

The Gulf of Maine Research Institute

***LabVenture!* At the Cohen Center For Interactive Learning**

Summative Evaluation Report

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This report would not have been possible without the time and thoughtful reflections of the many teachers and students who either responded to our survey or allowed us to interview them about their visit to the *LabVenture!* at the Cohen Center for Interactive Learning.

THE GULF OF MAINE RESEARCH INSTITUTE
LabVenture! at the Cohen Center for Interactive Learning
Summative Evaluation

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EXECUTIVE SUMMARY

SUMMATIVE EVALUATION OF TEACHERS' AND STUDENTS' VISITS TO THE *LABVENTURE!* AT THE COHEN CENTER FOR INTERACTIVE LEARNING

In spring 2008, the Program Evaluation and Research Group at Lesley University conducted a summative evaluation of the Gulf of Maine Research Institute's *LabVenture!* program at the Cohen Center for Interactive Learning.

THE STUDY

Teachers

PERG sent surveys to all teachers who visited the Center with their students since 2006. We asked them to relate their own and their students' experiences at the Center, to assess the student teams' work as they investigated the *Mystery of the X-Fish*, and to describe any follow-up work they planned or carried out back in their classrooms. One hundred and fifty teachers from 112 visiting schools responded to the survey, 114 completed the survey.

Students

PERG selected a small, representative sample of classrooms from GMRI's database of visiting schools, and asked teachers familiar with the Center to request permission to have students complete an online survey. Five teachers did so. Fifty-eight students completed the survey in their classrooms. Similar in design and structure, the student survey asked participants to describe their experiences at the Center, to assess the effectiveness of their teams' collaborative work, and to tell us what they learned as a result of their investigations. Students were also asked whether their visit had an impact on their interest in science or might influence their thoughts about a marine-related career.

FINDINGS:

SUMMARY OF TEACHERS' RESPONSES

Why do teachers bring students to the Cohen Center?

One-hundred and seventeen teachers (117) answered our open-ended survey question, '*Why do you bring students to visit the Cohen Center?*' Their responses were clustered primarily into four broad areas and were in close correspondence to the central goals of the program. Visiting teachers said that they valued:

- The design of students' learning experiences at the Center: hands-on, investigative, collaborative, and student-driven.
- Exposure to a laboratory setting and its research scientists, awareness of new career fields and opportunities, access to new technology and tools for scientific study.
- For some teachers, the close fit with or extension of existing curriculum studies.
- For others, students' opportunity to explore and learn about science content areas *not* offered at their schools, especially 'real world' and locally relevant topics.
- For teachers in the schools in the rural or more remote communities across the state, where resources to support student learning experiences that require lengthy travel to another part of the state are scarce, the trip provided rare and important learning opportunities for their students.
- The visit was offered free to their schools. Several teachers noted that without GMRI's sponsorship, they and their students would not have been able to afford the trip.

What do teachers do while visiting the Center?

GMRI encouraged teachers to allow students to work through the investigations on their own. When asked to describe what they did while visiting the Center, a few teachers said that they strategically positioned themselves at a single station, a few more followed a particular group of students. But the clear majority of teachers responded that they "stepped back" and allowed students to work on their own or monitored their behavior.

About half of all respondents included further comments on this survey question, describing their observations of and interactions with students at the Center. Their comments provided more information about teachers' experiences during their visits, and what they wanted to find out about their students as they worked.

- Most teachers supported the Center's request to allow students to work independently. Teachers said they watched and listened, but tried to stay out of the way.
- Some monitored students' behaviors, intending to encourage participation, to keep individual students or entire teams on task, or to be close-by and available to intervene when students' behaviors seemed inappropriate.
- Five teachers, all first time visitors, followed and observed students because they were curious about the investigations and about the problem solving approaches their students used. Some said they wanted to learn how best to prepare students for a visit in the future or plan follow-up activities once back in the classroom.

In addition to those observing and monitoring students, small numbers of teachers reported that they:

- took photographs of their students at work to document the visit,
- worked through the stations themselves, conducting investigations alone or with a small group of other adults on the trip,
- visited the control station at the Center and spoke with the staff as they assembled the final, large group session based on students' investigations,
- spent time on the Center's website.

Teachers' reflections on students' experiences at the Center

To learn more about visiting teachers' understanding of the Center's goals, and how well they felt its purpose and design contributed to student learning, we asked teachers a series of questions.

1. What did teachers 'notice' about their students as they worked at the stations?
 - The majority of teachers (88%) said students were excited, highly engaged, focused, serious, and invested in their work.
 - A few teachers noted that some students had difficulty in the *LabVenture!* setting: they saw students that were silly or rowdy at first, 'fooled around' in front of the camera, 'stretched the boundaries,' or were unable to maintain their focus over the course of the visit.

2. How effectively did students work in teams?
 - The majority of the teachers (88%) said that the *LabVenture!* experience challenged most individual students as well as most teams to learn *how* to collaborate with peers to solve the problems each station posed without the need for adult guidance.
 - Teachers provided specific evidence:
 - students acted respectfully, shared research tools, listened to teammates' ideas, discussed their work, resolved questions, and came to conclusions together.
 - some students demonstrated strengths and talents not recognized previously by teachers or classmates.
 - A few teachers said they observed a small number of students that did not take the tasks seriously, acted foolishly, or made their teams' work more difficult.
 - Some teachers said the most serious threat to a group's effectiveness was when one or more students sought to dominate the group, 'take over' the investigation, refuse to share resources, or did not actively encourage more hesitant students to participate.
 - Some teachers reported that the number of students in a group, as well as the *size* of the students, could affect a team's success. In some larger groups, and groups with the larger-sized students, teams found it more difficult to share tasks, there was less time to allow everyone a turn using tools, and less space for everyone to fit into the video or to gather together close enough to hear directions.

3. Teachers' reflections on student investigations
 - Teachers observed that students, as they worked through each exploration, developed confidence in their research skills as well as their ability to function effectively as a team.
 - Several teachers noted that the Center supported their students' ability to work independently on the investigations -- thinking together, using new tools, gathering evidence, making discoveries, and demonstrating sound scientific reasoning.

- Teachers qualified their observations—reminding us that their students varied. Individuals approached the demands for their participation with a range of prior knowledge, skills, and experiences, as well as maturity levels.
 - Teachers made sincere efforts to construct viable teams, cognizant of their students’ assets and needs. They were, at times, disappointed by individuals behaviors or, conversely, surprised by students they had concerns about--those they said were ‘below grade level’, those who teachers thought were less capable than their peers, or those referred to as students with ‘special needs.’
4. Access: how well did the Center’s overall design support students’ learning?
Teachers’ reflections about the design of the Center – their observations on how effective the approaches used to engage students in the activities were in light of the limited struggles students experienced with particular elements or stations -- demonstrate the level of success GMRI has had in meeting its goal of providing ‘*universal access*’ to visiting students.
- Teachers overwhelmingly viewed the Center’s program as effectively addressing the learning needs of most of their students (94%).
 - Twenty percent (20%) commented on the *experience as a whole* -- how the overall design and organization of the Center contributed to the pace and flow of students’ activities throughout the day.
 - Teachers also provided examples of how *specific design aspects* of the Center attended simultaneously to the learning needs of the ‘typical’ learner as well as those students designated as having moderate to severe ‘special needs.’
 - Workstation communications
Communications at the workstations used both auditory and visual cues. Teachers noticed that this dual-modal approach to providing instructions and guiding students’ next steps supported the full involvement of students for whom either modality was primary, for non-readers, or for students with hearing or sight limitations.
 - ‘Hands-on,’ investigative approach
Teachers identified the active, ‘hands-on’ nature of the investigations as effectively meeting the needs of a broad range of students. Some noted that this aspect of the Center’s design was especially effective for students that struggled with the dominant modes of learning expected and utilized in more traditional school environments.
 - Large muscle demands—active engagement
Teachers commented on how student ‘movement,’ their active versus passive engagement, influenced students’ learning experiences: activities at the Center required students to be on their feet, active and interactive, and transition from one station to the next throughout the visit. For different investigations, students had to position themselves in front of the camera and in relationship to one another; remove the ‘X-Fish’ from its container, closely examine its features and measure it; exchange positions with one another to examine stomach contents under the microscope, or take over the operation of the fishing trawler.

- Teamwork and collaboration
Teachers said that the Center relied heavily on student collaboration to successfully conduct their research at the four workstations. Teachers suggested that, by working in groups, most students were able to be engaged and contribute to the team's efforts.
- A number of teachers reported several aspects of the Center's design that did not serve *all* students well, or where they observed students having difficulty either individually or working together as an effective team. Some students:
 - had difficulty managing their work in an unfamiliar environment – they became over stimulated by the excitement, activity, and/or noise level in the Lab
 - needed more structure or adult guidance to work effectively
 - completed their work 'early' and were impatient waiting for others
 - struggled with following directions—either they had difficulty understanding what was expected, especially at first, or jumped too quickly into the activities without listening or reading the directions
 - found it difficult to perform in front of the video camera: some lacked confidence, became silly, or could not compose their thoughts in the time provided
 - had difficulty operating the microscope at the Lab station
 - 'felt squeamish' handling the fish
- Nine teachers mentioned that they found students' behaviors at the station with the large tank excessively active or inappropriate. Some teachers recommended that staff reconsider the activities at this station.
- Two teachers thought students had difficulty meeting together in the large group setting either at the start of the program or for the wrap-up session.
- Ten teachers said that some students struggled as they attempted to work together as a team.

Teachers' assessment of student outcomes

Benefits to Students

The majority of the teachers believed that, as a result of their visit, more than half of their students developed new investigative skills and increased their knowledge about the Gulf of Maine and the marine research being carried out in the region.

Knowledge

Students learned more about the *Gulf of Maine* as an ecosystem, the animal life it supports, the interdependence of the organisms found in the waters, its economic importance to the state, and its fragility.

- Students became familiar with the Atlantic Herring--its anatomy, what it eats, its habitat, its schooling behaviors, its search for prey and avoidance of predators, its place in the Gulf of Maine food chain, and its economic importance.
 - About 40% said that more than half of their students expressed interest in learning more about marine science after their visit.

- A little less than 60% thought at least half of their students became more aware of possible careers in science and research.
 - Students returned from the visit with more information about the diversity of *marine careers* available in the state –in fishing and in conducting scientific research.
 - Approximately two-thirds said a small group of students expressed interest in such careers.
- A few teachers added comments:
 - More than half of the students learned about careers in the *fishing industry* as well as the economic importance of fishing and tourism for the region.
 - Students’ experiences at the *fishing station* helped them learn about decisions that influence fishermen’s catch, the technology fishermen use to locate fish, and the economic importance of the industry.
- A few other teachers said that, in addition to learning about marine sciences, many students became excited about science and technology.

Skills

Teachers described the skills students were introduced to, had the opportunity to build upon or practice during their visit. Teachers’ observations of their students ‘at work’ in the Cohen Center reflect how effective the Center was at:

- actively engaging student teams by asking teachers/other escorts to stand back,
- presenting intriguing-enough questions to pursue and problems to solve
- providing essential tools for investigations – requiring their close examination of a fish specimen, their use of a simple ruler, learning to adjust a laboratory microscope, and accurately reading sonar graphs
- asking students to observe carefully, think critically about their evidence, discuss their findings, formulate and present their conclusions

Extending Student Learning, post visit

- More than half of the teachers reported that they discussed students’ investigations and their findings, and allowed students time to visit their and fellow students’ materials on their website spaces, post visit.
- Slightly less than half of the teachers continued to pursue marine related studies in the classroom – either through reading materials or investigations.
- About one-third of the teachers reported that they made use of other resources available on the GMRI website: their blog: *Today in Maine*, or the learning activities designed to extend students’ visit experiences.
- Just over 10% reported that they developed a unit of study directly related to students’ interests and experiences at the Lab.

SUMMARY OF STUDENTS’ RESPONSES

Students’ reflections on their visit

The student survey began by asking participants to rate their overall experience at the *LabVenture!* They could select one of four options on a scale from ‘*It was great!*’ to ‘*I*

didn't enjoy the visit'. All students rated their visit in the top two categories -- as either 'great' or 'fun.' No student chose either of the lower-rated categories.

We then asked students to recall the individual parts of their *LabVenture!* experience: the two large-group sessions -- the introduction and closing 'scientific conference' and the four investigation stations, and to provide us with their views about each of them.

- The Introductory Session.

About half of the students enjoyed the whole group meeting at the start of the visit: they enjoyed the video presentations that placed their community within the larger, bird's eye view of the state and the within the Gulf of Maine Watershed. Several liked learning about the Gulf of Maine, meeting the staff and/or a scientist, and finding out what research was being carried out at the Institute.

- Almost one-third were reserved in their assessment. They thought it was ok, too long, or boring.
- Ten students said they were eager to get to the individual stations and found it difficult to wait until the introductory session was completed.

- Students' Favorite Research Stations

We provided a brief description of the problems presented and the work required for each of the investigations. Students were asked to indicate which station they thought was the best, and to state their reasons for their selection. The majority of the students named either the fishing expedition (>50%) or the large tank of fish (34%) as their favorites. The rest, 15% of the students responding to this question, selected one of the other two investigations – *What Does the X-Fish Eat?* or *What is the X-Fish?*

- Fishing Expedition

Students said they liked this station best because it reminded them of a video game, because they learned how to use sonar to locate schools of fish, because it required decision-making, because the station provided immediate feedback on whether their net drops were successful, and because it was realistic – they learned how fishermen made money or thought their experience learning about the economics of fishing would be useful in the future.

- Large tank of fish

Students enjoyed observing the fish in the large tank: watching their behaviors - schooling, swimming, and positioning themselves within the tank seemingly by size. Students were impressed by their speed and appearance, and also liked 'becoming' fish – avoiding prey, finding food or shelter.

- What does the X-Fish eat?

While a smaller number of students (10%) mentioned this station as the one they considered the best, those that selected it liked using the microscopes, examining the stomach contents, and learning what Atlantic Herring eat.

- What is the X-Fish?

Only 3 students ranked this station as their favorite. However, students responded strongly (whether favorably or not) to their task of examining the preserved X-Fish specimen at the station as one means for gathering evidence about its identity.

- Closing Session and Wrap-up: The Scientific Conference.
Most students enjoyed the final presentation: students were surprised and pleased to find that the GMRI staff had integrated their team photos, clips of their teams' videotaped hypotheses and conclusions, and some of their work samples into the final presentation.
 - Students liked to see their own work as well as other teams' work projected on the large screen. They were interested in what other teams had discovered and some found the presentation helped them answer questions they still had after completing their investigations.
 - A smaller set of students rated the session as just 'ok' or 'too long.'

Working in teams

Group size

The majority of the students said their teams had 3-4 members. A little more than one-fourth said there were 5 or more classmates on their teams. Teachers and students described how the quality of students' experiences was influenced and sometimes compromised by the size of their groups. Specifically, they reported that large groups had more difficulty:

- getting close enough to hear the directions,
- having sufficient work space on the stations' platforms,
- providing opportunities for the active participation of all members team members,
- establishing an equitable system for taking turns,
- accomplishing the work and coming to a consensus within the allotted time,
- sharing airtime and fitting into the video frame when reporting out their findings.

A clear strength of the *LabVenture!* experience is the opportunity teams of students have to struggle and learn on their own and without adult intervention, how to take on novel problems, plan how best to use available tools and resources, and practice how to share the workload. Therefore, ensuring that student teams can be as effective and successful as possible is an important design consideration for the Center's staff.

Students evaluate their teamwork

More than 80% of the students reported that they viewed their group as quite productive. Half thought the team worked well at most stations, while a little less than one-third said the team took turns and made decisions together.

Less than 20% of the students reported that their team experienced some difficulty working together. Most of these students (7 out of 10) said their team faced problems at some of the stations, while the remaining three students felt their team was an "utter disaster."

Interestingly, teachers viewed students' teamwork at the Center's research stations more favorably than did the students themselves, albeit by a somewhat small margin of 10 percentage points. (More than 90% of the teachers said the student teams they observed during their visits were either 'very effective' or 'effective most of the time' whereas 80% of the students rated their teams in this way.) It is possible that students had higher expectations for themselves and their classmates to be able to work well together than did the teachers. Students, however, experienced the direct impact when their team was unable to collaborate, and this may have influenced their ratings.

Effective Teams

Students identified the important ways their teams had worked well together, citing communication, collaboration, and problem solving as their key indicators of team effectiveness.

- Communication
Students said they had discussions, stated opinions, listened to one another, reached consensus, and presented their findings.
- Collaboration
Students shared responsibilities, took turns, got along with one another.
- Problem solving
Students figured things out together, made decisions collectively, got the work done.

Struggling Teams

Students also reported on what made their teamwork more difficult. It is interesting to note that, at times, students first described their struggles and then added an explanation of how the team coped with the problem.

- Equitable participation
Students said the team struggled to establish a fair system that allowed all to participate equitably in the station investigations.
- Actions of individual members
Some students said the behaviors of one or more members were responsible for the difficulties their teams experienced. Specifically, they identified:
 - team members that were too aggressive or bossy – those that tried to 'take over' or tell others what to do;
 - team members that were too reticent – those that stood back rather than joining in with others; and
 - team members who distracted others, preventing the team from working together effectively – those that were too goofy, unfocused, or off-task.
- Students also reported that their teams struggled – not because they could not work together effectively, but because they were not successful in completing the tasks, operating the tools or technology, or solving the problem posed at one or more of the stations.

Team work time

From our observations of student teams working on the investigations at the Center, we realized that occasionally a team would run out of time before students had completed the tasks or worked through their different opinions about their findings. The survey

provided an opportunity to learn the extent to which student teams felt they were given sufficient time at individual stations or not.

- Sixty percent, (33 of the 54 students responding to the question), had enough time to complete their investigations.
- Another 35% said that was true *'most of the time.'*
- Very few students (2 of the 54 in the sample) felt they needed more time.

Student Learning

What would students do differently on a second visit?

As one way to gauge what students gained from their *LabVenture!* experience, we asked them to reflect on their visit and tell us whether there was anything they would do differently if they visited the Center a second time. Forty-four of the students (44/58) responded to this question. Of these,

- more than half said there was nothing they would do differently and/or that they did not want the experience changed for other visitors in the future.
- about one-fourth said they would work differently at one or more of the stations if they returned for another visit. Their examples included:
 - take a better group photo
 - manage money better, use the boat differently, or extend the time spent at the fishing station
 - pretend to be an X-Fish again (at the live tank station)
 - talk more, think about things a little more, experiment differently
 - be more serious: *'not be goofy', it was not helpful to horse around when we had a job to do', 'focus on the activities more.'*
- A few students (10%) focused their response on their teamwork. They wanted to work with a different team, rotate team membership as they worked through the stations, work more effectively with their team, or figure out how to take turns.
- One student requested the design of a new station when s/he returned, one where students could examine a live X-Fish up close, in a small tank, to *'observe its habits and see what it eats.'*

The Center's impact on students' knowledge, skills and interests

To understand what impact the *LabVenture!* had on participating students, we constructed a series of questions and asked those responding to the survey to tell which, if any, of the possible things we listed they felt they had learned more about, gained experience doing, or were now more interested in as a result of their visit to the Center.

The Gulf of Maine and the Research Institute

- More than three-quarters of those completing the survey said they had learned about *scientists' research in the Gulf of Maine.*
We suspect students' reports on this item were high because the Center first introduces information about scientists' ongoing research in the Gulf during the initial session, but then connects and extends this information to the investigative work students do at the stations. For example, at the station, 'What does the X-Fish eat?' short video clips demonstrate how scientists collect samples of herring stomach contents for their research to aid student understanding.

- Almost half of the students (48%) indicated that they learned *where the Gulf of Maine is located*.
- A similar number of students (46%) remembered *meeting a scientist* at the Center.

The Mystery of the X-Fish

While students told us that the fishing expedition and the large tank of fish were their favorite stations, they remembered the results of their investigation into the *identity of the X-Fish* and their efforts to discover *what the X-Fish eats* as readily as their learning about finding and catching the X-Fish or why this species travels in schools.

- Nearly 90% of the students learned what the X-Fish was.
- More than half said they discovered what it ate (54%).
- More than half remembered how fishermen find and catch the X-Fish (57%).
- A little more than one-third learned why the X-Fish travels in schools (35%).

Conducting investigations

Many students (74% of our sample) said they learned more about *conducting scientific investigations* by observing, forming hypotheses, collecting evidence, and analyzing their results while visiting the Center.

- Over half said they learned to *work as part of a research team* (55%).
- Half had the opportunity to figure out how to *use scientific tools* in their investigations (51%).
- Less than half remembered why it was important to make *careful measurements* (43%). Yet, paying attention to the size of the fish specimen, as well as the relative scale of the food sources depicted in the information cards, were critical aspects of their investigations for students to successfully determine what the X-Fish was and what it ate.
- Nearly half of the students said they were *interested in doing more investigations* similar to those at the Cohen Center (49%).

Several students added other things they remembered learning during their visits.

I learned how much fun oceanography can be!

I also learned what different types of tools scientist use.

I also learned what the X-Fish looked like.

That dolphins are predators to the X-Fish.

I learned that the X-Fish is going extinct.

I learned a lot of cool stuff that I didn't know.

Students' interest in the marine sciences

The visit to the Cohen Center increased some students' interest in the marine sciences.

- Almost one-third said they were more interested in *studying science* (31%).
- Nearly half wanted to understand more about the *Gulf of Maine Watershed* (47%).
- More than one-third expressed new interest in *local, fresh water resources* as well as wanting to know more about the *Gulf of Maine* (35%).
- Only 2% said the visit had *no impact* on their interest in science.

Career Interests

Career information during students' visits to the Center was provided only implicitly – visiting students may have met one of the GMRI research scientists during the opening

session, they viewed short videos about an aspect of scientists' work that informed an investigation, contributing scientists' and technicians' photos and brief bios were part of the 'trailers' at three of the stations, and they had the experience of 'becoming a fisherman or woman,' making financial decisions, operating a fishing vessel, and using sonar to locate schools of fish.

- Given the survey options, students showed the most interest in *learning more about the technology and tools scientists use* (42%).
- About one-third expressed interest in finding out more about *what the research scientists were studying in the Gulf of Maine*, as well as *how they went about doing their research* (34%).
- More than one-third said they were interested in an important aspect of the GMRI's institutional mission – that is, *how scientists and members of the fishing industry located within the Gulf of Maine were working together* (36%).
- Twelve of the 53 students answering this question said they were more interested in *fishing as a career* than in becoming a scientist (23%).

TEACHERS' AND STUDENTS' VISITS TO THE *LABVENTURE!* AT THE COHEN CENTER FOR INTERACTIVE LEARNING: THE SUMMATIVE EVALUATION REPORT

INTRODUCTION

The Gulf of Maine Research Institute (GMRI) opened their *LabVenture!* program at the Sam L. Cohen Center for Interactive Learning in 2006.

Since January 2006, GMRI has been providing every community in Maine with the opportunity to bring either their 5th or 6th grade classes to the Cohen Center (free of charge). During these visits, students use scientific equipment and methods to explore a science mystery based on a keystone species in the Gulf of Maine food web. Interactive learning activities highlight the work of individual marine scientists at work along the coast of Maine. Sophisticated pre-visit and post-visit online classroom activities and personalized student websites will extend the impact of this learning experience throughout the school year.

GMRI website

THE DESIGN OF THE *LABVENTURE!* PROGRAM

The opening of the new Cohen Center's *LabVenture!* was the result of extensive research and planning, design and development work by GMRI's education team, working in collaboration with exhibit designers from Imageworks. During the early design phase of the program, the team also consulted with nearby teachers and students to pilot test potential activities and conducted a front-end evaluation of a single station.

The vision for the Center was to create an interactive environment where students from grades 5 and 6 could conduct a series of guided investigations based on topics related to GMRI scientists' ongoing research in the Gulf of Maine. The setting includes four separate investigation platforms or stations designed to provide the technological foundation for any number of ocean science research topics. The Center's initial program for the past two years has been the *Mystery of the X-Fish*, an examination of the Atlantic Herring – its structure, anatomy, and behaviors; its food sources and habitat; and how it is located, studied, and caught in the Gulf of Maine.

The GMRI's description of visiting students' experiences in the *Mystery of the X-Fish* program studied for this summative evaluation report is provided below, in a slightly edited version.

During their visit, students spend a half-day investigating a mystery about the Gulf of Maine ecosystem. They assume the role of a scientist, conducting their own hands-on research.

Each visit opens with a large-screen, Google Earth fly-in that zooms in from space to take students on a virtual trip from their own schoolyard down the watershed to the Gulf of Maine. Students learn what makes the Gulf of Maine bioregion unique and the work that scientists are doing to better understand it. GMRI's research staff regularly make short presentations about their own research, connecting it to the current Mystery or to techniques students will use in their investigations. The current topic is the X-Fish, an important species in the Gulf of Maine.

Students then conduct four scientific investigations at a series of hands-on research stations. Working in small teams, they make observations, develop hypotheses, collect data, and form conclusions. As they work, they collect digital artifacts using a dissecting microscope and various cameras and video recorders.

At one station, students study the X-Fish's stomach contents to determine what it eats. Another station shows students how to find the X-Fish, first on a scientific cruise in the Gulf of Maine, then on a fishing expedition, where their team's decisions affect how profitable the trip is. A third station has students examining the X-Fish and comparing it to other species, honing their observation and classification skills. The fourth station is a large tank where students first observe, then imitate, the behavior of the X-Fish. Once all four activities have been completed, students' findings from each station are presented in a science colloquium and they work together to resolve the science mystery.

Throughout the *LabVenture!* experience, students are exposed to the scientific method, the significance of the Gulf of Maine watershed, and marine careers in a fun and engaging manner.

After the program, students and teachers can access personalized student websites to review and annotate the digital artifacts saved by students during their visit. Students can also learn more about the Gulf of Maine, and interact with GMRI staff through a frequently-updated web-blog. GMRI also offers 5th and 6th grade teachers a library of standards-aligned, pre- and post-visit activities designed to extend the *LabVenture!* experience.

-based on the GMRI website

GOALS FOR THE COHEN CENTER FOR INTERACTIVE LEARNING

In designing the *LabVenture!* at the Cohen Center for Interactive Learning, the Gulf of Maine Research Institute sought to achieve a broad set of goals. These are:

- to provide universal access for middle school students regardless of their economic circumstances or geographic location,
- to introduce middle schools students to a working research laboratory and connect them with the scientific research community in meaningful ways,
- to pique their interest in science concepts by illustrating them in a locally-relevant context
- to create authentic, hands-on research experiences using communications and computing technology,
- to design programs where students could use scientific tools and methods to investigate a range of topics relating to Maine's freshwater and marine ecosystems; programs that could help students develop essential scientific research and problem-solving skills,

- to offer students the opportunity to assume the role of scientist and to see themselves as scientists,
- to connect students with scientists as mentors and potential career role models,
- to enable students to use the Internet to share their observations and to explore other marine science topics, and
- to leverage Maine's growing cyber-infrastructure to tap students' innate interest for creating their own digital content.

As a result of students' visits to the Cohen Center and their participation in the *LabVenture!* program, the education staff at the GMRI wanted students to:

- become engaged with and excited about science
- know more about and be interested in Maine's marine ecosystem
- gain critical skills as competent analysts and critical thinkers
- be more aware of marine science as a potential career path
- be better equipped to support thoughtful public policy pertaining to science and technology

EVALUATION

FRONT-END EVALUATION

The Program Evaluation and Research Group conducted the initial, front-end evaluation for the Gulf of Maine Research Institute, observed the piloting of one station during the design phase and interviewed participating students and teachers to determine:

- Whether the station – its directions, props, imagery and technological tools worked effectively
- Whether it successfully engaged students' interest and piqued their curiosity about the topic
- How students worked together in teams to solve the mystery
- What they gained, in terms of new knowledge and skills from their experience

SUMMATIVE EVALUATION

Since the Center's opening in early 2006, GMRI has reached out to schools throughout the state of Maine and invited middle school teachers to bring their fifth or sixth grade students to visit the *LabVenture!* at the Cohen Center for Interactive Learning, without charge for either admission or transportation. Their invitation and sponsorship has been enormously successful. Teams of teachers and other invited adults have accompanied more than 10,846 students from 177 schools throughout Maine's 16 counties on visits to the Center to explore the *Mystery of the X-Fish*.

During these past 2 plus years, GMRI has assessed the Center in a number of ways.

- They have worked closely with teachers and students in nearby schools, gathering feedback and advice.
- They have received considerable favorable notice from media, as well as letters and expressions of thanks from students and teachers.

- They have accommodated a growing number of schools willing to release teachers and students for a visit to the Center.
- They mounted a survey that visiting teachers could do online at the Center.

Now, as GMRI develops a new program for the Center, the staff felt it was time to conduct an evaluation to determine the extent to which its first program, the Mystery of the X-Fish, as well as the Center's overall design, was achieving the intended goals. As a result, PERG was asked to conduct a summative evaluation of the Center to learn about its impact on visiting teachers and students.

- Why were teachers bringing students to visit the Center?
- What were teachers and students learning as a result of their visits?
- What new skills were they gaining?
- Were student visits influencing their interest in the study of the sciences or in a marine science career?
- Were teachers and/or students using the resources available on the website as preparation of or follow-up for their visits?
- What impact did school visits have on teachers' work in the schools?

PERG developed the plan for the summative evaluation in close collaboration with the education team members from the Gulf of Maine Research Institute. Together we honed the areas of inquiry and developed a set of key questions about the Center's effectiveness in meeting its goals, discussed the design of center and its accessibility and utility by diverse groups, and clarified what knowledge, skills, attitudes and interests participants might gain from their experience at the Center.

Data Collection

Evaluators reviewed existing information about the Center: the GMRI website, documents sent to teachers by the Center in preparation for a school visit; and prior surveys with teachers and studies of students at the Center.

Evaluators had discussions and exchanged emails with staff members who hosted visiting schools and were present throughout teachers' and students' visits to learn what their key messages were, and what their experiences observing participants had been over the course of the Center's life.

Evaluators used several methods for collecting data from visitors.

1. Observation

Evaluators observed a group of teachers and students who were visiting the Center for one entire session. We tracked a group of students as they conducted investigations and participated in opening and closing sessions, and we made note of teachers' involvement throughout the visit. We did not interview participants on this day. The observation helped us develop the survey protocols for both teachers and students.

2. Teacher Survey

Evaluators, with support from GMRI, emailed all teachers who had visited the Cohen Center with their students since it first opened in 2006, and requested they complete an on-line survey about their and their students' experiences.¹

3. Student Survey

Evaluators selected a representative sample of ten teachers from the visitor database, and sought their assistance in gaining parents' permission to conduct an on-line survey with students. The sample reflected the diversity of the schools and student populations in Maine in terms of:

- geographic location: inland, coastal, and island communities
- the schools' travel distance from Portland
- the relative size and population of the community: rural, suburban or small city
- demographics: primarily the number of students in the school that qualified for free or reduced lunch rates.

Both surveys were lengthy, 28 questions in the teacher survey and 21 items for students. Both included scaled responses, selected responses, and open-ended responses. The design of most items allowed participants to add comments or suggest other answers than those provided. We sought to keep some of the flexibility of a loosely structured interview protocol and to benefit from as broad a range of individual responses as possible. The goal was to secure a comprehensive data set, without the expense of visiting and conducting multiple in-person interviews.

4. Site visits

Evaluators visited two schools where both teachers had played active roles in the design and development of the *LabVenture!* program. One teacher served on GMRI's education advisory board. Both schools were located within close proximity to the Research Institute. We interviewed teachers individually, and conducted small focus groups with student teams.

Data analysis

We downloaded both teacher and student survey data, sorted and coded the long responses. We also sorted students' focus group interviews by question, and coded teacher interviews.

THE REPORT

The summative report is divided into four parts.

1. Introduction: Background and Evaluation Plan
2. Findings: Part I. Teachers' Experiences and Reflections
3. Findings: Part II. Students' Experiences and Reflections
4. Discussion

¹ GMRI sent a preliminary letter to teachers, describing the purpose of the survey and the intended uses of the data, and requested their participation. Evaluators used the Institute's database of visiting schools and teacher contacts compiled since the opening of the Center.

PART I. TEACHERS

VISITING TEACHERS SURVEY

In April, 2007, PERG sent surveys via the on-line *Survey Monkey* tool to 606 teachers or other educators that had visited the Center with students since its opening in 2006.² We asked educators to relate their own and their students' experiences at the Center, to assess the student teams' work as they investigated the *Mystery of the X-Fish*, and to describe any follow-up work they planned or carried out back in their classrooms.

One-hundred and fifty educators (150 classroom teachers, specialists, or principals) that visited the *LabVenture!* at the Cohen Center in 2007 responded to our request for information. Of these 150, 114 completed all survey questions, an overall return rate of 22%.

Table 1
Survey Return Rate

Survey Return Rate	Number	Percent
Surveys sent	606	
Undeliverable surveys	87	14%
Surveys delivered (estimate)	519	86%
Opted out	10	2%
Possible respondents	509	
Respondents	150	30%
Usable Surveys	114	22%

We believe the return rate to be low for a number of reasons.

1. Most but not all individuals that received our email could access the survey. A few schools' security systems appeared to block educators' access to the on-line survey; some reported that they were unable to make selections for key items on the survey. We suspect that there were others who experienced such technological glitches that we did not hear from, and believe these difficulties may have lowered the return rate or prevented some from completing the survey.
2. In addition, some people contacted us to let us know that (1) they were not the core teacher at the school arranging the trip to the Center, but did forward our survey request to the appropriate individual at the school, or (2) were not teaching or teaching science, or (3) were not teachers at all. Some adults who accompanied students to the Center were parents, principals, or other school personnel. A few teachers responded, telling us that they had changed grade levels or schools and had not visited the Center recently. They chose not to complete the survey.

² Evaluators used the Gulf of Maine Research Institute's contact information to secure email addresses of visiting teachers.

3. Finally, in examining survey returns, we found that while there were, at times, multiple visitor email addresses for individual schools, frequently only one teacher responded to the survey. Of the 177 schools in GMRI’s database of visitors for 2007, one or more individuals from 112 schools completed the survey, a 63% return rate for participating schools.

SNAPSHOT OF PARTICIPATING TEACHERS

Who responded to the survey?

The majority of the respondents were teachers (95%), and of these, most were classroom teachers. They were almost evenly split between teaching 5th and 6th grade students.³

- A small number of these teachers were science specialists in their schools (6%).
- Four percent (4%) worked with special student populations.
- Three respondents (2%) reported that they taught 5th or 6th grade but did not teach science.

Seven individuals who responded to the survey (5%) accompanied students to the Cohen Center visit but were not classroom teachers; they were principals, school administrators or ed techs. This subset, along with the teachers who were not responsible for science instruction in their schools, did not respond to survey questions about science teaching, nor about follow-up activities with students after the visit. They did, however, provide their observations and reflections about students’ experiences during the visit and are included in our analyses.

Table 2
Survey Respondents

Respondents <i>Check all that apply (N=144)</i>	Number	Percent
Teachers	137	95%
Classroom	130	90%
Taught science	127	88%
<i>Did not teach science</i>	3	2%
Science specialist	9	6%
Special education/ gifted/talented	6	4%
Non-teachers	7	5%
<i>Principal/other administrative staff</i>	4	3%
<i>Ed techs</i>	3	2%
Total Respondents	144	100%
<i>answered question</i>	144	
<i>skipped question</i>	6	

³ The grade configurations of elementary and middle schools vary. In some, students in grades 5 and 6 attend local elementary schools, or, in other communities, middle schools include grade 5-8 or 6-8 students. While students visiting the center were either 5th or 6th graders, they attended schools that included grades K-5, K-8, or 6-8.

THE CONTEXT: SCIENCE STUDY IN VISITING TEACHERS' AND STUDENTS' CLASSROOMS

To provide a context for understanding visitors' experiences at the Cohen Center, we asked participating teachers' to respond to a number of questions about the science programs in their schools. Teachers were asked:

- how much time was devoted to science instruction
- what science strands and topics students studied
- what materials and resources for learning were available
- what students did regularly during science class

Time for science study

Teachers provided an estimate of the amount of time they or the grade levels at their schools allocated to science study each week. On average, survey respondents taught science four times a week for almost one hour per session or approximately 4 hours per week. There was considerable variability. The range was 1-5 times per week and ½ hour to 2 ½ hours per session.

This was a surprising finding. Many states have recorded sharp declines in the time teachers devoted to science study since 'No Child Left Behind' was enacted. We do *not* know, however, if our survey sample is representative of the amount of time teachers of grade 5/6 students in the state dedicate to science teaching and learning. Further examination of non-participating schools would be necessary to determine whether the schools and teachers that opt to visit the Center are qualitatively different from those that do not in terms of their focus on or interest in providing opportunities for science study to students.

Science topics and strands studied in grades 5-6

Teachers who completed the survey described a rich and varied array of science strands and topics. Almost ¾ of the teachers taught 2, 3, or 4 science strands, most often a combination of topics and/or investigations in the geosciences, biology, and physical sciences. A little more than ¼ of the respondents (27%) said they focused their students' work in one science area, providing opportunities for more in-depth study over the course of the year.

Some of the variation in science topics taught was clearly due to state and local district curriculum expectations for grade 5 vs. grade 6 students. There were distinct grade level patterns of science topics and curricula units among a large sample of the schools. Typically, but not exclusively, teachers focused more on earth science studies in grade 5 and biology in grade 6. Yet, within grade variations were evident as well. And, it was clear that a few schools established their own, locally relevant environmental science studies.

Specifically, the teacher survey data showed that:

- Earth and space sciences were most the frequently mentioned topics of study in the 5th and/or 6th grade classrooms. Studies included weather; environmental sciences and ecology; geology – rocks, minerals, and soils; volcanoes and earthquakes; landforms; oceanography; watersheds and estuaries; astronomy and space science.
- In the biological sciences, students were learning about human anatomy and body systems, cells, evolution, insects, plants, and animals.
- In chemistry, several teachers mentioned their students were exploring the commercial science kit, “Mixtures and Solutions,” while a few others said students were learning about the periodic table.
- In the physical sciences, studies included energy and matter, force and motion, gravity, electricity, magnets and motors, light and sound.
- In design and engineering, a smaller group of teachers were introducing students to curriculum units on simple machines, models and designs, or pulleys and levers; others explored bridges, model making, and inventions.

In a few schools, students were involved in field studies and/or their investigations focused on their local environment. Teachers’ examples included the Penobscot Restoration Project or the Gulf of Maine and its watershed. Some classrooms studied Maine’s fishing industry while others learned about particular species important to the fishing industry in the region.

Fourteen percent of the survey respondents (14%) explicitly mentioned that students learned to use the scientific process or scientific method in grades 5 and 6. Some said their students gained ‘scientific inquiry’ skills or practiced ‘scientific thinking’ in their science studies; a few reported that students designed and carried out research projects during the school year.

Table 3
Science Study

Science Strands <i>Check all that apply (N=127)</i>	Responses	Percent
Earth and Space	96	76%
Environment/Ecology	46	36%
Local field studies	2	2%
Biology	83	65%
Physics	60	47%
Chemistry	17	13%
Design and Engineering	15	12%
Science processes	18	14%
<i>answered question</i>	127	
<i>skipped question</i>	23	

Classroom Materials and Resources

To better understand the resources available to support student learning in the schools visiting the Center, we asked teachers to identify what teaching materials they used regularly in their science classrooms. As shown in the table below, almost 80% reported using a combination of science texts, trade books, and locally developed materials for student investigations. Half of the teachers had commercially developed kits available; one-fourth said there was a science lab in their schools. Survey participants had the option to add other materials or resources to the list we provided. Thirty-five did so. More than half of these cited their incorporation of on-line, web-based resources to support student learning.

Table 4
School Materials and Resources

Science Learning Resources <i>Check all that apply (N=115)</i>	Responses	Percent
Science textbook or trade books	91	79%
Teacher, school, or district developed materials for student investigations	91	79%
Commercially developed science kits (STC, FOSS, GEMS etc.)	59	51%
Students use the science lab in the school	29	25%
<i>Other</i>	35	
<i>On-line or internet resources</i>	17	15%
<i>answered question</i>	115	
<i>skipped question</i>	35	

Student involvement in the science classroom

Given the range of materials and resources available for science study, we wanted to know more about what students did during science lessons and with what frequency. As shown in the table below, responding teachers said their students most often (weekly) read from their textbooks (77%), listened to lectures (57%), and/or watched classroom demonstrations (43%) whereas 28% said students had the opportunity to conduct investigations that frequently. Looking more closely at the data, we see that slightly more than half of the teachers responding to the survey involve students in science investigations on a monthly basis or more frequently.

Table 5
Student Activities in the Science Classroom

During science lessons, students (N=116)	Often (weekly)	About once/ month	Seldom (few times/year)	Never
Read textbooks/written materials	77% (89)	15% (17)	8% (9)	1% (1)
Listen to lectures	57% (65)	17% (20)	19% (22)	7% (8)
Watch classroom demonstrations	43% (50)	41% (47)	16% (18)	1% (1)
Watch videos/DVDs	16% (18)	55% (63)	28% (32)	1% (2)
Use on-line/library resources	19% (22)	39% (44)	34% (39)	8% (9)
Conduct investigations	20% (23)	34% (39)	32% (36)	14% (16)
Design/carry out own investigations	8% (9)	36% (42)	44% (51)	12% (14)
Conduct field studies	0% (0)	18% (20)	44% (50)	38% (43)
Meet with visiting scientists	1% (1)	4% (5)	46% (52)	49% (56)
<i>answered question</i>	116			
<i>skipped question</i>	34			

CLASSROOM VISITS TO THE COHEN CENTER’S *LABVENTURE!*

GMRI’s stated mission is to provide ‘universal access’ to the *LabVenture!* program at the Center for all 5th and 6th grade students in Maine, free of charge. GMRI dispatches its own bus to pick students up, bring them to the Center, and return them to their schools after the visit. Each year, the staff has expanded its outreach and an increasing number of teachers, students, and schools participate.

In 2007, one or more teachers from each of the 177 schools on the GMRI’s visitor database visited the Center along with 10,846 of their students. All 16 counties in the state were represented. Teachers from 111 schools responded to our survey.

While students visit just once during their 5th or 6th grade year, nearly 60% of the teachers who responded to the survey had visited two or more times.

- 41% were first time visitors
- 39% had visited the center twice
- 20% had brought students to the center three or more times

Table 6
Classroom Visits

Teacher Visits	(N=14)
Once	41% (47)
Twice	39% (44)
Three times	19% (22)
Four times	<1% (1)

When examining the survey results, the perspectives of returning teachers that had previously accompanied students to the Center varied from those who had visited just once, particularly on some questions. Where applicable, we make note of those differences in the discussions that follow.

Why teachers bring students to the Cohen Center

The excitement! The tech tools, the student as part of an investigative team approach, the connection to their community! The location...it's not BOSTON! The availability of the supportive and student-oriented staff...The opportunity to bring it all back to the classroom with the website...

It is a way to engage students in science. Many students don't like science before they attend but when they return 90% of them love science.

Maine is a large state; its regions are distinct geographically and socio-economically. Some visiting schools are located just down the street or over the bridge from the Portland-based Gulf of Maine Research Institute; others are a relatively close-by in the city’s outlying suburban communities. But, there are teachers and students that travel 4-5 hours one-way by bus from the northern inland lakes region or the eastern reaches of Mount Desert or set off on their journey to the Center from the schools located on island communities off the Maine coast. Schools’ visits can entail anywhere from a short ride to a very long day’s trip.

With the survey of participating teachers, we sought answers to the following questions:

- Why do teachers decide to come to the Cohen Center?
- What value does the visit experience offer their students?
- How do their reasons for making the visit align with the Gulf of Maine Research Institute's purpose for creating the Center as well as its central goals for students?

Teachers cite the importance of the Center's goals for their students

In the introductory section of the report, we outlined GMRI's intended goals and described how the learning opportunities presented sought to achieve those goals. A brief outline of those goals can be found below. The Cohen Center's *LabVenture!* was designed to:

- build students' awareness of the importance of the marine ecosystem and its relevance to their lives;
- expose students to current research being conducted in the Gulf of Maine and to the variety of career opportunities available in science and technology;
- engage students in immersive activities where, as members of a research team, they use the scientific process to solve a marine mystery. They observe, explore phenomena, form hypotheses, gather evidence, test their hypotheses, draw conclusions, compare results with peers, raise new questions for further study;
- provide students with access to research scientists' approaches, measurement tools and technologies to use in their own investigations.

One-hundred and seventeen teachers (117) answered our open-ended survey question, 'Why do you bring students to visit the Cohen Center?' Their responses were clustered primarily into four broad areas and were in close correspondence to the central goals of the program. Visiting teachers said that they valued:

- The close fit with or extension of existing curriculum studies.

*This is an incredible trip for them. It fits the curriculum like a glove...
It goes perfectly with our Invertebrates unit on fish classification and it is a great hands-on science experiment for my students.*

- Students' opportunity to explore and learn about science content areas *not* offered at their schools, especially 'real world' and locally relevant topics.

Because my students would NEVER be exposed to anything dealing with Marine Science otherwise (and I can say that for grades K-8), this program is a much-needed addition to our science curricula.

- The design of students' learning experiences at the Center: hands-on, investigative, collaborative, and student-driven.

(Students) love doing science in a way that puts them in control of their learning.

(Students) use the scientific method; they work cooperatively...

Exploratory, hands-on science with real life examples relating to the state of Maine.

- Exposure to a laboratory setting and its research scientists; awareness of new career fields and opportunities; access to new technology and tools for scientific study.

The center offers opportunities, technology, and information that I could never reproduce in the classroom.

(Students) get to use "real" equipment, like high-powered microscopes and other tools ...it's got everything!

Free Access to the Cohen Center

Most teachers in the schools in the northern and western regions of the state and those located *Down East* work in rural communities where the resources to support student learning experiences that require lengthy travel to another part of the state are scarce. They said the trip provided rare and important learning opportunities for their students.

Our students would not have the opportunity to visit such a center in our rural area. To get this type of hand-on experience with such technology is such an amazing opportunity for them. There is no way to duplicate what the center has to offer in our classroom.

We are a rural small school in eastern Washington County where children do not get to many places related to science much. So we love the experience for the horizons it opens to us.

For many of our students it is the first time they have traveled south of Bangor. It gives them an exposure to another part of the state beyond woods and potato fields. It is also an excellent tie-in with our environmental series that usually concludes at the end of the school year.

Nearly 20% of the teachers mentioned that they were able to come because the visit was offered free to their schools. Several added that without GMRI's sponsorship, they and their students would not have been able to afford the trip.

I know that we don't offer enough science instruction to our students. Because the trip is a rich learning experience and FREE, we take advantage of (it).

Other reasons

Some first time visitors said they accepted GMRI's invitation to visit the Center because other teachers or administrators in their schools had recommended the trip. A few (5) noted that the trip was 'required' in their schools.

Preparation for the visit

Once a school schedules a visit to the Cohen Center, the staff at the GMRI provides background information and instructions to help teachers and students prepare for their visits. These documents include a description of the Center and students' activities while there, travel logistics, and permission forms. The staff asks teachers to establish student teams prior to their arrival, and provides a set of guidelines to optimize students' experiences.

The LabVenture! Stations, where students will solve each query, are set up to promote students taking on different roles within their group so that they can work together successfully. This program is also designed for students to work independently, without interaction or assistance from an adult. Please keep this in mind when deciding which students will be working together.

GMRI visit materials

For the summative evaluation, we wanted to learn how teachers prepared students for their visits to the Center. For example:

- Did teachers have sufficient information about the visit?
- Were they or their students going to the Center’s website or using their on-line resources prior to their visit?
- To what extent were teachers heeding GMRI’s instructions in terms of team formation?
- Did teachers tell students what to expect or coach them?
- With what information or sets of directions were students entering the Center?

Survey responses showed that teachers, for the most part, followed GMRI’s guidelines for the visit.

- Almost three-fourths of the respondents (73%) said they provided a set of ‘rules’ to govern students’ behavior on the bus ride and/or at the Center.
- More than half of the teachers (54%) were clearly familiar with what the Center had to offer. They said they planned and scheduled their trip as a way to complement students’ science studies in the classroom.
- Slightly more than one-third (36%) of the teachers used GMRI’s activities on the website prior to the visit or said their students browsed the website before visiting.
- 30% purposefully decided that students should come to the Center *without* too many preparatory instructions.
- 28% said that they were uncertain what to expect as it was their first visit or that they did not know how to prepare students for what they would likely experience while there.

Table 7
Preparing Students for the Visit

In what ways, if any, did you prepare students for the visit? <i>Check all that apply. (N=109)</i>	Percent	Responses
Provided a set of guidelines/rules for the bus trip and the visit.	73%	80
Visit was planned to complement students’ science studies.	54%	59
I like students to have their experience without too much preparation from me.	32%	35
This was my first visit. I did not know what to expect myself.	26%	28
I used pre-visit activities on GMRI’s website to prepare students	23%	25
Students explored the GMRI website on their own, prior to visit.	13%	14
I did not know how to prepare students.	2%	2
Other	5%	5
<i>answered question</i>		109
<i>skipped question</i>		41

A few teachers offered additional comments, providing more insight into the work that was occurring in some classrooms prior to their visits to the Center.

We talk about the GMRI and how their work affects our lives. We visit the website. I discuss what they will be doing there with the hands-on activities and solving the mystery.

I discussed with students how the program was a great connection to our studies.

Often, I have introduced the idea of food webs/food chains before I visit with students.

We specifically try to tie in our own local watershed with the Gulf of Maine. We study ecosystems and biomes extensively prior to our visit and emphasize the role of plankton in aquatic and marine food chains and webs.

I give students homework on the geography of the Gulf of Maine.

TEACHERS' EXPERIENCES AT THE COHEN CENTER

What do teachers do while visiting the Center?

GMRI encouraged teachers to allow the students to work through the investigations on their own. But, was that happening? If it was, what did teachers gain from their observational stance?

When asked to describe what they did while visiting the Center, a few teachers said that they strategically positioned themselves at a single station; a few more followed a particular group of students. But the clear majority of teachers responded that they “stepped back and allowed students to work on their own (98%) or monitored their behavior (83%).

Table 8
Teachers' Roles during Visit to Cohen Center

Teachers' Roles during Visit to Cohen Center (N=110)	Yes	No	Responses
Stepped back and allowed students to work on their own	108 (98%)	1	109
Monitored all students' behavior	91 (83%)	17	108
Helped students when they were struggling	38 (35%)	66	104
Observed one group of students as they worked through each station	17 (16%)	81	98
Stayed at one station; observed each group of students as they worked	6 (6%)	88	94
Additional comments			47
	<i>answered question</i>		110
	<i>skipped question</i>		40

About half of all respondents to this question included additional comments, further describing their observations of and interactions with students at the Center. These self-generated comments provided additional information about the teachers' experiences during their visits, and what they wanted to find out about their students as they worked.

- Most teachers supported the Center's request to allow students to work independently. Teachers said they watched and listened but tried to stay out of the way.

I tried to stay out of the students' way while they were working. I wanted them to work through their struggles.

Actually, I tried not to get involved in what the students were doing but liked to talk with them as they were excited about some component of the stations.

I went from station to station, group to group, but I tried not to interrupt too much!

- Some explained that they monitored students' behaviors: to encourage participation, to keep individual students or entire teams on task, or to be close-by and available to intervene when students' behaviors seemed inappropriate.

I floated and tried to involve those hesitant students.

I circulated, monitored, encouraged, redirected.

I didn't want dominant students to take over the experiment leaving others to only observe.

I rotated around and watched many groups working at the various stations. I knew which groups needed the most "observing" on my part too.

- Five teachers identified themselves as first time visitors. They followed and observed students because they were curious about the Center's investigations and about the problem solving approaches students used. Some said they wanted to learn how best to prepare students for a visit in the future or plan follow-up activities once back in their classrooms.

I chose to walk around because I was curious to see what each kiosk offered and how students were reacting with the equipment and how they were trying to figure it all out.

I wanted to see the stations myself to get a better idea of what we might do in preparation for our visit as well as to see the complete cycle of stations.

In addition to those observing and monitoring students, two teachers said they spent their time documenting the trip. They walked through the space taking photographs of their students at work. One planned to use the photographs in the school's newsletter.

Finally, we learned that a small number of teachers (9 of 110 respondents, < 0.8%) did not observe or interact with students at the Center. Interestingly,

- four teachers (4) worked through the stations themselves, conducting the investigations, either alone or with a small group of other adults on the trip,⁴
- a few teachers visited the control station and spoke with staff there,
- three teachers (3) spent their time on the Center's website.

During a site visit interview, one teacher said s/he met with other science teachers from their school during the teaching team's visit to the Center, using the time to work together to plan follow-up lessons for students.⁵

⁴ In fact, a number of teachers responding to the survey expressed an interest in forming an adult team to conduct the investigations, as these teachers reported that had been able to do.

⁵ Teacher interview during site visit to school.

TEACHERS' REFLECTIONS ON STUDENTS' EXPERIENCES AT THE CENTER

To learn more about visiting teachers' understanding of the Center's goals, and how well they felt its purpose and design contributed to student learning, we asked teachers a series of questions on the survey. First, we asked them to tell us what they 'noticed' about their students as they worked at the stations. The question was open-ended; it provided neither specific prompts nor a set of options to influence teachers' reflections. In response, the majority of teachers remarked on their students' intense involvement, described their excitement about the *LabVenture!* setting, and reported on students' successes and struggles as they explored the investigations.

Then, as a follow-up to this initial query, we asked teachers to respond to a set of more targeted questions: we wanted teachers to (1) evaluate the effectiveness of the student teams, a critical component of the Center's design, (2) describe students' work as they encountered each station activity, and (3) assess and comment on how well the Center's overall design supported students' learning. We have integrated teachers' responses to both the more open-ended and targeted questions in the sections that follow.

Student enthusiasm and engagement

The majority of teachers (88%), in response to our open-ended question about what they 'noticed' about students during the Center visit, said they were excited, highly engaged, focused, completely involved, serious, and invested in their work.

The first thing that I noticed was the excitement that blossomed from them as they tried each activity at the different stations.

They were thoroughly engaged, trying to figure out what to do, and doing the activities. They were curious, and enjoyed the computer and video aspect.

They were very excited by the technology. Each station seemed like a new adventure to them.

Students' level of engagement was very high. The level of cooperation within groups and from station to station was also very good.

Energy, enthusiasm, high level of excitement and focus; universally loved touching and examining the fish specimen; their feelings of being scientists.

I noticed that they tended to be a bit silly at first but as they became accustomed to the format they became much more serious and focused. Of course students covered the entire spectrum.

I only stepped in with my designated students that might be having a hard time. Overall, I felt unwanted and unneeded while they were involved at the center. The center staff provided excellent structure and maintained a strong presence that allowed the students to explore and try new things in a safe and monitored area.

Student Teamwork

Effective teams

When asked to evaluate students' ability to work together at the Center, over 90% of the teachers reported that students worked effectively with team members most of the time.

Table 9
Students' Work in Groups

Teamwork (N=110)	Percent	Responses
Very effective	40%	44
Effective most of the time	54%	59
Somewhat	6%	7
Not effective	0%	0
<i>answered question</i>		110
<i>skipped question</i>		40

Teachers provided specific evidence, based on their observations and in response to our open-ended question, that students acted respectfully, shared research tools, listened to teammates' ideas, discussed their work, resolved questions, and came to conclusions together. Here is a small but representative sample of teachers' comments about their observations of students' teamwork at the Center.

The students tried to include all group members as they conducted their investigations.

Students worked well together. They were pretty respectful of each other, allowing everyone to touch and use the equipment. They also seemed to listen to everyone's ideas.

(I observed) team decision-making, shared responsibility, lots of conversation about background knowledge and experiences.

They worked hard to perform as a team. (They were) considerate and fair to one another. (They were) enthusiastic and took their work seriously. No bathroom breaks!

A few teachers said some students demonstrated strengths and talents not recognized previously by teachers or classmates.

I noticed active engagement and excitement. Some students, who are not normally leaders, became the organizer and motivator for their group.

Struggling teams

A few teachers realized that the number of students in a group, as well as the *size* of the students, could affect a team's success. In the larger groups, where there were 5 or more students, especially when the group was comprised of mature 6th graders, the team found it more difficult to share tasks. There was less time to allow everyone a turn using the microscopes, and less space for everyone to fit into the video or to gather together close enough to the station platform for all to hear the directions.

Some noted that the most serious threat to a group's effectiveness was when one or more students sought to dominate the group, 'take over' the investigation, refuse to share resources, and/or not actively encourage the more hesitant students to participate. Others

said they observed a few students that did not take the tasks seriously, acted foolishly, or made their teams' work more difficult.

There were a few students who disengaged and needed to be brought back on task, as well as a few students who tried to 'run the show.' Yet, for the cooperative learning atmosphere, those difficulties were few and far between.

Despite the struggles some teams had, it is important to stress that, in response to the survey questions, the vast majority of teachers said the *LabVenture!* experience challenged students to learn *how* to collaborate with peers to solve the problems each station posed without the need for adult guidance. Teachers thought most individual students as well as most groups were able to successfully meet that challenge within, and perhaps due to, the design of the Center's program.

The groups often have difficulty working with each other in terms of who gets to do what; sharing responsibilities. After their first station they tend to establish roles and the difficulties subside.

They grew in confidence, began to give-and-take as they saw their teammates' strengths. They stepped up to the plate!

Students using the microscopes were unsure at first how to operate them. But they worked together to figure out how to turn on the light and focus the lens. It was great teamwork.

Student investigations

The overall design of the Center, the cumulative experiences provided by opening and closing sessions as well as the set of 4 station investigations, were meant to work together in concert so that, over the course of the day, students were able to develop the capacity, confidence, and expertise needed to successfully conduct research, gather insights, begin to make sense of their findings, and place them within the context of the Gulf of Maine marine environment.

Rather than assume all students would arrive at the Center with the full complement of skills needed, GMRI staff purposefully set out to support the development of new knowledge and skills by asking students to tackle each of the challenges posed -- by making creative use of all the resources available at the stations, and by tapping into the knowledge and experiences held by members of their group.

Some teachers, in response to our survey questions, clearly recognized the developmental design of the visit experience. They observed that students, as they worked through each exploration, developed confidence in their research skills as well as their ability to function effectively as a team. Several teachers noted that the Center supported their students' ability to work independently on the investigations -- thinking together, using new tools, gathering evidence, making discoveries, and, throughout, demonstrating sound scientific reasoning.

They loved the chance to be scientists.

They were not as quick to ask questions, they worked through problems as a group. They enjoyed using the various materials especially since we do not have that equipment at school.

Listed below is a representative sample of teachers' observations of their students at work on the investigations.

Students generally were more methodical and followed directions better than I thought they would.

They had a little trouble at the beginning, following directions and working some of the equipment. This was much more techie than they are used to. After a while, though, they became more confident.

Each station provided challenges for them. As they progressed through the stations they became increasingly comfortable and more confident with the technology and were better able to problem solve and work together as a team.

Students had a bit of trouble with navigation but were eventually able to work out their problems themselves.

Groups chose different sized fishing boats and had a good discussion about cost v. earnings in the final discussion.

Throughout the survey, teachers qualified their observations – reminding the evaluator that their students varied. Individuals approached the demands for their participation with a range of prior knowledge, skills, and experiences, as well as maturity levels.

Some were rowdy; some very focused; most got something out of it.

Some students work better together than others!

Different students stepped up to different challenges and they bragged about that later.

While teachers made sincere efforts to construct viable teams, cognizant of their students' assets and needs, they said they were sometimes disappointed by individual students' behaviors and/or, conversely, surprised by other students they had concerns about -- those they said were 'below grade level', those who the teachers thought were less capable than their peers, and/or those referred to as students with 'special needs.'

Some students surprised me with their deductive thinking!

The lowest group of students came away with basic ideas while more capable students were excited to look at the station further.

Even those who are several levels below grade level in skills were actively involved and able to perform the task with little/no help.

'Special needs' students had a chance to shine.

In the next section we explore, in more detail, the extent to which teachers' viewed the Center's program as accessible to all their students.

Student Access

On the survey, we asked teachers to consider whether the design and overall organization of the Center was able to support *all* students’ learning, as intended. Based on their observations, we wanted to know how many of their students were successfully engaged in the activities, gained knowledge, developed new skills, and contributed to the team effort within the Center’s environment. Teachers overwhelmingly viewed the Center’s program as effective in addressing the learning needs of most of their students (94%).

Table 10
Student Access

Accessibility (N=108)	Percent	Responses
Most students	94.4%	102
More than half	3.7%	4
Less than half	0.9%	1
A few students	0.0%	0
Don't know	0.9%	1
<i>answered question</i>		108
<i>skipped question</i>		42

More than 100 teachers described how a variety of design components contributed to students’ success. Some provided just one example, while others wrote in more detail about what they viewed as especially effective design aspects and/or about their observations of an individual or group of students at work at the Center.

All students accessed the lab. All learning styles were met because of the variety of activities. It was hands-on, visual, high tech, and organized!

The activities were very hands-on which fit the learning style of many of my students, not just one.

The kids we've had in wheelchairs had an equal experience.

GMRI was especially suited for students with high to moderately high science interests and skills. Inquisitive students or inquiring minds did the best.

We coded their responses and provide a summary that displays the range and frequency of teachers’ comments in the table on the next page. Teachers’ comments focused on how the design and organization of the Lab program *actively* engaged diverse learners, the careful integration of the separate activities, the reliance on students’ capacity to solve problems using available tools and technology and in collaboration with one another.

Table 11
Design Elements Contributing to Student Participation

Design Elements (N=111)	Percent	Responses
Center's comprehensive design/organization	21%	23
Active, hands-on investigations	41%	46
Multi-modal communications	33%	37
Physical movement	18%	20
Support for students with special needs	18%	20
Interactive, collaborative learning	16%	18
Inquiry-based, student-structured learning	14%	16
Use of technology and scientific tools	10%	11
Scientific environment, real world problems	5%	5
<i>answered question</i>		111
<i>skipped question</i>		39

Merely coding and summarizing teachers' reflections about the Center's design, however, betrayed the richness of the descriptions they had to offer. Below, we provide a sample of their comments, organized by the design features they highlighted and the reasons why they thought these elements proved effective in supporting students' learning.

Comprehensive design and organization

About 20% of the teachers' comments focused on the *experience as a whole* -- how the overall design and organization of the Center contributed to the pace and flow of students' activities throughout the day.

Structurally the lab allows the students to move from area to area without much close interaction with different groups. The lighting directs the groups' activities and helps to provide a designated work area.

The pre-lecture outlined expectations, the use of various formats, many entry points to the materials, short lessons, hands-on, teaming, involvement in "game" and problem solving, wrap up and summation, non-involvement of adults.

It allowed (students) to be active while learning. It used a hands-on approach that students enjoy. It encouraged them to think for themselves while also collaborating with others.

Individual design aspects of the Center that proved successful for students

Teachers also provided examples of how *specific design aspects* of the Center attended simultaneously to the learning needs of the more 'typical' learner as well as those students designated as having moderate to more severe 'special needs.'

- Workstation communications

Communications at the workstations used both auditory and visual cues. One-third of the teachers noticed that this dual-modal approach to providing instructions and guiding students' next steps supported the full involvement of students for whom either modality was primary, for non-readers, or for students with hearing or sight limitations.

The lab work was great for my visual learners. They had the opportunity to see, smell, and touch specimens.

One of our students is hearing impaired. The visual and hands-on activities enhanced her learning experience.

Low readers were much more engaged.

I have a student who has great difficulty reading and comprehending what they are being asked to do. The Lab not only has the questions written but the computer also verbally asks the questions.

Similarly, students were called upon to state their hypothesis and conclusions orally, in front of the video camera, to create a record of their teams' ideas and research findings. In fact, as is the intention of universal design, *because* the Center attended to what one might consider more specialized needs of some students, it enhanced the learning opportunities for all.

There was an impressive variation in activities. Some required writing, but most relied on video or audio presentation.

The combination of auditory, visual and tangible cues gave all my students the opportunity to be successful.

Students loved the fact that information was spoken so they could concentrate on the ideas and work on solving the puzzle.

- 'Hands-on,' investigative approach

Over 40% of the teachers identified the active, 'hands-on' nature of the investigations as effectively meeting the needs of a broad range of students. Some teachers noted that this aspect of the Center's design was especially effective for students that struggled with the dominant modes of learning expected and utilized in more traditional school environments.

You provided visual directions, auditory experience and lots of materials to explore, with open-ended questions and room for the child's interpretation

The lab design provides hands-on learning for students with literacy challenges.

We have several students who learn best by doing hands-on activities. The lab design fully supported this mode of learning.

The hands-on activities allowed students to see and feel instead of just having to listen. Hands-on kinesthetic learners had a very good day.

One of my students in particular is hard to reach through the usual avenues of reading and writing and he responded to the activities with focus and enthusiasm.

- Large muscle demands—active engagement

Center activities required students to be on their feet, active, and transitioning from one station to the next throughout their visit. For different investigations, students had to position themselves in front of the camera and in relationship to one another; remove the 'X-Fish' from its container, closely examine its features and measure it; exchange positions with one another to examine stomach contents under the microscope, or take over the operation of the fishing trawler. Nearly 20% of the teachers commented on how student 'movement,' their active as opposed to passive engagement influenced students' learning experiences.

My kids that can't sit were more focused by being up on their feet and able to talk or "perform" for the video recording

One of my students is very active and seems to learn best when able to move around. He loved the GMRI trip and learned so much by being able to touch and move. It was great.

Students need "palate cleansers:" chances to take brain breaks, stretch and absorb information. By moving from station to station, the Lab design supports this need.

The hands-on, school-of-fish activity was a nice sensory break for many of my students.

Students' involvement at the large tank was indeed the most active of all stations. It encouraged students to join alongside the school of circling fish – to swim, dive, avoid prey, and find food; to be physically active *and appropriate* during what was for many a long day.

We had a couple of students who had severe ADHD. The constant movement from station to station and the "school of fish" activity allowed them to stay active and release energy while remaining focused, learning, and having fun.

The large tank activity was a great way for the more active members of my class to move about in a constructive way.

- Teamwork and collaboration

Teachers said that the Center relied heavily on student collaboration to successfully conduct their research at the four workstations. Teachers suggested that, by working in groups, most students were able to be engaged and contribute to the team's efforts.

I'm thinking of the 'what does the X-Fish eat' station. It was multi-tasked. Children could get involved at their own comfort level: listening, observing, comparing, supporting conclusions.

Teamwork (allowed) students to contribute in different ways.

It provided a range of entry points and demands for (students with) varied sets of skills.

Several who require 'special ed' services were part of a group. They didn't have to do all of the work, but had their part to do.

One of my students has a one-on-one aide most of the day for both academic and behavior issues. During our visit, this student was able to participate with her group and was not a problem at all.

One child is a low reader so working with pre-arranged groups was a great idea! He loves computers so he was able to work quite well and seemed to understand what was going on.

Design aspects or features of the visit that proved difficult for students

Despite all the ways teachers described how the Center was meeting students' needs, we did want to learn whether they observed any of the Lab's components or design elements that did not work well or failed to meet students needs. One hundred teachers responded to the survey question, 'What aspects of the design or other features of the visit proved most difficult for your students?' Of these, more than one-third said they observed no difficulties for their students during their visit to the Center.

Really, students found this engaging and challenging but did not find it difficult. Various sensory representations alleviated any difficulty.

I cannot think of any difficulties. Every aspect of the Lab was well thought out.

Honestly I can't think of one. My students did not encounter any problems.

The remainder of the teachers responding to this question (65) reported several aspects of the Center's design that did not serve *all* students well, or where they observed students having difficulty either individually or working together as an effective team. Please note that some, although not all, of the challenges students faced, and teachers noted, were part of the intentional design – meant to provide students with new experiences that required collaboration, close observation, and scientific reasoning.

LabVenture! Environment

Teachers observed that:

- a few students had difficulty managing their work in unfamiliar environments – they became over stimulated by the excitement, activity, and/or noise level in the Lab
- some needed more structure or adult guidance to work effectively
- some students that completed their work 'early,' in less time than the station allotted for the investigation or activity, were impatient waiting.

Following directions: using available research tools and materials

Teachers noticed that:

- some students struggled with the directions at the stations – either they had difficulty understanding what was expected, especially at first, or jumped too quickly into the activities without listening or reading the directions
- some students found it difficult to perform in front of the video camera: some lacked confidence, became silly, or could not compose their thoughts in the time provided
- a few 'felt squeamish' handling the fish
- some students had not had access to a microscope in their schools; they had difficulty operating the one at the Lab station.

Individual stations

Nine teachers mentioned that they found students' behaviors at the station with the large tank excessively active or inappropriate. Some teachers recommended that staff reconsider the activities at this station.

- *The one area that seemed the most difficult was the swim tank. I think it was not as involved and focused for students. This was the station where groups were the loudest and seemed to finish first.*
- *The only area that our students had trouble was when they had to run around a school of fish. Some got a little wild.*

Two teachers thought students had difficulty meeting together in the large group setting either at the start of the program or for the wrap-up session.

- *The students walked in and were all excited and wanted to get started right away. It was a tad difficult to focus on the instructors at first, but the instructors did a great job of grabbing them.*
- *The forum is hard for some because it is a long time for them to sit. However, seeing themselves on the big screen grabs their attention well.*

Teamwork

Ten teachers commented that some students struggled as they attempted to work together at the Center. However, most felt the experience was positive – that it presented students with opportunities to practice an important, if difficult, skill.

- Some students had difficulty meshing in groups, but it was a very positive experience for them.
- Working together as a group was probably the toughest part for some of them, but my making the groups helped.
- Reinforcing cooperative group rules is very important. I noticed a few of my students sometimes taking over without thinking about the others in their group.

Three teachers noted that some groups had difficulty working together at the stations.

- With last year's larger group, just fitting around the stations was at times difficult.
- There was not a lot of room at each station for all group members to be active. Smaller groups would be needed for some of the stations.

In the table below is a summary and count of the teachers' comments.

Table 12
Aspects of the visit that proved difficult for students

Difficulty (N=100)	Percent	Responses
None	34%	35
<i>LabVenture! environment</i>	21%	22
<i>Noise level</i>	9%	9
<i>Level of activity</i>	<2%	2
<i>Too much freedom</i>	5%	5
<i>Wait time/down time</i>	6%	6
<i>Stations' design, research tools/materials</i>	17%	18
<i>Directions</i>	9%	9
<i>Video taping</i>	5%	5
<i>Handling dead fish</i>	3%	3
<i>Microscope</i>	<1%	1
<i>Individual element/station</i>	11%	11
<i>Fish tank station/activity</i>	9%	9
<i>Whole group forum (pre-post meetings)</i>	2%	2
<i>Student teamwork</i>	10%	10
<i>Collaboration</i>	7%	7
<i>Size of group</i>	3%	3
<i>Other</i>	2%	4
<i>Students needed more preparation</i>	<1%	1
<i>Unfamiliar experience</i>	<1%	1
<i>Students got weary</i>	<1%	1
<i>Broken equipment</i>	<1%	1

Teachers' reflections about the design of the Center – their observations on how effective the approaches used to engage students in the activities were in light of the limited struggles students experienced with particular elements or stations -- demonstrate the level of success GMRI has had in meeting its goal of providing 'universal access' to visiting students. Teachers' observations of their students at work provide a window into what visiting teachers learned about and from their students as a result of the visit.

In the next section, we focus on teachers' perspective on what *students* gained from their visit.

STUDENT LEARNING

Teacher assessment of student outcomes

This was a long survey, and we appreciate the number of teachers (>100) who answered so many of the questions, often adding comments or thoughtful remarks about their and their students' experiences at the Center.

In the next set of survey questions, we probed teachers' ideas about whether/how their students benefited from the visit to the Center. As we did throughout the survey, we first asked teachers to identify what knowledge and skills they thought their students gained from their experience. Then we followed-up the open response questions by providing teachers with a list of possible benefits to students – *knowledge, skills, increased interest in marine sciences, awareness of or interest in a career in science* – and asked teachers for an estimate of how many students (*more than half, less than half, just a few*) accrued such benefits from their visit. We begin this section by presenting teachers' responses to our list of options, and then provide teachers' more detailed accounts of student learning, skill development, and career awareness.

Benefits to Students

A majority of the teachers believed that more than half of their students developed new investigative skills and increased their knowledge about the Gulf of Maine and the marine research being carried out in the region. A little less than 60% thought at least half of their students were more aware of possible careers in science and research, while approximately two-thirds said a small group of students expressed interest in such careers. Finally, about 40% said that more than half of the students expressed interest in learning more about marine science after the visit.

Table 13
Student Benefits

Based on their experiences at the Center, how many students gained... (N=109)	More than half	Less than half	Just a few	Don't know	Total Responses
Skills					
<i>Used scientific processes to investigate the X-Fish and its marine habitat</i>	95%	5%	0%	0%	108
<i>Developed problem solving strategies</i>	81%	14%	2%	<4%	108
Knowledge					
<i>Became more familiar with the Gulf of Maine waters and resources</i>	93%	6%	2%	0%	109
<i>Learned about current marine research and some of its findings</i>	82%	15%	3%	<1%	109
Interests					
<i>Expressed interest in learning more about marine sciences</i>	42%	36%	13%	9%	108
Career awareness					
<i>Increased their awareness of potential marine science or research-related careers</i>	58%	24%	11%	7%	109
<i>Expressed interest in a marine science or research related-related career</i>	18%	42%	26%	14%	106
Other					12
<i>answered question</i>					109
<i>skipped question</i>					41

A few teachers added items to the list provided in the survey – noting that more than half of their students learned more about careers in the **fishing industry**, as well as the economic importance of fishing and tourism for the region. A few other teachers said that, in addition to learning about marine sciences, many students became excited about science and technology.

These findings are very similar to the teachers' responses in the open-ended questions. We discuss what new knowledge students gained first, and then skills they practiced as they worked through the investigations.

Knowledge

Teachers' comments about what knowledge students gained from their experiences at the Cohen Center were coded into four broad categories: the Gulf of Maine, the fishing industry, the Atlantic Herring, and marine careers.

They learned about the food web, how important fishing is in our state, how fragile the food web is, and general information about the Atlantic Herring.

There are scientists who do this for real every day. That humans can impact this ecosystem in very specific ways. That the marine ecosystem is fragile and affected by all sorts of things that go on.

(They learned) how scientists and fishermen work together, using tools to study and observe fish.

A visual representation of the Gulf of Maine area. A much better understanding of the complexity of food webs. A better understanding of the relationship between science and the economy.

- Half of the teachers (50%) said students learned more about the **Gulf of Maine** – as an ecosystem, the animal life it supports, the interdependence of the organisms found in the waters, its economic importance to the state, and its fragility.

They gained a lot of knowledge about Maine and the Gulf of Maine. Many students don't know a whole lot about the environment or the animals that inhabit the Gulf of Maine.

Better understanding of the Gulf of Maine ecosystem, True understanding of the value of plankton.

The students learned about the food web and how one little problem within that food web can affect a world of things.

Better understanding of the complexities of food webs, the interdependency of organisms in a community, a better understanding of Gulf of Maine ecosystem, a better view of what science looks like outside of classroom.

- More than one-fourth (28%) identified students' interest in the **fishing station** and what they learned there about decisions that influence fishermen's catch, the technology fishermen use to locate fish, and the economic importance of the industry within the state.

They gained insight into what it takes to run a fishing business (which boat to take out, where the fish are, cost of fuel vs. catch taken on a given day)

They loved fishing and seemed to understand the difficulties fishermen have with choosing the right equipment and the right locale. They were amazed at the costs involved with fishing and the potential for earnings. They also loved working with the fish.

They got first hand experience as a "fisherman." They got a glimpse of the economic value of making wise fishing decisions. This was very important for my students who, for many, are not college-bound.

- Just over one-third of the teachers (35.5%) described what students gained from their explorations of **the X-Fish –the Atlantic Herring**. Students became familiar with its anatomy, what it eats, its habitat, its schooling behaviors, its search for prey and avoidance of predators, its place in the Gulf of Maine food chain, its uses and economic importance.

How the fish is part of a bigger story about the coast of Maine-economic livelihood.

Students learned the importance of the X-Fish. They learned the effects of over fishing. Students learned about classification and predator and prey relationships.

Physiology of the X-Fish, what it needs for survival, and its importance to the Gulf of Maine.

- Finally, almost one-fourth said students returned from the visit with more information about the diversity of **marine careers** available in the state –fishing and conducting scientific research.

They gained insight into actual work a scientist might do in Maine.

My students who live in-land had an opportunity to see that adults have jobs working on the water and fishing. Students had to think through some of the same challenges real fishermen have to do.

The students learned about another agricultural area. In this case the fishing industry. They also were able to relate the fishing boat to the equipment used in potato farming. The students now have a broader understanding of the diversity that is in the state of Maine.

We coded and sorted teachers’ comments about what they thought students had learned as a result of their experiences at the Cohen Center. The frequency of teachers’ responses can be found in the table below.

**Table 14
Knowledge Gained**

Based on their experiences, what KNOWLEDGE did students gain? (Please provide a few examples) (N=110)	Responses	Percent
Gulf of Maine Ecosystem Animal life Food chain/interdependency of organisms Economic importance Fragility/threats: over-fishing, population declines	55	50%
Fishing Industry Tools for finding fish Finances Economic importance	31	28%
Atlantic Herring (the X-Fish) Anatomy/physiology Habitat Food source Behavior/adaptation Economic importance	39	35.5%
Marine Careers Research science Fishing industry	26	23.6%
<i>answered question</i>	110	
<i>skipped question</i>	40	

Skills

One hundred and five (105) teachers described the skills students were introduced to, had the opportunity to build upon, or had reinforced during their visit. The teachers’ observations of their students ‘at work’ in the Cohen Center reflect how effective the Center was at:

- actively engaging student teams by asking teachers/other escorts to stand back,
- presenting intriguing-enough questions to pursue and problems to solve,
- providing essential tools for investigations – requiring their close examination of a fish specimen, their use of a simple ruler, learning to adjust a laboratory microscope, and accurately reading sonar graphs,
- asking students to observe carefully, think critically about their evidence, discuss their findings, formulate and present their conclusions

We coded teachers’ responses and totaled the number of times items within the categories occurred. Often, a teacher listed several different skills in their response; in such cases, each skill was counted separately. To derive the frequency of each skill mentioned, we divided the total number of responses in each category by the total number of teachers that responded to the question (in this case, 105). The coded categories included: group work, independence, listening to and following directions, research and data gathering, scientific tools and technology, cognition. The results are shown in the table below.

Table 15
Skills Practiced, Learned

Based on their experiences, what SKILLS do you think students acquired? (Please provide a few examples) (N=105)	Skills Referenced	Percent
1. Working together toward a common goal (Teamwork, cooperation, collaboration, taking turns, listening to differing ideas, coming to a consensus, appreciation for teammates, patience)	43	41%
2. Working independently, without adult instruction or oversight	5	4.8%
3. Listening to and following directions	10	9.5%
4. Scientific Method/Research and Experimentation (Gathering evidence, formulating questions, categorizing, developing hypotheses, learning from mistakes)	57	54.3%
Observation	22	21%
Measurement	12	11.4%
5. Scientific tools and technology (Use of microscopes, sonar, computers and touch screens, recording devices)	32	30.5%
6. Cognitive skills (Critical thinking, problem-solving, decision-making)	23	22%
7. Communication (Discussions with teammates, presenting ideas and findings, recording)	26	24.8%
answered question	105	
skipped question	45	

Many of the teachers’ observations of students were rich and detailed. We have clustered together a relatively large sample of their comments below.

- *Working through the inquiry instead of knowing or guessing at the answer. Realizing it takes a learning community to make the "connections." I now have one very shy and quiet budding marine biologist!!!*
- *It opened their eyes to team investigation and everyone is important. They became scientists doing research for a reason to solve a real world problem.*

- *Students learned to listen to differing ideas and to work as a group.*
- *Seeing some of their classmates through a different lens.*

- *Discovering concepts without teacher intervention.*
- *Learning from mistakes.*

- *The experience reinforced the use of a written procedure and the need for measurement and a controlled approach to studying an object.*
- *Students became better observers. They made predictions and followed through to see if their predictions were valid.*
- *Questioning skills - Does my answer make sense?*

- *Problem solving, critical thinking, cooperation, making a hypothesis based on information gathered, coming to a consensus.*
- *They learned how to really think and gather data to support their hypothesis.*

- *Use of technical equipment and the chance to investigate using real specimens was exciting for students.*
- *Using measurement tools to weigh and measure the fish was important. Concise conclusions when reporting out were also reinforced. Showing the videos at the end of the field trip really helped show the students how to communicate as a group.*

EXTENDING STUDENT LEARNING, POST VISIT

The amount of time that had elapsed since teacher and students had visited Center varied from a few weeks prior to their completion of the survey to one year earlier. To help us account for this variance, we asked teachers whether they involve students post visit in the activities we listed, or were planning to do so to get a general sense of which activities are most likely occurring after students visit the Center. However, an activity in the ‘planning stage’ may not occur during the same year as current students visit – nor may it occur any time soon. Because the results are somewhat unclear – we believe the most reliable information can be found in column #1 in the table below – those activities teachers report that they do post visit. We do provide however, a central column that sums one and two for the readers’ interest.

More than half of the teachers reported that they discussed students’ investigations and their findings, and allowed students time to visit their and their fellow students’ materials on their website spaces post visit. Both activities are of immediate relevance to students’ visits and allow students to continue to review and reflect on their own and other groups’ work at the Center.

Slightly less than half (~44%) continue to pursue marine related studies in the classroom – either through reading materials or investigations. This finding makes sense in light of earlier survey results that show that many participating teachers use the visit to the Center to complement on-going curricula study in the classroom.

About one-third of the teachers make use of other resources available on the GMRI website: their blog: Today in Maine, or the learning activities design to extend students’ visit experiences. Just over 10% report that they have developed a unit of study directly related to students’ interests and experiences at the Lab.

Table 16
Post-Visit Classroom Activities

Which of the following have you already done or are you planning to do to extend students' experiences at the Center? (N=105)	(1) We do this	(2) Planning to do this	<i>Column 1+2</i>	(3) Can't do this	(4) NA	Responses
Discuss/compare student teams' investigations and findings	55%	24%	79%	8%	14%	96
Provide time for students to visit their personal web space, view/share their work.	53%	34%	87%	7%	6%	101
Introduce reading/research materials to further students' learning about marine sciences.	44%	33%	77%	9%	14%	98
Use post-visit activities on GMRI website to review students' experiences	32%	45%	77%	12%	11%	100
Provide time for students to visit GMRI website or read their blog-Today in Maine - to learn more about current research efforts	22%	49%	71%	15%	14%	96
Use post-visit activities on GMRI website to extend students' learning; explore new content areas; further develop research skills.	19%	52%	71%	14%	15%	94
Develop unit of study on topics related to students' interests/experiences at the Lab.	14%	38%	52%	23%	25%	94
<i>Other examples/comments</i>	40%	13%		7%	40%	15
<i>answered question</i>						105
<i>skipped question</i>						45

PART II. STUDENTS

PERG selected a small, representative sample of classrooms from GMRI’s database of visiting schools, and asked teachers familiar with the Center to request permission to have students complete an online survey. Five teachers, all recent visitors to the Cohen Center, did so. Fifty-eight students completed the survey in their classrooms, 43 fifth- and 15 sixth-graders.

Similar in design and structure, the student survey asked participants to describe their experiences at the Center, to assess the effectiveness of their teams’ collaborative work, and to tell us what they learned as a result of their investigations. Students were also asked whether their visit had an impact on their interest in science or might influence their thoughts about a marine-related career. In the following sections, we report on students’ responses.⁶

STUDENTS’ REFLECTIONS ON THEIR VISIT

The survey began by asking students to rate their overall experience at the *LabVenture!* Students could select one of the four options on a scale from ‘*It was great!*’ to ‘*I didn’t enjoy the visit*’ and space was provided for additional comments. As shown in the table below, all students rated their visit in the top two categories -- as either ‘*great*’ or ‘*fun.*’ No student chose either of the lower rated categories.

Table 17
Rating the Overall Visit Experience

How would you rate your overall visit to the Cohen Center? (N=55)	Percent	Responses
It was great.	56%	31
It was fun. I liked it.	44%	24
It was OK, but I wouldn’t recommend it.	0	0
I didn’t enjoy the visit.	0	0
<i>Additional Comments</i>		29
<i>answered question</i>		55
<i>skipped question</i>		3

Twenty-nine students added further comments about their visit.

- 10 wrote favorably about design of or opportunities at a specific station.
 - The large fish tank (4)
 - What is the X-Fish? (4)
 - Fishing (2)
- One said s/he liked all the stations except the introductory session.

⁶ In almost all cases, students’ comments included in the report are presented as students’ wrote them. In a few places, we have added words or phrased in parentheses or adjusted spelling for the purpose of clarity.

- 9 students were exuberant.
 - It was the best trip we have ever gone on.*
 - There is nothing like it. It was AWESOME.*
 - I liked the trip so much.*
 - The people there were so nice and the facts were so interesting.*
- Five said they wanted to return to the Center.
- Two said they recommended the visit to others.
- Two students were more reserved in their evaluations of the visit.
 - It was ok.*
 - It was a little boring, but overall it was a cool trip that we went on and I am glad we went there.*

Once students had given their overall assessment of their visit to the Cohen Center, we asked them to recall the individual parts of their *LabVenture!* experience: the two large-group sessions -- the introduction and closing ‘scientific conference’, and the four investigation stations, and to provide us with their views about each of them.

1. The Introductory Session

About half of the students (49%) enjoyed the whole group meeting at the start of the visit. From those that added comments, we learned that they liked the video presentations that placed their community within the larger, bird’s eye view of the state and the Gulf of Maine. Several said they liked learning about the Gulf of Maine during the session, meeting the staff and/or a scientist, and finding out what research was being carried out at the Institute.

Almost one-third were reserved in their assessment. They thought it was ok, too long, or boring. Ten other students (18%) said they were eager to get to the individual stations and found it difficult to wait until the introductory session was completed. One student said s/he missed the session entirely – *‘I wasn’t there for it. I had a nose bleed.’*

Table 18
Students’ Impressions of the Introductory Session

What did you think of the introductory presentation? (N=55)	Percent	Responses
I liked learning about the Gulf of Maine.	49%	27
I just wanted to get to the stations.	18%	10
It was ok.	11%	6
It was boring.	4%	2
It was too long.	2%	1
<i>Other comments</i>	16%	9
<i>answered question</i>		55
<i>skipped question</i>		3

2. Students’ Favorite Research Stations

Next, we asked students about the four research stations at the Center. To help them remember them, we provided a brief description of the problems presented and the work required for each of the investigations. Students were asked to indicate which station they thought was the best, and to state their reasons for their selection.

As shown in the table below, the majority of the students named either the fishing expedition (51%) or the large tank of fish (34%) as their favorites. The rest, 15% of the students responding to this question, selected one of the other two investigations – *What Does the X-Fish Eat?* or *What is the X-Fish?*

Table 19
Students’ Favorite Research Station

Which research station was the best? (N=53)	Percent	Responses
<u>Fishing Expedition</u> At this station, you went on a simulated fishing trip: you selected a boat and the places to fish, used underwater sonar instruments to locate fish, and decided when to lower your net to catch fish. You learned how to make decisions based on how available the fish were, and the costs of operating your boat.	51%	27
<u>Large Tank Holding a School of Live X-Fish.</u> You observed the X-Fish’s behavior in the large tank and tried your own schooling behavior in response to simulated predators, ships, and food.	34%	18
<u>What Does the X-Fish Eat?</u> This station had a dead X-Fish, a sample of stomach contents, a microscope, measurement tools, and photos of possible food sources. You hypothesized what you thought the X-Fish might eat, then examined stomach contents under a microscope. As a team, you used your evidence to determine what you thought the X-Fish ate.	9%	5
<u>What is the X-Fish?</u> At this station, you planned your method of identifying the X-Fish, examined a dead X-Fish, collected photographic evidence of key features of the X-Fish, compared the X-Fish to several other species using identification cards, and reached a conclusion on the identity of the X-Fish.	6%	3
<i>answered question</i>		53
<i>skipped question</i>		5

We highlight students’ rationales for their choice of station below, and cite samples of their written explanations.

Fishing expedition

Students said they liked this station best because it reminded them of a video game, because they learned how to use sonar to locate schools of fish, because it required decision-making, because the station provided immediate feedback on whether their net drops were successful, and because it was realistic – they learned how fishermen made money or thought their experience learning about the economics of fishing would be useful in the future.

Because we got to see how to use radar.

I liked the Fishing Expedition the best because you had to think about whether there was fish or not and you got to earn money but not for real.

I liked the fishing expedition because we got to find where to drop the net and try and find the schools of fish on the screen.

It was like I was really fishing and I got more and more fish every time.

Because if I ever become a fishing boat captain I would have some experience.

Large tank of fish

Students enjoyed observing the fish in the large tank. They spoke about watching their behaviors - schooling, swimming, and positioning themselves within the tank seemingly by size. Students were impressed by their speed and appearance. Students also liked 'becoming' fish – avoiding prey, finding food or shelter.

Because it was like I was a real X-Fish and it was just like I was a part of them.

What I liked about the station the most is the way you had to become a school of fish and when my group was pretending to be a group of fish we were looking at the fish while we were going around in circles. We were looking at the movements that the fish were making and they were going around in circles with us and the bigger ones would stay down at the bottom and the little fish would stay near the top. That was what my team learned about that station.

What does the X-Fish eat?

While a smaller number of students (~10%) mentioned this station as the one they considered the best, those that did select it liked using the microscopes, examining the stomach contents, and learning what Atlantic Herring eat.

I liked using microscopes and I hope to continue with GMRI stuff. (job in the future)

I like it because I got to see what was inside the fish.

What is the X-Fish?

Finally, only 3 students ranked this station as the best. However, in their response to this question, and on other survey items as well, students responded strongly (whether favorably or not) to their task of examining the preserved X-Fish specimen at the station as one means for gathering evidence about its identity.

It was fun because you could feel a fish!!!!

My favorite part was when we examined the fish.

When we had to measure the fish, that was cool.

I liked studying and comparing to find out what it was.

I think the fish smelled funky and maybe (you could) put air holes in the container or not it's up to you.

3. Closing Session and Wrap-up: The Scientific Conference

Most students enjoyed the final presentation. Specifically, students were surprised and pleased to find that the GMRI staff had integrated their team photos, clips of their teams' videotaped hypotheses and conclusions, and some of their work samples into the final presentation. As noted in the table below, students liked to see their own work as well as other teams' work projected on the large screen. They were interested in what other teams had discovered and some found the presentation helped them answer questions they still had after completing their investigations. A smaller set of students rated the session as just 'ok' or 'too long.'

Table 20
Final Presentation at the *LabVenture!*

What did you think about the concluding presentation in the theatre section, the ‘scientific conference?’ (N = 55)	Percent	Responses
I liked seeing what other teams discovered.	36%	19
It helped answer some questions I still had after doing the work at the stations.	18%	10
I liked seeing our team’s work.	13%	7
It really helped me understand the whole visit better.	9%	5
It was ok.	18%	10
It was too long.	2%	1
It was boring	0%	0
<i>Other (please explain)</i>	5%	3
<i>answered question</i>		55
<i>skipped question</i>		3

WORKING IN TEAMS

Group size

The majority of the students responding to the survey said their teams had 3-4 members. A little more than one-fourth of the students said there were 5 or more classmates on their teams.

Table 21
Student Teams

Size of Student Teams (n=54)	Percent	Responses
2 students	0%	0
3 students	24%	13
4 students	48%	26
5 students	26%	14
More than 5	2%	1
<i>answered question</i>		54
<i>skipped question</i>		4

While we recognize that it might present logistical difficulties – given the diverse sizes of the classrooms that visit the Center, we believe the GMRI should strive to limit the size of the teams to 3-4 students. Teachers and students described how the quality of students’ experiences was influenced and sometimes compromised by the size of their groups.

Specifically, they reported that large groups had more difficulty:

- getting close enough to hear the directions,
- having sufficient work space on the stations’ platforms,
- providing opportunities for the active participation of all members team members,
- establishing an equitable system for taking turns,
- accomplishing the work and coming to a consensus within the allotted time,
- sharing airtime and fitting into the video frame when reporting out their findings.

A clear strength of the *LabVenture!* experience is the opportunity teams of students have to struggle and learn on their own and without adult intervention, how to take on novel problems, plan how best to use available tools and resources, and practice how to share the workload. Therefore, ensuring that student teams can be as effective and successful as possible is an important design consideration for the Center’s staff.

Students evaluate their teamwork

We asked students to consider whether they thought members of their teams worked together effectively while visiting the Center. More than 80% of the students reported that they viewed their group as quite productive. Half thought the team worked well at most stations, while a little less than one-third said the team took turns and made decisions together.

Less than 20% of the students reported that their team experienced some difficulty working together. Most of these students (7 out of 10) said their team faced problems at some of the stations, while the remaining three students felt their team was an utter disaster.

Table 22
Effectiveness of Student Teams

How effective or productive was your team? (N=54) (Select the best answer)	Percent	Responses
Our team worked well on most station activities.	50%	27
Great! Everyone had a turn. We made decisions together.	31%	17
Our team had trouble with some of the activities.	13%	7
Our team was a disaster!	6%	3
<i>answered question</i>		54
<i>skipped question</i>		4

As noted earlier in the report, the 100+ teachers that responded to our survey viewed students' teamwork at the Center's research stations even more favorably than did the students in our survey sample. More than 90% of the teachers said the student teams they observed during their visits were either 'very effective' or 'effective most of the time'. It is possible that students had higher expectations for themselves and their classmates to be able to work well together than did the teachers. Students also experienced the direct impact when their team was unable to collaborate.

Effective Teams

Students identified the important ways their teams had worked well together. They explicitly cited team communication, collaboration, and problem solving as their key indicators of team effectiveness.

- **Communication**

Students said they had discussions, stated opinions, listened to one another, reached consensus, presented their findings.

We all listened to each other.

We stated our all our opinions and made the best choice :)

We discussed what we thought the answer was because on some stations we would disagree on something so we did something to make us all agree.

- **Collaboration**

Students shared responsibilities, took turns, got along with one another.

We all felt that we should all get a chance to hold the dead fish.

We sometimes took turns with making an answer for things, like, at the fishing expedition, were to drop the net or when not to drop the net.

We helped each other and we all had fun.

- Problem solving
Students figured things out together, made decisions collectively, and got the work done.

We really worked well on figuring out what the fish ate and (identifying) the fish for the X-Fish. We got the work done.

Struggling Teams

Students also reported on what made their teamwork more difficult. It is interesting to note that, at times, students first described their struggles and then added an explanation of how the team coped with the problem.

- Equitable participation
Students said the team struggled to establish a fair system that allowed all to participate equitably in the station investigations.

Taking turns was a big problem.

Taking turns with the controls at the stations and talking about what we wanted for an answer.

My team had trouble with the microscope station, we all wanted to look in it.

At the begging we were a little off and then we talked it over and we worked and made sure every had a turn.

- Actions of individual members
Some students said the behaviors of one or more members were responsible for the difficulties their teams experienced. Specifically, they identified:
 - team members that were too aggressive or bossy – those that tried to ‘take over’ or tell others what to do;
 - team members that were too reticent – those that stood back rather than joining in with others; and
 - team members who distracted others, preventing the team from working together effectively – those that were too goofy, unfocused, or off-task.

Some people didn't let other people have a turn.

Some people were fighting on who got to hold the dead fish and who got to use the microscope.

The problem that we had with our team was when someone was goofing off.

We had to stop giving people the bunny ears on the web cam.

Students also reported that their teams struggled – not because they could not work together effectively, but because they were not successful in completing the tasks, operating the tools or technology, or solving the problem posed at one or more of the stations.

We had a problem at the expedition station; we had a hard time trying to find out where the fish were.

We had a little bit of trouble with the videos we did because we tried to let everyone get in it.

Well we really didn't have a problem it was just we didn't like talking on the video.

Some times we did not finish.

In the following table, students' reports of their successful team work and their struggles are placed side-by-side, along with the frequency with which participating students noted these issues.

Table 23
Teamwork: Successes and Challenges

Successful Teamwork (N=50)	Frequency of Responses (%)		Struggling Teams (N=51)
<u>Work collaboratively, share tasks</u> Everyone had a turn. Held fish Decide when to drop the fishing net Operated equipment Made selections Contributed to decision-making Contributed to video	51%	50%	<u>Work collaboratively, share tasks</u> No system for taking turns. Individual team members: those that didn't share; those that didn't get involved Sharing station tools; materials; air time Recording results
<u>Conducting research as a team</u> All involved in the investigations Examined evidence Stated opinions; discussed ideas Listened to one another Sought consensus Communicated findings Got work done	23%	25%	<u>Conducting research at some stations</u> What is the X-Fish? fish defrosted What does the X-Fish eat? using microscope Fishing: using sonar to locate fish Finding a solution, at times Not enough time to complete work
<u>Team was successful on some stations</u> What is the X-Fish? What does the X-Fish eat? Live fish tank Fishing	26%	25%	<u>Members' behaviors made work difficult</u> Some were 'goofy' Some made 'rabbit ears' when recording Some didn't listen to others Arguing among members

Team work time

From our observations of student teams working on the investigations at the Center, we realized that occasionally a team would run out of time before students had completed the tasks or worked through their different opinions about their findings. The survey provided an opportunity to learn the extent to which student teams felt they were given sufficient time at individual stations or not.

Sixty percent, or 33 of the 54 students responding to the question, had enough time to complete their investigations. Another 35% said that was true *'most of the time.'* Very few students (only 2 of the 54 in the sample) felt they needed more time.

Table 24
Did your team have enough time?

Did your team have enough time to complete the work at each station? (N = 54)	Percent	Responses
Yes	61%	33
Most of the time	35%	19
No	4%	2
<i>answered question</i>		54
<i>skipped question</i>		4

STUDENT LEARNING

What would students do differently on a second visit?

As one way to gauge what students gained from their *LabVenture!* experience, we asked them to reflect on their visit and tell us whether there was anything they would do differently if they visited the Center a second time.

Forty-four of the students in our survey sample (44/58 or 76%) responded to this question. Of these, more than half (> 50%) said there was nothing they would do differently and/or that they did not want the experience changed for other visitors in the future. Other students (> 25%) said they would work differently at one or more of the stations if they returned for another visit. Their examples included:

- take a better group photo
- manage money better, use the boat differently, or extend the time spent at the fishing station
- pretend to be an X-Fish again (at the live tank station)
- talk more, think about things a little more, experiment differently
- be more serious: *‘not be goofy’, ‘not horse around again – it was not helpful to horse around when we had a job to do’, ‘focus on the activities more.’*

A few students (~10%) focused their response on their teamwork. They wanted to work with a different team, rotate team membership as they worked through the different stations, or work more effectively with their team, and figure out how to take turns. One student requested the design of a new station when s/he returned, one where students could examine a live X-Fish up close, in a small tank, to *‘observe their habits and see what it eats.’*

The Center’s impact on students’ knowledge, skills and interests

What new knowledge about marine sciences, research skills, and/or interests resulted, if any, from students’ visit to the Cohen Center and their exploration of the four station investigations? To understand what impact the *LabVenture!* had on participating students, we constructed a series of questions and asked those responding to the survey to tell which, if any, of the possible things we listed they felt they had learned more about, gained experience doing, or were now more interested in as a result of their visit to the Center.

The Gulf of Maine and the Research Institute

First, we asked students to indicate whether they learned the location of the Gulf of Maine, something about scientists’ research in the Gulf of Maine, or met a scientist working at the Institute during their visit there. This information was primarily conveyed during the whole group, introductory session.

- More than three-quarters of those completing the survey (78%) said they had learned about *scientists’ research in the Gulf of Maine*.
We suspect students’ reports on this item were high because the Center first introduces information about scientists’ ongoing research in the Gulf during the initial session, but then connects and extends this information to the investigative work students do at the stations. For example, at the station, ‘What does the X-Fish eat?’, short video clips demonstrate how scientists collect samples of herring stomach contents for their research to aid student understanding.
- Almost half of the students (48%) indicated that they learned *where the Gulf of Maine is*.
- A similar number of students (46%) remembered *meeting a scientist* at the Center.

Table 25
The Gulf of Maine and the Research Institute

What did you learn from your experiences at the Cohen Center about the Gulf of Maine and scientists at GMRI? Check any that apply. (N=54)	Percent	Responses
I learned about scientists’ research in the Gulf of Maine.	78%	42
I learned where the Gulf of Maine is.	48%	26
I met a scientist who works at the Gulf of Maine Research Institute.	46%	25
<i>answered question</i>		54
<i>skipped question</i>		4

The Mystery of the X-Fish

Next, we asked students what they recalled about the X-Fish. Each item referred to work the students did at the stations. While the students told us that the fishing expedition and the large tank of fish were their favorite stations, they appear to remember the results of their investigation into the *identity of the X-Fish* and their efforts to discover *what it eats* as readily as their learning about finding and catching the X-Fish or why this species travels in schools.

Table 26
The Atlantic Herring

What did you learn about the Mystery of the X-Fish? Check any that apply. (N=54)	Percent	Responses
I learned what the X-Fish is.	87%	47
I learned what the X-Fish eats.	54%	29
I learned how fishermen find and catch the X-Fish.	57%	31
I learned why the X-Fish travels in schools.	35%	19
<i>answered question</i>		54
<i>skipped question</i>		4

Conducting investigations

Many students (74% of our sample) said they learned more about *conducting scientific investigations* by observing, forming a hypothesis, collecting evidence, and analyzing their results while at the Center.

- Over half said they learned to *work as part of a research team* (55%).
- Half had the opportunity to figure out how to *use scientific tools* in their investigations (51%).
- Less than half (43%) remembered why it was important to make *careful measurements*. Yet, paying attention to the size of the fish specimen, as well as the relative scale of the food sources depicted in their information cards, were critical aspects of their investigations for students to successfully determine what the X-Fish was and what it ate.

Nearly half of the students (49%) said they were *interested in doing more investigations* similar to those at the Cohen Center.

Table 27
Conducting Investigations

What did you learn about doing science? Check any that apply. (N=53)	Percent	Responses
I learned to work like a scientist: to make observations, form hypotheses, collect data, and think with others about the results.	74%	39
I learned how to work together with my team to conduct research and decide what the evidence tells us.	55%	29
I learned how to use a microscope and other scientific tools.	51%	27
I found out why it was important to make careful measurements.	43%	23
<i>I'd like to do more investigations like the ones at the Cohen Center.</i>	49%	26
<i>answered question</i>		53
<i>skipped question</i>		5

Several students added other things they remembered learning during their visits.

I learned how much fun oceanography can be!

I also learned what different types of tools scientist use.

I also learned what the X-Fish looked like.

That dolphins are predators to the X-Fish.

I learned that the X-Fish is going extinct.

I learned a lot of cool stuff that I didn't know

Interest in the marine sciences

Their visit to the Cohen Center increased some students' interest in the marine sciences.

- Almost one-third (31%) said they were more interested in *studying science*.
- Nearly half (47%) wanted to understand more about the *Gulf of Maine Watershed*.
- More than one-third (35%) expressed new interest in *local, fresh water resources* as well as wanting to know more about the *Gulf of Maine*.
- Only 2% said the visit had *no impact* on their interest in science.

Table 28
Interest in Marine Sciences

As a result of your visit, do you have any new interest in or ideas about marine science? Check any of the following that apply. (N=51)	Percent	Responses
I'd like to understand more about the Gulf of Maine Watershed. What is it and how does it connect to the ocean?	47%	24
I'd like to learn more about the fresh water resources in my community.	35%	18
I'd like to know more about the Gulf of Maine.	33%	17
I'm more interested in studying science.	31%	16
I'd like to know more about marine environments in general.	29%	15
I'm still not very interested in science.	2%	1
	<i>answered question</i>	51
	<i>skipped question</i>	7

Career Interests

Finally, did students' visit to the Center influence their thoughts about career opportunities? Career information during students visits to the Center was provided only implicitly – visiting students may have met one of the GMRI research scientists during the opening session, they viewed short videos about an aspect of scientists' work that informed an investigation, contributing scientists' and technicians' photos and brief bios were part of the 'trailers' at three of the stations, and they had the experience of 'becoming a fisherman or woman,' making financial decisions, operating a fishing vessel, and using sonar to locate schools of fish.

The full set of items and students' responses are displayed in the next table.

Table 29
Career Interests

As a result of your visit, would you want to learn more about marine scientists' work and/or careers in science and the fishing industry? Check any that apply. (N=53)	Percent	Responses
<i>Learn more about marine scientists and their work</i>		
Learn about the technology and special tools scientists use.	42%	22
Learn about what research scientists are doing in the Gulf of Maine.	34%	18
Know more about how scientists do their research.	32%	17
Meet and talk to a scientist working at the Gulf of Maine Research Institute.	25%	13
<i>Learn more about a career in science.</i>		
Find out what it's like to be a scientist.	28%	15
Find out how to become a scientist.	17%	9
<i>Learn how scientists are working with the fishing industry in the GoM</i>		
Learn how scientists & the fishing industry are working together in the GoM.	36%	19
<i>Learn more about a career in the fishing industry</i>		
I'm more interested in fishing and I'd like to learn more about it as a career.	23%	12
<i>None of the above.</i>	11%	6
	<i>answered question</i>	53
	<i>skipped question</i>	5

In summary:

- Given the survey options, students showed the most interest in *learning more about the technology and tools scientists use* (42%).
- About one-third (34%) expressed interest in finding out more about *what the research scientists were studying in the Gulf of Maine*, as well as *how they went*

about doing their research. These two items were certainly the most closely related to the students' experiences at the Center.

- More than one-third (36%) said they were interested in an important aspect of the GMRI's institutional mission – that is, *how scientists and members of the fishing industry located within the Gulf of Maine were working together.*
- Twelve of the 53 students completing this survey question said they were more interested in *fishing as a career* than in becoming a scientist (~23%).

DISCUSSION

Teachers' and students' descriptions of their visits to the *LabVenture!* at the Cohen Center for Interactive Learning clearly demonstrate that the GMRI is achieving its goals. The evidence compiled here, based on reports from visiting teachers and students is indeed compelling.

In this final section of the report, we present survey participants' final comments. While we were eager to hear their recommendations for improving their experiences at the Center, and we did get a useful set of suggestions, many teachers and students also used this open-ended question to speak quite directly to the GMRI staff. We provide both sets of data here – their more personal comments and their recommendations for the Center and its first program, *the Mystery of the X-Fish*.

TEACHERS AND STUDENTS COMMENT ON THEIR EXPERIENCES AT THE CENTER

At the end of both surveys, we provided teachers and students an opportunity to offer their comments, suggestions, or recommendations to the staff at the GMRI responsible for the programming at the Cohen Center. Eighty percent of the teachers and almost 75 percent of the students provided a response.

Some teachers took this opportunity to express their appreciation to GMRI.

We had an incredible experience here. We'd love to be able to do this every year! Thank you so much for the opportunity to come down.

Thank you so much for allowing our students to have the opportunity to use technology and to learn about the Gulf of Maine.

It was a tremendous opportunity for the students and gave them a chance to see science in a way that we can't provide.

Just a big thank you for playing such a powerful role in our learning community!!!

Great job with this. It is truly an amazing experience provided for our students.

Several teachers noted that they could not have come to the Center without GMRI's generous support.

I really appreciate the opportunity to bring students at no cost to a state of the art facility for them to do science.

It is an exciting and educational program that we would not be able to explore because of budget constraints if it were not free to all Maine 6th grade students. Thank-you!!

It was a fantastic experience! Chaperones loved it, too. Our school would have never been able to afford the busses so we never would have been able to do this. It was very nice to be invited to attend. Thanks to everyone for this opportunity.

Thank you for providing this opportunity to rural Maine students. Our opportunities and budgets seldom allow for a field trip of this caliber and distance from Washington County.

Thank you for this valuable program, and making it free for schools. We would not have been able to visit it if it had not been free.

Thanks so much for the opportunity. Without the financial backing this experience, as wonderful as it is, would be an impossibility.

Thanks for all the wonderful planning of such a successful unit. My students' loved it. Thanks also for the free materials, especially the CD's. What a valuable experience for our Maine children.

A number of teachers and students commended the program.

The overall GMRI experience was excellent and very professional: the high quality science that I want to be able to do in my classroom but lack the resources. *teacher*

Every 5th grader benefits by going, and the study of the ocean (75% of our planet, full of life and resources) should be in the science curriculum in each school. *teacher*

I always talk up this program. It is a resource that the state of Maine is lucky to have that addresses the state's specific regional science needs for its future. Keep providing such an excellent resource for our children! *teacher*

It is wonderful to have a research center that is accessible to students. *teacher*

I've looked forward to taking my students every time. They are well guided by the facilitators who always seem child-centered and science-smart. *teacher*

I liked the food web presentation--that really fit into our curriculum from last year, and it showed that what they're learning really is "used" in real life. *teacher*

Whoever comes next will love it. *student*

This was the best trip we went on in the whole school year. *student*

It was a fantastic trip. *student*

I liked all of it so I wouldn't change anything. *student*

They r great and i mean great. *student*

Some teachers took this opportunity to describe ways they planned to integrate their annual visit into students' on-going science studies.

This was my first visit and my first year with 5th grade science curriculum, so I hope that the next years will enable me to make better preparations and follow-up activities for my students.

This year we did not have computers in our rooms during the time of the visit, we do now, so I think that next year it would be a lot easier to review the site materials after the trip

We really need to develop our approach to the field trip and our follow up activities. One teacher on our team did an excellent job of follow up and I don't think the rest of us did as much. Next year I want to make the trip more central to our study of oceans.

This was our third visit and I feel pretty comfortable with the way we utilize our visit. I would like to work with our social studies teacher to tie in an economics piece.

TEACHER AND STUDENT RECOMMENDATIONS

Approximately half of the survey participants, 50 teachers and 29 students, offered substantive suggestions in the space provided on the survey. We have sorted their responses and provide an overview of their recommendations in the table below.

Table 30
Teacher and Student Recommendations

Teachers (N=50)	Students (N=29)
Pre-visit preparation	Pre-visit information and preparation
Mail suggested activities/resources to help me plan in advance for the trip. I don't have time to access things on the website.	Tell next group to pay attention because before I went to the X-Fish place, I thought that it was going to be boring and it was actually pretty interesting.
Give teachers information about what activities they will be doing and training for what is expected of them during their visits.	Bring a hand sanitizer for after touching the fish.
Provide pre-visit prep for some less experienced teachers.	
Travel and logistics	Travel and logistics
Teachers appreciate bus service	Make the bus ride longer
Provide video for bus to prepare students for life in the Gulf of Maine.	
Have enough seats on bus when 2 schools travel together.	
Have a space students can eat lunch inside if it is raining.	
Improving teachers' experiences	Improving students' experiences
Let teachers, especially first timers, work as a team so they get the same experiences as their students.	Attitudes and behaviors: I hope that they'd be more serious. Come in a good mood. Behave and be nice.
Observe students for half the time then go to a workshop about the program and how it can be bought back into the classroom.	Team work: Make a time limit so everyone gets a turn. Use time wisely; give everyone a turn! Don't argue with your group.
Have a teachers room with research materials and resources, have a scientist there for our questions and to generally increase our understanding-with coffee of course!	
Improving students' experiences	Improving students' experiences
1. Overall design	1. Overall design
<ul style="list-style-type: none"> • Improve the sound system; provide earphones. • Reduce team size: add a station so there could be fewer students on each team. • Allow teachers to create student teams. Teachers could then help kids stayed focused and on-task. • Time: Shorten time at 3rd & 4th stations by a few minutes. • Participants: Invite only 6th grade students [multi-age classrooms request.] • Provide more structure. 	Time <ul style="list-style-type: none"> • A little more time to finish. • Longer time for video taping. • More time at each station. • More time to investigate the fish.
2. Program changes or additions	2. Program changes or additions
<ul style="list-style-type: none"> • Have a scientist present to talk to students or answer questions, or have a video clip of one describing his/her work. • Create a new program, something other than the X-Fish. • Let students visit research area at GMRI • Include a working waterfront tour. 	<ul style="list-style-type: none"> • More dead fish or anything that lives in the ocean. • It would be awesome to see a live octopus. • I would like to see people that work there take a fish out of the tank & put it in a bowl so people can study them better. • Let everyone dissect a fish. • I'd like to do an experiment with a scientist and a couple friends. • Have more fun things to do like when you run around the live fish tank. • Learn how to be an X-Fish fisherman. • Get better and new technology.

**Table 30 (continued)
Teacher and Student Recommendations**

Teachers (N=50)	Students (N=29)
3. Opening Session of Mystery of X-Fish	3. Opening Session of Mystery of X-Fish
<ul style="list-style-type: none"> • Show students how to work equipment and make video recordings prior to their work at the stations. • Make expectations for video/sound recording at stations known. • Tell kids that their videos may be part of the final presentation. 	<ul style="list-style-type: none"> Listen well for if you don't, you won't understand a thing. Make first presentation shorter and way more fun. Have a 20-minute pre-station. Give a video example of how to work at the stations better. Tell them a little more about the stations.
4. Investigation Stations	4. What is the X-Fish Station
<ul style="list-style-type: none"> • Have students record observations on paper. • Have students use all data provided. 	<ul style="list-style-type: none"> Handling the fish: Wash your hands and throw away your gloves after you touch the X-Fish. Some people would suggest not touching the dead fish and I'm one of those people.
5. Closing Session: Science Conference	5. Closing Session: Science Conference
<ul style="list-style-type: none"> • Make sure all schools get shown during final presentation so no school is left out. 	<ul style="list-style-type: none"> Closing Session: Student Videos Have more group' works on the big screen.
Post-visit materials available	
CD/DVD that all computers can read; at times teachers or students could not access.	
Difficulty finding activities on website.	
Make information about post-visit activities on website known to all visiting teachers.	
Student artifacts from visit: Make all student comments in YOUR TURN downloadable without need for cut and paste.	
Requests for new post-visit materials	
Provide ready-made materials for follow-up.	
More lesson plans that tie into the Lab experience for before and after visits.	
Any professional development science opportunities to support students Lab experiences would be welcome!	
Provide materials for studying the Gulf of Maine.	
Requests for additional GMRI support	
Work with schools' science specialists.	

APPENDICES

Gulf of Maine Research Institute's Visit Information

1. Invitation to Visit GMRI's Cohen Center *LabVenture!*
2. Pre-Visit Information for to Participating Teachers and Schools
3. Letter to Parents

On-line Surveys

1. Teacher Survey
2. Student Survey

GULF OF MAINE RESEARCH INSTITUTE'S VISIT INFORMATION

1. Invitation to Visit GMRI's Cohen Center *LabVenture!*

Immerse your students in the world of marine science with the *Mystery of the X-Fish*

At the Gulf of Maine Research Institute in Portland, Maine, your 5th or 6th grade students will conduct marine research as they explore and discover the importance of the X-Fish in the Gulf of Maine.

Students will work in teams at four multimedia, digital kiosks to carry out hands-on scientific investigations:

- identifying what the X-Fish eats through a stomach content microscope activity;
- going to sea on a virtual research cruise and fishing trip to discover how and where the X-Fish is found;
- hypothesizing about how the X-Fish behaves by observing fish swimming in a live schooling tank; and
- discovering the true identity of the X-Fish.

All students will leave the program with their own personal websites that allow them to view the photo and video evidence that they recorded during their visits. Educators can also supplement the *Mystery of the X-Fish* program with engaging pre- and post- visit lesson plans and activities from our website. All activities at the Lab and on the website are aligned with the Maine Learning Results and the National Science Education Standards.

The Gulf of Maine Research Institute is committed to bringing in every 5th or 6th grade public school class in Maine; the program is **free of charge** and **transportation is provided**.

Visit our website at <http://mystery.gmri.org> for more information.
Please contact scheduler@mystery.gmri.org or call (207) 772-2321
for more information or to schedule a visit with your class.

Maine Learning Results Science and Technology Grades 5-8	What does the X- Fish eat?	Where is the X-Fish?	What is the X- Fish?	How does the X- Fish swim?
Classifying Life Forms A			1	3
Ecology B	4	2		4
Cells C	2			1 & 5
Inquiry and Problem Solving J	1, 2	3	1 & 2	
Scientific Reasoning K	3, 6, 8 & 9	8 & 9	3, 6, 8 & 9	8 & 9
Communication L	2, 3, 4 & 6	1, 2, 3, 4, 5 & 6	2, 3, 4 & 6	3, 4 & 6
Implications of Science and Technology M		1 & 7		

Program Logistics

Who can come? 5th or 6th grade students in Maine –

Districts must decide whether they send their 5th or 6th grade students, depending on which grade's curriculum that the program is best suited for.

Once this decision is made, please send an email to scheduler@mystery.gmri.org, or contact Ros at (207) 772-2321.

What is the cost? None! It is GMRI's mission to make this program universally accessible to Maine's 5th or 6th grade students by having no cost for the program and providing transportation.

How do we get there? Transportation is provided and arranged for you! GMRI will charter a bus to pick your students up, bring them to Portland, and take them back to school after the program.

How long is the program? The program lasts 2.5 hours, which includes an introductory presentation, four 20-minute scientific investigations, and a concluding presentation.

What dates are available? We are scheduling visits on Tuesdays, Wednesdays, Thursdays and Fridays, throughout the school year, with two programs a day (9-11:30am and 1-3:30pm).

How many can come? We can accommodate groups of up to 48 students, and will run as many programs as necessary to ensure that your entire 5th or 6th grade class has the chance to participate.

How do we sign up? Contact Ros at (207) 772-2321 or send an email to scheduler@mystery.gmri.org to schedule your class's visit to GMRI.

If you have any more questions, please contact scheduler@mystery.gmri.org or call (207) 772-2321 for more information, or visit our website at <http://mystery.gmri.org>.

The Gulf of Maine Research Institute has the resources to bring 15,000 students in either the 5th or 6th grades to Portland to participate in the *Mystery of the X-Fish* marine science education program. Below is a summary table of the Maine Learning Results that are alligned with the *Mystery of the X-Fish* program. There are also National Science Education Standards that are aligned as well, and you can view these at <http://mystery.gmri.org>.

2. Pre-Visit Information for Participating Teachers and Schools

To: Participating Teacher

From: GMRI

We're pleased that your students will be attending GMRI's *LabVenture!*, a hands-on science learning experience that will engage your students in the scientific process.

What is *LabVenture!*

Students will experience a dynamic introductory presentation about the Gulf of Maine and then rotate through four 20-minute activities at *LabVenture!* Stations (LVS). Each LVS is an interactive digital kiosk where students will work in teams of three or four doing hands-on experiments and scientific investigations. The students will take team photographs, collect digital data and record videos of their hypotheses and conclusions. The program concludes with a presentation displaying their team data and relating this data to current research being done in the Gulf of Maine.

Important Information for a Smooth Visit to GMRI

To help your visit proceed smoothly, here are a few important things you'll need to know.

- **We require a teacher/chaperone to student ratio of 1:10.** Seven chaperones is the maximum. We expect you to provide appropriate supervision of student behavior at all times on the bus and during your visit to GMRI.
- **You must bring a completed GMRI Parent/Guardian Permission Form for each student who attends the program (see attached form for photocopying).** Please make sure you have a permission form for each student before he or she boards the bus. We will collect the forms when you arrive at GMRI.
- Please call our Visit Coordinator at 228-1650 **at least one hour before your arrival at GMRI** if any new students have been added since you provided your student data. This is very important because any late changes will result in delays in uploading your students' websites.
- **Please let our Visit Coordinator know before your visit if we should be aware of any accommodations individual students may need.**
- **Departure from School and Arrival at GMRI.** The GMRI bus will arrive at your school on September 12th at 11:15, and is scheduled to arrive at GMRI by 1:00pm. If you need to contact the bus company it is CYR Bus Line available 24 hours on 1-800-341-0322 x241.
- **VHS on board.** You may show videos of your choice on the bus.

- **Lunch Considerations.** GMRI does not have indoor dining facilities. There is space outside GMRI where you may supervise students eating lunch during good weather, beware the groundhog holes along the fence line. If necessary, students are also allowed to eat their lunches on the bus.
- **Departure from GMRI and Return to School.** The bus will leave GMRI at 3:30, with a scheduled arrival time at your school of 5:15. Because we want to accommodate visits by students from every town in Maine, we are not able to accommodate transportation requests to other venues.

LabVenture! Mystery of the X-Fish at GMRI

Now that you have signed your class up for GMRI's LabVenture program, Mystery of the X-Fish, you can create teams for your students to work in throughout their experience here at GMRI. Log-in using your username: CBaldassari and password: BfXAk2 on the Student and Educator page at <http://mystery.gmri.org>. Once logged in you can access more information about our program and obtain GMRI's student permission forms. On this site you can also access our database where you will enter information for fellow educators joining you on your experience here and enter in your students names and place them into teams.

How to Set Up Your Student Teams

As visit coordinator for your visit to GMRI, you need to register all students that are coming with you to GMRI to participate in the Mystery of the X-Fish. If you wish for your fellow educators to enter in data for their own students, share your username and password with them.

Students will be working in teams of three or four throughout their visit to the Gulf of Maine Research Institute. If you have more than 48 students coming, you may have a few teams of five. In these teams, they will solve four different scientific investigations to discover the Mystery of the X-Fish.

The LabVenture Stations, where students will solve each query, are set up to promote students taking on different roles within their group so that they can work together successfully. This program is also designed for students to work independently, without interaction or assistance from an adult. Please keep this in mind when deciding which students will be working together.

Note: Please enter in all information for the educators who will be coming with you to GMRI for the Mystery of the X-Fish program before you enter student information, as each student will need to be associated with an educator. This can be done by going to the “Edit Educators” page (see link at right side of page).

You are asked to enter students first and last names, along with the educator they are associated with. This information is private, and is only used by GMRI administration to create student teams and individual usernames and passwords that will give students access to their own personal websites after their visit. If you prefer, you may enter in generic last or first names for your students such as “student” or your school name. Once you have entered this information, student usernames and passwords may be viewed on the “Educator Home” or “View Student Roster” pages.

If you are organizing a visit with another educator, you will need to determine the teams for all students. You will be asked to provide each student's first and last name and must associate each student with his/her teacher.

Each student who participates in the Mystery of the X-Fish program is required to have their parent or guardian sign our Student Permission Form prior to their program. This form describes our program to parents/guardians and gives GMRI permission to publish student data to the student websites. Please bring your signed Student Permission Forms with you to GMRI the day of your program.

There is a notes section at the bottom of this page for you to enter any special accommodations that need to be made for your visit.

Note: Only the Visit Coordinator can add or edit any information on the student roster or educator information pages, and all edits must be done before the day of your visit. If you have any changes to make on the day of your visit to the student roster, due to absences or new students joining, please contact GMRI's visit administrator at (207) 228-1650 at least one hour prior to your visit.

3. Letter to Parents

THE GULF OF MAINE RESEARCH INSTITUTE
350 Commercial Street, Portland, Maine Telephone: 772-2321

**MYSTERY OF THE X-FISH EDUCATIONAL PROGRAM
PARENT/GUARDIAN INFORMATION AND
PERMISSION FORM**

Dear Parent/Guardian:

On _____ (date), your child's class (**or identify other organization if not a school**) will be visiting the Gulf of Maine Research Institute ("GMRI") to participate in a 2-1/2 hour educational program called *Mystery of the X-Fish*.

Students will experience a dynamic introductory presentation about the Gulf of Maine and then rotate through four 20-minute activities at *LabVenture!* Stations (LVS). Each LVS is an interactive digital kiosk where students will work in teams of three or four doing hands-on experiments and scientific investigations. The students will take team photographs, collect digital data and record videos of their hypotheses and conclusions. The program concludes with a presentation displaying their team data and relating this data to current research being done in the Gulf of Maine.

Student data is saved to a website created for each student, which he/she can access after the program with a username and password provided by GMRI. Student websites will also be accessible to GMRI staff and your child's classroom teacher. The websites are username and password-protected and are not accessible to the general public. If you have questions about the security of the website and our privacy policy, you may review the policy at <http://mystery.gmri.org/about/privacy.aspx>.

Important Points for Parents/Guardians

- **Student Participation.** Students must be able to participate in the photo and video portions to obtain full value from this program. If you do not want your child to participate in the activities described above, he/she will not travel to GMRI with his/her class. Parents/guardians must complete the attached Permission Form in order for their child to attend the program.
- **Student Photos and Videos.** GMRI may use student photos or videos in our publications or presentations explaining our programs. GMRI does not identify students by name or school when using photos or videos. In addition, local newspapers and t.v. stations occasionally take photos of students participating in the program. If you do not want your child's photo and/or video used by GMRI or local media, please let us know on the permission form.

- **Data Collected is Property of GMRI.** All data collected by students during the *Mystery of the X-Fish* program becomes the property of GMRI.

We hope that your child has an exciting and enjoyable learning experience at GMRI. If you have any questions about the program, please do not hesitate to contact us at 772-2321.

ON-LINE SURVEYS

1. Teacher Survey

Part One: Teacher Information

Name

School

Position: *Classroom teacher, science specialist, other*

Grade Level: *5th, 6th, other*

Part Two: Science Study

1. What science topics do your students study at their current grade level?

2. During science classes, students use the following books and/or materials:

(Check all that apply)

- *Science textbook or trade books*
- *Commercially developed science kits (STC, FOSS, GEMS, etc)*
- *Teacher, school or district developed materials for student investigations*
- *Students use the science lab in the school*
- *Other*

3. During science lessons, students

Never Seldom (few times/year) About once a month Often
(weekly)

- *Read textbooks or other written materials*
- *Listen to lectures*
- *Watch classroom demonstrations*
- *Watch videos/DVDs*
- *Conduct research on science topics on-line or with the use of library resources*
- *Conduct investigations using locally developed or published materials*
- *Design and carry out their own investigations*
- *Conduct field studies`*
- *Talk with scientists that visit the classroom*
- *Other*

4. On average, how often do students study science each week?

Approximately _____ times each week

Approximately _____ hours each classroom session

Part Three: Visit to the Gulf of Maine Research Institute's Cohen Center

1. How many times have you brought students for a visit to the Cohen Center? *1,2,3, other*

2. Why do you bring students to visit the *LabVenture!* at the Cohen Center?

Pre Visit

3. In what ways, if any, do you prepare students for the visit?

- *This was my first visit and I did not know what to expect myself.*
- *I do not know how to prepare students.*
- *I like students to have their experience without too much preparation from me.*

- *I provide a set of guidelines or rules for the bus trip and the visit.*
- *I use pre-visit activities on GMRI's website to prepare students*
- *Students explored the GMRI website on their own, prior to the visit.*
- *The visit was planned to complement students' classroom science studies.*
- *Other*

Experiences at the Cohen Center

4. On your most recent visit, what did you do while your students were working at the stations? (Y/N)

- *I monitored all students' behavior and intervened when necessary.*
- *I stepped back and allowed students to work on their own*
- *I helped students when they were struggling.*
- *I observed one group of students as they worked through each station.*
- *I stayed at one station and observed each group of students as they worked.*

5. If you either followed along with one group or remained at one station, observing all students as they work, please explain why you this was your choice.

6. What did you notice about your students as they worked through the stations?

7. How effectively did the student groups work together during your visit?

- *Not effective*
- *Somewhat*
- *Most of the time*
- *Very effective*

8. What difficulties did the groups experience?

The Cohen Center's *LabVenture!* experience is designed to be accessible to and support the learning of *all* students over their extended visit.

- Students explore the Lab by traveling in small groups to four activity stations.
- Information and directions for each station use a combination of auditory, visual and tangible cues.
- The overall layout of the Lab provides opportunities for focused work; followed by time to move, stretch, and transition between stations.
- One station (large tank) engages visitors kinesthetically, as members in a school of fish.

Based on your observations, was the *LabVenture!* design effective in supporting **your students'** learning? How many of your students were able to fully access the learning opportunities provided by the Center?

1. *A few students*
2. *Less than ½*
3. *Most than ½*
4. *Most students*
5. *Don't know*

9. Please provide an example of how the Lab design supported the learning needs or learning styles of one of your students.

10. What aspects of the design or other features of the visit proved most difficult for your students?

11. Based on their experiences at the Center what knowledge do you think students gained? *(Please provide a few explicit examples.)*

12. Based on their experiences at the Center, what skills do you think students gained? *(Please provide a few explicit examples.)*

13. In thinking about their experiences at the Center, how many of your students ...

1. *most students*
2. *more than 1/2*
3. *less than 1/2*
4. *a few students*
5. *I don't know*

- *Became more familiar with the Gulf of Maine waters and the importance of its resources?*
- *Learned about current marine research and some of its findings*
- *Used scientific processes to investigate the X-Fish and its marine habitat*
- *Developed problem solving strategies*
- *Expressed interest in learning more about marine sciences*
- *Increased their awareness of potential marine science or research-related careers*
- *Expressed interest in a marine science or research related-related career*
- *Other*

14. What do you think the students enjoyed the most during the visit?

15. What surprised you about your students' responses to the Center and its activities during the visit?

Post visit

16. What aspects of their experience at the Center did your students talk about most on the bus ride home or once back in the classroom?

17. In what ways, if any, have you already or are you planning to do to support or extend students' experiences at the Center?

1. *We do this*
 2. *in the planning stages*
 3. *We can't do this*
 4. *Not applicable*
- *Provide time for students to visit their personal web space, view, share their work.*
 - *Use post-visit activities on the website to review students' experiences*
 - *Discuss and compare the student teams' investigations and findings*
 - *Use post-visit activities from the Center's website to extend students' learning – explore new content areas and/or further develop their research skills.*
 - *Provide time for students to visit the GMRI website or read their blog-Today in Maine - to learn more about current research efforts*

- *Introduce other reading or research materials to further students' learning on ocean-related concepts.*
- *Develop a unit of study about a topic related to students' interests or experiences at the Center.*
- *Other examples/comments*

Recommendations

18. Based on your most recent visit to the Cohen Center, what recommendations do you have for improving teachers' and/or students' experiences during the visit?

19. Other comments?

2. Student Survey

Student Information

- *School*
- *Grade*
- *Teacher*

Remembering your visit.

Take a few moments to think back to the day you visited the Center.

Remember...

- *What you did at the different stations.*
- *Who you worked with.*
- *How you solved the mysteries.*
- *What you learned.*
- *If you had questions you couldn't answer.*
- *If there was something you wanted to learn more about.*

Here's a little information to get you started as you recall your visit.

The LabVenture! program began in the large group space. You saw maps, photographs, and videos of the Gulf of Maine on the large screen. There were examples of what research scientists are studying in the Gulf, and one of the scientists at the Institute may have given a special presentation.

Then, you and your team worked at four different research stations. At each station, there were questions to research, problems to solve, materials or specimens to examine, and tools to use. You collected evidence, and you and your team created video records of your thoughts and ideas.

When you were finished your work at the stations, you gathered back in the bleachers for a 'scientific conference' to share and compare your results with those of the other groups. Samples of work from each team appeared on the big screen, as well as some of your hypotheses and conclusions videos.

Ok, now you are visualizing your visit, here are the questions.

1. How would you rate your overall visit to the Cohen Center?

1. *I didn't enjoy the visit.*
2. *It was OK, but I wouldn't recommend it.*
3. *It was fun, I liked it.*
4. *It was great.*

Additional comments? (open-ended)

2. What did you think of the introductory presentation?

1. *It was boring.*
2. *It was ok.*
3. *It was too long.*
4. *I just wanted to get to the stations.*
5. *I liked learning about the Gulf of Maine.*
6. *Other:*

3. Check which research station you think was the best? Then, in the space below, tell us why.

- **What Does the X-Fish Eat?**

This station had a dead X-Fish, a sample of stomach contents, a microscope, measurement tools, and photos of possible food sources for the X-Fish. You hypothesized what you thought the X-Fish might eat, then examined stomach contents under a microscope. As a team, you concluded what you thought the X-Fish ate.

- **Fishing Expedition**

At this station, you went on a simulated fishing trip: you selected a boat and fishing grounds, used underwater sonar instruments to locate fish, and decided when to lower your net to try to catch fish. You learned how much money you could make based on the decisions you made during your trip.

- **What is the X-Fish?**

At this station, you planned your method of identifying the X-Fish, examined a dead X-Fish, collected photographic evidence of key features of the X-Fish, compared the X-Fish to several other species using identification cards, and reached a conclusion on the identity of the X-Fish.

- **Large Tank Holding a School of Live X-Fish**

You observed the X-Fish's behavior in the large tank and tried your own schooling behavior in response to simulated predators, ships, and food.

Comment section: Why do you think this was the best station? (*Open-ended*)

Working with your Team

4. How many students were in your group?

- 2
- 3
- 4
- 5
- *more than 5*

5. How effective or productive was your team? (*Select the best answer*)

- *Our team was a disaster!*
- *Our team had trouble with some of the activities*
- *Our team worked well on most station activities*
- *Great! Everyone had a turn; we made decisions together*

6. What did the team do well together?

7. What problems did you have as you worked with your team?

8. Did you and your team members have enough time to complete the work at each station?

- *Yes*
- *Most of the time*
- *No*
- *Comment section: Where/when did you need more time?*

9. If you visited again, is there anything you would do differently?

10. What did you think about the concluding presentation in the theatre section, the ‘scientific conference?’

- *It was boring.*
- *It was ok.*
- *It was too long.*
- *I liked seeing our team’s work.*
- *It liked seeing what other teams discovered.*
- *It really helped me understand the whole visit better.*
- *It helped answer some questions I still had after doing the work at the stations.*
- *Other:*

Learning from your experiences at the Cohen Center

11. What did you learn from your experiences at the Cohen Center? *Check all that apply)*

- *I learned where the Gulf of Maine is.*
- *I learned about scientists’ research in the Gulf of Maine.*
- *I met a scientist who works at the Center.*
- *I learned what the X-Fish is.*
- *I learned with the X-Fish eats.*
- *I learned why the X-Fish travel in schools.*
- *I learned how fishermen find and catch the X-Fish.*
- *I learned to work like a scientist: to make observations, form hypotheses collect data, and think with others about the results.*
- *I learned how to work together with my team to conduct research and decide what the evidence tells us.*
- *I learned how to use a microscope and other scientific tools.*
- *I found out why it was important to make careful measurements.*
- *Other? (Open ended)*

12. Based on your experiences at the Cohen Center, what new things did you learn about scientists’ work? *(Open-ended response)*

After your Visit

13. What did you do when you returned from your visit to the Cohen Center? *(Check any/all that apply)*

- *I talked about the visit with my family or friends.*
- *I used the CD I brought back from the visit.*
- *I visited my web page on the Mystery of the X-Fish website.*
- *Our class discussed the visit.*
- *Our class discussed our research findings.*

- *We tried to figure out why teams got different results at some of the stations.*
- *The teacher and/or our class identified other marine research we could do.*
- *Our class read about other research scientists are doing in the Gulf of Maine*
- *Our class studied other topics about the oceans or ocean environments.*
- *I did my own research about research or fishing using on-line sources.*
- *Other (open ended)*

What's next? Any changes in your attitudes or interests?

14. As a result of my visit: *(check all that are true for you)*

- *I'm more interested in studying science.*
- *I'd like to know more about marine environments in general.*
- *I'd like to know more about the Gulf of Maine.*
- *I'd like to learn more about the fresh water resources in my community.*
- *I'd like to understand more about the Gulf of Maine Watershed. What is it and how does it connect to the ocean?*
- *I'd like to do more investigations like the ones at the Cohen Center.*
- *I'd like to know more about how scientists do their research.*
- *I'd like to learn more about what research scientists are doing in the Gulf of Maine.*
- *I'd like to learn more about how scientists and the fishing industry are working together in the Gulf of Maine.*
- *I'd like to meet and talk to a scientist who is working at the GMRI.*
- *I'd like to find out what it's like to be a scientist.*
- *I'd like to learn more about the technology and special tools scientists use.*
- *I'd like to find out how to become a scientist.*
- *I'm more interested in fishing, and I'd like to learn more about it as a career.*
- *I'm still not very interested in science.*
- *None of the above.*
- *Other (open ended)*

Recommendations for the Cohen Center

15. What suggestions do you have for improving students' visits to the Center?