ET CURE Undergraduate Program
Center for Biophotonics Science and Technology

Summative Evaluation Report

Inverness Research
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I. BACKGROUND

A. Evaluation Questions

Inverness Research was hired in the summer of 2011 to do an external summative evaluation of the ET CURE program[1] since its inception (2009). The ET CURE program at UC Davis is co-sponsored and funded by the Center for Biophotonics Science and Technology (CBST) and by the NCI's Center to Reduce Cancer Health Disparities (CRCDH)[2].

The aim of the evaluation is to address the following ***evaluation questions*:**

- Program Design*:* What are the critical design features of this program? How do those features articulate with the program goals, activities and outcomes?

- Student Experience and impacts: What are students' current college and career trajectories? In what ways and to what extent has the ET CURE program activities and design features influenced students' thinking about Cancer Research careers, and /or careers involving emergent technologies? What other kinds of influences and impacts did the program have on students?

- ET CURE Research Mentors Experiences and Perspectives: How has the mentorship program influenced CURE faculty's ideas about education and outreach? What are the challenges associated with this program and how are they met? What insights and suggestions do they have about the design and outcomes of the program?

B. Purpose and Organization for this report

This report is written to provide the project leadership with external evaluation findings and insights that may be useful in the project's efforts to report to funders, generate publications, and to pursue future funding for the project.

Evaluation methods, presentation of results, findings and conclusions are organized into the following sections:

- Evaluation Methods include describing data sources and collection methods, and analysis procedures.

- Lenses for the Evaluation describe the frameworks with which we assess the program results and findings.

[1] Emerging Technologies Continuing Umbrella of Research Experiences (ET CURE) is a supplemental program sponsored by the National Cancer Institute (NCI).

[2] Six of the ten students supported through this program were funded by CBST and the CRCHD Continuing Umbrella of Research Experiences (CURE) program funded four.

• Results Part A: Portrayal of the Project Theory of Action depicts three phases of the ET CURE experience over time (at least two years), and describes project designs, activities, and intended outcomes in relation to those phases. Included in the description of this model are specific program features that enable students to successfully be introduced to (recruitment), participate in and complete (retention), and expand or extend the ET CURE research training experience (future career and educational trajectories). Examples from the interview and observational data are integrated to demonstrate how these program mechanisms were experienced by and impacted student and mentor ET CURE participants.

• Results Part B: Student Outcomes are reported in terms of degrees earned, publications, presentations given, grants and fellowships, and student trajectories are reported as aggregated data, and anonymously. In addition, two student profiles are also presented to help illuminate the transformative nature of the experience. These profiles coincide in large part with the three phases of the program model, and demonstrate the spectrum of student experiences impacts. Entire stories are not represented in the profiles, rather two or three compelling aspects of the student/mentor experience are described. Particular attention is paid to critical experiences and junctures in the students' development and how the program facilitated, supported and inspired the students to remain in the program and pursue STEM –related careers, including cancer research. Students' voices and mentors' voices are included in these profiles. Additional profiles demonstrating more of the range of outcomes may be generated for the purpose of publication.

• Results Part C: Mentor Experiences and Viewpoints report on findings from the mentor interviews, and also demonstrate a range of experiences and perspectives on the mentoring process and program, including successes and challenges.

Discussion of results in light of the evaluation lenses, concluding ideas from participants, and perspectives from Inverness Research make up the final section of this report.

C. *Evaluation Methods and Data Sources*

Because of the small numbers of participants (students and mentors) and the charge to look individually at program participants' experiences over time, Inverness Research took a *qualitative approach* to this evaluation. This approach included in-depth structured interviews, on-site observations of students working in their laboratory settings, and program document review and mining.

Generating the rationale or logic (theory of action) for the project's design and strategies was an iterative process informed primarily from ET CURE documents and project leadership interviews, and then revised and refined through analysis of the participants' interviews and the process of writing the student profiles. By

studying the congruence of the project's theory of action (mental models) with the field realities (as described by the student and mentor participants and demonstrated in observations) we are able to generate an assessment of the quality and efficacy of the effort. Inverness Research calls this a "groundtruthing" approach[3], which is akin to *grounded theory*[4] but applied to a model representation of the purpose, activities, audiences, and outcomes of the project.

Open and selective coding processes were used in iterative readings of the transcripts. Student profiles were written based on a template constructed from the second round of transcript readings. Three researchers read the same transcript, one researcher used the template to write a profile, and a subsequent meeting was held to discuss the integrity of the template and adjustments were made. The final profiles were written by the three researchers each using the template for one or more student/mentor pairs of transcripts.

Data Sources and Collection

- **In-depth structured interviews** with nine students, five mentors, and two program leaders (for student and mentor interview protocols see appendix A). Inverness attempted to contact all student and mentor participants. Nine out of ten students participated and five out of six mentors participated. Of these nine, five were interviewed by telephone and four were interviewed in person. All mentor interviews were done by phone and one actively participated in the laboratory observation as well as the phone interview. For their time and consideration student and mentor participants were given a modest incentive.
- **On-site research laboratory observations** were done for four students who currently work in the UC Davis research labs involved with the program.
- **Review of project documents** including past annual reports, materials used in the summer program, and online materials provided by the project

Data Analysis

All interviews were recorded and transcribed. A team of three researchers, each with particular students and mentors assigned, completed all of the interviews and read all of the transcripts. The first cycle of analysis was an open-coding process of the transcripts aimed at extracting recurring themes that emerged from the student interviews and the mentor interviews. After a preliminary review of the data, two theoretical frameworks were identified through which to consider and frame these

[3] M. St. John (2005) http://linux01.crystalgraphics.com/view/229513-MDY0Z/Some_Thoughts_About_Evaluating_nsfs_investments_in_informal_science_education_flash_ppt_presentation

[4] The basic idea of the grounded theory approach is to read (and re-read) a textual database (such as a set of interview transcripts or a set of field notes) and "discover or label variables (categories, themes, concepts…and their inter-relationships. Theory is then developed inductively from the data. (Glasser & Straus, 1967; Strauss and Corbin,1990).

data. The themes and data were again revisited in light of these frameworks and a decision about which framework was the best fit for the results is in process.

Additionally, a project "Theory of Action"[5] emerged from learning about the program designs and activities through the leadership interviews and then discussing those design features and activities through interviews with students and mentors. This Theory of Action is considered a result of the study, is described and then portrayed through a presentation of attributes of the model accompanied by examples and instances cited from the data. Data are also used in reported results pertaining to the student outcomes and the mentor perspectives. In those cases, data are used to exemplify themes that emerged from the data. This being a qualitative methods evaluation report, we use both representative and unique student and mentor quotes throughout[6], since their voices best represent both common experiences and unique perspectives.

II. EVALUATION LENSES - *NCI ET CURE Assessment Outcomes and Program Characteristics of Proven Interventions for Underrepresented Minorities in STEM*

For this report we view the results and findings from this study through two lenses or frameworks. First are the assessment outcomes described by the NCI for the ET CURE program[7] which include:

- Final assessment report that includes a description of the activities and outcomes and an assessment of the success obtained.

- Mechanisms to enable student trainee's ability to successfully complete ET CURE research training opportunity and to identify the next research training opportunity to ensure retention in the ET CURE pipeline and future success.

A second framework we use to assess the effectiveness of the ET CURE program in this report is strictly programmatic, and drawn from the National Academies of Sciences, Engineering and the Institute of Medicine *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*[8]. We found the discussion of ***program characteristics of proven interventions for underrepresented minorities in STEM*** resonated well with what we learned about the design of this ET CURE program. Figure 1 is excerpted from this source and provides a useful set of criterion with which to assess the ET CURE program objectives, activities, experiences and outcomes.

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[5] Agrys, C., & Schon, D. (1978). *Organizational Learning II: Theory, method and practice,* Reading, Mass: Addison Wesley; Eisner, E. W. (1998) *The Enlightened Eye. Qualitative inquiry and the enhancement of educational practice,* Upper Saddle River, NJ: Prentice Hall.

[6] Some quotes are lightly edited for grammar; their meaning has not been changed.

[7] These assessment outcomes are from the NCI Guidelines call for administrative supplements proposals for ET CURE.

[8] *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads.* National Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies. (2011). National Academy Press, Washington, D.C.

The results sections of this report are presented in relation to the first lens for evaluation, namely the NCI assessment outcomes. In the final discussion section of this report we will revisit the findings of the evaluation through the second lens, namely characteristics of proven interventions for underrepresented minorities in STEM.

Program Characteristics

While many strategies for academic support and social integration apply equally to students in STEM fields regardless of their racial or ethnic background, for underrepresented minority students these can be critical for opening doors of opportunity. Proven, intensive interventions for underrepresented minorities in STEM include:

Summer Programs: Summer programs that include or target minority middle and high school and undergraduate students provide experiences that stimulate in terest in these fields through study, hands-on research, and the development of a cadre of students who support each other in their interests.

Research Experiences: At the undergraduate and graduate level, engagement in rich research experiences allows for the further development of interest and competence in and identification with STEM and enhances academic competitiveness.

Professional Development Activities: Opportunities for undergraduate and graduate students to engage in networking, participation in conferences, and presentation of research provide opportunities to develop and socialize students within a discipline and profession.

Academic Support and Social Integration: Success may also hinge on the extent to which undergraduate and graduate students participate in activities—such as peer-to-peer support, study groups, social activities, tutoring, and mentoring programs—that can promote academic success and social integration.

Mentoring: Engaged mentors can provide undergraduate and graduate students with information, advice, and guidance and support generally and at critical decision points.

Figure 1. Program characteristics of proven Interventions for underrepresented minorities in STEM from *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads.* (p. 10 and pp. 164-169).

III. RESULTS Part A: Portraying the CBST ET-CURE Project Model

A significant result from our study of the program was the development and portrayal of a **theory of action (a kind of project logic model)** for the CBST ET CURE program. This project model depicts the student experience in three phases, each phase serving a particular purpose and characterized by a set of experiences and supports for students' participation over time.

Descriptions of the experiences had by students and mentors suggested the ET CURE Program design features and activities fall into three categories of efforts/activities that occur over the course of up to two or more years. We have named these three categories of efforts/activities as **Phase I (*Into* the Program), Phase II (*Through* the Program)** and **Phase III (*Beyond* the Program)**[9]**.** The phases may overlap to some degree.

Each Phase of the program involves approaches and mechanisms (activities) for working with students that progressively introduce them to different aspects of the culture and enterprise of science, resulting in most cases in acculturation[10] into the science research field. Approaches and mechanisms include structured activities that may be repeated over time (up to three times) thereby extending and deepening experiences over time. Students' relationships with the discipline, with their community, and with the field progress and grow.

Constant conditions exist across all three phases. These include financial support for students through the NCI ET CURE program and several other sources[11], ongoing immersive laboratory experience, multiple mentors serving different purposes, and continuing professional development opportunities. These constants may be the cornerstones for the success of this program. Over time these four program characteristics require the most investment on the part of the funders, the scientists serving as mentors, and the program coordinators.

Figure 2 depicts this 3-phase Theory of Action and identifies key efforts involved in each phase – namely effective recruitment (of students AND mentors), retention of the students in the program over time, and supports for propelling students toward future educational opportunities and STEM research career trajectories.

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[9] D. Brinton, C. Holten (1997). Into, Through and Beyond: A Framework to Develop Content-Based Material. *Forum* 35(4).

[10] A third possible conceptual framework for considering the outcomes of this program is the notion of acculturation. Project leadership will consider this framework more carefully as a possible construct to use in future publications about the project.

[11] Important to note here is the NCI ET CURE funds only supported four students for one year. CBST provided other financial support for other students and also a constant effort to help students secure additional funding through the NCI Minority Grants program, NIH and other resources to allow them to continue to pursue their research studies.

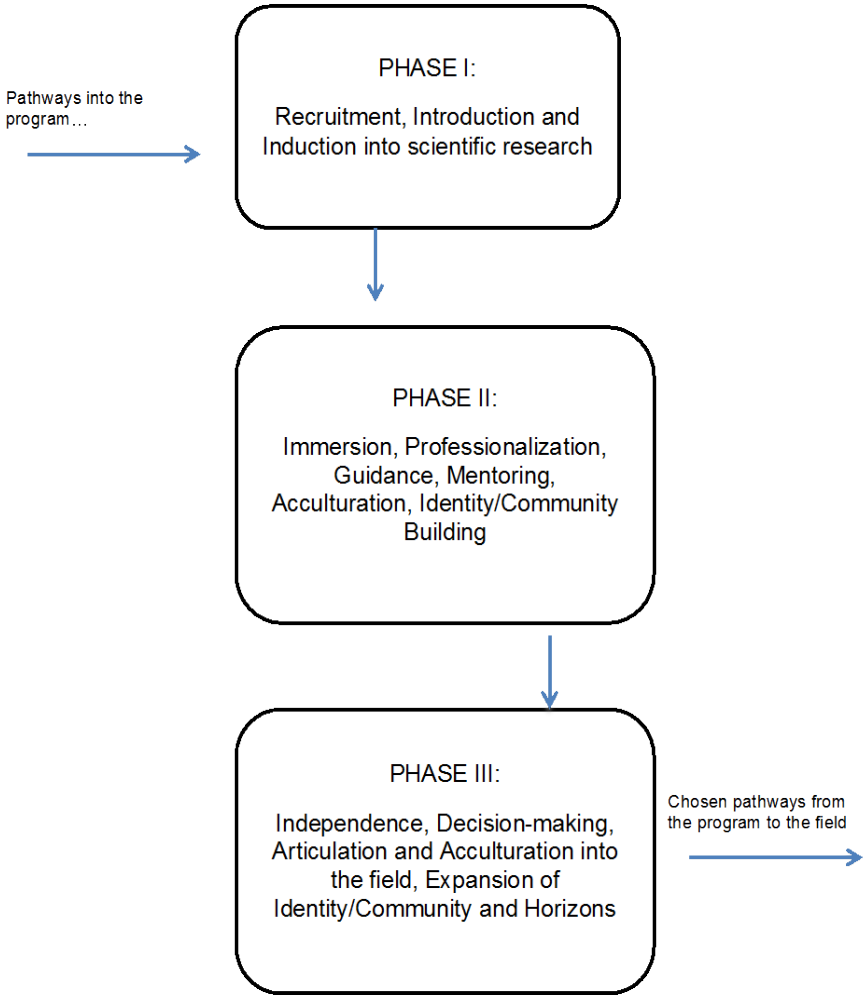

Figure 2. ET CURE Theory of Action

This theory of action was vetted with ET CURE Project leadership. They then worked with us to align the program activities, timeframes and funding sources with the three phases identified in the model. In Table 1 we hope to clarify the relationships between the program phases, the program activities and funding arrangements for students moving through the multiple years of ET CURE opportunities. Shown here and emphasized later is the fact that the NCI funded ET CURE students were strategically integrated into a more comprehensive CBST effort that included more students with similar trajectories. ET CURE was designed to leverage and add value to resources and programs already in place and available. We acknowledge the value-added of ET CURE students' experiences because of this programmatic and financial leveraging that resulted from this integrated approach.

ET CURE Phase	Program Activities experience by ET CURE Students*	Timeframes	Funding Sources
Phase I	• recruitment • CBST winter intensive program for Community College students • student selection • Summer intensive PD program #1 • Summer induction into research and the laboratory	Year 1: Winter/Spring/Summer quarters	• CBST ongoing • NCI – ET CURE
Phase II	• Academic year #1 lab research • short courses • SACNAS and other conference attendance and presentations • NCI Minority Supplement applications (for year 2) – most students applied • NIH Post-Bac Fellowship Application (1 student) • Summer intensive PD program & research #2, and in some cases #3	End of Year 1 and into Year 2: First Fall quarter, second and third winter and spring quarters	• CBST ongoing • NCI - **ET CURE ends spring quarter**, year 2. • NCI – Minority Supplement grants • NIH – Post-bac fellowship
Phase III	• Academic year #2 lab research continues and in some cases Academic year #3 • Career coaching • Writing NCI Minority Supplement grants (most students) • Grad school and med school application supports • CBST Supports finding bridge Funding in some cases • Supports finding RA positions and employment positions	Year 2, year 3 and 4 (for some students)	• CBST ongoing • CAMP funding • BSHARP funding • UCD Cancer Center funding • Individual PIs funding • NIH – Post-bac fellowship funds *NOTE: NO NCI ET CURE FUNDING FOR THIS WORK*

*A majority of students persisted in the program even though NCI ET CURE funding was no longer available to support them. The project made every effort to find additional funding for continuing to support their research work in the labs. In one case this amounted to four years of ongoing support for a student to continue research work in oncology.

In order to portray the Theory of Action using actual data, following is a general description of each phase, which includes mechanisms and activities that characterize each phase (indicated in bold type). Imbedded within these mechanisms and activities are a few excerpts[12] from the interviews and observations data that illuminate experiences and perspectives of participants in each phase, through the voices (quotes) of the participants.

[12] There are many more quotes and instantiations of these phases. Examples included here represent just a few of the many that exist in the interview data.

PHASE I – INTO the ET CURE Program: *Recruitment, Introduction, Induction and Immersion*

This phase of student engagement with the program represents the introduction and initiation phase. Questions that could be asked about the student experience and the project designs in this phase include: What are the students' backgrounds upon entering the ET-CURE program? Were they involved in any "pipeline" programs or supports in their schools prior to participating? How did they learn about the program? What recruitment strategies, structures or mechanisms were used? Was recruitment through a person-to-person referral, or did it happen through a program presentation they saw and decided to apply to? Were they encouraged to apply? If so, by whom? What were the students' initial entry experiences and what were they like? What were the students' reactions to and reflections about those experiences? What were students' expectations? What did they think the program was aimed at doing?

Not all of these questions were answered for all of the students. What we present here are those recurring themes, observations and experiences that emerged from the data, supported with examples.

Strategic and in-person recruitment

Strategic and personal/face-to-face recruitment methods were instrumental in identifying students from the target populations with sincere interest, commitment and aptitude toward STEM. Intentionally working through existing departmental, campus and local programs and networks found in local Community Colleges, CSUs and UCD, the ET CURE program cast a carefully aimed net to identify a strong pool of potential students from underrepresented groups who could gain from and contribute to the cohort. Keeping recruitment local insured ET CURE students could spend substantial time in the Cancer Center labs, while continuing their college coursework. Of note and mentioned by most students are the in-person formal presentations project leadership (Dr. Ana Corbacho, Dr. Marco Monlinaro and Dr. Jody Galosy) made at community and CSU college campuses.

One student's story about how she learned about ET CURE and got involved demonstrates the importance of an aggressive recruitment effort. She came to ET CURE from a regional community college but learned of the program through a program at CSU Sacramento. She had significant research experience prior to the ET CURE Program.

> *I had done two research projects prior to applying (one through ARC and one through CSUS) so I already had research. I kind of knew that I wanted to go into research, and I just wasn't sure which way to go. So when I applied to ET CURE I was specifically interested in cancer because my sister has ovarian cancer. She was diagnosed when she was 19 and it has come back for the third time. I was really*

interested in cancer because they say it is a disease of the elderly, but also gets young people. I know it's not as high, but I was always curious about that.

Marco actually went to Sac State recruiting for ET CURE and he was specific in the students that he was looking for. Dr. McCarthy is one of the biochemistry teachers at CSUS and she had a class in the afternoons for a program called the Science Transfer project. It was for the Los Rios CC students in the sciences and was a bridge program for transfer students.

Marco came to the class and gave a presentation about the ET CURE program and the need for minorities or disenfranchised people to go into cancer research. After this presentation, we had questions, I applied and then found out I was accepted. So that is how I started.

Another student described his initial contact and experience,

My chemistry instructor (at a regional community college) spoke about research; we talked about an email she got, the thing Ana sends to community colleges. So she (my chemistry teacher) told me to apply for the program and that she would write me a letter of recommendation. So when I applied to the program I got in for that winter (The winter program is a previous experience to ET-CURE, called CCWinter and funded by CBST, it is a two-week intensive research experience for community college students. The students that participate are invited to apply to the summer and in this case we selected motivated students to apply to ET-CURE). Then Ana offered the summer opportunity, so I applied to that and got in.

Several of the students mentioned the MESA program in response to the question about how they heard about the program. Student C who at the time of his interview was working 8 hours per day, full time, in the lab referenced this and also his participation in the 2-week winter internship program.

It was kind of a process. At my college I was involved with MESA, so my MESA advisor was really adamant on getting us to do something like an internship if you were in sciences. He was always pushing us, so I said, 'OK, I will apply for this winter internship that CBST had. It was a two-week internship where they would get you involved in research. There were people there who had never been to a research lab or even seen a lab; it was to get some kind of experience.

The recruitment efforts of the program were aggressive, based on knowledge of local and regional STEM "pipeline/pathways" programs and on personal relationships with instructors, professors, and who knows whom. The concerted and ongoing effort to recruit through established programs/networks and creating new points of contact and potential pools of students exemplifies the importance of relationships, not just person-to-person but program-to-program and institution-to-institution. The aggressive and engineered recruitment strategy paid off in terms of identifying and placing students who would gain the most and offer the most in their ET CURE Laboratory placements.

One mentor noted,

> *What I think (they) did when they were selecting the CURE students is they picked most of the top students from the (CBST) summer internship program based on whether they had met and interacted with them before, and based on the quality of their application. It really showed that these were some very highly motivated very smart people who were very glad for an opportunity. They were hard workers and determined and were the least likely to have a sense of entitlement. They saw this as an opportunity to prove themselves.*

With one exception, all mentors interviewed commented on the very high caliber of students and applauded program leaders for providing them with capable, gifted and dedicated students.

Program Integration

Integrating the initial and subsequent ET CURE experiences with established undergraduate program with similar goals created economic and strategic ways to expose interested students to the program, and get an initial immersion in the lab setting. An **introductory two-week winter internship program and summer intensive one-week professional development program, both sponsored by CBST** gave most of the potential ET CURE students a preliminary sense of what it would be like to work in a research lab, and additionally some grounded professional development about the real world of science. These programs were ripe recruitment pools for the ET CURE program.

> *What I really liked about the summer intensive was they were very realistic. They would tell you how it was like in the actual workforce… they are very honest and they tell you like it is. The biggest thing that I took away was realizing that in the research lab you get a taste of what day-to-day things are like, and you see how the whole structure comes together.*

> *I heard about (the two-week winter internship program) through AR and I applied and got in. That was where I first started doing research. It was more like an entry to research. From there on, Dr. Corbacho told us to look for research programs. So I applied to the summer program and the ET CURE program.*

Recruitment of effective mentors

Recruitment of effective mentors for the program was as important as recruitment of students. Prior to the first year of engagement with students, Program leadership met with leaders from the UCD Cancer Center to carefully consider the internships - where and with whom the students would be placed in their internships. Labs led

by PIs who are leaders in emerging technologies and are dedicated to investing in carefully raising the next generation of cancer scientists were identified. However, students assigned to those labs typically worked most closely with a graduate student or a post-doc as their primary mentor. One student's description of this circumstance presents a picture of the "tiered" nature of these mentoring relationships in the labs. These tiers seem to occur because of shifts in mentors' work and also because of the evolution/development of the students' skills. At the time of the interview, this student was in his third year in the program.

Every mentor I had had a different perspective on the field. Mentor A was more like 'let see if this happens… we're going to try it and see if it happens or not, if it doesn't, we will move on. Mentor B was more the organized type. He had a plan for the next couple of weeks going and he was more steady, older… he has been in research longer. Mentor C lets me do most of the work. If I have a question I would talk to her, but most of it is me. I had a very different experience with each mentor. The last one is more independent, the middle one was getting an idea of what a real experienced person is, the first one was kind of an introduction – this is kind of exciting…

Matching students' interests and dispositions with a complimentary research laboratory environment proved to be challenging.

The matchmaking process of students and mentors involved the PIs from the collaborating labs doing a presentation about their research and labs to the ET CURE students, who had completed a questionnaire about their own interests, preparation and goals. PIs, in collaboration with the project leaders, then decided on their student(s) and due to the high quality of all targeted applicants, ten students were placed (even though only four were funded by ET CURE). This seemed to be a pretty straightforward almost simplistic process. For seven of the nine student/mentor cases this match worked very well or reasonably well for both the mentors and for the students. In two cases the match resulted in less than satisfactory outcomes for either the student or the mentors, or both. In one particular case, the project experience left a mentor unwilling to participate in the future. However, for the student in this particular relationship, what was learned from his primary mentor and research experience was absolutely transformative. (See Student Profile A for that story in Appendix C).

One student, brought her experience to bear on a thoughtful suggestion for the program,

When we picked our lab they did presentations and we heard about the projects, so we just picked whichever one sounded the best, but there is so much more to it than what sounds good... What about all the people in the lab? Do they rub you the right way? Is it more a work environment and everyone does their own thing? Is that the kind of person you are? Or do you like an environment where everyone is really hands-on and talking to you and totally helping you out? Every lab is so different and I think everyone is so different. … I think working in the lab is not

only about the project, but also about the way it feels. I would have liked to work in the different labs that we had available, maybe for a week or so. If all of the members of ET CURE could rotate and work in a lab for one week and then do a match depending on …

After observing students in four labs we can definitely say that each lab environment has its own persona -- ways of working, routines, culture, expectations around communications and productivity, and hierarchies. Three of the four student/mentor/lab environments observed struck us as being very simpatico. One was less than an ideal match, but still works worked well. We acknowledge effectively matching the students with the mentors including their lab environments is not a trivial task, especially given the length of time the students ultimately may be working in their labs (up to two or more years).

Establishing a Community

Establishing a cohort and sense of community during this first year grew from specific activities students engaged in during the summer CBST Professional Development interns' workshop (of which they were a part), through more informal social activities and one-on-one communications with the program leaders, and through their initial immersion in the research lab. Through these initial experiences students began to reflect on their own and together about their past experiences and preparations in STEM, and their own sense of science in relation to themselves.

When asked about the level of support from the program leaders, one student's comment resonated with what other students had to say, several of who used a family metaphor.

Anything we needed…. It was never a delayed response, if it was last minute or we were in over our heads they were always there. They were easy to get a hold of and it is like a family, a very supportive family.

Professional Development in the Summer Program

The first week-long summer intensive professional development experience is included in Phase I, but was attended by most ET CURE Students at least twice. We included this description in Phase II, since it is the jumping off place for more in-depth work through the program.

PHASE II **- THROUGH the Program:** *Induction, Mentoring-Guidance, Counseling, Immersion, Professionalization, Acculturation into the research lab, and Retention in the program and STEM*

This phase of the program extended for one or into two years for most students. During this phase, students spend at least 10 hours per week throughout the school year in the labs and also participate in the year-round professional development

opportunities (one week intensive workshop and 7 weeks short courses,– seminars, activities, journal club).

Supports for induction into the culture, routines and habits of the lab and an introduction to the real, in-situ world of cancer/scientific research, the "enterprise" of science defines this phase of the program. Also supports for retention and broadening of experiences throughout first year of immersion into the research laboratory

Professional Development in the Summer Program

ET CURE Students participated in an intensive one-week summer program during which students learned about aspects of the enterprise of science that are not as explicitly addressed during their laboratory experiences. The intensive one-week professional development experience dovetailed with other campus and CBST undergraduate research preparation programs, including the CBST Internship program, which drew students from across the country. This gave ET CURE students an opportunity to mix with students from other campus programs that target support in STEM for diverse students. The Summer Intensive program also was a place where potential ET CURE students were recruited, and where experienced ET CURE students returned for a second summer.

The content of the week was as diverse as the students who attended. Sessions included topics such as "Challenging Stereotypes", "Real Life Mentor and Worst Case Scenario", "Laboratory Safety Training", Tours of CBST Labs, "Learning Styles", "Dissecting a Scientific Article", "How I Got Here and What is Next" and "Well-Rounded Person". One particular session called 'Challenging Stereotypes' stood out for several of the students we interviewed. The session, co-facilitated by Ana Corbacho and Marla Leech (Diversity Consultant) produced vivid impressions and memories on the part of at least a couple of students.

In one student's case this particular session, along with presentation on Public Health were critical events in her own thinking about career pathways.

> *During this activity everyone stands in a long line. If she said, for example, you have been to a private school, or your parents both graduated college, you would take a step forward, and if this thing hasn't happened to you, stay still or take a step back. She asked things like "Are you an immigrant?" or things that were disadvantages in the system (you'd step back) or things that were advantages (you'd step forward). Anyway, when you looked at it in the end you would see all of us, and it was so diverse, like our crowd of students. I came from not the best circumstances, but look where I am now. That was really inspiring and motivating and I really enjoyed the exercise… I will never forget it!*

One student, in his third year in the lab, saw the purpose for the summer program clearly.

The summer part is like a rich program that just lasts for the summer. They have all of these professional development activities, like panels with professionals… we kind of fused together with (the CBST) group during the summer and so we participated in the same activities. When that program ended we still continued on with our own program, research.

Summer and Academic Year Research Lab work

During the summers, students worked full time (on average 8 hours per day) in the lab. During the academic year students continued to work in their research labs with support (from various sources) for at least 10 hours per week. With no exception the actual research lab experience was the most profound and paramount experience students talked about.

One student describes the diversity she found in the lab.

I worked with my graduate student (mentor) who was from Spain. She was really inspiring because she moved here just to do the cancer graduate program (not ET-CURE). I was really inspired by her drive, but sometimes it would be hard to communicate between us because we were so different. We had different cultures and we looked at life totally different. Then we had another grad student that I worked with and she had two kids and her life was completely different. Then there was another woman from Germany. I learned a lot about Germany from her, and another guy was from Nevada. So I learned to work with people that were very different and older than me too. I think that will be very useful in terms of my new job, really anywhere. I am used to being around college students. Prior to that I wasn't used to being around people of all different levels of education.

The first experience in the lab was a transformative one for some of the students. One student mentioned how it immediately spurred his interest in research, has pursued since and intends to continue to pursue for a career.

When I came into CBST[13] I started liking the research part of it right away. That was my first time having the experience of working in the lab. The thinking and the design of it were different from regular class work and everything I'd done before.

Journal Club

The Journal club was part of the full summer program and was organized and facilitated by a postdoctoral fellow, Gene Gurkoff (not one of the original ET-CURE Mentors but a person who interacted with many of the students and currently mentors one of the ETCURE graduates). The intent of the journal club was to expose

[13] In our interviews, students may refer to ET CURE/CBST interchangeably. Because the programs were so closely integrated, it was often hard for students to discern where one program began and another left off.

students to a variety of kinds of academic publications, teach them a bit about how to read and synthesize ideas from peer-reviewed publications.

When asked what aspects of the program (outside of the lab) students found to be most useful and memorable, the Journal Club was mentioned by most of the students we interviewed.

> *The journal club was a very, very good experience. It helped me to know how to read a research article. I didn't know how beneficial learning that would be until I got to Berkeley where most of my classes have close to three articles to read and analyze. That was really, really helpful!*
>
> *I didn't realize how important the journal club was in ET CURE until I got to Maryland where we did them more often and you are really involved, I was actually presenting journal articles to the group.*
>
> *The journal club was a good aspect… to really dissect the journals and to figure out what to look for and what is important and how to read the graphs. I read journals before but I never really understood certain things. I think the journal club really put that in perspective for me, especially because we had to give presentations on journal articles and read and answer question.*

Short courses and workshops during the academic year

Project leaders worked to identify and target the students' interests and needs through offering a menu of opportunities to participate in workshops and/or short courses.

> *What was really great is Marco would want our feedback about which topics would be most beneficial to us and which ones we were interested in. The teacher wasn't "This is what you are going to do and here are the times you are going to do it". It was more. These are the things that we thought you guys might enjoy and which ones do you think would benefit you? All of the extra things outside of the lab were very memorable. The retreats[14] were a great experience. Every level of people were so great and helpful and would talk to us and network with us.*

Through out the summer and school year, workshops were offered focused on topics related to the enterprise of science. "Building your Resume", "Write an Abstract", "Interview Skills", panels of professionals talking about career opportunities, "Preparing presentations and posters" to name a few. Additionally through out the year Project leaders encouraged participants to attend CBST and Cancer Center Symposia events and special events and talks. These often conflicted with students' research and class schedules, but many did attend at least a couple of these events.

Social networking and group activities

[14] CBST sponsors an annual retreat that involves the Cancer Center.

Interestingly, though the project leadership talked in some depth about the social activities and group activities the program provided, all of the students either didn't mention this aspect of the program, or talked about it very minimally. These kinds of social activities included bowling, dinners, and a variety of kinds of get-togethers. We guess these activities contributed to the sense of "family" described by a couple of the students and the establishment of a community of learners with shared experiences and goals.

Ongoing guidance, career counseling, mentoring

The steadfast presence and dependable support of the ET-CURE leadership was acknowledged by virtually all of those interviewed. Lab mentors and students alike commended the consistency and commitment.

> *Marco and Ana were both very available for any type of assistance that I or any of the other interns needed, whether it be school stuff or more personal things that we felt like we wanted to talk to them one on one…. Ana gave a talk on resumes and one of the post docs, Gene gave a talk on lab etiquette… I appreciated that!*

Presenting and participating in conferences

Presenting their research at conferences was an understood expectation of ET CURE students from the beginning. Two annual conferences that students were supported and expected to attended were the Cancer Center Symposium and SACNAS.

> *We were able to present at many occasions. I really liked it because that is something at a young age you don't really get that much experience with. You can perfect those oral skills and talk in front of large audiences.*

> *Presenting, whether it be in a lab meeting or symposium or conferences, for me personally, that is the time that I get the most excited about my project. When I am telling people who don't know what I am doing… it's like I'm telling you why it is important. That is the most exciting time. That is like my scientific fire.*

Participation in Professional Development during the year[15]

Additionally, ET CURE students were integrated into annual academic year activities sponsored by CBST and the Cancer Center, such as Thursday morning science Seminars at the Cancer Center, Medical Center and Cancer Center speaker events, and the annual CBST Lake Tahoe retreat.

[15] CBST sponsors an annual Center retreat that involves many researchers from the UCD Cancer Center.

We went to the (CBST) retreat in Lake Tahoe, and that is when I really started to understand what science is. After you finish your undergrad, you work on your PhD and you come to places like this and present your work and people ask you questions and you have to know what you are talking about… it was really interesting and eye-opening.

PHASE III – Beyond the program **–** *Articulation and Acculturation into the field, Independence, Expanding Horizons, Decision-making*

This phase of the program coincides with aspects of phase II but serves a different purpose. Phase III deepens the acculturation experiences in the cancer/STEM research field, career counseling, and mentoring aimed at expanding students' horizons, supporting them as they apply for additional opportunities aimed at maintaining momentum of their trajectories, and increasing opportunities for next step of students' growth in this or other fields. These kinds of supports take a variety of forms and opportunities within the ET CURE Program and have particular kinds of impacts. It is within this period of the experience, which occurs in years two and three of the project, when students move closer to making concrete career and continuing education decisions[16]. Many programs do not support students through this "beyond" stage of the experience, but investing in this beyond stage may very well raise the likelihood that students will continue in their cancer/STEM research career paths.

Continuing work in lab

One of the mentors spoke at some length about the time commitment to the lab as being one of the remarkable aspects of the program. He spoke in not just in terms of hours per day, or days per week, or even hours per quarter. He meant years of commitment.

The work that you do in the lab, it is real. That is what hits me the most. This is a real problem in the population, there is a real need and the needs aren't being addressed and I get to be a part of it. Personally for me it is so gratifying to know that not only do I get to do a job that I love to do, but that there is actually some benefit to another human being.

Research Meetings in the lab

ET CURE students were integrated into weekly research meetings within the labs they worked. These meetings helped students organize their research for presentation to colleagues, provided them with valuable input about their work and challenges, and also gave them a clearer sense of how their work fit into the bigger

[16] One leader noted, "As a pilot, ETCURE funded 1 year, then we were allowed to have a few more months of paid interaction. All additional work in year 2 were NIH grant supplements to PIs and or CBST summer funds or PI funds."

picture. This seemed to be a significant mechanism for their acculturation into the science field.

> *It is a community and you go over everybody's project and give them help, constructive criticism for everyone's project. It is nice to be a member of the audience and come up with ideas as well as being a presenter and have people talk about what you are doing. We were expected to present at least once every year we were in the lab… that was great and effective. You are going to need that for when you do orals or poster presentations at conferences or symposiums.*

ET-CURE Cohort meetings

ET CURE students met on a monthly basis as a cohort. These meetings served several purposes including giving the students a supportive space to talk about their research, and to share as a community outside of their lab setting things they were learning and challenges they were facing.

> *I liked meeting with (Marco, Ana and Jodie) and everyone in our group to go over what we had been doing and what everyone else was thinking and going. That kind of non-science support time is also good. Prepping for presentations or talking about what we are doing in our lab. The communication... is almost practice networking for when you talk to people you don't know. I would really look forward to those meetings.*

When asked about ongoing relationships, all students indicated they are still in very close contact with each other…

> *I talk to almost every one of them, to this day!*

Leadership opportunities within UCD/CBST/Cancer Center research programs and events

Students who continued their work in ET CURE have a variety of opportunities to develop leadership skills. There was no shortage of opportunities. One student met representatives from the NIH ICRC program while helping in the CBST booth at a SACNAS conference. After having a conversation there, she applied (with support from CBST/ETCURE leaders) and was accepted to do a post-bac. She worked with another MD-PhD in another oncology lab at NIH, amassing a total of 4 years of oncology research (3 at UC Davis and 1 at NCI).

> *In Maryland I got to do a lot more and the responsibility put on me was like a graduate student doing my masters or some kind of a PhD. … I don't think without it (the year with CBST and ETCURE) I would have had the same experience in Maryland. It would have been a lot more difficult for me… they*

wouldn't have to train me for a lot of things … I brought those skills to the project from what I learned in Dr. Lam's lab.

Some ET CURE students who continued their research into a second or third year were invited to participate in the intensive summer CBST Professional Development workshop as peer leaders (for students new to the summer internship program), and at least one ET CURE student participated in programs that brought CBST/ET CURE science to K-12 group outreach activities.

Continued mentoring and guidance for professional, educational and personal decision-making

By this time in the program, students had gathered a variety of mentors for different purposes and needs. Personal visioning and decision-making about educational and career opportunities gained momentum during this time (year 2 and beyond). Though an ever-present support, ET CURE mentors were called on by students for grant-making, for publications, for resume writing, for med and graduate school applications and more. Personal and professional issues were focal points for students who sought out their mentors for support within their research labs and from the ET CURE staff.

Marco and Ana and my PI from the lab and the post doc that I worked with definitely shaped what I want to do in my career life and also the path in education I would need to take to get there. I wasn't sure what I wanted to do (in my Freshman and Sophomore years). I knew that I liked science and I liked math, but then actually seeing what real research is like at a young age and so hands-on – doing the actual research – made me take a serious look and consider research as part of my future as well. Ever since then, that has definitely been part of what I consider as far as my education and career goes… without a doubt those programs have shaped what I am going to be doing in the future.

Following career paths

For at least a couple students who are immigrants, the ET CURE program presented a landscape of opportunities that were either not possible or known to them in their home countries.

Back home when I was growing up you had three options in life. If you are a baller, you play soccer, which can easily lead to prosperity; if you are in the sciences you can go through the route of M.D. or engineering, and if you are in the social sciences you go through the route of backing, accounting or MBA. I

stuck with the sciences… the benefit of doing the MD is that if I relocate home, I could easily [be] proactive and benefit my society…

Following her NIH post-bac year in Bethesda, this ET CURE student landed a job at a local biotechnology firm. She talked with us about her experience there and future aspirations.

Genetech has been great. It is a different side of the science world to look at. It's on a much smaller scale than the bench work I am used to doing, so it's nice to see it from that angle as well and be a part of the creation of drugs that get distributed to many patients worldwide!

When asked about where she would like to be in 3-5 years she states,

Because of the influence that science and research has had on me over the last few years I am considering the MD-PhD route. Initially (before CBST) I was only really sure about the MD.

Acculturation into the enterprise of science

Supports for students for participating in the enterprise of science including co-authorship of publications, attending and presenting at professional meetings/conferences and being collaborators on grants, were characteristic of this phase of the program

One student had this to say about the Cancer Symposium,

They put us all in there, and one of us actually won! And two of them won oral awards – pretty large sums of money! For college students, they won and who ever judged didn't know that we were undergraduates presenting. I was really happy about that. Being there was great.

Another student notes,

Here (in the research lab) we have things we have to present almost every month, either to our labs or to the radiologists here or in conferences, so I got used to actually going to their (meetings) and present my work to public audiences or scientists or others. If it wasn't for this lab, I wouldn't actually be able to put together presentations… that is a very useful skill!

Applying for fellowships

Two of the nine ET Cure Students applied for post-bac programs through NIH and both were accepted. One spent one entre year in Bethesda and the second is spending his year interning there this year. Another student was awarded a HHMI Research Fellowship and conducted his second summer of research in nanotechnology at MIT.

My summer experience at MIT was one of the most valuable experiences in my academic career. Everything leading up to that experience could not have prepared me more. Being part of ET CURE and having available resources such as Immunology seminars, cancer seminars/discussions with research faculty gave me the tools to be successful at MIT.

We note that the one student that left ET CURE also participated in an HHMI fellowship.[17]

Five of the ET CURE students applied for and were awarded NCI Minority Supplemental grants to continue their work in the research lab.

Inverness Research Comment RE: NCI Assessment Outcomes

We pause at this point in the report to call attention to evidence provided in the above portrayal of the project model, including instantiations of the program mechanisms/activities that characterize each phase of the model, and the two assessment outcomes described by NCI for ET CURE that frame our assessment of program effectiveness:

- **Final assessment report that includes a description of the activities and outcomes and an assessment of the success obtained.**

- **Mechanisms to enable student trainee's ability to successfully complete ET CURE research training opportunity and to identify the next research training opportunity to ensure retention in the ET CURE pipeline and future success.**

As described, even briefly, the core program Phases' activities/strategies and reported in tandem participant outcomes (experiences and impacts) associated with those activities and strategies, our assessment is that the project achieved success in accomplishing the purposes and goals associated with each phase of the ET CURE experience.

Many more instantiations and quotes could be inserted to portray these three programmatic phases. And more detailed information could be offered to describe each of these and even other mechanisms and activities.

As Student Outcomes and Mentor Perspectives are presented in the next two results sections, it is relatively easy to match the experiences cited with the program model phases, and to attribute results to meeting the assessment outcomes.

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[17] Though we are not completely sure why this student left, we know the experience of being sent away was difficult for him and for the student who remained in the program.

RESULTS PART B: Student Outcomes, Trajectories and two Student/Mentor Profiles

Structured student interviews were done in the summer and fall of 2011 with all nine of the ET CURE students in touch with ET CURE at that time. Five interviews were done in person at UC Davis, and four were phone interviews. The student interview protocol (Appendix A) was developed in collaboration with project leadership[18] and was aimed at gathering students' experiences and perspectives about the program, their sense of the personal impacts the program had on them, as well as their current educational status, and visions for their future education and career trajectories. Additionally, students were asked to rate particular aspects of the program, though this turned out to be difficult for some of the students.

1) Student Outcomes: Aggregate Interview Data

Here we present a compilation of this interview data summarizing what these students have accomplished (program outcomes) and some information about their backgrounds and trajectories. Information gathered was member-checked with the Coordinator of the project.

Student Demographics: We interviewed four females and five males; five were Hispanic and four were African American. Three interviewees were immigrants. Two females were also raising their own families.

Degrees Earned: All students interviewed are pursuing degrees in STEM fields. Seven of the nine students interviewed have earned bachelors degrees in the sciences, and all of these students intend to apply for graduate level education. Four of the seven graduated from UC Davis, two from CSU Sacramento and one from UC Berkeley. At the time of the interviews two remaining students are in their 5th years, with anticipated graduation dates in 2012 in the sciences from UC Davis (these two are also both in their third years in the ET CURE labs working from an NIH Diversity Supplement).

Fellowships and Grants awarded: Two students applied for and were awarded NIH Post-bac fellowships and spent (or are spending) at least a year in Bethesda, MD as a research fellow. Additionally, eight students wrote NIH diversity supplements and were awarded grants to support their continued work in the ET CURE laboratories. One student indicated he was included in a research grant application his lab was submitting.

Presentations, Publications and Awards: In the two years of participation of these nine students, all made at least one formal presentation at a professional conference, two made at least four presentations, and three won prizes for their posters and/or

[18] A previous ET CURE interview protocol and student transcripts from previous interviews helped inform the nature and scope of the questions.

presentations. Three students were authors in five papers published in tier one, peer-reviewed journals. It is also worthy noting that one student produced "libraries" and "protocols" for her lab that are regularly used by other researchers in the lab.

Applying to Medical and/or Graduate schools: All students interviewed indicated they were in the process or intended to apply to attend postgraduate education. Five of the students indicated dedication to applying to medical school and six indicated an interest in applying for graduate programs toward a PhD or an MD/PhD (two indicated an interest in both medical and graduate schools). One student is applying to pharmacology school.

Pursuing Cancer Studies: At least half of the students interviewed intend to remain in the area of cancer research. Two others indicated they are dedicated to continuing to work in the area of public health with a focus on health disparities of underprivileged populations.

Current and future employment and endeavors: Four of the nine students interviewed who are graduated are currently employed. One in biomedical industry, two in the Health Care field/industry, and one as a Specialist in a lab run by one of the CBST Internship mentors. All four currently employed intend to apply to graduate school this year. One of these graduates also intends to enter the Peace Corp before applying to medical school.

2) Student Outcomes: Two Student Profiles

The impact of the ET CURE program on students held some strong commonalties and also some very unique attributes. To portray our take on the opposite ends of the spectrum in terms of students' experiences, the kinds of impacts the project had, and their trajectories, we generated two profiles.[19] The framework we used to write these profiles emerged very naturally and coincides for the most part with the three phases of the program – namely into, through and beyond the ET CURE program.

Though we present these profiles in the Student Outcomes results section, they also carry messages and insights into the powerful roles of the ET CURE mentors and the laboratory experience. They also both are examples of the transformative nature of the ET CURE experience.

Profile titles:

Student A –*Turning on the Cancer Research Gene* (Appendix B)
Student B –*Profound Life Lessons* (Appendix C)

[19] Our intention was to include one or two more profiles, which may be part of the writing process needed for publication. Two additional profiles are drafted, but are not yet completed.

RESULTS Part C: Mentor Experiences and Perspectives

To learn about the ET CURE mentors' experiences and perspectives we held structured phone interviews. Five of the six mentors we invited participated in the interviews. (In respect of the mentors' time, these interviews were significantly shorter than the student interviews.) Following are recurring themes and some unique perspectives that emerged from the analysis of the mentor interviews, along with some representative, and unique, quotes. We present them as a set of bullet points.

• Mentors like that program addresses needs of under-represented students; at least one mentor would like to grow the program.

> *I really think this should be broadened. This thing should be available to everyone. The research enterprise is sadly lacking in native scientists. Most of my lab, most of my colleagues' labs are people who don't come from the United States and if we are serious about wanting some homegrown talent at some point, we need to make these opportunities available not just to the few.*

• Mentors, for the most part, spoke very highly of the ET-CURE students and were proud of their accomplishments.

> *I have found in life that surrounding yourself with talented people is a great way to get ahead. So it is a win-win situation, you get these kids in and they get an experience and have situations, but if you got talented people, they do good stuff. Which is a win-win for everybody's benefit.*
>
> *I think if Marco hadn't selected the students so well, I doubt very much that we would have had such a good outcome. This business about getting the outreach at the high school level, and grooming these students ahead of time is very, very important, I think.*

• More mentors felt the students were an asset in the lab more than a hindrance. When asked about the costs to his lab of having an undergraduate student to mentor, one mentor indicated,

> *Well, to be honest, because he is so high caliber, not any (cost) greater than I would expect from any student… He has got an abstract and he is going to get a paper and that is what we are here for. And he is a nice guy and that always helps!*
>
> *…He (the student) did contribute and he worked very well with my students and post-doc and I can tell you, my colleagues did not complain, it was a great thing. They actually were happy and they hate to see him leave, he is about to leave in a month or so. All of the signs show that he worked extremely well and is a major contributor. So, in this case, I can't say enough about how well this process has been, but it may not always be the case…*

• Most mentors were inclined to participate in future similar opportunities.

> *I don't know that I would be doing it again, because I absolutely get no benefit at all from the university in terms of teaching and so essentially, I am not paid for teaching, and so I have to support myself entirely, salary wise and so having students is kind of more of a distraction than a help. This being said, I enjoyed doing this immensely, but if I were to do it again, I don't know that I would, but that is just me because of my specific university arrangement, because it is definitely time-consuming.*

• One mentor felt that the time required for the student to be in the lab was at odds with what the student could realistically accomplish. In this case, the student also expressed frustration and a deep sense of guilt. The time conflict arose during his second year in the program and because of the time-intensive process of preparing for the MCATS and preparing his med/grad school applications. The student had this to say about the situation.

> *I was really starting not to have a good experience in my lab (during the second year) when I had to apply. I felt that they (the lab) had such high expectations. We were still supposed to keep our lab commitment while preparing for the application and preparing for admissions tests. I felt that really was slammed on me since most all of my summers were taken for research experience as well as during the year. I felt there wasn't really enough time for me to prepare and then I felt guilty neglecting lab hours to study. The lab didn't seem very understanding about it.*

This particular student took the admissions test three times and is still aiming for oncology as a career[20]. He added,

> *Right now I am still looking at oncology, at the cancer field, and it is definitely that ET CURE influenced me. I had been thinking neuroscience the whole way, so this is definitely something that ET CURE influenced me to do… for me it is just whether or not I can handle the philosophical aspect of the field… whether or not I can take the drama I guess. Other than that I am still eyeing research in the cancer field.*

• Some scientists are more naturally inclined to be true mentors and they have put thought into how best to work with the students. One mentor notes,

> *It is the students who benefit either way but I think the challenge for the mentor is to define something that is small enough, but still very significant and I think in the case of (student), we did that and I would say that is one challenge. The second challenge is the motivation and that is always a balance of wanting to show them too much, or wanting to have them challenged and for*

[20] Since the interview this student was accepted to several graduate schools.

example, reading papers, or you don't want to overwhelm them, again there is a balance and you want to make sure they read papers.

• They also see dedication to mentoring as a part of the vision they have or their lab and for their own work.

I believe mentoring the next generation of cancer researcher is very important, not just for the cancer center but also as a faculty at UC Davis. My laboratory has always been involved in mentoring undergraduate students. From time to time we open up our laboratory staff for talented undergraduates to have hands-on experience with usually prepares them either for more advanced studies in medical schools or graduate schools. Somehow, sometimes just their initial exposure to research, allows them to tell whether they want to be involved in such endeavor as a career goal.

Another mentor noted,

The reason one stays in academics or at least the reason I stay in academics, is because of the mentoring, because you have an opportunity to provide students with challenges and tasks and goals and that is going to help them get to where they need to go… even though I was opposite of most ET CURE students … I had every advantage in my life growing up…and all those opportunities, but there were still opportunities that were given to me by somebody. Si I definitely see that my role, one of my jobs, one of my goals, and what I owe is the ability to provide those opportunities to somebody else.

• The matching process worked well for most mentors, and most were pleased with the work and dedication of the ET CURE students. One raved about the exceptional characteristics of the ET CURE student, who is in his third year now working in the lab.

He is exceptional, truly exceptional -- so much better than other undergraduates that didn't go through the matching process, the non-minority students – majority students. He already has a paper with us, a co-author paper with us in the first year with a prestigious journal. He was co-author of that paper and that shows how much we appreciate his work.

• At least half of the mentors interviewed did note there was not much support or training from the program to be mentors. This could be an area to invest more time and thought in the future, especially for those mentors with less experience and history of mentoring undergraduates. Part of this preparation could involve providing more frequent feedback opportunities to mentors about student progress. At least a couple of the scientists interviewed have significant experience and wisdom to bring to bear on the process. We wonder how the project might draw on or from that knowledge to support the other less inclined or experienced mentors. For example one mentor delineated the process pretty clearly…

Once it started it's basically just routine laboratory apprenticeship if you will. The students in my lab are supervised by experienced post-docs. The graduate students are basically who they work with. I actually call them resource person rather than supervisor in that we let the students have a certain degree of freedom – they have their own project. We let them make their own mistakes and learn from that, but when they need help they would ask the graduate students or post-docs. In the initial phase the students and post-doc have to spend a great deal of time showing them how to do the routine things. Then they all have their own projects. In terms of time, we usually do not measure how much you work, but usually by the products. So the time can also be flexible which helps them. Usually I meet with the post-doc students, the graduate students every day, and if not every day every week; interns maybe every two weeks or every month, but the interns and the graduate students work close together, the graduate students sometimes also inform me about their progress.

• We note here that during the matching process the post docs and graduate students are not directly involved, yet play a significant role in the mentoring. We wonder if in the future having them involved in some way might also boost the success and opportunities for training that the mentors experience. One mentor noted,

It probably would have been better to have a real outcomes measure and real feedback on a more regular basis, just from the standpoint, you got a better idea of what is working and what is not because clearly this is not cookie cutter, this is developing and the personalities of every investigator need to be taken into consideration, but that is who you have to work with.

• Mentors saw growth in students' abilities

His presentation skills are better. He is still learning how to critically analyze his own data, but he is a lot better at that than he was. That is even tricky for the PhD students, and some for them don't even get that until year 2 or 3. Seeing improvement there is very good. And I feel that he is very heavily invested in what he is doing here… it's great to see him working hard…. I wasn't expecting this level of competence. I really wasn't, to be honest.

• From the perspective of a couple mentors there seems to be an issue with students sometimes going in the direction of pre-med (not research) and using this program as "resume building". Not all mentors felt this way.

In the words of one mentor… *I thought the students were good. I think the biggest problem I had was really the commitment to research and a realistic expectation of what to expect from research.*

• A couple of mentors indicated there is a need to recognize cost to labs.

I pay for the materials of the experiment and everything else, out of my grant and NIH doesn't really care that I am being a good citizen as far as teaching. They want to know what our productivity is and so that is what I think needs to be taken into consideration as well.

• One mentor suggested perhaps providing a transitional research lab experience for the students before going directly to the big time.

I think if they really want to learn research, being in a cutting edge research lab may or may not be the best idea to start out with. Maybe to have more of a transitory program where there is more development of basic techniques, expectations, skills … otherwise it really falls on the mentor to do it all.

Inverness Research Comments on student research lab experiences and mentor perspectives

As a result of studying the student outcomes together with the mentor perspectives, we offer some summary comments the evaluation team generated about research lab assignments and mentor recruitment and supports. They are intended to inform thinking about future program design activities and strategies.

• **Recruitment of mentors is as important as recruitment of students**. Strategic and intentional recruitment of mentors is worth the care and time invested. Making sure the environment fits and suits all partners (mentors and mentees) in the program is important.

• **Depending on desired outcomes for students, establishing clear criterion and expectations for mentors involvement as "partners" in the project** is important. ET CURE needs mentors with a passion for growing new scientists, patience, and presence. Also mentors with status and positions that allow them to do this work without negative consequences for the time it takes to work with the students.

• **Consideration of different levels of mentors' positions is important in selecting labs for placements.** Not just the head of the lab (though that person needs to oversee the relationships and work), but the other scientists who will be interfacing and working with students is important (post docs, grad students, researchers).

• **The laboratory experience was by far the most important experience for the students, so identifying strong mentors and insuring a good match is critical.** Rather than keep a student in a lab that is not a good fit, we suggest having a period of time when the match is tried out and an alternative is prepared if it isn't a good fit. Per participants' suggestions, more systematic communication around progress and the project as a whole is needed.

• **Not all students who participate will follow the narrowest of desirable paths (become cancer researchers). That being said, all students were impressively and significantly influenced by the immersive lab experience**… it proved to be transformative in one way or another for all students. In all cases, the ET CURE experience helped them realize more about what their choices and paths can be.

V. DISCUSSION AND CONCLUSIONS:

A. The ET CURE Program and Characteristics of Proven Interventions

When we hold up the ET CURE program - its purpose, design, implementation and outcomes, against the five attributes of proven interventions as described by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine in *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads,* we find strong congruence in most of the areas. Based on this summative evaluation, we provide our qualitative comparative assessment of the ET CURE program to the proven interventions.

Proven Intervention	ET CURE
Summer Programs: Summer programs that include or target minority middle and high school and undergraduate students provide experiences that stimulate interest in these fields through study, hands-on research, and the development of a cadre of students who support each other in their interests.	**Summer Programs** target minority undergraduate students, provide experiences that stimulate interest in the Cancer Center and Emergent Technologies fields through authentic and immersive research laboratory experiences and an intensive professional development institute. Students from ET CURE and similar programs come together in social and academic settings in support of growing a community of learners and budding scientists.
Research Experiences: At the undergraduate and graduate level, engagement in rich research experiences allows for further development of interest and competence in and identification with STEM and enhances academic competitiveness.	**Research Experiences** at the undergraduate level engage student in rich, authentic, immersive and purposeful experiences that, with the support of the program, may extend far beyond and deeper than the immediate financial supports of the program, offering them an academic advantage. The research experience is paramount and transformative in terms of the students' acculturation into research science and the cancer science field, and in terms of illuminating for them unknown STEM pathways and opportunities.
Professional Development Activities: Opportunities for undergraduate and graduate students to engage in networking, participation in conferences, and presentation of research which provide opportunities to develop and socialize students within a discipline and profession.	**Professional Development Activities** are integrated throughout the summer and academic year, are diverse, and provide inputs and training for the world of scientific research as well as opportunities to explore and engage with networks of scientific communities (Cancer Center, CBST, SACNAS, NIH, HHMI, etc.). Students are expected to present their research in their research labs and at professional conferences, write

	grants, and contribute to publications, which provides authentic and substantive experiences within the scientific discipline and with the enterprise of science.
Academic Support and Social Integration: Success may also hinge on the extent to which undergraduate and graduate students participate in activities – such as peer-to-peer support, study groups, social activities, tutoring and social integration.	**Academic Support and Social Integration**: Undergraduate students meet as a cohort on occasion for social activities, attend monthly cohort meetings that provide a forum for sharing success and challenges (peer-to-peer support), and may participate in a Friday Journal Club and Thursday seminars at the Cancer Center. Social networking provides additional peer-to-peer supports. Tutoring may occur within the students' laboratory settings; supports for preparing for entrance exams (GREs and MCATS) were missed by students and are needed.
Mentoring: Engaging mentors can provide undergraduate and graduate student with information, advice and guidance and support generally at critical decision points	**Mentoring:** A strength of the program, undergraduates acquire a palate of mentors through the ET CURE staff and their research labs. Mentors include PIs, graduate and postdoc students, and ET CURE program coordinators. Mentors provide academic, career and personal guidance and supports that are hallmarks of the ET CURE project. In a significant minority of cases the match between lab mentors and students was not ideal, but even in those cases students learned life and career-choice lessons. All students gained significant knowledge and skills from the program mentors, and gathered entre points into a broad span of networks and opportunities through these relationships.

Figure 3. Qualitative comparison of "Program Characteristics of Proven Interventions" with the ET CURE Program

Of these five program characteristics, we gauge the research experience, mentoring, and professional development activities (which in the case of ET CURE also include the summer programs), of the ET CURE program to be the most impactful on students.

We suggest an additional program characteristic, not identified in the "proven characteristics", that we think is a strength of the ET CURE project. The sixth characteristic is strategic and opportunistic integration of the program and program participants with other local programs dedicated to similar goals. In terms of leveraging resources and expertise, adding value to students' experiences, and

broadening the community, contacts and networks students accumulate through the experience; we think this attribute of the ET CURE program was exceptional.

B. Summary Statements about ET CURE

When asked what the student and mentor participants thought the program was trying to accomplish, responses were very consistent: supporting underrepresented students with significant potential to experience and actually produce cancer science research. Another prominent theme was the effort to tackle the disparities that exist in cancer research communities and in populations and healthcare at large.

Nearly all of the participants in our studies left us with some compelling and thoughtful statements about what they think this project is about, and what it meant for them. Here, we present just a three student quotes.

> *When you have a good experience with people and stuff you like – I like biology and I like things on a small level and seeing what people are really doing in the lab, applying things you have learned in textbooks… I can't even put into words how gratifying that is and how much that sticks with you. Even now, and I know I am more experienced now than I was back then, I don't belittle those experiences, I feel like they definitely put me where I am right now.*
>
> *What shaped my choices for a career in education like academics was mainly my time in the lab with my mentors, but everybody who mentored me had a say in it….I don't want to leave oncology and I know that because of the experience in that type of research.*
>
> *The promise of the research and the mentors that are helping you - that is the meat of it.*

C. Inverness Research Comment: The Return on the Investment

In our work evaluation large and small-scale educational improvement efforts, we often take a "return on investment" perspective when evaluating federally funded projects. We study whether there exists documentable and measurable return on the investment of time and resources that are devoted a particular project. Though that is not the perspective we set out to take for evaluating this project, given the results to date of the project around student outcomes, and the documented alignment of the program design features with characteristics of proven interventions for underrepresented minorities in STEM, we think it is worth our while to think about the project in this way.

We know that nine of the ten ET CURE students are actively pursuing cancer, medical, and STEM-related careers; most are dedicated to continuing their education into graduate school and at least seven of them have strong interests in continuing to pursue scientific research through a PhD. We also know that all but one mentor involved in the project rated the program highly, realized real

contributions their students' made to their research and lab communities, and would gladly take another ET-CURE student into their labs.

Though each of the nine students' experiences, dispositions, and goals ended in our study on slightly different notes, without exception we were struck with how profound the students' deep and in many cases transformed dedication to pursuing medical-related and /or STEM research-related careers. Each spoke eloquently and sincerely about their dedicated to improving the future health of individuals and underserved populations. All of the students we interviewed related a deep appreciation for the ET-CURE experience and identified it as a critical experience that helped (and continues to help) them discern their educational and career goals. Though not all of the students are leaving the program intent on pursuing cancer research careers, they are all intent on pursuing STEM or health related careers, and the majority will continue their research journeys.

From narrow and dimly lit ideas about what the possibilities for their futures might be, to broadening illuminated visions about real tangible education and career options, students spoke articulately and enthusiastically about their future plans and the many possibilities and decisions that lie ahead. They have experienced acculturation into the field of science, know how to network with other career scientists, students and professionals, and have gained exposure, experience and perspectives about scientific research in general, and cancer research in particular, that few masters, or second year Ph.D. students have a chance to gain.

Our research team agreed that the ET CURE Program produced a significant return on NCI's investment.

Next Steps

Data for this evaluation was gathered at one of several pivotal points in these students' ET-CURE experiences and in their educational and career trajectories. We strongly suggest the program continue to track the education and career choices of these students. Given the their personal commitments to each other as a cohort and community, and to their mentors from their labs and the program, this should not be a hard task to accomplish. Doing so would be a significant and ongoing test of the transformative nature of this investment for minority students and their contributions as new cancer scientists, STEM researchers, and those who choose health fields devoted to contributing to reducing the disparities between privileged and underprivileged populations, both in our country and abroad.

VI. APPENDICES

Appendix A: ET CURE Student Interview Protocol

Appendix B: Student A Profile: The Gene for Cancer Research is Turned On

Appendix C: Student B Profile: Profound Life Lessons

Appendix A

ET CURE Student Interview Protocol

Introduction and Background – introduction of researcher and what we do at Inverness Research

This Interview: Thank you for taking some time to talk with us today. We have organized our questions in a few chunks that we think will help us understand your experiences and perspectives. We will be talking about your own background and engagement with the project; then we'll ask you to rate and comment on various components of the project. Next we'll want to know how ET CURE may or may not have influenced your thinking about careers, academic directions, or other aspects of your education and working worlds. Finally we'll ask you about your suggestions or recommendations for this and other programs like ET CURE.

We are recording this conversation for our own research purposes. Is that OK with you?

(1) Student Background

a. Tell me a little about yourself. What was/is your major at UCD? What are you doing now?

b. When did you participate in ET CURE? Are you still connected to anyone in the project? If so, whom and why?

c. What are your education/career goals at this time. What can you imagine doing in three years? Five years?

(2) Your engagement with the ET CURE:

a. Tell me how you got involved with this program?

How did you learn about the ET CURE? Who did you contact?

What was your understanding of the program? (purpose, commitment, activities); what were you hoping to get out of the project?

Who did you work with?

Did you complete the program? Why or why not?

b. Briefly, from your point of view, what were the major components of the program? What do you think was their intention or purpose? (We'll ask you to rate particular aspects of the program soon).

c. Talk with me a bit about your research – tell me the story. What interested you? How did you get started? What challenges did you (or are you) facing over time? What successes did you experience?

EXPERIENCE WITH THE PROJECT

a. Now I am going to ask you to **rate various aspects/activities of the project** from a scale of 1-5 with 1 being not useful and didn't learn anything to 5 being highly useful and learned a lot – made a big difference in my thinking. Please comment on your rating.

Activity	Rating	Comments
CBST Summer Intensive Program		
Year-Round activities-- discussions and field trips with leading researchers. At Med Center and other campus facilities - lab group meetings, - Thursday morning science seminars at Cancer Center - CBST Journal Club, - Cohort meetings		
Academic year research		
Community-building activities	Any social activities they did together…	
Work in the laboratory with your mentor and others? PROBE ON THIS ONE A BIT… WANT TO GET AT MENTOR/STUDENT INTERACTIONS AND WORK TOGETHER		
Work with project staff?		
Work with other students?		
Mentoring other HS students or work with CBST teacher program	Ask if they did this and rate if they did	
SACNASs conference attendance and/or other conference presentation (posters, papers)		
Grant writing/papers		
Publications		

b. What did/do you spend most of your time doing in the program?

c. Do you have any other memories about any of these activities that stand out for you in terms of being difficult, fulfilling, enjoyable or frustrating?

(3) INFLUENCES OF THE PROJECT talk with us about its influence on your academic and career choices

a. Was there anything about the experience that you think had the most influence on your thinking about academic and career choices?

b. If you decided to pursue a different area, how did this program influence that decision? Any connections of what you are doing today with emergent technologies or research?

d. other influences, benefits, experiences.

a. What were the central achievements for you? Personally? Academically? Professionally?

b. What, if anything did you take away from the program that has supported your successes today?

c. Anything else?

(4) We will be writing up some portrayals of students who have been effected by this project in different ways. If we have further questions can I follow-up with you?

Appendix B

Student A: *The gene for cancer research is turned on!*

Student A was already on science path - he was always interested in biology. As a community college student he was involved in his campus MESA program where he learned of a winter research internship opportunity offered through CBST, which successfully led him to participating in the ET CURE program. The experience was a turning point for him. He had always thought he would pursue a career in biology but had never considered cancer research.

> *I was introduced to cancer biology from the ET CURE program. I was put in a cancer lab and I started researching it on my own and getting more knowledge about it, and I went from there.*

At the time of his interview Student A\ was a 5th year UC Davis Biochemistry major working in the same lab he was assigned through the ET CURE program, studying Kaposi sarcoma-associated herpesvirus (KSHV) and mRNA. His aims following graduation in the spring include attending graduate school and eventually doing a post-doc working along the same trajectory – namely cancer research.

Upon visiting Student A in his laboratory environment, the excellence of the fit was obvious. His passion for the content and the process, and his quiet independence, intense, systematic and methodical ways of working seemed to be a profile that was matched by the lab's atmosphere and ways of working.

I. INTO THE PROGRAM

While attending community college, Student A's MESA advisor encouraged him to apply for a two-week winter research program for Community College students held at UC Davis and sponsored in part by CBST. He applied, was accepted and describes the process,

> *It is a two-week winter internship for people who have never been in a lab or even seen a lab could go and get some kind of experience. S I went and after that one of the mentors that I had there recommended me to apply for the ET CURE program.*

The ET CURE Program actively recruited students in tandem with other similar undergraduate research experience programs sponsored by CBST, such as this two-week winter internship. Student A's experience in the winter internship and acceptance to ET CURE program marked his first research experience, which for him represented a turning point in his thinking about what was possible for him as he pursued his interests in science.

His participation in the first intensive weeklong summer intensive professional development program and in the summer research internship (40 hours per week) fueled his dedication and interest, and gave him a push. He talks about getting

encouragement to attend his first professional conference (SACNAS) at the end of his first summer with ET CURE.

> *I wouldn't have gone (to SACNAS) if it weren't for ET CURE, because they really push you to do this kind of thing. Your whole summer culminates to this kind of activity, where you go out there and talk with other scientists from around the country and other students like you.*

He reflected on his first taste of real research that first summer,

> *They give you enough time to do a legitimate amount of research, to get a good taste of what is going on in a natural lab… it all helps develop you professionally.*

Student A ended up transferring to UCD all the while continuing to work in the ET CURE research lab he was originally placed in.

II. THROUGH THE PROGRAM

The financial and programmatic supports provide for an opportunity for students to experience an authentic science research experience. When asked what he thinks ET CURE is designed to do, David has this to say:

> "ET-CURE is aimed at helping students get in the lab. I wouldn't have done any of this if I hadn't got in a lab in the first place, and actual cancer lab, and so it helps you do that and gives you the means to do that… they fund you so you don't have to worry about how you are going to live – that is settled."

He talked easily about his experience doing research in the lab, with a 40 hours/week schedule[21] providing a real-life authentic experience. He talked about how the science dictates the schedule.

> "You can actually get a good idea of what it is like, because as a scientist you are not going to be in and out. Another thing I noticed early on was that if I was going to be working in the lab, then it is kind of like the experiment dictates your schedule, so if you have to be there, then you have to be there. Otherwise you have to have somebody else do it for you and then you kind of lose out on seeing the whole picture. Because I was able to be there when I had to be there, I was able to see it from start to finish and not kind of rely on my mentors to fill n the gaps. I like that part a lot."

When asked about what happened that moved him into this research path, Student A's comments reflect much about what he has learned about the nature and enterprise of scientific research.

[21] Student B is working close to full time in the lab with support from his PI and an NCI Minority Supplement grant.

"You are doing something that nobody has done before and you don't know what is going to happen. A lot of times stuff that you don't want to happen happens and other times stuff that you didn't expect to happen happens and it is really interesting. It is nothing that I have ever experienced before. The closest thing that I had to a job before this was yard service and it's nothing like this. It is great… it is hard to explain."

MENTOR A'S MISSION AND LAB

When interviewed, the PI for the lab that Student A works in spoke with experience and dedication about the value if undergraduate internship, for the undergraduate but also for his lab scientists and the field of cancer research.

I believe mentoring the next generation of cancer researchers is very important, not just for the cancer center, but also as a faculty at UC Davis. My laboratory has always been involved in mentoring undergraduate students. … I think the (ET CURE) program is trying to educate and in a sense produce the next generation talents in cancer research by exposing them to cutting edge kinds of science. CBST is really a leader in developing new platform research, and the interaction between CBST and the cancer research lab are probably ideal for some of the channeling of the new applications to cancer research. The students serve as a bridge and so that is why I really welcome the opportunity.

Student A became acculturated into the lab. He talked about the multiple mentors he had a chance to work with over the course of his years in the lab and how they each taught him something different.

I liked it (working with different mentors) because you get to see everybody has a different kind of take on how they do things. .. I had a very different experience with each mentor. The last one was more independent, the middle one was kind of getting an idea of what a real experienced person is like, and the first one is kind of an introduction and was exciting.

He also expressed appreciation for the weekly lab meetings as a window into the bigger picture, and as a way to gain knowledge and information that would assist his own work.

There is a place in your research where you are so concerned with the day-to-day basis of what you are doing that you can get consumed in it. You've got to plan for the next day…Dr. A's lab meetings force you to pull it all together into a cohesive story that is not just each paragraph. I liked that because it gave me (a sense of) where this all connects.

Mentor A's (the lab PI) describes the big picture and purpose for mentoring,

From the mentor, like me, the hierarchy is to not only defined through the working relationship, as some kind of person to person relationship (which is very important), but more importantly it is to define a project that is small enough so

they (the mentee) feel they can accomplish it, and significant enough so that they can contribute. And that's not easy.

During his three years in the lab, Student A has co-presented his work at several professional conferences, and was a co-author on one publication. He applied for and was granted an NCI Minority Supplement grant and is well on his way toward a cancer research career path.

III. BEYOND THE PROGRAM

With supports from his PI and ET CURE, Student A applied for an NIH supplement grant to fund his work in the lab for the year following his graduation. He was awarded a grant, and is now considering where to apply to grad school for a Ph.D.

"I would vision myself hopefully becoming a post-doc and doing full time research where I could… do my own thing, stuff that interests me, which is cancer… but there are so many different directions that you could take. I obviously like working with other people's programs, other people's thoughts, because I need that kind of direction at this point. But I am looking forward to the independence when you get to that level."

And when asked how he would explain to someone without the cancer science background or knowledge, Student A had this to say,

The big idea is that we are trying to see how cancer is regulated on its own, so that we can understand the basics. Then we can hopefully generate therapies that will have the knowledge of the whole system, so we can fight it better. There is still a lot about cancer that we don't know, basically, and we are trying to figure that out.

INVERNESS RESEARCH INTERPRETATION

This portrayal exemplified the strategic and successful recruitment and retention of an ET CURE student through the Community College MESA project, to the CBST winter and summer internship programs and eventually into an ET CURE lab that provided a perfect environment for him to flourish. It exemplified an excellent match-up in terms of the students' disposition and intentions, and the lab's working culture and goals for the mentorship. We consider this a "best fit" scenario.

The portrayal also demonstrates how the NCI funded portion of the experience was broadened and deepened "into" the program (2-week winter internship) and beyond the program (supports for finding additional funding to continue research). We think this is a good example of how a student with a pretty clear but un-developed sense of their interest in a biological career early on in college can be channeled through supports and experiences to pursue a career in cancer research.

Appendix C

Student B Profile: *Profound Life Lessons*

This profile depicts a familiar sequence of events that led a community college student to get involved in ET CURE. Once engaged the key aspect represented in this account of his experience in the lab and his work with his mentors demonstrate that a high quality program can offer surprising benefits that can't always be predicted, and sometime are never really communicated.

In this case, for Student B, the ET CURE immersive research experience shed strong and illuminating light on what research science is and what motivates and drives a scientist, and this was the main lesson learned. His experience was profound and transformative. Mentor B (Dr. B), on the other hand, had a very different take away message from participating in the program.

This profile has a dichotomous tone. Though a disappointment to the mentor because the student decided not to pursue STEM research, we guess the lessons learned for Student B from his work with his mentors will ultimately provide a lifelong lesson that will serve him deeply and well regardless of his career path.

We wonder if and whether the project could have assisted with opening the doors of communication and understanding between these two dedicated participants.

INTO THE PROGRAM

Before attending UC Davis, Student B attended junior college in Sacramento where he was part of the Math, Engineering, Science Achievement Club (MESA[22]). It was there that he met Dr. Ana Corbacho, from the Center for Biophotonics Science and Technology; she came and spoke to the MESA group during Student B's first semester there. He was so impressed with Ana that he decided to participate in a two-week winter CBST internship. He went on to do a the summer internship that year and stayed with the program through the following June.

Student B was interested in participating in ET CURE because he wanted to know,

> *"Is this for me? Do I want to do research? Can I see myself in a lab as a scientist in the future? I definitely wanted to try it out."*

Prior to his work at UC Davis, Dr. B, Student B's mentor, had previously taught at a University where he had created a cancer class for undergraduate and graduate students. Dr. B had also worked at the National Cancer Institute for 12 years where they had a similar program for both high school and undergraduate students. Ralph deVere White, the Director of the UC Davis Cancer Center suggested to Dr. B that he would be a good mentor for the ET-CURE program because of his prior experiences.

[22] For more information about the MESA program, visit http://mesa.ucop.edu/

Dr. B has a clear vision for how to incorporate students into his lab. First, he has the students learn the basic lab techniques and the proper procedures for working with the animals. Then, says Dr B.,

> *"I put them (undergraduate students) with seasoned students and it is the old medical school mantra of 'see one, do one, teach one'. They see the techniques, they observe, they do it side-by-side, and they learn more comfortably to be technically proficient. Then they can start actually doing things on their own and we can start talking about the projects."*

STUDENT B PERSPECTIVE ON WORK WITH HIS MENTORS AND THE YEAR IN THE RESEARCH LAB:

Student B describes the work in Dr B's lab…

> *We were researching the effects of combining a particular antibody with an interleukin to get anti-tumor effects. We worked with mice in the lab. The mice with cancer were treated with the immunotherapy to study its potential to combat cancer. It also had the potential to hurt the host (mice). So the project was trying to find a balance and maximize the anti-cancer effects of the treatment and at the same time trying to minimize the auto-immune effects that we were getting.*

When asked to describe his relationship with his primary mentor, Student B noted,

> *Dr B. placed such an importance and priority on education that he would always make time to meet with the grad students and specifically with myself and the other student in the lab, and he would just talk to us about cancer, about the experiments and about science and what doing the science entails, including trying to get funding and all the different aspects of it. It was a great experience….*
>
> *He really emphasized that in order to do good research you have to know what was done before, what worked, what didn't work, what they did and why they did it, and 'do you have to do it this way? or can you try it a different way?' You have to be a critical reader and sometimes you spend a lot of time just reading papers.*

This was an important perspective into research that Student B. hadn't fully anticipated, and it provided him with an important insight about himself.

Student B also had a secondary mentor that he worked with closely. She was a grad student in the lab and he describes her as awesome.

> *My second mentor, the one I saw the most, my grad student, she was awesome. She was very patient and she taught me a lot of stuff and would come in on weekends, or spend time and do experiments and talk about her kids and it was a really good bonding experience.*

MENTOR B'S PERSPECTIVE ON WORK WITH HIS STUDENTS AND THE YEAR IN THE RESEARCH LAB

Dr. B thought the ET-CURE students in his lab were good, but that they were not going to pursue research as a career and therefore should not have been in the program. He found many aspects of the program frustrating and doesn't think he will participate in the future. In particular he noted several factors that have informed this decision. He finds the student's steep learning curve requires too much time and attention of the PI and other graduate students in the lab; undergraduate students have classes and exams which keep them from working full-time in the lab; the competitive nature of the research business doesn't make taking undergraduate students a viable way to use time and resources; and he is worried that the tasks the students end up doing in the lab are too basic and leave the wrong impression about what research actually is and isn't. One of the most frustrating things for Dr. B was helping his ET-Cure students apply for and get NIH grants, only to have to turn them back when the students decided not to continue with research. He had this to say about the likelihood of his future involvement:

> *I probably won't participate anymore just from the standpoint that it is like jumping into the deep end of the pool. A lot of laboratories, with the current biomedical research funding rates down by 10%, are struggling just to stay alive, so my sense is being able to do teaching is an altruistic endeavor.*

This perspective on the experience was in contrast to what Student B felt he experienced and learned from their interactions.

BIG LESSONS LEARNED IN THE LAB FOR STUDENT B

Student B says he learned about many aspects of the research…

> *keeping a journal (which he learned is a legal document), learning about the grant writing and the policy. What kinds of things get funded…there are projects a PI might be interested in but it won't have a chance of being funded…*

Presenting research at the SACNAS conference was another highlight for Student B. He presented some of the immunotherapy work that he had done with his mentors and he was proud to receive a presentation award.

But by far, the most important aspect of ET-CURE for Student B was working with Dr B and experiencing first-hand his all-consuming love for research. The fact that given the opportunity Dr B would happily spend every waking minute holed up reading research papers was an inspiration to Student B. Seeing Dr B living his dream made Student B realize that he needs to find something that inspires him in the same way.

One day Dr. B shared a story with Student B about wanting to go into law enforcement before eventually finding out that research is his true love and passion. Student A said he knew from that day forward,

I am not going to settle and at the end of the day, nobody is going to live my life. I'm going to try 100 different things and I am going to find the things I love and I am going to chase it because I see Dr B… I am in awe because I want that. I don't know what it is yet, but I want it.

Dr B may be somewhat disappointed that Student B isn't going to continue in research, but his mentoring of Student B has had an enormous impact on the vision he has for his life.

It is like I was able to say, this (research) is not for me, but there is something for me, somewhere, and I want to love it as much as he loves his research, and I want to spend as much time doing it as he does. ET CURE was a great experience for that, small reason, small but big.

ET-CURE gave Student B a chance to see if research was something he wanted to pursue as a career. He eventually came to the realization that research is not a good fit for him, but the program still had a profoundly positive influence on him.

BEYOND THE PROGRAM

Student B studied Nutrition Science and Biochemistry at UC Davis and at the time we spoke he was about to set off to Oaxaca, Mexico for 3 months to complete what would be his last quarter at UC Davis. The Oaxaca program will allow him to receive a minor in Chicano Studies. He was looking forward to working in public health, being in and out of clinics, as well as working on his Spanish.

He sees medicine as being closely tied to science with its scientific research and clinical trials. Being in the ET CURE program,

definitely solidified that I want to be in the realm where I am working with people, like maybe I am not the person who works in the lab abstract, but the person who takes it and applies it.

As a self-described people-person the lab was just too lonely for him.

After Student B returns from Oaxaca he plans to apply to the Peace Corps, and he eventually hopes to go to medical school.

Student B says of Dr B and his internship,

I had a great experience in his lab and I hope that if I ever get in the position like his or somewhere where I have students underneath me, I hope I can relate to them like he did to us.

It was an experience… there is good, there is bad, and there is boring and exciting and it was life. If I could do it again, I would do it again.

BEYOND CURE

Student B's mentor served as a role model for him, not just in terms of teaching about the processes and world of scientific research, not just in terms of helping him carefully discriminate and decide about his path and trajectory, but in terms of his dedication to living a career that you are passionate and dedicated to. In this way Student B indicated in the future he should search for something in life that…

…makes me as happy, excited and rewarded like Dr. B finds doing research.

Student B now plans to go into the Peace Corps and doesn't think he would have ever considered that path without the influence of ET CURE. Prior to the program he toyed with the idea of being an optometrist primarily for career stability, but ET CURE opened his eyes to other possibilities. He discovered that he likes science but working on his own in a lab at all hours of the day and night is too solitary a pursuit for him.

In the end, Dr B showed Student B what it means to really love what you do, and that was the most important thing he said he will take away from the ET-CURE program.

It was a priceless thing!

ET CURE student