	( )	( )	( )	( )	( )
Participating in workshops and meetings at the Koshland Museum in Washington, DC.	( )	( )	( )	( )	( )

### Science and your future

How much do you agree or disagree with each of the following statements about SCIENCE IN YOUR FUTURE?\*

	1-Strongly disagree	2-Disagree	3-Neither agree nor disagree	4-Agree	5-Strongly agree
I would consider taking more science classes in high school if I could.	( )	( )	( )	( )	( )
I do not plan to do any more science unless I have to.	( )	( )	( )	( )	( )
If I go to college, I will probably major in a science field.	( )	( )	( )	( )	( )
I plan to work in a science field as a career.	( )	( )	( )	( )	( )
I can see myself maybe getting a graduate degree in a science field.	( )	( )	( )	( )	( )

### Thoughts on the Research Process

How CONFIDENT are you in conducting each of the steps of the research process?\*

	1-Not at	2-Not	3-	4-Very	5-
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	all confident	very confident	Somewhat confident	confident	Extremely confident
Generating research questions	( )	( )	( )	( )	( )
Developing hypotheses	( )	( )	( )	( )	( )
Reviewing prior scientific research related to my research question	( )	( )	( )	( )	( )
Creating a research tool like a survey or interview	( )	( )	( )	( )	( )
Collecting data from human subjects using a research tool like a survey or interview	( )	( )	( )	( )	( )
Analyzing data (either quantitative data like calculating percentages from numbers or qualitative data like open-ended responses or comments)	( )	( )	( )	( )	( )
Interpreting the results of my study to draw conclusions	( )	( )	( )	( )	( )
Writing up the results of a research study (e.g. completing a field journal, creating a poster)	( )	( )	( )	( )	( )

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**Final thoughts**

**What suggestions do you have for improving the program?**

**What incentives could we have offered that would have helped to motivate you better?**

**What advice or suggestions would you give to future students who might be interested in the program?**

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**Amazon.com gift card**

**As a thank you for helping us out, we will send you a \$5 Amazon.com gift card via email. Please provide an email address where we can send the gift card. You should receive your gift card no later than 5pm on Friday January 27th.**

Example: jane.doe22@yahoo.com

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**Thank You!**

**Thank you for your thoughts and feedback related to the program. We will review all responses carefully to ensure we create the best program possible for next year. Good luck with your spring semester!**