S-Pattern Task – CLIP 1
Teacher: Jeff Ziegler
District: Pittsburgh Public Schools
Grades: 11-12

Group 1 – First Interaction with Teacher

1	S:	The top is your *x* but that's constant. That's always gonna stay the same.
2	S:	Okay.
3 4	S:	So, then you have to find the number that's before *x* to get to that. You already found what you have to add to get to that. Now you have to multiply to get to that.
5	S:	We figured this *(pointing to the table)*…
6	S:	We found out a pattern.
7	S:	I can't do equations. I can't factor. So...yeah, we figured that out first period.
8 9	T:	Okay, so, you're...okay so you're going to start with a table and see if you can find the equation from the table?
10	S:	Yeah.
11	T:	Okay.
12	S:	But we don't know how...we don't know…
13	S:	I don't even know how to start to find the equation there.
14 15	S:	We know what the "*b*" is. We don't know if it should be *x* + 3 or *x* + an odd. *X* + an odd 'cause these are all odds on the bottom.
16	T:	Right.
17 18	S:	They're always going to be odds. So it's plus 2 between them. There's a difference of two between them.
19	T:	Okay.
20	S:	We already know the top rows are *x*. One, 2, 3, 4...like that's our *x*.
21	T:	Right.
22	S:	Our pattern. The growth is…I don't know what the growth is.

23	S:	You got something.
24	S:	The growth is an odd. It's like odd numbers.
25	T:	Okay, so you have the table, you have these numbers written out.
26	S:	Right, if we had the equation we should be . . .
27	S:	How do we graph it with no equation?
28 29	T:	Well no kidding. Oh yeah, if I gave you the equation, life would be great. What do you have?
30	S:	This.
31	T:	Which is a what?
32	S:	*S.*
33	T:	Okay. It has what?
34	S:	Squares.
35	T:	Okay. How many?
36	S:	26.
37	T:	In number 5?
38	S:	Yes.
39 40	T:	Okay, that's 26. There's no other way you can come up with that number 26 than just counting?
41	S:	You can go by, like ...
42	S:	So *x* plus . . .
43	S:	He's leaving us.

Group 2 – First Interaction with Teacher

44	S:	I broke it down real easy, real simple to this. It obviously looks real simple. So…
45	T:	Do you guys know what he's doing?

46   S: Yeah.

47   S: Yeah.

48   S: We all helped.

49   T: Hold up. You did this. Tell me what you did. You don't know?

50   S: I was working by myself.

51   T: Oh, okay. Do you know what he was doing? Okay what's this?

52   S: This is a group effort.

53   S: I know.

54   S: Whatever the pattern number is, not even looking at...not even looking at this, just
55   whatever the pattern number is, you take it and you times it by 2 because there's 2,
56   there's obviously 2 rows and each...the top row and the bottom row both have the
57   number...this number, the 2. And then times that by 2 and that will give you the top and
58   the bottom and the middle is a square so...

59   T: Right.

60   S: You min...you do 2...you do the...ah, I'm going to call this x. $(X-1)^2$. That will give you
61   the middle and you just add them together.

62   S: I understand him, I just can't explain it.

63   S: Did you understand that, Zieg?

64   T: Yes.

65   S: And then I got another one, I got another one, though. I don't know...if you take it and
66   go this way, rectangle, you take $x + 1$ and then do $x - 1$ and that will give you, that will
67   give you this dimension right here.

68   T: Go back to the first one. There. Look at what he's doing. Tell me what he is doing.

69   S: What do you mean, like?

70   T: When he came up with it, when he was explaining the top row and the bottom row and
71   the center, do you know what he was talking about?

72   S: Yeah.

73   T: What?

74	S:	I don't know how to say it, but I helped him do that, too, like it's not just all him.
75	T:	Okay. So tell me, show me. I mean, do you have it in your head? Is it on paper?
76	S:	It's in my head. He said that, okay, the middle, there's one square in the middle and
77		then there's 2 on the top. Subtract 1 to get the number...subtract one and square it to
78		get the number of the boxes in the middle.
79	T:	Okay.
80	S:	So x - 1...so 3 - 1 is 2 and then you square 2 to get 4 in the middle and then you multiply
81		the whatever sequence you're on times 2 'cause there's a top and a bottom.
82	T:	Okay. And that's how you came up with the equation? So, okay, can you take his
83		equation $2x + (x - 1)^2$ and can you put it to a picture? Can you put it to these pictures?
84		Like let's, let's, let's pull out, let's say number 4, okay? If we take this, how does this
85		picture right here relate to $2x + (x - 1)^2$?
86	S:	So that's simpler than...
87	S:	...and then you add 2. You see what I'm saying? You see what I am saying, Nick?
88	S:	That's simpler than...
89	S:	That's the easy way to break it down. You go from...you just take these 2...

S-Pattern Task – CLIP 2
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Group 2 - Second Interaction with Teacher

90 T: Okay, I'm back. All right, so when I left, I asked the group to come up and explain how
91   we came up with $2x + (x - 1)^2$ and where that relates in the picture. So are you ready to
92   tell me?

93 S: Yeah.

94 T: Okay.

95 S: Well, actually I think that she made a different equation. I think hers is better.

96 S: I thought we were just going to go with this one.

97 S: We have one.

98 S: Hers is $x^2 + 1$.

99 S: Yeah, but that doesn't explain the picture.

100 T: What I asked when I left was does $2x + (x - 1)^2$ fit the pattern, correct?

101 S: It fit the pattern.

102 S: Yeah.

103 T: Okay. What I wanted to know when I left was how does it relate to the tiles?

104 S: Um…

105 T: Where is $2x$ in these tiles? Where is the $(x - 1)^2$ in these tiles?

106 S: Well x is that number right there.

107 T: Okay.

108 S: And 2, you just multiply 2 by that number…

109 T: Why?

110 S: Which gives you…

111	T:	Why?
112	S:	Because, um…
113	T:	The tiles…
114	S:	Because it gets bigger. It doubles.
115	S:	Yeah, it doubles…
116	T:	What doubles?
117	S:	That…that…the tiles. Like for 1, it doubles and then for 2 it doubles, 3 it doubles.
118	S:	That's the top and the bottom.
119	S:	Oh, it's the top…oh it's the…oh, yeah. Those 2.
120	S:	The x is the top number and the bottom.
121	T:	What's the matter?
122	S:	I don't…I mean, I understand but I can't really explain it. Like those 2…
123 124	T:	If you want, see, my thoughts always were if you really, truly understood then explaining would be the easy part.
125	S:	Well, I do understand but…2 is right here. That's where they got the 2 from.
126	S:	2x.
127	S:	Like 2x 'cause you just take out those 2 and then use that. And then x - 1 is like 4 - 1.
128	S:	Which is 3.
129 130	S:	Three. Oh yeah. How much is…each row right there. Then you square it and that's how much is in the middle.
131	T:	Okay, so…
132	S:	Has to be a square number.
133 134	T:	Take the sheet of paper right now. Take number 4. Separate…I want you to actually manipulate those black tiles on here. Show me the 2x, show me the $(x - 1)^2$.
135	S:	All right.
136	T:	Okay.

Group 1 -– Second Interaction with Teacher

137	S:	You add 1.

138 T: Are you listening? *(Teacher directs this to the student he is sitting next to.)*

139 S: I am.

140
141 S: All right, you have 2 on the bottom, 2 on the top *(referring to the second figure in the sequence).*

142 S: I get it.

143
144 S: You got 1 in the middle that's an extra. So you add that. That's plus 1. So it's 2 and 2 is 4. That's 2 squared is 4 then you add this extra 1 in the middle. That's 5.

145 T: Okay. What is, what is he telling me here? Where $(x + 1)^2$ came from.

146 S: Are you asking me?

147 T: Yeah, I'm asking you.

148
149 S: Oh, I get it. It's like, because you start off with 1 and then you times it by itself and then you add 1.

150 T: Okay.

151 S: And then you just keep going...you want me to keep going?

152
153
154 T: No, what I want you to do is...I want you to take these, these black tiles that are sitting right here *(referring to the figures of tiles)* and I want you to show me, I want you to show me, where do you see 2 squared? And then where's the plus 1 at?

155 S: Like…

156 T: Where's the 2 squared?

157 S: Right here.

158 T: What's that?

159 S: And right here. These are 2.

160 T: Okay.

161 S: Then the 1 is the middle.

162	T:	Okay. So, for number 2, for pattern 2, top row and the bottom row, you're putting those
163		2 together, making a square and adding 1 to it. So, if I did the same thing in pattern
164		number 3, I took the top row and the bottom row and I put them together, is that 3
165		times 3? Is there 1 left over? *(Students acknowledge that this doesn't seem to work.)* So,
166		what I'm telling you is, how do you manipulate these tiles for your $x^2 + 1$. If it obviously
167		works…

| 168 | S: | I mean, 'cause look, there's 1, 2, 3; 1, 2, 3; 1, 2, 3, we're just doing it like that. |

| 169 | T: | Where? |

| 170 | S: | And there's the 1 left over. |

| 171 | S: | You can do that. |

| 172 | S: | Come on, I can do this. |

| 173 | S: | And this is the way to do 4, 4, 4. |

| 174 | T: | Okay, you have…How many tiles do you have in pattern 3? How many tiles do you have |
| 175 | | in pattern 3? |

| 176 | S: | 10. |

| 177 | T: | Okay. I'm giving you 10 individual tiles on this piece of paper. Okay? They're not |
| 178 | | touching. |

| 179 | S: | They're a new pattern? |

| 180 | T: | I want you to take those 10 tiles and I want you to show me how you put them together |
| 181 | | to get $x^2 + 1$. That's what I want you to show me. |

| 182 | S: | We can go like this. Look. |

| 183 | T: | I'll be back. |

| 184 | S: | No, just stay with us. |

| 185 | S: | "I'll be back" *(mimicking the teacher)*. |