Center-Level Portfolio: Rice University/University of Houston

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 **Rice University/University of Houston**

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
Rice University/ University of Houston	2019	2020	2021	2022	2023	2024	2025
	All have been helpful in my understanding of particle physics so when I teach the Standard Model to my students I can answer questions and give students extra activities if they are interested. So far, I have not had time to do a complete activity, but I have pulled out portions of LIGO e-Lab, Quark Workbench and CMS Data Express. There are a variety of activities and several different levels so beginners through advanced students can learn something in an area that they are interested in exploring. It would be nice to put together a lesson for my classroom, but I realize that would take a lot longer time than is available. I really enjoy collaborating with other physics teachers - hearing their ideas and what works or doesn't work in their classroom. QuarkNet has provided so many valuable tools to further my understanding of particle physics so I can do a better job informing my students about the current research - what we know, what questions we still have, who is trying to answer those questions. I have also gotten to travel to ISE Summer School in Greece to see how teachers internationally are teaching physics. I would love to one day travel to CERN to do the same. QuarkNet has provided the opportunity to attend these great workshops which I would not be able to financially afford otherwise.	I teach the conservation laws as part of the required state curriculum. I give my students a Standard Model lecture during the 4th quarter each year and I have them explore the Particle Adventure online. Examples: I used Rolling for Rutherford when I taught Chemistry. I would like to use Mass of Top Quark. I really enjoy taking QuarkNet Workshops each summer. I learn something new each session. I also like meeting fellow teachers who are interested in particle physics. They are a good resource.	I plan to use the Step Up Careers Activity and Masterclass prep: Standard Model, Conservation Laws, Mass of Z activity. I have also taught about Gravitational Waves. Examples: Mass of Pennies, Particle Cards, Mass of Z Calculation. I have been attending QuarkNet Workshops since 2007 and I always learn something new. It re-invigorates my love of physics and helps me prepare for the next school year.	Have done Rolling with Rutherford, Masterclass and Standard Model presentation. Plan to do Shuffling the Particle Deck, and Coding Activities. Examples: Use Rolling with Rutherford already, Plan to use Shuffling the Particle Deck and more STEP UP activities like Careers in Physics. I love finding alternate ways to bring real world examples to students and to relate things that are actually happening in physics (research) currently.	Rolling with Rutherford really gives a good example of indirect measurement. The variety is nice, including the introduction to coding - a necessary skill for the future. I appreciate all of the ideas given to teach Inquiry based science. I also really like the Professional Development opportunities through QuarkNet	I intend to incorporate my "Standard Model" talk when I am reviewing the parts of an atom. I don't just stop at protons, neutrons and electrons - I include the quarks. I also plan on using a modified version of Rolling for Rutherford during our Atomic Theory unit. Students can see how "indirect measurement" works. Examples: Rolling for Rutherford, Particle Workbench (Particle Cards), Mean Lifetime (Rolling Dice) I get all sorts of questions about Dark Matter and other topics that pop up in popular culture. QuarkNet has given me the ability to answer some of those questions (not all! but some).	The particles/parts of the Standard Model when teaching about parts of an atom. A variation of "Rolling for Rutherford" experiment when teaching about atomic structure. Also conservation of energy and mass several times throughout the year. Examples: Rolling with Rutherford, Shuffling the Particle Deck, Quark Workbench 2D/3D. I really enjoy having so many resources for hands-on experiences for students.
	Data camp was the most useful as we had time to discuss how to implement into the classroom and not just learn how the program worked. I anticipate CERN will have a similar impact as I attend this summer. Mass of the Penny, Quark Workbench, Shuffling the Deck, Rolling with Rutherford, Mass of Top Quark Rolling with Rutherford, mass of the penny. I love the inquiry based approach to the labs, as I use mostly modeling in my classroom. QuarkNet has allowed me to get to know and interact with area professors and have a network to discuss material with and ask questions. QuarkNet has greatly increased my desire and ability to model physics in the classroom and help students learn how science is “done” rather than just learn about it.	I intend to use coding in the jupyter notebooks for both my engineering classes as well as my physics classes as a way to deal with large data sets as well as some basic coding skills. Penny Mass, Quark Workbench, Dice Histograms The data activities keep getting better and easier to implement		I will be using short coding projects throughout my courses. I use data activities as year starters (Shuffling the Particle Deck and Quark Workbench). I also use particle physics with momentum conservation. Shuffling the Particle Deck, Quark Work Bench, Calculating the Z Mass		I have a collection of coding notebooks that are ready to be used in both my AP physics classes as well as my astronomy classes. I will use them to not only show students real life data usage but also incorporate some usage of python in analyzing data, Mass of the penny, quark workbench, shuffling the particle deck. I love how the material is prepared for multiple levels of student learners and methods of incorporating into multiple courses.	I will continue to use the coding activities in my physics and astronomy classes. I also use the activities as real examples of momentum conservation in my physics classes. Mass of the top quark, particle deck, quark workbench, mass of the penny, intro to coding. great way to learn more for myself and how to incorporate into my classroom.

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2020	2021	2022	2023	2024
	Cosmic Ray e-Lab is helping me use my CRD with students to collect data and publish posters. Rolling With Rutherford Particle Adventure Mass of US Pennies Quark Workbench Dice Histogram Particle Deck Cosmic Ray E Lab. I love that the lesson is completely organized level and pathway. In addition each activity is organized by Student Expectations with answer keys, and student activity sheet, and any additional needed materials for the activity. This workshop is amazing and I hope to be able to implement more of the activities in my classroom. It has already changed how I use excel files to analyze data using classical physics. In the 12 years I have attended, I have made dear friends and amazing colleagues that I can use as reference sources for my curriculum. Unfortunately Modern Physics is our last topic of the year. I work diligently to make sure I have enough time to bring in my experiences and data portfolio experiments into my classroom.		University and my students love it. Our mentor is amazing and energetic mentor and does a great job of creating.	equations. 1. Probability with multi sided dice Coding, Probability with multi sided dice and net momentum using excel to write equations Rolling with Rutherford to determine radius Nuclear chemistry refers to the particle deck. Mean ½ life of muon, I really enjoyed the coding workshop and plan to attend Coding 1 and 2 next summer. Thank you so much for helping us. I believe this was the best QuarkNet I've attended yet. I brought 19 students to Masterclass this Spring and hope to increase that amount next Spring.	Decay activity, Rolling with Rutherford, Histograms and Probability. The data portfolio is an awesome resource.	As lead teacher at the Rice/UH center I plan to share my experience at my QN2024 workshop. Then, I will plan a QN2025 workshop around the experiments we toured such as DUNE(neutrinos) and LUX-ZEPLIN (Dark Matter). I appreciate the shared folder QN staffer made available so I can prepare for my presentation. For my students, I can share my experience in my classroom and introduce some concepts into the Masterclass projects. Today I met a neutrino physicists -- we can use, including all the teacher guides.

Table (con't.)

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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2020	2021	2022	2023	2024
	Both e-Labs gave me several ideas of how to incorporate these labs into my classroom. Mass of the US penny. I would recommend many of the activities to describe how particles work. These are helpful for beginning and experienced physics students because they are arranged at different topics and levels. I love how organized all of our activities are in the data portfolio with teacher and student resources and that I can pick the level and strand to use with my students. When planning my next year's physics class I will be able to use the portfolio to add several activities to my class. All of the speakers from the different campuses who came to talk to us about their research was very interesting and helpful to see the importance of the particle physics in actual experiments going on now and what they are trying to find. QuarkNet has been very helpful in giving me resources and practice using those resources for particle physics concepts. I look forward to bringing things to upper level physics students that will make them interpret data and come up with conclusions that support it.		I plan on getting my cosmic ray detector working and try doing some e-labs and masterclass. Examples: Mass of Pennies Shuffling the particle deck Making tracks 1. I am really excited to use CMS data and the cosmic ray detectors	This year I plan on incorporating histograms and coding into my classes. I plan on using simple coding with matching potion time graphs to have students graph motion. I will be also using the standard model and have a much better background for teaching it. I have used the shuffling the particle deck and rolling for Rutherford. I plan on using mean lifetime part 2 this next year for a more original way of doing half life representation. I am excited to use more of what I have learned this year about particle physics. I will be much better prepared this year to teach that unit.	I have used the particle cards and the half life activities. QuarkNet has really helped my understanding of particle physics. I have done a masterclass with my students and I want to continue this for the next school year. As I get more comfortable with my new curriculum, I am going to try to include more QuarkNet activities.	Topic 1: Start the year with energy mass and momentum and linearization that way. Use their handouts for linearization along with the practice that I already do. IB Topic 7: Particle cards and then do the quark workbench Particle transformations for finding the rules for conservation Feynman diagrams activity to see how particles work IB Topic's for fields use the Making it around the bend. I have used the standard model cards, and half life of the dice, I will add on Energy, Mass and Momentum, particle transformations, Feynman diagrams, making it around the bend and the half life of a muon. QuarkNet has been the most important and helpful resource I have received when it comes to anything on standard model and particle physics. Without the info that I have gotten over the last couple years, I would not have been able to properly prepare my IB Physics students for their tests and all of the particle physics that is on it.

Table (con't.)

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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2020	2021	2022	2023
	The CMS data e-lab because it will give students hand on and real life experience with current and relevant data. Students can connect with the forefront of science knowledge. I think engaging with the data would be the most helpful to students. They will learn to discover how to interpret data from different perspectives. I would recommend this workshop because it helps expand our knowledge and what we can share with our students. We can get them excited about what is going on in the world of Physics today. What students can do with the data activities apply the Newtonian physics that we learn with the cutting edge science discoveries particle physicist are making today and tomorrow! QuarkNet did a great job of showing us the activities and showing us how to access the teacher notes and resources. I feel confident in the connections I have made with the mentor and facilitator, and other teachers in the city that I would be able to participate in other activities such as World Data Day and Masterclass. I enjoy QuarkNet and how much it expands my own knowledge. I feel more confident this year in integrating the activities in my own classroom that I was the year before. I would definitely recommend this session for other high school physics teachers and look forward to attending QuarkNet next year and the next!		I plan to use QuarkNet activities at the beginning of the year with careers in physics. I plan to use the particle cards to introduce modern physics to students. We can use the mass of z with the conservation unit. Examples: Mass of pennies, particle cards. it is very valuable in providing current and new physics.		Step Up Program, Coding Camps, and other activities. Examples: Careers in Physics, Histogram making, Particle physics Cards
	It is the guest lectures that are the most informative and constructive. The activities give real world examples of advanced physics concepts that can be used to teach physics fundamentals. CMS data can be used to teach conservation of energy, momentum as well as dimensional analysis application, concepts and even where and why it might be discounted. I would recommend the instructional materials as they are topical examples of advanced physics concepts that give students insight into the modern realm of physics studies while building foundations of math and science. I consider this a powerful experience that gives pedagogical guidance as well as insight and understanding it advanced physics that solidifies my teaching capabilities, especially in the topics of advanced physics and non-mechanical topics. Spending instructional time with peers passionate about continued learning in their field, utilizing professionals in that field, is priceless. It would be important to ensure that the participants are serious about implementing the concepts and strategies presented during the event. This has the potential of growing into a dynamic learning event and there should be room for new participants and that participants are not just using the event for personal reasons.				

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2020	2021	2022	2025
	It provides a tool to offer higher level academic course and help me to create a research based classroom environment where my students do research in latest scientific discoveries in particle physics. I implemented QuarkNet learning for my classroom project both in Physics and Chemistry classes. I used the data from CMS e-lab where my students do their own research and provide their outcome in form of research paper as a project. The Data help my students for better understanding the atom structure beyond proton or electron. Can you provide individual lessons, so that I can use in my class as it will be more research based and curriculum aligned for college readiness. As the program is research based and all contents are aligned with NGSS so it's offering a real scenario to create lessons for classrooms to make students to take higher level of particle physics classes in college including astronomy and nuclear science. Only need the lesson plans prepared by Quark Net faculties for high school students where more details and examples can be included for faster and easier learning of hard topics in Particle physics.		I am going to create lesson plan where students learn about quark particles while they do research about various colliders while searching latest news. Examples: 1. Rolling with Ruth. 2. Mass of Z 3. Particle cards while printing sets for each group. The workshop was real good and helpful for me to create better lesson plans for my students.	Teaching dual credit physics and a research-based class I have incorporated QuarkNet material in the discussion of conservation laws, and uncertainty. I have also allowed the research based class the opportunity to use the cosmic ray detector as a research project. I am not teaching physics this year, so activities will be limited from the portfolio. I still plan to offer the use of CMS detector for my project based if they desire to utilize for research.	I am going to use masterclass and e-labs, also going to use python language to analyze and synthesize the data. My students do the research and they used those data for presentation in slide show or poster
	Cosmic Ray e-Lab into workshop, because I teach general physics and I can take some of the introductory material and apply it to my lessons as well as my own understanding. Shuffling the Particle Deck - It is a GREAT introduction to the standard model for students who have never seen it or are just learning about it. It also allows them to use pattern recognition and critical thinking to help students gain better understanding. I do like and use several others for similar reasons. I also like the teacher notes and organization of the activities, it makes using them much easier. I believe they provide a deeper understanding to the students along with giving the actual teachers themselves a guide to better understanding of the topics. Some teachers do not have much background in these areas, yet alone some have never seen this, so having such well organized information with resources and teacher notes it makes it much more accessible. I truly look forward to this program every year. I find it mentally stimulating and a great opportunity to enhance my overall knowledge of particle physics. I also enjoy learning about ideas and materials I can immediately use in my classroom to further the knowledge of my students and coworkers. Making the Big Picture connections is extremely important to me not only for my understanding but for my students as well. This is one of many things I love about QuarkNet, it provides me with several opportunities to ask questions and develop a deeper understanding of the Big Picture. I love it! I may not fully understand everything that we discuss, but every year I feel I have made more connections and take back SO much information that I can share with my students. Thank you!		District Workshops sharing information, Careers in Physics, Detector Studies, analyzing data, scientific method, Mass of Z, histograms, Current Events. Mass of Z Particle Cards W2D2	Data Activities, Content Knowledge using the Standard Model, STEP Up activities, Professional Development for Teachers Plan to use: -Intro to coding -Energy, Momentum, and Mass -Step up - Changing the Culture. I thoroughly enjoyed my time here and the knowledge I have gained over the years has been beneficial in not only my teaching (content knowledge), but also in the master classes I have been taking. I also plan on using all of my knowledge to share with other teachers in the district.	

Table (con't.)
Self-reported Use of Data Activities Portfolio Activities: Based on Reponses from the Full Survey and then Responses from the Update Survey in Subsequent Years **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year
Rice University/ University of Houston	2019	2020
	CMS e-lab: has the best connections and applications for students in the classroom. Great way to introduce students to using real-world data, and encourage the incorporation of particle physics in high school. Cosmic Ray Workshop: Served as a personal challenge as a teacher to gather real world data with interested students. Encouraged my understanding of particle physics, and has helped guide students in pursuing independent research topics in IB Physics, and extra curricular programs. Rice Teacher Workshops (speakers): Multiple professors and lecturers have provided resources and connections to professional level physics experimentation, which has helped me guide students who are interested in choosing physics and related studies in university. I teach both biology and physics but was primarily a biology teacher when I first learned about the e-lab. Having taught a year of IB physics I see a lot of opportunities to integrate the data activities in the classroom. In particular, the lessons that encourage students to derive relationships using graphical analysis prior to teaching the specific laws. This also provides a great resource for students looking to incorporate accessible and professional databases into their senior research projects in IB physics. There are excellent connections to classroom work. Especially in higher level learning environments where students are encouraged to explore. I've been keeping notes of the most applicable activities and I hope to have our students join in on world wide data day. Connecting lessons in trainings to daily classroom work is always a challenge. It's also tedious to try and lesson plan in the middle of an engaging training. QuarkNet does an excellent job of having teachers experience the lessons they can bring to their students, but I do think more pointed reflection on "how would this lesson look in your classroom" would be beneficial. Otherwise, engagement in the lessons is fantastic, instructors and guest lecturers are open to questions and really try to help explain higher level concepts to teachers with basic physics knowledge. My experience with QuarkNet has helped connect me to professors and fellow physics educators in Houston. When promising high school students ask for summer recommendations, I feel confident in directing them towards professors and departments I've been able to see during this week. The weeks I've spent here have helped shaped my career as an educator, including preparing me to both work internationally, and in upper level high school programs. The summer programs here at QuarkNet have easily been some of the most impactful single weeks in my science education career. I know I would not have participated in this program were it not for the enthusiastic support of other teachers who highly recommended it to me. Most of my teaching career has been with high school Biology. However, upon switching to teaching IB Physics and Biology I have found a system that encourages the use and incorporation of real world data and connections to scientific disciplines. I have not used QuarkNet resources directly with my biology students, and while teaching IB Physics abroad I found myself struggling to find the resources I had used two years before during my last QuarkNet experience. However, because of QuarkNet I knew the data was present and I encouraged my students to find and utilize it. In teaching Biology IB I encouraged my students to regularly search through abstracts of published work and utilize the databases for their own research. Time with QuarkNet had helped provide a template for myself to incorporate scientific data and research in other fields. Having returned to QuarkNet, and expecting to return to the physics classroom next year, I'm excited to have these resources available to further engage students in topics including collaboration, data collection and presentation. I now have a lot of resources I can share with the other physics teachers at my new institution.	

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2021	2022	2023	2024
	They all contributed in about the same capacity, to further my understanding of particle physics. Rolling with Rutherford and the Penny Lab. I would recommend because the exercises are good resources for relating particle physics concepts to the students. Many of the discussions represent topics beyond what I am required to teach to my student population, but the camp is useful for both increasing my own knowledge and being able to better explain how discoveries in science are made. The Data Camp was a wonderful experience! The Fellows were great and they made the experience friendly and fun. There was a wealth of things to experience and take part in. It was well facilitated and I got a lot out of it. I would recommend because the exercises are good resources for relating particle physics concepts to the students.		Personally I am using the coding skills I have gained to get students into coding with auxiliary lessons and tasks. I am currently being used as a biology teacher, so I have not been able to implement many of the activities in my classroom yet. However, I am able to provide better insight to students into what people in physics fields do.		**2025:** Mass of the Penny, Rolling with Rutherford, Shuffling the Particle Deck
	CERN Summer Program only because of the number of classroom resources they provided us with. Examples: "Mass of US Pennies" makes a great introductory lab exercise. "Calculate Top Quark Mass" is my most frequently used exercise. Well organized resource pool.	I use the Data Activities at various times in the year especially when studying momentum and energy conservation. Examples: MASS OF U.S. PENNIES, CALCULATE THE Z MASS, CALCULATE THE TOP QUARK MASS	Case of the Missing Neutrino Energy, Momentum, and Mass Shuffling the Particle Deck. Examples: Mass of U.S. Pennies Shuffling thee Particle Deck Intro to Coding Using Jupyter Calculate the Top Quark Mass The Case of the Hidden Neutrino	Mass of U.S Pennies, Shuffling the Particle Deck, Calculating the Z Mass, Calculating the Top Quark Mass. They seem to be very useful for the students	Penny Mass

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2019	2021	2022
	The CMS Masterclass was probably the most helpful as it provides an opportunity to bring my students into the particle physics community with hands-on experiences, bringing the LHC to students. I have utilized several of the Data Analysis activities contained in the portfolio within my physics classroom. Rolling with Rutherford is an activity that provides students with the opportunity to use data they have generated for themselves, take measurements, and perform relevant calculations. The activity also provides students with the opportunity to learn firsthand how Rutherford made his influential discovery which resulted in our modern view of the composition of the atom. I would recommend instructional materials within the Data Activities portfolio to other teachers because these materials are tailored to provide meaningful learning, incorporating multiple levels of understanding that appeals to a diverse student population and that can be tailored to the specific needs of learners by the teacher. QuarkNet provides multiple opportunities for me to share meaningful, hands-on learning opportunities to students in a manner that learners rarely have the opportunity to experience in today's classroom. QuarkNet provides multiple opportunities for physics and physical science teachers to interact with scientists and collaborate with one another in a collegial, challenging and productive environment that encourages professional growth and a sense of belonging within a professional learning community of like individuals which in turn translates into more meaningful experiences for students within the classroom. I very much appreciate QuarkNet provision of ongoing professional development for physics teachers such as myself who are part of the program, including the annual summer workshop at my local center, supplemented with opportunities to participate in other workshops at Fermilab, CERN, and ISE. I value the opportunity to help develop inquiry-oriented investigations by which my students will learn about kinematics, particles, waves, electricity and magnetism, energy and momentum, radioactive decay, optics, relativity, forces, and the structure of matter for an improved understanding of these important concepts. My experiences through my involvement in the QuarkNet program have provided me with a deeper understanding of physics content, an appreciation for the machinery of modern science, an introduction to inquiry-based teaching as well as an evolution in individual teaching to a more student-centered mode of instruction. All of these experiences combine to enhance my students learning within the classroom.		

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2020	2021	2022
	Most of all classes are very eye-opening and learning opportunities for me. I learn and implement it in my classroom. I used the Rutherford model of finding subatomic particles in an atom and implemented Bohr model too. These activities are related to real-world applications and help us analyze real-time data. I would love to absorb as many concepts from QuarkNet workshops like this and implement in my classroom. Yes, I have created network of people including teachers, scientists as well researchers in this group. Thank you for providing such a wonderful workshops. I am interested in doing fermi lab or CERN researches. because the lessons are student center with excellent data analysis. really enjoyed time spent at QuarkNet.		I have incorporated rolling with Rutherford with my chemistry students, particle deck, mean 1/2 life
	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
	2021	2022	2023
	Only been to one so far I will be incorporating much of what I learned over the past week into my instruction. Examples: Rolling with Rutherford and mass of pennies.	I have incorporated Rolling with Rutherford with my chemistry students, particle deck, mean ½ life. Examples: Rolling with Rutherford, half-life, particle deck.	Rolling with Rutherford Energy momentum and Mass. Mass of penny Shuffling the particle. QuarkNet is valuable resource that I have used to improve my student's ability to observe and analyze ata and draw conclusions.
	Haven't had a class to use it in yet.	Will be using Shuffling the Particle Deck, Particle Transformation, Calculate the Top Quark and Mapping Poles this year. The opportunity to work with other teachers is great.. This experience will allow me to bring a lot back to my classroom. The availability of real data from current research is key to helping students understand why they are studying physics	
	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
	2021	2022	2025
	Step-Up in terms of increasing diversity. Cosmic Ray in terms of how to discuss collaborative science projects. The materials are vetted and a support system exists for use of them in the classroom.	I have used QuarkNet while teaching nuclear chemistry and sent students to master class. Rolling with Rutherford Half life - Dice	I greatly appreciate the DAP activities - they are well designed and work well in the classroom. I also appreciate the activities that cross STEM disciplines - more of those would be great.

Table (con't.)

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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
Rice University/ University of Houston	2021	2022	2023
	First year		Shuffling the particle deck - I introduce particle physics with this activity. Calculate the top mass -conservation laws
	Subsequent Program Year		Subsequent Program Year
	2022		2023
	Just introduced to them in this workshop so have not had a chance to implement		I need to look through these more. I know of them, but I am not familiar with any other than what I have done in workshop.
	Input data into spreadsheet for calculation and graphing.		Students use to make histographs to conduct data analysis. Data Activities are very useful tool to implement in the lesson delivery.
	Subsequent Program Year		
	2023		
	I feel they are good activities that can be used in the classroom for student growth and learning.		
	The Data Activities Portfolio gives students a new method of learning.		
	First year. Using Colab is very applicable in the classroom. You get to learn from others.		
	coding activities. Finding muon mass activities.		
	The coding definitely is helpful as it gives me ideas on how to assess my students differently in lieu of the usual object test. I like the rigor and relevance of the activities, hence, I rated excellent. QuarkNet experience definitely adds something in my teaching repertoire and I am excited to try them in my class.		
	Ability to pull in actual research into teaching a topic. Example: radioactive decay activity. Well developed and easy to use in the classroom. well developed and easy to implement in the classroom. Great way to meet local science teachers and get ideas.		

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.

Table (con't.)
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 **Rice University/University of Houston**

Center	Program Year (Year of Full Survey)	Subsequent Program Year
Rice University/ University of Houston	2024	2025
	CMS Data Workshops increased my understanding and gave me teaching ideas with regard to our Modern Physics unit. I learned a lot and look forward to digging in to the available activities to share with my students.	
		I plan to join Master class in upcoming school year. It seems very beneficial for my students. I plan to implement a few of the activities in my classroom. Mapping the plots Energy, momentum and mass activity Mean Lifetime Part 1: Dice. I loved the new additions to this year's workshop. Such as they added coding to our workshop. I learnt basics of Python. Thank you.
	I loved the different aspects and experiments we can create using the same sensors and actual data we all have access to.	

Program Year (Year of Full Survey)
2025
The QuarkNet Teacher Program has been a tremendous boost in curriculum resources, teacher professional development, and educator community building. The intro to coding through Google Collab I think will be very useful in opening the door to coding thanks to its ability to bypass the need of processing power on the user end. I am very interested in the Data Activities that introduce students to the standard model and measurement linearization. It's publicly available, vetted by physicists, and community members can comment. The activities are excellent and I wish I had known of their existence a decade ago! So cool! Being encouraged to participate with our "student-hat" on and consider implementation later in the training was very useful.
shuffling the particle deck, rolling with Rutherford, Mass of Pennies. Useful, interactive activities that give students exposure to concepts they may not otherwise cover. Very good workshop. There is a lot of information to take in during a one week workshop.
I gained a better understanding of quantum physics and particle physics. During the workshop, we played with the cosmic watches and completed the totem activity. I would recommend the activities in DAP because it will expose my kids to working with meaningful Data and showing what information that graphs show.
I have only attended this workshop. It included a 2-day coding camp, During the workshop, we played with the cosmic watches and completed the totem activity. Having access to resources / activities to modify for the classroom is great. I am new to the QuarkNet resources. Therefore, I will look forward to get more familiar with the activities. I am new to QuarkNet. Therefore, implementing the DAP resources into my lessons has not yet occurred, but I am very excited in implementing these resources moving forward. I want to move my physics lessons from strictly historical to involve current topics in physics.
I am not sure which would be the best. I am interested in many of them: Coding Camp, summer programs, Masterclasses
Coding camp. I am looking forward to implementing some of the QuarkNet resources in my classroom and increasing the implementation every year
CERN Summer Program. data is related to my chemistry classes. if we can open the participation for more teachers that would be great.

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.

Excerpt from a teacher's open-ended response to question about QuarkNet (as reported in fall 2023):

The big picture incorporated into science curriculum has a trickle-down effect on students and their life choices. We had a student that went to Masterclasses as an interest in this program through his classroom teacher and now he is a grad student at Rice in Physics.

Coding Projects (2023) and implementation plans (2024 and 2025) created by participating teachers are presented in a supplemental document to this portfolio.