

# The University of Iowa Summer Quarknet Teacher Institute Summary



Dr. Onel with the Quarknet Participants

The University of Iowa hosted a teacher institute this summer. The intention is to bring particle physics content and engagement to the high school level. This summer we were excited to see that for many of the participants, this was their first quarknet institute. The week was intended to get teachers a deeper dive into physics, as well as showing them what activities they can bring into the classroom from the Quarknet website and show how they align with the NGSS.

## Monday

Our week began with observing cloud chambers and making models to explain their observations. This allowed the group to see quickly what the level of understanding of the members of the group was. This also helped generate questions that we can work on answering through the week. A later portion of the day included a modification of the [Shuffling the Particle deck](#) activity, where I gave them the cards in a stack faced down in chronological order. As they flipped more cards, they arranged the particles into groups. Once completed, they compared their models to the standard model and looked for similarities. Next we checked out the [Particle Adventure](#) website so we could learn about the particles and forces that hold everything together. The last activity for the day was the [Quark workbench](#) to show that there

are many particles that can be created as long as all conservation laws are followed, but we do not observe them because their half life is so short.

#### Tuesday

Today was all about collisions. We started off with [Rolling with Rutherford](#) to show how we collect data in particle physics as well as to show how to collect data without a direct measurement of the particle itself. We also used two activities to show where teachers can use conservation of momentum, energy, and mass quantitatively in the classroom through [mass of the Z boson](#) and calculating the [mass of the Top quark](#). We also had the opportunity to hear a lecture from Dr. Nachtman on her work with the [DUNE Experiment](#).

#### Wednesday

We went back to the cloud chambers today so that the teachers could refine their model of understanding, and also start to think how they might start to implement observable particle physics to their students while looking at [Making Tracks 1](#). We used [Making Tracks 2](#) so we could observe many types of events in the same still frame. We also used the [Energy, Momentum and Mass](#) activity to include the skill of linearizing graphs into the classroom. Later in the day we listened to a lecture and participated in a discussion from Dr. Onel over the work being completed at [LHC and CMS](#). The last activity for the day included the start of the work to think about an implementation plan.

#### Thursday

Today was about the [NGSS and phenomena based learning](#). We had Chris Like, the science coordinator at the Iowa Department of Education come and run a simulated phenomena, talked about how a unit progression should look and also helped explore websites for different NGSS phenomena resources. The day was coupled with demonstrations and conversations with Dale Stille, the instructional services specialist. The day ended with group work to find everyday examples of particle physics that can be relatable to their students.

#### Friday

Our final day was to sum up the learning for the week. We started by getting into their groups from Thursday and finishing up working on the outline of a phenomena for their classroom, hunting through the quarknet website to find possible other activities that they could implement. Each participant also posted their implementation plan onto the quarknet website as a comment on the [University of Iowa's page](#). Once we shared out the work that has been worked on for the past two days, we ended by adding resources to a [teacher resources document](#) that has been in the works since the 2021 Institute as well as a final survey, summative assessment, and an update to our model of understanding.