



The Beginnings of Energy in Third Graders' Reasoning

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Introduction

We present some data from third-graders considering and comparing different ways to make a toy car start moving. This case study illustrates an approach to coordinating inquiry- and traditional content-oriented objectives in early science education.

Third Graders Discuss Motion

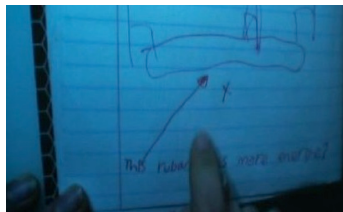
- Teacher Sharon Fargason
- 3rd Grade Class
- 14 Days, Fall 2009
- Discussed and tested various ways to get a toy car moving

The Responsive Curriculum

- ✧ designed to promote attention and responsiveness to the substance of student thinking
- ✧ anticipates possible student ideas, suggests possible next moves
- ✧ allows and demands teacher decisions about how to proceed based on student thinking
- ✧ promotes the pursuit of inquiry as well as addresses the matter of conceptual significance to their progress in understanding energy

Paying Attention to Student Thinking

- allows the teacher to focus discussion around students' ideas
- helps the teacher identify and utilize students' conceptual resources
- shows students that they are being taken seriously so they can feel more comfortable sharing their ideas
- helps the teacher assist the student in articulating ideas more effectively



“What’s going on here?”

Often, the way that the teacher presents an activity can impact both the students' attitudes and the quality of substance in discussions.

- On day 14, Ms. Fargason decided to start discussing the concept of energy
- She opened the discussion with an idea she found in Kevin's notebook
- He had written that a stretched-out rubber band would push the car farther and have “more energy” than a loose rubber band
- Ms. Fargason asked, “So what do you think that can mean that, that rubber band has more energy? Or why would this rubber band push the car farther? What do we think about that?”

The way Ms. Fargason introduced this discussion sent the students some subtle messages about what kind of activity this was and what she expected from them:

1

By asking, “why would this rubber band push the car farther?” she revealed that their answers to this question should be focused on **physical mechanism**.

2

Discussing a student's specific idea supported a mindset of thinking about **knowledge as something they can construct**, rather than need to rely on an authority to give to them.

3

Because her question focused attention on the “new” topic of energy while drawing on the students' familiar experiences with rubber bands, the students could feel comfortable **giving explanations from their already existing store of knowledge**.

Toward an Understanding of Energy

We suggest that focusing on student thinking is one way to coordinate inquiry and content oriented objectives in the classroom. By tapping into children's conceptual resources through inquiry-based methods, the teacher can help the students build a solid foundation for future content acquisition. However, our notion of progress is not merely a succession of correct conceptual attainments. We do not expect that third graders will achieve “closure” on the scientifically correct conception of energy. Rather, we hope to see students learning to put ideas together and take them apart, and the progress we hope to see is their doing this in ways and with resources that will help them in later, more sophisticated constructions.

Constructing Ideas About Energy

The discussion that followed Ms. Fargason's question was full of rich and productive ideas where the students talked about energy in many different ways. One particular idea was Caleb's. He was the first one to answer Kevin's question.

Caleb: **The rubber band is just like a steep hill.**

SF: What do you mean?

Caleb: By where the car heads down the ramp but it's getting pushed by a rubber band --- instead of going down a hill.

SF: So you said --- so it's like a steep hill. So this rubber band and a steep hill are kind of similar? And did you say why you think they're similar?

Caleb: **Because they have the same energy.**

SF: They have the --- these have ---these two have the same energy? What do you mean by that?

Caleb: **They go the same speed.**

A little bit later, he expressed an idea that someone walking slowly is building up energy, because “you'll be able to catch up on your breathing.” Ms. Fargason asked him to think about his idea in terms of a ramp.

Caleb: When you start to run--when you're, when you're trying to walk down a ramp, you'll start to go to running power, but **you're still building up energy because you're not doing the running.**

SF: What do you mean, “you're not doing the running?”

Caleb: Because the more steeper of the hill that you're walking down, the more faster that you go.

SF: Why?

Caleb: If you don't, if you keep getting more energy, because, because, because every time that you do a running step, then you're about to start sweating.

SF: When I run I'm about to start sweating?

Caleb: When you're not heading down a hill.

SF: But when I am heading down a hill you said that I'm not doing the running.

Caleb: No.

SF: **What-who's doing the running for me?** If I'm going down a hill?

Caleb: **The hill is.** Because-

SF: It's like the hill is running for me?

Caleb: **Because the hill, because the weight makes you go faster.**

SF: What weight?

Caleb: The weight on your body.

What Do We See in Caleb's Thinking?

- He thinks about energy in different ways depending on context (speed for a car going down a ramp and personal energetics for a person going down a ramp)

- He uses his everyday experience to explain a physical phenomenon

- He can use his understanding of ramps, rubber bands, and personal energetics as a beginning for understanding the principles of energy



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