

## **The Role and work of Inverness Research 2004 – present**

Inverness Research has served as the external evaluator for the LIGO Science Education Center since its inception in 2004. Over the years, we have studied LIGO education partnerships with Southern University – Baton Rouge, Exploratorium, LASIP/LA GEARup, Core Element, and more. In addition, we have studied key LIGO programs, particularly the SUBR docent program, the Project MISE professional development programs, and the field trip program.

Each year, we have jointly developed an evaluation scope of work, based primarily on questions the LIGO SEC staff and PI were interested in exploring, or areas they felt were in need of improvement or change. One year, we facilitated a site visit of two directors of similar Education and Outreach facilities associated with a large research center. At this visit, the directors shared best practices, challenges and solutions as they discussed their respective programs and strategies for bringing the very complex science at their centers to school children, teachers, and the public. An extensive report of this visit was prepared.

Ultimately, our goal has been to document the goals, work and impact of LIGO SEC, challenge and support the staff and PI to improve their work, and provide the NSF with an external perspective on their work and progress.

This set of documents provides a high-level summary of both our observations of the field trip and docent programs as well as recent data collection efforts, within the last 3 years. Data are drawn from staff, student, docent, and teacher surveys, interviews, or focus groups. The purpose of this collection is to provide the reader with an overview of an external perspective on LIGO SEC field trip and docent activities.

## Field Trips & Student Experience

*The LIGO SEC Field Trip program began in 2004 and continues today, with approximately 100,000 students served. This brief includes data from student focus groups, a student survey about career interest, teacher interviews and teacher surveys. The data are drawn from the last 2 years of evaluation activities. Students are participants in classroom field trips, and most teachers quoted are participants in Project MISE or the Joseph Meyinsee Teacher Leadership Institute (JMTLI) at Southern University at Baton Rouge.*

### **Inverness Research Observations:**

**In this region, LIGO SEC is one of few opportunities to explore science through interactive, hands-on exhibits that reflect a world-class, cutting edge scientific endeavor.**

**The LIGO SEC staff creates experiences for students that are enjoyable, rich in science learning, and unique.**

**Overall, we observe a very high level of student engagement in the field trip experiences. Students actively ask questions and engage in hands on science learning activities to increase their understanding about the cutting edge science happening in their region of LA.**

**LIGO has the potential to significantly influence the STEM identities of students who participate in field trips.**

**Teachers believe field trips are a unique, valuable, and inspiring STEM learning experience for them and their students.**

## STUDENT PERSPECTIVE

**Physical science concepts students are learning in school are illustrated and reinforced by the LIGO experiment, exhibits and activities (i.e. waves, light and magnetism). Students make connections between their school learning or personal interests and the science of LIGO.**

*When I heard that we were going to go, I searched it up on my computer at my house and I discovered that it was like discovering gravitational waves and stuff and all that. I love that because I love physics and space and all that. (5<sup>th</sup> grade girl)*

*I saw people in the laboratory. My mom is a civil engineer and she is on the computer all of the time because she is modeling stuff, she models dams and levees, so those people in the laboratory, they really reminded me of her. (6<sup>th</sup> grade boy)*

*I am really interested in music and I am really interested in science, and when you look at the sound wave and things like the piano, I play the piano and use that kind of science a lot. (5<sup>th</sup> grade girl)*

*I like being observant about things and there are a whole lot of things that I learned today that I could see with my eyes. It was making me want to do it even more. (High School (HS) girl)*

**Students also explore ideas that are not typically found in the K-12 curriculum, particularly related to complex concepts related to the fabric of the universe, and the behind-the-scenes activities of a large, multi-disciplinary science experiment.**

*I like the models and the explanations, we wouldn't know that in school. People in the physics class, they never would know about the mirrors unless they come here, so you learn more about it. (HS boy)*

*I feel more informed. The stuff that you learn here, you are not going to learn all of that at school. We learned the basics, but not in detail like we learned here. (HS girl)*

*I like that I finally actually learned something, because most of the things that at school I already know. (5<sup>th</sup> grade boy)*

*Only a handful of people get to see it and we are one of that handful. (5<sup>th</sup> grade girl)*

*LIGO makes me more interested in science. I am interested in learning about astronomy, and so learning about the different sound waves and gravity in space, I wonder would I learn about that here? It is just interesting. (HS girl)*

**Students hear about, and are inspired by, the range of roles and careers at LIGO.**

In an online survey of 150 students (58-6th graders, 37-7th graders, 14-8th graders, 24-10th graders, 10-11th graders, and 7-12th graders), 77% said they either “like” or “love” science or engineering.

72% said that they believed they could be a scientist or engineer at a place like LIGO. When asked to explain why (or why not), some wrote:

*The summer internship that was talked about was very interesting in getting to go into more detail about everything they look at to determine what happens out in space. (12<sup>th</sup>)*

*Science and engineering is not my thing but I would like to try different things and make new discoveries. At one point I wanted to be a astronaut because I had read this awesome book about the solar system and it had Neil Armstrong in it (12<sup>th</sup>)*

*Because I went to LIGO and they taught me many things that I could use to teach other kids that come to LIGO. Also because I have always wanted to be a scientist. (6<sup>th</sup>)*

*Because when I went to LIGO I experienced cool things that I had never seen before. I love what LIGO does and I would really like to work there because I would be making a difference in the world. (6th)*

*I feel like if I really wanted to I could work hard towards it and be able to go there. (6th)*

*I have a passion for science and I am well-versed in math. I feel like I could handle research and engineering jobs and probably enjoy them a good deal as well. (11th)*

*I think I will be able to [work at LIGO] because if I work hard enough I will be able to be a scientist or engineer. (6th)*

*I really enjoy engineering and science, and from the experience of going I would DEFINITELY enjoy being an engineer or scientist at LIGO. (7th)*

*I like science and engineering but I want to be a welder so that would be my first priority. If I could yes, I would want to work there as a scientist or engineer, it was very fun and interactive. (10th)*

*Because in 5th grade I got a perfect on my science LEAP so I am basically a scientist. (7th)*

In focus group interviews, they said:

*I think that I would be an engineer because my parents have always helped. I have built like robots out of pieces and I build a lot of things out of my mind. Something that backed up my thinking about being an engineer was that machine where you pull down the string and it shows and then also the guitar strings where you spin the wheel and the guitar string like vibrates. That was really cool and it is easy for you to see. (5<sup>th</sup> grade girl)*

*In the auditorium the video that showed the black holes colliding - that got me really, really interested. (5<sup>th</sup> grade girl)*

*I want to be a scientist when I grow up, but I don't know what science. I like learning about gravity stuff but I am not like into space much. But, I like learning about waves, and making things and building. (5<sup>th</sup> grade girl)*

*The fact that you don't have to have a college degree to come here, that it helps you because sometimes people aren't good in school, but they are good at what they do. (HS girl)*

### **LIGO field trip activities spark students' curiosity and wonder.**

*It made me more interested because when I find something out, I tend to want to learn more about it in science. (5<sup>th</sup> grade girl)*

*It made me more interested in science because it just didn't tell about one thing, it showed about lights and magnets and all of those different other stuff, especially waves. (5<sup>th</sup> grade girl)*

*I really like science and [the field trip] just makes me think that there are so many things that I haven't thought about in science, and that I will have to learn a lot to be able to be a scientist, a lot, a lot, a lot and I want to do it. (5<sup>th</sup> grade girl)*

*I thought especially after we played with the magnets and saw the iron and we were playing with that, I thought that was really cool. (5<sup>th</sup> grade girl)*

*We don't generally get to see, like we don't generally get to see stuff like the ultraviolet rays that we found from our bracelets or the magnetic force visually, we just don't get to see that and when we came here we do. (5<sup>th</sup> grade boy)*

*I want to come back again. Like every month they are open. (HS boy)*

**LIGO field trip activities confirm (or inspire) their interest in pursuing further study and/or careers in science or engineering.**

*I thought I would go into finance most likely, but this [experience] probably made me change my mind. (HS boy)*

*There are probably thousands and thousands of different engineers, but I would like to be like an agricultural one, and modeling would probably be one of the most important things, so seeing them working on their computers was cool. (6<sup>th</sup> grade boy)*

## TEACHER PERSPECTIVE

**Teachers provide high ratings of the LIGO field trip experience for their students:**

Answer options	Not at all	a little	Somewhat	A lot	A great deal
My students had an excellent field trip experience.	0%	0%	1%	10%	89%
The science concepts covered during the field trip aligned with what I am expected to teach in the classroom.	0%	1%	9%	22%	68%
I was able to transfer the inquiry approach into my classroom.	0%	0%	4%	31%	65%
I have incorporated my students' experience from the field trip into my regular classroom teaching.	0%	0%	5%	34%	61%
My students gained a better understanding of LIGO SEC-related science concepts on their field trip.	0%	0%	0%	24%	76%

**Teachers believe students get a unique experience at LIGO**

*LIGO is the BEST science field trip experience in southeast Louisiana. I have been teaching for 35 years and have been on quite a lot of field trips, but LIGO is by far the best because it is geared towards the needs of our students. Three months later, and they are still talking about it!*

**LIGO field trips are an opportunity to experience innovative science research in students' own community:**

*It was a great overall experience that took the students outside the walls of our classroom. Louisiana often gets a negative connotation when it comes to education and research. The field trip helped connecting the students with paradigm shifting community in their own "backyard."*

**LIGO field trips inspire teachers to improve their own teaching:**

*The students love LIGO and want to continue to go there year after year. It has also inspired me to be a better science teacher.*

**LIGO field trips can improve student learning in science:**

*I brought students to LIGO three years straight. These trips were made right before standardized testing. Each year students' test scores increased. I feel the LIGO field trip was a contributing factor to that increase and would definitely recommend and have recommended LIGO to other teachers*

**Teachers report that distance and transportation are key barriers to field trips to LIGO:**

Distance	44%
Transportation	31%
Cost	19%
Limited classroom materials	19%
Alignment with curriculum/standards	9%
Appropriateness for my students	2%
Limited internet access	1%

**Teachers believe that LIGO SECLIGO SEC is a resource for the improvement of science teaching in the region (91% agree).**

## The Docent Program

*The LIGO Docent Program, in partnership with the Southern University at Baton Rouge, has continued to serve SUBR and other students who have a strong interest in STEM, education, and service to the community. There have been 138 docents trained since the program began in 2007. Since the beginning of the program in, we have surveyed and interviewed the docents on a regular basis, observed docent training, and observed docents in action on the exhibit floor.*

### Key Accomplishments of the Docent Program:

- LIGO SEC is recruiting docents who have a strong interest in STEM, education and service
- Docents highly value all of the activities we asked about
- ~50% say their docent experience has influenced their college, job, or career decisions
- LIGO SEC offers a unique experience in the docent program
- LIGO SEC impacts docents' interactions at work and in the community
- Docents have significant memories of their LIGO SEC experience

LIGO SEC offers a **unique experience** for Docents (N=29, 2017):

Answer Options	Not at all	A little	Some	A lot	A great deal
The LIGO Docent Program provided me with <b>experience</b> I could not have gained anywhere else.	0	7	18	11	64
The LIGO Docent Program provided me with <b>knowledge and skills</b> I could not have gained anywhere else.	0	7	18	18	57

LIGO SEC Docent Program **influences Docents' engagement and work in the community:**

*The program has allowed me to confidently and effectively communicate scientific concepts in a way for a non-scientific person can understand. It has helped in boosting my confidence and self-esteem when presenting in front of individuals. I am able to use snacks in the classroom to help relay scientific concepts to my students. Participating in the program also helped me to be able to successfully organize a Family STEM at my current school.*

*My experience as a docent has changed the way I interact with my community. LIGO has given me more growth and confidence within myself to be able to speak in front of a big crowd and convey my message to them without any hesitation.*

*LIGO] made me more interested in volunteering and giving back to the community because the children need it.*

*LIGO has taught me the importance of reaching out to our youth, which are the foundation to the future of this country. Having them Educate in a STEM background will grant them many educational and career options.*

**Docents' experiences at LIGO SEC influence their decisions about college, jobs and careers:**

<b>Answer Options</b>	<b>Not at all</b>	<b>A little</b>	<b>Some</b>	<b>A lot</b>	<b>A great deal</b>
<b>College decisions</b>	7%	17%	21%	28%	28%
<b>Job decisions</b>	0%	24%	17%	38%	21%
<b>Career decisions</b>	0%	14%	24%	38%	24%

**LIGO Docent program helps to prepare Docents for future careers in STEM:**

<b>Answer Options</b>	<b>Not at all</b>	<b>A little</b>	<b>Some</b>	<b>A lot</b>	<b>A great deal</b>
The LIGO Docent Program helped me know better what to expect if I go into a math, engineering, medical or technical field.	0%	11%	21%	29%	39%
The LIGO Docent Program provided role models and/or mentors to me.	0%	7%	18%	39%	36%
<b>The LIGO Docent Program taught me about how to effectively communicate about STEM concepts and skills.</b>	0%	4%	7%	32%	57%
<b>The LIGO Docent Program gave me personal contacts and information that have been useful to me.</b>	4%	18%	21%	21%	36%