Appendix A: Why K-12? The case for including K-8 teachers in our work

A special note is merited for the inclusion of K-8 educators in the PMTL recommendations for the AAPT, a membership organization that has historically been primarily composed of secondary and higher education physics teachers:

Elementary science instruction in the United States is in crisis. It is all too common to hear of elementary schools that teach no science, and in those schools that do, we see a national average of 20 minutes per day spent on science instruction for K-5 schools (Trysgstad, 2012, 19). Of elementary teachers surveyed on their preparedness to teach different science topics, only 17% report feeling prepared to teach physical science (Trygstad, 2012, 6). Federal testing mandates and the reform movement's emphasis on high-stakes testing in English/language arts (E/LA) and math have led elementary schools across the country to disregard science. This has left elementary teachers increasingly unprepared to teach science, with no incentives in place or strategies for teachers to find ways to incorporate science into their curricula.

This crisis exists in the context of a larger crisis in popular attitudes towards scientific thinking that begin very early in students' learning trajectory. The distressing turn in the national conversation away from evidence-based reasoning has led us to a dangerous moment in our history, with irreversible climate change being just one of the results of our inaction. Although there have been several calls to turn this crisis around, such as President Obama's call at his 2011 State of the Union address for 100,000 new STEM teachers by 2021, these efforts will reach only a small fraction of students, and we will leave a huge number of potential scientists and scientifically-literacy citizens behind. If we don't do much more to build a foundation of scientific thinking in student's early years, we will never reach many students. A disproportionate number of these students who we don't reach will be students of color, students who are frequently found in underserved, urban, or rural environments with little access to high-quality lab equipment, academic experiences, or discipline-specific professional development for their teachers.

AAPT has historically served secondary and higher education physics education, which is reasonable since these are the schools where we find "physics teachers." However, it is easy to forget that our elementary schools are home to the greatest number by far of teachers who are tasked with teaching physics. Every general science teacher from as early as pre-K through 8th grade has the opportunity to teach a broad range of physical science concepts that provide students the foundation for all future learning of physics. National conversations about standards and testing have turned elementary schools into arenas where a zero-sum game determines what we teach, with math and E/LA currently taking up the vast majority of the weekly schedule. The AAPT, by expanding its focus from "physics" at the secondary and higher education levels to be inclusive of "physical science" at all levels, could put itself in a position not just to enter this arena, but to change the game, so that the indispensable nature of physical science education can benefit students in a much broader way.

There are many good reasons to make a concerted effort to promote increased and improved science teaching in our elementary schools. Research has shown that students' enthusiasm for science is highest in grades K-6, and we need to capitalize on this by ensuring science education that does not just offer young people fun science activities, but teaches children to think scientifically. Science has a unique role in the elementary curriculum, and can promote universally needed cognitive skills. Personal experience of some of the PMTLs who work with elementary teachers shows that K-8 teachers are often unwilling and unable to teach science classes that have their roots in studying and describing physical phenomena with evidence-based reasoning. Although the Common Core State Standards and related programs such as Writer's Workshop actively promote evidence-based reasoning in young people, they don't come close to the structure and support provided by the NGSS in developing young critical thinkers who are capable of robust argumentation. In short, good science classes can capitalize on K-8 students' potential to develop not just into scientists, but into responsible citizens in a way that no other elementary subjects can address.

As we look at our needs to promote physics education, and support our teaching of physics in the secondary and post-secondary classroom, we must attend to the crisis that has gutted the foundations of our students' science education. By developing elementary teachers' abilities to grow scientific thinkers, physics educators at the secondary and higher education level will have a solid foundation on which to deeper student's understanding and practice of physics.