Language Arts, Vol. 81 No. 4, March 2004 303 – 311

# The Puzzling Child: Challenging Assumptions about Participation and Meaning in Talking Science



Cynthia Ballenger

*Focusing on the talk of children who are not excelling in school challenges and expands our view of what counts as knowledge.*

*"Our kids don't have the cognitive skills, they are not developed as much. They don't know how to summarize, analyze. I am not saying they don't have the ability. They are coming from a different socio-economic background. It is not realistic for us to have the same expectations."*

–Bilingual Teacher, Boston, MA (quoted in Hudicourt-Barnes, 1999, p. 5)

A group of teachers teaching urban immigrant children watched a film of second graders from a wealthy suburban community. After watching these children develop science experiments and discuss their results, some of the teachers responded with distress that their own students could not do the same level of work in science. It didn't seem possible to them that their students could talk and perform in comparable ways.

Researchers interested in culture and schooling have described the ways of talking and learning practiced at home in various communities, such as African-American, Hawaiian, Haitian, and Athabaskan, and compared them with the ways of talking and learning accepted at school. They found significant differences in the two contexts. At the same time, they demonstrated the

intellectual power and sense-making traditions in what Heath (1983) called the "ways with words" identified with particular communities or cultural groups (e.g., Boggs, 1985; Gee, 1989; Hudicourt-Barnes, 2003; Labov, 1972; Lee, 1993; Michaels, 1981; Scollon & Scollon, 1981; Smitherman, 1977). As educators, many of us are aware of this work and yet, in the routine practice of teaching, it is often difficult to appreciate the different ways in which children learn and make their knowledge known. Further, it is difficult to recognize how those ways with words, which are unfamiliar to us or which we consider too social or informal for schooling, are nevertheless sense-making tools relevant to academic work. How can teachers better incorporate this perspective into their practice?

I propose that we regard these children who are not doing well academically as "puzzling children." Puzzling children are those whose ideas are less the result of problematic social lives or lack of ability as we often assume, than the reflection of intellectual lives that we as educators need to puzzle our way through. We need to expand our own view of what counts as knowledge to include these children's very real thinking. By doing so, we will come to better understand both ourselves and what we are teaching.

In this article, I describe in detail the talk during one conversation among third graders about plant growth. I focus in particular on a puzzling child, Elena, and the times when she or her classmates said unexpected or surprising things or made remarks that I would not have made, or times when I did not immediately see the scientific value of the talk. I explore how these children present their meaning in these cases and what resources they draw upon for thinking and for expression. I compare it to what I would have expected or would have said myself. I hope to demonstrate the value in Elena's ideas—in her ways of stating those ideas, in her thinking, in her scientific clarity, and in her impact on her classmates. I hope to show the role of this puzzling child in opening up the conversation to deeper thinking and more difficult questions. In addition, using myself as an example, I propose that one's own assumptions about the subject matter and how it should be discussed may explain why it is sometimes difficult to see these children's intellectual and linguistic strengths. By looking closely at children's talk, especially the talk of those children whose abilities we are not seeing, we can challenge our assumptions about what ability and thoughtfulness look and sound like.

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## Teachers Studying Classroom Discourse

The children's science discussion took place in Marcia Pertuz's third-grade classroom. Her class was part of a Spanish-English two-way immersion program. Some students spoke Spanish as their first language and others spoke English. Many of these children were highly successful in school, though others were not.

Marcia organizes her curriculum around tasks that are real and demanding in many different ways, from writing poetry to doing science. She is interested above all in creating independent learners. As she says, "I strive to put my children in charge of their own learning, set up situations in which they have to problem-solve, and stay out of their way while they think."

Marcia was a member of the Chèche Konnen Seminar (CKC). The CKC was funded by the National Science Foundation to support teachers and researchers in exploring the achievement gap in science for minority and bilingual students. The seminar met every three weeks for a period of five years. There were two strands of study in the seminar—science and classroom discourse. At the time of this conversation, members had been studying plants together by developing their own questions, observing, reading botany texts, and designing and carrying out experiments. In the classroom discourse strand, participants explored videotapes of discussions in each other's classrooms, paying particular attention to children's ideas and connecting them to science and to their own understandings. My role in CKC was that of one of two principal architects of the classroom discourse strand. I also videotaped in classrooms and talked with teachers about the talk and ideas of children, particularly those who were not excelling.

Marcia had been reading Karen Gallas's (1995) book *Talking Their Way into Science.* Gallas emphasizes using the children's own questions to pursue scientific study as well as giving the children a large amount of control in these conversations. Marcia decided to try these ideas out in her science curriculum. As a member of the CKC staff, I helped Marcia explore these science talks as she tried them out. We video-

taped the talks and met regularly to view and discuss the tapes. Sometimes another teacher from the bilingual program and other members of CKC staff joined us. We planned science activities based on the children's ideas.

In science talk, children are given the opportunity to control more of the classroom discussion themselves than is usually the case. This shift in the way status and authority operate often leads to a different kind of talk. Douglas Barnes (1976) terms this kind of talk "exploratory talk." The goal of this talk is to develop knowledge, not to display what the speaker already knows and understands. The pace of exploratory talk can be quite slow because the speaker is exploring ideas for herself as well as for her audience. It can contain extended pauses and self-correction. In some instances, exploratory talk can be full of laughter; on other occasions, it may seem chaotic or even argumentative. Exploratory talk allows children to bring their experiences into the conversation, which is consistent with the view that learning consists of making connections between old experiences and ideas and new ones.

Often in this altered context, puzzling students can demonstrate both the power of their thought and their ways of discussing the subject (Alamar & Green, 2003; Ballenger, 1999, 2003; Barnes, 1976; Beseler, 2003; Gallas, 1995; Hanlon, 1998; Pothier, 1999; Sylvan, 1996). But, they don't always do this in ways many of us immediately value as academic (Dyson, 1992; Gee & Clinton, 2000; Labov, 1972; Lee, 1993; Michaels & Sohmer, 2000). Besides giving them the space to express their thoughts, educators are further obligated to explore the ideas and approaches to knowledge contained in their participation to see their academic potential and expand their own sense of what counts as knowledge.

## A Close Analysis of Children's Conversation about Science

The following analysis began with members of the CKC seminar who looked at this conversation with the question, "Who gets to feel scientific?" The analysis also benefited from discussion with a science inquiry group from Whittier School in Chicago and participants in a forum on teacher research at the National Reading Conference. Final responsibility for the claims and interpretations that follow, however, rests with me.

For the purposes of this account, I focus on two children. Serena, very much at home in both Spanish and English, is the child of two university professors, one from Colombia and one from the U.S. She is considered an excellent student. Elena, on the other hand, is a puzzling student. Elena's mother is an immigrant who works in restaurants. Her father is rarely around. Elena speaks both Spanish and English at home. Elena is not seen as a strong student; in fact, she was not promoted at the end of the previous year.

The goal of this talk is to develop knowledge, not to display what the speaker already knows and understands.

Serena's strengths are in many ways familiar to most educators. Elena's strengths are less familiar and, in fact, often invisible to teachers and perhaps to classmates as well. However, I believe that Elena's ideas and ways of developing them are not only intellectually powerful in themselves, they have value for the other children as well. In this conversation, I believe that it was largely Elena's approach that led both to unprecedented participation from so many of her classmates and to a depth and clarity in their understanding of science issues unusual for their age.

The children in Marcia's classroom had been growing a genetically engineered variety of mustard plant that is particularly useful for classroom studies because the plants move through the cycle from seed to flower to seed again in only 45 days. The children had planted their seeds and were measuring the plants regularly as they began to grow. Marcia had been collecting the children's questions about plants and posting them on the wall. Once a week, she asked one child from the classroom to choose a question from the list for the class to discuss in science talk. On this day, the question chosen was, "Do plants grow every day?"

In the text that follows, I present a large part of the children's conversation on this question, alternating the children's words with my analysis in italics. The scientific and mathematical ideas that the children were developing are identified along with the ways in which Elena, in particular, proposed her ideas on these topics. Of course, it is not possible to be entirely sure what people mean when they talk, so there is a speculative quality to this analysis that teacher–researchers and others will recognize. This uncertainty is stronger early in the conversation when the children are just making contact with their ideas.

Despite some uncertainty, I will, nevertheless, be contrasting Elena's approach with Serena's. While I don't mean to stereotype either child on the basis of one conversation, Serena's response does represent the

goals many educators would have for such a conversation, a response whose power is easily visible. While most teachers would also honor Elena's participation and recognize that she is thinking hard, the power of her approach as scientific and mathematical thought is less easy for many educators to see.

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It is my position that what Elena has to say challenges the assumptions that underlie this differential evaluation. First of all, I hope to show the intellectual power in Elena's approach, an approach that I think we tend to honor more in terms of its social role—we're glad she's participating—than as a basis for intellectual work and thought. Second, I hope that delving into how Elena approaches this question will allow us to see other routes into science that, as educators, we don't usually expect or promote, but which are routes that could improve science learning for all students.

*Serena immediately responds to the discussion question "Do plants grow every day?" by saying "It's so obvious. They grow all the time and so do we. Our eyes can't see it."*

*But, Carlita asks her, "If you can't see it, how can you tell it's happening?"*

Serena seems to be saying that "seeing" growth like you see someone walking is not possible; it goes on so slowly, in tiny increments. But Carlita asks her how she knows then, that it's happening at all.

*Serena responds to her, "Don't you grow every day? [Carlita nods] Then these ones do." Another child disagrees: "We don't grow every day." Lara chimes in with her ideas on the subject, "On our birthday. On our birthday, we grow." Then the following exchange takes place:*

Serena: *When you finally notice that someone's grown they just grow like that?"[Serena moves her hands apart suddenly to demonstrate fast growth.]*

Lara: *Only one day they grow that fast?*

Elena: *I only grow in months. That's—*

Serena: *Do you see yourself growing? All of a sudden at midnight you grow like this [moves hands apart a few inches quickly] and then the next day at night you grow like this [same gesture]?*

Lara talks about growing only on her birthday; she may be thinking about when one's age changes. At another point, she mentions that she has a growth chart for her height at home—perhaps she is measured on her birthday. When Elena talks about only growing in months, she may be thinking about the way we talk about age; we might say someone is 2 years 9 months, or 6 months old, but we rarely calibrate age to the day. Rather we talk about age in years and months. Or maybe Elena is thinking about the amount of time that must pass before one is aware that one has grown; you don't notice it on a day-to-day basis. Serena seems to be reminding them of her idea that all the growing must take place over time, not all at once, even if it appears so. Her offering, "all of a sudden at midnight," seems to take the most extreme case to show the absurdity of growing all at once, rather than steadily. Serena is arguing logically, but also in a rhetorically playful way. One wonders how the children respond to this idea of growing at the exotic hour of midnight.

*A little later, Elena enters the conversation with an account of her experience watching her plant.*

> *Elena: I think it does grow every day because every single day, every single day we look at the plant. . . . every single day we look at the plants and it's growing a little bit more. Then we look again and then it—and then tomorrow we look again and it's—it's growing a little bit more. And the other—to—today—yes—I mean—I think it was Wednesday that—n—no [pause] today's Wednesday [pause] it was Tuesday that I looked at my plant and it was all crooked and it's getting—it's getting stronger and the little piece, the little piece that they have on there—I had a little teeny, teeny, teeny one now it's fat.*

The first thing of note is that what Elena says is much more than she usually has to say on any topic in school. Elena has stayed very close to her experience of observing the plant itself. She seems to be seeing it again in her mind and noticing things even as she gives her account. As she recalls her memory of the way the plant has changed, she includes as an example of growth the development of what she calls the "little pieces," which are in fact the seedpods, and she mentions as well the development of greater strength. The children have been charting the height of their plants, measuring from the soil to the highest point. They have been considering height and growth largely as one

and the same. Elena offers new ideas on what might count as growth, i.e., getting fat, getting stronger.

Elena goes on to describe what she has seen and begins exploring ideas about the rate of growth. At first, as she says, "every single day we look at the plants and it's growing a little bit more. Then we look again and then it–and then tomorrow we look again and it's–it's growing a little bit more." Here she is describing her sense of steady, gradual growth–every day a little bit more. In contrast, her final comment, emphasized by the way she uses her intonation, suggests a jump in growth, a growth spurt. She says "the little piece that they have on there–I had a little teeny, teeny, teeny one–now it's fat." She emphasizes "teeny, teeny, teeny," using a high, steady, emphatic pitch and repeating the word three times. The repetition and the steady rhythm of teeny, teeny, teeny suggests how long it was the same. Then she speeds up her speech and lowers her pitch for "now it's fat." Using rhythm this way emphasizes, and almost enacts, the sudden contrast between when it was teeny, and "now." One could almost understand her meaning without words–with only the pitch and rhythm.

Changes in rhythmic pattern and pitch are often part of the surprise endings used in stories told in social situations to amuse others. In this case, the change has additional relevance in that the two rhythms represent rather directly the two kinds of growth that are under discussion; slow and steady is one rate of growth, sudden and rapid being another. A narrative strategy, something with which probably all the children have practice and skill, has been brought into the service of a scientific and mathematical distinction relevant to their developing question on growth and measurement.

*However, the discussion now moves to a different approach to seeing growth when Marcia asks, "But does anybody notice when they looked at their plant some days there was no growth at all?" Serena nods and replies, "Our rulers can't be perfect."*

Although Marcia asks whether anyone looked at their plant and saw no growth, she may actually be thinking of the growth charts the children have been keeping as the place to see growth. Marcia goes on to ask them how many times they have seen no growth, which seems again to be a reference to the measurements taken for their charts.

This is a normal moment in a conversation, where people are talking about the same thing, but not exactly.

Serena certainly takes the question this way and she answers from her knowledge of the chart she has been keeping and the measurements that it records. She questions whether or not their rulers can always detect growth and thus whether or not the growth charts reliably indicate whether or not the plant has grown. Serena and her teacher are "seeing" growth through these numbers recorded on paper, although with some critical awareness of the limitations of the tool. Elena, on the other hand, seems very close to the plant itself. It is the plant and her memory of how the plant looked to her that Elena "sees."

This is a normal moment in a conversation, where people are talking about the same thing, but not exactly. Without the tape to peruse, it is unlikely that any of us would have noted the difference here in what various people are looking at. This distinction in how different participants "see" growth is a theme I will follow in the rest of this analysis.

*Susannah and Serena next collaborate to suggest that it is easier to see the growth of the plants over the weekend, when "we're not there."*

Susannah: *Serena is right because every day when–when we're like–every week we get bigger and bigger.*

Serena: *But we can't tell.*

Susannah: *But we can't tell. We just get one inch bigger.*

Serena: *Until–*

Susannah: *And then weeks–on weekends when we're not here they get bigger too.*

Teacher: *So you've noticed a big difference over–from Friday to Monday?*

Susannah: *Yeah, they were like this little. Every week we get bigger and bigger/*

Serena: */but we can't tell.*

Susannah: *but we can't tell. We just get one inch bigger.* [Lots of cross talk among students]

Serena: *If we were ever twenty-eight years old what would tell that we have grown? What would tell? Unless you have a grow chart and you grow yourself like every year you'll see that–*

Lara: *I do. I mark myself on the wall. I would say I'm more bigger.*

Serena: *And then–*

Susannah: *In the week, when we came back Monday my plant was a little bit big. Every week we grow bigger but we can't tell.*

This piece of the conversation is largely co-constructed by Susannah and Serena. Like Elena, Susannah is

a student who has difficulty in many school situations, a student who is not at home in academic language in English or Spanish and rarely has much to say in class. In a sort of rhythm with Serena's prompts—"until," "but we can't tell"—Susannah argues that over time, small changes may become visible. She focuses not on the ruler, like Serena did earlier, but on the plant itself, and on herself, in relation to the time between views. If we don't look at our plants every day, if we wait over a weekend before we look again, we may be able to see that there has been growth. It is possible that Serena's "but we can't tell" is referring to a different way of "telling" than Susannah's, one relying on measurement tools and their imperfections. It seems probable that Susannah is talking about differences you can see by looking directly at the plant, or at yourself.

Juana: *[Juana seems to be responding to these "but we can't tell" comments as she asks in a tone of deep concern]. How come we can't really see it—us grow and the plants—how come we can't see the plants grow and how come we can't see us grow?*

Serena: *Well, if we had a chart for them—*

Serena answers Juana, again from her experience of using the chart. But Juana seems to want to see growth by looking directly at the plant and to see it as it happens, "really see" it. She appears not to be taken with the power of the numbers and the growth chart to demonstrate growth.

*Elena next attempts to answer Juana: I think I got the answer to Juana's question. That I don't—I don't think we could see them grow but I think they could feel theirselves grow. Sometimes we can feel ourselves grow because my feet grow so fast cuz this little crinkly thing is always bothering my feet. That means it's starting to grow. It's starting to stretch out.*

Elena seems to be thinking about growth in its minute-to-minute aspect like Juana. "How would the plant feel?" she wonders, and, "How would I feel?" She uses her body to explore this. She wriggles her nose as she describes the crinkles in her feet, and she makes her voice high and throaty as if to feel the air as she speaks. It seems she is trying to experience again, and at the same time dramatize for others, the crinkly feeling of growth. She is speaking from a perspective inside her body as it grows, rather than observing from outside.

**This is a level of questioning you rarely get from children of any age.**

*A few turns later, Juana herself responds: "I have two things to say. How—what makes the plants grow so slow? And I think I can kinda see myself grow because one day I putted on my socks and they was too small for me so I can fit in my mom's socks now."*

Recall that a little earlier, Juana was asking how one could know something had grown if one couldn't see it happen. She is now relying on a measurement system of sorts to answer this concern; it is not the usual measurement system, but a measurement system that has features that evidently satisfy her. Probably she could feel when she put on her old socks that they were too small. Perhaps it was a "crinkly feeling." Juana seems to be combining Elena's way of feeling growth with a measurement system over time, as suggested in different ways by Serena and Susannah—her feet don't fit, then her feet do fit. Wearing her mom's socks allows her to, as she says, "see [herself] grow."

Susannah continues in a similar fashion as she remembers the change in clothing size that her little brother has gone through—he was a size 5 when he was little, now he's a 10. She speeds up as she says "now he's a ten," echoing Elena's way of representing the growth of the seed pods and similarly suggesting that the change was sudden and remarkable.

*At the end of this discussion, we find the children seeking to understand the role of the sun in plant growth. They say that they have been told that the sun helps plants to grow, but, they ask, how? John says he thinks it has something to do with oxygen and carbon dioxide, that* The Magic Schoolbus *said so. Ronaldo kneels, holds his arms out like branches, palms toward the sky, rolls his eyes, and asks, "But* how? *They just stand there, like a statue." He has transformed himself into a plant. The children are delighted and break into laughter. There is a pause. Then Elena asks, "What does the plant do with the sun?" Lara wonders how it gets "inside the leaves." Ronaldo, again holding his arms out, speculates that "the plants have to open their leaf to grow." Serena then asks, "Yeah, but* how *do the leaves open?"*

As they explore their questions about the role of the sun, there is a good deal of laughter and cross-talk. They turn towards each other. They seem thrilled with the difficulty of their question. They are clearly deeply engaged, asking for more information, trying to imagine the process by which the sun gets

## Books about Growth and Measurement

Alder, David. *How Tall How Short How Far Away.* Illus. N. Tobin. (Holiday House, 1999). Introduces different systems of measurement as well as their histories.

Aliki. *I'm Growing!* (HarperCollins, 1992). A young boy describes all of the ways his body is growing and changing.

Briggs, Raymond. *Jim and the Beanstalk.* (Paperstar, 1997). Jim helps an old giant by measuring him for false teeth, glasses, and a wig, and then obtaining each item.

Brown, Stephanie G. *Aesop's The Crow and the Pitcher.* (Tricycle, 2003). The crow applies the scientific method to get the water to rise in the pitcher in this innovation on the classic fable.

Hutchins, Pat. *You'll Soon Grow into Them, Titch.* (Mulberry, 1992). When Titch grows out of his hand-me-down clothes, he gets a new set for the first time.

Leedy, Loreen. *Measuring Penny.* (Holt, 1997). A young girl measures her dog, Penny, using a variety of measuring units.

Murphy, Stuart. *Pepper's Journal: A Kitten's First Year.* Illus. M. Winborn. (HarperCollins, 2000). Lisa keeps a journal chronicling the growth and changes her kitten experiences in its first year. Connect with *A Kitten's Year* by Nancy Day.

Murphy, Stuart. *Room for Ripley.* Illus. S. Wickstrom. (HarperCollins, 1999). The story of a boy preparing a bowl for his new fish is used to introduce liquid measurement.

Schwartz, David. *Millions to Measure.* Illus. S. Kellogg. (HarperCollins, 2003). Marvelosissimo the Magician explains the development of standard units of measure and shows how to calculate length, height, weight, and volume using the metric system.

Sweeney, Joan. *Me and the Measure of Things.* Illus. A. Cable. (Crown, 2001). Explains different weights and measurements in the daily life of a girl.

—Marilyn Carpenter

inside the plant to do whatever it does. This is a level of questioning you rarely get from children of any age, a sense of evaluating an answer as insufficient, a desire to see beyond an easy explanation.

### Students' Learning

What have the children learned? First, they have explored how you can know that something has grown. Serena refers to the charts they have made. Other children recall their observations, imagine the plant, remember feelings, and tell stories in which they represent in various ways the changes that they have noted in plants and in people. Susannah talks of the change in her little brother's size, Lara mentions the growth chart she has at home and her birthday, Juana, her sock size. In exploring various ways by which you can know that something has grown, growth itself becomes a more complex category. Linear measurement as a system for noting growth is reorganized into only one part of a set of ideas that include volume; constant versus intermittent rates of growth; strength and the development of important new parts (seed pods); what measurements can show you, and some of what they cannot.

Furthermore, these different aspects of growth involve taking different perspectives on the phenomenon as well. Serena measured her plant and then spoke of growth from the numbers she recorded and her understanding of how rulers work. She does not talk about the plant itself. In contrast, Elena and a number of other students look at the "grower" itself. Seeing growth in this way leads a number of children to wonder about the process of growth, rather than just the visible result.

Based on experience with many similar conversations, I believe Elena's way of participating was crucial in inviting others into this conversation and in making it a powerful space for thinking. What did she do? First, she returned the discussion to the plant, although perhaps not the plant as physically present but rather the plant as she remembered or imagined it. In addition, she brought imagined and remembered experiences of her own growth into the conversation—two little stories, one based in her memory of close observation of the plant, and one in her sensory memory of her own growth. She used her voice to demonstrate a sense of growth itself, and the different rates by which it might proceed. As her voice mimicked the rapid growth of the pods, she appeared to be trying to *be* "growth," rather than to be an

outsider observing it. She explored what growth might feel like inside by crinkling her nose and using a throaty voice. In doing these things, she brought the others into the phenomenon with her. She put herself and her listeners into contact with what they already knew of growth; what they had experienced.

Elena is trying to be a fellow creature with the plants and to know new things in the same way—as a thinker and as a participant. This brings to mind the way Nobel-prize-winning biologist Barbara McClintock spoke of her work with corn genes.

> *I start with the seedling, and I don't want to leave it. I don't feel I really know the story if I don't watch the plant all the way along. So I know every plant in the field. I know them intimately, and I find it a great pleasure to know them.*
>
> *When I was really working with them I wasn't outside, I was down there. I was part of the system. I was right down there with them, and everything got big. I even was able to see the internal parts of the chromosomes—actually everything was there. It surprised me because I actually felt as if I was right down there and these were my friends. . . . As you look at these things, they become part of you. And you forget yourself. (Quoted in Fox-Keller, 1985, p. 165)*

Like McClintock, Elena doesn't want to leave the plants for the numbers about them too soon. Serena makes a logical connection between human growth and plant growth—"don't you grow every day? Then these ones do."—and she looks at the measurements for evidence of growth. Elena's connection is different, organized around shared experience and seen from within. The world of plants is not explored as a world separate from us, a world in which our own knowledge and experience and ways of talking and seeing are not relevant or as one in which we must start over to acquire scientific ways, as so often happens in school science. Rather, the children are excited to discover the importance of their own experience, and their questions arise from this. As a result, they are committed to the idea that explanations need to make sense to them and that their own ideas are sensible. If you can't see growth, why can't you? And, how does the sun help plants to grow? These are not questions one thinks to ask in many contexts. In the context of this discussion, it is more possible for the children to question knowledge that they might have taken for granted. They try to get inside the phenomenon in various ways based on their experience, rather than accepting one particular way of seeing. Elena has helped them to go beyond what the curriculum would ordinarily expect into deeper and more complex views and concerns.

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I am certainly not arguing that what Serena knows is not also powerful. Moving from the organism to the data collected about that organism is surely one of the ways science is able to progress, making all kinds of comparisons and analyses possible. But it is also true, as the Barbara McClintock example demonstrates, that an intimate and imaginative connection with the life of the phenomenon under study is also part of the process of science. Elena has been crucial in adding to the definition of growth, in seeing it as a process, and in recognizing ways in which what we already know about growth connects with this new knowledge and new situation. Both children have a good deal to learn from each other.

## Educator's Learning

Most people assume that an in-depth study of the central ideas of science and mathematics is an activity reserved for a special and talented few. In school, too, science is often a subject for the elite. Few excel. It is often seen as the province of those children who are regarded as the smartest and best prepared. However, in these kinds of conversations, combined with well-designed science experiences and activities, a different pattern of talent and achievement emerges. Very often in the sort of context that Marcia created, we hear much more than usual from "puzzling students" like Elena, and we are able to see their intelligence.

As I investigate what they have said, I often find my own assumptions about the subject matter challenged. For example, my expectation about how to see growth was that the ruler would tell us. In general, this limited my view of growth to vertical growth. It also didn't lead me to look for it in the moment, which tacitly excluded the views of certain children, like Juana who wanted to see growth as it happened, or Elena who was eager for an insider's experience. While I thought these girls' ideas were charming, I was not expecting their responses and was unable initially to see them as places for the science to build.

The way in which Elena acted out growth with her intonation and her nose was, I think, valuable to her thinking and to the other children,

but it is not something I would have noticed without time spent poring over the tape. She made me aware of the role that expressive language, drama even, can play in thinking deeply about growth. What it means to "see" growth, how you might measure it, and the role of a relationship with the plant all became more complex for me and for my colleagues with whom I shared this. Elena, a child who was not doing well, had a great deal to teach.

I hope it is now clear that both children had powerful knowledge and ways of thinking scientifically. It is important that we continually reevaluate our assessment of children's abilities. By following children's ideas and exploring the scientific content of ideas we find unfamiliar as well as those put forth by children we don't recognize as powerful thinkers, we can change these children's experience of schooling in a way that also improves learning for all children—and for us, their teachers.

### Author's Note

*The research reported herein was partially supported by the National Science Foundation, REC- and ESI 9555712, the Spencer Foundation in a grant to the Brookline Teacher Researcher Seminar, and the Office of Educational Research and Improvement, U.S. Department of Education, through the Center for Research on Education, Diversity, and Excellence at the University of California, Santa Cruz (CREDE, Cooperative Agreement No. R306A60001-96). This article benefited from two extremely thoughtful anonymous reviewers as well as conversation among participants in CKC.*

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