[slide 1]

I'm going to talk about project QuEST, which stands for *Quality English and Science Teaching*. I want to acknowledge people who have participated in this project with me, Julie Mazrum, who's a research associate at the Center for Applied Linguistics, and Jennifer Powell and Michele Lombard, who are curriculum specialists with Arlington Public Schools.

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The overarching goal of this study is to improve the science knowledge of middle grade students and concurrently build their language and literacy skills. And I think I was very strategic in putting science knowledge first here. We're teaching these children in science classrooms. And I believe that, first and foremost, we really need to ensure that these children learn the science; but in the context of doing that, to build their language and literacy skills. And this, as you've heard already today, is a major strand of the National Research and Development Center on English Language Learners, CREATE.

We're now just entering our third year. What I'd like to do today is talk a little bit about our first year work and what we learned from that, what we did the second year and provide you some examples of some of the activities that we created for students and teachers, and then talk a little bit about what we're going to do in the third year.

[slide 3]

In the first year, we were pilot testing in six middle grade classrooms with a focus on earth, moon, and sun and this is a funny story. I asked the teachers what they'd like me to help them teach. And unbeknownst to me—because I'm not a science teacher—they picked the most complex topic imaginable for middle grade kids, which is the one that is related to the earth, the moon, and the sun. So it was quite interesting to try to teach this to children. There was a lot of collaboration with mainstream science teachers, the ESOL specialists, and the special education teachers. When I work with schools and teachers, there's a great deal

of collaboration that goes on. We work on choosing the topic together and we generate the ideas and the methods that we're going to use in classrooms.

I was working in heterogeneous classrooms composed of ESOL students, native English speakers, and special education students. And I have to tell you that this was a community that was predominately English speaking with small groups of second language learners sprinkled throughout classrooms in select schools. Where I worked in the second year—and will be working in the third year—is very different. Context really matters, and I'll talk about that in a little while.

[slide 4]

What did we learn from the first year? What were the successful elements of the intervention? Cooperative grouping: I was working in classrooms where there were a lot of very proficient English speakers, and one thing that worked very well was to pair the second language learners with these English proficient speakers. The other thing I could do in this context was to create cooperative groups, which gave teachers the opportunity to really work with children around the text in a small group. And it worked well in this situation because I happened to be working with very well-trained teachers. We used glossaries with visuals to build general, academic, and discipline-specific vocabulary. We focused on science with explicit attention to building language and writing skills of all students. For example, I'm a firm believer of giving children access to grade-level tests -- this was one of the things that Aída mentioned as being important. The ESOL children and the children who were special education, as well as the monolingual speakers, were exposed to the same science texts. And one of the things we tried to do is to have the teacher help these children make sense of the text. We used a lot of the Questioning The Author techniques that Isabel Beck uses, which is a lot of ongoing questioning and discourse and paraphrasing text to make sure that the students understand it.

What were the lessons I learned? I learned a lot of lessons. I'm always learning lots of lessons. This is what I find. I've been doing this for 30 years and one of these days, I feel like I will have learned the lessons. But it's really interesting that, working in schools, one is always learning. I've learned that there was a real need for project staff with deep science expertise. In this project, I happen to be working very closely with the supervisors at the district level where there was one person in charge of science and the ESL specialist in charge of science, but I didn't have people actually developing curriculum with deep science expertise. And this is critical, because if you don't have this expertise, if you want to make this content accessible to children, it is very difficult to do. Now, I have science specialists on staff. In fact, I borrowed them from the district in which I was working; it's one of the nice things that came out of this collaboration.

There was a focus on overarching questions in guided reading. With English learners, you want to keep asking them lots of questions, because you're afraid that if you don't, they really won't make sense of the text. What's really important is to keep front and center those questions that you're really trying to answer through all the smaller questions and through the experiments that you're doing, to keep those questions present for the students and the teachers. It's something we learned. And the need for materials for ESL specialists that were aligned with the mainstream classroom instruction. This context is different than the context in which I'm working right now. Most of the children in these classrooms were mainstreamed, monolingual English speakers with very strong science skills. To incorporate the English language learners in this setting really requires some pre-teaching. These children needed to be exposed to the academic vocabulary and to the reading materials prior to being integrated with the rest of the class. In this situation, it was critical.

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What happened the second year? One thing that happened is I began working in a community in which 98 percent of the students are Latino and come from Spanish-speaking

homes. This school district is one of the districts in the United States with the highest poverty levels. So the context totally changed. One of the take-home lessons there is that context really matters in the way that you craft instruction and the kind of professional development that you need to provide.

In the second year, we worked with 10 6th grade science teachers in five middle schools, and each teacher taught two classes using the QuEST curriculum and two classes using regular district curriculum—which happened to be the Prentice-Hall 6th grade textbook and assorted materials. Within teacher, then, we randomly assigned classes to either a QuEST or the regular curriculum with each teacher teaching two classes with QuEST and two classes as they would normally teach science.

We prepared two six-weeks units, focused on living systems and the environment, and aligned our instruction with state and district standards. There was a major focus on teaching science and, in that context, ensuring English learners understood the grade-level lessons, a focus on building all students' language and literacy skills, and a significant amount of professional development and mentoring.

[slide 6]

I want to show you briefly some of the materials that we used and some of the things we did, and then I'll talk to you about what we learned and what we've learned going into the third year. We were trying to integrate science; language and literacy development—including writing; and student learning strategies—what we could teach students so that they were better independent science learners. We tried to build in methods that would bolster student's motivation to learn—which is especially important in the middle grades level and especially important with kids who have spent a lot of years failing in school; teacher collaboration, in which teachers work with researchers and work with each other to develop these materials and implement them; and a lot of professional development and mentoring.

[slide 7]

Again, a real lesson for us is we are beyond the day when you can go into a school and say, "I have this great curriculum that I want you to use." I don't think that works any more. As a researcher, you have to go into a district and say, "What are you working on? What textbooks are you using?" You have to look at the state and district standards and figure out how you can contribute to that district endeavor. You can see we have the TEKS standards here. Now you know that I'm working in Texas right now. They were covering force, motion, and energy; earth and space; and living systems and environment, the last in a 12-week sequence.

[slide 8]

We looked at their Language Arts standards and their English as a Second Language standards. And any of you who have worked with those English as a Second Language standards know that they're not entirely helpful, because they are usually very general. But they're listed. The idea is that you start with the state and district standards, and you look at the materials the district is using, and you really try to figure out how you can intervene to enhance what they're doing.

[slide 9]

In terms of student learning strategies, what kinds of strategies did we build into the curriculum? We gave—or we attempted to give—students strategies so that they could uncover word meanings. There's so much direct instruction teachers can provide here. And so the idea was: how can we create students who are more independent learners? That is, teaching them to use context to clarify meaning of unfamiliar words; cognates (in South Texas that was a useful strategy), root words, prefixes and suffixes; dictionaries, glossaries, and other references. We're also trying to help students become familiar with the syntax that's typical of science. This is very important because it goes beyond focusing at the word level; trying to think about syntactic structures and how those structures may make

meaning less clear to students. Other strategies included: comprehension monitoring and repair, question generation, and summarization.

Basically, we really looked at those strategies that have been validated by research as effective. You'd be surprised how many strategies people talk about that have no research base. We looked at the National Reading Panel Report—which is the report that preceded ours [Report of the National Literacy Panel]—and tried to pick those strategies that have a solid research base with regard to their effectiveness.

[slide 10]

Writing skills: We're trying to help students write for a variety of purposes—comparison writing, explanatory writing, informational writing, and persuasive writing—aligned with the science content. Again, having students revise for composition and written expression, [slide 11] enhancing motivation through maximizing hands-on experiences, optimizing student choice, embedding comprehension strategies in content, and promoting and supporting student collaboration. [slide 12] Again, some of the same activities that are motivators for all kids are very important for second language learners, hands-on activities, for example, guided reading of the reading selection, the development of technical and academic vocabulary, bilingual materials, and student-to-student support.

[slide 13]

I'll give you a sense of what our weekly curriculum cycle looks like, and I'm going to then give you some examples of some of the curriculum we developed. Then I'm going to talk to you about what we perceived as strengths of what we're doing and the adaptations we're going to make to improve these materials.

We have a weekly cycle. We start with a warm-up. On days one, two, and three, we have a hands-on science activity. This is really important for kids. One of the things that I learned early on with science is: unless the kids are doing something, they don't get it. It doesn't help to show them a picture; it doesn't help to show them a movie. You can't do

that; it doesn't work. You really have to get them involved. A lot of what we do is have kids involved in these hands-on activities that are totally aligned with their textbook and their standards, but also with a lot of work developing the vocabulary that connects to that science activity.

Then on days one and three, we're doing guided reading. As Aída mentioned, I think a real issue for these children is that they've never been exposed to grade-level text. It's always too hard for them, so teachers just put the book down, and they never use it. The result is you have kids in 6th grade—probably kids at 3rd grade—where even if the text is read to them in a straightforward way, they don't understand it.

In an ideal world, I would go into a school and start working with children in kindergarten, expose them to the text in kindergarten, first, second, et cetera, so by the time they got to 6th grade, they could understand the text. When we enter into those classrooms—and I have a real commitment to make that text accessible to the kids—we have the teachers do a guided reading read-aloud of the text with the students asking a lot of guided questions. I've discovered with most kids that it helps if they have something they can take notes on, so we've developed these student worksheets or charts so that the students—as they work with the teacher—can really note the main parts of the selection.

The other thing Aída mentioned is you have to be really strategic about what you give the kids to read and what you expose them to because if you want them to understand a piece of text, you better focus on a piece of text and not 10 pages of text. The idea is to be very strategic about the selections: choose selections that are aligned with the content standards, aligned with the district standards, and give students exposure to academic language.

What we're going to do this year in day four is similar to what we did last year. In language arts, we're going to work on the strategies I talked about; we're going to focus on writing, for example. We're going to focus on giving kids strategies to unpack word meaning

 

and then, each day, we have a wrap-up. Each day, we have a warm-up that introduces the kids to the lesson and a wrap-up that concludes the lesson. On day five, we always assess, whether it's vocabulary or science.

[slide 14]

We've developed lessons for the teacher that start with the preparation and the materials needed. In this particular lesson, the kids started with a quiz of the science vocabulary from the week before but we start with a warm-up with a question. For example, the students were studying plant and animal cells. The question would be: "Plant cells have a cell wall which supports and protects the plant cell. Why do you think animal cells don't have a plant wall?" I'm working with science teachers. They really like asking lots of questions for which the kids don't have answers. I'm a language arts person, and so there was a lot of tension because I am used to providing background information and then asking questions, but I came around to their point of view that it's okay to ask kids questions when they don't have the answers and have a conversation about it because it gets them thinking about what they're actually going to do.

This looks like a straightforward lesson plan but there's a lot of thought that's gone into what kinds of question you should ask kids to get them engaged in whatever task they're doing. Our activity was really a lab activity where the children were actually looking at plants and animal cells; we adopted it from the district curriculum. Then there was a wrap-up activity where we went back to the main question and asked the students after this lab what the main differences were between plant and animal cells. [slide 15] As you can see, for everything we did, we had the instructions for the children here that they used. They observed plant cells and then they observed animal cells under different magnifications and they wrote the answers down. One of the things that we were doing here also is pairing kids—the stronger English speakers with children who are acquiring English—and this was really critical. In this context, effective pairing was very challenging

because I'm working in a context where, basically, all the kids are language minority. I just think about Guadalupe's talk this morning and the dilemma of teaching children in a context where they don't have access to native speakers. It makes the learning so much more challenging, but we did attempt here to pair the kids and give them an opportunity to talk—to minimize 100% teacher talk. We started out with small cooperative groups. We had to dissolve the cooperative groups and moved to direct teacher instruction and paired student work. [slide 16] We have kids recording what they learned in order to consolidate their learning from this lab. Examples include: "What natural color appeared in the plant cell?" "What structure gives the plant cells its color?" "Why is it important to record your observations while you're examining a specimen?" Then we would have a wrap-up question: "…differences and similarities between plant and animal cells?" In summary, the kids looked at the cells, recorded their information, had a conversation around it with teachers, and kept track of what they were doing.

[slide 17]

This is a chart that we gave students so that they could take notes as they read. This happened to focus on photosynthesis with a key question: "What happens during the process of photosynthesis?" [slide 18-19] Here are some examples of a writing activity where we gave the kids a chart to note each of the characteristics of plant and animal cells and bacterial cells and then to write a compare and contrast paragraph based on this information. What we've learned is it's helpful to provide some scaffolding for a compare and contrast paragraph or any writing assignment. Again, the writing was aligned with the actual hands-on work that the students were doing.

[slide 20]

Then we did a lot of assessment. We assessed the kid's vocabulary knowledge as well as their science knowledge. We tested the vocabulary kids were taught, and we pulled science items from a bank of items that were part of the science curriculum. Some of the

questions were multiple choice and some of them were constructed response. I don't know if any of you have seen the Prentice-Hall series, but the 6th grade book is really challenging. [slide 21]

This is an example of our glossaries. We focused firstly on academic words, which are words that are not what I call *discipline-specific*—they cross-cut disciplines. And what we did to find these words is we ran them through Coxhead, which identifies all the academic words in a text. There are always too many to teach, so then we had to figure out which words were most important for that particular passage and which came up the most. When we taught these words—*adequate, concentrated, consequence, likewise, located*—we would have a brief definition, we would have a picture that demonstrated the definition, we would have the definition in Spanish, and we would have the children for homework write sentences which showed that they understood the meaning of the word. [slide 22] Secondly, we focused on technical or discipline-specific words—these were the words that were really specific to science—for example, *permeable*, *selectively permeable, diffusion, molecule*. What we found here is in creating this glossary, we could not use the actual definitions in the back of the textbook; they didn't work. They were just impossible to understand, so we went back to the text itself and created the definition for the students. We also had the definitions in Spanish. [slide 23-24]

[slide 25]

What did we learn from our year two work? What was successful? We focused on district and state standards; I hired two people with very strong science expertise; we had lots of hands-on activities aligned with the textbook content; exposure of all students to grade-level text with scaffolding; partner work; and extensive professional development. What did we learn? We needed more professional development with ongoing mentoring. It is not enough to just tell teachers what to do. And I think Aída brought this out: Even if you have the teachers do what they're supposed to do with children, you really need to have

them work with each other, and you need mentors in there to support these teachers, to help them. They need to see what good science teaching looks like, and they need people who are good science teachers to watch what they're doing. Other lessons include the importance of writing associated with reading, and as I've mentioned, context matters.

Our data is currently being analyzed. The good news is, with some trepidation, we gave the teachers a survey at the end and we asked me to rate the various components of the program. They rated the program a 9.2 on a 10 point scale which I thought was a really good sign. These are middle grade teachers. We had sort of barged into their district, we were asking them to do a lot of work, and they really liked the curriculum. In fact, some of them liked this curriculum so much that it was very problematic for the study because they started using our treatment materials in their control classrooms.

[slide 26]

Hopefully, I'll be working in the same district next year. We're going to ramp up things a bit: We're going to work with approximately 20 teachers. And we'll do 24 weeks of instruction in which teachers will teach 12 weeks using our materials and then 12 weeks without and then they'll reverse it, or we will randomly assign some of a teachers' sections to our program and other sections to teaching as usual.

[slide 27]

In summary, the program elements include aligning with state and district standards, a focus on making grade-level science content accessible, concurrently building language proficiency, using peer work to help students develop language, ongoing assessment, and a lot of collaboration.

[slide 28]

What are some of the real challenges here? There are a lot of generic issues related to working in a high-poverty district with high concentrations of language minority students —all of you are aware of this. In this district, four out of the 10 teachers I was working with

had no teacher preparation. It is very difficult to find science teachers. They were basically hired because they knew science. Other issues include lack of native English speakers as language models and the impact of poverty on student learning. We're not just working with English learners in these districts, as you know all know; we are working with children who are in poverty, which has its own set of issues to deal with.

I just leave you with this. The great challenge we all have is a lack of a robust knowledge base on how to give very limited English proficient students access to grade-level content. We have a lot to learn about how to do this.

Thank you very much.