Dr. Tiffany Wild is an assistant professor in the Department of teaching and learning. In the College of education in human ecology at Ohio State University. Previous research into the conceptual understanding of students with visual impairments has reached across the science curricula. Presented with Dr. Wild is Dr. Marilee Higson and a researcher and teaching science through inquiry she will start us off today. Welcome to Perkins, Dr. Higson.

Thank you very much and welcome to all of our listening audience here. As Robin said, I am Dr. Higson and this is Dr. Wild and we will be taking team each other on the slides. You'll see us go back and forth a lot. Today we are going to talk about science inquiry in students with visual impairment but we are also going to spend a little bit of time talking about some of the new standards they you may have heard about and we will talk a bit about assessment in relation to those new standards. The first thing we want to -- let's see if we can get our slide to go.

Hover over the arrows at the bottom of the slide. You may have lost focus while you are on pause.

That is our first slide. We want to talk about what exactly is inquiry? What do we mean? Inquiry is a way of learning about the natural world, and highlighted on the screen are some of the features that we would expect the learners to be engaged in if they were learning through inquiry. The first is questions. Students would have opportunities to ask scientifically oriented questions in their lessons. Those lessons would then lead to them giving a priority to evidence when they start collecting their data. And that evidence would lead them to the development of explanations. And those explanations of course are supposed to be related to their research questions. The evaluation that students conduct of those explanations should be based in science and they should be comparing their outcomes to what is already known in the science community. We would also expect that learners would engage in communication and justification of their findings.

RDIS and Cory fit into a learning theory? Inquiry reflects the theory of constructivism and it mimics the knowledge and acquisition process of scientists. How do scientists get knowledge? They ask lots of questions that may go through a process and that are what we are doing in inquiry. Knowledge is thought to be gained by applying to problems and then confirming or revising beliefs in light of new data. The research and inquiry -based instruction, there is very little in the field for students with any type of disability. However, in the general education realm with on the inquiry -based instruction has been documented to rise to children's test scores and have a greater confidence, more likely to learn, and they have ability to overcome misconceptions. For students with disabilities inquiry -based instructional techniques were very beneficial. In a study by Linde she found that students with disabilities who had inquiry -based instruction really improve their knowledge of scientific understanding with their peers. And also has led to less behavior problems. When using inquiry -based methodologies. For students with visual impairment, there are very few studies that have been done. However, in 2012 I and Dr. Peter Paul did a study where we found that science teachers utilized inquiry -based methodologies in 61% of classrooms that we surveyed which contained visually impaired students. A survey of 1088 science teachers done by common Lewis found that 54% of those teachers felt least prepared to teach students with visual impairments out of all the disability groups that we are serving. 66% found -- felt unprepared in using assistive technology while 29% felt concerned about safety in the science classroom with students with visual impairments and 80% felt that mandatory training should take place to teach students with disabilities. Those were of all teachers at 29%. In terms of the inquiry -based curriculum research with students with visual impairments there’s been some research done and that research has looked at teaching concepts of scale, environmental science, seasonal change, space, sound and geoscience. We will talk about some of these a little later. The inquiry -based instruction has been beneficial for students with visual impairments and overcoming scientific misconceptions. And we found that students that have visual impairments have different misconceptions from their sighted peers.

Let's talk a little bit about some of the research that Dr. Wild and our other colleagues Dr. Hobbs is done. In the summer, we wanted to find out what children with visual impairments might understand about sound so we collaborated with our local residential school for the blind and we put on a weeklong summer camp. Most of the children were middle to upper elementary age and we have 15 participants. In our camp we had an intentional integration of braille so that we could use reading and writing with our science instruction. The science portion of it was we gave them many opportunities to engage in inquiry investigations about sounds. We have lots of fun things like tuning forks and we allow them to tap on bottles with different levels of water. We rated the kitchen and broke out all the metal bowls and spoons. So that the kids could manipulate all kinds of materials to make sound and to change the sound that they could hear. We even had a day when we had musicians come and play and Dr. Wild was one of the musicians who brought her trombone sowed children could learn that sound -- the pitch and a volume could be manipulated in sound. As a result, all of the students developed some scientifically accurate concepts of sound and that was very interesting to us, because the students before that had never really considered sound as a topic that they could study. And that sound wasn't a quantity that they could manipulate and change. So they learned quite a bit about sound that week. We have so much fun during sound camp that we came back the next summer and this time we put on a camp for the older kids. It was about geoscience. And again, it was a weeklong camp and we had 16 students but these were a little bit older. Middle and high school aged kids and the purpose of the camp was telling the story of the Earth through looking at its rocky surface. We incorporated many feel -based experiences in this camp, so we took the students to case; caverns, fossil hunting, and we also did some lab work back at the school. We had them calculate density rules and we took a field trip to a science lab on the campus of a local university so that we could help them train understand geologic time. So they could see dinosaur samples and different rock samples from different geologic time periods. We found that in this week of inquiry opportunities and feel -based exercises that students did increase the number of scientific understandings they had, but they held them simultaneously with their misconceptions. And science we say misconception is when a student or any person, an adult even has not a clear scientifically -based understanding of a concept. In the case of geoscience, the students were able to hold both scientific conceptions and misconceptions simultaneously.

The next any we want to talk about is about seasonal change. Trying to understand what causes the seasons is very difficult concept. There is a video that's available for a person goes down the line at Harvard University during graduation and asks people what causes the seasons among many other science questions. Even those Harvard graduates had a tough time with understanding and explaining seasonal change. What I did was I looked at seventh-grade students and they were in two different residential school settings. Three students were taught traditional methodologies, lots of books. Very few models on lots of answering questions out of the back of a textbook. For students who were in and inquiry -based classroom that used a published inquiry -based curriculum. All the students, all seven had misconceptions before instruction. However all the students of a traditional classroom still have those misconceptions after instruction but the students in the inquiry -based classroom all held at least some scientific understanding. Two of the students had complete scientific understanding and none of the students had any misconceptions after going through that inquiry -based curriculum. Another study that we looked at was conservation. This was a blast. This was with the national wild Turkey Federation. They had a teaching unit available for all teachers to use that uses the wild Turkey as the basis but it is actually environmental science curriculum. Students were here enrolled in residential school or a public school resource classroom. They all came together and all had visual impairments. Before we started this unit, we found that 40.9% of those students had scientifically accurate answers. 21% still exhibited misconceptions but afterwards, that number jumped to 90% of those students had accurate answers and the only .7% of their answers were misconceptions. We also recently did a study in the study is still in review where we looked at a science inquiry camp for students with visual impairments. This was a weeklong summer camp for students aged eight to 18 and the students initiated their inquiry projects. They come up with their own questions that they wanted to ask, their own list of supplies, and their own methodologies for answering those questions. Included all eight of the science and engineering practices that Dr. Higson will tell you about. The results, we are still analyzing some data and we have some information in review but the results indicated that the students demonstrated a capacity to ask questions, collect data, create explanations from evidence and go through the inquiry process.

Let's go back to class review of this. What are teachers supposed to be doing in inquiry -based instruction property the big thing is that people -- teachers are supposed to be facilitators and what that means is that we hope that teachers are asking lots of productive questions to help their students develop testable questions and to follow through on them. Those kinds of questions would contain a thrust towards -- what did you notice about that? When students are doing their investigation. Those questions would prompt students to engage in some counting or measuring of variables. Those questions would also encourage students to make comparisons between what they are seeing and what a colleague is doing on the other side of the table or perhaps what they've read about in a book. Those questions would also follow along the lines of what if we added some key to that? What to suppose would happen? Or even some problem posing questions. A teacher could say how you think you might -- all those kinds of questions prompt students into further action and that is why we call them productive questions. Another job for the teachers to structure the environment in order to help the students obtain and focus on their evidence. We would hope that teachers would have a safe learning environment, that they would provide supplies and resources necessary for students to do their inquiry, perhaps special measurement tools they might need such as a talking calculator or some kind of a probe that has an audio -- to it. We would also -- also the teachers job to help the students make connections between there observed evidence and existing scientific theory. Students sometimes have a difficult time translating hands-on science activities to what they encounter when testing situations. Teachers need to help the students understand what they are seeing and to help them supply the scientific terminology and tied to how it works with science as a whole. The teachers also lastly need to ensure that students communicate their learning. It's not enough to do the work you have to be able to tell other people about it. Whether it is in written format or oral presentation or perhaps constructing some kind of a model, communication is certainly a part of inquiry. On the screen now is a model of one format for engaging in inquiry lesson. This is called the 5 E model. We would start with engage. In the engage part of the lesson the teacher would bring supplies to the classroom or stage some kind of an event to get the students interested in the new topic of study. It might be a discrepant event where you demonstrate something where the outcome that is not really expected by the students, it could be a storytelling time where you share something that you learned on another occasion. It is some way to get the kids engaged in the topic. The next E is for exploring or exploration. In this stage, the teacher engineers opportunities for students to explore the topic at hand. There would probably be a fair number of planned lessons were the teacher sets the question answer lies the necessary materials and tries to direct the students attention toward the content. But it would be very -- there would be multiple opportunities to explore the content. After a while, you would move to the next phase which is the explanation phase. Here's where you would stop the action in the classroom and have kids share their data. You would probe what they're explanations for their data. Why do they think things happen the way they did? You could then tie that to scientifically accepted explanations of the content. This is where the teachers would really rollout the special science vocabulary that kids have to know. They would have the experiences to make meaning out of science words. After the explanation phase comes elaboration.

In this phase, the teacher can offer opportunities for students to apply what they have just learned to slightly different situations are really the same content. You can also uses phase of models to allow students to ask their own questions after engaging and exploring and explaining they probably have enough content knowledge to ask a testable question in the content area. That's a good time to let them have that experience. In the center is the word evaluation. If valuation does not have an at the end. It happens throughout the process. It is really a more formative assessment and we would think that the evaluation would be largely in terms of teacher questioning or perhaps exit tickets at the end of the day or looking at student notebook data logs to see how they are coming along with their investigations. But it would be ongoing. Another thing that teachers need to know about the model is that it would be an unlikely situation that you would get through all five of them in 150 minute class period. Typically a lesson goes for days and days. You might spend several days on each phase of the model. It is not a quick process. And allows plenty of time for students to think about what they're doing and to have lots of opportunities within the content.

Some additional science research for students with visual impairment. We have been looking at the [Indiscernible] national longitudinal transitional database that we have available to us. We found that students who receive science instruction significantly outperform their peers who are visually impaired who did not receive science instruction. We'll supplement students who receive science instruction in the general education classroom significantly outperform their peers who did not receive science instruction in a general education classroom. We also looked at -- accommodations on the IEP, five over, both the applied subtest and these are national generalized tests and still outperform their peers. This data presented represents restricted use data from the national longitudinal transitional study database developed one or 50 students with visual impairments. The data was given to us by the Institute of educational sciences and it has gone through a full review for potential disclosures. For analysis of classroom accommodations and modifications and the impact and testing will be presented in the future. We are still looking at this data set.

Now let's talk a little bit about science standards. Every teacher knows that you need to base your lessons around whatever state or national standards are in place for your school district or school. On the screen is an image of a tulip bulb in a gradually -- first a couple little leaves coming out of it and in subsequent images, it gets bigger and bigger until it blooms totally. That's what's been going on with the next generation science standards. These standards have been under development for a long time, and the purpose of them is to provide science education for all students in the K-12 pipeline so that it prepares them for college and/or careers so that when kids leave 12th grade, they have a good strong science education behind them and they have strong scientific literacy so that they can be informed decision-makers in a democracy and knowledgeable consumers.

There were number partners in the development of a next generation science standards. The first one out there is the national research Council. A staffing arm of the National Academy of Sciences which serves as the nation’s advisers on scientific and technological issues. The next organization as the national science teachers Association which is the largest organization in the world that is committed to promoting excellence and innovation in science teaching and learning. The next organization the American an Association for the advancement of science is a nonprofit organization that is dedicated would get excited throughout the world. Last group up there, achieve was created in 1996 by the nation's governors and corporate leaders, achieve is an independent bipartisan nonprofit educational reform organization that helps raise state academic standards and graduation requirements and improve assessments to strengthen accountability. Some high-powered people involved in this new standards movement. The next generation site standards have three main components were dimensions. The first one of the science and engineering practices. This is a component called crosscutting concepts and the third are the core ideas and this is what you typically think of and standards. What students are supposed to learn in physical science life science and Earth and space but also amount we are having them learn about engineering, technology and applications of science? The first four practices on the screen now and the first one up there is asking questions and defining problem. Asking questions is an important part of inquiry. The kinds of questions we want students to ask. These are students are supposed to be doing in lessons. They should be asking testable sense questions about the natural world. It may begin with a need or problem. Policies questions would also involve defining criteria parameters of problems. So they have a good of what they're asking marker of developing and using miles. Where talk about a wide variety of bottles. Mathematical modeling, they might do actual physical models, build things and maybe they work and maybe they are just a static model to help them think through their questions on how their data are playing out. Models are important because enable us to make predictions about what might happen next in a process and it also helps us to understand the strengths and limitations of designs that we are working on. Practice number three is planning and carrying out investigations. In this, students would actually be conducting maybe an investigation but they may be doing an outdoor observation. It does not have to be a laboratory type investigation. It is whatever they need, whatever ways they need to find data to answer the question. They will use a variety of resources. They need to gather the data and then record it in some fashion. The fourth one up there is analyzing and interpreting their data. This is probably something we have been falling a little short on in some of our science classes from K-12. Everybody likes to answer questions on plan investigations but then you have to do something with the data that you get. When you analyze that data, you can use a lot of different tools. Hugh can make tables, routes, statistical software, and in analyzing the data you are looking for patterns, significant patterns in your findings. The data, if you are engaged in engineering design Project the data would give you information about whether your design was working well within the constraints that you have set for it. Practice number five, using mathematics and computational thinking. Mathematics is very important in science. They define our variables for us. They help us understand how much of this or how much of that is having an impact on what. We have to have a way to quantify what we are observing and measuring. And furthermore, it helps us to think clearly and logically about our work. Number six, constructing explanations and designing solutions. We know that one of the big goals of science is to develop theories to explain how the natural world works. When we are having students engage in their inquiry lessons and science lessons, we want them to be -- to develop explanations of why they think things happen the way they did and to furthermore write it out or explain the solutions to the question or the problems they were working on. Sometimes or often, students may discover that there is month -- multiple solutions to the same problem and then they have to decide which the best one is. Which fits the constraints of the materials and the time and the questions that they have asked? Number seven is engaging in written and oral argument from evidence. This is important because students must be able to communicate what they have learned. Not only in a testing situation, but they need to make their thinking visible to their teachers into their peers. It doesn't matter whether it is in writing or oral, both of them need to be from there evidence. That's a tough one for kids to learn. Sometimes they will write up a lab report and cite evidence that they never collected. They're drawing upon prior knowledge so we need to make sure that students understand that the evidence they use must be the evidence they collect or that their peers collect or that they gather from a scientifically validated source. The last one up there, obtaining, evaluating and communicating information , I think we touched on this a little bit before but when students do their inquiry, it is important that they read what other people have done before them. So they have to be able to glean information from complex tax. They have to be able to determine if what they are reading is valid, particularly if they’re making it -- a strong use of Internet resources. We need to be teaching students how to tell the difference between a good Internet site and one that has valid information and one that does not. Then we need to teach them to use communication. All forms of communication. We should be rolling out as much technology as we can because the children that we are teaching now in K-12 are not going to be living in the same world that we are. It will be even more complex than ours.

Underlying all of this good business practice is a concept that science is a body of knowledge based on evidence. We want kids to use all of these different practices. They are different avenues to inquiry, but all of them must follow through the evidence pathway. Science standards, crosscutting concepts. These are the big ideas in science. That we see no matter what domain we are in. Life, physical, Earth, space. The first one on the list is patterns. Patterns have always been important because they help us guide organization of our rethinking and it prompts questions about relationships and causes. The next one on there is cause and effect. A lot of times if you start noticing a pattern in your data, you may be able to start making some statements about cause and effect. The next one, scale proportion and quantity. This is important because we have to recognize what is relevant at different size, time, and energy skills. For example, if you had one child in your class that had the flu, you would think too badly for Johnny but he will get better. 50% of your children in your school had the fluid that would make you think differently about the situation. If 10,000 students in your school district had the flu that would really be a different thing to consider. There are many examples in science where scale proportion and quantity matter a lot. Also on the list is now we have systems and system models. We want students to be able to think about their data as a whole because we do what to consider theories is isolation. Systems are a way of understanding how the world works. Likewise, we want them to take notice of energy and matter and systems and the flow of energy gives us a lot of information about what we are watching. Or what we are observing. Structure and function. We know that how things are made, whether it is a life structure or whether it is a physical structure will have a great deal of impact upon how it can be used. Next is stability and change of systems. Scientists have always studied the stability of a system and many have predictable rates of change within them but one that rate of change accelerates or declines, that is reason to sit up and take notice. That is what we are all about now with global warming that is going on. We know that the world has warmed and cooled many times in its history. The rate of change has not -- is not what is normal expected now. That is why it is being investigated. Westfall the interdependence of science engineering and technology. It did do standards there is an intentional and -- [Indiscernible]. We know that they have always been connected but perhaps students did not understand the connection between them. Basic science provides information that engineers can then use to design important tools. And different things that we can use them to make more science. We have always worked back and forth with engineers so now we need to -- make that explicit to students.

Looking at key shifts of -- in instruction in science, if you have been teaching for a while, you probably have heard about inquiry but now we want teachers to use this expanded idea of inquiry and that means using the eight practices. Another shift is the inclusion of engineering and technology concepts right in the science classroom. You'll find that if you have the that's generated site standards of your state, there will be fewer topics and greater integration among the science -- science domains. An intentional integration of literacy and mathematics into the standards. You will find many of the -- your curricula a gets written in your school district and in your state will have connections to real world problems and of course, the ultimate goal is that we want all of our students to leave 12th grade ready for college and career being scientifically literate. The timeline for those standards is very active and dynamic right now. The standards were released early in 2013 in the spring and already seven and actually it is eight states now have adopted the next generation science standards. It changes almost weekly now. Most of the states that adopted the standards and indicated that they anticipate a three year or for your rollout until the helpful implementation of the standards. Because they need time for teacher in-service training and perhaps updating textbooks. And certainly the last item on here, they have to design assessments because assessments were not provided by the standards, assessments have been left to individual states to develop. That always takes a little bit of time. Expected three or four your rollout if your state has adopted the standards. On the screen I was showing to resources if you want more information. The first one is a publication by the national research Council and if you go to the -- Lakota express could search for document called framework for Kate 12 -- practicing best practices crosscutting counts of securities. This is the guiding document for writing the standards and it is a free download or you can read it online for free. And then you can always go to the next generation science standards website and read about the updates that are there and find out who else has adopted these vendors.

The next thing we will talk about are the common core State standards and the reason why we brought this into this presentation as many questions are surrounding the common core State standards and a lot of people get those confused with the sign standards. We will go over some of the common core State standards information with you. You can certainly go for more information on the common core State standards website that was on the previous slide. The purpose of the common core State standards is to guide K-12 instruction to ensure that every student is college and career ready following high school graduation. Very similar to those next generation science standards. Many states have already adopted the common core. The big states that have the include Texas and Alaska. On the slide there is a map of all the states have adopted the standards along with the website at common core standards .org. Let's compare the next generation science standards to the common core curriculum standards. The next generation science standards focus almost -- science and engineering practices with crosscutting concepts and core ideas that Dr. Higson described at the common core curriculum standards focus mainly on or do focus on English and mathematics. English language arts you are looking at reading, writing, speaking and listening and language. The key is that there are some concepts that are crosscutting over to science. Literacy is not to be taught in all subjects. Literacy is present in the common core standards of science, social studies and technical subjects. Mathematics, very similar to science standards. There are eight practices. Again, some commonalities between the next generations signed standards and common core instruction. Very rigorous and the whole point is to compare students for college and career. There are fewer topics so that teachers can go more in-depth. Is integration across content areas? A constructivist teaching methodology invented in both an emphasis on science as students explaining and justifying there thinking. An emphasis on student collaboration and very similar, emphasis on real-world connections.

Some of the key shifts in literacy if you have been teaching reading and writing for the last few years you will notice that a big key shift is literacy is now a shared responsibility for all content area teachers. A bigger emphasis on reading informational text and also an emphasis on steadily increasing student's abilities to understand more complex text overtime. Students will be encouraged to integrate their research skills across standards and grades. And there’s an emphasis on writing to argue inform and explain in the upper grades so that they will be prepared for college-level work. Quiches and mathematics like weird he said fewer topics more generalizing and linking of concepts. And this is -- instruction in the United States more with the way Heights even countries around the world have been teaching mathematics. A big emphasis on conceptual understanding and procedural fluency starting in the early grades so if you are tired of getting kids in your classroom that don't know their math facts, they are now getting time in the lower grades to learn that procedural fluency so they will have it when they get to you. In the upper grades, a focus on mastery of concept -- complex concepts, hands-on learning. The math manipulatives are going to be moving into the -- high school just as mathematical models. We put the common core website appear, core standards .org and there are many resources about the common core available online now.

The next thing we will talk about is assessment in the common core and there is a picture of a baby looking at a computer. It is telling what is coming ahead because all of the assessments are moving online. There are two groups that are working on common core assessments. The first is Park, partnership for assessment of readiness for college and careers and they have their own website. You smarter balanced organization, smarter balanced assessment Consortium and they are available. Who has will be 18 states, Arizona, Arkansas, Colorado, Florida, Illinois, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Rhode Island, Tennessee as well as District of Columbia and Virgin Islands. Smarter balanced has 25 additional states and the US Virgin Islands as well. Alaska and California are some of the bigger states including Pennsylvania, South Dakota, Vermont, West Virginia and Wyoming. All the assessments will be delivered online via computer. It will include a mix of construction response items performance-based tasks and computer enhanced items. A combination of automated scoring and him and scoring. Let's talk about the accessibility. I get lots of questions about the accessibility. A lot of information still to come but what we call this can say is PARCC has accessibility features and the features and accommodations manual was released in 2013. Coming soon will be additional appendices that will explain further different accommodations, accessibility features and what can be done in the classroom. Updates will also be done and we’ll be added as result of the field testing and assessment items as they become available. So love the web that could cover they should the use of braille, braille displays and hard copies of braille. A braille edition for mathematics that will only be available on Phuong. PARCC.Human interpreter videos that are used, and I can only be used that a person has not been used -- one students use the software or videos, they must be used with a headphone where the student must be placed in a separate setting. Additional assistive technology guidelines will be coming out this fall. They are do any time. Students and also be used a scribe or speech to text and color contrast adjustments can be used as well. Other PARCC adjustments include the use of mathematical tools such as large print ruler, braille ruler, tactile compass or braille protractor. Calculation devices can be used only on the non- calculator sessions. Talking calculators will also require headphones or the student will need to be placed in a separate setting. For those unique needs and unique accommodations there is a formal approval process but you'll need to contact PARCC for those formal processes and they must be documented and again we have placed on the slide additional information. There is a teacher brochure that has these accommodations that are available on the PARCC website. A great resource has next to US you are working through and have available for your people in your district as well.

Friends at smarter balanced have also been working on accessibility. They're accessibility is based largely on universal design principles. They also have foreground and background color variation available. They're assessments will have tactile presentation content meeting braille. They would have translated content in signed form for the hearing-impaired, they will offer assessments and multiple language and they too are hard at work field testing their items that will inform their final formats. We welcome you to contact us. We have e-mails up on the screen. Dr. Wild has her e-mail at OSU and I have my e-mail at my school district where I teach. Thank you very much for listening.

Thank you very much. Let's open the floor for questions. I am interested to hear how some of you are thinking about the common core and the expanded core for science and maybe some of the questions that you have. I will tell you one thing that I was thinking of as you were wrapping up, are you yet aware of any school districts or institutions that you feel like are doing this particularly well? That you might reference?

Doing inquiries?

Yes.

Yes. The national Federation of the blind has been rolling out lots of different inquiry -based camps, working closely with myself and Dr. Higson on content and they have been focusing in with their use program and children programming on inquiry. Methodologies and as I have been traveling, I am seeing a ruled out more and more and I think it's going to become more and more prevalent because of these new standards. We'll force teachers to have to teach that we may have been using a lot of direct instruction in the past. The shift is going to be made nationally but there are some doubt is already doing it.

It is a nice fit -- a nice fit between the science standards and common core in that they both are asking teachers to teach students to be able to argue from evidence. Doesn't matter whether its mathematics or reading language arts or science. Students are being expected to think deeply and to be able to justify their thinking.

Exactly what I was going to say. You had touched on this earlier. You it is worth repeating that the kinds of leadership and problem-solving skills that are learned through the inquiry -based activity even just the self-discipline of finding a problem and solving it for your self can be applied across all the curricula but also just in word preparation. In adulthood preparation. Students learning how to have an idea and explore that idea and prove their hypothesis.

That leads to great self-determination as part of that expanded core curriculum for students as well.

It also made me wonder as we have been talking before, the webinar started about the turkey project and you had mentioned it in some of the earlier slides. It made me curious; do you find that students with visual impairment are more or less eager than their sighted peers when it comes to exploring the natural worlds through their senses? That kind of touch? Do see a difference in general terms?

When I was working with a young man, we had been working for about a week, at the end of the week the student started crying when he had to leave and I said what is wrong? He said nobody has ever taught me signs like this. I've never allowed to take science courses. There are research studies that show that students with visual impairments are excluded from science courses because for a myriad of reasons and you can imagine in the life sciences when you're doing dissections and things like that and the safety issues of giving a child with a visual impairment tools . Scalpel. But there are ways to do that in ways that you can make that save. And that has been the fun part for me is to be able to go around and I'm sure for Dr. Higson as well and show that these students different ways that you can make these things safe and you can go and participate with your peers and be a part of the science classroom. And take that information back to your teachers and teach them how you can be a part of the classroom and make things accessible. How do I make astronomy accessible? There are tactile planetariums out there that you can have access to. It has been a lot of fun for us to work with the kids that way and give them the power to use their self-determination skills back in their regular classrooms as much as possible.

I would add to that that general education students are doubt this uniform block. Many of the things we have discovered that worked well in teaching science to students with visual permit also worked terrifically with the general education kids. And vice versa. We have done a lot of reading and asking about that so how are you teaching your science to the vigil impaired kids? What kind of resources do you have? And we have been really excited by what we see. There are wonderful resources available, teachers have to be willing to try it out and know that kids are going to spill no matter what. It happens in the general ad groups to. You get the mop and clean it up and get on with it.

You even think about that example of astronomy, how can you teach something that people can't directly experience and the general at student has the luxury that you can point at the sky or look through a telescope that they still can't dive under the ocean or go into outer space or walk with the dinosaurs. Would've learned ways of making those intangibles and distinct concepts teachable in general add that is not much of a leap to take that to an audience of people with visual impairment and make just one more step.

A lot of our research on curriculum is using the general education curriculum as a starting point and tweaking and antinomies to make it more accessible for students with visual impairments. The geology work we did, those kids were going and hiking into caves and going caving just like her sighted students would as well. We had sighted guides available and gave them a low but more information about where the divots were and where not to trip but we did the exact same things and again, they were so excited to have that opportunity to be able to do that and experience those and have the same experiences that their sighted peers had?

Some of our visually impaired students notice different things. Been cited peers. If you take normally sighted peers into a cave, they see the stalactites and stalagmites but they don’t necessarily notice the musky smell for the temperature change or how close the sides are to your body. The age-old notice that kinesthetic stuff. It's been interesting to document whether comments are but they learned just as much as the sighted kids.

The biggest difference we’re seeing is their understanding. I will say that students with visual impairment have different conceptual understandings of science concepts and their peers and we have documented that will. And the next phase is to look at what causes that and we have many hypotheses but we wanted to do the research to document that but that is the biggest difference is the conceptual understanding and misconceptions they bring into the classroom. Teachers need to be aware of that because you need to know that those differences exist and you need to be able to provide curriculum to help them overcome those misconceptions and get to a scientific understanding. The biggest difference is not in the curriculum or what we're teaching them, just in the understanding that they bring to the classroom.

Out of those summer camp experiences that you have had, what has surprised you the most either Bobby students experience or about your own that you did not expect to have happen?

I would say how much the kids actually did. We have high hopes, we have high expectations, and we were blown away I the level of the work and the questions and the enthusiasm, and it was just -- they have been some of the most rewarding teaching experiences of my entire life.

Once again proving the people will rise to the level that you set for them.

For me it has been hearing those stories from parents that we have interacted with or from kids I keep telling us they are not allowed to be in a science classroom or not allowed to do science with their peers. And it breaks my heart because I know that they can. And so hearing those stories drives me more and more to get as much information out as possible to the teachers, to educators. I teach here at the University and I teach science methods, and all of my teachers taking my courses learn about teaching methodologies for students with visual impairments because it transcends all students to general add and across disabilities and I just want him to walk out and know that our students can do what their students can do. It is just kids are kids and we should not be looking at the deficit but we should be looking at them as kids. They can all do signs.

We do have one question from the participants. Janie asked about introducing the microscope and microscope activities with students were visually impaired. A couple of minutes to respond to that?

Janie, I put together a handout and if you contact me I can give you more information but you want to get them to understand the different parts for its. I introduced the microscope by introducing the different parts. How the different parts of the microscope work, and some safety issues depending on what -- that goes along with that. And if they have low vision we can also hook that microscope up to a monitor or we can video what is going on with the microscope and blow that up onto a smart board for all the students to see which is cool when you put it on the Smart Board because then you are not singling out the students. You are making it enlarged for all students to see and you can point out different specimens and things you are looking at. Start getting to know the microscope and move forward that way.

I like the suggestion of star with what your individual student can respond to or what they might need rather than trying to design an all-purpose curriculum for the next 20 years. Let's get one student learning and see what we learn from that. I'm afraid we're out of time. Jaswant things were getting good. I want to thank you both Dr. Wild and Dr. Hilson for joining us today ensuring this research and starting this conversation. The standards are fairly new as you mentioned and I think we will see more questions as we go along. And I want to remind everybody that the webinar today was recorded, and well be available probably by tomorrow. It takes about one business day to come to our website and we will have these slides available as a PDF and as Dr. Wild mentioned if you are interested in other topics that were mentioned here or other findings that they might have, their e-mail addresses are on the screen. I want to plug that there is only one more webinar in the schedule for this calendar year. Casey Stratton is presenting a discussion on sexuality for young adults with multiple disabilities , that critical 15 to 22 age group and Perkins e-learning webinars will go on a brief hiatus while we make the rounds for fall conferences. We look forward to meeting many of you there. Thanks again for joining us in helping spread the word about the webinars. If you do have other topics you would like us to address, you will be receiving an evaluation survey from us in the mail and please take the time to let us know other topics or speakers that you have seen or have more questions about on behalf of the Perkins e-learning team and all this at Perkins, Phuong Nguyen and I and Mary [ Indiscernible ] we want to thank you and have a great weekend.

Thank you, goodbye. [ Event Concluded ]