



Unit on Force and Motion: February 7th

“Seeing” Rollerblading the Way Physicists “See” Motion



To understand the language in these commentaries...

It is important to have read our Discourse Primer, found at:

http://tools4teachingscience.org/tools/discourse_tools/primer.html

The commentaries also draw upon the language of our Discourse Tools, which should also be reviewed first:

http://tools4teachingscience.org/tools/discourse_tools/index.html



As you watch this video episode...

Keep track of where you are by noting the time codes in the left-hand column. In the right-hand column are important features of the classroom discourse.

In one or more of the time segments, we ask you to do more than follow along—we leave the discourse commentary section blank. Here we ask you to listen closely to the video and fill in the commentary yourself.

The teacher’s commentary for these sections can be found at the end of the document. Compare what you heard with what the teacher noted.

Summary of Episodes:

1. Warm-Up Question – comparing & contrasting everyday and science-specific meanings of the word “acceleration” before we start examining accelerated motion.
2. Observing & Beginning to Explain Rollerblading – small group conversations with students in the hallway WHILE they are engaging in the activity itself [this is most like Discourse 2]
3. Whole Class Discussion of Observations & Explanations
4. Small Group Elaborations, Further Explanations, and Representations [this is an example of how I’m starting to aim for Discourse 3 even while I’m still eliciting students’ initial models]
5. Highlighting an Exemplary Representation to use as a “Model Text” – this is a literacy intervention where a text is used as a “model” for others to emulate.

Time points	Commentary
In the interim between the last video and this one	<p>In the interim between the last video and this one, there were about 5 days of instruction where students became proficient with measuring speed of an object moving in a straight line at constant speeds and varying speeds. Students also learned to represent these differences in an object’s motion using a Position v. Time graph and then learned to interpret from the shape of the line how the object was moving.</p> <p>The goal was to get students proficient at “translating” across representations:</p> <ol style="list-style-type: none"> 1. Looking at the moving object – a person walking or a ball rolling. 2. Measuring the distance moved & time taken to move → data table. 3. Graphing the data and making a line on a Position v. Time graph. 4. Looking at someone else’s graph and interpreting an object’s motion even if they did not observe the object’s motion first hand.

Now, this is a 2nd round of Eliciting Ideas – here I’m trying to find out how students are: 1) thinking about the forces responsible for changes in motion (classical physics has you study this kind of ‘accelerated motion’ as a second step after studying uniform motion) and 2) I’m trying to find out how students are using what they’ve learned about graphing speed to help them think about speed, velocity, and acceleration of the rollerblader.

0:00 → 1:26

Housekeeping about homework assignments

1:27 → 5:31

Question of the Day:

Compare & Contrast two uses of “acceleration” in everyday talk & in physics talk using a Venn Diagram

Partners work on the Question of the Day discussing the everyday and physics-specific uses of the word “acceleration” ... the students are also using a conceptual representation of a Venn Diagram to help organize their ideas.

Important ideas/language I heard:

4:00 (Destiny & Sydney) Destiny brings up “miles per hour” as the everyday way of talking about speed and acceleration

Questions I use to help kids say more:

4:16 (Destiny & Sydney) I use some paraphrasing to establish that the girls think that in everyday language acceleration means the same thing as speed, and then I press them to consider the usage in physics by asking: But what about in physics? ... these aren’t new questions – they are straight from the assignment, but the girls were totally stuck.

Other important discourse moves:

3:49 (Destiny & Sydney) The girls are having a hard time getting started thinking about “everyday” uses of acceleration so I prompt them to think about car commercials – this sets the stage for Destiny to talk about miles-per-hour.

Literacy support:

1:30 → using the Venn diagram to help students find similarities and differences between the everyday and physics-specific uses of the word “acceleration” – this is an example of a way to use a graphic organizer to help students organize ideas and find relationships between words with dual (but not totally different) meanings

2:20 → turn to your neighbor ... lets students try out their own idea and hear some other possible ideas from their neighbors before having to make a public contribution to the whole class

5:32 → 9:27

Important ideas/language I heard (you fill in below, then check your observations against teacher commentary at end of this document)

Whole class discussion of students’ ideas about acceleration.

+

Instructions & questions for the observation of the rollerblader:

1. How do they get started

Important discourse moves:

(rollerblading)?

2. How do they coast & stay moving?
 3. How do they stop (without crashing)?
-

9:28 → 15:59

Group of boys observing the rollerbladers and recording ideas about the three questions.

Notice how the students use terminology that does, in fact, have very specific meanings in physics BUT, like acceleration, the words have everyday meanings as well. It is tempting to infer that these students are using the words to express physics ideas – but until I ask them to elaborate their talk I cannot be sure about the tentative ideas that the kids have in their heads.

Key words to listen for:

- Momentum
- Power
- Drag

Important ideas/language I heard:

10:05 (Clayton & then later Samson) – “the way he stops is he makes a T” [Later I will grab onto their phrase about “making a T” to try to get them to tell me more about what the T-shaped arrangement of skates is doing to his motion] ... Yael adds a sound effect “tssss” that I think is his way of talking about friction at this point.

10:29 (Samson) – he starts using the word “momentum” and he’ll bring it up again later ... it’s unclear right now what he means by this word [it has very specific meaning in physics so it’s tempting to assume that Samson means something big when he uses this word, but like many motion words, he could just be using it to mean “movement” or “energy” without any deeper meaning].

11:15 – the boys come up with ideas like “drags” and “acts like brakes” in response to my press for why he makes a “T” with his skates.

13:50 to 15:00 – **ELL experience:** we can REALLY see Yael struggling to find the words to express the ideas that he has – he has a GREAT model of how the two skating feet work together to start and stop the skater’s movement but he is really having a hard time putting his idea into words [remember that Yael speaks Spanish outside of school – he was born & spent his early childhood in Mexico] ... he understands MUCH more than he is able to fully communicate ... Bradley eventually is able to help add some more words to Yael’s ideas. Bradley doesn’t speak English outside of school, but he has lived here his whole life.

Questions I use to help kids say more:

11:07 – I pick up on the boys’ use of “make a T” and ask “Why does he make a T?”

Other important discourse moves:

11:23 – **Elaborate/Clarify/Extend** “Can you say more about ‘acting like brakes?’”

11:29 – **Marking** ideas that I heard: “I heard “dragging,” and “not rolling anymore” and “acts like brakes,” and something about “momentum” “... I did this because the boys were all talking over one another and I wanted each to be able to elaborate his idea or link them together.

11:42 – **Elaborate/Clarify/Extend** “Can you tell me about your ‘momentum’ idea?” .. and then “What do you mean by ‘momentum?’” and then when he says “power” [another physics-specific word that I think he’s using generically] I ask if he means “how hard he’s pushing forward?”

Press for Explanation:

11:07 – I pick up on the boys’ use of “make a T” and ask “Why does he make

a T?”

12:18 – “So if he’s just standing here like this [with parallel feet], how does he push himself?” ... I’m trying to get the boys to start telling me a step-by-step story about the skating motion.

12:40 – “Why can he push on the BACK foot? Why does that work?”

12:54 – “What if the hallway was made out of ice?” ... this is a pre-planned back-pocket question designed to press students to tell me more about friction ... I had anticipated that students would talk around the idea of friction without directly mentioning the force. I wanted to propose a scenario that would make it necessary to talk about “slippery” or “sliding” so that kids would have to start talking about friction.

13:30 – still pressing for ideas about friction & trying to get them to tell me a story ... “Can you guys tell me more about the T close together to stop? ... You know, he’s skating, skating, skating, and then ...”

16:00 → 17:27

Conversation with
Lilliana and Shawna

Important ideas/language I heard:

16:37 – Shawna: “move their feet out ... and get some speed” [She’s noticing the side-to-side movement of the skates and connecting that to a change in speed ... this is early $F = ma$ thinking so I press more on the side-to-side idea.]

17:16 – Lilliana: “it makes them get out of a straight path ... get going faster ...” [Lilliana raises an idea about the ‘straightness’ of the path having something to do with speed.]

17:24 – Shawna: “Because he’s pushing.” [She finally verbalizes an idea about forces that I think was there all along, but she hadn’t brought it up before.]

Press for Explanation:

17:02 – “So Shawna you noticed that he moves his feet out. How does that work? Why does that work?” [Pressing to see if she can tell me more about how the skates push against the floor to change the skater’s motion.]

17:15 – “What do you think the side-to-side movement is doing?” [still pressing to see if she’ll tell me ideas about forces.]

17:23 – “Why does that make him go faster?”

17:28 → 25:51

This part highlights how a back pocket question (about “what if the floor was ice”) can open up lots of discussion and give kids a chance to get more ideas on the table.

Important ideas/language I heard:

17:30 – Destiny: “pushing air back ...” [Destiny raises an idea that movement is somehow related to displacement of air ... not sure where she’s going with this idea ... it’s not necessarily an important idea for the skater’s motion, but it IS an important idea for other kinds of motion like arrows, airplanes, etc., and air played a MAJOR role in the way Aristotle thought about motion so I certainly can’t dismiss her idea out of hand.]

18:00 – Hilina “It wouldn’t work” ... Destiny “It’s like when we were doing the carpet, it’s hard to move on like a really rough surface vs. a flat surface” ... [girls begin to wrestle with the idea of friction and its relationship to motion.]

18:28 – Hilina “because it has little cracks” [No idea what she’s thinking

Key Physics word to listen for:

- Tension

about here so I have to keep her talking in order to find out what she's imagining.]

18:49 – Destiny “Those aren't made to go on ice.” [So she's getting at the idea that materials have properties ... but I'm trying to get her to tell me which properties are required for the skating motion to occur ...]

19:29 – Destiny (talking about the importance of the blade and ice skating) “you can't get the tension ...” [The girls invent a term “tension” which means “friction” for them ... another instance of kids using an important physics word to mean something that isn't quite the standard use of the word so I have to think carefully about accepting their terminology or correcting them.]

20:26 – Sydney poses her own question (which reveals some of her partial understandings about forces & motion – she's been listening and participating without talking the whole time): “If you're shopping for a new pair of skates ... with smooth wheels ... if you're going really fast and you try to stop would you keep going ... on ice?”

21:40 – “you'd have to push yourself” [the girls are trying to figure out how you would get started skating if you were wearing rollerblades on ice]

22:55 – Destiny: “it's kind of like a car and ice ...” [Destiny is making a connection between the rollerblader and cars – I will use this connection in future lessons because it's a common experience that lots of kids have had.] Sydney also uses a car example to think about how a rolling object moves on ice.

Questions I use to help kids say more:

18:51 – “Why not? Why wouldn't they work?” [Trying to get Destiny to tell me more about her idea that rollerblades aren't ‘made for’ ice.]

21:43 – “How would you push yourself?”

22:50 – “What if you were stopped on the ice and you tried to make yourself go really fast? What do you think would happen?”

Other important discourse moves:

Again I do LOTS of paraphrasing/re-voicing to make sure that I have heard their ideas correctly.

Press for Explanation:

17:52 – “What if the floor was made out of ice?” [I had intended to ask this question as a ‘back pocket question’ to press kids to talk about the importance of friction ... but in this case I also use it to push Destiny to think about the relative importance of the floor/skates interaction vs. the air/skater interaction.]

21:34 – “If you have rollerblades on ice, how would you *get started* moving?” [This is in response to Sydney's hypothetical question about rollerblading on ice, but I see that she's missing part of her reasoning about why it would be difficult if not impossible to rollerblade on an icy surface ...]

25:52 → 35:55

Important ideas/language I heard (you fill in below, then check your observations against teacher commentary at end of this document)

Whole class discussion of ideas from observing the rollerbladers ...

Pay attention to how the consensus model builds by one student adding an idea onto another students' idea ... for example, Clayton starts the story, then Yael adds to it ... etc.

Important discourse moves:

35:55 → Small group conversations about graphing & explaining the skater's motion.

Instead of continuing to “tag” the students' discourse at this point in the film, I'm thinking that it might be good to preface this section with a task – to have the viewer now keep track of how each student or group of students weaves together certain threads of ideas that have been raised earlier in the footage. The threads are totally obvious now that the viewer's attention has been focused in the right direction, I think.

In each conversation with students we can hear threads of ideas from the previous episodes of this segment start to resurface in kids' talk. LOTS of force ideas are making their way into kids' talk at this point.

Literacy Support – in this case it's physics-specific literacy involving representations:

at 46:44 – Shawna shows us her graph representation of the skater's position vs. time ... this might be an important time to highlight how students are having to move through lots of different “language” conventions in physics – the phenomenon itself + notes about your observations, diagrams of the skater, position vs. time graph of imagined (in this case we didn't take actual measurements) data ...

49:40 – Amy and Yael talk about their diagrams & representations ... when Yael says “because on the blue paper it says” ... he is citing a short reading that I gave about using graphs to represent speeds on a position vs. time graph.

52:31 – Clayton talks about his graph and asks a BRILLIANT question about being able to go a constant speed when coasting ... without having read anything about Newton's Laws, Clayton has already made sense of why - in a frictional world – we cannot rely on inertia to keep us moving indefinitely; we have to apply force in order to overcome the friction.

55:11 – Juan shares his graph and diagram ... Juan is REALLY quiet so it's hard for me to get him talking.

56:12 – Featuring Clayton's graph and having Clayton explain his representation (using his work as a model text) ... “you can't coast forever ... you don't got no more force ... you're gonna stop sooner or later ... the wheels and your weight is basically the brakes ... “

END OF LESSON

Teacher's
commentary from
5:32 → 9:27

Important ideas/language I heard:

5:32 (Samson) – raises the idea that both are measurements but in everyday language people tend to talk about miles (per hour) and in physics there are many units used

6:10 (Hilina) – contrasts the equation for acceleration [velocity divided by a period of time] and then she agrees with Samson's idea about miles (per hour) ... she also brings up the idea that acceleration is the same as speed in everyday language but it has a specialized mathematical meaning in physics

6:52 (Liliana) – contrasts the “science” register from the “normal” register of talk

Important discourse moves:

5:55 – I say “Does anyone have something that they would like to add or change about Samson's idea?” ... the “add or change” prompt is used consistently across subject areas to help kids learn to build off of each other's comments or gently critique each other's comments ... you later hear Liliana say “adding on to Hilina” (at 6:52) and other students will say this throughout the videos because it is a discourse norm that we're building program-wide.

Throughout this section I'm doing lots of paraphrasing/re-voicing

Teacher's
commentary from
25:52 → 35:55

Important ideas/language I heard:

26:50 – Clayton starts a thread of talk about “pushing” and “gliding” – these words become really important for the class to talk about the skaters’ motion and their different feet.

28:20 – Yael adds to the thread of talk by elaborating about what is pushing against what AND adds the idea that the rubber of the wheels can “stick” to the floor but not to ice.

29:08 – Hilina adds an idea about how the displacement of air might be responsible for helping the skater KEEP moving once they are rolling (this is exactly what Aristotle thought about arrows) ... and then she adds the word “gravity” and it’s unclear how this idea is related to the air?

30:20 – Jadyn adds the idea that when the skate pushes against the ground, the ground is pushing against the skate which “shoves” the skater forward ... “like lilypads”

31:30 – Liliana adds ideas about “since the surface is flat” ... and “constant speed” ... “except for when they add more force, it makes them go faster” ... “if it was a more bumpier surface they would go slower or faster”

Important discourse moves:

30:50 – I hold Jadyn’s idea and Hilina’s idea in comparison and point the differences out to Hilina so that she explicitly sees how his explanation is a possible alternative to her explanation.

32:30 – I pick up on Liliana’s ideas about “constant speed” and “faster” and use this as a chance to make a connection back to the students’ prior knowledge about using position vs. time graphs to represent ideas about speeds (you can even watch Amy and Yael “draw” their graphs in the air and on the desk with their fingers)
