

Supplemental Material

*CBE—Life Sciences Education*

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**Supplementary Table 1.** Examples of questions asked in student surveys and interviews.

Category	Questions and Topics Addressed			
	<i>Surveys 1 and 2</i>	<i>Interview 1</i>	<i>Interview 2</i>	<i>Surveys 3, 4, and 5</i>
Science Identity	<ul style="list-style-type: none"> <li>- How would you describe yourself (science person, musical person, artistic person, athletic person)?</li> <li>- List characteristics of a scientist and rate how much these characteristics are like you.</li> <li>- Rate your attachment and interest in science.</li> </ul>	<ul style="list-style-type: none"> <li>- What do you think a scientist is like? What qualities do they have?</li> <li>- Do you consider yourself a science person?</li> <li>- Why are you interested in science?</li> </ul>	<ul style="list-style-type: none"> <li>- What do you think a scientist is like? What qualities do they have?</li> <li>- Do you consider yourself a science person?</li> <li>- What does doing science mean to you personally?</li> </ul>	<ul style="list-style-type: none"> <li>- How did participating in the research experience influence your interest in science?</li> <li>- Do you think of yourself as a science person?</li> <li>- What aspects of research had the greatest impact on you personally?</li> </ul>
Science Understanding and Practices	<ul style="list-style-type: none"> <li>- Rate your interest in solving scientific problems.</li> <li>- Rate your ability to be successful in science.</li> <li>- Rate your interest in using science logic and methods.</li> </ul>	<ul style="list-style-type: none"> <li>- What do you like and dislike about science?</li> <li>- How would you describe the process of science?</li> </ul>	<ul style="list-style-type: none"> <li>- What did you learn and what skills did you gain by participating in research?</li> <li>- How did interaction with peers influence your experience?</li> <li>- How did your view of science change, if at all?</li> <li>- What do you like and dislike about science?</li> </ul>	<ul style="list-style-type: none"> <li>- List the skills you learned as part of the research experience.</li> <li>- List the skills you would still like to learn in the future.</li> <li>- Do you use any of the skills you learned during the research experience?</li> </ul>
Degree/Career Trajectory	<ul style="list-style-type: none"> <li>- What is your current degree track?</li> <li>- How easy it is for you to visualize a career in science?</li> <li>- Do you enjoy your degree track?</li> <li>- Do you plan to continue your degree?</li> </ul>	<ul style="list-style-type: none"> <li>- What is your current degree and why did you choose it?</li> <li>- Do you like your current degree, and do you plan to continue it?</li> <li>- What is your ideal career? Where do you see yourself after you graduate?</li> </ul>	<ul style="list-style-type: none"> <li>- How did this experience influence your career or degree plans, if at all?</li> <li>- What is your ideal career? Where do you see yourself after you graduate?</li> </ul>	<ul style="list-style-type: none"> <li>- What is your current degree track and do you like it?</li> <li>- What is your career goal?</li> <li>- How has participating in the research experience impacted your academic progress and your professional goals?</li> </ul>
Identity Artifacts		<ul style="list-style-type: none"> <li>- Describe your identity artifact and explain why you chose it.</li> </ul>		<ul style="list-style-type: none"> <li>- Describe your identity artifact and explain why you chose it.</li> </ul>
Significant Circles (social/personal influences)		<ul style="list-style-type: none"> <li>- Describe your significant circle and explain each item you included.</li> </ul>		<ul style="list-style-type: none"> <li>- Describe your significant circle and explain each item you included.</li> </ul>

**Supplementary Table 2.** Sample quotes exemplifying student perceived gains in knowledge of coral biology.

Student	Responses	Outcomes
Allison	<p>“I think I learned a lot more than I would have in class, I probably wouldn’t have gone over all of this in biology class.”</p> <p>“I learned a lot about coral.”</p>	Allison learned more about corals by conducting research than she felt she learned in classes.
Kate	<p>“Hands-on experience with a mentor allowed me to think about the influence of corals.”</p> <p>“I had to learn about corals in order to know what [questions] to ask and what to test.”</p>	Kate learned about corals while designing experiments and by working with a coral biologist.
Julie	<p>“I had never thought about how coral larvae look. It was cool to see how they develop.”</p> <p>“In school you talk about this stuff, but it’s cool to actually see [corals] in real life.”</p>	Julie experienced learning about corals by working with and seeing corals first-hand.
Hannah	<p>“I’ve expanded my comfortableness in speaking about corals.”</p> <p>“I had little to no confidence in working with corals before the internship. Learning about corals paired with hands-on research led me to ask more in-depth questions.”</p> <p>“Handling corals and going in the field and being able to collect a colony... That was the highlight of my life.”</p>	Hannah became more comfortable and confident in handling and talking about corals through hands-on experience.
Nancy	<p>“I learned more lab skills and more knowledge about corals.”</p> <p>“There were things that I didn’t even know existed. [It was cool] to see the different tools that are used and how corals are being kept.”</p> <p>“I feel like I gained more knowledge about corals. I loved learning about corals but felt like I could learn more, which is why I pursued this internship.”</p>	Nancy learned about corals and coral husbandry techniques by seeing how corals are studied in a lab.

**Supplementary Table 3.** Sample quotes exemplifying increases in student understanding of research and scientific practices.

Student	Responses	Outcomes
Allison	<p>“Working amongst professionals in the field and hearing their conversations about how difficult the grant process is and the reality of corals was eye-opening.”</p> <p>“I learned the process of planning our experiment - starting from scratch and thinking, ‘what would scientists do?’”.</p> <p>“Learning what the whole process is. It’s not just the research, but it’s like publishing, getting grants.”</p>	<p>Allison learned how to conduct research and became more knowledgeable of the complex process of science.</p>
Kate	<p>“[I learned] the different steps in an experiment and the importance of a supporting community.”</p> <p>“I learned how to set experiments up. How time is crucial in an experiment. Looking at the variations, the variables and what do you want and setting up the report properly.”</p> <p>“It showed me how real research is done and how science fields are related.”</p>	<p>Kate gained skills in experimental design and how to do science in an authentic setting.</p>
Julie	<p>“I became better at making inferences about the data collected and opened my eyes to how many possible experiments we could do with the same data. I learned to better communicate my findings and learned more scientific jargon.”</p> <p>“I learned how much you make your own stuff and [scientists] are very innovative, almost like architects or engineering your own water tables and stuff.”</p>	<p>Julie learned that science is innovative and learned about the process of communicating science.</p>
Hannah	<p>“[I learned] to digest, summarize, and discuss scientific literature with scientists, colleagues, and professors. Through this practice I became more comfortable talking about these topics.”</p> <p>“Just recently I read a paper and instead of just reading what they said, I was saying something else in my head in a simpler way.”</p> <p>“[Science] is never linear. It’s a big web. You’re always going to go back and forth and be able to be flexible.”</p>	<p>Hannah learned to interpret and summarize scientific information and that science is a complex process.</p>
Nancy	<p>“I gained more lab skills... It was really interesting to see how everything works.”</p> <p>“There were things that I didn’t even know existed. [It was cool] to see the different tools that are used and how corals are being kept.”</p>	<p>Nancy gained more laboratory skills and became aware of aspects of science that she wasn’t aware of before.</p>

**Supplementary Table 4.** Sample quotes exemplifying student understanding of challenges and limitations in research.

Student	Responses		Outcomes
	<i>Interviews</i>	<i>Desired skills to learn (surveys)</i>	
Allison	<p>“The last time [I made graphs] was in high school. This has been a good refresher. We had a hard time with that.”</p> <p>“I had a hard time with graphs.”</p>	Excel fluency, writing reports, presentation skills, statistics, communication, data analysis, science writing	Allison expressed difficulty in analyzing data and presenting results.
Kate	<p>“I’m very good at almost everything except math.”</p> <p>“I need to work on how to understand data sheets. It’s difficult for me to know what I’m looking for.”</p> <p>“The report [was challenging for me]. The challenging part is finding sources to support my data.”</p>	Plotting graphs, sharing results, academic writing, citing sources, specialized software, communication	Kate was challenged in math and incorporating scientific literature into her writing.
Julie	<p>“I’m not very good at math and equations. It’s hard for me.”</p> <p>“I don’t like math... Any calculations that I have to do.”</p> <p>“I feel I still need to work on writing papers and telling people [about my work].”</p>	Writing, data collection, analyzing and presenting data, communication	Julie expressed difficulty with math and calculations as well as writing research papers.
Hannah	<p>“I think when it comes to writing [it was difficult]. I wanted to do more reading and have more time.”</p> <p>“[I need to improve on] data analysis and presentation. It comes down to data analysis and knowing what statistics to use.”</p>	Scientific writing, grant writing, statistics, specialized software	Hannah wanted to improve on data analysis and communication of her work through writing.
Nancy	<p>“When I decided to do this major, [I knew I was] going to have to do a lot of math. That is one thing I completely dislike, but I love it enough to conquer that.”</p> <p>“I love everything but the math. Math has never been my strong suit, but I will work through it.”</p>	Documenting and recording data, graphing and analyzing data	Nancy reported difficulty and dislike of math but knew working in science required persisting through this challenge.