

BIO REU Second Year Report

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Executive Summary

This report presents the results of the *Undergraduate Research Student Self Assessment* (URSSA) for Summer 2010 and Summer 2011. Summarized are average scores on survey items, comparisons with matched groups in other programs, comparisons between years for the BIO REU program, and analysis of demographic differences among students and institutional sites taking the survey. The survey asked students to report on the benefits of their undergraduate research experience and rate their satisfaction with different areas of their program. Other questions ask students to report which research activities they participated in, how they learned about the program, and if the program changed future educational or vocational plans.

1.1 About URSSA

The URSSA assessment instrument was developed under NSF grant #CHE-0548488, *Mapping the Extent and Character of the Undergraduate Research Experience at Public Research Universities: An Exploratory Study*, funded by the Divisions of Chemistry and Undergraduate Education, the Biological Sciences Directorate, and the Office of Multidisciplinary Affairs.

The URSSA is a self-report survey instrument intended for use by Undergraduate Research program administrators for program-level evaluation of student outcomes. The assessment is intended for campus organizations like BIO REU with multiple laboratories where undergraduates work in internships or REU settings.

The survey instrument for BIO-REU contained 132 questions, grouped in 17 blocks of conceptually related items. A core group of items ask students to rate how much they have gained in skills and understanding, and in areas such as “*Application of Knowledge to Research Work*” and “*Attitudes and Behaviors as a Researcher.*” In the online survey, the core group of questions is “locked” and cannot be altered by those administering the survey. The remaining items are optional and can be deleted, moved or edited to customize the survey for a given program. These questions relate to students’ satisfaction with the program and its particular components, motivation for joining the program, and demographic information. Salgsite.org, the web platform developed for the SALG classroom instrument, allows for free anonymous online administration of the survey, with users immediately receiving summarized and item-by-item results.

1.2 2010 and 2011 Administrations

Two-hundred and –thirty-two (232) students at 28 sites and 23 institutions took URSSA during Summer 2010, in 2011 this number more than doubled to 538 students at 61 sites and 43 institutions. Of the 61 institutional sites taking URSSA in 2011, 26 sites repeated the administration and 35 were new for 2011.

Students participating in 2010 the BIO-REU program primarily (83%) came from public institutions with 72% from public institutions during 2011. A large majority of students (80%) came from Research One and larger universities.

During 2010, students came primarily from upper classes (64% Junior and Senior), were diverse with 46% White, 20% African American and 17% Hispanic, and majority female (61%). Demographic characteristics of the sample changed little during 2011 with 59% Junior/Senior, 46% White and 62% female.

Thirty-four percent of students during 2010 and 31% of students in 2011 had never participated in the BIO-REU program before, 35%/37% previously participated once and 23% (both years) had participated twice.

Table 1 Institutional characteristics for students.

		Year			
		BIO REU 2010		BIO REU 2011	
		N	%	N	%
Carnegie Code	Institute/private lab	12	5.2%	55	9.5%
	Associates	--	--	3	.5%
	Baccalaureate A & S	---	--	16	2.7%
	Doctoral Granting	29	12.5%	12	2.1%
	Masters (large)	25	10.8%	23	4.0%
	Masters (medium)	--	--	--	--
	Specialized*	15	6.5%	7	1.2%
	Research One	151	65.1%	466	80.1%
Public Private	Public	194	83.6%	420	72.2%
	Private	26	11.2%	107	18.4%
	Independent Laboratory	12	5.2%	55	9.5%

- Includes medical schools.

Table 2 Carnegie code and public/private status by sites.

	N	%
Institute/Private Lab	5	8%
Baccalaureate A & S	2	3%
Associates	1	<1%
Doctoral Granting	4	7%
Masters (large)	4	7%
Research One	42	70%
Specialized	2	<1%
Private	10	16%
Institute/Lab	5	8%
Public	51	84%

Table 3 Demographics for 2010 – 2011.

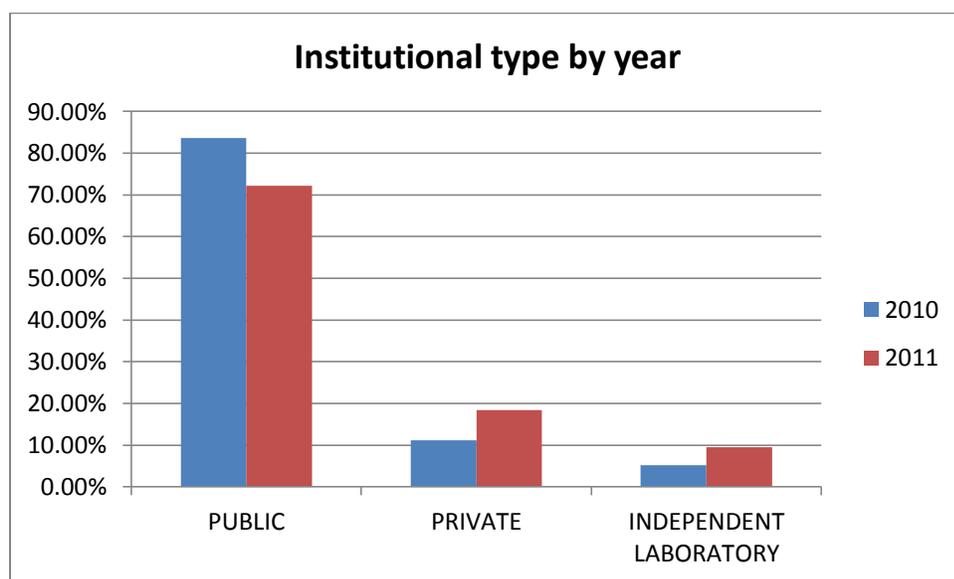
		BIOREUYEAR			
		BIO REU 2010		BIO REU 2011	
		Count	%	Count	%
Class Standing	Freshman/Rising Sophomore	19	8.2%	49	8.6%
	Sophomore/Rising Junior	54	23.3%	168	29.4%
	Junior/Rising Senior	88	37.9%	195	34.2%
	Senior	63	27.2%	143	25.0%
	Other	8	3.4%	16	2.8%
Race/Ethnicity*	Native American	18	7.8%	14	2.6%
	Asian American	12	5.2%	46	8.6%
	African American	44	19.1%	94	17.5%
	Pacific Islander	7	3.0%	9	1.7%
	White	108	47.0%	250	46.6%
	Hispanic	41	17.8%	124	23.1%
Gender	Female	142	61.5%	297	62.1%
	Male	89	38.5%	181	37.9%

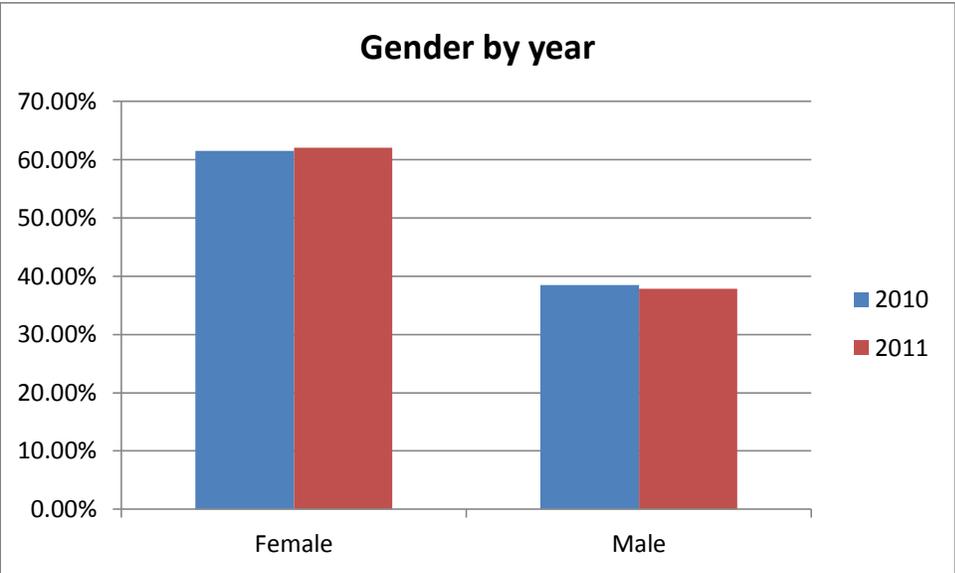
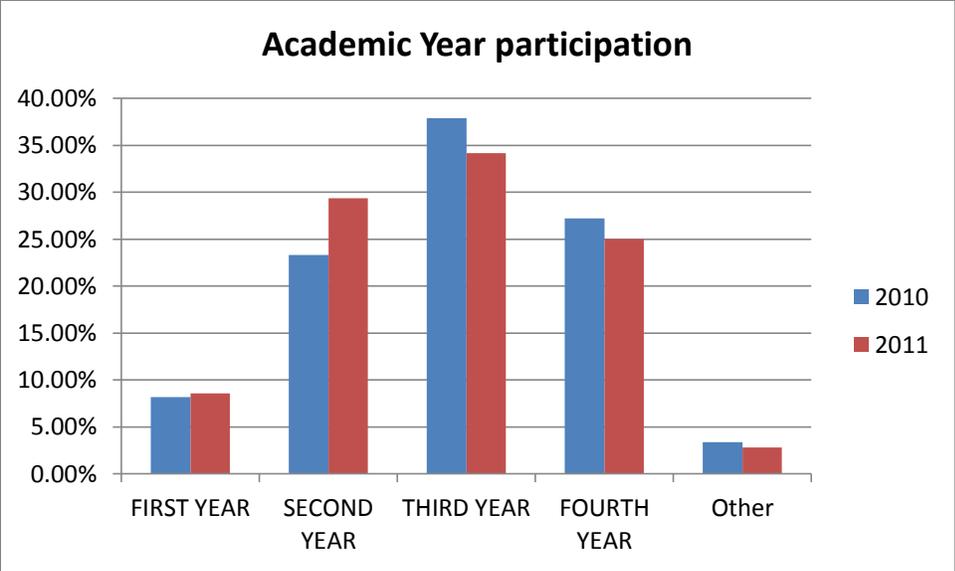
- Students identifying as Hispanic and other race were included in classification as Hispanic

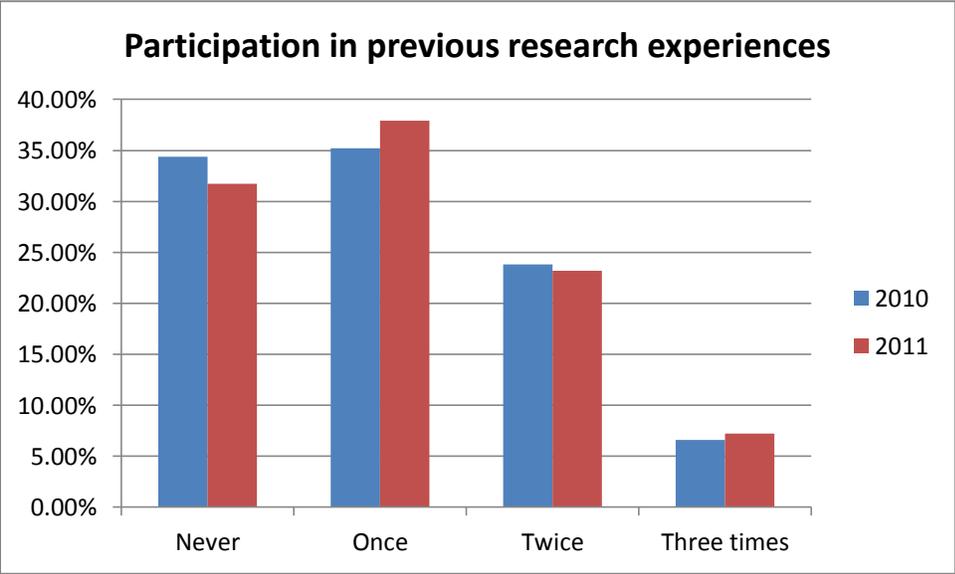
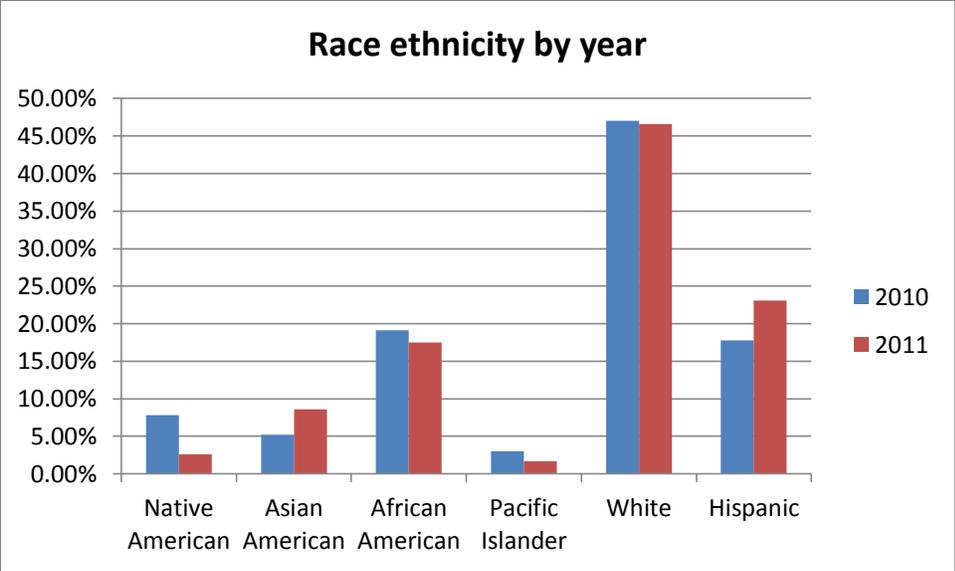
Table 4 Participation in previous research experiences.

		YEAR			
		BIO REU 2010		BIO REU 2011	
		Count	%	Count	%
How many times have you participated in summer research?	Never	78	34.4%	176	31.7%
	Once	80	35.2%	211	37.9%
	Twice	54	23.8%	129	23.2%
	Three times	15	6.6%	40	7.2%

Figure 1 - 5 Institutional and Demographic characteristics of BIO-REU students.







1.3 Core Items: Comparisons with other students and between years.

Four sections of the URSSA are used to measure self-reported gains assessed at the end of students' REU experience. These items were developed from extensive interviews with REU students and assess perceived gains and benefits of participation in the REU. Core areas include *Thinking and Working Like a Scientist, Personal Gains, Skills and Scientific Attitudes and Behaviors*. Specific items and averages for each item are presented in tables 1.1 – 1.4 (see appendix) and show comparisons with the larger group of students taking the survey and between years. Averages computed over all the items in each section (composite variables) were used for statistical comparisons with the larger group, between years and demographic/academic status comparisons.

Differences in demographic and institutional factors between the REU years and other groups were controlled for during the analysis with a propensity analysis. This analysis first used logistic regression to learn which variables predict membership in BIO-REU; the predictive variable then was used as a statistical covariate to test the difference between group means for composite variables. In effect, propensity analysis adjusts for pre-existing differences between groups due to differences in their demographic and institutional characteristics. Appendix 1 presents the logistical regression analysis. Comparison of means between years, and with the other programs then used an Analysis of Variance using the propensity variable as a covariate. ANOVA models are also included in the appendix.

The between year sample was also analyzed using a matched site sample. These were only the sites that administered the URSSA both years.

Tables 5 and 6 show the comparisons between BIO-REU years and students in other programs. Asterisks denote significant differences between BIO-REU years.

Table 6 presents the comparison between years for a matched sample of sites taking the survey both years. Overall, significant differences were evident for the comparison of BIO-REU groups with the larger group on all composite variables, but no significant differences were seen for any of the variables between years for either the wider or matched samples.

Significant Differences Key

*Significant difference between BIO-REU (either year)

^ Significant difference between year for BIO-REU group

Table 5 Comparison of all students and between years, non-matched sample.

		BIO REU 2010	BIO REU 2011	OTHER STUDENTS
THINKING & WORKING LIKE A SCIENTIST	Mean	4.1	4.2*	4.0*
	Standard Deviation	.8	.7	.7
	Valid N	232	580	1119
PERSONAL GAIN	Mean	4.2	4.3*	4.1*
	Standard Deviation	.85	.7	.7
	Valid N	232	581	1115
SKILLS	Mean	3.9*	3.9*	3.7*
	Standard Deviation	.9	.8	.8
	Valid N	232	581	1113
ATTITUDES AND BEHAVIORS	Mean	4.2*	4.2*	3.9*
	Standard Deviation	.7	.7	.8
	Valid N	232	581	1105

*Significantly different at a = .05 level for comparison with other students

^Significantly different at a = .05 for comparison between BIO REU years

Table 6 Comparison of BIO REU years with matched sample.

		BIOREUYEAR	
		BIO REU 2010	BIO REU 2011
THINKING & WORKING LIKE A SCIENTIST	Mean	4.1	4.2
	Standard Deviation	.83	.66
	Valid N	183	272
PERSONAL GAIN	Mean	4.2	4.3
	Standard Deviation	.86	.69
	Valid N	183	272
SKILLS	Mean	3.8	3.8
	Standard Deviation	.89	.79
	Valid N	183	272
ATTITUDES AND BEHAVIORS	Mean	4.2	4.2
	Standard Deviation	.73	.73
	Valid N	183	272

*Significantly different at a = .05 level for comparison with other students

^Significantly different at a = .05 for comparison between BIO REU years

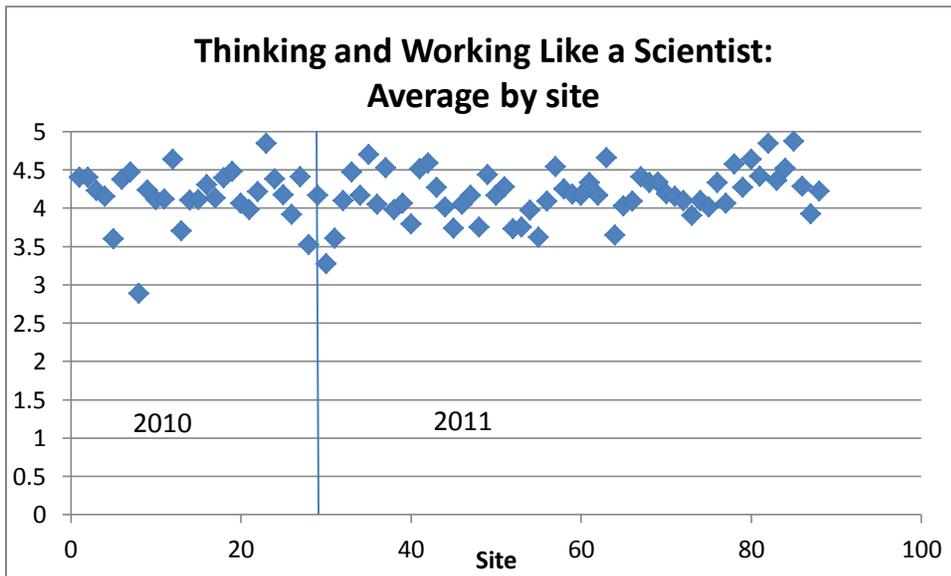
*Matched sample is by site, students are assumed to be independent between years.

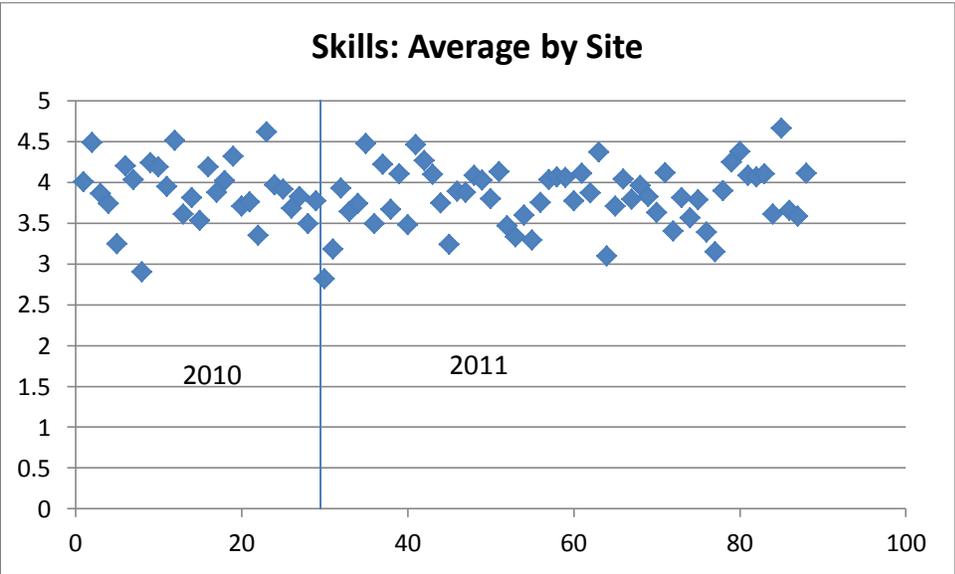
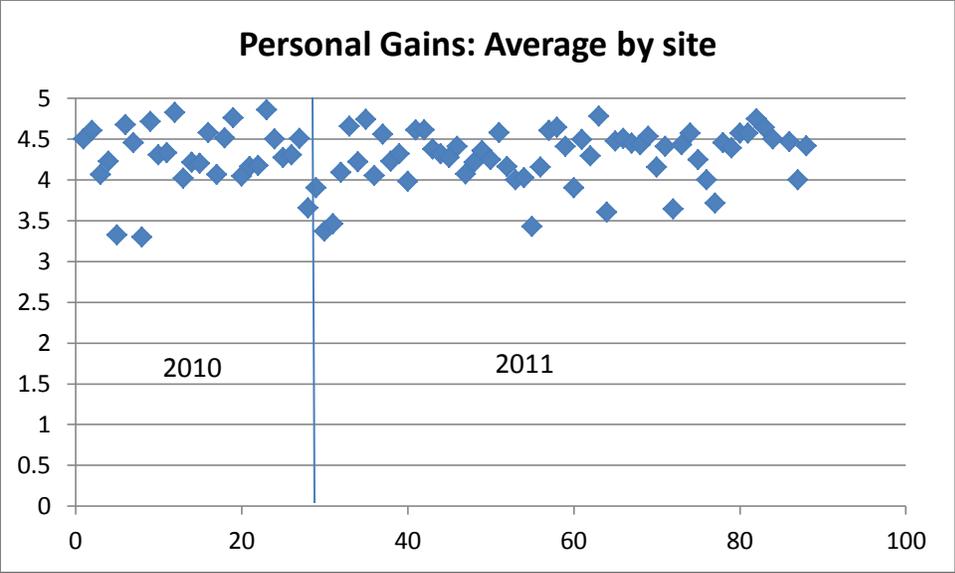
1.4 Core Items: Comparisons across sites

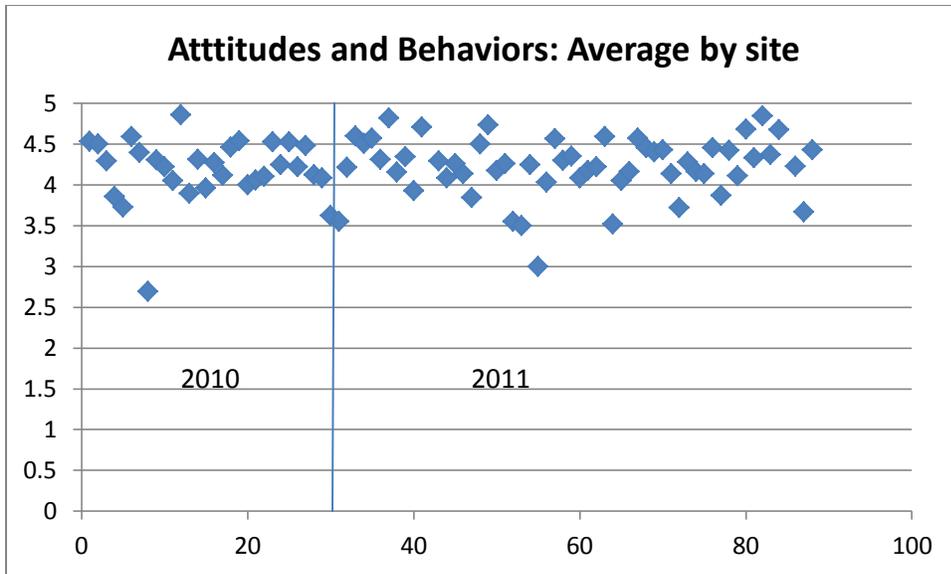
Averages on the core variables were also calculated for each of the 88 sites from 2010 -2011. Figures 6 - 9 shows the dispersion of averages on these variables; specific sites are not identified by name.

Examination of the figures suggests that students at most sites give similar ratings, although at some sites, especially for the *Personal Gains* score, students at several sites collectively gave much lower average ratings. Overall, the site where a student participated in their REU explained 10% of the variability in their ratings.

Figure 6 - 9 Dispersion of ratings for REU sites.







1.5 Core Items: Institutional differences and “norms.”

Information about institutional settings included *Public or Private Status*, *Size of Institution*, and *Carnegie Code Classification*. Other variables such as *Percentage of Minority Students*, *Percentage Gender*, *Percentage Academic Year*, and *Percentage of Students with Previous UR Experience* were also examined for the larger URSSA data set. All institutional variables were entered into linear regression and generalized linear models to determine if they predicted differences in the core outcome measures. Normative charts were then made that show the expected average values for all levels for these variables. These normative charts and comparisons are included in the appendix (charts x-x) and will be placed online with a calculator that allows instructors to find expected values for their group of students based on the demographic makeup of their lab.

Significant predictors of core measures included *Carnegie Code Classification*, *Percentage of Minority Students*, *Public-Private Status*, *Institutional Size* and *Percentage Gender*, although not every predictor was significant with every core measure.

1.6 Core Items: Demographic and institutional differences

Information about students including *Gender*, *Class Standing*, *Race/Ethnicity*, and *Previous Experience with REU’s* were compared for students in the BIO REU program. The tables summarize demographic differences for the core items found to be statistically significant.

Table 7 Significant demographic differences.

	Gender	Race/Ethnicity	Academic Year	Previous experience
<i>Thinking and Working Like a Scientist</i>	--	^ .3 Hispanic minus White		
<i>Personal Gains</i>	--	^ .3 Hispanic minus White	^ .3 Senior minus Freshman	
<i>Skills</i>	--	.4 Hispanic minus White		.3 Never minus more than 3 times
<i>Attitudes and Behaviors</i>	--	.2 Hispanic minus White		

Some of the differences may seem surprising, these included 1) First year students reported gaining more in skills than Seniors, 2) Minority students (especially Hispanic students) reported gaining more than Whites on all composite variables, and students who had never participated in REU's said they gained more from the experience than students who had attended three or more times.

2.0 Optional Sections for URSSA

2.1 Research Experiences

The first optional block of questions examined common research experiences for undergraduate students in REU's. These included more frequently reported activities such as presenting talks or posters to other students, and less common activities such as attending conferences and writing journal articles. BIO-REU students reported attending conferences more often than students in other programs, and planned to present and attend conferences at greater rates than students in other programs. Other differences were found for activities such as planning to present at conferences or talks. The between-year comparisons (both matched and unmatched) showed differences between years only for presenting at conferences, with participation lower for 2011 than 2010.

Table 8 Research experience for all students taking URSSA.

	Program		
	BIO REU 2010	BIO REU 2011	OTHER STUDENTS
	Mean	Mean	Mean
I presented a talk or poster to other students or faculty	.94*	.92*	.84*
I presented a talk or poster at a professional conference	.34^*	.24^*	.17*
I attended a conference	.31*	.35*	.22*
I wrote or co-wrote a paper that was published in an academic journal	.04	.03	.05
I wrote or co-wrote a paper that was published in an undergraduate research journal	.08*	.07*	.13*
I won an award or scholarship based on my research	.05*	.03*	.11*
I will write or cowrite a paper to be published in an undergraduate research journal	.	.22*	.38*
I will present a talk or poster at a professional conference	.	.85*	.55*
I will present a talk or poster to other students and faculty	.	.41*	.57*
I will apply for an award or scholarship based on my research	.	.53*	.32*

Table 9 Research experiences for matched sample of BIO-REU students.

	BIO REU 2010	BIO REU 2011
	Mean	Mean
I presented a talk or poster to other students or faculty	.95	.95
I presented a talk or poster at a professional conference	.34 [^]	.26 [^]
I attended a conference	.30	.36 [^]
I wrote or co-wrote a paper that was published in an academic journal	.05	.04
I wrote or co-wrote a paper that was published in an undergraduate research journal	.09	.13
I won an award or scholarship based on my research	.05	.02

2.2 Ratings of Satisfaction with the program.

Students rated their satisfaction with a range of program activities, support received from the program, and preparation for future education and work. Ratings of most activities were very high, with averages between 4 and 5. Lower ratings were seen for some activities such as safety training, and for training for human subjects research (some of these activities were only carried out at a small number of sites).

Comparisons with other programs found that students in the BIO-REU program rated their mentors and activities with roughly the same satisfaction as did other students. For the general satisfaction item *rate your research experience overall* most sites averaged between ratings of 4 and 5, although some sites had much lower average ratings.

Table 10 Other Satisfaction Ratings.

	BIOREUYEAROTHER		
	BIO REU 2010	BIO REU 2011	OTHER STUDENTS
	Mean	Mean	Mean
My working relationship with my research mentor	4.4	4.2*	4.5*
My working relationship with research group members.	4.4	4.4	4.5
The amount of time I spent doing meaningful research.	4.3	4.3	4.3
The amount of time I spent with my research mentor.	4.0	4.0	4.1
The research experience overall.	4.5	4.5	4.6

Table 11 Satisfaction ratings matched sample 2010- 2011

	BIOREUYEAROTHER	
	BIO REU 2010	BIO REU 2011
	Mean	Mean
My working relationship with my research mentor	4.5	4.3
My working relationship with research group members.	4.4	4.4
The amount of time I spent doing meaningful research.	4.3	4.3
The amount of time I spent with my research mentor.	4.0	4.0
The research experience overall.	4.6	4.5

Figure 10 Overall satisfaction by site

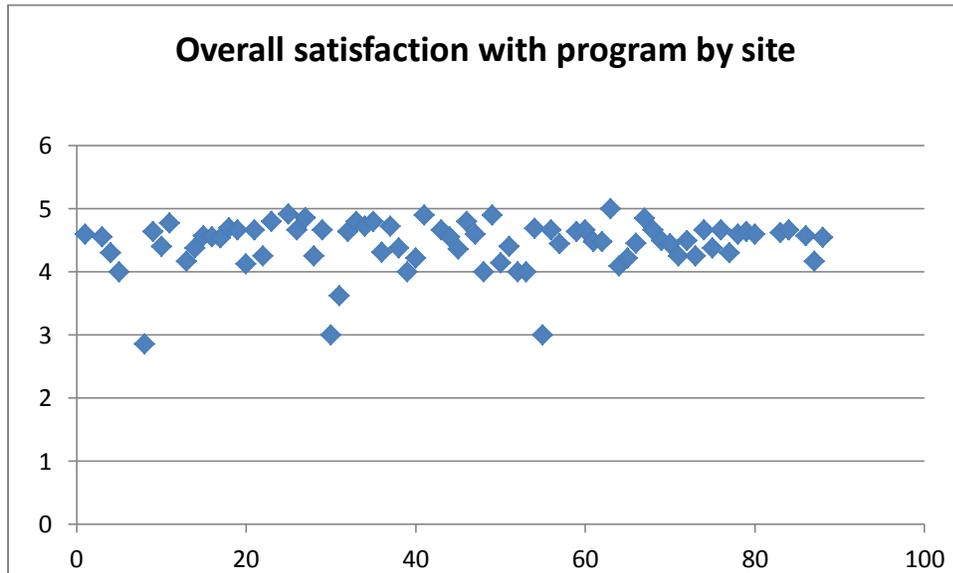


Table 12 Satisfaction with program

How satisfied were you with: (2 - 5, Very dissatisfied – Very satisfied)	PROGRAM		
	BIO REU 2010	BIO REU 2011	Other Programs
Information available to help me choose a research project.	4.1*	4.1*	3.6*
Support and guidance from program staff.	4.7*^	4.5*^	4.5*
Support and guidance from my research mentor.	4.7	4.5	4.6
Support and guidance from other research group members.	4.5	4.6	4.6
Financial support.	4.7*	4.6*	4.4
Group social activities.	4.2	4.2	4.2
The application process.	4.4	4.5	
Lab or field equipment.	4.5	.4.5	
Research group meetings.	4.1	4.1	
Field trips.	3.8^	4.1^	
Safety training	3.6	3.3	
Ethics seminar(s)	4.0	3.5	
Information provided by my research mentor.	3.8	3.8	
Information from other research group members.	3.9	3.9	

- Matched sample analysis not possible due to low numbers in some optional items.

Table 13 Preparation for education and other future endeavors

Agree/Disagree (2 – 5, Strongly Disagree – Strongly Agree)	BIO REU 2010 (n = 232)	BIO REU 2011 (n = 582)	OTHER STUDENTS (n = 1089)
	Mean	Mean	Mean
Doing research confirmed my interest in my field of study.	4.2	4.2	4.2
My research experience has prepared me for graduate school.	4.3	4.4	4.3
My research experience has prepared me for a job.	4.1	4.2	4.1
Doing research clarified for me which field of study I want to pursue.	4.1	4.1	4.2
My research experience has prepared me for advanced coursework or thesis work	4.2.	4.2	4.3

2.3 Source of information about the program and reasons for attending

Students were asked where they learned about their REU. The most common places were from announcements (63% - 67%), the NSF website (60% - 54%) and academic advisors (60% - 73%). Less common sources were web searches (25% -28%).

A large majority of students chose multiple options for reasons for attending the program, these included exploring their interest in science (96%-98%), having a good intellectual challenge (93% - 97%). Fewer students were drawn to programs because of specific professors (48% - 47%).

Table 14 Source of information about REU.

I found out about the REU from: (Proportion “Yes”)	BIO REU 2010	BIO REU 2011	Other Programs
From a professor or other students	.50	.51	.47
The NSF web site	.60	.54	.51
An academic advisor	.60	.73	.60
An announcement (flyer, poster, email, website, etc.)	.63	.67	.40
A presentation given by professors or students about their research	.48	.51	.45
Web search	.25	.28	.25

Table 15 Reason for doing research.

I wanted to do research to: (Proportion “Yes)	PROGRAM		
	BIO REU	BIO REU	Other programs
	2010	2011	
...explore my interest in science	96%	98%	85%
...clarify which field I wanted to study	86%	92%	68%
...clarify whether graduate school would be a good choice for me	83%	88%	68%
... clarify whether I wanted to pursue a science research career	84%	94%	66%
... have a good intellectual challenge	96%	97%	76%
....work closely with a particular faculty member	48%	47%	46%
...participate in a program with strong reputation	75%	84%	81%
... get good letters of recommendation	75%	84%	70%
.... enhance my resume	91%	97%	92%

2.4 Likelihood of future endeavors

The URSSA asks students if they were more likely to pursue educational or vocational paths after they completed the REU than before starting. The table compresses the original five response categories into three categories of responses: *Not at all likely*, *Slightly/Somewhat more likely*, and *Much more/Extremely more likely*.¹

Higher percentages are seen for the *much more/extremely more likely* for activities such as working in a science lab (54%-52%), enroll in a Master’s program (41%-42%), and enrolling in a Ph.D. program in science, mathematics and engineering(51%). Lower numbers of students responded that they were more likely to enroll in medical school (20%), or enroll in a program for a different professional degree (16%).

Student in the BIO-REU program were more likely to say they would enroll in a Ph.D program, enroll in a Master’s program and work in a science lab than students in other programs, they also expressed more likelihood of entering medical school than the other students, although this probability went down significantly between years for the BIO-REU students.

¹ This part of the survey needs revision; examination of open-ended responses suggests that many students had already made a decision before starting the REU, and answers reflect plans they had already made beforehand.

Table 16 Likelihood of intentions (% of all students).

Compared to your intentions BEFORE doing research, HOW LIKELY ARE YOU NOW to:				
		BIO- REU 2010	BIO REU 2011	Other Programs
...enroll in a Ph.D. program in science, mathematics or engineering?	Not at all likely	18.3	21.1	21.3
	Slightly/somewhat more likely	31.5	27.6	33.2
	Much more/Extremely more likely	50.2*	51.3*	45.5*
...enroll in a masters program in science, mathematics or engineering?	Not at all likely	33.5	33.8	40.1
	Slightly/somewhat more likely	25.6	23.9	25.9
	Much more/Extremely more likely	40.9*	42.3*	33.9*
... enroll in a combined M.D/Ph.D program?	Not at all likely	46.5	48.3	48.8
	Slightly/somewhat more likely	24.8	23.3	21.9
	Much more/Extremely more likely	28.6	28.5	29.4
... enroll in medical or dental school?	Not at all likely	67.2	63.5	81.5
	Slightly/somewhat more likely	12.5	15.5	10.3
	Much more/Extremely more likely	20.4*	21.0*	8.2*
...enroll in a program to earn a different professional degree (i.e. law, veterinary medicine, etc.)	Not at all likely	68.1	69.6	79.5
	Slightly/somewhat more likely	15.4	15.5	12.6
	Much more/Extremely more likely	16.4*	14.9*	7.9*
...pursue certification as a teacher?	Not at all likely	55.3	61.0	64.4
	Slightly/somewhat more likely	28.1	27.0	25.1
	Much more/Extremely more likely	16.6*^	12.0^	10.4*
...work in a science lab?	Not at all likely	16.3	17.1	20.2
	Slightly/somewhat more likely	29.1	31.0	35.4
	Much more/Extremely more likely	54.6*	51.9*	44.4*
...complete your Bachelors degree in science, mathematics or engineering?	Not at all likely	25	19.0	20.6
	Slightly/somewhat more likely	12.5	6.3	39.2
	Much more/Extremely more likely	62.5*^	74.7*^	40.2*

Table 17 Likelihood of intentions (% of matched sample students).

Compared to your intentions BEFORE doing research, HOW LIKELY ARE YOU NOW to:					
		BIO REU 2010		BIO REU 2011	
...enroll in a Ph.D. program in science, mathematics or engineering?	Not at all likely	34	19.2%	61	22.9%
	Slightly/somewhat more likely	55	31.1%	60	22.6%
	Much more/Extremely more likely	88	49.7%	145	54.5%
...enroll in a combined M.D/Ph.D program	Not at all likely	75	45.5%	127	53.4%
	Slightly/somewhat more likely	38	23.0%	48	20.2%
	Much more/Extremely more likely	52	31.5%	63	26.5%
...enroll in medical or dental school?	Not at all likely	29	18.6%	160	67.8%
	Slightly/somewhat more likely	42	26.9%	32	13.6%
	Much more/Extremely more likely	85	54.5%	44	18.6%
...enroll in a program to earn a different professional degree (i.e. law, veterinary medicine, etc.)	Not at all likely	105	66.5%	167	68.2%
	Slightly/somewhat more likely	25	15.8%	44	18.0%
	Much more/Extremely more likely	28	17.7%	34	13.9%
...enroll in a masters program in science, mathematics or engineering?	Not at all likely	55	34.4%	80	32.4%
	Slightly/somewhat more likely	37	23.1%	56	22.7%
	Much more/Extremely more likely	68	42.5%	111	44.9%
...pursue certification as a teacher?	Not at all likely	94	58.8%	158	62.9%
	Slightly/somewhat more likely	46	28.8%	67	26.7%
	Much more/Extremely more likely	20	12.5%	26	10.4%

2.5 Hours per week engaged in activities

Students were asked to report how many hours they spent talking per week with their research mentor. Forty-five percent reported spending 4 or more hours, 38% reported this amount in 2011. In 2011, 77% reported spending four or more hours per week talking with others in their lab.

Table 18 Frequency of activities

		2010		2011	
On average, how many hours per week did you spend talking with your most recent research mentor?	None	7	4.1%	12	2.9%
	One	32	18.6%	93	22.6%
	Two	38	22.1%	80	19.4%
	Three	17	9.9%	67	16.3%
	Four or more	78	45.3%	160	38.8%
How many hours per week did you work at research-related activities in your most recent research experience?	None			18	4.7%
	One			28	7.4%
	Two			12	3.2%
	Three			28	7.4%
	Four or more			294	77.4%
On average, how many hours per week did you spend talking with someone in the lab about your research project?	None			0	0%
	One			4	6.0%
	Two			13	19.4%
	Three			16	23.9%
	Four or more			34	50.7%

3.1 Student answers to open-ended questions

Students answered open-ended questions about several topics. The survey asked students to 1) describe other gains from the research not included in the ratings questions, 2) how the research influenced their future work and graduate school plans, 3) the strengths of their program, and 4) how the program could be improved. Categories of student responses are found in the tables below (tables).

Three-hundred-sixty seven students responded to the first question: *Did you make other gains from doing research that we didn't mention? If so, please briefly describe these.* Most frequently cited benefits (25%-26%) included networking with peers, mentors and graduate students. Students also reported learning specific skills such as lab techniques, data analysis, computer skills, and personal skills such as time management. Other areas mentioned were increased confidence in students' ability to do science (17% - 14%), familiarization with practical scientific activities (12% - 8%), and clarification of plans for the future (9% - 3%).

Four-hundred-fifty-one students answered the question: *How did your research experience influence your thinking about future career and graduate school plans? Please explain.* Twenty-one percent of students in 2010 and 26% in 2011 said their experience confirmed or strengthened an existing decision to attend graduate school. Twenty percent the first year, and 14% the next year said they changed their mind during the REU and did not want to attend graduate school. Another 20%-26% said that the experience had provided them with important information about graduate school or allowed them to understand more of the reality of conducting scientific research, thus giving them a better basis for making a choice about continuing their education. Ten percent in 2010 and 7% in 2011 said they changed their mind during the REU and wanted a career in science, either as a researcher or technician.

URSSA also asked students how they would improve their REU experience (*What would have made your research experience better?*) Seventeen percent (2010) and 16% (2011) answered they wanted more time with their mentors and their mentors more involved in the students' research. Other concerns included:

- *Scheduling*; (12%-18%) not having enough time during the summer session to complete projects.
- *Logistics*: (6% - 4%) concerns with housing or transportation.
- *Organization*: (11% - 1%) Lack of organization with lab activities, guidance in getting started, "dead time" during the daily schedule.

Table 19: *Did you make other gains from doing research that we didn't mention? If so, please briefly describe these.*

	% 2010	% 2011	Example
Networking, meeting new people	25%	26%	<i>It was really positive to meet so many female professors. It made me feel good about my future in science to see women doing high level work and supporting such an amazing department.</i>
Specific skills	23%	21%	<i>I became much more familiar with lab techniques and actually applying what I learned in class to what I used in the labs.</i>
Increased confidence, other personal skills	17%	14%	<i>I feel a lot more confident in my ability to conduct independent scientific research.</i>
Learned about practical aspects of science	12%	8%	<i>I gained some insight into the daily tasks of a researcher</i>
Clarified Plans for the Future	9%	3%	<i>I realized that if I do choose to pursue a PhD, then I would like to pursue it in the field of cancer biology.</i>
General positive comments	6%	1%	<i>Met wonderful people and became involved in amazing projects I expect to continue doing and collaborating with!</i>
Learned about how science works	3%	8%	<i>I learned that biophysics is very similar to chemistry, and that I like it even more!</i>
General negative comments	3%	1%	<i>No, the research was not intellectually challenging or very engaging. My mentor even said to me that the study was a "no-brainer" during one of our first weeks together. I did not find my research very meaningful and my mentor was unable to convince me that it was meaningful or relevant research.</i>
Learned importance of mentor	1%	2%	<i>I realized how important it is to have a good mentor when going to grad school. Before I thought it was all about the school or the strength of a particular program at a school, but this summer research experience really made me realize the importance of having a good mentor who you get along with.</i>

Table 20: *How did your research experience influence your thinking about future career and graduate school plans? Please explain.*

	% 2010	% 2011	Example
Confirmed existing plans for going to graduate school	21%	26%	<i>It confirmed that I want to continue on to graduate school.</i>
Changed mind and will attend graduate school	20%	14%	<i>My research influenced me to want to pursue a PhD and get a career doing research.</i>
Provided better information about graduate school so can make a more informed decision	20%	26%	<i>It helps me narrow down which path i want to follow. More specifically it helps me narrow which sector of science i'd like to pursue a PhD in.</i>
Changed mind about vocation, will get a job in science	10%	7%	<i>It made me realize that a career in science is definitely what I wish to pursue.</i>
No change in plans	10%	6%	<i>Not much. Plans remain to attend Graduate school.</i>
Changed mind about going to graduate school, will not go	9%	7%	<i>This research has given me direction in the fact that I have realized that I do not want to do research but would be much happier in industry. I plan on obtaining a Professional Sciences Masters degree.</i>
Gave me confidence to know I can go to graduate school	4%	4%	<i>It made me much more excited for the opportunities I have in the future.</i>
Will go to medical school	1%	1%	
Off topic	3.2	--	

Table 21: *What would have made your research experience better?*

Category	% 2010	% 2011	Example
Nothing needed to change, good as it was	30%	30%	
Wanted mentor more involved in work, more accessible, more time with mentor	17%	16%	<i>If my mentor was more enthusiastic and excited about the research I was doing. If she was available to answer my questions</i>
Wanted to do different activities or learn different skills	13%	12%	<i>Maybe more presentations on our research throughout the summer versus only having the big presentation at the end.</i>
Scheduling; not enough time to complete work	12%	18%	<i>Having more time to think and learn. Less rushing for results. We would have gone further if we had not rushed everything.</i>
Lab disorganized, needed activities better organized	11%	1%	<i>Maybe more organization. I was never really sure when I had to be certain places or do certain places with the other REU students.</i>
Logistical problems	6%	4%	<i>Having a car, or some reliable means of transportation.</i>
Relationships with peers	5%	9%	<i>More motivated and excited participants...in some cases.</i>
Needed more information about program	4%	7%	<i>Needed a session on graduate school programs.</i>
Insufficient resources	1%	3%	<i>Having more instruments to work with...like a PCR machine for example.</i>

Appendix: Supplementary Tables

Table 1.1 Thinking and Working Like a Scientist

How much did you GAIN in the following areas as a result of your most recent research experience? (Five point scale: No gains – Great gains)			
	BIO REU		Other Programs
	Mean		Mean
Analyzing data for patterns.	4.00	4.03	3.87
Figuring out the next step in a research project.	4.16	4.21	4.13
Problem-solving in general.	4.19	4.17	4.06
Formulating a research question that could be answered with data.	3.95	4.08	3.82
Identifying limitations of research methods and designs.	4.21	4.26	4.25
Understanding the theory and concepts guiding my research project.	4.43	4.44	4.31
Understanding the connections among scientific disciplines.	4.05	4.12	4.18
Understanding the relevance of research to my coursework.	4.10	4.17	3.91
Understanding the importance of ethics and the responsible conduct of research.	4.18	4.03	.
Understanding how data are collected.	4.31	4.21	.

Table 1.2 Personal Gains

How much did you GAIN in the following areas as a result of your most recent research experience? (Five point scale: No gains – Great gains)	BIO REU	BIO REU	Other Programs
	2010	2011	
	Mean	Mean	Mean
Confidence in my ability to contribute to science.	4.21	4.17	4.03
Comfort in discussing scientific concepts with others.	4.25	4.24	4.06
Comfort in working collaboratively with others.	4.21	4.21	4.11
Confidence in my ability to do well in future science courses.	4.29	4.23	3.96
Ability to work independently.	4.31	4.33	4.20
Developing patience with the slow pace of research.	4.07	4.11	4.05
Understanding what everyday research work is like.	4.48	4.59	4.45
Taking greater care in conducting procedures in the lab or field.	4.30	4.36	4.20

Table 1.3 Skills

How much did you GAIN in the following areas as a result of your most recent research experience? (Five point scale: No gains – Great gains)	BIO REU	BIO REU	Other Programs
	2010	REU 2011	
	Mean	Mean	Mean
Writing scientific reports or papers.	3.78	3.78	3.44
Making oral presentations.	4.10	4.10	4.02
Defending an argument when asked questions.	3.77	3.71	3.62
Explaining my project to people outside my field.	4.24	4.21	4.15
Preparing a scientific poster.	4.11	4.05	3.94
Keeping a detailed lab notebook.	3.96	3.74	3.72
Conducting observations in the lab or field.	4.06	3.99	3.89
Using statistics to analyze data.	3.52	3.43	3.13

Calibrating instruments needed for measurement.	3.41	3.42	3.42
Understanding journal articles.	3.94	3.88	3.81
Conducting database or internet searches.	3.69	3.76	3.58
Managing my time.	3.87	3.94	3.59

Table 1.4 Attitudes and Behaviors

During your research experience HOW MUCH did you: (Five point scale: None – a great deal)	PROGRAM		
	BIO REU 2010	BIO REU 2011	Other Programs
	Mean	Mean	Mean
Engage in real-world science research	4.59	4.62	4.48
Feel like a scientist.	4.41	4.37	4.31
Think creatively about the project.	4.22	4.20	4.05
Try out new ideas or procedures on your own.	3.67	3.74	3.73
Feel responsible for the project.	4.45	4.50	4.32
Work extra hours because you were excited about the research.	4.03	4.08	3.81
Interact with scientists from outside your school.	3.95	4.08	3.90
Feel a part of a scientific community.	4.33	4.35	4.19

Table 1.5 Class standing and averages for composite variables (2010)

		Class Standing				
		Freshman /Rising Sophomore	Sophomore /Rising Junior	Junior /Rising Senior	Senior	Other
THINKING & WORKING LIKE A	Mean	4.05	4.01	4.05	3.92	4.45
	SD	1.21	.85	.92	1.23	.52

SCIENTIST	N	16	59	90	59	7
PERSONAL GAINS	Mean	4.39	4.44	4.30	4.07	4.92
	SD	1.16	.80	.89	1.28	.29
	N	17	59	94	63	5
SKILLS	Mean	4.13	3.92	3.87	3.70	4.63
	SD	1.09	.93	.92	1.14	.50
	N	14	45	62	52	3
ATTITUDES & BEHAVIORS	Mean	4.46	4.28	4.21	4.04	4.49
	SD	.69	.84	1.06	1.17	.45
	N	19	59	88	62	7

2011

		Class Standing				
		Freshman/ Rising Sophomore	Sophomore /Rising Junior	Junior/Rising Senior	Senior	Other
THINKING & WORKING LIKE A SCIENTIST	Mean	4.21	4.10	4.09	4.09	4.25
	Standard Deviation	.70	.70	.76	.82	.61
	Valid N	159	527	616	496	53
PERSONAL GAIN	Mean	4.32	4.20	4.16	4.19	4.32
	Standard Deviation	.71	.72	.78	.83	.63
	Valid N	159	526	616	494	53
SKILLS	Mean	3.85	3.78	3.77	3.78	4.00
	Standard Deviation	.81	.78	.86	.90	.89
	Valid N	158	526	616	493	53
ATTITUDES AND BEHAVIORS	Mean	4.16	4.01	4.13	4.10	4.26
	Standard Deviation	.72	.79	.79	.84	.73
	Valid N	158	523	615	489	53

Table 1.6 Gender and averages for composite variables

		GENDER	
		Male	Female
THINKING & WORKING LIKE A SCIENTIST (ADJ MEAN)	Mean	4.04	4.01
	SD	.95	1.04
	N	91	139
PERSONAL GAINS (ADJ MEAN)	Mean	4.28	4.31
	SD	1.03	1.00
	N	94	143
SKILLS (ADJ MEAN)	Mean	3.78	3.93
	SD	1.01	1.00
	N	75	101
ATTITUDES & BEHAVIORS (ADJ MEAN)	Mean	4.17	4.23
	SD	.98	1.03
	N	90	144

2011

		Gender	
		Female	Male
THINKING & WORKING LIKE A SCIENTIST	Mean	4.11	4.11
	Standard Deviation	.77	.74
	Valid N	916	808
PERSONAL GAIN	Mean	4.20	4.19
	Standard Deviation	.78	.77
	Valid N	915	806
SKILLS	Mean	3.81	3.77
	Standard Deviation	.86	.83
	Valid N	915	804
ATTITUDES AND BEHAVIORS	Mean	4.08	4.09
	Standard Deviation	.81	.79
	Valid N	912	799

Table 1.8 Race/Ethnicity and averages for composite variables

		RACE ETHNICITY				
		WHITE	AFRICAN-AMERICAN	ASIAN-AMERICAN	NATIVE AMERICAN	HISPANIC (NON-WHITE)
THINKING & WORKING LIKE A SCIENTIST	Mean	3.78	4.34	4.13	4.31	4.15
	SD	1.04	.58	.97	.98	.87
	N	83	43	8	11	28
PERSONAL GAINS	Mean	4.11	4.69	4.61	4.28	4.43
	SD	.99	.63	.59	1.31	.89
	N	85	47	8	12	29
SKILLS	Mean	3.64	4.29	4.00	3.97	3.83
	SD	.97	.71	1.43	1.19	.90
	N	60	33	6	12	22
ATTITUDES & BEHAVIORS	Mean	4.05	4.42	4.23	4.23	4.14
	SD	1.05	.79	1.47	.96	1.09
	N	85	42	8	12	28

		Race Ethnicity					
		Native American	Asian American	African American	Pacific Islander	White	Hispanic
THINKING & WORKING LIKE A SCIENTIST	Mean	4.18	4.16	4.26	4.19	4.00	4.33
	Standard Deviation	.88	.70	.68	.76	.78	.62
	Valid N	55	210	202	29	1027	270
PERSONAL GAIN	Mean	4.30	4.24	4.41	4.26	4.08	4.46
	Standard Deviation	.87	.76	.63	.77	.78	.62
	Valid N	55	210	202	29	1023	271
SKILLS	Mean	3.90	3.91	4.08	3.77	3.64	4.07
	Standard Deviation	1.00	.85	.75	.89	.83	.75
	Valid N	55	210	202	29	1021	271
ATTITUDES AND BEHAVIORS	Mean	4.13	4.07	4.26	4.23	3.99	4.36
	Standard Deviation	.80	.84	.70	.68	.82	.66
	Valid N	54	210	201	29	1015	271

Table x Logistic regression model for propensity analysis.

		Variables in the Equation					
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	CC Baccalaureate	-1.580	.300	27.697	1	.000	.206
	Public/Private	-.731	.097	56.320	1	.000	.481
	Percentage White	-3.786	.243	242.325	1	.000	.023
	Percentage fourth year	-.287	.119	5.852	1	.016	.750
	Research One	-1.097	.149	54.344	1	.000	.334
	Constant	3.827	.294	169.399	1	.000	45.923

- Dependent variable is BIO-REU membership coded 1, other students coded 0.
- Site is unit of measurement.

THINKING & WORKING LIKE A SCIENTIST

	Carnegie Code	Public/Private	Size	Percentage Minority	Percentage Gender
4.9					
4.8					
4.7					
4.6					
4.5					
4.4					
4.3					
4.2	MASTERS (LARGE) INSTITUTE/PRIVATE LAB	INDEPENDENT	5000 - 10000	Over 75% 50 - 75%	0 -25% MALE 76 -100% MALE
4.1	R1 DOCTORAL GRANTING MASTERS (MEDIUM)	PUBLIC PRIVATE	10000- 20000 Over 20000		26% - 50% MALE 51 - 75% MALE
4.0			Under 5000	25-50%	
3.9	BAC A & S			Under 25%	
3.8					
3.7					
3.6					
3.5					

PERSONAL GAINS

	Carnegie Code	Public/Private	Size	Percentage Minority	Percentage Gender
4.9					
4.8					
4.7					
4.6					
4.5					
4.4	MASTERS (LARGE)				0 -25% MALE
4.3				Over 75%	
	DOCTORAL GRANTING			50 - 75%	
4.2	MASTERS (MEDIUM)				26% - 50% MALE
	R1	PUBLIC			51 - 75% MALE
	INSTITUTE/PRIVATE	PRIVATE	Over 20000		76 -100%
	LAB	INDEPENDENT	10000- 20000		MALE
4.1			Under 5000		
	R1		5000 - 10000	25-50%	
4.0	BAC A & S			Under 25%	
3.9					
3.8					
3.7					
3.6					
3.5					

SKILLS

Carnegie Code	Public/Private	Size	Percentage Minority	Percentage Gender
4.9				
4.8				
4.7				
4.6				
4.5				
4.4				
4.3				
4.2				
4.1				
4.0				
3.9			Over 75%	
	MASTERS (LARGE)		50 - 75%	0 -25% MALE
3.8	DOCTORAL GRANTING PRIVATE			26% - 50% MALE
	MASTERS (MEDIUM) PUBLIC	10000- 20000		51 - 75% MALE
	R1	Over 20000		
3.7	INSTITUTE/PRIVATE INSTITUTE			
	LAB BAC A & S /PRIVATE LAB	Under 5000	25-50%	
3.6		5000 – 10000	Under 25%	76 -100% MALE
3.5				

ATTITUDES AND BEHAVIORS

Carnegie Code	Public/Private	Size	Percentage Minority	Percentage Gender
4.9				
4.8				
4.7				
4.6				
4.5				
4.4	PRIVATE INSTITUTION			
4.3				
4.2	MASTERS (LARGE)		Over 75%	
			50 - 75%	0 -25% MALE
4.1	INSTITUTE/PRIVATE LAB	5000 – 10000		26% - 50% MALE
	R1	10000- 20000		51 - 75% MALE
	PUBLIC			76 -100%
	PRIVATE	Over 20000		MALE
4.0	DOCTORAL GRANTING MASTERS (MEDIUM)		25-50%	
3.9		Under 5000		
3.8			Under 25%	
3.7				
3.6				