
Center-Level Portfolio: Florida State University

The following table, proposed implementation plans by participating teachers, and when available other examples are intended to provide an overall narrative about how and in what ways program participation has influenced teachers in using QuarkNet content and materials in their classrooms (and in-after class events). The value of these qualitative reviews is to expand on the instructional practices measured quantitatively via Teacher Survey responses to specific sets of questions/self-reported by teachers providing narrative examples of implemented or planned instructional practices in teachers' classrooms and in schools. This evaluation approach is consistent with the use of *authentic assessment* to evaluate performance, "teaching for understanding and application rather than for rote recall" (Darling-Hammond & Snyder, 2000, p. 523).

In keeping with Darling-Hammond, Hyler and Gardner (2017), we do not naively expect a single workshop (or event) to have a measurable impact on teachers' knowledge and subsequent classroom implementation. A characteristic of effective professional development is a program of sustained duration, providing "multiple opportunities for teachers to engage in learning around a single set of concepts or practices; that is rigorous and cumulative" (Darling-Hammond, et al., 2017, p. 15). As such, the table summarizes responses by teachers over the course of several program years and likely several QuarkNet programs and/or events.

These responses come from the Teacher Survey (either the full or update version) where each row represents the responses to open-ended questions from the same teacher over time. Also, each row starts with the original responses to the first time a teacher completes his/her full teacher. If a particular box in the table is blank, it likely means that that teacher did not participate in an event for that program year (or, the center may not have had a major event that year). The table provides the essence of these responses; a given response, as presented, may be a direct quote, a paraphrase, or lightly edited; the intent is to convey the overall idea or its essence from that particular teacher.

Because these are responses to open-ended questions, teachers are free (and encouraged) to provide information that he or she thinks most relevant. Each highlighted response is intentionally anonymously to respect the principles of collecting evaluation data (*Guiding Principles for Evaluators*, American Evaluation Association) and to help encourage teachers to respond frankly to these questions. If a reader is familiar with a given center, it may be possible to "reverse engineer" the identify of a particular teacher. We encourage readers to respect this anonymity. At various times, we may have identified a given teacher by name and/or school; when this happens the written approval of that teacher has been obtained. It is also important to note that the full breath of a response by a given teacher may not be fully articulated in this table. For example, responses related to how QuarkNet may have advanced the knowledge of a given teacher or bolstered a collegial network among participants are likely discussed elsewhere in subsequent evaluation reports.

The table is followed by examples of implementation plans, and at times teacher presentations and student presentations when available. The intent of providing these examples is to deepen the narrative as to what and how teachers have planned (and have used) QuarkNet content and materials in their classrooms and in-after class events (e.g., Physics Club). Examples from Annual Center annual reports may be highlighted as well.

Table

Self-reported Use of Data Activities Portfolio Activities: Based on Responses from the Full Survey and then Responses from the Update Survey in Subsequent Years **Florida State University/University of Florida Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Florida State/University of Florida	2019	2020	2021	2022	2023	2024	2025
	Rolling with Rutherford, and Pennies. To give more resources to teachers to use.		I've used them before in just having the students look at real world data and how to analyze it. Examples: Rolling with Rutherford, Shuffling the Particle Deck. These experiences help to give new ideas on how to add in more real-world data and incorporate how science is collaborated around the world.	I intend to incorporate more histograms, go over the standard model and possibly try to do a masterclass this year. Examples: Mass of pennies. My experience was positive and it is a great way to interact with other teachers in the community		I have used the Mass of Pennies and the CoLab coding activities. I have recommended the CoLab and Mass of Pennies cause they are easy to implement without having to have to much background knowledge for teachers to use while some of the others are more intimidating for some teachers who haven't seen them fully implemented out by someone. QuarkNet has been helpful in building community among other teachers in the area and with the local area to help bring more ideas and strategies into the classroom and was to implement those ideas.	Using particle data (like muons) with the beginning kinematics that the students learn to introduce the students to these topics since we don't have it in our standards or curriculum Also using more histograms for the students to see the collective data (whether through sticky notes on the board our through a shared excel worksheet) and what observations they can derive from it The careers in physics STEPUP lesson is also a good introductory lesson to start the year with getting students in se
	Data Camp; the parts of my center's workshops which were directed/planned by our local teachers. Quark workbench; Top Quark. There's a great range of levels and topics; teacher plans are well-documented and aligned with standards; they provide readily usable lessons to incorporate particle physics into K12 not found elsewhere. QuarkNet allowing us to build our local community has been a game-changer in my State.	I plan on using some of the great ideas for coding implementation from the other teacher participants. Examples: Top Quark, Quark Workbench, Muon Time of Flight, Rolling with Rutherford					

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Florida State/ University of Florida	2019	2021	2022	2023	2024	2025
	<p>The data camp. It put me in touch with many different teachers as well as gave me a bunch of new ideas that I think I could implement in my class. I want to use the Rutherford activity and the card sort. I have not used them yet. I think these both are activities I think my students can grasp and have a conversation on. (<i>First year teaching general physics</i>) The activities are clear cut and easy to implement. I like that there is a teacher guide as well as a student guide. All the resources and PDFs are all there. I think the teaching and learning fellow did an amazing job. They really made the Data camp experience. Their grouping strategies and ability to guide while not giving away the answers was amazing. I've been inspired by them and excited to have them as resources in the coming year. Thank you for selecting such a great group. My QuarkNet group has been my little home away from home to collaborate with teachers who normally I wouldn't get the opportunity to work with.</p>					

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Florida State/ University of Florida	2019	2020	2021	2022	2023	2024	2025
	<p>CMS workshop will help with teaching particle physics to my IB classes. Rolling with Rutherford is a great activity and shuffling particles is something I use in the classroom. This camp/training has been very helpful and provided many ideas/activities for my classroom. Being able to connect with other physics teachers in the community has helped build great relationships between the schools.</p>	<p>I will be implementing the Rolling with Rutherford activity and standard model activity in my classes. As well as the case of the hidden neutrino. Examples: I will use Rolling with Rutherford, case of the hidden neutrino, and standard model 2d/3d. The resources are great tools for my classroom.</p>		<p>Penny mass, standard model, uncertainty, NOvA neutrino oscillation data. Examples: Penny mass, NOvA neutrino oscillation. Very informational. I enjoy being updated on physics content. QuarkNet provides for teacher collaboration, connections to University faculty/resources, keeping us updated on current science, and pushing teachers to become more comfortable.</p>		<p>Good activities.</p>	<p>Cosmic watch activity, Feynman diagram particle reactions, Penny mass investigation. Examples: penny mass investigation, rolling with Rutherford, standard model table. The ideas for implementing the lessons have been a great help in talking not just about particle physics, but all science.</p>
	<p>Attending FSU QuarkNet Workshops have been the most helpful in my teaching. We hold one every year, but do not always have one of the prepackaged programs as a part of it. We always have HEP related talks and activities, but some of what is really helpful is the back and forth amongst colleagues and our QuarkNet mentor. We talk about best practices, what we do in our classrooms to encourage teaching modern topics and continue to learn things which equips us to better teach our students. Penny mass histogram activity, great for showing measurement variation and identifying peaks in histograms. Easy analogue to particle masses. Great activities if we can get teachers to address the topics.</p>	<p>Google Science Journal for labs and science fair. Rolling with Rutherford virtual simulator is very convenient. Great way to do the activity if you are pressed for time or going virtual. Examples: Rolling with Rutherford Mass of U.S. Pennies Quark Workbench Case of Hidden Neutrino. The platform QuarkNet provides for teacher collaboration, connections to University faculty/resources, keeping us updated on current science, and pushing teachers to become more comfortable with high energy physics.</p>	<p>Cosmic Ray, W2D2, and Master Class hopefully this year. Want to incorporate g-2 with angular momentum in AP Physics. Rolling with Rutherford (and virtual), Shuffle Deck, Making Tracks QuarkNet Workshops always encourage me and I always find something to take back to the classroom, whether it be from a fellow teacher, from our mentor, or from a QuarkNet fellow.</p>				

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Self-reported Use of Data Activities Portfolio Activities: Based on Responses from the Full Survey
and then Responses from the Update Survey in Subsequent Years **Florida State University/University of Florida Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Florida State/ University of Florida	2019	2020	2021	2022	2023
	Examples: Pennies, Z-mass, rolling with Rutherford. I would recommend them (DAP), it does take some time to learn effective way to use them and tie them into current curriculum.	vectors, conservation, energy, atomic models, ... Examples: Rutherford, topquark, pennies,	penny lab, rolling with Rutherford, particle mass calculations, Jupiter notebooks, Examples: Pennies, Probability, Rolling with Rutherford, Calculate the mass of a particle. I love being exposed to new ideas. Networking with other teachers and learning new approaches and tools. This is the most valuable training group that I get to attend all year.	I have used data and topics related to: LHC, Conservation, uncertainty, standard model, histograms, data collection. Examples: Penny mass, film canister nickles, NOvA, Adam's python activities.	
	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
	2019	2020	2021	2022	2025
	Today's workshop (CMS Workshop @ FSU); multiple activities that can be used and appropriately modified in several lessons throughout the school year. Conservation of momentum and energy used in the identification of particle interactions. examples of measurement and scientific method. An inspiring learning/teaching experience. Demonstrates scientific research as an international endeavor. Inspiring!	I will use several QuarkNet e-labs for distant learning during the COVID pandemic. Modeling conservation of energy and momentum, demonstrating principles of physics and the development of mathematical skills. Examples: Rolling with Rutherford, Case of the Missing Neutrino. In addition to the QuarkNet developed activities and labs, QuarkNet gives teachers the opportunity to share what works best in their particular teaching environment. It demonstrates multiple ways.		conservation of momentum and energy - finding particle mass from LHC etc data.	Demonstrate the use of kinematics, momentum and energy conservation via QuarkNet labs/activities. Demonstrate experimental Particle Physics as a collaborative effort. Examples: Rolling with Rutherford Particle Cards Histogram basics Mass of Pennies

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Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	
	2020	2021	2022	
Florida State University/University of Florida Center	Rolling with Rutherford. It is always good to have multiple resources from reputable sources. This year was my first QuarkNet participation. I am a chemistry teacher but can see where some ideas and lessons from data activities could be incorporated into my classroom. Also the collegial relationships I can develop through QuarkNet can become invaluable.			
	They are different and interesting activities and user friendly.			
	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
	2021	2022	2023	2024
	Coding camp. Coding has been the easiest to apply to my classroom since I don't directly teach physics. I would recommend these activities because they expose students to particle physics, and they don't have to deeply understand the subject prior to exposure.	Used coding to find surface area of a large data set in my geometry class. I plan to adapt penny mass and rolling with Rutherford for middle school and use them as nature of science lessons.		I will be integrating particle physics into the momentum section of my physics class in addition to using python for data analysis, and I will use various activities from the portfolio to explore particle physics more specifically. Examples: Penny Mass Rolling with Rutherford Intro to Coding Quark Workbench
		I plan to adapt penny mass and rolling with Rutherford for middle school and use them as nature of science lessons.		

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Center	Program Year (Year of Full Survey)	Program Year (Year of Full Survey)
Florida State/ University of Florida	2022	2023
	I think the biggest take away is ALWAYS how absolutely frustrating it can be to be thrown into something unfamiliar. I've been doing physics SO long that I forget it's intimidating. It helps bring back that compassion. It's scary to not know and have to ask questions.	A few of the momentum activities
	I've used the Mass of Pennies and the Dice activities to introduce data analysis and histograms to my Physics Honors students. Most of my students don't have any prior experience in data analysis, so I like to start the year with helping them learn what we can do with data, how we can manipulate it. I'm excited to introduce a little coding.	
	I think they (DAP) are very well written and thought through. I have trouble connecting some of it to the level and standards my students must reach, but I make it work.	
	I enjoy my weeks spent with QuarkNet. I missed it over the last 5 years. Glad to be back	
	Program Year (Year of Full Survey)	
	2023	
	Intro to Standard Model, network of teachers. Rolling with Rutherford intro to statistics histogram activities (<i>new to program</i>). I think our AP Chem teacher might benefit from using some of them (DAP).	
I've worked through them during a QuarkNet workshop, but have not taken them back to my classroom. (They don't fit in with the courses I teach.) They are great minds-on activities that bring current physics into the classroom. The exchange of instructional materials and strategies within QuarkNet workshops reminds me, every school year, of what it means to teach science and the importance of scientific consensus. As a life-long learner, interaction with QuarkNet instructors and participants inspires me personally and professionally.		
Participants sharing lessons that relate particle physics to multiple disciplines. Relating conservation of energy and momentum in the detection and identification of specific particles. These workshop's instructional materials engage students in such a way as to encourage individual investigation of particle physics and physical science in general.		
I'm excited to discover the available resources that QuarkNet has to offer. I hope to be able to attend some local events so that I may meet and collaborate with other teachers in my area.		

Note: Each row presents responses from the same individual teacher from a given center. Empty table cells indicate that the teacher did not participate in QuarkNet in that subsequent program year(s). Or, less likely did not complete the Update Survey; or did not answer specific questions about the use of DAP activities in their classrooms.

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Center	Program Year (Year of Full Survey)	Program Year (Year of Full Survey)
Florida State/ University of Florida	2024	2025
	Will teach about Quarks in chemistry when we look at atomic theory. It was well done.	
	Coding camp... it has been easier to apply to other disciplines. This will be my first year actually teaching physics, so I am excited to use some this year. (DAP) Really useful for introducing abstract concepts	
	Program Year (Year of Full Survey)	
	2025	
	All of them. The immersive quality and access to workplaces and speakers were helpful for the on-location workshops, and the virtual camp was a good introduction/refresher. I have used notebook I've created at the camps, however most of the activities on the Portfolio are not topics my curriculum addresses. The topics are relevant to high school physics and an interesting introduction to higher level physics and particle physics. I think the students will enjoy it. I'm going to check on it again and see if there is anything I can fit in, perhaps for Science Club. I think I looked at the Data Activities Portfolio a few years ago and some things weren't relevant to my curriculum, however if the notebooks in the agenda are from the Portfolio that may have changed. So I'll look again.	
	Coding Camp - Most applicable outside of physics. (I also teach Earth and Space Science and Geometry.) Data Camp- Pushed me out of my comfort zone. I just started teaching physics last year, and I have only used Shuffling the Particle Deck, though I plan to use Rolling with Rutherford and Speedy Muons this year as well as Penny Mass. It needs some work in the background info for the teacher documents, but I think it does a good job of providing easy to follow instructions. As a participant, but more as a lead teacher I am learning more and more how to teach the way science is done.	
	The annual workshops because I get to collaborate with other science teachers. (DAP) notes and instructions are provided	

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The next several pages present implementation plans created by QuarkNet teachers during the FSU 2025 workshop.

Implementations Plans

FSU QuarkNet 2025

Please add a slide with your name, and include a takeaway that you got from this workshop and how you plan on implementing it in your classroom. This can be as detailed or freeform as necessary for your needs.



Teacher 1

- Using particle data (like muons) with the beginning kinematics that the students learn to introduce the students to these topics since we don't have it in our standards or curriculum
- Also using more histograms for the students to see the collective data (whether through sticky notes on the board or through a shared excel worksheet) and what observations they can derive from it
- The careers in physics STEPUp lesson is also a good introductory lesson to start the year with getting students in seeing how physics expands across different job fields and not just the typical lab idea students have

Teacher 2

- Cosmic watch activity
 - Student freedom to choose and create an investigation
- Poster presentations
- Speed of muons data activity
 - Excel and motion graph practice
- Particle transformations
 - Students discover rules and observations
- Norms poster

Teacher 3

1. **Step Up Norms Poster (good for discussions in any subject)**
2. **As part of my effort to teach graphing skills and excel data manipulation skills:**
 - **I can use the detector data provided to plot muon speed vs time using excel**
 - **Add trendlines and equations to the graph**
 - **Develop a histogram of the results**
 - **Dice, Histograms and Probability**
 - **Histograms: The Basics**
 - **Plotting a Consensus**
 - **Other data practices**

Teacher 4

- The use of sticky notes to make graphing (histograms) less abstract
- Working in groups
- Making class-wide data sets or beyond
- Coding in the classroom to analyze and visualize data
- Commiserating with other teachers and feeling like I am not the only one who struggles with a given topic or management issue / Contacts with teachers that I can ask for help
- Regular refreshers and updates on particle physics happenings so I can stay current on what I'm telling my students

Teacher 5

- Demonstrate the relationship between real world measurement, math and engineering.
- Demonstrate the application of physical laws, use of particle physics examples of kinematics, momentum and energy conservation
- Stress that the results of experimentation and the application of the scientific method need be repeatable and interpreted via consensus; group activities/sharing of data
- Demonstrates Particle Physics is an International collaboration ... lab visits