Evaluation of the West Virginia Established Program to Stimulate Competitive Research (EPSCoR)

2019-20 Annual Progress Report

A West Virginia Higher Education Policy Commission (WVHEPC) project
Funded by the National Science Foundation (NSF)

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List of acronyms and terms

AFI	Appalachian Freshwater Initiative
DIY	Do It Yourself
ECT	Early Career Teacher
ELT	Executive Leadership Team
EPSCoR	Experimental Program to Stimulate Competitive Research
EWD	Education and Workforce Development
GLOBE	Global Learning and Observations to Benefit the Environment
GS	Graduate Student
GW	Gravitational Waves
K-12	Kindergarten through twelfth grade
LIGO	Laser Interferometer Gravitational Wave Observatory
MS	Master of Science
MU	Marshall University
NA	Not applicable
NANOGrav	North American Nanohertz Observatory for Gravitational Waves
NSF	National Science Foundation
NRAO	National Radio Astronomy Observatory
NRL	Naval Research Laboratory
PBI	Project Based Instruction
PBL	Project Based Learning
PhD	Doctor of Philosophy
PLC	Professional Learning Community
PSC	Pulsar Search Collaboratory
SPOT	Space/Science Public Outreach Talks
SPSS	Statistical Package for the Social Sciences
STEM	Science, Technology, Engineering and Math
UG	Undergraduate
UREP	Underrepresented persons
URM	Underrepresented minorities
WET	Water Education for Teachers
WV	West Virginia
WVHEPC (HEPC)	West Virginia Higher Education Policy Commission
WVSTA	West Virginia Science Teachers Association
WVSU	West Virginia State University
WVU	West Virginia University

Executive summary

The West Virginia EPSCoR project is led by the West Virginia Higher Education Policy Commission (WVHEPC) and three universities: West Virginia University (WVU); Marshall University (MU); and West Virginia State University (WVSU), with additional participants from West Virginia Wesleyan College and Shepherd University. The project focuses on two key research areas: water science (Appalachian Freshwater Initiative) and gravitational wave science (Gravitational Waves Astrophysics Project). It aims to build the research infrastructure in the state and impact the educational pipeline, including the recruitment and retention of Science, Technology, Engineering, and Mathematics (STEM) students, faculty, and researchers. This summary is based on findings from the annual progress survey, student follow-up survey, interviews with project participants, follow-up surveys with teachers, previous evaluation reports, institutional data from WVHEPC, and project tracking information provided by project coordinators.

Year 5 project initiatives:

- Appalachian Freshwater Initiative (AFI) research
- Gravitational Waves Astrophysics (GWA) research
- Recruitment of faculty, postdocs, graduate students, undergraduate students
- Early career teacher courses
- K-12 outreach and teacher workshops
- Summer research experiences for K-12 teachers
- Mentorship of undergraduate and graduate students
- Industry and education partnership development

In year 5, the project reached:

- 315 participants including:
  - 89 graduate students
  - 122 undergraduate students
  - 224 AFI researchers
  - 62 GWA researchers
  - 28 underrepresented minority (URM) participants

Year 5 highlights:

Goal 1 (AFI)

- 49 publications
- 152 presentations
- Average impact score of 2.63 in year 5 publications
- 59% of survey respondents shared that they were able to study new topics

Goal 2 (GWA)

- 118 publications
- 59 presentations
- Average impact score of 9.04 in year 5 publications
- 84% of survey respondents shared that they were able to study new topics

Goal 4 (Diversity)

- The project exceeded its student diversity targets in year 5
- The project exceeded its targets to recruit early career and in-service teachers from schools with high URM/UREP populations
- Interviewees shared that the project increased their awareness of the need for diversity among participants.

Goal 3 (Education and workforce development)	➢ Teachers gained: research skills, knowledge of teaching methods, understanding of scientific process, and new collaborations ➢ The project exceeded nearly all of its community outreach targets, reaching over 1,300 students at 30 schools through outreach festivals ➢ Student interviewees appreciated the opportunities to attend conferences and build their research and professional skills ➢ 86% of student survey respondents indicated that they felt prepared to apply for an internship and 62% felt prepared to enter the STEM workforce
Goal 5 (Partnerships)	➢ 107 total partner institutions, from 26 states and 11 countries ➢ Work with collaborators resulted in: o new proposals o publications o research findings o outreach to the community ➢ Industry Advisory Board developed
Overall project	➢ Researchers completed 70% of the 122 subactivities for year 5 ➢ Interviewees noted the greatest achievements of the project included student training, becoming more competitive as research institutions, and expanding research topics ➢ ELT started implementing regular meetings to address communication concerns

Consider these adjustments:

- Continue to have regular ELT meetings to share project updates and ideas for sustaining project activities and include how information will be shared with others in the project.
- Promote education and outreach activities that span the two research areas to increase collaboration and cohesion across the project.
- Consider including student research presentations at the virtual all-hands meeting in 2020 and consider planning an additional student meeting where students can present their work.
- Continue to formalize the industry advisory board and ensure follow-through on tasks by discussing updates of the industry advisory board at regular ELT meetings.
- Continue to send the quarterly newsletter to further build cohesion within the project and consider adding potential funding opportunities for participants to sustain research and education efforts after the project ends.

Overall, the project made progress in its targeted research areas and education and workforce development objectives, preparing students for the STEM workforce. In the final year of the project, the management team should continue to focus its efforts on improving industry engagement and coordination across the project while planning for sustainability.

Evaluation and report overview

Background

In 2015, West Virginia (WV) was awarded a five-year National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR) grant to help expand and enhance the research capability of scientists in West Virginia.[1] The project aims to create a statewide infrastructure that supports the ongoing adaptation, innovation, and sustainability of water and gravitational wave science. The research areas of this EPSCoR project, Appalachian Freshwater Initiative (AFI) and Gravitational Waves Astrophysics (GWA), were selected because they aligned with West Virginia's science and technology plan and NSF priorities. The goal of both research areas is to develop tools to acquire and analyze large quantities of measurement data to help build needed infrastructure[2]. The intended impact of this EPSCoR project is to be statewide and multi-faceted, making the project complex and systemic in nature. The West Virginia EPSCoR project is led by the West Virginia Higher Education Policy Commission (WVHEPC) and three universities: West Virginia University (WVU); Marshall University (MU); and West Virginia State University (WVSU), with additional participants from West Virginia Wesleyan College and Shepherd University. The project is at the end of its fifth year of NSF funding, and recently received a no-cost extension for a sixth year and is applying for supplemental funding.

Evaluation approach

Often, evaluations of specific interventions focus on end-results to determine whether, and how, a single intervention has worked[3]. EPSCoR grants, however, do not represent the implementation of a single intervention to create change in a state; rather, they involve multiple strategies, interventions, partnerships and the leveraging of people and resources to create change. This evaluation uses a **collective impact**[4] lens to illuminate how EPSCoR's many different parts interact and evolve over time to achieve its mission. Collective impact occurs when institutions, groups, or leaders from different sectors collaborate to solve a specific social problem by using a common agenda, aligning their efforts, and using common measures of success.

The evaluators developed a Theory of Change, as shown in Figure 1, to better understand how the project is operating as a collective impact initiative to achieve its impact. A Theory of Change is a visual tool that helps to illustrate collective impact initiatives. It provides a map linking activities to a broader, large-scale vision. A Theory of Change enables users to strategically plan how activities (i.e. processes, discrete activities and strategies) and resources lead to short and long-term outcomes. These outcomes are mapped out to show how they, in combination, produce a desired vision.[5]

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[1] National Science Foundation (n.d.). OIA's Established Program to Stimulate Competitive Research (EPSCoR) Section. Retrieved from https://www.nsf.gov/od/oia/programs/epscor/.
[2] West Virginia Higher Education Policy Commission Division of Science and Research (2015). West Virginia EPSCoR Strategic Plan for RII Implementation 2015-2020.
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[4] Kramer, M., & Kania, J. (2011). Collective Impact. Stanford Social Innovation Review. Retrieved from http://c.ymcdn.com/sites/www.lano.org/resource/dynamic/blogs/ 20131007_093137_25993.pdf.
[5] Taplin, D. H., & Clark, H. (2012). Theory of change basics: a primer on theory of change. ActKnowledge, Inc. Retrieved from http://www.theoryofchange.org/wp-content/uploads/toco_library/pdf/ToCBasics.pdf.

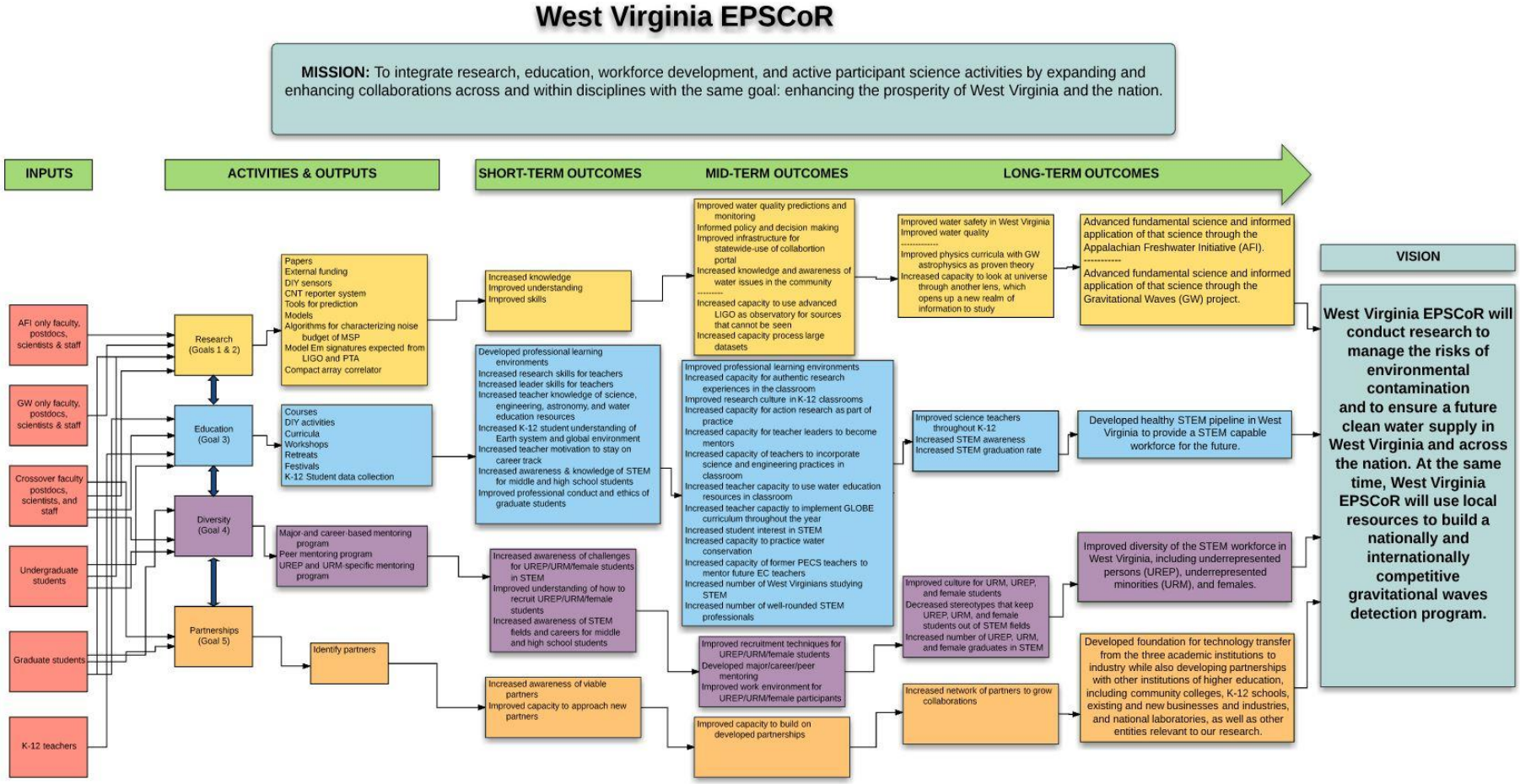


Figure 1. WV EPSCoR Theory of Change

Two types of evaluation are being conducted for this project: a formative evaluation to monitor project implementation and give ongoing feedback to the principal investigators, and a summative evaluation to assess the impact of the project and progress made toward reaching stated goals. The current report presents a summative evaluation assessing the progress made toward reaching the project's goals and targets in year 5. It also includes feedback regarding project management and sustainability. This report was originally submitted in April 2020. This report has been updated to include findings from the annual progress survey and student follow-up survey. Findings from this report should be used by project leads to demonstrate the impact of the project to NSF and to discuss ways to enhance the impact of the overall project. The following are the summative evaluation questions examined in the evaluation:

Goals 1 & 2: Research (AFI and GWA)

- To what extent did research teams (AFI and GWA) meet their objectives?
- How well did research teams disseminate information about their science to the academic community?
- To what extent did participating in EPSCoR broaden the scope of the research the scientists were able to do?
- To what extent did EPSCoR improve the competitiveness of the project institutions?

Goal 3: Education and Workforce Development

- Have the EPSCoR institutions made research a requirement for their teaching program?
- How does the early-career teaching program affect teachers' ability to teach science?
- To what extent did teachers engage in authentic research experiences?
- To what extent did the EPSCoR program engage the community in learning about target science areas?
- To what extent did the EPSCoR program prepare post-secondary students and postdocs for the workforce?

Goal 4: Diversity

- To what extent did the EPSCoR program increase diverse student groups' awareness of college and STEM fields?
- To what extent has EPSCoR improved the retention of underrepresented person (UREP) groups?
- How effective are peer-mentoring and career mentoring programs in retaining UREP students?
- To what extent has the EPSCoR program improved the diversity of the participants in STEM programs?

Goal 5: Partnerships

- To what extent have EPSCoR partnerships with K-12 schools, universities, and industries benefitted the EPSCoR project and its participants and how have the partners benefited?
- To what extent have partnerships with national laboratories improved?

Evaluation measures

To assess these evaluation questions, evaluators utilized multiple data sources for this annual report:

- Evaluators revised the **annual progress survey** using feedback from project leads, to assess participant approaches to research, collaboration among participants, mentorship, recruitment of participants and students, student perceptions of career preparedness in a STEM field, and perceptions of partnerships. Respondents also answered questions about their satisfaction with project management and provided suggestions for improvement. Unless otherwise noted, all items were rated on a five-point scale.
- Evaluators developed a **student follow-up survey** for all past EPSCoR students. Respondents answered questions regarding implementation of knowledge and skills gained from participating in EPSCoR and their academic and career plans.
- Evaluators developed an **interview protocol** for key project participants (students, researchers, goal leads, and project administrators) about research progress, collaborations within the project, diversity, partnerships development, workforce development, technology development, sustainability of the project, and achievements in the overall project.
- Evaluators developed a **teacher follow-up survey** for all past teachers who participated in long-term training through the project (Early Career Teacher courses and Summer Research Experiences). Respondents answered questions regarding their confidence and motivation to teach STEM as well as how they have implemented knowledge and skills gained from participation in EPSCoR activities.
- Evaluators reviewed **institutional data** regarding institution demographics, retention rates, graduation rates, and student GPA for West Virginia University, West Virginia State University, and Marshall University.
- Evaluators reviewed **tracking documents** regarding project participation, products, and partnerships, provided by project leads, to measure progress made toward targets.
- Evaluators summarized findings from **previous evaluation reports** regarding teachers' knowledge and skills gained as a result of participating in education activities. For more details about the Education and Workforce Development (EWD) data sources used, see The Mark's 2019-11-Education Activity Report-WV EPSCoR and activity reports from January 2020.

Data collection and analysis

The annual progress survey was administered in April 2020 to 294 year 5 participants and 122 (41%) responded, including 10 partial responses.[6] The student follow-up survey was administered in April 2020 to 220 participants and 28 (13%) completed the survey, including 3 partial responses. Results were analyzed with Statistical Package for the Social Sciences (SPSS) using descriptive and inferential statistical tests. Qualitative results of open-ended survey questions were coded for themes. Due to partial responses, sample size varies throughout the report. Note that evaluators only presented on main themes for open-ended questions. Thus, responses will not always add up to the total or to 100%. For demographic information of survey respondents, see Appendices A and B.

Evaluators conducted online interviews through video teleconferencing with 18 key project participants during October and November 2019. Interviews varied in length and lasted anywhere from 15 to 75 minutes. Of those interviewed, six were from the AFI research group, eight were from the GWA research group, two were from the EWD group, and two were project administrators. Evaluators developed a coding scheme which was used to code all interview notes using the qualitative software program, Dedoose. Once coded, evaluators examined interview data by role in the project. For more detailed information about interview findings, please see The Mark's 2020-01-Interview Findings-WV EPSCoR report.

The teacher follow-up survey was administered through the online survey software platform, Survey Gizmo. Forty-one out of 113 (36%) completed the survey and five additional teachers partially responded. Results were analyzed with SPSS using descriptive and inferential statistical tests. Qualitative results of open-ended survey questions were coded for themes. This report includes summaries of findings from previous reports, which are referenced when necessary.

Project leads collected information regarding participation, research products, and partnerships for the past year. Project leads shared these tracking documents with evaluators who used descriptive statistics to compare participation and resulting products to targets. Evaluators coded partnership outcomes from the tracking sheet for themes.

[6] In year 5, between survey administration of the annual progress survey and participant reporting to the project coordinator, 33 participants were added to the project participant tracking. Demographic information on gender and ethnicity and additional student demographics were not collected for these participants. They are represented in participant tracking information, but not represented in survey results.

Project participant overview

All EPSCoR participants

The project has increased its number of participants to 315 in year 5, and particularly, the number of students (graduate and undergraduate) has steadily increased to 211 in year 5. As the largest institution in the project, WVU continued to have the largest proportion of participants, with 48%. Marshall University and WVSU also increased in their overall number of participants. Between the two research groups, AFI has consistently had the majority of participants (71% in year 5), which is expected based on the strategic plan. Nearly all new participants in year 5 were associated with AFI. These findings suggest the project's efforts to recruit participants, particularly students, have been successful.

Demographics	Year 1[a] (n=131)		Year 2 (n=217)		Year 3 (n=246)		Year 4 (n=284)		Year 5 (n=315)	
	#	%	#	%	#	%	#	%	#	%
Institution										
Marshall University	59	45%	84	39%	103	42%	103	36%	124	39%
Shepherd University	3	2%	3	1%	3	1%	3	1%	3	<1%
West Virginia Higher Education Policy Commission	5	4%	5	2%	3	1%	5	2%	3	<1%
West Virginia State University	21	16%	34	16%	37	15%	27	10%	32	10%
West Virginia University	40	31%	87	40%	95	39%	143	50%	150	48%
West Virginia Wesleyan College	3	2%	4	2%	5	2%	3	1%	3	<1%
Role[b]										
Co-investigator	9	7%	11	5%	5	2%	5	2%	3	<1%
Faculty	46	35%	54	25%	60	25%	63	22%	61	19%
Graduate student (research assistant)	28	21%	63	29%	69	28%	77	27%	89	28%
Postdoctoral	1	1%	10	5%	13	5%	21	7%	17	5%
Staff scientist/Non-student research assistant	1	1%	1	1%	1	<1%	2	1%	2	<1%
Technician	5	4%	10	5%	12	5%	7	2%	6	2%
Undergraduate student	31	24%	55	25%	74	30%	92	32%	122	39%
Other professional[c]	10	8%	13	6%	10	4%	17	6%	15	5%
Research area										
Appalachian Freshwater Initiative (AFI)	97	74%	138	64%	174	71%	192[d]	68%	224	71%
Gravitational Waves (GWA)	18	14%	64	29%	51	21%	61	21%	62	20%
Other[d]	16	12%	15	7%	21	9%	32[d]	11%	30[e]	10%

a. Year 1 tracking in year 1 annual evaluation report only included those who received a baseline survey. The current table reflects everyone in the project, including those in administrative and staff positions.
b. In year 3, the roles of two participants were not specified. Therefore, n=244.
c. "Other professional" includes those working on financials and outreach activities and those in administrative positions and non-student research assistants.
d. "Other" indicates those working on Goals 3 (Education and Workforce Development), 4 (Diversity), or 5 (Partnerships), AFI and GWA administrative staff, and those not affiliated with the research goals (West Virginia Higher Education Policy Commission staff and other members of the executive leadership team).
e. One respondent in years 4 and 5 engages in both AFI and Education and Workforce Development ("Other") and is therefore counted twice under research area.

Figure 2. Project participant overview by year

Overall, the dispersion of gender and race/ethnicity in the project has remained relatively similar year-to-year. Just over half of participants in year 5 were male (58%) and most participants were White (non-Hispanic or Latino) (76%). The proportion of females in year 5 (42%) is comparable to Science, Technology, Engineering, and Math (STEM) majors at each of the institutions. WVU, MU, and WVSU had between 37% and 46% of female undergraduate and graduate STEM students in Spring 2019, which is a slight increase from 2018. Notably, the percentage of Black or African American (7%) and Hispanic or Latino (5%) increased from year 4 (5% and 4% respectively). Additionally, the percentage of White (non-Hispanic or Latino) participants is less than the percentage of White (non-Hispanic or Latino) undergraduate STEM students at WVU (86%) and MU (81%).[7] These findings suggest that the project's recruitment efforts to increase URM participation in the project have been successful.

Demographics[a]	Year 1		Year 2		Year 3		Year 4		Year 5	
	#	%	#	%	#	%	#	%	#	%
Gender	n=116		n=132		n=237		n=283		n=308	
Female	47	41%	54	41%	105	44%	121	43%	130	42%
Male	69	60%	77	58%	132	56%	162	57%	178	58%
Do not wish to specify	--	--	1	1%	--	--	--	--	--	--
Racial/ethnic background[b]	n=116		n=132		n=202		n=225		n=232	
American Indian or Alaska Native	--	--	1	1%	1	<1%	--	--	--	--
Asian	11	10%	17	13%	30	15%	27	12%	26	11%
Black or African American	5	4%	6	5%	12	6%	11	5%	16	7%
Hispanic or Latino	5	4%	5	4%	7	3%	9	4%	11	5%
White (non-Hispanic or Latino)	88	76%	96	73%	146	72%	176	78%	176	76%
Other	3	3%	4	3%	3	1%	2	1%	--	--
Two or more races[c]	--	--	--	--	--	--	--	--	3	1%
Do not wish to specify	4	3%	3	2%	3	1%	--	--	--	--

a. Project leads provided demographic background information on participants in years 3 through 5. Demographic information was not provided for all participants. Therefore, sample size varies from total project.
b. Evaluators collapsed race and ethnicity into one category based on participant tracking.
c. One participant in year 5 identified as White and American Indian or Alaska Native, and is therefore considered an underrepresented minority (URM) participant. The remaining two participants who identified as two or more races did not specify which races and are therefore considered non-URM participants.

Figure 3. Participant gender and race/ethnicity

[7] Due to small sample sizes, the number of URM STEM undergraduate students at the institutions could not be calculated.

Demographic information of graduate and undergraduate students

Evaluators collected additional demographic information from graduate and undergraduate students who responded to evaluation surveys to track participation of underrepresented persons (UREP).[8] Project leads also collected demographic information on their students in year 5. It should be noted that these demographics are not reflective of total UREP participation in the project, as they only reflect those who participated in the survey or from whom project leads could collect information. The percentage of respondents who were first generation college students slightly increased from 31% in year 4 to 38% in year 5. Project and institutional leads should discuss strategies to recruit underrepresented students during monthly and quarterly meetings. These strategies should be shared with faculty members to help them recruit more diverse participants to their programs.

Demographics	Year 1 (n=48)		Year 2 (n=62)		Year 3 (n=60)		Year 4 (n=68)		Year 5 (n=60)	
	#	%	#	%	#	%	#	%	#	%
First generation college student[ab]									n=60	
Yes	8	18%	10	17%	22	37%	21	31%	23	38%
No	33	75%	46	78%	36	60%	45	66%	36	60%
I'm not certain	3	7%	3	5%	1	2%	1	2%	1	2%
Prefer not to answer	-	-	-	-	1	2%	1	2%	--	--
Adult learner[cd]									n=20	
Yes	14	29%	22	36%	4	17%	1	4%	1	5%
No	32	67%	39	63%	19	83%	26	93%	18	90%
I'm not certain	2	4%	1	2%	-	-	1	4%	1	5%
Free or reduced lunch in high school									n=50	
Yes	10	21%	11	18%	13	22%	11	16%	8	16%
No	35	73%	43	69%	39	65%	49	72%	30	60%
Not sure/prefer not to answer	3	6%	8	13%	8	13%	8	12%	12	24%
Disabilities									n=50	
Yes	2	4%	2	3%	4	7%	5	7%	3	6%
No	43	90%	57	92%	53	88%	60	88%	46	92%
Not sure/prefer not to answer	3	6%	3	5%	3	5%	3	4%	1	2%
Veteran									n=54	
Yes	--	--	--	--	2	3%	3	4%	4	7%
No	48	100%	62	100%	57	95%	64	94%	50	93%
Not sure/prefer not to answer	--	--	--	--	1	2%	1	2%	--	--

a. First generation college student is defined as an individual both of whose parents or guardians did not complete a baccalaureate degree; OR in the case of an individual who regularly resided with and received support from only one parent or guardian, an individual whose only parent or guardian did not complete a baccalaureate degree.

b. Due to an error in the data download, responses from four students are missing in year 1 (n=44) and three in year 2 (n=59).

c. Adult learner is defined as an undergraduate who is 25 years of age or older. However, in years 1 and 2, adult learner included graduate and undergraduate students. After discussion with project director, adult learner now only includes undergraduate students.

d. Because adult learner only includes undergraduate students in year 3, n=23 and in year 4, n=28.

Figure 4. Student demographics by year

[8] Underrepresented person is defined as a female, first generation college student, adult learner, low-income (received free or reduced lunch in high school), person with a disability, or veteran.

Teacher demographics

In addition to university participants, 145 K-12 teachers also participated in the project through EWD activities. Teacher demographics presented are for year 4 (August 2018 through August 2019).[9] These participants are not reflected in previous demographic tables in this report. Project leads provided evaluators some demographic information for teachers who participated in the EWD activities and evaluators collected other demographic information from those who responded to evaluation surveys. The following are the K-12 teacher activities that occur each project year.

- A three-course series at West Virginia University focusing on supporting early career teachers (ECT) through studying their teaching and creating professional learning communities.
- One-day teacher workshops that provide training in science activities for teachers at West Virginia State University and Marshall University.
- Summer research experiences at all three lead institutions that engage pre- and in-service teachers in authentic research experiences.
- A Project Based Learning (PBL)[10] workshop and follow-up course at West Virginia University focused on instructing teachers about the merits of and how to apply PBL in their classrooms (years 3 and 4 only).[11]

Figure 5 shows the demographic information of teachers reached through the project. During all four years, there was a higher percentage of females than males, which is expected in the teaching profession.[12] More than half of the teachers who participated in year 4 (53%) were first generation college students[13]. Although the EPSCoR project has difficulty recruiting racially diverse participants, it has been able to reach underrepresented populations through teacher participants. The project targets early career teachers; however, less than a third (30%) of the teachers reached in year 4 and for most of the years fell under this category. Education leads should consider recruiting early career teachers for the one-day workshops during the no-cost extension year to better support them and increase the overall proportion of early career teachers reached through the project.

[9] The activities listed for teachers take place during the summer, so information on teachers in all annual reports is presented a year behind.
[10] The workshop was formerly known as Project Based Instruction (PBI) workshop. The education team changed the term to Project Based Learning (PBL) exclusively to avoid confusion and to match the majority of language used in the field.
[11] Data from the PBL workshop was not included in the October 2018 formative report. Therefore, the number of teachers for year 3 that are presented in this report is higher than in the October 2018 report.
[12] National Center for Education Statistics. (2015). Teacher trends. Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=28
[13] Although these teachers are not currently students, education leads are tracking whether the teachers were first generation college students for the diversity component of their activities.

	Year 1 (n=68)		Year 2 (n=75)[a]		Year 3 (n=102)[b]		Year 4 (n=97)[c]	
	#	%	#	%	#	%	#	%
Gender								
Female	49	72%	52	69%	81	79%	52	68%
Male	17	25%	17	23%	18	18%	21	27%
Do not wish to specify	1	1%	5	7%	3	3%	4	5%
Other	1	1%	1	1%	--	--	--	--
Race								
Asian	1	1%	--	--	--	--	--	--
White (non-Hispanic or Latino)	66	97%	65	87%	97	95%	71	92%
Black or African American	--	--	--	--	3	3%	2	3%
Other	1	1%	1	1%	--	--	--	--
Do not wish to specify	--	--	9	12%	2	2%	4	5%
First generation college student[de]								
Yes	23	43%	33	44%	44	52%	41	53%
No	29	55%	40	53%	39	46%	36	47%
I'm not certain	--	--	1	1%	--	--	--	--
Prefer not to answer	1	2%	1	1%	1	1%	--	--
Teacher status								
Early career[f]	22	32%	28	37%	33	32%	23	30%
In-service[g]	39	57%	43	57%	64	63%	50	65%
Preservice	5	7%	4	5%	5	5%	4	5%
Other	2	3%	--	--	--	--	--	--

a. The project reached a total of 84 teachers during year 2, but only 75 (89%) responded to evaluation surveys.
b. The project reached a total of 105 teachers during year 3, but only 102 responded to the surveys. Participants from one-day workshops received general links to the surveys and evaluators are unable to discern the identity of the respondents. Because eight participants attended multiple events, they may have completed multiple surveys and might be included twice in the table.
c. The project reached at least 145 teachers during year 4, and 97 responded to activity surveys. Because PBL participants were not asked for demographic information in the survey, the demographic breakdowns of this year do not include their information.
d. In year 1, evaluators only surveyed teachers who participated in summer research experiences at Marshall University. Of the teachers who participated in summer research experience, first generation college student information was only collected from six respondents. Therefore, n=53 in year 1.
e. In year 3, the PBL survey did not ask teachers whether they were first generation college students. Therefore, n=84.
f. "Early career" is defined as one to ten years teaching for ECT and PBL courses, and one to five years for workshops and research experience.
g. "In-service" is defined as teaching for 6+ years for workshops and research experience and 11+ for ECT and PBL courses.

Figure 5. Teacher demographic information by year

Progress made in developing research infrastructure and gaining scientific knowledge in Appalachian Freshwater Initiative (AFI) and Gravitational Waves Astrophysics (GWA) (goals 1 and 2)

Progress made by research areas

According to the benchmark and milestones tracking, overall, the project completed 70% of the 122 subactivities for the research goal areas for year 5, 24% in progress, 2% were not met, and the status of 4% was unknown/not reported at the time of annual reporting.[14] Notably, this is a higher percentage of completed tasks compared to year 4.

Appalachian Freshwater Initiative (goal 1)

During year 5, AFI completed 61% of the 94 subactivities related to the three objectives, sensors, complexity, and modeling, and 31% were in progress at the time of the annual report (Figure 6). This is an improvement from the project status at the time of the year 4 annual report. In response to the NSF site visit report in 2018, AFI set out to ensure accountability for research tasks by identifying who would be responsible for each task and designating technical leads to oversee the research at their institutions. AFI planned to have bimonthly cross-objective telecons and for each of the objective areas and have technical leads meet once a semester face-to-face to discuss the project. These have occurred on schedule since the start of the 2018-19 academic year. The higher completion of tasks possibly indicates that accountability and oversight in this project area have improved over the course of the project. Notably, one interviewee noted that they were proud of how much they caught up to progress within their tasks in the project, since in the beginning of the project the majority of tasks were not met.

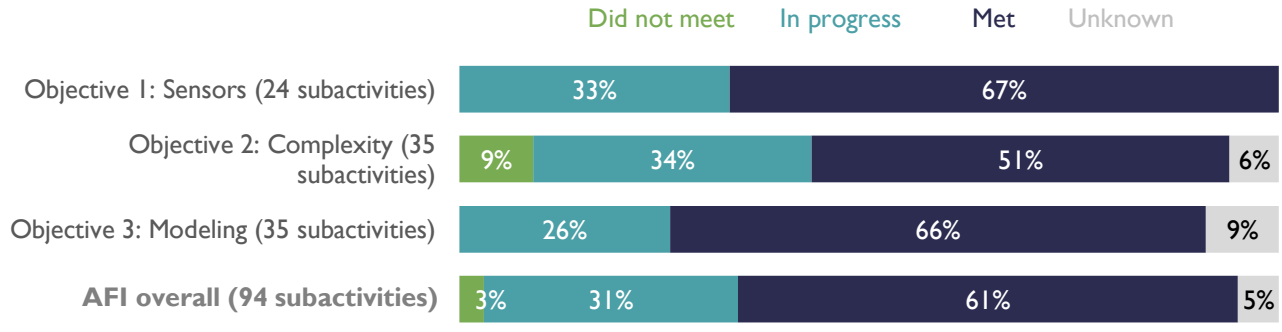


Figure 6. Percentage of AFI subactivities met, in progress, or not met in year 5

[14] Data on milestone tracking is completed by project leads and provided to evaluators. This data is based on annual reporting, which was completed in May 2020.

Gravitational Waves Astrophysics (goal 2)

During year 5, GWA completed 100% of the 28 subactivities related to the three objectives, gravitational wave detection and algorithm development, signals and populations, and pulsar timing array development (Figure 7). According to the GWA project leads, notable achievements in year 5 included publishing limits on low-frequency GWA emission from supermassive black hole binaries, based on the 11-yr data release published in year 4 and developing a state-of-the art code to implement the model developed in year 4 for use in analyses of real data, among other achievements. Interviewees from the GWA research group noted that they have made many advances in their research during the project.

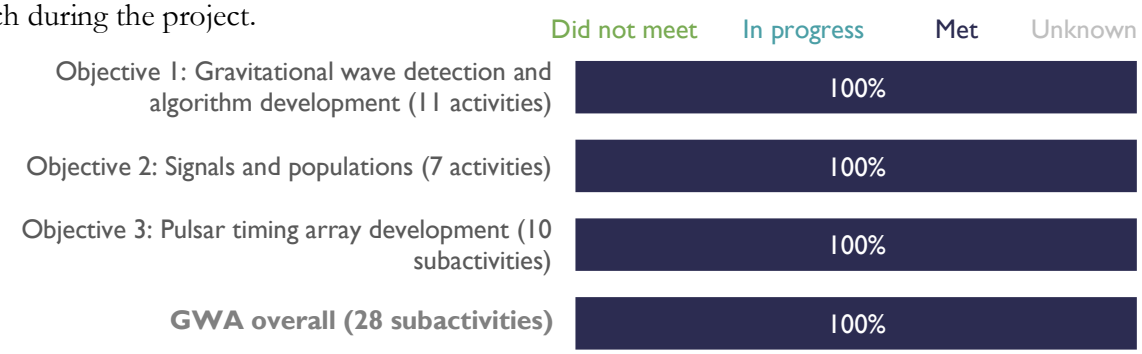


Figure 7. Percentage of GWA subactivities met, in progress, or not met in year 5

Dissemination of research

In year 5 of the project, WVU, WVSU, and MU shared their products developed for the year with evaluators, which included manuscripts submitted and accepted for publication, conference papers and presentations, dissertations, and other products. As shown in Figure 8, overall, the EPSCoR project exceeded the dissemination targets to an academic audience, with a total of 167 publications published in year 5 and 211 presentations. The GWA research area had more publications than AFI (118 compared to 49), while the AFI research team had more presentations (152 for AFI and 39 for GWA). Of the seven dissertations defended in year 5 of the project, all but one were in AFI research area.

Dissemination type	Year 1 target | actual		Year 2 target | actual		Year 3 target | actual		Year 4 target | actual		Year 5 target | actual			Year 5 status
	AFI	GWA	AFI	GWA	AFI	GWA	AFI	GWA	AFI	GWA	Yr 5 Total	
# manuscripts submitted to journals[a]	4 | 1	-- | 0	19 | 26	0 | 55	12 | 21	0 | 58	17 | 46	0 | 59	17 | 46	0 | 132	17 | 178	↑
# publications[bc]	-- | 0	-- | 2	-- | 23	-- | 56	-- | 24[d]	-- | 58	-- | 46[e]	-- | 59[f]	-- | 49[g]	-- | 118[h]	-- | 167	↑
# presentations[i]	-[j] | 8	0 | 9	-[j] | 82	0 | 9	1 | 88	0 | -	1 | 90	0 | 1	1 | 152	0 | 39	1 | 211	↑
# dissertations[ck]	--	--	--	--	--	--	-- | 8	-- | 1	-- | 7	-- | 1	-- | 8	↑

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. Manuscripts submitted to journals includes products that are under review, accepted, or published in the year being reported on.
b. Publications includes products that were published in the year presented as well as any products from previous year that were in review or accepted and then published the year presented.
c. No target listed in strategic plan.
d. This includes one book chapter.
e. This includes three book chapters, one government report, number of published journal articles from year 4 (40), and accepted journal articles in year 3 that were published in year 4 (2). It does not include those that were not yet published in year 4. This is the same as the number of manuscripts submitted, but this is only a coincidence.
f. This includes the number of published journal articles in year 4 (58) and accepted journal articles in year 3 that were published in year 4 updates (1).
g. This includes two book chapters and four journal articles submitted in year 4 that were published in year 5
h. This includes one journal article submitted in year 4 that were published in year 5.
i. This includes conference, seminar, and workshop presentations.
j. No target listed for that year.
k. Dissertations were not tracked in evaluation reports until year 4 of the project.

Figure 8. Research dissemination compared to targets by year

As shown in Figure 9, when broken down by institution, WVU had the most products in year 5. WVU produced 149 journal or juried conference papers, 79% of which were produced by the GWA research team. WVU produced 111 conference presentations/papers in year 5, of which AFI produced 66%. Other products from WVU AFI researchers included two book chapters and three dissertations. WVU GWA also produced one dissertation. MU had 68 total products, all of which came from the AFI research team. This included 15 journal or juried conference papers and 53 other conference presentations or papers. Other products by MU AFI researchers included two dissertations. Lastly, the AFI researchers at WVSU produced one journal or juried conference paper and 26 other conference presentations/papers and other products. These findings demonstrate that overall, the project has made accomplishments in each research area and has increased the dissemination of findings to the academic community.

	AFI		GWA		Total
	#	%	#	%	
Publications					
Marshall	15	100%	-	-	15
WVSU	1	100%	-	-	1
WVU	31	21%	118	79%	149
Presentations					
Marshall	53	100%	-	-	53
Shepherd	-	-	1	100%	1
WVSU	26	100%	-	-	26
WVU	73	66%	38	34%	111

Figure 9. Publications and presentations disseminated by research area and institution in year 5

A database search on the Web of Science using the NSF project ID of OIA-1458952 generated 115 results as of April 2020, which is nearly double the results in year 4 (67 in April 2019). The NSF site visit report from 2018 noted a small proportion of people who used the project ID out of the reported publications. In year 4, evaluators recommended that technical leads encourage researchers to use the project ID when submitting manuscripts. Of the 115 results in April 2020, 59 articles were published in 2019 or 2020. This possibly suggests that researchers are citing EPSCoR funding in their publications more often. However, the number is still below the actual number of articles reported by the participants. A possible reason may be that papers were published in journals that do not have an impact score. Program leads should continue to encourage researchers to use the project ID when submitting publications to increase program visibility.

Broadening of research topics

"In terms of science, the machine learning and radio instruction techniques helped to expand my research."

Nearly all interviewees in Fall 2019 noted that the project has helped broaden their research topics by sharing new topics and/or methods outside of their research area. The AFI interviewees shared that they were able to collect more data, develop new research questions and projects, make great contributions to their own research (e.g. pathogen E.coli, molecule sensing, fish physiology), and expand the number of sites used for water collection because of the project. GWA interviewees shared that the project helped them broaden research ideas, advance their research, and develop collaborations in new research areas. These findings are consistent with the annual progress survey where 66% of annual survey respondents (69 of 104) indicated that they have been able to study new research topics since participating in the project. About a third (35%) of the 71 AFI respondents studied new research topics in biology related fields and more than half (63%) of the 32 GW respondents studied new topics in Astronomy (all new areas are listed below). Annual survey respondents shared that the project enabled them to conduct research in new areas by giving them funding towards that new area or to acquire students/staff (14 respondents), teaching them new methods or techniques (12 respondents), and creating collaboration opportunities (nine respondents). Additionally, eight other respondents said they were provided with resources, eight said that the project created opportunities and access to the new field of research, and five said that they gained knowledge about the new research topic.

59% of AFI respondents have studied new research topics

- Biology, medical, and ecology (25 respondents)
- Water research and climate (8)
- Chemistry (5)
- Physics (3)
- Computer science (1)

84% of GW respondents have studied new research topics

- Astronomy (20 respondents)
- Computer Science (5)
- Physics (1)
- PTA related topics (1)

Respondents' collaborations with AFI and GWA research groups

"For real ionic sensing, it was nice to have two collaborators inside the group. We are developing molecules that bind to other molecules, and I am working with someone that is working on a patent for a molecule that does that."

Half of interviewees noted that the EPSCoR project has made accomplishments in promoting collaborations both across disciplines within home institutions and across institutions within the same research group. The majority of these interviewees discussed how the project has facilitated cross-disciplinary work which has led to collaborative publications or proposals. Notably, 73% of AFI survey respondents (n=73) and 70% of GWA survey respondents (n=33) indicated that they worked in more than one objective area, indicating that the majority of research survey respondents are cross-collaborating in their research area. However, interviewees also shared that a challenge they faced was a lack of cohesion across research groups. Half of interviewees shared that the two research groups were in two distinct, unrelated research areas, making collaboration challenging. This is consistent with the survey findings where only 10 non-AFI respondents indicated that they collaborated with the AFI group and four non-GWA respondents indicated that they collaborated with the GWA group. Collaborations were also difficult between and within groups as GWA research group already had the infrastructure in place for collaborations, whereas AFI needed to build their collaborations from the ground. Additionally, one of the most commonly identified missed opportunities was cross-project collaboration across research areas, which the interviewees noted could have been more successful with better project management. Notably, the project fostered a stronger collaboration in education between the two research groups. Some interviewees shared that nearly all cross-project collaboration happened through education outreach activities. Of survey respondents who shared how they collaborated across research areas of the project (n=10), six shared that it was through education and outreach activities. This suggests that AFI and GWA may be able to enhance their collaborations through outreach. Survey respondents shared that collaborations through the project have been helpful in understanding the program better, improving outreach, expanding research, learning new data analysismethods, and sharing ideas and resources. With the no-cost extension year, the Executive Leadership Team (ELT) should look for more ways that the project can collaborate across research areas to create a better sense of project cohesion, such as through the education components of the project.

Competitiveness of project

The competitiveness of the EPSCoR project in year 5 was evaluated by examining recruitment efforts, which will help improve the STEM workforce pipeline, as well as the number of proposals submitted, which aim to increase funding in the targeted research areas. As shown in Figure 10, the project far exceeded all areas of participant recruitment in year 5, demonstrating the project is attracting both undergraduate and graduate students, which will help lead to a trained workforce in the AFI and GWA fields. Notably, 10 out of 38 (26%) student survey respondents indicated that they pursued a degree at WV because the program aligned with their interests, and 10 (26%) said that they pursued it because there was funding involved. Additionally, five student survey respondents (13%) said that they

chose a WV institution for higher education because of the mentorship or faculty there, and four (11%) said that they chose to pursue a degree in WV because of the academic reputation of the institution. This suggests that WV EPSCoR institutions are attracting students, thereby helping to improve competitiveness of the institutions. Additionally, half of the interviewees also noted that they were able to apply for new grants and obtain new funding through new collaborations and partnerships to further pursue these expanded research areas

Competitiveness indicator	Year 1 target | actual	Year 2 target | actual	Year 3 target | actual	Year 4 target | actual	Year 5 target | actual	Year 5 status
# proposals submitted	3 | 3	3 | 71	9 | 29	5[a] | 7[ab]	6 | NA[c]	--
# undergraduate students recruited	3 | 11	3 | 39	3 | 42	3 | 56	3 | 62	↑
# graduate students recruited	2 | 9	2 | 46	2 | 23	2 | 27	2 | 32	↑
# faculty hired	None | 1	None | 1	None | 6	None | 6	None | 1	↑

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. Some milestone tracking indicators just list that the goal was met, without indicating a number. In this instance it was counted as 1 proposal.

b. One proposal was listed as in progress

c. Data on the number of proposals was not available at the time of this report.

Figure 10. Proposals submitted and student recruitment by year

Overall, the project published 160 journal articles[15] in 62 journals during year 5 with an average journal impact score of 4.87.[16] Concurrent with their high number of publications, the GWA research team also submitted to more high impact journals, with an average journal impact score of 9.04 compared to 2.63 for AFI. This may be because GWA is a more established collaboration team than AFI and has a longer history of publishing in collaboration. The researchers at WVU published a total of 146 manuscripts in 49 journals, with an average impact score of 5.12 (AFI: 2.38 GWA: 9.04), while Marshall University published 13 total journal articles in 12 journals with an average journal impact score of 3.64 (all AFI). WVSU published one journal article in a journal with an impact score of 2.52 (AFI). Despite the large number of journal articles published in year 5, the majority of the listed first authors are from only two schools, WVU and MU. Although this is to be expected given WVSU has fewer participants, more effort should be made to include WVSU in collaborations to further integrate them into the project and in future collaborative proposals. Notably, half of interviewees said that increasing the competitiveness of all three institutions was an accomplishment of the project, sharing that publications were considered an important indicator that demonstrate competitiveness.

Research Area	Journal	Number of publications	Impact factor
AFI	Algal Research	1	3.723
GWA	American Journal of Physics	1	1.194
AFI	Annals of Chemical Science Research	1	NA

[15] Only includes academic journals published in year 5 and those accepted or under review in year 4 but published in year 5, and therefore does not include 3 book chapters and 1 government report listed in Figure 7.

[16] Journal impact scores were calculated from the Web of Science's InCites Journal Citation Reports for 2019. If impact scores were missing from Web of Science, they were not included in this average.

Research Area	Journal	Number of publications	Impact factor
AFI	Aquatic Geochemistry	2	1.44
GWA	arXiv e-prints	2	NA
GWA	Astro2020	22	NA
GWA	Astronomy and Astrophysics	1	6.209
GWA	Astronomy and Astrophysics Review	2	15.143
AFI	Bulletin of Environmental Contamination and Toxicology	1	1.65
GWA	Bulletin of the American Astronomical Society	15	NA
AFI	Cells	1	4.829
AFI	Chemistry Teacher International	1	NA
GWA	Classical and Quantum Gravity	2	3.487
AFI	Climate	1	NA
AFI	Ecology and Evolution	1	2.415
AFI	Ecosphere	1	2.746
AFI	Energy & Fuels	1	3.021
AFI	Environmental DNA	1	NA
AFI	Environmental Toxicology and Chemistry	1	3.421
AFI	Geomicrobiology Journal	1	1.609
AFI	Global Ecology and Conservation	1	2.751
AFI	Journal of Applied Meteorology and Climatology	1	2.364
GWA	Journal of Astronomical Telescopes, Instruments	1	3.143
GWA	Journal of Astronomical Telescopes, Instruments, and Systems	1	3.143
AFI	Journal of Ecotourism	1	NA
AFI	Journal of Environmental Quality (Special Section)	1	2.579
AFI	MDPI Encyclopedia	1	NA
AFI	Microchimica Acta	1	5.479
GWA	Monthly Notices of the Royal Astronomical Society	15	5.231
GWA	Nature	1	43.07
GWA	Nature Astronomy	1	10.5
GWA	Nature Reviews Physics	1	NA
AFI	Northeastern Naturalist	1	0.488
AFI	Open Access Journal of Biomedical Science	1	NA
AFI	Open Journal of Genetics	1	NA
AFI	Open Journal of Philosophy	1	NA
AFI	Origins of Life and Evolution of Biospheres	1	NA
GWA	Physical Review D	11	4.368
GWA	Physical Review Letters	3	9.227
GWA	Physical Review X	1	12.211
AFI	Plant Ecology	1	1.789
GWA	Publications of the Astronomical Society of Australia	1	NA
GWA	Publications of the Astronomical Society of the Pacific (PASP)	2	NA
AFI	Remote Sensing	2	4.118
GWA	Research Notes of the American Astronomical Society	1	NA
AFI	Restoration Ecology	1	2.826
AFI	Science of The Total Environment	2	5.589

Research Area	Journal	Number of publications	Impact factor
GWA	The Astrophysical Journal	32	NA
GWA	The Astrophysical Journal Supplement Series	1	NA
AFI	Transactions of the ASABE	1	1.153
AFI	Water	2	2.524
AFI	Water: Special Edition	6	2.524
AFI	Wetlands	1	1.854
GWA	White Paper submitted to Astro2020 (2020 Decadal Survey on Astronomy and Astrophysics)	1	NA
AFI	Wilson Journal of Ornithology	1	0.634

Impact factors in blue indicate a score higher than 2.00

a. NA indicates no impact score was available, possibly because the journal is new or the application to receive an impact factor was denied.

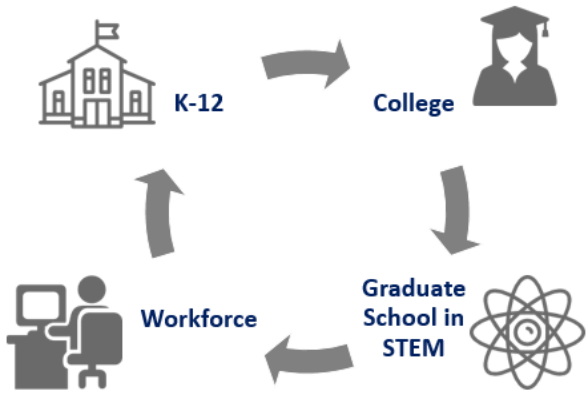
Figure 11. Journal publications with impact factor by research area

Summary of AFI and GWA research

Overall, the EPSCoR project is continuing to make progress in their respective research goals, by completing 70% of the research subactivities for year 5 (61% for AFI and 100% for GWA) while 24% were still in progress at the time of the annual report. This project is also making notable contributions to the fields of AFI/GWA as evidenced by the large number of publications and presentations. Consistent with previous years, the GWA research group had more publications and in higher impact journals than AFI. However, AFI conducted more presentations. The number of publications found in Web of Science using the project ID nearly doubled from year 4 (67 to 115), suggesting that researchers have been more consistently using the project ID when submitting publications. However, given the number is significantly lower than the total publications reported in the project, project and technical leads should continue to remind researchers to use the project ID. Sixty-six percent of annual survey respondents as well as most of the interviewees noted that they have been able to expand their research and gain new knowledge and skills through the project. Additionally, the majority of interviewees noted that the project has facilitated cross-disciplinary work, which has led to collaborative publications or proposals. However, interviewees also shared that a challenge they faced was a lack of cohesion across research groups, which is consistent with findings from evaluations in previous years and the NSF site visit report in 2018. Half of interviewees shared that the two research groups were in two distinct, unrelated research areas, making collaboration challenging. This was further supported through the annual progress survey where only 10 non-AFI respondents indicated that they collaborated with the AFI group and four non-GWA respondents indicated that they collaborated with the GWA group. During the no-cost extension year, the Executive Leadership Team (ELT) should continue to look for more ways for the project participants to collaborate across research areas to create a better sense of project cohesion, such as through the education components of the project.

Progress made by education and workforce development for K-12 and general communities (goal 3 objectives 1-4)

The Education and Workforce Development (EWD) initiatives of the EPSCoR project fit within a circular pipeline. The aim is to host Kindergarten through twelfth grade (K-12) outreach events and improve STEM education in K-12 classrooms to increase enthusiasm for STEM among K-12 students, who in turn are recruited to pursue undergraduate STEM degrees. Training and education at the undergraduate level will hopefully influence undergraduate students to pursue STEM graduate degrees. By training all students, the program hopes to successfully build a STEM workforce in West Virginia, including STEM teachers, who receive training through early career teacher courses, one-day workshops, and summer research experiences to improve STEM education in the K-12 classrooms. This is done through the work done in five objectives areas. This section of the report focuses on objectives 1-4, which are aimed at educating K-12 and general communities. Objective 5, which is focused on educating student researchers, is addressed in the following section of the report. Objectives 2-4 include summaries from previous evaluation reports. For information about these findings, see The Mark's October 2019 Activity Evaluation Report and two January 2020 Activity Reports on Early Career Teacher (ECT) courses and Project Based Learning (PBL) workshop and follow-up course.



Objective 1: Enhance the continuing education/professional development of high-quality science teachers entering the field

In order to enhance the professional development of high-quality teachers entering the field, the EWD group has been working to create a requirement that pre-service teachers must have authentic research experience in order to complete their degree. To date, all three lead institutions (WVU, MU, and WVSU) have made it a degree requirement. One interviewee noted that one of the greatest achievements of the project was providing opportunities for teachers to conduct research. Notably, nearly all teacher follow-up survey respondents (96%) who attended the summer research experience agreed that it contributed to their confidence in their abilities to teach STEM. This demonstrates that making a research experience a requirement for early career teachers and providing them with an opportunity to conduct authentic research may help to improve their confidence and quality of teaching. As the project progresses, education leads plan to transition these research experiences for pre-service teachers off NSF EPSCoR funding and institutionalize them within each university.

Objective 2: Support early career teachers in learning to teach through studying their teaching, thereby increasing teacher retention during the most vulnerable period of a teachers' career

Early Career Teacher course

In order to support early career teachers, those who have taught for ten years or less, the EPSCoR project offered courses to teachers. These courses aimed to support them in learning to teach through studying their own teaching and to enable teachers to build professional learning communities (PLCs). Ten teachers completed the series of three courses, starting in Spring 2019 and ending in Fall 2019. Of the teachers who responded to evaluation surveys (n=10), all (100% in the Fall course) indicated that they were very or extremely likely to implement the skills they gained into their own classrooms, which included using daybooks for themselves and their students, having students collaborate and engage with each other, and other strategies they learned from the courses. Respondents also shared they would implement teaching methods learned and would incorporate more student assessment. Three respondents (60%) indicated that a barrier to implementing what they learned was student needs and behavior. Two indicated that time constraint was a barrier for them. Providing an opportunity for teachers to discuss best practices may help them brainstorm and learn strategies to overcome these barriers.

ECT course survey respondents noted that their abilities increased after completing the courses. These skills included the ability to: construct/frame suitable research questions that might explore your practice, students, and context; create narratives through inquiry and reflection that provide insight into experiences and knowledge; and create spaces for readers of their narratives to question and learn, and to enact, reflect, and create narratives that document the stances/poses to inform your teacher identity. Respondents also shared that the most important takeaway from the course was reflecting on their own teaching.

All who attended the West Virginia Science Teachers Association (WVSTA) conference found it very or extremely useful and feedback throughout the survey indicated that teachers appreciated networking and learning from each other. Instructors should consider potential ways for teachers to meet in person at an additional time during the semester and continue to provide the opportunity to attend the WVSTA conference. Although the COVID-19 pandemic may impact the opportunity to do this during the upcoming year of the project, these findings highlight the importance of networking through the course.

A breakdown of participation in the in-person activities associated with the ECT course is shown in Figure 12. Based on project tracking data, all teachers who were enrolled in the summer ECT course attended the in-person mentor retreat. Additionally, based on survey findings with teachers who attended the summer workshops, 13 indicated that they developed PLCs through the workshop,

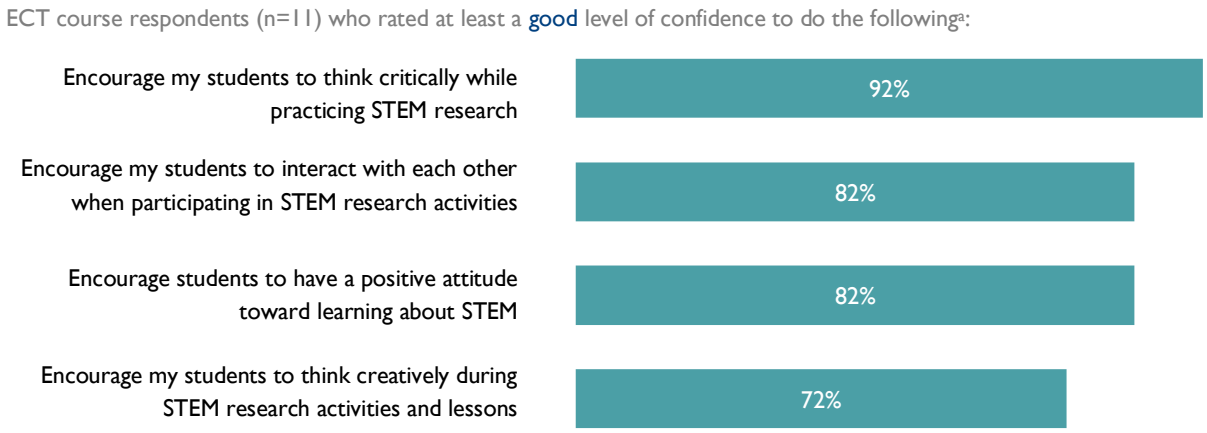
exceeding the target of 10. These findings suggest that the project has met or exceeded its participation targets for the ECT course activities.

Event	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 4 status	Year 5 proposed
# teachers attending PLC mentor retreat	14 | 6	14 | 14	14 | 12	14 | 14	✔	14
# EC elementary & secondary teachers who developed PLCs from summer workshops	14 | 8	10 | 14	10 | 12	10 | 13	↑	10

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

Figure 12. Early-career teacher course activity participation by year

Evaluators administered a follow-up survey to teachers who participated in the ECT courses, and of the survey respondents (n=12), 75% reported that they were still teaching STEM, and 17% reported that they were still teaching but not as a STEM teacher. This teacher retention rate (92%) is greater than the retention rate in West Virginia for first-time teachers within four years of their teaching career (68%) reported by the Regional Education Laboratory[17]. Notably, all ECT respondents who were still teaching (n=11) agreed that they had the ability to teach STEM and that teaching was professionally engaging for them. The majority of respondents also rated the confidence in their ability to engage students in learning as at least good, suggesting that the course has helped to support teachers in STEM instruction. Three respondents commented that the ECT courses contributed to their confidence because the courses provided tools and resources for classroom teaching



[a]On a scale of minimal, fair, moderate, good, extensive.

Figure 13. ECT course follow-up respondents' ratings of their confidence in abilities

[17] https://www.wvpublic.org/post/study-third-wva-teachers-leave-within-4-years#stream/0

Project Based Learning workshop and follow-up course

In addition to the ECT courses, WVU added a Project Based Learning (PBL) workshop in year 3, which taught teachers how to use the method of PBL in their classroom to engage students. Twenty-five teachers participated in the 2019 PBL workshop, and 20 of them completed the workshop follow-up survey. All survey respondents stated that they implemented and planned to continue implementing PBL in their classroom. At least half of the respondents (50%-85%) stated that they were able to implement various PBL elements into their classroom after participation in the course/workshop. Respondents also reported that their students have shown increases/improvements in cognitive development, motivation, engagement, and participation after they implemented PBL elements. While the majority of respondents (95%) stated their students were more engaged with the use of PBL in the classroom, some respondents identified students' absence, lack of participation in class, or lack of understanding of the material or project (8 respondents), time constraints (5 respondents), and internet/technology issues (4 respondents) as challenges to the implementation of PBL in the classroom. Seven respondents suggested that having access to information like resources, workshops, or chat groups would be helpful for continued support.

Objective 3: Engage pre-service and early-career teachers in authentic research experiences

Recruitment in research activities for K-12 teachers

Figure 14 shows proposed recruitment targets for each of the project years. The year 4 column contains the proposed and actual numbers achieved during the fourth year of the project. Because all activities will take place in summer, year 5 actual numbers cannot yet be reported. The project has made great success in year 4 by exceeding (↑) or meeting almost all its recruitment goals.

Event	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 4 status	Year 5 proposed
Summer research experiences						
Recruit mentors (WVU)	10 | 10	10 | -	10 | 10	10 | -[a]	-	10
Recruit mentors (MU)	4 | 5	6 | 5	6 | 6	6| 7	↑	6
Recruit mentors (WVSU)	4 | 7	4 | 4	4 | 4	4 | 3	✓	4
Recruit students (MU[b])	4 | -	6 | -	6 | 6	6 | -[a]	-	6
Recruit HS students (MU)	None | 5	None | 5	None | 6	None | 7	↑	None
Recruit in-service teachers (WVU)	5 | 8	5 | 3	5 | 13	5 | 21	↑	5
Recruit in-service teachers (MU)	4 | 5	6 | 3	6 | 6	6 | 7	↑	6
Recruit in-service teachers (WVSU)	2 | 2	2 | NA	2 | 3	2 | 3	↑	2
Recruit pre-service teachers (WVU)	5 | 3	5 | 1	5 | 3	5 | 5	✓	5
Recruit pre-service/EC teachers (MU)	4 | 5	6 | 7	6 | 6	6 | 7	↑	6
Recruit pre-service teachers (WVSU)	2 | 2	2 | 4	2 | 1	2 | -[a]	-	2

Event	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 4 status	Year 5 proposed
Workshops						
Project Learning Tree[c] participants	15 | 15	15 | 13	15 | 14	15 | 28	↑	15
GLOBE workshop participants (MU)	15 | 21	15 | 20	15 | 15	15 | 15	✔	15
GLOBE workshop participants (WVSU)	15 | 12	15 | 13	15 | 15	15 | 15	✔	15

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

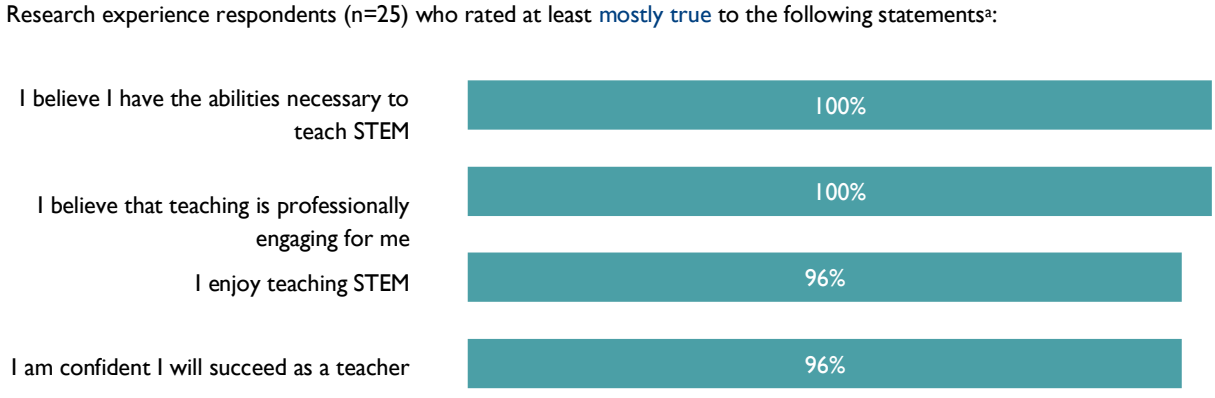
a. Data is unavailable for year 4.
b. It is unclear if these students were to be recruited as mentors or participants; no data available on progress
c. This activity was formerly known as Project Water Education for Teachers (WET) workshop.

Figure 14. Teacher recruitment targets by year

Summer research experiences for teachers

Teachers who participated in summer research experiences and responded to evaluation surveys (n=34) showed statistically significant increases in their understanding of the basics of conducting scientific research and the long-term process involved in research as a result of participating in the summer research experience. However, respondents had more difficulty discussing with students how STEM research is connected to their daily life compared to other abilities, such as incorporating research principles in the classroom and leading research in the classroom. This suggests that although teachers are learning how to conduct authentic scientific research, they may not be able to immediately connect it to the classroom setting with students.

Notably, as shown in Figures 15 and 16, on the teacher follow-up survey, nearly all respondents who attended the research experience agreed that that they were motivated to teach STEM and that they had a good level of confidence to teach STEM. These percentages for motivation to teach STEM and confidence in their abilities to teach STEM are higher compared to the percentages seen in respondents who participated in the ECT courses, which demonstrates that research experiences are highly beneficial to early career teachers.



[a]On a scale of not at all true, slightly true, somewhat true, mostly true, very true

Figure 15. Research experience follow-up respondents' ratings of their motivation to teach

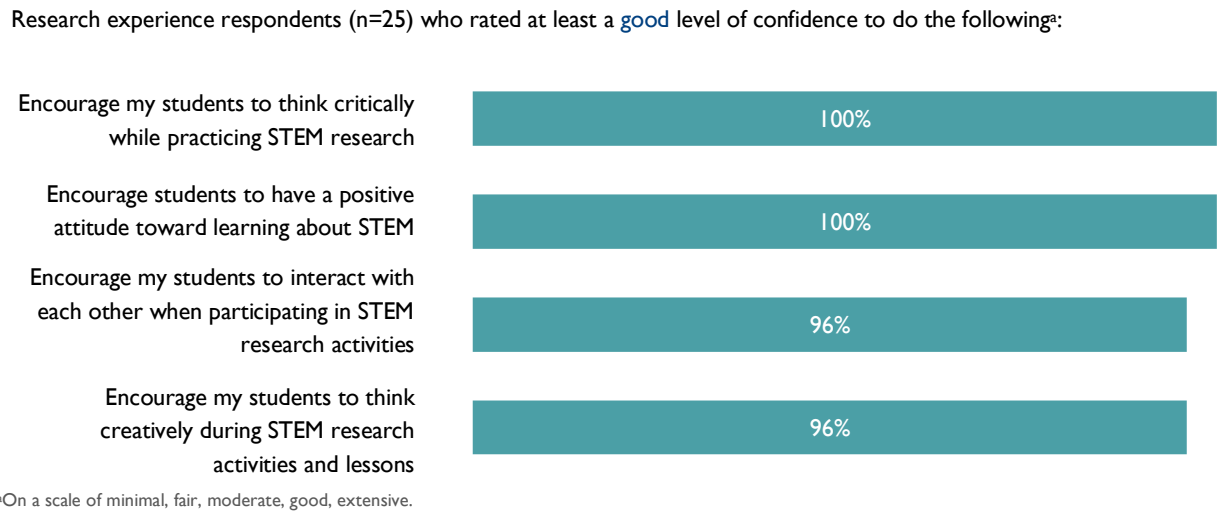


Figure 16. Research experience follow-up respondents' ratings of their confidence in abilities

One-day teacher workshops

EPSCoR conducts two different one-day workshops: Global Learning Observations to Benefit the Environment (GLOBE) and Project Learning Tree (Project WET in years 1-3). Both introduce teachers and other educators to international science curriculum and hands-on activities that they can bring back to their classroom or school. All Project Learning Tree participants and 92% of GLOBE respondents were at least very likely to implement what they learned in the classroom. About one third of respondents from both workshops (36%) planned to implement water sampling activities over all the other activities. Three quarters of respondents (75%) from both programs said that they would like to have continued support in the classroom from program leads. Respondents requested additional materials, more training, and classroom visits from trainers.

Objective 4: Engage the community to disseminate information about target science research areas

The EPSCoR project proposed to host various K-12 outreach events each year, including festivals at MU and outreach presentations at local schools. These outreach activities help to bridge the gap between the two project research areas (AFI and GWA) and provide an avenue for participants in both research areas to work together on project-wide goals for education, diversity, and partnerships. As shown in Figure 17, overall, the project exceeded its targets to engage the public to disseminate the project science through AFI Science Public Outreach (SPOT) presentations and through the Water Festival in Fall 2019. In year 4, the project reached 1,376 students at 30 schools through outreach festivals at Marshall University. In year 5, the project conducted 22 presentations through SPOT and reached over 200 middle school and high school students through the Pulsar Search Collaboratory (not shown in figure below). Water Festival survey results revealed that learning about the water cycle and pollution were the most useful for students' learning of science. Five more respondents at the Sky Festival shared that the weather station, including its presenter, was the most useful station. Teacher

respondents indicated that they would implement what they learned at the festivals in the classroom by expanding on and discussing the topics in their classrooms. Six Sky Festival respondents in year 4 shared that they would use an activity from the presentations in their classroom; most mentioned the register tape/solar system activity. Notably, one-third of project interviewees shared that the outreach activities were one of the greatest accomplishments of the project. Interviewees shared that the project enabled them to devote more resources to support outreach initiatives. These results demonstrate the success these activities have had over the years to disseminate science from the different research areas.

"Promoting the outreach aspect was great. Usually [there is] not enough time to do so."

Event	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 5 proposed | actual	Year 5 status
Festivals/events						
Water Festival, Marshall University (September)	Schools: None[a] | 5 Teachers: 10 | 5 Students: 200 | 210	None | 7 10 | 7 200 | 269	None | 6 10 | 13 200 | 218	None | 12 10 | 12 200 | 280	None | 18 10 | 18 200 | 276	↑
Brain Expo, Marshall University (April)[b]	Schools: None | 9 Teachers: None | 11 Students: None | 523	None | 12 None | --[d] None | 758	None | 10[c] None | 64 None | 806	None | 11[d] None | --[d] None | 796[d]	None None None	--
Sky Festival, Marshall University (April/May)[e]	Schools: None | 1 Teachers: NA[f] | 1 Students: NA | 60	None | NA 10 | 18 200 | 266	None | 7 10 | 20 200 | 360	None | 7 10 | 18 200 | 300	None 10 200	--
Science/Space Public Outreach Talks (SPOT) presentations						
Presentations at schools (GWA)	20 | 9	20 | 3	20 | 99[g]	20 | 42[g]	20 | 3	↓
Presentations at schools (AFI)	NA	NA	5 | 35	5 | 40	5 | 35	↑
SPOT expansion to Water in West Virginia talks						
Recruit/train undergrad students	NA	NA	2 | 5	2 | 8	2 | 7	↑
Give water talks at K-12 schools	NA	NA	3-5 | 14	3-5 | 59	3-5 | 15	↑
Do-It-Yourself (DIY) sensors						
Recruit WVU undergrad students	NA	NA	2 | 0	2 | NA[h]	2 | NA[h]	--
DIY sensor workshops	NA	NA	5 | 1	5 | NA[h]	5| NA[h]	--

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. None= no target listed in strategic plan

b. Brain Expo in year 4 took place in April, and therefore data was not available in the year 4 annual report. The Brain Expo in year 5 was cancelled due to COVID-19.

c. In addition to the 10 elementary schools reached, 37 students from the local homeschooling community and two groups of students from various schools in Campbell County attended.

d. Number of teachers unknown at time of evaluation report.

e. Sky Festival in year 5 was cancelled due to COVID-19.

f. NA= no target listed for that year.

g. GWA presentations included those conducted by NANOGrav (61 in year 3 and 4 in year 4) and the Invisible Universe 2.0 presentations (58 in year 3 and 38 in year 4). Twenty of the 99 presentations in year 3 combined the NANOgrav presentations and Invisible Universe 2.0.

h. This activity was not conducted in year 4. Education leads are working on developing water stations in every county in West Virginia as an alternative activity.

Figure 17. Outreach activity targets by year

Summary of K-12 and community outreach

Overall, the project exceeded its targets to engage the public through science training workshops, festivals, events, and SPOT presentations/recruitment in year 5. Teachers, especially pre-service and early career teachers, benefited from the project. Respondents from activity surveys indicated that they gained new knowledge and skills in both pedagogy and STEM research to implement in the classroom. Teacher survey respondents also shared that networking and learning from other teachers were a benefit of the activities, suggesting that providing opportunities for teachers to continue to meet as a learning community can further support them in their careers. Follow-up surveys with past teachers demonstrated that the activities had a positive impact on their confidence in and motivation to teach STEM. This also possibly resulted in a higher retention rate where 92% of follow-up survey respondents were still teaching compared to the state average of 68%. To further support teachers, survey respondents suggested that trainers provide additional materials, training, and classroom visits following the activity.

Progress made by education and workforce development for student researchers (goal 3 objective 5)

Undergraduate and graduate student recruitment

In addition to training K-12 teachers and conducting outreach to K-12 students, the EPSCoR project proposes to improve training and education at the undergraduate (UG) and graduate student (GS) level. Specifically, the project aims to increase undergraduate student interest in pursuing STEM graduate degrees and prepare students for the STEM workforce. Figure 18 shows the proposed recruitment targets for each year of the project and actual numbers achieved during the past five years of the project. The project exceeded its student recruitment targets throughout the project including year 5. However, findings from the project interviews suggest that students have been siloed within their research tasks. Students shared during the interviews that they were disconnected from the big picture of the project. They noted that they were unaware of overall project goals and the organizations behind the efforts. However, students also shared that when they had a chance to attend the all-hands meeting or the Water Symposium, they learned more about the broader vision of the project. This suggests that it would be helpful to invite students to the larger project meetings to help integrate them more into the overall project.

Workforce pipeline	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 5 proposed | actual	Year 5 status
Recruit a total of 2 postdocs (project overall)	None[a]	None | 9	None | 2	None | 4	None | 6	↑
Recruit a total of 8 PhD/MS students (project overall)	None	None	None | 23	None | 27	None | 32	↑
Recruit AFI Master's students	2 | 9	2 | 68	2 | 22[b]	2 | 6	2 | 10	↑
Recruit AFI undergrad students	3 | 10	3 | 26	3 | 41	3 | 39	3 | 51	↑

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. None signifies that the total of 2 postdocs and PhD/MS students are the totals across the five years of the project, therefore there are no yearly targets listed.

b. AFI recruited 22 graduate students in year 3. However, it is unknown how many are Master of Science (MS) students compared to Doctor of Philosophy (PhD) students.

Figure 18. Undergraduate and graduate student recruitment targets

Preparedness to enter the STEM workforce

Mentorship received

Postdoc, graduate, and undergraduate respondents (n=55) indicated whether they had received mentorship from faculty advisors, postdoc advisors, graduate advisors, and/or experienced peer mentorship on different aspects of their research, academic and career planning, and communication with scientists and the community. Most respondents indicated that they received mentorship in defining a researching project (87%), collecting and analyzing data (82%), preparing to attend scientific meetings (82%), and communicating with other researchers (80%). Fewer respondents indicated that they received mentorship related to working with industry partners (communicating with industry members, 40%; and preparing to attend meetings with industry partners, 29%). These findings are expected given that students are less likely to be involved with industry partners in the project. See Appendix C for a full list of tasks in which respondents received mentorship.

Respondents rated the usefulness of mentorship they received in 14 activities, regardless of who their mentor was, on a scale of not at all useful (1) to extremely useful (5). Evaluators averaged items to create three composite scores: mentorship related to (1) academic and career planning, (2) research activities, and (3) communicating and networking. As shown in Figure 19, overall, respondents rated the mentorship they received for research activities higher than mentorship for academic and career planning and communicating and networking. Notably, URM (n=7-8) and female (n=15-18) respondents rated the mentorship they received higher than the overall average of all respondents, suggesting that the project is helping to support underrepresented students in STEM. However, URM and female respondents rated the mentorship they received for communicating and networking slightly more useful than academic and career planning. This possibly suggests that mentors are helping to support underrepresented students in communication but should focus more on academic and career planning. This is especially important as project diversity goals focus on retention of

underrepresented groups in STEM. Overall, the majority of respondents (74% of 50) were satisfied with the amount of time they met with their mentor/supervisor. However, four of the nine postdocs (44%) and seven of the 21 (33%) GWA respondents indicated that they would like more time. Respondents shared that to improve mentoring in this project, it would be helpful to have increased communication and have junior personnel oversee trainees, with senior personnel advising, to help increase the number of supervisors. One respondent also suggested providing training to faculty on how to mentor graduate students, and particularly help them encourage graduate students.

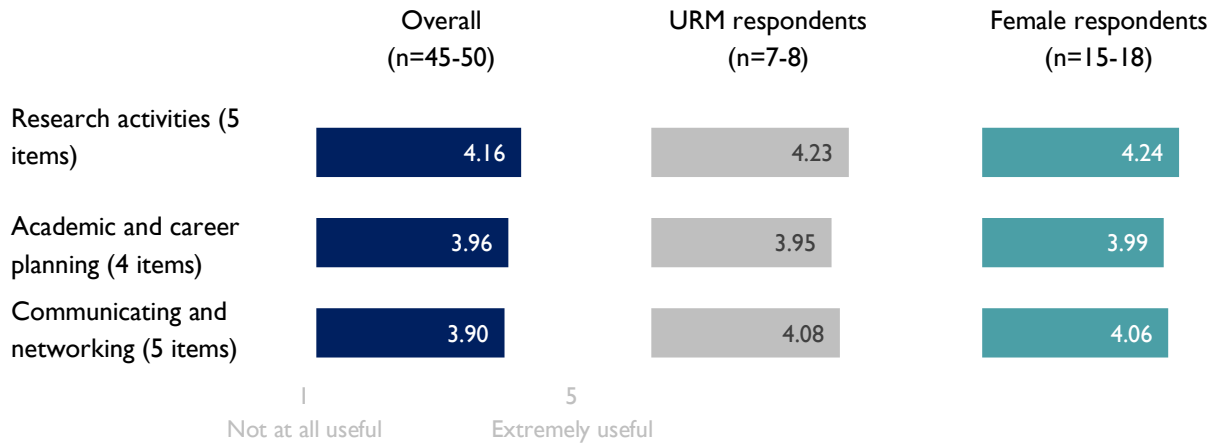


Figure 19. Survey respondent ratings of usefulness of mentorship activities

Benefits of mentoring

Thirty-nine respondents shared how mentoring others (either as a supervisor or as a peer mentor) has helped them. Of those 39, 16 shared that it enabled them to develop personal leadership and mentoring styles. Thirteen shared that mentoring others enabled them to expand their own research. Other benefits of mentoring included improving knowledge and skills for their own research project (4 respondents), time management skills (3 respondents), communication skills (3 respondents), satisfaction of seeing students excel (3 respondents), and increased collaborative work (1 respondent). These findings suggest that mentorship has had a positive impact on respondents.

Student training opportunities

Half of the project interviewees shared that one of the greatest accomplishments of the project was that it provided opportunities for student training. Student interviewees noted that participating in the project allowed them to attend conferences and meetings and attend career workshops to help them polish their resumes. In response to evaluator recommendations in year 4 to facilitate cross-project collaboration through data analysis workshops for students, project leads encouraged students from both research areas to take advantage of the Python programming workshops organized by the Associate Vice President for Research at WVU. A graduate student

> "I am getting skills in outreach. I am able to talk to people who are working on the education aspect. I learned a lot about how to reach out to high school students and structure the workshop."

supported by GWA was the instructor for some of these workshops in which both AFI and GWA students have participated in the past. GWA also produced tutorials on their data analysis methods which can be utilized for undergraduate students in both GWA and AFI. Although there was no formalized career panel planned as part of the overall project as recommended in year 4, interviewees shared that students have had the opportunities to attend career workshops at their respective institutions. Both student and faculty interviewees mentioned that the project has been helpful in preparing students for research careers. Nearly all student interviewees stated that they were able to learn about new opportunities within the field by participating in the project. They shared that these opportunities as well as working on the project helped facilitate learning new skills for both research (e.g. coding, analysis, microbiology, chemistry) and communication (e.g. presenting, conducting outreach). These findings suggest that the project has helped student participants prepare for STEM careers in both research and industry.

Internships and other off-campus research experiences

Eleven of 42 (26%) graduate and undergraduate student respondents indicated that they had participated in an internship or off-campus research experience, 10 of whom were underrepresented persons. Of those 11 respondents, 10 indicated that they had the skills needed to conduct their work at their internship. Eight of the 10 indicated that the EPSCoR project helped them learn those skills through working on their thesis, communicating with advisors and researchers, and learning to code. Despite only 11 respondents participating in internships, 86% of all student survey respondents indicated that they feel confident in applying for an internship, including all 16 undergraduate respondents, and 74% indicated that they know where to find information about internships. These findings suggest that although respondents feel confident in applying for internships, few have participated. Continuing to build relationships with industry partners and the Industry Advisory Board may help to not only open opportunities for internships for students, but also allow students to engage with industry partners or the Industry Advisory Board which may help them understand the benefits of internships and motivate them to participate in one.

Perceptions of feeling prepared

Of 42 graduate and undergraduate student respondents, 88% plan to pursue a career where their STEM degree is utilized, with the remaining respondents indicating that they were unsure. Notably, 62% of the 42 respondents indicated that they felt very or extremely prepared to enter the STEM workforce, including all undergraduate student respondents. However, a higher percentage of non-UREP respondents (78% of 9) compared to UREP respondents (58% of 33) indicated that they felt very or extremely prepared. This may suggest that UREP students may need more support in academic and career planning, consistent with URM and female respondents rating the usefulness of mentorship in academic and career planning lower than that of mentorship in research or networking. Although a high percentage of respondents plan to pursue a career in STEM and feel prepared to, only 45% indicated that they believe jobs are available in their field in West Virginia. This percentage is lower among graduate student respondents compared to undergraduate student respondents (31%

vs. 69%). Project leads and mentors should consider identifying whether there is a shortage of job opportunities for graduate level professionals in West Virginia and communicate the results to students to help them understand what options are available. Additionally, they should consider hosting career panels with employers in West Virginia. By helping to connect students to internships and career panels with employers in West Virginia, students may have a better understanding of the opportunities available in West Virginia.

Grade point average (GPA) at EPSCoR institutions

Evaluators also assessed GPA to examine preparedness to enter the workforce. At an institutional level, there has been a steady increase in students' GPA as they progress toward graduation across the three main institutions (MU, WVSU, and WVU), with a range of 1.63-3.09 in their freshman year to 2.69-3.29 by their senior year, meeting the average minimum GPA needed for graduate school in STEM (2.50). This demonstrates an improved readiness for graduate school among undergraduates at each of the institutions. Of the 20 undergraduate student annual survey respondents, the average GPA was 3.56, which is higher than the average at all three institutions. This possibly suggests that EPSCoR students may be more prepared than other students at their institutions. At EPSCoR institutions, female students had a higher average GPA (2.77-3.34) in Spring 2019 compared to male counterparts (2.65-3.08). On the other hand, the undergraduate male survey respondents (n=11) had a slightly higher GPA (3.63) compared to female undergraduate survey respondents (3.55, n=9). Additionally, students from low-income households at EPSCoR institutions (2.28-3.11) had lower GPAs than students who were not from low-income households (2.66-3.26). These findings suggest that at the EPSCoR institutions, more support may be necessary for low-income students, such as tutoring, to help prepare them for graduate school and/or the workforce

Graduation within four years at EPSCoR institutions

In Spring 2019, 1,645 undergraduate students graduated from Marshall University and 282 graduated with a STEM degree. At WVU, 4,420 undergraduate students graduated in Spring 2019, 1,408 of which were in STEM. At WVSU, 342 undergraduate students, including 31 STEM students, graduated in Spring 2019. Of the STEM undergraduate students who graduated in Spring 2019 at MU and WVU,[18] less than half (45% and 44%) completed their bachelor's degree within four years. At MU, this percentage was higher than the university level (38%), whereas for WVU it is the same as the percentage of all students who graduated within four years. Notably, among the Spring 2019 female STEM graduates at MU, 59% graduated within four years, whereas 36% of the male STEM graduates graduated within the same time frame. At WVU, 57% of the female STEM students and 37% of the male STEM students finished their undergraduate program within four years by Spring 2019. These findings suggest that female students majoring in STEM are likely to graduate within a shorter time frame than male students.

[18] The number of students graduating with a STEM degree from WVSU in Spring 2019 was too small to share data. Therefore, WVSU is not included.

Past student participant retention in STEM

Sixty-nine percent of the 308 students w have been tracked over the course of this project were still in STEM, either in school or working as of January 2020. (See Appendix D for complete list of student tracking.) A higher percentage of graduate students were still in STEM compared to undergraduate students. This is expected as they are more established in their fields than undergraduate students. Notably, a higher percentage of GWA graduate students remained in STEM (95%) compared to AFI (80%), but a higher percentage of AFI undergraduate students (65%) remained in STEM compared to GWA (59%). Although this could not be disaggregated by UREP status because the tracking data did not include demographic information, this indicates a high percentage of retention in STEM for project participants.

Student tracking	AFI (n=221)				GWA (n=74)				EWD (n=14)				Total (n=308)[a]			
STEM status	STEM		Non-STEM/ NA		STEM		Non-STEM/ NA		STEM		Non-STEM/ NA		STEM		Non-STEM/ NA	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	156	71%	65	29%	57	77%	17	23%	1	7%	13	93	214	69%	94	31%
Student status																
UG	90	65%	48	35%	22	59%	15	41%	1	20%	4	80%	113	63%	66	37%
GS	66	80%	17	20%	35	95%	2	5%	-	-	9	100%	101	78%	28	22%
University																
Marshall	71	59%	49	41%	4	67%	2	33%	-	-	6	100%	75	57%	56	43%
Shepherd	-	-	-	-	2	33%	4	67%	-	-	-	-	2	33%	4	67%
WVSU	23	74%	8	26%	-	-	-	-	1	100%	-	-	24	75%	8	25%
WVU	62	89%	8	11%	50	93%	4	7%	-	-	7	100%	112	85%	19	15%
WVWC	-	-	-	-	1	13%	7	88%	-	-	-	-	1	7	13%	88%

a. One student was both AFI and EWD group areas and is counted in both sections.

Figure 20. Student tracking (n=308)

Implementation of knowledge and skills gained from EPSCoR

On the 2020 student follow-up survey, respondents shared how they have used the knowledge and skills they gained from the EPSCoR project in their current coursework, research, and/or careers and how participating in EPSCoR influenced their career plans. Almost all of the follow-up respondents (24 out of 25) said that they had used the knowledge and skills from EPSCoR in classes, jobs, or research. Nine respondents (38%) further explained that they used the data analysis skills in research, and seven respondents (29%) said they used data analysis skills in their classes. Two respondents (8%) said that the skills they learned helped them get a job, and two respondents (8%) said that they learned soft skills or research design skills that would help them in future research. The majority (80%) said that their participation in EPSCoR influenced their research and/or career interests. Six of 20 (30%) respondents elaborated that they found out the type of research they wanted to pursue, and six other

respondents (30%) said that they had a furthered interest in pursuing STEM research or a STEM career. However, two respondents (10%) said that they discovered that they do not want to pursue research after participating in the EPSCoR program. Of the five student follow-up respondents who said that their participation in EPSCoR did not influence their research and/or career interests, three said that it was because they already had solid research and/or career goals before participating in EPSCoR. These results possibly indicate that the program helped to retain students in STEM research and/or careers and that the program helped students further their research or careers by giving them applicable skills.

Summary of education and workforce development for student researchers

In year 5, the project continued its success in exceeding the recruitment targets for undergraduate and graduate students. Interviewed students appreciated the opportunities to attend conferences and career workshops, through which they were able to further develop their professional skills and receive feedback on their resumes. Overall, student respondents from the annual survey found the mentorship they received useful. They rated the mentorship they received for research activities higher than mentorship for academic and career planning and communicating and networking. Additionally, 62% of student survey respondents indicated that they felt prepared to enter the STEM workforce and 86% indicated that they would feel confident applying to an internship. These findings suggest that the project has helped students to feel prepared through its different training opportunities. At the institutional level, undergraduate students' average GPA increased each year, demonstrating increased preparedness for graduate school. Notably, female students' average GPA was higher than male students' average GPA at all three institutions. Additionally, of MU undergraduate students who graduated in Spring 2019, the percentage of those who graduated within four years was higher for STEM students (45%) than the university-wide percentage (38%). Notably, of students tracked through the project, 69% were still retained in STEM and nearly all (24 out of 25) follow-up survey respondents indicated that they have been able to implement what they learned from the EPSCoR project in their current academic studies or career. Interviewees also shared the desire to be more informed with the big picture of the project, as they showed a lack of understanding towards the overarching project vision, goals and the organizations behind these efforts. Project leads thus should consider including students or student representatives in large project meetings and sending students updates on project progress and achievements.

Progress made toward expanding project diversity (goal 4)

Recruitment strategies

Interviewees shared that the project increased their awareness of the need for diversity among participants.
One interviewee mentioned the importance of having a diverse faculty, as it provides a role model for students.
Three quarters of interviewees discussed the recruitment strategies they implemented during the project to recruit diverse participants, including:

"Everyone engaged recognizes the value of recruiting diverse students, first generation or other underrepresented groups. Students will eventually get PhD and be placed at university and attributes that in part to EPSCoR community outreach. The project has been impactful in that way."

- Participating in and holding outreach events (e.g. Weather stations and physics events in High Schools, tabling at conferences (American Astronomical Society), holding Conference for Undergraduate Women in Physics)
- Reaching out to diverse groups (e.g. Engaging women in general, having diverse staff to recruit diverse students)
- Creating institutional opportunities to encourage discussion of diversity (e.g. Diversity, Equity, and Inclusion journal club, Diversity Inclusion Committee)
- Encouraging diversity in established activities (e.g. asking teachers to bring one boy and one girl to summer camp)
- Tailoring recruitment messages for diverse groups

Interviewees also identified engaging participants with diverse backgrounds in summer camp and building a good network to recruit first generation college students as the most effective strategies while recruiting diverse participants.

In addition to the strategies listed above, annual survey respondents also shared that funding and scholarship opportunities as well as mentorship were successful strategies in recruiting and retaining students, particularly underrepresented minority/underrepresented population students. Ten non-student[19] annual survey respondents (19% out of 52) commented that they found that funding or scholarship opportunities were successful strategies in recruitment, and seven (13%) said that mentoring or professional development were successful strategies for recruiting students. Similarly, seven of 24 student annual survey respondents (29%) indicated that funding was a successful strategy in recruiting them into the program, and five respondents (21%) indicated that mentorship and professional development were successful strategies in recruiting them to the program. As shown in the demographics section of the report, the project overall increased the number of URM participants, demonstrating these strategies have been successful in recruiting more diverse participants.

[19] Non-student annual survey respondents include any respondents who were not undergraduate or graduate students.

Diversity of participants in project activities

Diversity of participants in outreach activities

The project aims to use outreach activities to increase college awareness and increase the pool of URM/UREP students in college. Figure 21 shows the participation of diverse students in project outreach activities[20] and respective proposed targets for each year of the project and the actual numbers achieved. The project met or exceeded most of its diversity targets in year 5, with the exception of presenting at schools with high UREP/URM populations and recruiting undergraduate students for SPOT - GWA.

Objective	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 5 proposed | actual	Year 5 status
Recruit undergraduate UREP/URM students for SPOT-AFI	None | NA[a]	None | NA	1 | 15	7 | 8	1 | 1	✔
Recruit undergraduate UREP/URM students for SPOT-GWA	12 | NA[b]	12 | NA	13 | 13	15 | 6	16 | 2	↓
Present SPOT-AFI at schools with large populations of UREP/URM students	None | NA	None | NA	3 | 9	3 | 16	3 | 7	↑
Present SPOT-GWA at schools with large populations of UREP/URM students[c]	4 | 0[d]	6 | 2	8 | 23	10 | 23	12 | 7	↓
Involve UREP/URM student leaders in PSC[ef]	25% | 0%	25% | 18%	25% | 60%	25% | NA	25% | 25%[g]	✔
Involve female student leaders in PSC[ef]	50% | 33%	50% | 27%	50% | 60%	50% | NA	50% | 50%[g]	✔
Recruit residential assistances from undergraduate UREP/URM/female students working in GWA for PSC[ef]	3 | NA	3 | 1	3 | 4	3 | NA	3 | 3[g]	✔

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. None | NA = no target listed for that year and actual number for that year not applicable.
b. NA = data not available to evaluators at time of report, when target is listed.
c. Reporting form may not have been up to date and number of presentations might actually be higher.
d. In 2015-16, only one school was reached, but this school did not have a large URM/UREP population. However, data for this school were from the 2010-11 academic year.
e. Data collected only from survey respondents at Pulsar Search Collaboratory (PSC) each year. Only race/ethnicity and gender data were collected.
f. PSC activities occur during the summer. Therefore, reporting is one year behind.
g. Data for year 5 on the PSC were provided through project milestone tracking. Exact numbers were not provided, but tracking indicated that targets were met.

Figure 21. UREP and URM student participation in activities by year

[20] Outreach activities also include DIY Sensor Workshop and a climate and hydrology workshop. However, these were not implemented during year 4 and are therefore not included in the table.

Recruitment of diverse students to research activities

In addition to recruiting diverse students to outreach activities, the project aims to recruit diverse students to its research activities. Over the past five years, the project has consistently met or exceeded most of its targets for recruitment of diverse students in research activities, as shown in Figure 22. In year 5, the project exceeded all of its targets, with the exception of recruiting veteran students. However, this information may be underreported and should therefore be interpreted with caution. These findings suggest that the project has been successful in recruiting diverse students to the research areas, helping to contribute to diversity in their respective fields.

Objective	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 5 proposed | actual	Year 5 status
Recruit graduate UREP/URM students AFI	1 | 12	1 | 4	1 | 9	1 | 23	1 | 11	↑
Recruit undergraduate UREP/URM students AFI	1 | 15	1 | 7	1 | 7	1 | 18	1 | 21	↑
Mentor UREP/URM AFI undergraduate students	None[a] | NA	2-3 | NA[b]	None | 4[c]	None | 16	None | 51	↑
Recruit undergraduate and graduate UREP/URM students to GWA	2 | 6	2 | 12	2 | 0	2 | 4	2 | 8	↑
Recruit veteran students	None | 0	None | 0	None | 2	1 | 3	1 | 0[d]	↓

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target

a. None | NA = no target listed for that year and actual number for that year not applicable.
b. NA = data not available to evaluators at time of report, when target is listed.
c. The number of mentored URM/UREP AFI students was identified through the annual progress survey. This number may be higher than indicated.
d. The number of veteran students was identified through project tracking data. However, there was limited data on student demographic information. Therefore, this number may be higher than presented.

Figure 22. UREP and URM student participation in research activities by year

Recruitment of teachers at schools with diverse populations

Education leads also aimed to recruit teachers from schools with large UREP/URM populations to increase the college awareness of diverse students and therefore increase the pool of diverse students. As Figure 23[21] shows, over the past four years the project has consistently exceeded its targets to recruit early career and in-service teachers from schools with high URM/UREP populations, suggesting that the project has excelled in this area.

[21] Numbers and percentages presented in this figure are calculated following the project definition, that schools with more than 30 percent of students receiving free or reduced lunch are considered as schools with larger UREP/URM populations. The average ratio of students receiving free/reduced lunch in West Virginia is 45% for high schools (see: https://high-schools.com) and 51% percent for elementary and middle schools (see: https://elementaryschools.org). By that definition, the project has recruited 50% of the early career teachers and 27% of the in-service teachers from schools with large UREP/URM populations in year 4.

Objective	Year 1 proposed | actual	Year 2 proposed | actual	Year 3 proposed | actual	Year 4 proposed | actual	Year 4 status	Year 5 proposed
Involve science teachers from schools with larger UREP/URM populations in PSC	10 | 6	10 | 5	10 | NA[a]	10 | 11	↑	10
Recruit EC teachers from schools with large UREP/URM populations	30% | 60%	35% | 81%	40% | 81%	45% | 82%	↑	50%
Recruit in-service teachers from schools with large UREP/URM populations	30% | 76%	35% | 83%	40% | 87%	45% | 78%	↑	50%
Recruit teacher mentors from schools with large UREP/URM populations	None | NA	2 | NA	2 | NA	2 | 3	↑	2

✔ indicates the project met its target. ↑ indicates the project exceeded its target. ↓ indicates the project did not meet its target
a. NA = data not available to evaluators at time of report, when target is listed.

Figure 23. Recruitment of teacher participants from schools with diverse populations

UREP retention in STEM

The EPSCoR project aims to increase diversity of the STEM workforce by not only recruiting diverse participants, but by also retaining them in STEM. To assess retention in STEM, evaluators examined retention in STEM from institutional data and whether past student participants are still engaged in STEM. Evaluators assessed overall student retention and then disaggregated by gender to understand how retention for UREP participants compares to non-UREP participants. Data on URM participants and other underrepresented groups were small. Therefore, the data could not be disaggregated at those levels.

Institutional data from MU and WVU revealed that male freshmen are more likely to continue their study in STEM the next year compared to female freshmen. At MU, 61% of male first-time full-time students who started as freshmen in STEM majors in Fall 2018 remained in STEM until Fall 2019, whereas 52% of female STEM students were retained. At WVU, 65% of male students and 59% of female students who started as freshmen in STEM majors in Fall 2018 were enrolled as STEM majors in the next academic year. Although male students are more likely than females to be retained from freshman to sophomore year, a higher percentage of females than males graduated within 4 years with a STEM degree in Spring 2019 as referenced earlier in the report. This indicates that while females graduate sooner, there is more work that is needed to retain females in their first year of college.

Past student participant retention in STEM

On the student follow-up survey respondents, 40% (10 of 25) were working, six respondents (24%) were in an undergraduate program, and nine (36%) were in a graduate program. The majority of those working (nine of 10) indicated that they were employed in a science-related field. There was a higher proportion of UREP respondents (five of five) who were working in a STEM-related field compared to non-UREP respondents (four of five). All of the respondents in graduate school were pursuing a degree in a STEM field. There was no difference in the type of degree pursued by underrepresented minority status, as respondents were studying in a wide variety of STEM fields, which can be seen in the figure below. These findings suggest that retention in STEM is high among past students, for both UREP and non-UREP students.

Student follow up respondents (n=19)[a]	UREP (n=8)		non-UREP (n=11)	
	#	Field	#	Field
Current graduate students (n=9)	3 (38%)		6 (55%)	
Doctoral 5 (56%)	2 (67%)	• Plant and soil sciences • Water resources	3 (50%)	• Bio-hydrology • Physics • Biochemistry
Masters 3 (33%)	1 (33%)	• Wildlife and fisheries	2 (33%)	• Applied mathematics • Ecology
MD program 1 (11%)	--	--	1 (17%)	• Medicine
Currently working (n=10)	5 (63%)		5 (45%)	
STEM field 9 (90%)	5 (100%)	• Biology • Bridge (structural) engineering) • Medical devices • Molecular medicine • Science[b]	4 (80%)	• Biological sciences education • Instructional design • Software • School[c]
Non-STEM field 1 (10%)	--	--	1 (20%)	• Entertainment

a. Undergraduate students were not asked their current field of study.
b. Respondents did not elaborate further.

Figure 24. Follow-up survey respondents' (n=19) current academic and/or career status and fields by UREP and non-UREP status

Summary of project diversity

Over the past 5 years, the project has consistently met or exceeded its targets for the engagement and recruitment of diverse students and teachers at schools with diverse populations, with a few exceptions (e.g. the unmet number of SPOT-GWA presentations at schools with large populations of UREP/URM students and the unmet number of veteran students recruited in year 5). Notably, of the respondents on the student follow-up survey, all UREP respondents were working in a science-related field while one non-UREP respondent was working in a field not related to science. Since a higher percentage of males were retained in STEM within one year compared to females at two of the lead institutions, project leads should consider focusing efforts on providing support to female students during their first year to help retain them in STEM.

Developing and enhancing partnerships (goal 5)

Current partnerships

During year 5, the project overall had 107 total partner institutions,[22] from 26 states and 11 countries, a slight decrease from year 4 (114 partner institutions) and from year 3 (157 partners). This demonstrates that although the project has a wide array of collaborating partners, project participants should continue to work on sustaining the partnerships they have. Of the 107 partner institutions, AFI collaborated with 39 and GWA collaborated with 70. The majority of partner institutions' contribution to the project was collaborative research (86%), followed by outreach (16%), and facilities (9%).[23] Other contributions included financial support, in-kind support, personnel exchanges, and data collection. Project tracking also showed that work with collaborators resulted in new proposals, publications, research findings, and outreach to the community. An AFI interviewee also shared that through collaboration, the Department of Environmental Protection hired project students as interns and let them work on important environmental projects. Students were thus able to build connections at an early stage which can lead to jobs. These findings suggest that working with partners helped to advance research and education in the AFI and GWA fields. Although collaborations with industry or commercial firms decreased from since year 3, the ELT is working toward formalizing Industry Advisory Board during the no-cost extension year, which is anticipated to increase the number of industry partners in the project.

Type of partners	Year 1[ab]	Year 2	Year 3	Year 4	Year 5
Academic research institutions[c]	10	15	93	79	69
Historically Black Colleges or Universities	2	2	5	--	--
Primarily Undergraduate Institutions	0	2	12	5	2
National/federal government	4	1	22	6	19
Government	2	1	5	4	5
Schools/school systems	0	3	1	3	3
Nonprofit	2	2	10	9	8
Foreign federal government	0	1	1	1	--
Industry or commercial firm	1	0	8	4	2
Other organization (foreign or domestic)	--	--	--	3	1
Total	21	27	157	114	107

a. Marshall University did not provide partnership information in year 1. Therefore, number of partnerships in this year may actually be higher.
b Partnerships were tracked differently in year 1. Year 1 partnerships were re-categorized to match year 2 categories (i.e. academic research institution, international academic institution, Historically Black Colleges or Universities, etc.) for consistency.
c. Academic research institutions include research institutions not only across the state, but also national and international partnerships.

Figure 25. Number and types of partnerships

[22] There may be multiple collaborators at an institution and multiple project participants may be collaborating with the same institution. Each institution is only included once. Partner institutions also exclude EPSCoR participating institutions.
[23] Some partner institutions have made multiple contributions to the project and therefore have been double counted, resulting in contributions totaling over 100%.

Partnerships with national labs

The project is on track with its activities to build partnerships with national labs. According to benchmark and milestone tracking, four undergraduate and two graduate students are conducting research with National Radio Astronomy Observatory (NRAO) and three graduate students are interning with Naval Research Laboratory (NRL) or another national laboratory.[24] These relationships should continue to be fostered though the industry engagement plan. This will help to ensure these collaborations are sustained and continue to improve workforce development for students by providing them with internship and research opportunities.

Outcomes of working with partnerships

About a third (31%) of annual survey respondents indicated that they developed partnerships or worked with partners (i.e. industry, government, etc.) through the EPSCoR project. Of the annual survey respondents who said they worked with partners or developed partnerships, 27 commented on how partnerships they developed through the EPSCoR project influenced their thinking and/or approach to their work or research. Eleven respondents (41%) indicated that partnerships brought awareness of industry needs, helped them develop their research, gave them the opportunity for outreach, or generally helped them. Eight other respondents (30%) explained that partnerships gave them access to data or new samples and the ability to share ideas or resources. Additionally, four respondents (15%) commented on how the partnerships that they formed led them to better value the role of industry and other partnerships in their work or research. This indicates that the formation of partnerships through the project was useful for advancing research and outreach efforts as well as helping respondents value partnerships with industry more after their experience.

Industry Advisory Board engagement

"Hopefully the advisory board and industry people will have those contacts. We've really only had 1 meeting with 2 members. It's unfortunate that we didn't have that earlier."

At the 2017 all-hands meeting, project leads discussed the development of an Industry Advisory Board. Evaluator and NSF site visit recommendations in 2018 included formalizing the Industry Advisory Board to help build and strengthen collaborations with industry partners. In 2019, project leads worked with an industry engagement lead to develop an action plan and the Industry Advisory Board met for the first time at the 2019 all-hands meeting. According to the project leads, the Industry Advisory Board has met with each research team during Fall 2019. However, a missed opportunity identified by many interviewees was having an engaged industry board that provides advice and facilitates partnerships. Interviewees noted that it would have been helpful to meet with an Industry Advisory Board sooner in the project to help build collaborations and receive guidance on research needs in the industry. To address this concern, since March 2020, the Executive Leadership Team (ELT) has been meeting with the industry engagement lead to refine the industry engagement plan. They have discussed action items, assigned tasks and

[24] The benchmark and milestone document lists the subactivity as interns at NRL or another national laboratory. It is unknown at which national laboratory these students are interning.

identified someone accountable for those tasks, re-evaluated goals, and adjusted the timeline based on the progress.

Of the 87 annual respondents (asked of everyone except undergraduate students), 15% reported that they engaged with the Industry Advisory Board for the project. Although only 15% engaged with the board, they shared that it was beneficial because of the opportunities for collaboration (four respondents), the discussion and research advice (three respondents), and the increased understanding they gained of the work that needs to be addressed (two respondents). See Figure 26 for a full list of types of engagement and benefits from engagement with the Industry Advisory Board. Despite only 13 respondents indicating that they engaged with the board, 41% who did not engage with the board shared that they would have liked to, indicating that as this is being developed in the supplemental year, it will be important to continue to reach out to researchers to ask them if they would like be involved. Eight of 41 respondents (20%) who said that they would not have liked to engage with the advisory board explained that they were not sure what the advisory board was. Additionally, 12 respondents (29%) said they were too busy, and eight (20%) said that their research was unrelated to industry. Two possible reasons for the low engagement with the industry board are: (1) that the industry board was not formed until late in year 4 and (2) a lack of awareness of the board or of how their research relates to the industry. Four respondents who engaged with the advisory board suggested that the board needs clear objectives and a clear structure to be sustained after the EPSCoR project ends.

Industry Advisory Board engagement (n=13)	
Types of engagement	• Attended meetings (6 respondents) • Gave presentations or research talks (3 respondents) • Had discussions or developed plans (2 respondents) • Were members of the industry advisory board (2 respondents)
Benefits of engagement	• Collaboration opportunities (4 respondents) • Discussion and research advice (3 respondents) • Increased understanding of work that needs to be addressed (2 respondents) • Understanding of the importance of AI to make connections (1 respondent) • Creating opportunities for students (1 respondent) • Unsure/not much gain (2 respondents)

Figure 26. Respondents' engagement with Industry Advisory Board

Summary of partnerships

The project had 107 partnerships from 26 states and 11 countries during year 5, which is a slight decrease from year 4, suggesting that the project should continue to work on sustaining the partnerships it develops. Although the Industry Advisory Board was developed at the end of year 4, it was not early enough in the project. Interviewees noted that this was one of the most significant missed opportunities of the project. Only 15% of survey respondents indicated that they were engaged with the Industry Advisory Board, and of those who were not engaged, 41% shared that they would like to be. The ELT is working to refine the goals for the industry engagement plan and adjust the timeline for the no-cost extension and supplemental year to better utilize the Industry Advisory Board. Since collaboration tracking, interviews, and survey data revealed the benefits of partnerships (proposals, publications, advancing research and education outreach), acting on the industry engagement plan can help to sustain research in the AFI and GWA fields after project funding ends.

Project management

Research team management

Overall management of research areas

The majority of annual survey research respondents (73%-84%) indicated that they had at least a good understanding of the research objectives in their project area. Sixty-five percent of 49 AFI survey respondents and 89% of 27 GWA respondents indicated that management of their research area was very/extremely effective, and interviewees were generally satisfied with management of their research areas. Notably, all five AFI survey respondents who commented on management shared that they felt supported by research leads. Overall, research respondents were very or extremely satisfied with resource sharing within their objective and research area (54%-93%). However, fewer respondents were satisfied with resource sharing across institutions, suggesting that this is an area to focus on in the upcoming year of the project. A breakdown of respondents' satisfaction of resource sharing by research area can be found in Figure 27. Some interviewees shared that it might have been more helpful to have an automated process for reporting. A few interviewees also shared that although there were some challenges at the start of the project in terms of accountability and work assignment when someone left the project, it has gotten better in the last couple of years and the research teams are now on track. Interviewees also noted that focusing on infrastructure sustainability should be an important focus for project leads as funding ends.

Percent of respondents who are very/extremely satisfied	
Sharing resources across institutions	
AFI (n=56)	39%
GW (n=21)	76%
Sharing resources within research or project area	
AFI (n=62)	54%
GW (n=30)	83%
Sharing resources within objective area	
AFI (n=55)	61%
GW (n=29)	93%

Figure 27. Percent of respondents who were very/extremely satisfied with sharing of resources

Meeting effectiveness

At the end of year 4, evaluators recommended that research leads use collaboration calls to discuss ways to share resources across objectives and institutions as well as provide the agenda ahead of time so that people who are unable to meet can comment. Several interviewees noted that telecons have helped to facilitate collaboration across the project by discussing ideas and resources, suggesting that these topics have been incorporated regularly into telecons. However, less than half of the AFI survey respondents found AFI group meetings and cross-group meetings to be very/extremely effective (49% of 43 and 39% of 39, respectively). Notably, of the 27 GWA respondents, 78% indicated that meetings were very/extremely effective. Respondents provided the following suggestions for more effective meetings:

AFI meetings

- Distribute reports before and after meetings to share information
- Allow for networking opportunities during meeting for collaborations
- Have agendas

GWA meetings

- Have smaller, more focused meetings with research areas
- Increase the participation of graduate students and non-astronomers

Overall project management

"Top-up organization and management [was a challenge]. There needs to be better communication and better structure. The head needs to have a system that guarantees accountability for all the moving parts. At the beginning you need a solid structure for 'here's the task and here's the timeline.' We only discussed those when deliverables were due."

Annual progress survey findings throughout the project and the NSF site visit summary suggested that there had been consistent communication challenges during the course of this project. This may in part have been due to having two separate research areas in the project. As a result of the NSF site visit in 2018, project leads developed a communication structure designed to improve communication. Additionally, as recommended in previous evaluation reports to improve communication across the project to all levels and improve understanding of program objectives, the communications director at HEPC distributed quarterly newsletters to project participants highlighting research, education, and outreach achievements of the project as well as providing updates. However, on the annual progress survey, only 44% of 93 survey respondents were very/extremely satisfied with communication across the project and only 55% of 112 respondents had a good/extensive understanding of the overall project's objectives while the majority (63% of 80) were very/extremely satisfied with the overall project management. Suggestions to improve project management and communication are shown below.

Suggestions to improve overall project management:

- Provide clearer, concise communication (4 respondents)
- Promote collaboration/communication across institutes/disciplines (4)
- Assembling groups to expand project (2)
- Define project areas/project expectations (2)
- Promote collaboration/communication across institutes/disciplines and make aware the progress made (2)
- Need a centralized system for data collection (1)
- Provide training and support for mentors/members (1)

As part of the updated communication structure, project leads indicated that they would start including quarterly ELT calls and monthly calls with the co-PIs of the project. However, from April 2019 until March 2020, there was only one ELT meeting during the all-hands meeting. Notably, half of interviewees noted a lack of organization and miscommunication within the project. Interviewees shared that there was a lack of coordination of deliverables, absence of an effective communication system, and unclear distribution of responsibility. Interviewees were particularly concerned with the loss of information and misinterpretation occurred during the communication process, especially during cross-project collaborations. In February 2020, after the project director retired, a new director was hired at HEPC. Under the leadership of the new project director, the ELT has implemented regular meetings. Six of the seven (86%) ELT respondents indicated that the ELT meetings are very/extremely effective, and two shared that the meetings are more helpful now and they feel that they have more input on the project. Based on feedback from Spring ELT meetings, project leads attempted to consolidate the reporting process this year through the use of Google Docs, which helped facilitate the short turnaround of the report after the decision to apply for a no-cost extension.

Sustainability

The development of the Institute of Water Security and Science and the Center for Gravitational Waves and Cosmology at WVU will help to sustain research and education efforts for the respective research areas after the project. To further plan for sustainability, interviewees made several suggestions about what should be sustained and how to implement it. About one third of the interviewees planned to sustain their collaborations which have been created or strengthened through this project. GWA respondents shared their plan to use monthly meetings and telecons to stay connected with others for research. They also plan to sustain the collaboration through other existing collaborative activities, such as NANOGrav and PSC. AFI respondents reported that they will continue their relationships with external partners and use listservs to share job opportunities and project updates. The education leads interviewed would like to continue the collaborations as well, but they were unsure how to continue collaborating and what their role would be. To sustain the outreach activities, interviewees plan to follow up and stay connected with teachers who participated in the project (e.g. through a Listserv). They also plan to continue training teachers through opportunities such as the WVU Teach Research Methods course and incorporate teacher training into other programs. To sustain the project, mainly the research collaborations and outreach events, interviewees suggested (1) focusing on securing funding to maintain research efforts, particularly equipment maintenance, (2) continuing with regular meetings and possibly having HEPC provide funding for annual in-person meetings to help sustain collaborations, and (3) having engaged leadership to facilitate collaborations across the project and with industry partners. The WV EPSCoR project will proceed into a no-cost extension year and project leads plan to apply for supplemental funding, which will help to sustain infrastructure and education activities.

Twenty-eight out of 103 annual survey respondents (27%) commented that they would continue/build on their research/work after the project funding ends by continuing their research through another funding source. Additional 23 respondents (22%) said their new research area will continue but did not specify in what way it would continue. Ten respondents (10%) said they would use the methods and techniques they learned in future research. Out of eight education participants, three said they would continue the relationships they made, two said they would look for another funding source, two said they would provide resources or professional development to teachers, and one said they would continue to conduct training and outreach. Annual survey respondents were asked to describe how the development of new partnerships has helped the project's sustainability. Six of 38 respondents (16%) shared that the partnerships connected researchers to establish future collaborations. Five respondents (13%) said that partnerships gave access to data, new samples, and shared resources. Four additional respondents (11%) said that partnerships could possibly lead to new funding opportunities. These results show that partnerships with industry could help sustain the project by providing access to shared resources and new funding opportunities.

Evaluator recommendations

- **Continue to have regular ELT meetings to share project updates and ideas for sustaining project activities. Consider meeting monthly, or at least quarterly. Meetings should also include what and how information will be shared with others in the project to ensure consistent communication across the project.**
  - As a result of the NSF site visit in 2018, project leads developed a communication structure to improve communication, including quarterly ELT calls and monthly calls with the co-PIs of the project. While there was only one ELT meeting between April 2019 and March 2020, the ELT is beginning to meet more regularly. Having regular communication across project leads can foster cohesion within the project, ensure that targets remain on track during the no-cost extension/supplemental year, and address any issues as they arise.
  - On the annual progress survey, 63% of 80 respondents shared that they were very/extremely satisfied with overall project management, but only 44% of 93 survey respondents were very/extremely satisfied with communication across the project. Additionally, half of interviewees noted a lack of organization and miscommunication within the project. Interviewees shared that there was a lack of coordination with deliverables, absence of an effective communication system, and unclear distribution of responsibility. Interviewees were particularly concerned with the loss of information and misinterpretation during the communication process, especially during cross-project collaborations. Collaboratively identifying what and how information will be shared with others in the project will ensure consistent communication, leading to less misinterpretation or loss of information.

- **With the no-cost extension year, the ELT should continue to look for ways that the project can collaborate across research areas to create a better sense of project cohesion, such as through the education components of the project. Encouragement of collaboration through the education components could also help to sustain them after funding ends.**
  - The majority of interviewees discussed how the project has facilitated cross-disciplinary work leading to collaborative publications or proposals. These findings are consistent with the annual progress survey results showing that 66% of annual survey respondents (69 of 104) have been able to study new research topics since participating in the project. Such collaborations were identified as one of the greatest achievements of the project by half of the interviewees. However, interviewees also shared that a challenge they faced was a lack of cohesion across research groups. This is consistent with survey findings where only 10 non-AFI respondents indicated that collaborated with the AFI group and four non-GWA respondents indicated that they collaborated with the GWA group. Half of interviewees shared that collaboration was challenging because the two research areas were distinct and unrelated, indicating that collaboration across the project may need to occur through efforts outside of research tasks.
  - The project has been very successful in training teachers and conducting K-12 outreach events. Teacher follow-up survey respondents shared that they had increased confidence and motivation

to teach STEM after participating in EPSCoR activities. Additionally, teachers who responded to activity surveys in year 4 showed increased knowledge/skills in teaching STEM and conducting scientific research after participating in EPSCoR activities. The project has also exceeded the majority of its targets in K-12 outreach each year through festivals, SPOT presentations, and PSC, helping to expose K-12 students to science in the targeted areas. Helping to facilitate collaborations across the project through education activities could not only help to develop cohesion across the project, but also enable researchers and education team to stay connected after the project ends, leading to sustainability of education activities that lead to strengthened and diverse education-workforce pipeline.

- The NSF site visit report in 2018 and consistent feedback from evaluation findings suggested that there has been minimal cross-project collaboration, with the exception of education and outreach efforts. Notably, some interviewees shared that nearly all cross-project collaboration happened through education outreach activities. Similarly, of the 10 survey respondents who shared how they collaborated across research areas of the project, six shared that it was through education and outreach activities. Given the success of the education efforts, project leads should consider how to bring in researchers who have not yet worked with the education and outreach activities and help make connections to further cross-project collaborations.

➢ **Consider including student research presentations at the virtual all-hands meeting in 2020 and consider planning an additional student meeting during the no-cost extension/supplemental year where students can present their work and hear updates from project leads about the status of project activities.**

- In year 5 alone, the project reached 211 students. Close to 70% of past students from the project who were tracked are still in STEM and nine of the 10 student follow-up survey respondents who were working were working in STEM. Additionally, 62% of the 42 student annual survey respondents indicated that they felt very or extremely prepared to enter the STEM workforce, including all undergraduate student respondents. Although the project has consistently exceeded student recruitment targets and helped to train and retain students in STEM, findings from the project interviews suggest that students have been siloed within their research tasks. Additionally, student interviewees shared that when they had a chance to attend the all-hands meeting or the Water Symposium, they learned more about the broader vision of the project. Engaging students in whole-project activities can help them understand how their research ties to the larger vision of EPSCoR, which can help them feel more connected to the project and enhance their understanding of collaborative research.
- Overall, respondents rated the mentorship they received for research activities as more useful than mentorship for academic and career planning and communicating and networking, suggesting that this may be an area in which the project can provide more support. This can be done by having an avenue for students to present their research to and engage with other students and faculty in the project.

- Student interviewees shared they appreciated the opportunity to attend conferences and practice their presentation skills. They shared that these opportunities as well as working on the project facilitated learning new skills for both research (e.g. coding, analysis, microbiology, chemistry) and communication (e.g. presenting, conducting outreach). Providing an opportunity for students to present at the all-hands meeting, which may need to occur virtually in 2020 due to COVID-19, and potentially at an additional meeting in person when restrictions are lifted, will expose more students to the overall project as well as enable them to practice skills in communicating their research with others.

➢ Continue to formalize the Industry Advisory Board and ensure follow-through on tasks by discussing updates of the Industry Advisory Board at regular ELT meetings.

- During year 5, the project overall had 107 total partner institutions from 26 states and 11 countries, which was a slight decrease from year 4 (114 partner institutions). The majority of partner institutions' contribution to the project was collaborative research (86%), followed by outreach (16%), and facilities (9%). Other contributions included financial support, in-kind support, personnel exchanges, and data collection. Project tracking also noted that work with collaborators resulted in new proposals, publications, research findings, and outreach to the community, demonstrating that continuing to foster collaborations can help to provide resources to project activities, which will be important after funding ends.
- Project interviews revealed that a significant missed opportunity for the project is having an engaged industry board that could give advice and facilitate partnerships. Forty-one percent of survey respondents who were not engaged with the recently established Industry Advisory Board indicated that they would have liked to. Interviewees noted that it would have been helpful to meet with an Industry Advisory Board sooner in the project to help build collaborations and receive guidance on research needs in the industry. To address this concern, since March 2020, the Executive Leadership Team (ELT) has been meeting with the industry engagement lead to refine the industry engagement plan and to re-evaluate goals. These goals should continue to be evaluated to ensure that progress remains on track.
- While the majority of student survey respondents (n=42) indicated that they feel confident in applying for an internship (86%) and that they know where to find information about internships (74%), only eleven respondents participated in internships in year 5. Additionally, although a high percentage of the respondents plan to pursue a career in STEM and feel prepared to, only 45% indicated that they believe jobs are available in their field in West Virginia. This percentage is lower among graduate student respondents compared to undergraduate student respondents (31% vs. 69%). Working with the Industry Advisory Board would help connect students to internships and career panels with employers in West Virginia, which in turn will allow students to have a better understanding of the opportunities available in West Virginia.
- To sustain the project, mainly the research collaborations and outreach events, interviewees suggested focusing on securing funding to maintain research efforts. They suggested that

partnerships could lead to funding for activities. Annual survey respondents also shared that partnerships provided access to data, new samples and shared resources, and may lead to new funding opportunities (nine open-ended comments). These results show that partnerships could be a vital resources for sustaining the project. Formalizing the Industry Advisory Board and ensuring follow-through on tasks could potentially lead to efforts to sustain research and education activities after EPSCoR funding ends.

- **Continue to send the quarterly newsletter to further build cohesion across the project. Consider adding potential funding resources (such as websites for RFPs, grant writing workshops, etc.) to the quarterly newsletter to help participants identify opportunities for funding to sustain research and education efforts after the project ends.**

  - The AFI members interviewed shared that they were able to collect more data, develop new research questions and projects, make great contributions to their own research, and expand the number of sites used for water collection because of the project. GWA interviewees shared that the project helped them broaden research ideas, advance their research, and develop collaborations in new research areas. However, interviewees shared that one of the missed opportunities of the project was cross-project collaboration and learning about other aspects of the project. Continuing to use the newsletter to share updates on the project and also provide potential funding opportunities could help foster cohesion as well as help facilitate sustainability of the project's research activities.
  - To sustain project activities, interviewees suggested focusing on funding to ensure research infrastructure, particularly equipment, can be maintained. Interviewees noted that it would also be important for leads in the research areas to focus on how to sustain infrastructure after project funding ends. Using the newsletter to share funding opportunities and resources could facilitate efforts to secure funding to sustain these efforts.

Appendix A: Annual progress survey respondent demographics

Annual survey respondent demographics (n=122)	#	%[a]
Gender		
Female	49	40%
Male	71	58%
Do not wish to specify	1	1%
Other	1	1%
Racial/ethnic background		
American Indian or Alaska Native[b]	3	2%
Asian	10	8%
Black or African American	8	7%
Hispanic or Latino	8	7%
White (non-Hispanic or Latino)	92	75%
Other	-	-
Do not wish to specify	1	1%
Institution		
Marshall University	33	27%
Shepherd University	3	3%
West Virginia State University	20	16%
West Virginia University	63	52%
West Virginia Wesleyan College	1	1%
West Virginia Higher Education Policy Commission	2	2%
Research area		
AFI	74	61%
GWA	33	27%
ED/Administrator	15	12%
Role		
Faculty/University academic researcher	46	38%
Governmental agency employee	1	1%
Graduate student	30	25%
Postdoctoral fellow	10	8%
Professional staff	3	3%
Technician	3	3%
Undergraduate student	21	17%
Other	8	7%

a. Percentages might not equal 100% due to rounding.

b. One respondent ~~indicated that they were a mix of~~selected both American Indian and White and was placed in American Indian.

Appendix B. Student follow-up survey respondent demographics

Student follow-up survey respondent demographics (n=25)	#	%
Gender		
Female	9	36%
Male	14	56%
Do not wish to specify	2	8%
Racial/ethnic background[a]		
American Indian or Alaska Native	-	-
Asian	2	8%
Black or African American	1	4%
Hispanic or Latino	2	8%
White (non-Hispanic or Latino)	19	73%
Other	-	-
Do not wish to specify	2	8%
First generation college student		
Yes	6	24%
No	18	72%
Prefer not to answer	1	4%

a. Respondents could select more than one ethnicity. Therefore, the number of responses does not equal the n and total percentage does not equal 100%

Appendix C. Percent of annual survey respondents who indicated that they received mentorship in specified areas by research area, role, and UREP status

		Research area			Role in project			UREP status	
	Total	AFI	GWA	ED	Postdoc	GS	UG	UREP	Non-UREP
	(n=55)	(n=31)	(n=22)	(n=2)	(n=9)	(n=29)	(n=17)	(n=39)	(n=16)
Defining research project	87%	84%	96%	50%	89% (9)	86%	88%	82%	100%
Planning experiments	78%	87%	68%	50%	89%	76%	77%	74%	88%
Obtaining research supplies	73%	81%	64%	50%	78%	72%	71%	72%	75%
Collecting data	82%	90%	73%	50%	89%	72%	94%	80%	88%
Analyzing data	82%	81%	86%	59%	78%	79%	88%	77%	94%
Identifying further educational opportunities	58%	58%	59%	50%	56%	48%	77%	64%	44%
Identifying career opportunities	60%	55%	68%	50%	56%	59%	65%	59%	63%
Identifying stipend/fellowship opportunities	53%	58%	46%	50%	44%	41$	77%	51%	56%
Preparing to attend scientific meetings	82%	77%	91%	50%	89%	83%	77%	82%	81%
Planning for a career	62%	61%	64%	50%	78%	62%	53%	56%	75%
Communicating with other researchers	80%	87%	73%	50%	89%	72%	88%	77%	88%
Communicating with non-science community	53%	55%	50%	50%	44%	45%	71%	51%	56%
Communicating with industry members	40%	45%	36%	0%	33%	38%	47%	36%	50%
Preparing to attend meetings with industry partners	29%	36%	23%	0%	33%	31%	24%	28%	31%

Appendix D. Student tracking

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Paris	Adkins	adkinspe@mail.uc.edu	UG	x	x		x		YES - BS Biochem, May 2018	Enrolled in MD/PhD program at Univ. Cincinnati	
MU	AFI	Karah	Alberts	albertsk@marshall.edu	UG			x	x	x ?	Graduating from High School May 2019	Enrolled in MD/PhD program at Univ. Cincinnati	Studying Biology at WVU (Twitter and WVU Directory)
MU	AFI	Nicholas	Alexander	alexander50@marshall.edu	UG	x					YES - BS Comp Sci, May 2016	unknown	Software Developer at MedOne Systems, Marietta, OH (LinkedIn)
MU	AFI	Elizabeth	Allenger	allenger@marshall.edu	UG		x	x			YES	continuing UG studies at MU	
MU	AFI	Corey	Alley	alley32@marshall.edu	UG	x					YES - BS BSC, May 2016	Current MU medical school	
MU	AFI	Rachel	Arrick	arrick1@marshall.edu	GS		x	x	x		YES - MS May 2018	USDA Natural Resource Specialist, Monongahela National Forest, WV	
MU	AFI	Tanner	Bakhshi	backhshi@marshall.edu	GS				x	x	Yes - MD/PhD student in Biomedical Sciences		
MU	AFI	Katie	Barker	barker227@marshall.edu	UG				x	x	Yes	Enrolled at MU	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Joseph	Barton	barton33@live.marshall.edu	UG			x	x		YES - BS Env Sci, May 2018	unknown	Emergency Nurse at CAMC, Charleston, WV (LinkedIn)
MU	AFI	Zach	Baumgard	baumgard1@marshall.edu	UG		x		x		YES - BS BSC, May 2017	Medical School (Pikeville College of Osteopathic Medicine)	
MU	AFI	Allyson	Bias	bias110@live.marshall.edu	UG	x	x				YES - BS CHM, May 2016	MU Medical School	
MU	AFI	Nicholas	Bolin	bolin5@live.marshall.edu	GS				x	x	Yes - Pursuing his Master's in Biological Sciences		
MU	AFI	Kinsey	Booth	roberts289@live.marshall.edu	UG			x	x		YES - BS Biotech, May 2018	currently enrolled in MU Clinical Med Tech program	
MU	AFI	Andrew	Boyles	boyles24@live.marshall.edu	GS	x	x	x			YES	left the program, taking other courses at MU	
MU	AFI	Gabriel	Brown	brown1003@marshall.edu	UG		x	x			YES	enrolled at MU for Spring 2019	
MU	AFI	Ben	Browning	browning275@live.marshall.edu	GS					x	YES - MS student	enrolled at MU	
MU	AFI	Joshua	Burnette	burnette20@marshall.edu	UG			x	x		YES - BS BSC, May 2018	DVM/PhD student Miss State Univ	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Logan	Buzzard		UG					x	YES - Undergraduate		
MU	AFI	Austin	Carpenter	carpenter144@live.marshall.edu	UG	x	x				YES - BS BSC, May 2016	Started MS at MU, current status unknown	No information available (last LinkedIn position was summer 2017 - construction work)
MU	AFI	Samantha	Carter	carter342@marshall.edu	UG			x	x	x	YES - BS May 2019	enrolled at MU for Spring 2019, CHM and MTH double major	
MU		Franklin	Cavallo	fwc0004@mix.wvu.edu	UG			x	x	x	YES		
MU	AFI	Sonia	Chandi	chandi@live.marshall.edu	UG	x	x	x	x		YES - BS BSC, May 2017	WVU Medical School	
MU	AFI	Robert	Cooper	cooper239@live.marshall.edu	GS	x					YES - BS BSC, May 2014; MS BSC May 2016	Instructor of Biol Sci at MU	
MU	AFI	Taylor	Corbin	corbin18@marshall.edu	GS			x	x		YES	Current MS student (BSC)	
MU	AFI	Jessica	Crislip	crislip11@marshall.edu	UG				x		Yes		
MU	AFI	Zachary	Crow	crow24@marshall.edu	UG			x	x		YES - BS CHM, Dec 2017	Industry (Marathon Petroleum)	Lab Tech (FB)
MU	AFI	Jingxuan	Dai	daij@marshall.edu	UG			x	x		currently enrolled at Ohio State University, Biochem	currently enrolled at Ohio State University, Biochemistry undergraduate	UG in Computer Science, Rice University.

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
											istry undergraduate		
MU	AFI	Chris	Davenport	davenport19@marshall.edu	UG	x	x				unknown	unknown	No information available
MU	AFI	Diane	Dawley	dawleyd@marshall.edu	GS	x					YES - MD, May 2018	unknown	Resident - Vidant Medical Center, East Carolina University, emergency medicine
MU	AFI	Bryson	Dolly	bkd0007@mail.wvu.edu	UG					x	YES		
MU	AFI	Katherine	Duty		UG				x	x	Graduated May 2019		
MU	AFI	Geneve	Edwards	edwards166@marshall.edu	GS	x	x	x			Graduated 2018		
MU	AFI	Kessel	Erica	kessel13@live.marshall.edu	UG				x				
MU	AFI	Joseph	Folio	jmf0030@mix.wvu.edu	UG				x		YES		
MU	AFI	Kourtnie	Farmer	farmer73@marshall.edu	UG				x		graduated 2019	unknown	
MU	AFI	Alex	Foote	foote5@live.marshall.edu	GS				x		Yes	M.S. Biology/Biological Sciences program at MU	
MU	AFI	Ramin	Garmany	garmany@marshall.edu	UG		x	x	x		YES - BS BSC, May 2018	Medical School	
MU	AFI	Joseph	Hageman	hageman@marshall.edu	GS	x					No record of degree completion	Working as industrial microbiologist, Cincinnati, OH	
MU		Madison	Haddix					x	x	x	Yes		

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Maggie	Hager	hager130@marshall.edu	UG		x				YES - BS BSC, May 2018	Medical School (Marshall)	
MU	AFI	Michael	Harless	harless65@marshall.edu	GS			x	x		YES	Current PharmD student	
MU	AFI	Emily	Hatzel	hatzel1@live.marshall.edu	UG			x			YES - BS Biotech, May 2018	unknown	No information available (but now lives in Cattlesburg, KY)
MU	AFI	Andrea	Hensley	hensly164@marshall.edu	GS		x	x			YES -BS CHM, May 2016	entered BMS graduate program, current situation unknown	
MU	AFI	Aaron	Holland	holland45@live.marshall.edu	UG	x	x				YES - BS CHM, Dec 2016	Employed at Sofie Biosciences	
MU	AFI	Leigha	Holt	holt60@marshall.edu	UG			x	x		YES - BS CHM, May 2018	Pharmacy School in North Carolina	
MU	AFI	Gary	Huff	huff59@marshall.edu	UG			x	x		YES	BS BSC expected, Dec 2018	
MU	AFI	Kenneth	Humphrey	humphrey58@marshall.edu	UG			x			YES - Graduated BS May 2018	enrolled Medical School at MU	
MU	AFI	Jeanine	Janowski	janowski@live.marshall.edu	GS			x			YES - MS Forensic Sci, May 2017	unknown	Brewer at Victory Brewing Co., Charlotte, NC (FB)
MU	AFI	Cayman	Jarrell	jarrell122@marshall.edu	UG		x	x	x		YES - BS Biotech, May 2017	unknown	July 17, 2018 to present
MU	AFI	Emily	Jones	jones578@marshall.edu	GS	x	x	x	x		YES	Graduated MA Dec. 2018	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Shakirah	Keith	keith35@live.marshall.edu	UG			x	x		YES - BS Biotech, May 2018	unknown	
MU	AFI	Christopher	Kelly	kelly182@marshall.edu	UG		x				NO record of degree completion	unknown	
MU	AFI	James	Kessler	kessler42@marshall.edu	UG	x	x				YES - BA Spanish, Dec 2017	unknown	Attending Queen Margaret U in Edinburgh, Scotland (FB)
MU	AFI	Shefali	Khanna	khanna1@live.marshall.edu	UG	x					YES - BS BSC, May 2017	enrolled Medical School at MU	
MU	AFI	Rachel	King	king412@marshall.edu	UG			x			YES	MU Environmental Sci student	
MU	AFI	Daniel	Kipps	kipps2@marshall.edu	UG				x		YES		
MU		Tyler	Kisling	thk0004@mix.wvu.edu	UG								
MU	AFI	Emma	Kist	levinnielsen@marshall.edu	GS	x					YES - MS BSC, May 2016	Working for USACE, Huntington District	
MU	AFI	Manoj	Kumar	kumar26@live.marshall.edu	GS				x		YES		
MU	AFI	Cody	Lambert	lambert216@marshall.edu	GS		x	x	x		No, completed MS.	Grauated June 2019	
MU	AFI	Anna	Lefevre	lefevre7@live.marshall.edu	UG	x	x				YES - BS BSC, May 2016	MU Medical School	
MU	AFI	Brambilla	Luca	brambilla@live.marshall.edu	UG				x		YES		

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Yiannakis	Lysandrou	lysandrou@marshall.edu	Highschool/UG				x		Yes	PERT program participant. Now enrolled at Marshall and working in Markiewicz lab.	
MU	AFI	Venkata	Madala	venkata@marshall.edu	GS		x	x	x		YES - MS Env Sci, Dec 2017	SEEKING PH.D.	
MU		Claire	McDonald	cm0023@mix.wvu.edu	UG					x	YES		
MU	AFI	Shelby	McKeand	mckeand@marshall.edu	UG			x	x		YES - RBA July 2018	current MA student in Counseling program	
MU	AFI	Ellen	McNamara	mcnamara4@marshall.edu	UG		x	x			YES - BS BSC, Dec 2017	completed BS, taking additional coursework at MU	
MU	AFI	Nadye	Menking-Hoggatt	menkinghogg1@live.marshall.edu	UG	x					YES - BS BSC, Dec 2017	enrolled Medical School at MU	
MU	AFI	Ashley	Milgram	milgram@marshall.edu	UG			x	x		YES - BS, BSC Aug 2017	Applied to PA school, status unknown	Physician Assistant program, University of the Cumberlands
MU	AFI	Rubir	Moawad	moawad1@marshall.edu	GS		x				YES - PharmD, May 2018	PharmD student	
MU	AFI	Omar	Mohamed		UG				x	x	Graduated May 2019		
MU	AFI	Hunter	Monroe		UG				x	x	Graduated May 2019		
MU	AFI	Jada	Morton	morton35@marshall.edu	UG	x					YES - BS BSC, Dec 2017;	Starting MS program MU BSC Fall 2019	Business Development Rep. at N3, Charleston, WV (LinkedIn)

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
											BA Psych, Dec 2017		
MU	AFI	Sitora	Muhamedova	muhamedova@marshall.edu	GS		x				YES - PharmD, May 2018	Working as Pharmacist	
MU	AFI	Ashton	Mullens	mullens48@marshall.edu	UG				x	x	Yes	2018-19 president, MU Honors College Student Assn.	https://www.marshall.edu/honors/current-students/hcsa/
MU	AFI	Bradley	Muncy	muncy48@marshall.edu	UG				x		Yes	Working with Georgel as per Y4, Q2 report	
MU	AFI	Ethan	Napier	napier214@marshall.edu	UG				x		YES, BS Biochem, May 2021		
MU	AFI	Akhil	Parupalli	parupalli@marshall.edu	GS			x			No, completed MS.	Ramp Safety Coordinator, San Jose, CA, Airport	
MU	AFI	Vani	Pathuri	pathuri@live.marshall.edu	GS		x	x	x		YES - MS July 2017	Private sector work	No additional information available
MU	AFI	Annabella	Pauley	pauley233@marshall.edu	UG				x	x	BS Biochem, Graduated May 2019		
MU	AFI	Veda	Penta	penta1@live.marshall.edu	GS		x	x	x		YES	Current MS student (BSC); completion expected Dec 2018	
MU	AFI	Ian	Perry	Perry410@marshall.edu	UG				x		Graduated May 2019		Facebook: Forensic Scientist, WV State Police, June 2019-present

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Nichole	Perry	george94@marshall.edu	UG		x	x			YES	scheduled to graduate May 2019, applying to PhD programs in Environmental Science	
MU	AFI	Kathryn	Pitton	pitton@live.marshall.edu	GS			x	x	x	YES - Graduated BS May 2019	PhD at University of Kentucky	
MU		Lucas	Poe	lbp0001@mix.wvu.edu	UG					x	YES		
MU	AFI	Amber	Propps	propps1@marshall.edu	UG	x					YES - BS BSC, May 2016	unknown	Lab Tech at ALS, Charleston, WV (LinkedIn)
MU		Carney	Quek		UG			x	x		Graduated May 2019		
MU	AFI	Ana	Ramirez	ramirez9@live.marshall.edu	UG	x					YES - BS BSC, Dec 2016	Completed MS Tulane, LA, Masters of Public Health; Currently working in nonprofit sector Public Health, Monterey, CA	
MU	AFI	Mohammed	Ranavaya	ranavaya3@marshall.edu	UG	x					YES - BS BSC, May 2017	Current MU medical school	
MU	AFI	Joshua	Rawson	rawson7@marshall.edu	UG				x				
MU	AFI	Lauren	Reasor	reasor@marshall.edu	UG		x	x	x		YES	Graduated Fall 2018. Applying to PhD schools	
MU	AFI	Sarah	Reger	reger12@marshall.edu	GS		x	x	x		YES	PharmD student	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Austin	Richardson	richardso142@marshall.edu	UG			x	x		YES - BS BSC, May 2017	unknown	Hollywood Casino at Charles Town Races (https://www.facebook.com/ahrichardson.us)
MU	AFI	Austin	Riggs	riggs73@marshall.edu	UG	x					YES	Current MU Pharmacy school	
MU	AFI	Yasamin	Sadeghian	sadeghian@marshall.edu	UG		x	x	x		YES - BS BSC, May 2018	Graduate school (BMS at Marshall - applying to med school)	Accepted to Pharmacy School at Marshall University
MU	AFI	Lena	Salameh	salameh3@marshall.edu	UG			x	x		YES	enrolled at MU for Spring 2019	
MU	AFI	Eric	Saunders	saunders120@marshall.edu	GS	x	x				No record of degree completion	unknown	No information available
MU	AFI	Nathan	Shin	nathanshin@ucwv.edu	UG				x	x	Yes.	University of Charleston. New graduate student in Norton lab as per Y4, Q2 report.	nathanshin@ucwv.edu
MU	AFI	Brittany	Short	short101@marshall.edu	UG				x		Graduated May 2019		
MU	AFI	Sophia	Simental	simental3@marshall.edu	UG			x			YES	changed major to Visual Art	
MU	AFI	Danielle	Slone	slone111@marshall.edu	UG				x		YES, BS Biochem, May 2021		
MU	AFI	Anthony	Smith	smith2220@marshall.edu	GS	x					No record of degree completion	Working as industrial microbiologist, Columbus, OH	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Chelsea	Smith	smith1854@marshall.edu	UG	x	x		x		YES - BS BSC, May 2016	unknown	Sonographer in Charleston, WV (https://drpatton.com/sonographers/)
MU	AFI	Ethan	Smith	smith1876@marshall.edu	UG	x					YES - BS BSC, May 2018	unknown	No information available
MU	AFI	Hannah	Smith	smith1861@marshall.edu	UG		x	x			YES	BS Biochem expected Dec 2018	
MU	AFI	Mackenzie	Smith	smith2276@live.marshall.edu	UG				x		Yes	Schultz lab as per Y4, Q2 report	
MU	AFI	Ciara	Stanley	stanley149@marshall.edu	UG				x		Yes	Secondary Ed major at MU	
MU	AFI	Monica	Stanwick	stanwick1@marshall.edu	UG			x	x		YES - BS BSC, May 2018	Woodrow Wilson Georgia Teaching Fellowship at Mercer University in Macon, Georgia, Master's program 2018-19	Pursuing MA in Teaching - STEM Ed. at Mercer U, Macon, GA (FB)
MU	AFI	Rebecca	Thacker	thacker84@marshall.edu	UG	x	x				YES - BS BSC, May 2016	MU Medical School	
MU	AFI	Scott	Thiesfeldt	thiesfeldt@marshall.edu	GS	x	x				YES - MS BMS, May 2017	Currently enrolled in MU Medical School	
MU	AFI	Joel	Turley	turley37@marshall.edu	GS		x				YES - PharmD, May 2018	Working as Pharmacist	
MU	AFI	Vijaya	Valiveti	valiveti@marshall.edu	GS			x	x		YES	Benaroya Research Institute, VMI	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Ryan	Vincent	vincent43@marshall.edu	GS				x	x	Graduated MS in Physics December 2019	Took a job with nanotech company "DUST Identity"	
MU	AFI	Ian	Waddell	waddell20@marshall.edu	UG	x	x	x			YES	currently enrolled in Biochem program	
MU	AFI	Chris	Waldeck	waldeck13@marshall.edu	GS			x	x	x	BS Env Sci, Dec 2017; Graduated December 2019 Env Sci MS program	took job with environmental consulting company	LinkedIn: Staff Scientist at Alliance Consulting, Inc
MU	AFI	Tanner	Way	way4@marshall.edu	UG			x	x	x	YES - BS BSC, May 2018	currently enrolled in MU MS Biomedical Research program	
MU	AFI	Amanda	White-Smythers	white461@live.marshall.edu	GS	x	x	x	x	x	YES - Graduated MS May 2019	Fall 2019 started PhD at UNC Chapel Hill	
MU	AFI	Thomas	Whitlow	whitlow10@marshall.edu	UG		x	x			YES - BS Biotech, May 2018	unknown	Studies Molecular Genetics, Biochemistry and Microbiology at University of Cincinnati (FB)
MU	AFI	Sean	Wineland	wineland@marshall.edu	GS		x	x	x		MS May 2018	In PhD program at Oklahoma State	
MU	AFI	Pimporn	Wiwekin	wiwekwin@marshall.edu	UG				x		YES, BS Biochem, December 2019	unknown	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	AFI	Dana	Zeid	zeid2@live.marshall.edu	UG	x	x	x			YES - BA Psych, May 2016	PhD Student in Neuroscience at Penn State	
MU	AFI/Ed	Sydney	Harry	harry@live.marshall.edu	UG				x		Yes - Undergraduate		
MU	Ed	Taylor	Beaty	beatty19@live.marshall.edu	GS		x	x	x		YES - MS Forensic Sci, May 2018	unknown	Most Recent Position: Sales Associate at Under Armor (Sept. 2018; LinkedIn)
MU	ED	Jessica	Jacoby	Jacoby3@live.marshall.edu	UG			x			YES - BA, Secondary Ed, May 2017	unknown	No information available
MU	Ed	Olivia	Richardson	richardso158@live.marshall.edu	UG			x			YES	enrolled at MU for Spring 2019, Elementary Ed	
MU	Ed	Nathan	Young	Young398@marshall.edu	UG			x			No record of degree completion	unknown	No information available
MU	Ed	Rebekah	Zuberbuehler	zuberbuehler@marshall.edu	GS		x	x			YES	MA Ed expected Dec 2018	
MU	GW	Brandon	Allman	allman31@marshall.edu	GS		x				YES - PharmD, May 2018	Working as Pharmacist	
MU	GW	Omar	Bhatti	bhatti1@live.marshall.edu	UG				x				
MU	GW	Dillon	Buskirk	buskirk16@live.marshall.edu	UG		x	x			YES - BS PHY, May 2018	currently enrolled in MU MS PHY program	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
MU	GW	Ryan	Howell	howell101@live.marshall.edu	UG				x				
MU	GW	Emma	Lockyer	lockyer@live.marshall.edu	UG		x	x			YES	currently enrolled, BS PHY, BA French	
MU	GW	Emily	Sutherland	sutherland32@live.marshall.edu	UG		x				YES	enrolled at MU for Spring 2019, PHY	
MU	AFI	Abigail	Dropik	dropik@marshall.edu	UG					x	YES - Undergraduate	currently enrolled in Biology program	
MU	AFI	Bethany	Koontz	koontz30@marshall.edu	UG					x	Yes - Undergraduate	currently enrolled in Biology program	
MU	AFI	Parham	Ghafourifar	ghafourifar2@live.marshall.edu	Undergradaute Student					x	yes - Undergraduate	currently enrolled in Chemistry program	
MU	AFI	Kennedy	Snavely	snavely6@live.marshall.edu	UG					x	YES - Undergraduate	currently enrolled in Chemistry program	
MU	AFI	Coy	Smith	"Smith, Coy" <smith2493@live.marshall.edu>	UG					x	Yes- Undergraduate	currently enrolled in biology program	
WVU	AFI	Musfique	Ahmed	mfahmed@mix.wvu.edu	GS	x	x	x	x	x	Yes	Currently pursuing Ph.D. in Civil Engineering. GRA with Dr. Lian-Shin Lin.	
WVU	AFI	Ryan	Anders	randers@mix.wvu.edu	UG				x		Yes	Geology	
WVU	AFI	Angela	Anderson	aander38@mix.wvu.edu	GS	x	x				Yes	Currently pursuing DDM	
WVU	AFI	Joshua	Ankeny	jna0010@mix.wvu.edu	GS			x	x	x	No	Graduated May 2019 MS in Wildlife and Fisheries Resources	Linked In: Fisheries Technician, Tacoma Power - Sept 2019-present
WVU	AFI	Rifat	Anwar	ra0009@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing Ph.D. in Civil Engineering. GRA with Dr. Lian-Shin Lin.	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	AFI	Andrew	Arko	adarko@mix.wvu.edu	UG				x	x	No	Graduated BS December 2019. Forestry Technician at The Joseph W Jones Ecological Research Center.	
WVU	AFI	Jack	Bajerski	jnb0021@mix.wvu.edu	UG				x		Yes	Civil Engineering	
WVU	AFI	Emily	Bausher	emilybausher@gmail.com	GS		x	x	x		No	Graduated with MS in Geology in 2018. Currently working as an Environmental Technician for The Thrasher Group.	
WVU	AFI	Sam	Bearinger	scb0014@mix.wvu.edu	UG			x	x	x	Yes	Pursing graduate degree in Energy Environments	
WVU	AFI	Mathew	Bell	mlb0083@mix.wvu.edu	GS				x		Yes	Geology	
WVU	AFI	Maggie	Black	meb0033@mix.wvu.edu	UG				x		Yes	Research Apprentice Program (RAP) student, pursuing B.S. in Wildlife & Fisheries	
WVU	AFI	Levi	Canterbury	lhcanterbury@mix.wvu.edu	UG			x			No	Graduated August 2019 BS wildlife and Fisheries	
WVU	AFI	Joe	Carrara	jocarrara@mix.wvu.edu	GS				x		Yes	Biology	
WVU	AFI	Morgan	Carte	mpcarte@mix.wvu.edu	UG				x	x	No	Graduated May 2019 BS Wildlife and Fisheries Resources. Temp employee for West Virginia Department of Environmental Protection.	
WVU	AFI	Franklin	Cavallo	fwc0004@mix.wvu.edu	UG				x	x	Yes	Civil Engineering	
WVU	AFI	Molly	Chlovechok	mac0089@mix.wvu.edu	UG				x	x	?	Works in Ireland as a seal conservation technician.	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	AFI	Jillian	Clemente	jfclemente@mix.wvu.edu	UG				x		No	Graduated May 2019 Wildlife and Fisheries Resources Currently working at Hawk Mountain	
WVU	AFI	Connor	Cunningham	cycunningham@mix.wvu.edu	UG			x	x	x	Yes	Graduated May 2019 B.S. in Wildlife and Fisheries Resources. Pursuing a Master's in Fish Mangement at Missouri State University.	
WVU	AFI	Dongyang	Deng	ddeng@ncat.edu	GS	x	x	x			No	Associate Professor, North Carolina A&T State University (https://www.ncat.edu/employee-bio.php?directoryID=1533970704)	
WVU	AFI	Zachary	Dienes	zrd0003@mix.wvu.edu	UG				x	x	Yes	Graduated May 2019 BS Wildlife and Fisheries Resources. Started Master's at Iowa State University in August 2019.	
WVU	AFI	Autum	Downey	ardowney@mix.wvu.edu	UG		x	x	x		Yes	Graduated with her BS and is working toward her MS in Geology. Vesper. She had some summer funding on AFI but is not currently funded on the project.	
WVU	AFI	Justin	Earle	jaearle@mix.wvu.edu	GS			x	x		Yes	Currently pursuing MS in Forestry	

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WVU	AFI	Kevin	Eliason	kme0019@mix.wvu.edu	GS				x		Yes	Forest Resources Science	
WVU	AFI	Sarah	Frazier	skf0009@mix.wvu.edu	UG				x		Yes	Wildlife and Fisheries Resources	
WVU	AFI	Brandi	Gaertner	bagaertner@mix.wvu.edu	GS			x	x		Yes	Currently pursuing degree in Instructional Design at WVU. Assistant Professor of Environmental Sciences, Alderson-Broaddus University, Philippi, WV	
WVU	AFI	James	Giannone	jag0068@mix.wvu.edu	UG				x		Yes	Wildlife and Fisheries Resources	
WVU	AFI	Brian	Gordon	brg0007@mix.wvu.edu	GS			x	x		Yes	Currently pursuing MS in Wildlife and Fisheries Resources. Anticiapted graduation August2020.	
WVU	AFI	Jonathan	Gordon	jjgordon@mix.wvu.edu	UG				x		Yes	Wildlife and Fisheries Resources	
WVU	AFI	Luis-Andres	Guillen	luisguialm@gmail.com	GS		x	x	x		Yes	Currently pursuing MS in Forest Resources Science	
WVU	AFI	Madison	Haddix	mrh0031@mix.wvu.edu	UG				x	x	Yes	Civil Engineering	
WVU	AFI	Jimmy	Hartley	jrhartley@mix.wvu.edu	UG			x	x		No	Seasonal Marine Field Worker/Intern, Haskin Shellfish Research Lab, Rutgers University	
WVU	AFI	Zachary	Heck	zheck@mix.wvu.edu	GS				x		Yes	Forestry	

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WVU	AFI	Nicole	Hegele	nahegele@mix.wvu.edu	UG		x				Yes	Currently pursuing MS in Civil Engineering.	
WVU	AFI	Jason	Horne	jph0021@mix.wvu.edu	GS				x	x	Yes	Environmental, Soil & Water Sciences	
WVU	AFI	Lauren	Janowicz	lj0029@mix.wvu.edu	GS				x	x	Yes	Currently pursuing M.S. in Recreation, Parks, Tourism Resource Management	
WVU	AFI	James	Jones	jjones77@mix.wvu.edu	UG			x			No	Completed his BS in summer 2018	Lab Tech in Chemistry Dept. at Northrup Grumman Innovation Systems in Keyser, WV (email response)
WVU	AFI	Matthew	Kearns	mrk0015@mix.wvu.edu	GS			x			No	Environmental Resources Specialist at WV Department of Environmental Protection	
WVU	AFI	Ritika	Khurana	rk0022@mix.wvu.edu	GS			x	x		Yes	Currently pursuing a Ph.D. in Natural Resource Economics. Funded on a different project that better fits her research interests	
WVU	AFI	Joseph	Kimmet	jkimmet@mix.wvu.edu	GS					x	Yes	Energy Environments MS student working for Strager	
WVU	AFI	Lucas	Kinder	llmkinder@mail.wvu.edu	UG			x	x	x	Yes	Pursuing undergraduate degree in Energy Land Management	

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WVU	AFI	Garret	Layne	grl0005@mix.wvu.edu	UG				x		Yes	Wildlife and Fisheries Resources	
WVU	AFI	Kyle	Lee	kjlee@mix.wvu.edu	GS	x	x	x	x		no	Completed data collection and is currently writing his thesis.	
WVU	AFI	Lili	Lei	lilei@mix.wvu.edu	GS	x	x		x		Yes	Currently pursuing Ph.D. in Plant and Soil Sciences.	
WVU	AFI	Jonas	Leveque	jgleveque@mix.wvu	GS/Postdoc	x	x	x	x		No	Graduated with Ph.D. in Summer 2017. Worked as a postdoc at WVU for a year then returned to France. Currently serves as an Account Manager at Caisse Fédérale du Crédit Mutuel de Maine-Anjou et Basse-Normandi.	
WVU	AFI	Corey	Lilly	jclilly@mix.wvu.edu	UG		x				No	Manager of ACE Adventure Gear, Fayetteville, WV	
WVU	AFI	Rebecca	Long	ral0018@mix.wvu.edu	GS				x	x	No	Graduated May 2019 MS in Wildlife and Fisheries Resources	
WVU	AFI	Alice	Millikin		GS	x				x	?	AFI Year 1 participant. Came back and completed Phd dissertation Fall 2019.	
WVU	AFI	Nashid	Mirza	nm0070@mix.wvu.edu	GS				x		No	Received a job offer from Carollo Engineers	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	AFI	Jonney	Mitchell	jmitch@mix.wvu.edu	GS		x	x	x		no	Currently pursuing Ph.D. in Geology. GRA with Dr. Vesper. currently on leave of absence	
WVU	AFI	Kelly	Morgano	KM0027@mix.wvu.edu	GS		x				No	Environmental Scientist at Reliance Environmental, Inc.	
WVU	AFI	Sara	Mullett	sara.mullett@gmail.com	UG		x				Yes	Enrolled in online Masters of Education in STEM education	
WVU	AFI	Rivkah	Nisan	rnelson8@mix.wvu.edu	GS			x	x	x	No	Completed non-thesis Master's in Environmental, Soil & Water Sciences in May 2019.	
WVU	AFI	Conner	Owens	connerowens95@comcast.net	UG			x			No	Graduated with BS in May 2018. Currently pursuing a Masters degree at Mississippi State University	Currenly pursuing a Masters degree at Mississippi State University
WVU	AFI	Fritz	Petersen	petersenfritz@gmail.com	GS			x	x		Yes	Currently pursuing MS in Environmental, Soil & Water Sciences. GRA with Dr. Jason Hubbart. Anticipated graduation December 2018. Planning to pursue Ph.D.	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	AFI	Pariya	Pourmohammadi	papourmohammadi@mix.wvu.edu	GS	x	x	x	x	x	yes	Graduated with Ph.D. in Human and Community Development in December 2019. Continuing to complete coursework toward Master's in Computer Science at WVU.	
WVU	AFI	Carney	Quek	cq0001@mix.wvu.edu	UG				x		No	Civil Engineering	
WVU	AFI	Jill			GS				x		Yes	Geology	
WVU	AFI	Tim			UG				x	x	No	Graduated December 2019 with BS in Wildlife and Fisheries Resources. Works as Field Laboratory Technician at WVU.	
WVU	AFI	Alex			UG			x			No	4D Tech Solutions, Inc.	
WVU	AFI	Danielle			UG				x	x	Yes	Civil Engineering	
WVU	AFI	Geoff	Schwaner	gws0006@mix.wvu.edu	GS				x		No	M.S. in Forestry, August 2018.	Field Technician, Luquillo Critical Zone Observatory
WVU	AFI	Shannon	Shy	sshy@mix.wvu.edu	GS	x					No	Urban Forester Technician, Maryland-National Capital Park and Planning Commission	
WVU	AFI	Kurt	Sigler Riddel	jlriddell@mix.wvu.edu					x	x	No	Graduated May 2019 BS in Wildlife and Fisheries Resources. Works as Wildlife Ecology Technician at the	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
												Jones Center at Ichauway.	
WVU	AFI	Karl	Sperry Robine	tsrobine@mix.wvu.edu				x			Yes	Currently pursing a B.S. in Wildlife and Fisheries. No longer working on AFI projects.	
WVU	AFI	Maria	Suarez Rodriguez Rubenstein	alrubenstein@mix.wvu.edu					x		Yes	Exchange student to WVU for one semester. Returned to home institution (Electric/Systems Engineering major at Simon Bolivar University, Venezuela).	
WVU	AFI	Liam	Sullivan Schlapo	dnschlapo@mix.wvu.edu					x	x	No	Graduated May 2019 BS in Wildlife and Fisheries Resources. Works as Resort Activities Group Sales Manager @ Nemacolin Woodlands Resort	
WVU	AFI	Parameshwor	Takhachhe	pt0023@mix.wvu.edu	GS			x	x	x	No	Graduated December 2019 Non-thesis Master's in Environmental, Soil & Water Science.	
WVU	AFI	Martin	Traver	mstraver@mix.wvu.edu	UG			x			No	Graduated with BS in May 2018	LinkedIn: Project Manager, Sunset Outdoor Supply (Aug 2019-present)

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	AFI	Cody	Welsh	cwwelsh@mix.wvu.edu	UG				x	x	No	Graduated May 2019 BS in Wildlife and Fisheries Resources. Works as Environmental Inspector at Truhorizon Environmental Solutions NE.	0
WVU	AFI	Christopher	Ramezan	christopher.ramezan@mail.wvu.edu	UG				x		yes	Geography major	
WVU	AFI	Alice	Morgan	anm0049@mix.wvu.edu	GS				x		yes	Adventure grad student did work for STrager but not in year 5	
WVU	AFI	Cameron	Pauley	cepauley@mix.wvu.edu	UG				x		yes	geogrphaphy major	
WVU	AFI	Hunter	White	hwhite@mix.wvu.edu	UG			x	x		No	Environmental Consultant at Michael Baker Consulting in Pittsburgh, PA	
WVU	AFI	Michelle	Williams	mlw0021@mix.wvu.edu	UG		x	x	x	x	Yes	Graduated May 2019 BS in Biology. Started Master's Program in Zoo Sciences at West Liberty University in August 2019.	
WVU	Ed	Elleanor	Bell	ebell2@mix.wvu.edu					x	x	Yes	Started Year 4	
WVU	Ed	Derek	Brown	dbrown37@mix.wvu.edu	GS	x	x				No	Graduated with M.A. Employed in Educational Course Design	
WVU	Ed	Brent	Jones	bjones30@mix.wvu.edu	GS		x				No	Graduated with M.A. Employed in Teaching	
WVU	Ed	Sharon (Dale)	McGill	smcgill1@mix.wvu.edu	GS			x			Yes	?	

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WVU	Ed	Dana	Skerbetz	dmskerbetz@mix.wvu.edu	GS			x			No	Graduated with M.A. Employed out of degree field	
WVU	Ed	John	Tudek	jtudek@mix.wvu.edu	GS		x	x			Yes	Still in school	
WVU	Ed	Zachary	Willhoite	zrwillhoite@mix.wvu.edu	GS				x				
WVU	Ed	Devin	Williams	dwilli51@mix.wvu.edu	GS	x	x				No	Graduated with M.A. Employed out of degree field	
WVU	GW	Thomas	Adams	tadams14@mix.wvu.edu	GS	x	x				No	Graduated with M.S. in Math. Working in IT.	
WVU	GW	Devansh	Agarwal	da0017@mix.wvu.edu	GS			x	x	x	Yes	Graduation anticipated in August 2020. Seeking a career in data science.	
WVU	GW	Gabriella	Agazie	gyagazie@mix.wvu.edu	UG				x	x	No	Entering graduate Physics program at University of Wisconsin-Milwaukee, Fall 2020.	
WVU	GW	Kshitij	Aggarwal	ka0064@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Marwan	Alkhweldi	malkhwel@mix.wvu.edu	GS					X	Yes	Currently pursuing PhD in EE	
WVU	GW	Serdar	Bilgili	sabilgili@mix.wvu.edu	GS	x	x	x			Yes	Currently pursuing PhD in Physics	
WVU	GW	David	Buch	dnbuch@mix.wvu.edu	UG	x	x				Yes	Currently pursuing M.S. in Math	
WVU	GW	Fernando	Cardoso	rcardoso@mix.wvu.edu	GS	x					No	MS in Physics. Engineer at a medical diagnostics company.	
WVU	GW	Belinda	Cheeseboro	bdc0001@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Physics	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	GW	Ashok	Choudhary	aschoudhary@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Bingyi	Cui	bcui@mix.wvu.edu	GS	x	x				No	ABD. Research associate at Shanghai Astronomical Observatory.	
WVU	GW	Caleb	Devine	calebdvn@gmail.com	GS	x	x				No	Graduated with M.S. in Math, currently working for NIST in Computer Science Division	
WVU	GW	Thomas	Devine	tdevine4@mix.wvu.edu	GS	x	x	x	x	x	Yes	Currently pursuing PhD in Computer Science	
WVU	GW	Rodney	Elliott	rde0001@mix.wvu.edu	UG		x	x	x	x	No	Attending grad school in Physics at University of Colorado Boulder.	
WVU	GW	William	Fiore	wcf0002@mix.wvu.edu	GS				x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Pete	Gentile	pgentile@mix.wvu.edu	GS		x	x			No	Graduated with PhD in Physics. Employed as a data scientist at GCP applied techologies.	
WVU	GW	Jason	Gibson	jbgibson@mix.wvu.edu						x	No	Graduated with BS Aerospace Engineering, Physics minor, May 2019. PhD engineering program at University of Florida.	
WVU	GW	Golnoosh	Golpayegani	gogolpayegani@mix.wvu.edu	GS	x	x	x	x	x	No	Graduated with PhD in Physics. Seeking	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
												opportunities in data science.	
WVU	GW	Kara	Green	kng0018@mix.wvu.edu	UG				x		Yes	Currently pursuing BS in Physics	
WVU	GW	Benjamin	Gregg	bagregg@mix.wvu.edu	UG				x		No	BS Physics 2018. Pursuing PhD in Physics at U.Mass Amherst	
WVU	GW	Xiaoqian	He	xihe@mix.wvu.edu	GS	x	x	x			No	MS Electrical Engineering 2018. Software intern at Uhnder, Inc.	
WVU	GW	Vani	Jain	vajain@mix.wvu.edu	GS	x					No	MS Physics 2016	
WVU	GW	Min	Jiang	mijiang@mix.wvu.edu	GS		x	x			Yes	Currently pursuing graduate degree in Computer Science and Electrical Engineering	
WVU	GW	Brittany	Johnstone	brjohnstone@mix.wvu.edu	GS	x	x				No	MS in Physics. Employed out of degree field.	
WVU	GW	Megan	Jones	mljones1@mix.wvu.edu	Postdoc		x	x	x	x	No	Graduated with PhD in Physics. University of Wisconsin-Milwaukee postdoc.	
WVU	GW	Andrew	Kaiser	ark0015@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Joseph	Kania	jkania@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Tyler	Knowles	tk0014@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Math	
WVU	GW	Malcolm	LaRose	mflarose@mix.wvu.edu	UG			x	x	x	Yes	Year 4. Currently pursuing BS in Physics	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVU	GW	Amber	Lenon	al0034@mix.wvu.edu	GS		x	x	x	x	No	Currently pursuing PhD in Physics at Syracuse University	
WVU	GW	Tyler	Matheny	tdmatheny@mix.wvu.edu	UG			x	x	x	Yes	Currently pursuing BS in Physics	
WVU	GW	Jacob	Mayberry	jtm0007@mix.wvu.edu	UG				x		Yes	Year 4. Currently pursuing BS in Physics	
WVU	GW	Alex	McEwen	almcewen@mix.wvu.edu	UG		x	x			No	BS in Physics. Graduate student in Physics at University of Wisconsin-Milwaukee.	
WVU	GW	Trey	McNeely	ihmcneely@mix.wvu.edu	UG	x	x				No	BS Physics 2017. Currently pursuing PhD in Statistics and Data Science at Carnegie Mellon University	
WVU	GW	Michael	Mingyar	mgmingyar@mix.wvu.edu	UG		x	x	x	x	No	Post baccalaureate student.	
WVU	GW	Menke	Morgan	mrmenke@mix.wvu.edu	GS				x	x	Yes	Computer Science and Electrical Engineering	
WVU	GW	Patrick	Nelson	penelson@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Timothy	Olszanski	teo0008@mix.wvu.edu	GS					x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Antonia	Orsini	alorsini@mix.wvu.edu	UG		x	x			Yes	Currently pursuing BS in Physics	
WVU	GW	Di	Pang	dipang@mix.wvu.edu	GS	x	x	x	x	x	Yes	Currently pursuing PhD in Computer Science	
WVU	GW	Nihan	Pol	nspol@mix.wvu.edu	GS		x	x	x	x	Yes	PhD in Physics Summer 2020. Postdoc at	

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												Vanderbilt, Fall 2020.	
WVU	GW	Kaustubh	Rajwade	kmrajwade@mix.wvu.edu	GS	x	x				No	PhD in Physics, May 2017. Research Associate, School of Physics & Astronomy, University of Manchester	
WVU	GW	Akshaya	Rane	arane@mix.wvu.edu	GS	x	x				No	PhD in Physics, 2017. Data Scientist, British Columbia, Canada.	
WVU	GW	Anika	Rowe	ahrowe@mix.wvu.edu	UG		x	x			No	BS Chemistry, Physics minor 2018. Employed by Dow Chemical.	
WVU	GW	Pranav	Sanghavi	prs0010@mix.wvu.edu	GS		x	x			Yes	Currently pursuing graduate degree in Computer Science and Electrical Engineering	
WVU	GW	Brent	Shapiro-Albert	bjs0024@mix.wvu.edu	GS		x	x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Kenneth	Sible	kjs0001@mix.wvu.edu	UG				x	x	Yes	Currently pursuing BS in Physics.	
WVU	GW	Evan	Smith	ets0005@mix.wvu.edu	GS					x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Emily	Stiner	esstiner@mix.wvu.edu	UG	x	x				No	BS Physics 2017.	
WVU	GW	Annie	Turner	anniekate.turner@gmail.com	UG				x	x	Yes	Junior majoring in Physics	
WVU	GW	Jacob	Turner	jet0027@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing PhD in Physics	

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WVU	GW	Haley	Wahl	hmw0023@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Simon	Wirth	sgwirth@mix.wvu.edu	UG				x	x	Yes	Currently pursuing BS in Physics.	
WVU	GW	Caitlin	Witt	caw0057@mix.wvu.edu	GS			x	x	x	Yes	Currently pursuing PhD in Physics	
WVU	GW	Kristin	Wolfe	knw0013@mix.wvu.edu	UG				x		Yes	Switched major to international studies	
WVU	GW	Calvin	Wolfes	cgwolfes@mix.wvu.edu	UG				x		Yes	Senior, majoring in Electrical Engineering	
WVU	GW	Olivia	Young	ory0001@mix.wvu.edu	UG				x	x	Yes	Currently pursuing BS in Physics. Entering graduate Physics program at Rochester Institute of Technology, Fall 2020.	
WVU	GW	Cabot	Zabriskie	cazabriskie@mix.wvu.edu	GS				x	x	No	Data Science Fellow at Insight Data Science	
WVSU	AFI	Hunter	Aliff	haliff@wvstateu.edu	UG		x	x	x		Yes	Attending WVU working toward a graduate degree in Biochemistry	
WVSU	AFI	Katrib	Alnairouz		GS	x		x			No	She has passed away	
WVSU	AFI	Brandi	Bricker	bbricker@wvstateu.edu	UG		x				Yes	Still in school	
WVSU	AFI	Morgan	Bright	mbright@wvstateu.edu	UG		x				No	Working at MATRIC Inc. (Research Consulting Firm in WV)	
WVSU	AFI	Miranda	Buckley	mbuckley2@wvstateu.edu	UG	x					No	Science Teacher at McKinley Middle School in WV	

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WVSU	AFI	Saugata	Dutta	Saugata.Dutta@MGH.harvard.edu	GS		x	x	x	x	Yes	Graduated MA May 2019. Working at Harvard since July 2019.	
WVSU	AFI	Leslie	Garcia	lgarcia1@wvstateu.edu	UG	x	x				No	Graduated with Biology degree	
WVSU	AFI	Bandana	Ghimire	bghimi8@lsu.edu	GS		x	x			Yes	GRADUATED / PhD student studying Biological Sciences at Louisiana State University	
WVSU	AFI	Brittany	Graham	bgraham6@wvstateu.edu	UG		x				Yes	Still in school	
WVSU	AFI	Sarah	Greenberg	sgreenberg@wvstateu.edu	UG			x	x	x	No	Graduated Dec 2019. Pursuing MS degree in environmental science; school unknown	
WVSU	AFI	Abraham	Guerra	gohekani@hotmail.com	GS	x					NO	Assistant Professor at Universidad de Coahuila, Mexico	
WVSU	AFI	Flor	Guerrero	fguerrero@wvstateu.edu	GS				x	x	No	Graduated Dec 2019 with PhD in Agroindustrial Engineering (Universidad Autonoma Chapingo, Mexico). Currently seeking Postdoctoral position.	
WVSU	AFI	Ugwangyi	Ifeoma	iugwuanyi@wvstateu.edu	GS	x	x		x		NO	Graduated. Currently PhD student, environmental science, Rutgers University	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVSU	AFI	Dylan	Jayasuriya	djayasuriya@wvstateu.edu	UG	x	x	x	x		YES	Attending medical school at Marshall University	
WVSU	AFI	Joel	Jimenez	joeljivi@hotmail.com	GS	x					NO	Assistant Professor at Universidad de Coahuila, Mexico	
WVSU	AFI	Morgan	Jividen	mjividen1@wvstateu.edu	UG		x	x			Yes	Still in school	
WVSU	AFI	Larissa	Kemajou	akemajoutchamba@wvstateu.edu	GS			x	x	x	No	Graduated MS December 2019. Seeking PhD program in environmental microbiology	
WVSU	AFI	Sabin	Khadgi	skhadgi@wvstateu.edu	GS		x	x	x	x	Yes	Graduated MS in Biotechnology December 2019. Started PhD at Ohio University.	
WVSU	AFI	Chandra	Martin	cmartin18@wvstateu.edu	UG		x				No	Teaching ESL in Japan	
WVSU	Ed	Martin	Nicolay	mnicolay@mail.kana.k12.wv.us	UG			x			No	Teaching chemistry, robotics, and general science at George Washington High School, Charleston, WV	
WVSU	AFI	Vadesse	Noundou	vlhilhinoundou@wvstateu.edu	GS	x	x	x	x		Yes	Graduated, MS in Biotechnology. Curreny PhD student at University of Delaware	Currently pursuing Ph.D. student in Biological Sciences at University of Delaware
WVSU	AFI	Carlos	Ortiz	carlos.ortiz@wvstateu.edu	GS		x				YES	Currently working at WVSU as Research Associate (Genomics Lab)	

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
WVSU	AFI	Victoria	Ramey	vramey@wvstateu.edu	UG			x	x		Yes	GRADUATED (in December 2018) - Working as a nurse	
WVSU	AFI	Joshua	Ricket	jricket@wvstateu.edu	UG		x	x	x		Yes	Still in school	
WVSU	AFI	Jesus	Rivera	jrivera1@wvstateu.edu	UG		x				NO	GRADUATED / Candidate for M.S in Computers Sciences at WVSU	LinkedIn: Captor Administrator / IT Specialist at Gestamp North America
WVSU	AFI	Elizabeth	Roldan-Suarez	elizabeth.roldansuarez@wvstateu.edu	GS			x			NO	Graduated in December 2018 - Doctoral Degree Universidad Chapingo, Mexico	
WVSU	AFI	David	Stone	dstone7@wvstateu.edu	UG		x	x	x		No	Working at MATRIC Inc. (Research Consulting Firm in WV)	
WVSU	AFI	Ahasan	Tanim	tkm@wvstateu.edu	GS	x		x			No	GRADUATED / Accepted in Doctoral Program at Emory University	
WVSU	AFI	Benjamin	Thompson	bthopson3@wvstateu.edu	UG			x	x		Yes	Graduated WVSU. Attending Pharmacy School at UC.	
WVSU	AFI	Jeffrey	Thompson	jthompson9@wvstateu.edu	UG			x	x		No	Graduated with a degree in Chemistry. Currently pursuing a job in the field.	
WVSU	AFI	Jesus	Velasco-Espin	jvelascoespin@wvstateu.edu	UG				x			Still in school	
WVSU	AFI	Maria	Irfan	mirfan@wvstateu.edu	UG					x	Yes		
Shepherd	GW	Ben	Denny	bdenny01@rams.shepherd.edu	UG		x	x			No	?	Warehouse staff at Martin Distributing Company, WV (LinkedIn)

Institution	Group	First	Last	E-mail Address	Most Senior role	1	2	3	4	5	Still in school?	Student Tracking - Where are they now? (Institution Responses)	DSR Web Search
Shepherd	GW	Cristyn	Bauer	cbutle05@rams.shepherd.edu	UG			x			No	Biological/Envi Tech Projects Coordinator, Moorefield, WV	
Shepherd	GW	Mason	Athey	mathey01@rams.shepherd.edu	UG	x					Yes	UG student, Shepherd University	
Shepherd	GW	Wesley	Miller	wmille03@rams.shepherd.edu	UG	x	x				No	Software Engineer, Leesburg VA	
Shepherd	GW	Austin	Temples	ATEMPL01@rams.shepherd.edu	UG				x	x	Yes	Still in school	
Shepherd	GW	Daniel	Speck	DSPECK01@rams.shepherd.edu	UG				x	x	Yes	Still in school	
WVWC	GW	John	Harvey	harvey.jd.2016@wvwc.edu	UG		x				yes	Still in school	
WVWC	GW	Mark	Leadingham II	mpltwo@udel.edu	UG	x	x				yes	University of Delaware	
WVWC	GW	Olivia	Rycroft	rycroft.or.2015@wvwc.edu	UG	x	x	x			yes	Still in school	
WVWC	GW	Randy	Corathers		UG		x	x			no	Thrasher Engineering	
WVWC	GW	Kaylee	Burdette	burdette.kn.2015@wvwc.edu	UG			x	x		yes	Still in school	
WVWC	GW	Elizabeth	Meier	meier.er.2015@wvwc.edu	UG			x	x		yes	Still in school	
WVWC	GW	Eric	Roy	roy.es.2018@wvwc.edu	UG				x		yes	Still in school	
WVWC	GW	Virginia	Martin	martin.vl.2018@wvwc.edu	UG				x		yes	Still in school	