Description: Ariel solving the Ladder problem **Parent Tape: Early algebra: Investigating linear functions,** **Series 7 of 7: Ariel's 8th grade interview** **Date: 2007-05-017** **Location: Frank J. Hubbard Middle School – Plainfield, NJ** **Researcher: Carolyn Maher**	**Transcriber(s): DeLeon, Christina** **Verifier(s): Yedman, Madeline** **Date Transcribed: Spring 2009** **Page: 1 of 5**

Line	Time	Speaker	Transcript
1		**Ariel**	(Reading the problem out loud) The ladders problem. A company makes ladders of different heights from very short ones to very tall ones. The shortest ladder has only one rung, and looks like the figure on the right. You can build a model of it with five light green Cuisenaire rods. A two-rung ladder could be modeled using eight light green rods, and looks like this. Build a rod model to represent a three-rung ladder. How many rods did you use?
2			(inaudible)…five, and this one's eight…(inaudible)… it's gonna have eleven. It's gonna have eleven rods probably.
3		**R1**	You knew it was gonna be eleven right away, huh?
4		**Ariel**	Yeah.
5		**R1**	While you're building it, can you explain to me why you thought that it was gonna be eleven?
6		**Ariel**	Well, I saw the difference between the first, um, the first ladder and the second ladder and I saw that it had increased by three rods, and then I looked at it and I just like, in my head, placed in another three rods you would get the third rung, and then the two sides (inaudible, starts building it). So then it's one, two, three, four, five, six, seven, eight, nine, ten, eleven. It's eleven, eleven rods
7		**R1**	Do you mind explaining, or what you just said to me do you think you could write it on here? So you said how you knew it was going to be eleven was because you noticed the difference.
8	1:41	**Ariel**	(Writing response on paper)
9		**R1**	Wow, that's a pretty, pretty elaborate explanation. Ok, so it's funny because you said you did it in your head, you

			added it in your head first, and then –
10		**Ariel**	and then I did it visually.
11		**R1**	Just as a way to –
12		**Ariel**	Yeah, to make sure.
13		**R1**	To make sure.
14		**Ariel**	Mmhmm.
15		**R1**	So the question asked you what was the diff, uh –
16		**Ariel**	How many rods…
17		**R1**	If you had a three-rung?
18		**Ariel**	Yeah. And I had eleven rods.
19		**R1**	So your prediction was correct.
20		**Ariel**	Yeah.
21	2:13	**R1**	Alright, well, what is the next one asking you?
22		**Ariel**	How many rods would you use to build a ten-rung ladder? Well, I'm not gonna build it, I'll just do a X, Y table. Then, a ladder with one rod – rung – had 5 pieces, one with 2 rungs had 8 pieces, one with 3 had 11, so the first difference between each is 3 (indicates this on table), so then if you were to keep on adding, it'd be 14, then you'd get, uh, 17, with 6 it'd be 20, 7… 23, 26 at 8, then 29 at 9, and at 10 it would be… let's see… (inaudible) 32… 32. And then… (starts to build ladder to check).
23			(Counts rungs) one, two, three, four, five, six, seven, eight, nine (continues to build).
24		**R1**	So those little things in the middle are the rungs?

25		**Ariel**	Yeah. (finishes building ladder) Ok, and then, my prediction was thirty-two, so 1, 2, 3,… (continues to count pieces all the way to thirty-two).
26		**R1**	Wow. So… so you said that you built this as a way to, to prove it. Um, when you were making the chart here, you said something about 'first differences'… can you just show me what you meant by that?
27		**Ariel**	Um, that the difference between the Y, the Y, um, variables, was… from 5 to 8 it increased by 3, from 8 to 11 it increased by 3… so you would just keep on increasing by 3, so… until… and then, it'll keep on going. And then it shows –
28		**R1**	Ohh.
29		**Ariel**	… that it, uh, it's linear obviously because in a linear equation the first difference is always the same. So, it's linear.
30		**R1**	You mean the – if these numbers are all the same here? (pointing to Y column)
31		**Ariel**	Yeah.
32		**R1**	So you know it's gonna be a linear equation. That's interesting.
33	4:48		Hmm… what about the next bullet point?
34		**Ariel**	Um, how could you represent the number of rods needed to build a ladder with any number of rungs? That would be… hmm… Oh! That's easy. Y equals 3X plus 2.
35		**R1**	Wait… where'd that come from?
36		**Ariel**	Cause uh… how could you represent the number of rods needed to build a ladder with any number of rungs.
37		**R1**	Mmhmm.

38		**Ariel**	So, you'd get the number of rungs from multiplying the, the… ladder which it is, like if it was the first ladder, second ladder, third ladder… multiply by 3, like on this one… it would be nine… and plus two is eleven. So, (starts writing explanation) substitute the number, for, in each X, it would be 3 times 3 plus 2… it would be 9 plus 2… it's 11. And it works out, for every one.
39		**R1**	Ok, so you were just using the same variables that are in your chart?
40		**Ariel**	Yeah.
41		**R1**	Oh ok. And… you got that pretty quick. So… the three you said was the first difference?
42		**Ariel**	Yeah.
43		**R1**	Ok… and then… and then how did you see the plus two again? Can you just show me that?
44	6:05	**Ariel**	Because… I just looked at it and if… if you multiply each by three…
45		**R1**	Mmhmm
46		**Ariel**	… it's gonna be, um, m plus the y intercept, which is gonna be 2. Cause if it's adding three each time, if you reverse this to when it was at 0, it would be a 2 right there. Wait… yeah, it'd be a 2 right there. And then, this would be your slope of 3, and your y intercept of 2. And then it's a linear equation.
47		**R1**	Oh, so you're saying if you graph that, it would –
48		**Ariel**	Yeah. That's how it would be. And then… cause 0 rungs would look like this (shows using rods). Just that, without the top piece. (Adds piece) this is with one rung…
49		**R1**	Ohh, right, cause you said that the horizontal –

50		**Ariel**	Yeah.
51		**R1**	… piece was your rung. Ohhh. Ok. And, so you're saying this rule's gonna work no matter how many rungs I give you?
52		**Ariel**	Mmhmm.
53		**R1**	So if I gave you… 75…
54		**Ariel**	75?
55		**R1**	Ha, I don't know…
56		**Ariel**	(Solving out problem, inaudible)… Y equals 227.
57		**R1**	You need 227 of these little things?
58		**Ariel**	Yupp.
59		**R1**	Wow. Haha ok, well I'm not gonna ask you to build that. Haha. Um, what I am going to do now is, I actually want to show you a clip of yourself working on this problem when you were in IML.