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SUMMARY OF RESEARCH FINDINGS



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To date, the AMNH RGGGS MAT Earth Science Residency Program has prepared 124 certified Earth Science teachers for high-needs middle and high schools in New York State

EXECUTIVE SUMMARY

In this summary, we highlight the main research findings for the AMNH RGGGS MAT ESRP to date:

- **Findings from our first ten cohorts from 2012-2021 indicate that the program is successfully recruiting diverse candidates into teaching in NYS public schools.**
- **Findings from our first four cohorts of graduates indicate that our retention rate is on par with, and even exceeds the average retention rate reported by residency programs—and is far above the national average for teachers prepared across all programs working in high-needs schools and teaching in subject areas for which there are teacher shortages.**
- **Students of AMNH RGGGS MAT ESRP teachers are performing significantly higher, on average, on the Earth Science Regents than students of other teachers.**
- **Schools that have hired our graduates have seen an increase in the number of students taking the Earth Science Regents Exam.**
- Through extensive evaluation, there is evidence that AMNH RGGGS MAT ESRP is having a **positive impact on the partner schools** as well as on the schools where graduates teach.
- Recent case studies highlight **graduates' use of the museum and museum resources in their teaching, as well as pedagogical practices** that they learned in the program.

THE AMNH RGGGS MAT EARTH SCIENCE RESIDENCY PROGRAM: BACKGROUND

As an urban residency program, we partner with five high-needs middle and high schools in New York City and Yonkers: Bronx Early College Academy for Teaching and Learning (Bronx), Midwood High School (Brooklyn), Hunter's Point Community Middle School (Queens), Roosevelt High School (Yonkers), and South Bronx Preparatory (Bronx).

Residents complete two five-month residencies at partner schools working with a science content-based mentor and a discipline

specialist mentor (English as a New Language (ENL) and Special Education (SpEd)).

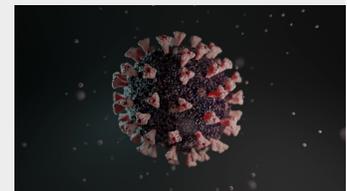
During 2020-2021, 29 school-based clinical faculty (mentor teachers) participated in the program, comprising 17 science teachers and 7 discipline specialists (ENL/SpEd).

Across partner schools, an estimated average of 3,600 students are taught in classes with AMNH RGGGS MAT ESRP residents over the course of the year.

THE COVID-19 PANDEMIC

During the pandemic, courses and residencies operated in a combination of in person, blended/hybrid, and remote settings. All residency program components shifted online during the Museum closure from March 13-September 9, 2020. Residents continued their clinical placements with their mentor teachers throughout Spring 2020 remotely.

In August 2020, courses transitioned from fully remote to blended, which continued throughout the 2020-2021 year. School residencies took place in a combination of in person, blended, and remote settings; this is rather unique as recent studies show that clinical practice experiences for teacher candidates in programs nationally were greatly reduced and varied immensely by district (Choate et al., 2021; AACTE, 2021a). For instance, results from a recent survey conducted by AACTE indicate that 44% of participating teacher preparation programs suspended clinical placements in spring 2020 (AACTE, 2021a).





RESEARCH & EVALUATION

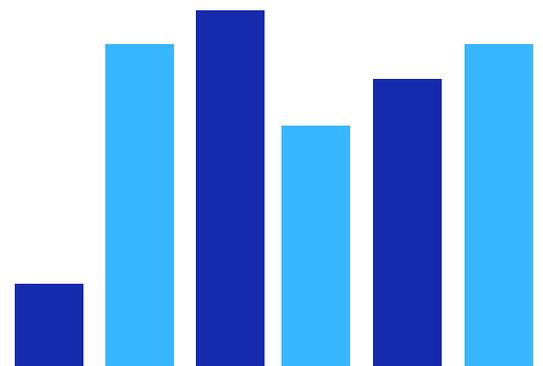
As a relatively recent teacher residency program in our tenth year, we have a deep commitment to understanding and learning from our program. Starting with the pilot year of the program, we have adopted a rigorous and systematic approach to document, examine, reflect on our work, and strive for continual improvement.

We use a multi-pronged, mixed methods approach to examine evaluation data, program outcomes, retention and attrition. As a program, we acknowledge the importance of documenting and sharing our findings.

METHODS

To examine and better understand our program, we conduct multiple research and evaluation studies using a wide variety of methods and approaches, including:

- Longitudinal quantitative impact study of graduates' students' academic performance
- Mixed methods, multi-pronged evaluations
- Case studies, multiple case studies, cross-case analyses
- Cross-institutional studies
- Self studies
- Teacher research
- Scientific research





THE RESIDENCY MODEL

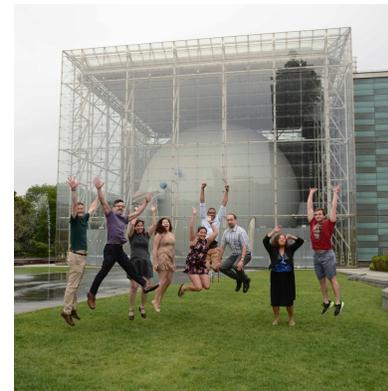
The AMNH RGGs MAT ESRP reflects features that research on residencies have found particularly effective and important in preparing teachers, features that specifically help teachers learn and to support them in staying in the field. These features include recruiting strong candidates, extensive clinical partnerships, providing financial incentives such as free tuition and a living stipend, ongoing mentoring at the residency schools, and two years of comprehensive induction supports for new teachers.

Uniquely, academic courses take place in the Museum and aspects of informal learning are integrated within the program.

The design of the teacher residency model provides strong clinical preparation (Guha et al, 2016; Sutchter et al, 2016; AACTE, 2018) and offers potential and promise for addressing many of the challenges that teacher preparation in this country face, including recruitment, shortages, and attrition across the nation (Darling-Hammond et al., 2018). With key characteristics, research finds that the **residency model is effective in promoting, preparing, and retaining high-quality teachers** (AACTE, 2018; The SFP, 2016).

Studies indicate **especially high retention rates** of new teachers who graduated from residency programs (Berry et al, 2008; Guha et al, 2016; The SFP, 2016), despite the increase in teacher attrition rates and shortages nationally (Carver-Thomas et al., 2017). Research suggests that residencies are particularly important in terms of **high-retention for teachers of color** due to the support they provide for learning to teach. With the increase in high-quality, well prepared teachers, residency programs offer a viable solution to the incredible cost and financial strain of teacher turnover that districts and schools continue to face (The SFP, 2016; Carver-Thomas et al., 2017).

LEARNING TO TEACH IN A MUSEUM



UNIQUE TEACHER PREPARATION IN A MUSEUM

- Museum-based summer residency learning to teach using the museum and museum resources
 - Learning and practicing strategies to support museum visitors' thinking
 - Summer rotations in museum-based youth programs
- Courses co-taught by museum scientists/curators and teacher educators
- Summer science practicum working closely with museum scientists to conduct research in the field and labs on astronomy, geology, and oceanography
- Coursework focusing on how children learn in out-of-school settings

TEACHER RECRUITMENT & DIVERSITY

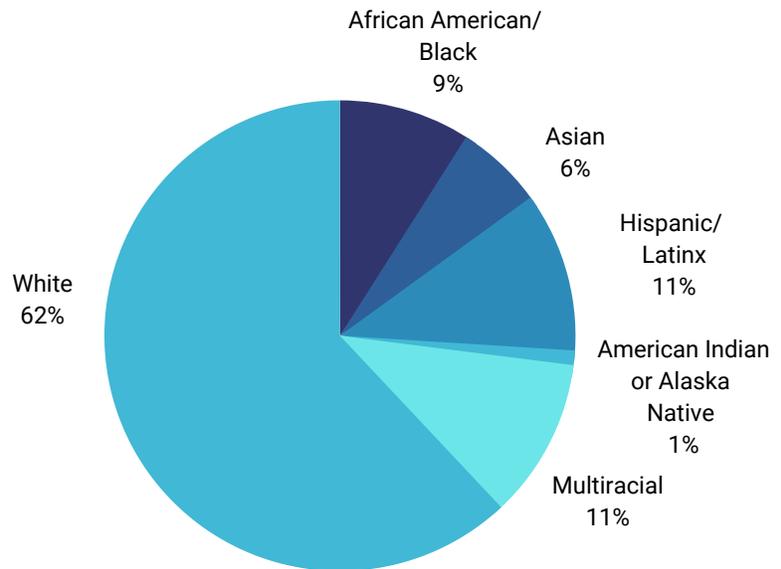
Nationwide: Research finds that 45% of teachers in residency programs in 2015-2016 were people of color, which is more than twice the national average of teachers of color entering the field at 19% (Guha et al., 2016). In 2019-2020, 62% of teachers in a network of residency programs across the country identified as people of color (NCTR, 2020). Declining enrollment related to the pandemic is a significant challenge that teacher preparation programs are facing (AACTE, 2021a; Lachlan et al, 2020).

New York State: Studies in NYS show that 39% of candidates enrolled in teacher preparation programs in 2016-2017 were people of color (NYS DOE, 2019), although not specific to residency programs. Research shows 539 conferred master's degrees in STEM education in 2018-19 in NYS compared with 1,231 in 2009-2010 (AACTE, 2021b).

Science teaching: Studies find a 32% decline in total number of mathematics and science education degree recipients of color in 2018-19 compared with 2011-12, and 36% less degree recipients who are male (AACTE, 2021b).

The AMNH RGGGS MAT ESRP continues to strive to recruit for diversity. Findings from our first nine cohorts, indicate that the program is **successfully recruiting diverse candidates into teaching in NYS public schools.**

The AMNH RGGGS MAT ESRP has recruited and enrolled approximately **35% (57 of 163) residents of color since its inception.** Across cohorts, residents who have joined the program identify as African-American/Black (9%), Asian (6%), Hispanic/Latinx (11%), multiracial (11%), and American Indian or Alaska Native (1%).



CONSIDERING DIVERSITY IN OUR CONTEXT OF NY PUBLIC SCHOOLS



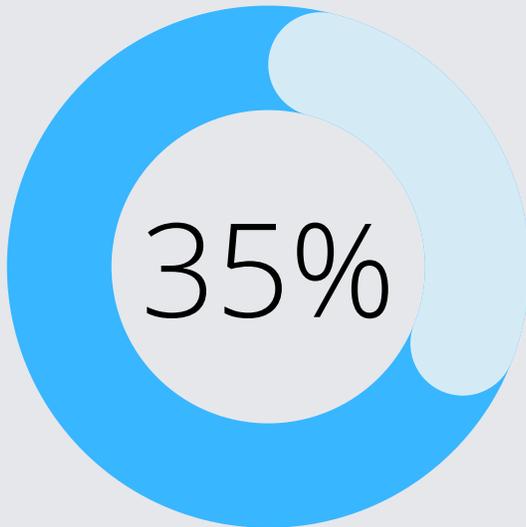
The number of teachers of color in the system remains lower relative to the proportion of students of color; shortages of teachers of color are of special concern given the importance of diversifying the profession. The student body in New York is increasingly diverse in terms of race, ethnicity, and gender while the educators teaching the students are 80% white with teachers of color underrepresented (NYS DOE, 2019).

RESEARCH FINDS THAT STUDENTS IN SCHOOLS WITH LARGER PERCENTAGES OF STUDENTS OF COLOR DO NOT HAVE AS MUCH ACCESS TO CERTIFIED TEACHERS COMPARED WITH SCHOOLS WITH LOWER ENROLLMENT OF STUDENTS OF COLOR (CARDICHON ET AL., 2020).

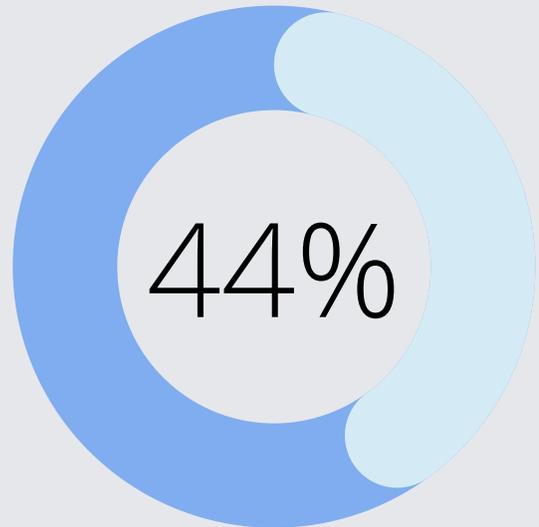
TEACHER RECRUITMENT & DIVERSITY

2012-PRESENT, ACROSS 10 COHORTS

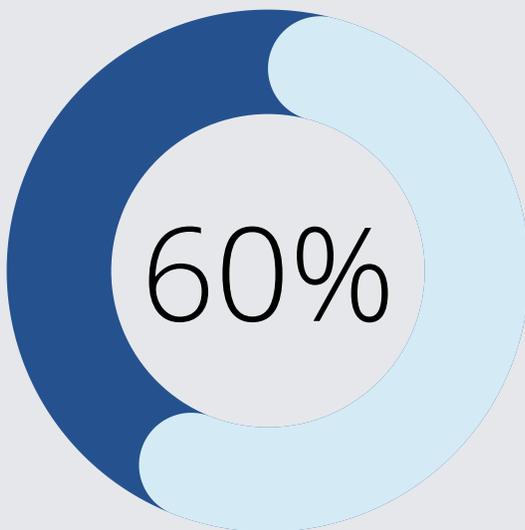
(N=163)



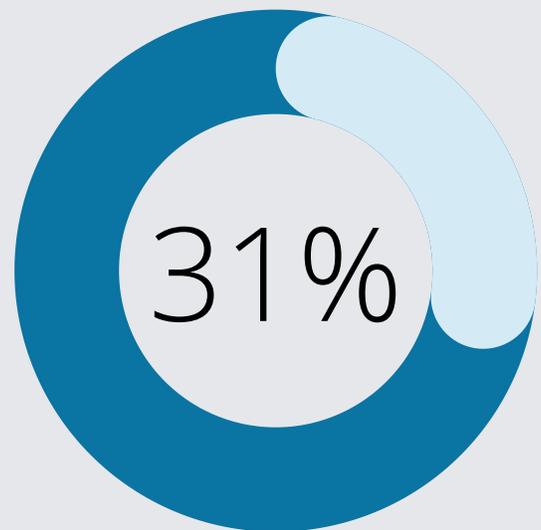
Recruited and enrolled residents of color



Almost one half are from out-of-state



More than half identify as women



Nearly one third are career changers, including veterans

*Data as of August 2021

TEACHER ATTRITION & SHORTAGES

The AMNH RCGS MAT ESRP prepares teachers specifically to teach Earth science in high-needs schools and was designed to address the shortage of certified Earth science teachers in New York State. Thus, we review recent research on teacher shortages nationally, statewide, and in science, to provide context for our high-level findings.

Impacts of COVID-19 pandemic nationally:

Exacerbated by the pandemic, studies show an increase in resignations and retirements, and estimated rise in teacher shortages across the country – long-term effects of which are still to be determined. Findings from a recent survey indicate that nearly 27% of K-12 educators in the US are considering leaving teaching or taking a leave of absence due to the pandemic (Horace Mann, 2020). Another study cited an estimated loss of 9.2% of the teaching force in New York State due to budget cuts with estimated loss of 21,542 teaching positions (Griffith, 2020).

Prior to COVID-19: Research finds that about 8% of public school teachers leave the profession with an additional 8% who change schools annually. Approximately 90% of teacher demand is due to teacher attrition (Darling-Hammond & Podolsky, 2019). Studies show that teacher attrition affects low-income districts disproportionately, with more acute teacher shortages in high-poverty and high-minority schools. In fact, the attrition rate is 50% or more in high poverty schools and in high-needs subject areas including science (Allensworth et al., 2009; Guha et al., 2016).

NYS and science teacher shortages: In 2019-2020, science for grades 7-12 was designated as one of the 17 teacher shortage areas in NY by the US Department of Education (NYSUT, 2019). The shortage of science teachers is consistent nationwide, reported by 43 states in 2017-18, and increased slightly from the previous year (Sutcher et al., 2019). In 2017, 59% of NYS superintendents reported challenges finding qualified teachers in one or more science areas including Earth science (Heiser, 2017).



KEY PROGRAM STATS

124

Certified Earth science teachers prepared to teach in high-needs middle and high schools in New York State

92%

Graduates teaching beyond 3 years

89%

Graduates currently teaching

93%

Graduates currently teaching in high-needs schools

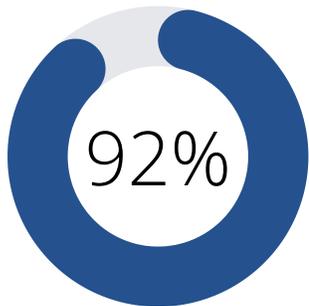
94%

Graduates currently teaching in New York State

*Data as of August 2021

TEACHER RETENTION & PATTERNS OF EMPLOYMENT

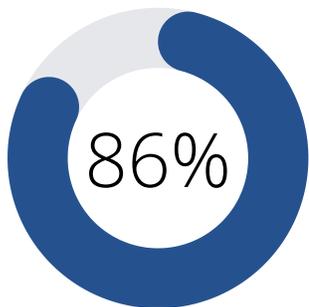
Findings from our first four cohorts of graduates indicate that our retention rate is on par with, and even exceeds the average retention rate reported by residency programs—and is certainly far above the national average for teachers prepared across all programs working in high-needs schools and teaching in subject areas for which there are teacher shortages.



92% stay in teaching for 3+ years

Findings indicate that 57 out of 62 graduates from the first four cohorts, or 92%, have stayed in teaching for 3 or more years:

- 95% (54 out of 57) continued to teach in high-needs schools;
- ~98% (56 out of 57) continued to teach in New York State.



86% completed 4 years of teaching

Findings from our first three cohorts of graduates show that 43 of 50, or 86%, completed four years of teaching (although not all in high-needs schools in New York).

SITUATING WITHIN TEACHER RETENTION RESEARCH

Studies consistently find that 20-30% of new teachers leave within five years, and attrition is even higher for teachers in higher poverty schools (similar to the ones in which our residents often teach) (Ingersoll, 2003; Sutcher et al., 2016).

For residency program graduates, studies of retention show higher rates of those who stay in the same district after three years ranging from 80-90% (Guha et al., 2016, Silva et al., 2015). In fact, some studies indicate graduates of residency programs, including those teaching in high-needs schools, stay in teaching at rates above 90% after four years, compared with national turnover rates of 40-50% in the first five years (The SFP, 2016).

*Data as of September 2020

GRADUATE RETENTION STUDY

A recent study examining influences on retention of AMNH RGGs MAT ESRP graduates from the first four cohorts after completing their teaching commitment finds that graduates' decisions to stay or leave the profession were complex and shaped by multiple factors and levels of influence (Fallona et al., 2019). **Graduates reported that a primary motivating factor to remain in teaching was their relationships with their students.** School level support and education policies such as standardized assessments also played a role in their decision to stay in teaching. This is consistent with literature on factors that influence teachers' career decisions (Johnson et al., 2005), and there is a need to better understand reasons that science teachers stay in teaching, particularly in high-needs schools (Grillo & Kier, 2021).

Findings indicate that **graduates' who decided to leave teaching after four years were more strongly influenced by external factors, including original intent to pursue another career path and financial and geographical considerations** (Fallona et al., 2019). In addition, **AMNH RGGs MAT ESRP graduates who decided to leave teaching after their commitment felt a general sense of satisfaction with their teaching.** This is an important finding, as several teacher retention studies identify a critical factor in teachers' decisions to leave the profession is often related to dissatisfaction or feelings of lack of success or efficacy (Boyd et al., 2011; Johnson & Birkeland, 2003).

This study highlights that graduates who decided to stay in teaching had an ongoing and evolving relationship with the Museum. Findings surfaced the **significant and salient role that the program and Museum resources played in graduates' first years of teaching as a source of support.** In fact, **both the program and the Museum contributed to graduates' identity as a teacher, suggesting the development of a Museum teacher identity** (Fallona et al., 2019). Although the only Museum-based teacher residency program, this finding resonates with other studies that developing a strong sense of identity in the profession can contribute to teachers' decisions to stay in the profession (Lindqvist & Nordanger, 2016; Grillo & Kier, 2021).



STUDYING RESIDENCY PROGRAM IMPACT ON STUDENTS



Few studies of residency graduates' pupil outcomes exist, because most residency programs are still in their early years (Guha et al, 2016).

However, those studies that exist suggest that our findings are similar to those of other programs. A study of the Boston Teacher Residency, for instance, found that achievement gains of their program graduates were similar to those of other novice teachers' in ELA and Math, but that graduates' student outcomes surpassed new and veteran teachers by their fourth year (Papay et al., 2012).

At the same time, scholars point to the limitations of drawing strong inferences from measuring teacher effectiveness using value-added analysis to examine student gains, noting the instability of measures from year to year, and particularly inaccurate for students at the top and bottom of the distributions, and small sample sizes add to the challenges of drawing strong inferences (American Statistical Association, 2014). **We recognize the limitations of these analysis, and, as such, seek additional measures of student learning.**

GRADUATES' REACH

Considering the current reach of our graduates, we estimate that AMNH RGGS MAT ESRP graduates were teaching approximately **12,600 students overall** across the 2020-2021 school year (with shifts between hybrid/blended and remote instruction through the end of the school year due to the COVID-19 pandemic). **Of the 12,600 students taught by graduates this past year, 11,800 were in New York State and 11,760 were in high-needs schools.** Residents commit to teach in a high-needs school for three years in the USA.



*Data as of August 2021

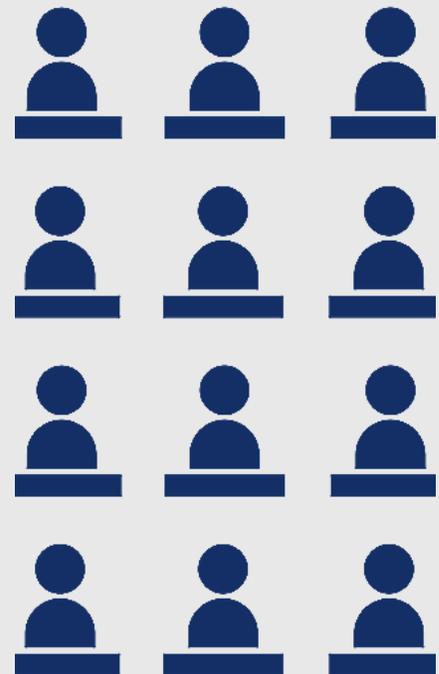
IMPACT STUDY

We use data from the New York City Department of Education to examine student outcomes presented below related to the AMNH RGGGS MAT Earth Science Residency Program. We use this data to help us understand who our candidates are serving and whether they are working in

the high-needs schools for which we prepared them; as well as how students in the classrooms of our graduates are doing on the Earth Science Regents Exam. Below we summarize findings from our most recent analysis (Weinstein, 2021).

AMNH RGGGS MAT ESRP GRADUATES CONTINUE TO TEACH STUDENTS WHO ARE DISADVANTAGED

Findings from a recent analysis show that in 2019-20, in schools where graduates teach, over 80% of students were eligible for free and reduced price lunch, 22% were students with disabilities, 57% were Latino and 24% were Black. Graduates' students were also lower performing in science, with a mean z-score of .23sd on the 8th grade Intermediate Science exam with only 47% meeting the standards.

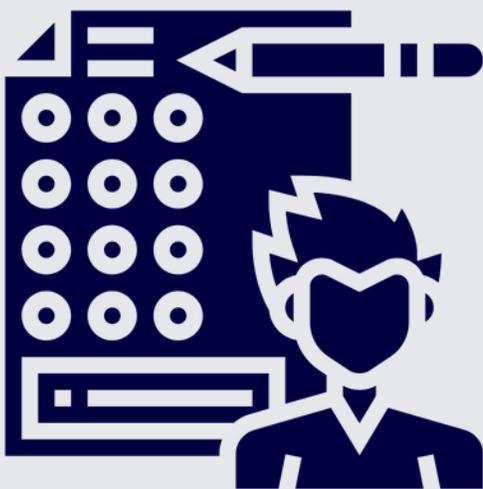


IMPACT ON STUDENTS

STUDENTS OF AMNH RGGGS MAT ESRP GRADUATES BEGIN TO OUTPERFORM OTHER STUDENTS ON THE EARTH SCIENCE STANDARDIZED EXAM

Findings from a longitudinal study reveal that **students of MAT ESRP teachers score significantly higher on the Earth Science Regents Exam, on average, compared to other students.**

Students of MAT ESRP graduates begin to outperform other students in 2016. In 2019, MAT ESRP graduates' students performed .118sd higher than other students in the matched comparison group (Weinstein, 2021a).



Additionally, **students of AMNH RGGGS MAT ESRP graduates are more likely to pass the Earth Science Regents Exam at 65 and 85 or higher compared to other students.** In 2019, graduates' students are 2.9 percentage points more likely to pass the exam at 65, and 3.2 percentage points more likely to pass at 85 or higher than students in the matched comparison group -- the equivalent of 47 additional students passing the exam at 65 or higher (Weinstein, 2021a).

IMPACT ON STUDENTS

SCHOOLS THAT HAVE HIRED OUR GRADUATES HAVE SEEN AN INCREASE IN THE NUMBER OF STUDENTS TAKING THE EARTH SCIENCE REGENTS EXAM

In relationship to one of the main goals of the program, which is to provide students in New York State with greater access to Earth Science education, data from New York City shows an **increase in the number of students taking the Earth Science Regents exam in the schools that have hired our graduates.** Between 2013-2014 and 2018-2019, there has been a 28% increase in the number of students at schools where AMNH RGGGS MAT ESRP graduates teach taking the Earth Science Regents Exam (Weinstein, 2020).



Additionally, a higher percentage of students taught by AMNH RGGGS MAT ESRP teachers take the Earth Science regents. Overall in 2018-2019, 58.2% of students taught by our graduates took the exam, compared to 26.9% of all other enrolled students in an Earth Science course (Weinstein, 2021b).

IMPACT ON PARTNER & HIRING SCHOOLS

Through extensive evaluation since its inception, evidence indicates that the AMNH RGGGS MAT ESRP is having a positive impact on the partner schools where residents carry out their residency placements as well as on the schools where graduates teach.



100% mentor teachers reported making changes to practice

Recent evaluation findings indicate that 100% of mentor teachers reported making **changes to their teaching practice** as a result of their involvement in the program, approximately 85% viewed the program as having **beneficial impact on their students academically**, and more than 85% saw positive changes in their school due to partnership with the program (Silvernail, 2020).



Hiring principals report graduates are well prepared

Results from an annual survey show that 100% of hiring principals reported satisfaction with the graduates they hired as first-year teachers in their schools. Hiring principals, on average, considered graduates **well prepared in areas of science content knowledge, safety, professionalism, and instructional planning** compared to graduates of other teacher preparation programs (Silvernail, 2020).



IMPACT ON TEACHERS' PRACTICE



Few studies have focused more on a qualitative approach to looking at effects of teacher preparation on teacher practice. Recent research on how teacher preparation affects teacher practice has found reflections of programs' ideologies, values, and pedagogies in their graduates' teaching practices (Tamir & Hammerness, 2014) and connections between graduates' practices and their preparation program's specific approach to teaching, learning, and teacher development (Lit et al., 2015).

Recently, we conducted qualitative case studies of four graduates from the first three cohorts (Howes & Wallace, in preparation; Doykos et al, 2017) and a cross-case analysis (Fallona et al., 2017; Wallace et al., 2020) to examine the impact of the program on graduates' practices as teachers. **The case studies explore graduates' use of the Museum and Museum resources in their teaching, as well as pedagogical practices that they learned in the program.** The teaching practices that surfaced amongst graduates across the cases reflecting what they learned in the program include teaching the practice(s) of science, modeling scientific thinking and natural processes, making science local and relevant, and using assessment to inform instruction. **Findings highlight the impact of the program on graduates' teaching practices. The case studies also suggest that graduates have positive effects on their students' learning content and engagement in science practices.**



AREAS OF RESEARCH: GROWING EXPERTISE

Program faculty and staff engage in multiple areas of research on and related to the program, including:

- mentoring and mentor practices
- high-leverage science teaching practices with pre-service and in-service teachers
- culturally responsive and sustaining teaching
- teaching and learning in informal science settings
- scientific research and fieldwork by faculty and pre-service teachers
- collaborative research and inquiry by faculty and graduates
- designing teaching and learning experiences aligned with NGSS
- development of programmatic tools
- leadership and teacher learning continuum

In addition to studies conducted internally, the program is a [case study of new graduate schools of education](#). Researchers continue to disseminate and share their work on teacher learning broadly across the field.

AMNH RGGGS MAT ESRP Faculty Research and Dissemination:
<https://www.amnh.org/learn-teach/evaluation-research-and-policy/research/amnh-rggs-mat-faculty-research-and-dissemination>

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AMNH RGS MAT Earth Science Residency Program:
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