

Preliminary Evaluation Results

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Evaluation Resources

Evaluation Resource Links:

Program Theory Model:

<https://quarknet.org/content/program-theory-model-2022>

2022 Evaluation Report:

<https://quarknet.org/content/2022-evaluation-report>

2022 Executive Summary:

<https://quarknet.org/content/2022-evaluation-report-executive-summary>

One-page Summary Evaluation Results:

<https://quarknet.org/content/one-page-summary-evaluation-results>



Evaluation Focus

Three Themes:

1. **Develop (and use) of a Program Theory Model (PTM) ✓**
2. **Teacher-level Program Outcomes (based on PTM) at National- and Center-level -- *on going***
3. **Center-level Program Outcomes and Program Sustainability Assessment (based on PTM and Sustainability Framework) – *on going***

QuarkNet Partners



NSF: The National Science Foundation is an independent federal agency created by Congress in 1950 “to promote the progress of science; to advance the

national health, prosperity, and welfare; to secure the national defense...” NSF supports basic research and people to create knowledge that transforms the future. QuarkNet is funded through NSF’s Integrative Activities in Physics Program.



Fermilab: America’s particle physics and accelerator laboratory

whose vision is to solve the mysteries of matter, energy, space and time for the benefit of all. Fermilab, a co-sponsor of QuarkNet, hosts Data Camp held each summer and supports the cosmic ray studies program. Fermilab hosts DUNE and the Long-Baseline Neutrino Facility. DUNE brings together over 1,000 scientists from more than 175 institutions in over 30 countries.

Diversity – Women and Minorities: QuarkNet partners with other STEM organizations to reach more students underrepresented in STEM, either through their teachers or directly. Recent partners are *Step Up 4 Women*, an American Physical Society program to increase the representation of women amongst physics bachelor’s degrees and *STEAM Workshop at NACA*, a program of the Native American Community Academy, Albuquerque, in which students create visual stories using projection art about ideas in Western science and indigenous culture. An example of being nimble to respond to opportunities is the *i.am. Angel Foundation*, transforming lives through education inspiration and thinking. Also, some centers partner with other organizations to reach beyond QuarkNet schools to students traditionally underrepresented in STEM.

Advisory Board: Seven or eight individuals both familiar with and new to the program meet annually to review QuarkNet program achievements and make recommendations for future plans and objectives. Members represent a diverse mix of high school physics teachers, education administrators, research physicists and physics outreach leaders.



QuarkNet: The QuarkNet Collaboration is a long-term, national program that *partners high school science teachers with particle physicists* working in experiments at the scientific frontier. A professional development program, QuarkNet immerses teachers in authentic physics research and seeks to engage them in the development of instructional strategies and best practices that facilitate the implementation of these principles in their classrooms.



QuarkNet Centers: Centers both form the essential backbone of and are partners in QuarkNet. A center is housed at a university or laboratory, serving high school physics and physical science teachers; active local centers number 50+.

U.S. ATLAS: A collaboration of scientists from 45 U.S. institutions. ATLAS is one of two general-purpose detectors at the Large Hadron Collider in Geneva, Switzerland. The ATLAS experiment investigates a wide range of physics, from the search for the Higgs boson to extra dimensions and particles that could make up dark matter. U.S. ATLAS is a co-sponsor of QuarkNet.



U.S. CMS: A collaboration of more than 900 scientists from 50 U.S. institutions who make significant contributions to the Compact Muon Solenoid (CMS) detector. Discoveries from the CMS experiment are revolutionizing our understanding of the universe. USCMS is a co-sponsor of QuarkNet.

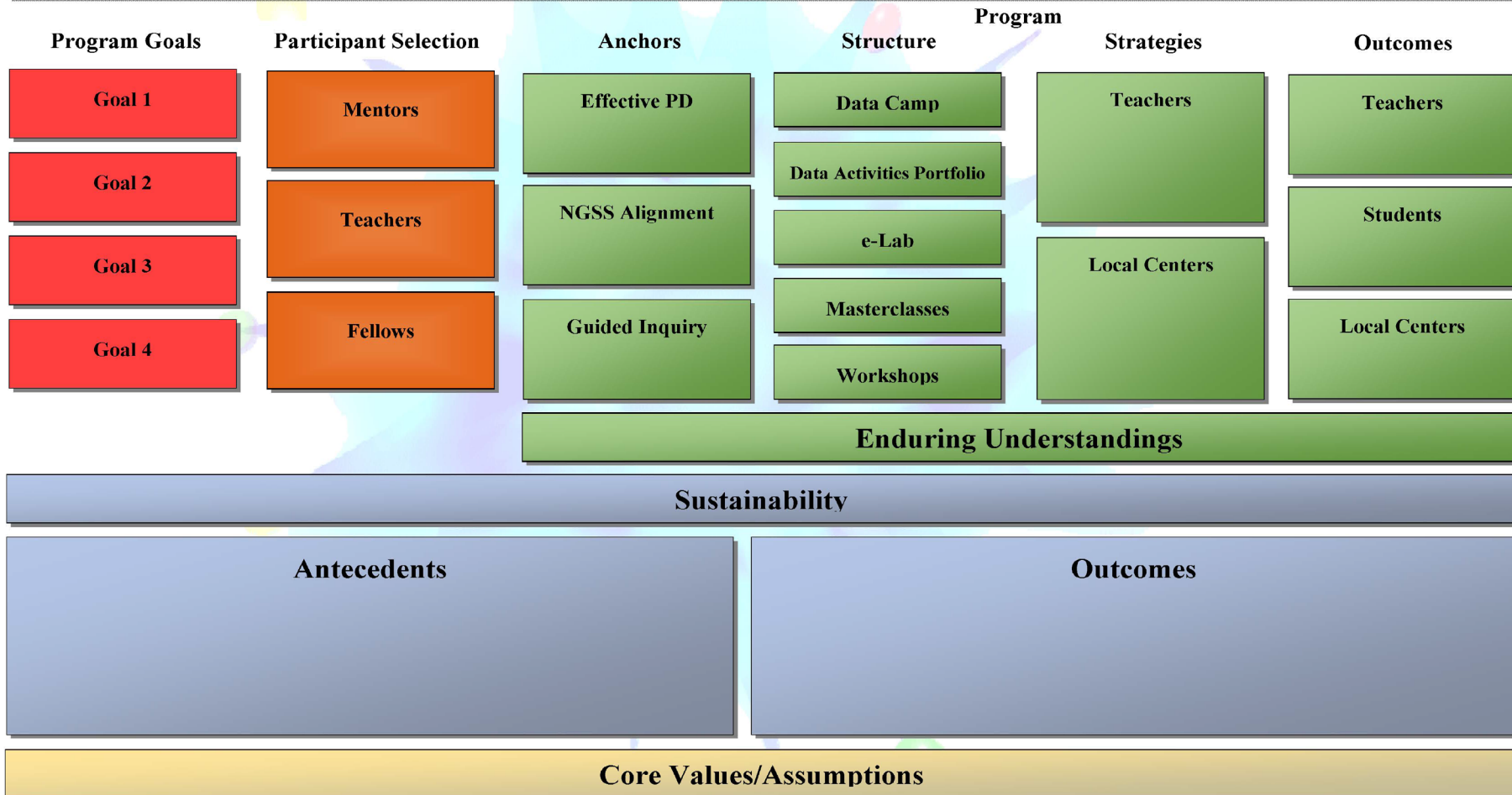
Broader Impacts and Community Outreach:

QuarkNet efforts extend beyond the program. Often, centers integrate QuarkNet in other community outreach and broader impact efforts. QuarkNet has led in facilitating the public use of large particle physics databases. QuarkNet staff and teachers attend and present at meetings of the American Association of Physics Teachers and the American Physical Society. At International Particle Physics Outreach Group (IPPOG) meetings QuarkNet presentations have highlighted how QuarkNet works, e-Labs, the Data Activities Portfolio and scientific discovery for students. QuarkNet has developed and coordinated the CMS masterclass, led the global cosmic ray studies project, and provided a wealth of information for other IPPOG members to consider in their own education and outreach programs.

QuarkNet Program Theory Model

Program Statement: The QuarkNet Collaboration is a long-term, national program that partners high school science teachers with particle physicists working in experiments at the scientific frontier. A professional development program, QuarkNet immerses teachers in authentic physics research and seeks to engage them in the development of instructional strategies and best practices that facilitate the implementation of these principles in their classrooms.

Centers: QuarkNet delivers its professional development program in partnership with local centers.





Teacher Outcomes

Measured Two Principal Ways:

- 1. Full Teacher Survey, and**
- 2. Update Teacher Survey**

Each teacher is asked to complete the Full survey (once); then in subsequent years the Update survey (one survey each year).

Teacher outcomes analyzed in relationship to program exposure



Teacher Surveys

Full Teacher Survey (2019, 2020, 2021 and 2022)

A unique count of teachers – 483

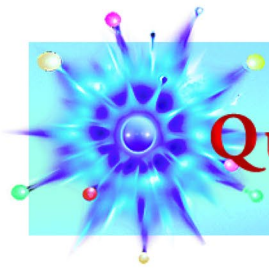
Update Teacher Survey (2020, 2021 and 2022)

A total of 362 surveys

A unique count of teachers – 208

A good annual response rate:

79%, 72%, 79%, and 79%



QuarkNet

Who is the QuarkNet Teacher?

Gender:

Male	274 (57%)
Female	204 (43%)

School Location:

Suburban	182 (38%)
Urban, central city	106 (22%)
Urban	96 (20%)
Rural	91 (19%)

Teach Physics?:

Yes	387 (81%)
No	91 (19%)

Number of Years with QuarkNet:

On average 5-6 years in the program

Number of Years Teaching:

About 16-17 years

Number of Years at School:

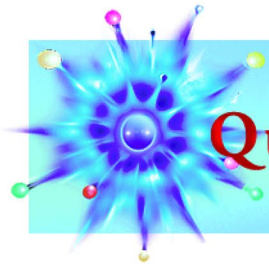
About 10 years



Center Outcomes

Center Outcomes used to determine *implementation* level of program and to better understand teacher outcomes, and

Centers assessed through Center Outcomes and Sustainability Factors



QuarkNet

Center Outcomes

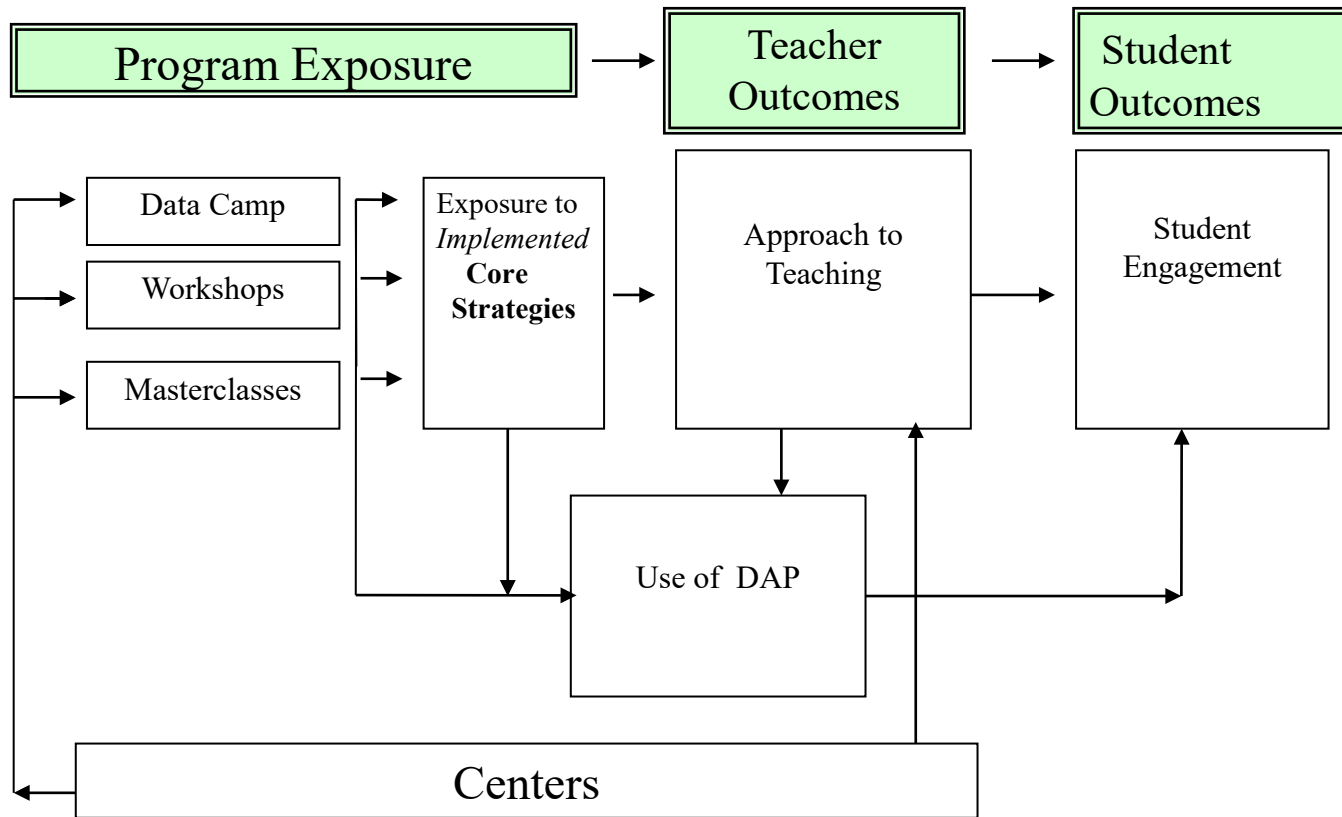
**Measured through a Center
Feedback Template Process**

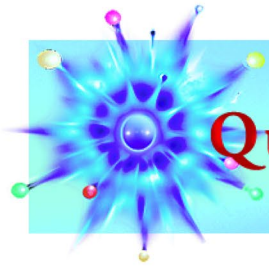
26/27 Centers completed

(1 center deemed semi-active)

3 Centers in the works

Overview of Analyses Related to Teacher (and their Students) Outcomes





QuarkNet

Teacher-level Measures

Program Exposure:

Core Strategies

Outcomes:

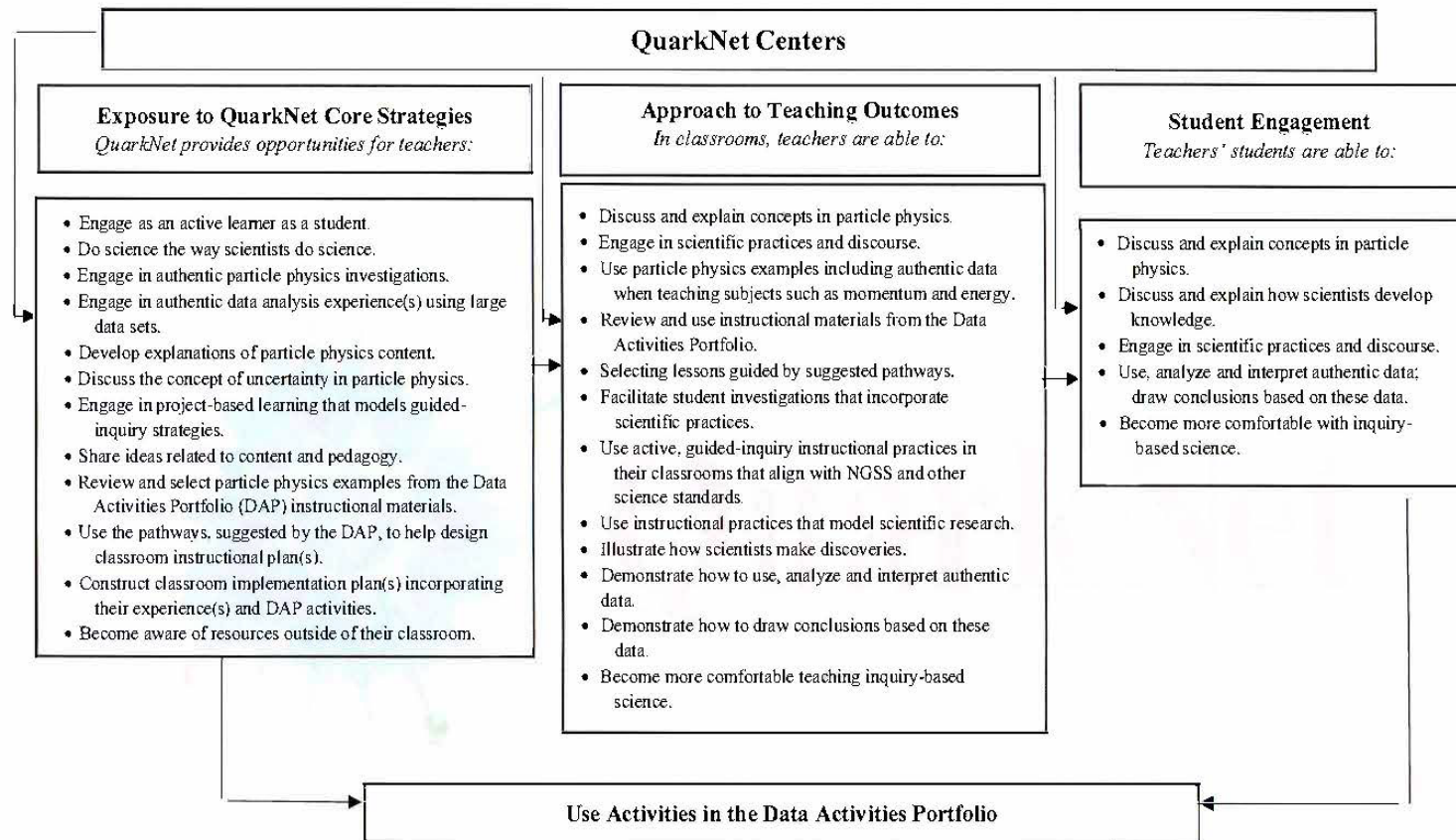
Approach to Teaching

QuarkNet's Influence on Approach to Teaching

Student Engagement (as perceived by teachers)

QuarkNet's Influence on Student Engagement

Each is measured by a score – where the higher the score the more positive the perception.



Teachers in QuarkNet, through partner-centers, participate in: Data Camp, Workshops (Center- or Nationally-led), Masterclasses, and e-Labs during the summer and during the school year. (Each of the following statements is backed by statistical analyses from the QuarkNet evaluation.)

Centers Matter: Centers play an important role in getting to teacher and student outcomes.

QuarkNet Teachers: The more QuarkNet teachers participate in QuarkNet, the more they engage in strategies that are core to the program. These core strategies (and content) are reported as helping teachers achieve many teacher outcomes in their classrooms when possible. Active engagement in activities from the Data Activities Portfolio helps teachers implement these in their classrooms (activities that align with NGSS science practices and address specific topics that support physics curriculum). Teachers report that the program helps them foster the active engagement of their students in their classroom. Teachers report that the QuarkNet experience creates opportunities for teachers to develop and maintain collegial relationships with other teachers, mentors, and other scientists.

Centers: Centers report that their teachers engage in QuarkNet as active learners (as students) and then as teachers often sharing classroom implementation experiences. Centers report, as well, that their teachers often form collegial relationships with other teachers, mentors, and scientists that support the development of a learning community.

We are grateful to the many teachers who have taken the time to complete the surveys requested of them and who provide very thoughtful responses; and to the QuarkNet Centers who have participated in the Center Feedback process; both are part of the QuarkNet evaluation.



Program Engagement and Teacher Outcomes

The more QuarkNet teachers participate in QuarkNet, the more opportunities to engage in strategies that are core to the program.

These core strategies (and content) are reported as helping teachers achieve many teacher outcomes in their classrooms when possible.

Active engagement in DAP activities helps teachers implement these in their classrooms.



Teachers and Centers: Tend to Agree

Teachers report: the program helps them foster the active engagement of their students in their classroom.

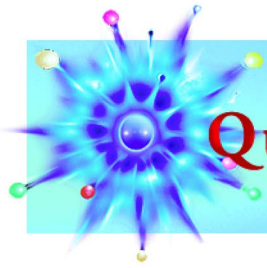
Centers report: their teachers engage in QuarkNet as active learners (as students) and then as teachers often sharing classroom implementation experiences.

Teachers report: the QuarkNet experience creates opportunities for teachers to develop and maintain collegial relationships with other teachers, mentors and other scientists.

Centers report: their teachers often form collegial relationships with other teachers, mentors, and scientists that support the development of a learning community.



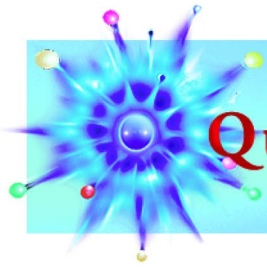
Each of the following statements is backed by statistical analyses from the QuarkNet Evaluation



QuarkNet

Exposure to Core Strategies

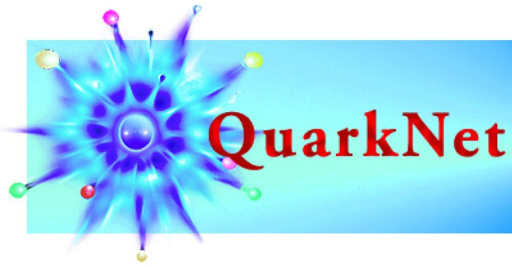
Single-variable analyses suggest that engagement in QuarkNet (the type and degree of program engagement) is positively related to **Core Strategies** scores; and, the use of activities from the Data Activities Portfolio (**Use of DAP**) is positively related to QuarkNet engagement as well.



QuarkNet

Centers *Matter*

**QuarkNet Centers:
Play an important role in getting to
Teacher and Student Outcomes**



Approach to Teaching

In hierarchical linear regression (based on 24 centers)

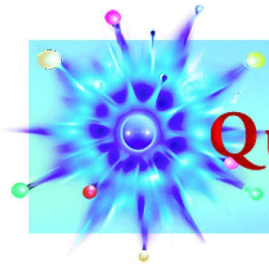
Teacher outcomes (**Approach to Teaching scores**), are positively related to *perceived* QuarkNet's Influence on Teaching and Core Strategies scores – and **also** the QuarkNet Center (as measured by Approach to Teaching center-level means).



Student Engagement

In hierarchical linear regression (based on 24 centers)

Student Outcomes (**Student Engagement scores** as perceived by their teachers) are positively related to perceived QuarkNet's Influence on Student Engagement, Approach to Teaching scores (teacher outcomes) and QuarkNet's Influence on Teaching ---- and **also** the QuarkNet Center: Center-level Student Engagement and QuarkNet Influence on Teaching mean scores.



QuarkNet

Building on These Analyses

Still exploring –descriptively – the role that the QuarkNet centers play in these results. Descriptively looking at teacher implementation plans.

These analyses are buttressed by information obtained from QuarkNet centers (e.g., Agendas, Annual Reports).

Adding Center-level Outcomes and Sustainability Factors.



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