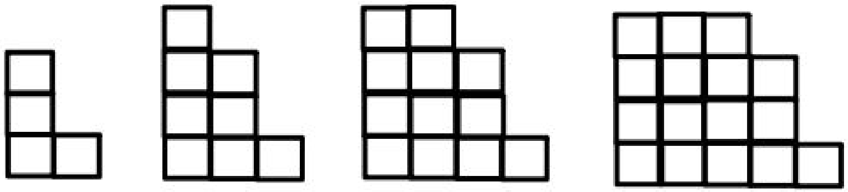
Which one doesn't belong?



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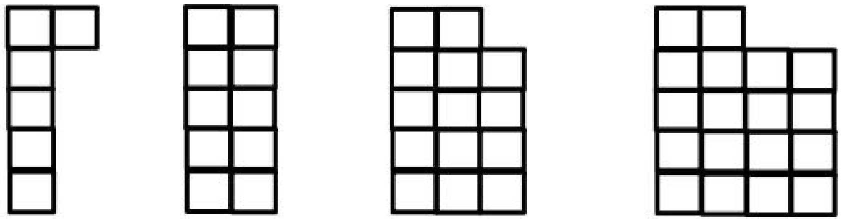

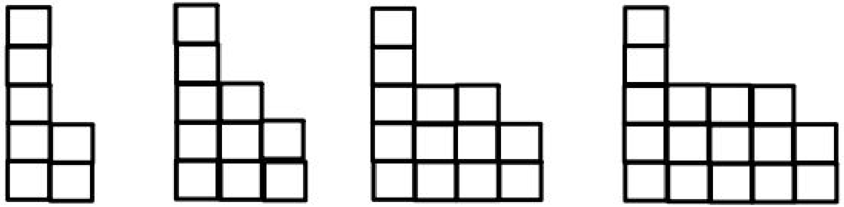

Describing patterns algebraically

Finding the next or finding the *n*th?

2016 NCTM Regional - Philadelphia, PA

Belinda Thompson and Erin McDonough
11/01/2016

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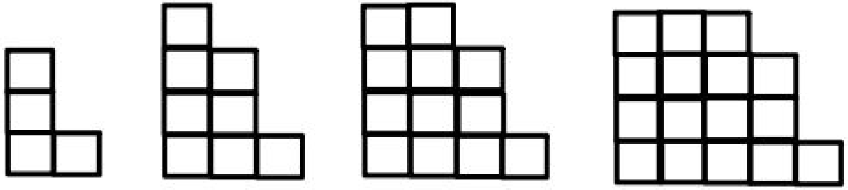
Which one doesn't belong?



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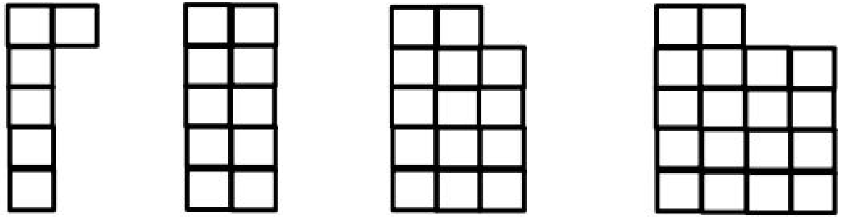
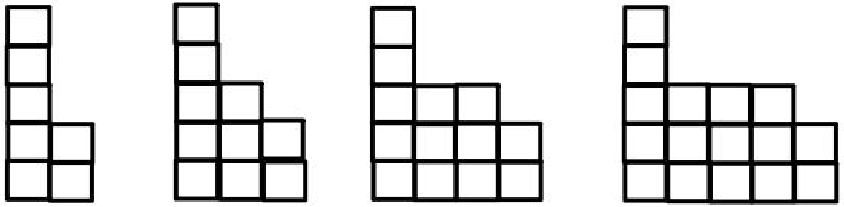
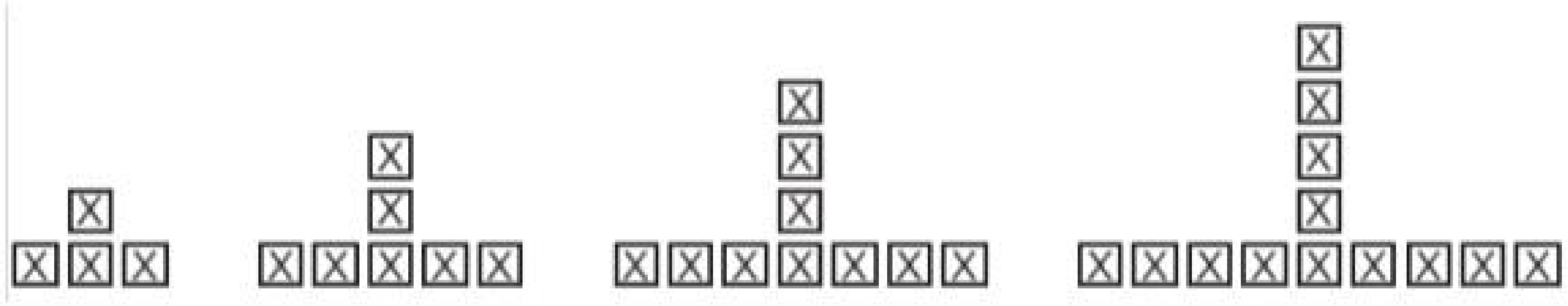




Do math together

How do you see this pattern growing?

- Describe **two** different ways you see it growing.
- Write a bunch of stuff down because somebody will be looking at your work!



3-2-1 Sharing

3 People

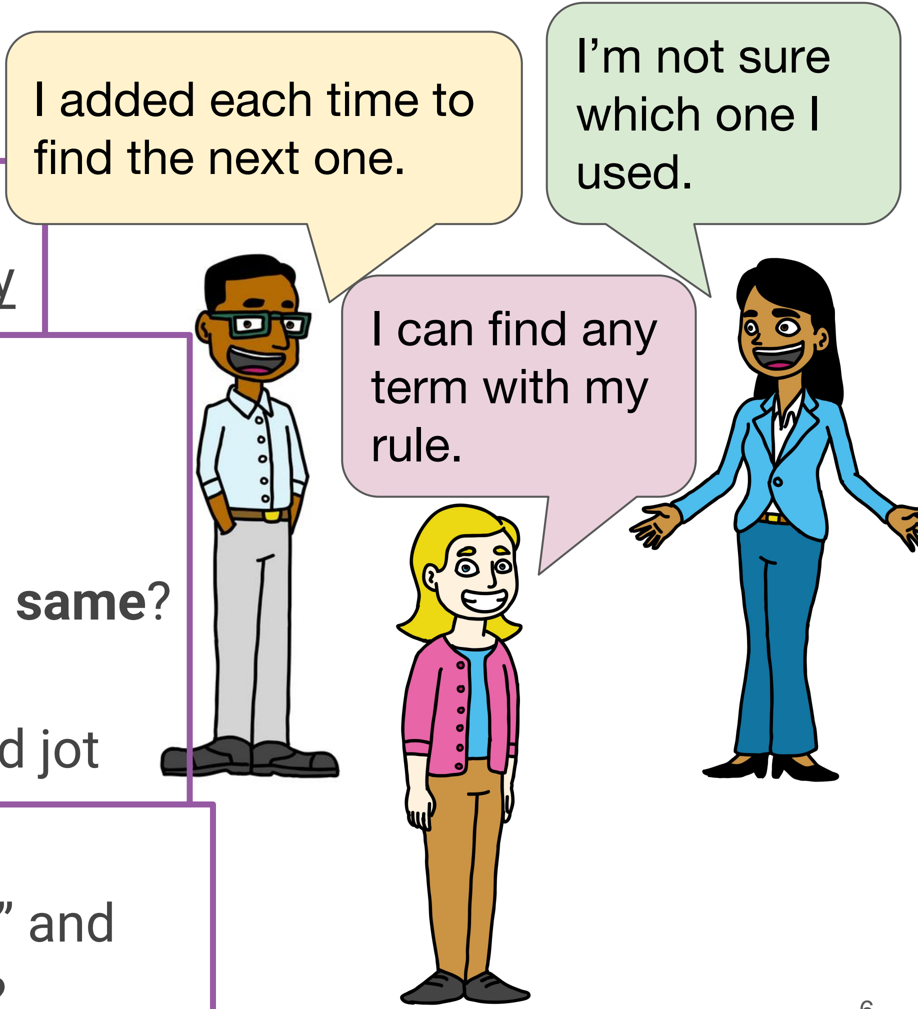
- Work on the problem <u>independently</u>

2 Silent Passes

- Form a triad
- Pass your work to the right
- Jot notes: How is the approach the **same**? How is it **different**?
- Pass the work to the right again and jot

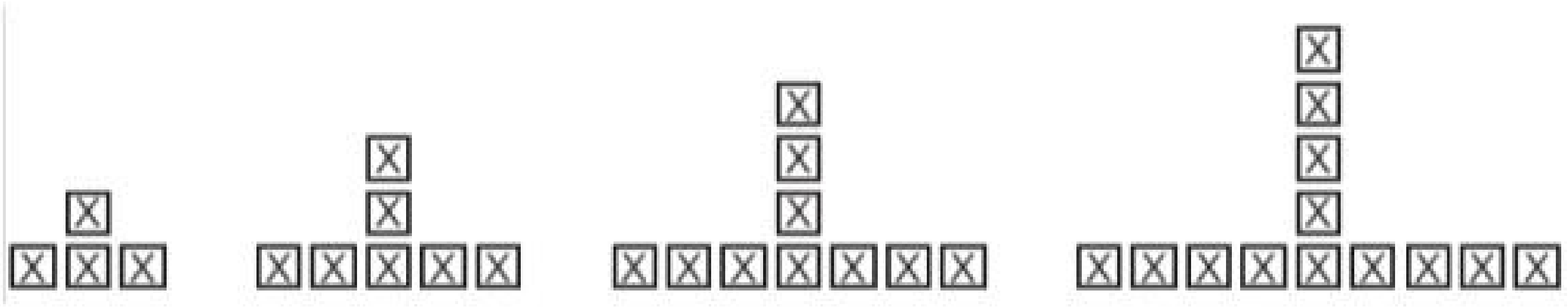
1 Discussion

- Where do you see "finding the next" and where do you see "finding the nth"?



How do you see this figure growing?

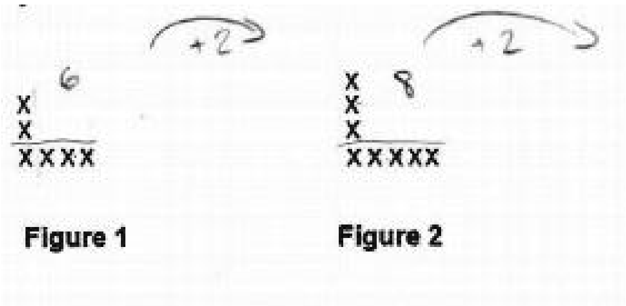
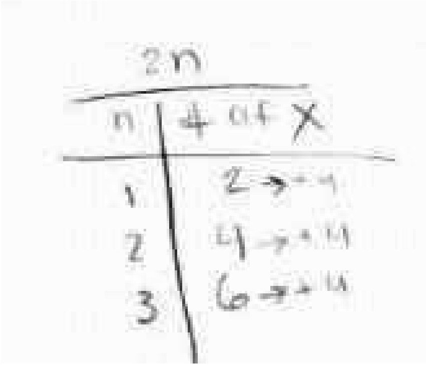
How many Xs in the 27th figure?



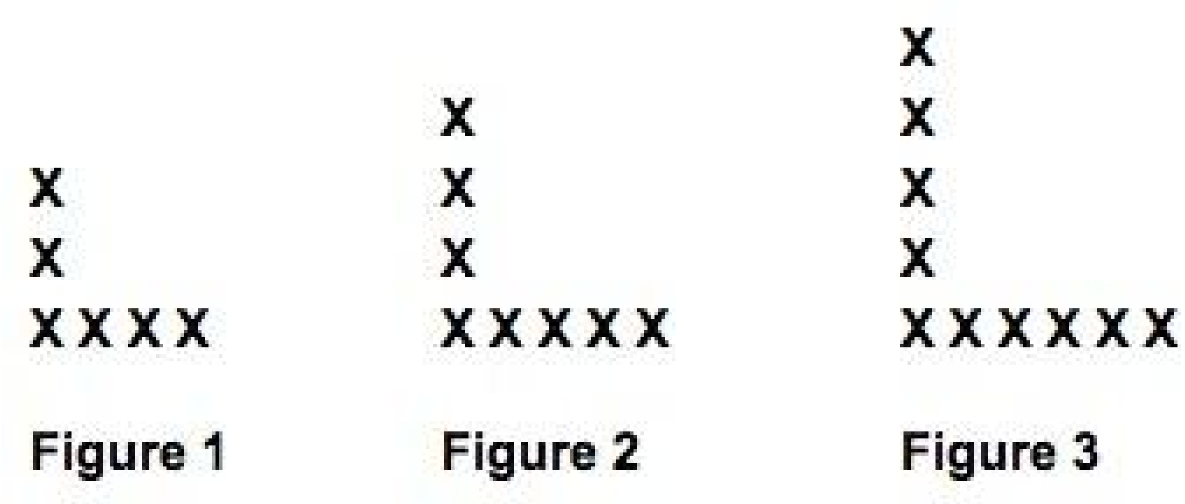
Let's Share!

A **recursive** explanation (find the next)	A **functional** explanation (find the nth)	Another **functional** explanation
Add 3 to get the next	3n + 1	4 + 3(n-1)

What’s the difference?

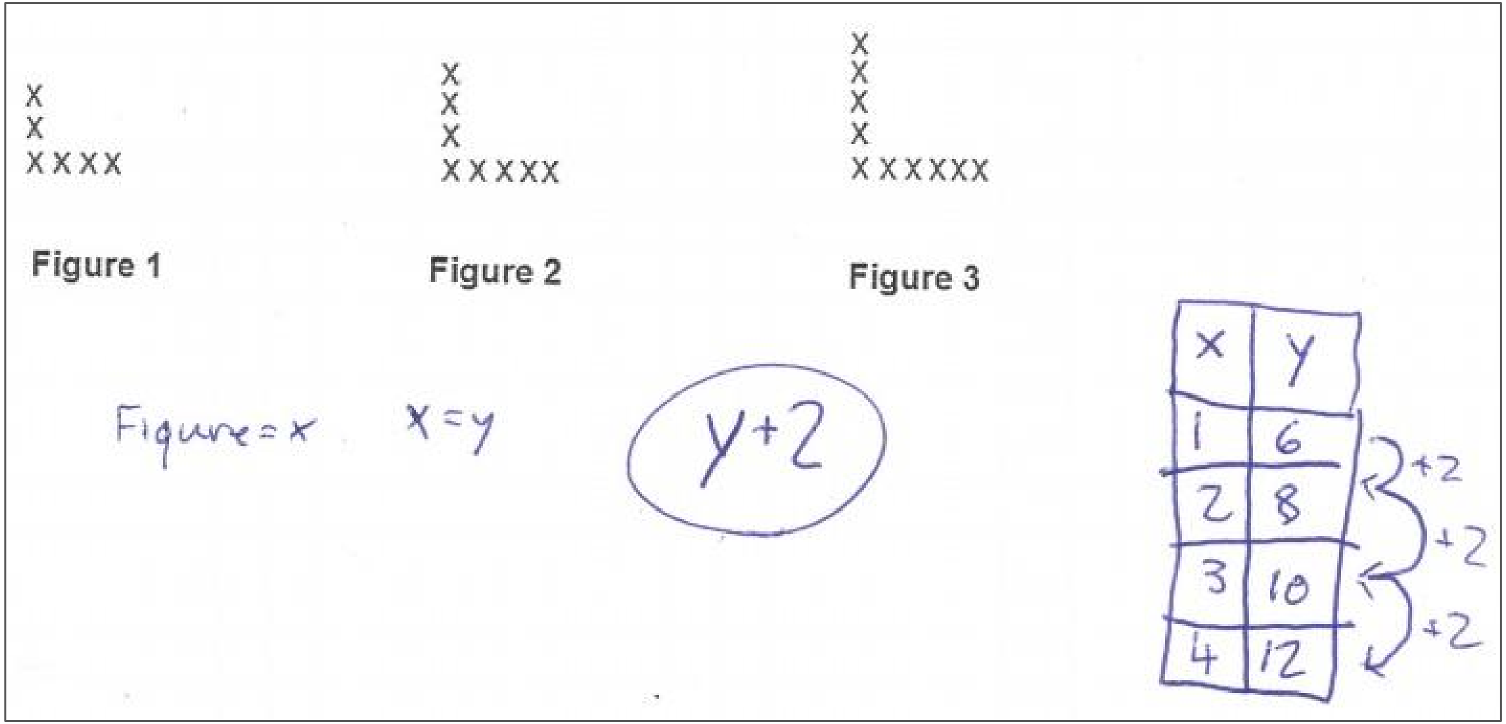
	Recursive rule	Functional rule
	Find the next	**Find the *n*th**
Sounds like...	**“I added two to this one to get the next one”**	**“To find the 10th figure, I can multiply 2 times 10 and add 4”**
Looks like...		

How do you see this figure growing?



Student work from Erin's class

- **Where do you see recursive thinking?**
- **Where do you see functional thinking?**



Student work from Erin's class

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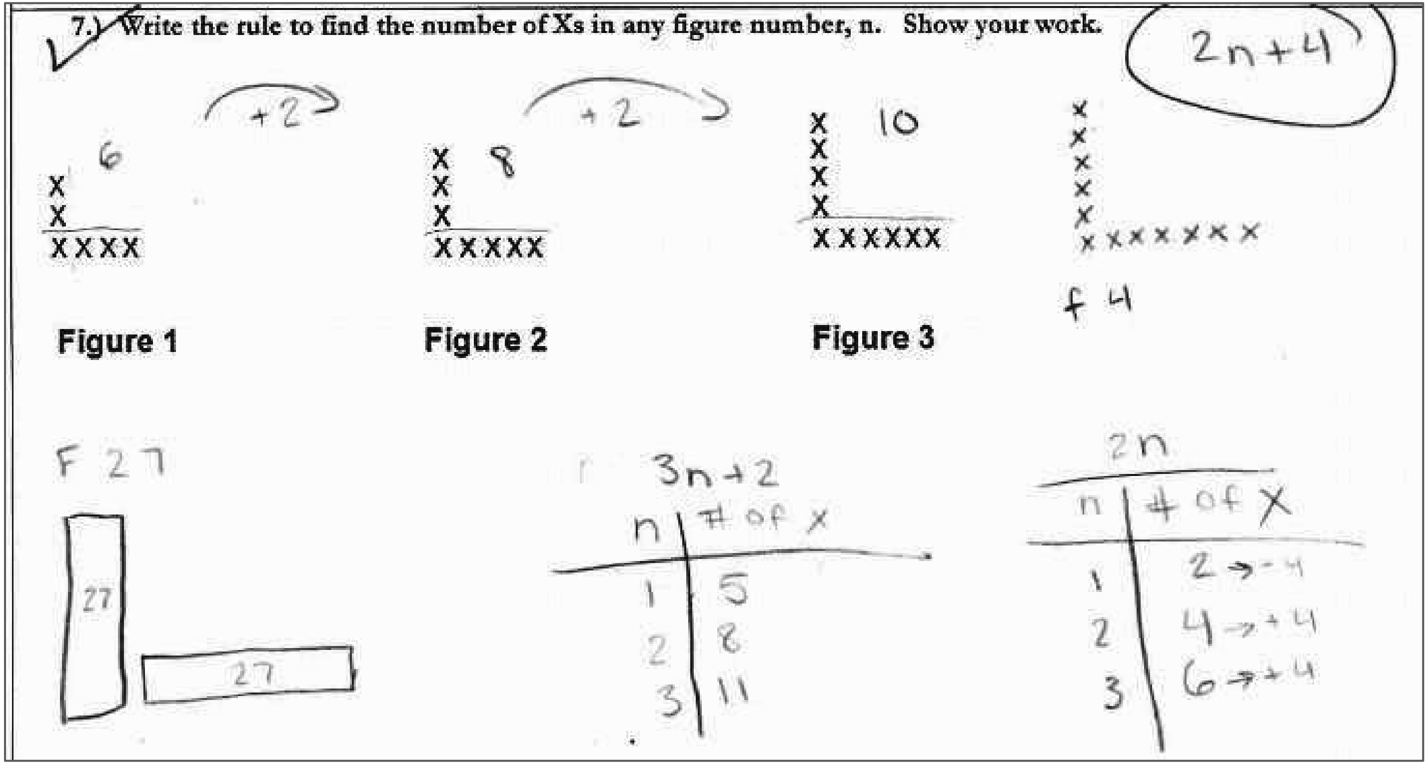
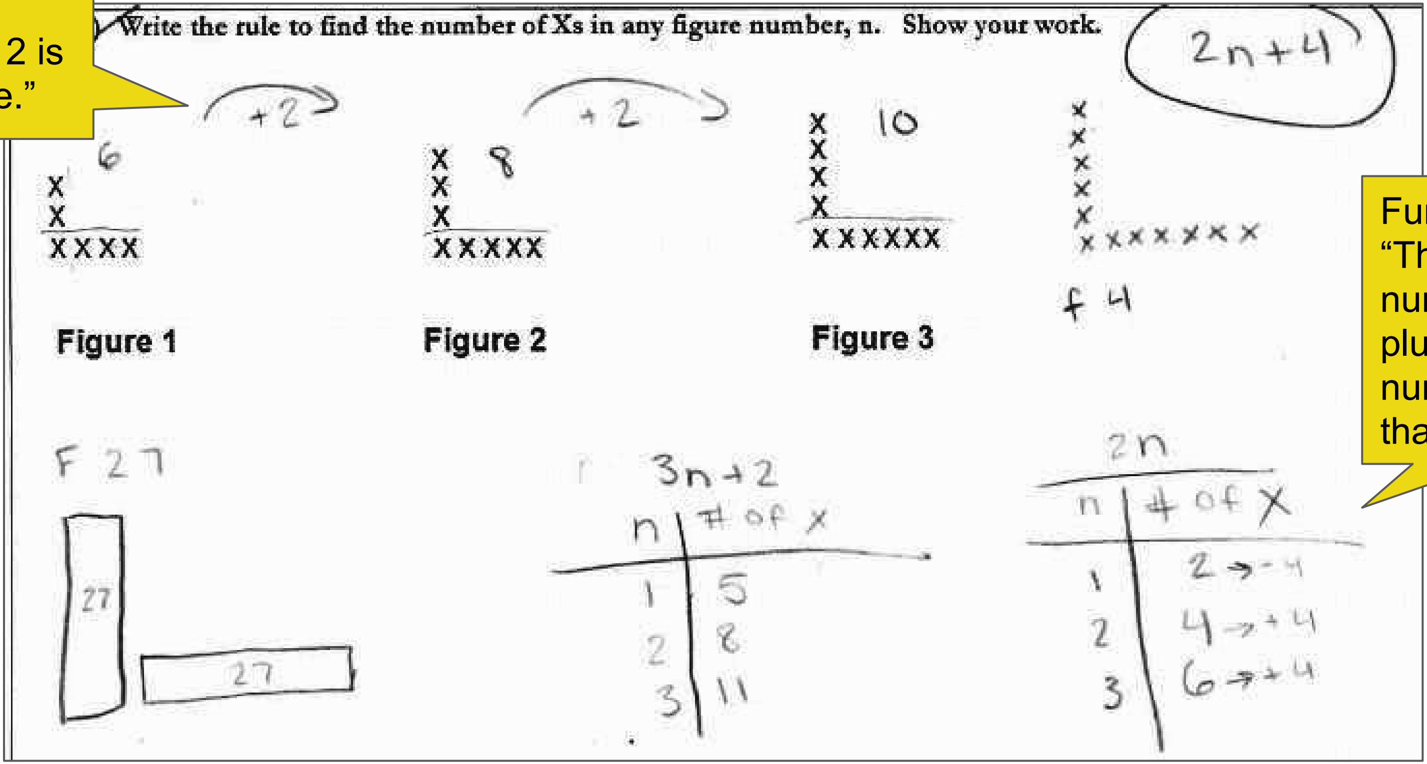


Student work from Erin's class

- Where do you see recursive thinking?
- Where do you see functional thinking?

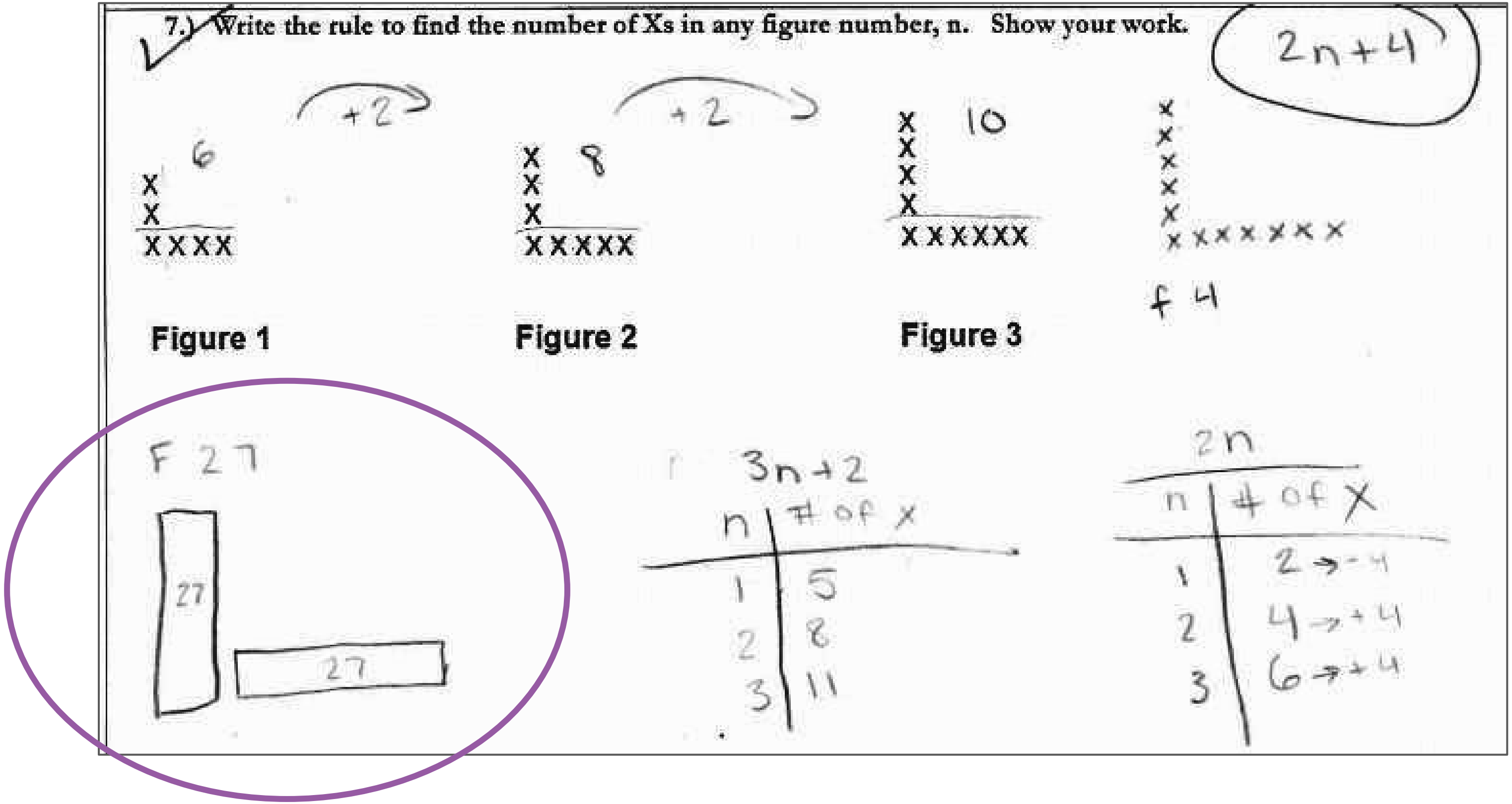
Recursive:
"This one + 2 is the next one."



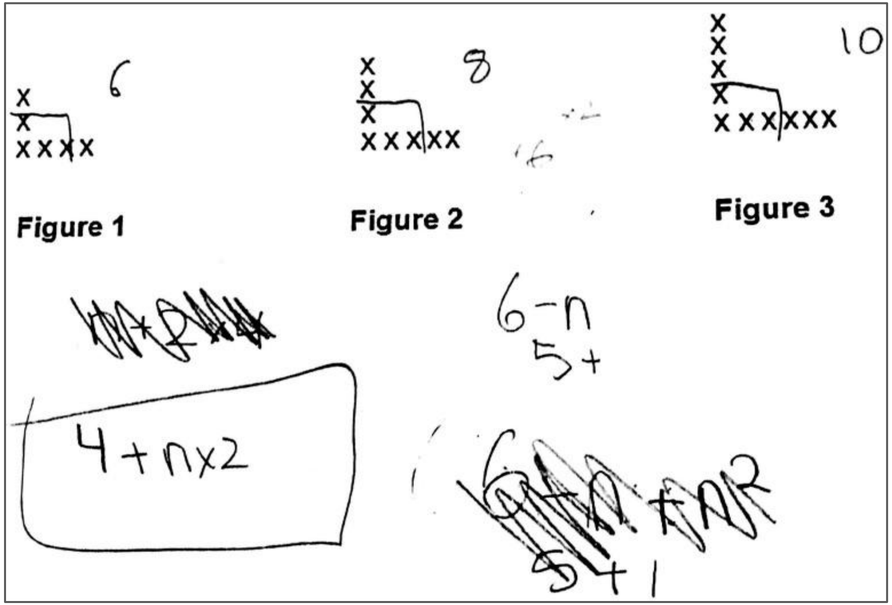
Functional:
"The figure number times 2, plus 4 is the number of Xs in that figure."

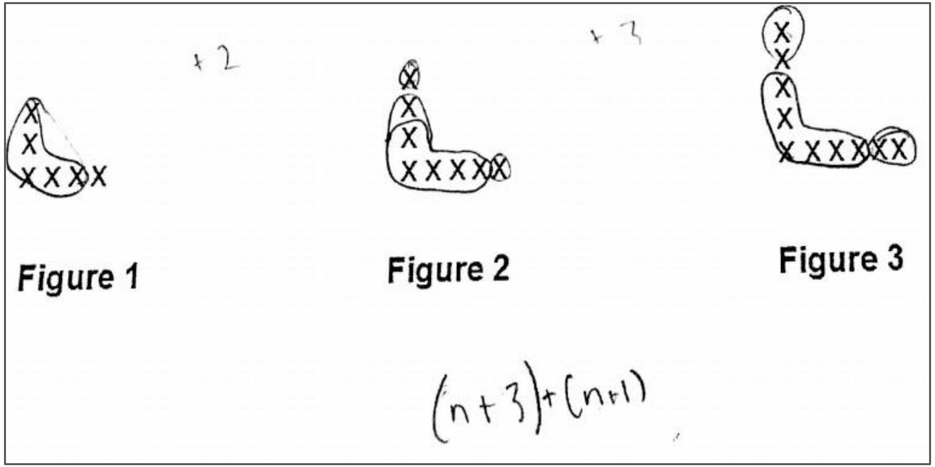
Student work from Erin's class

- **What's going on here?**
- **How does this fit or not fit?**



Student work from Erin's class



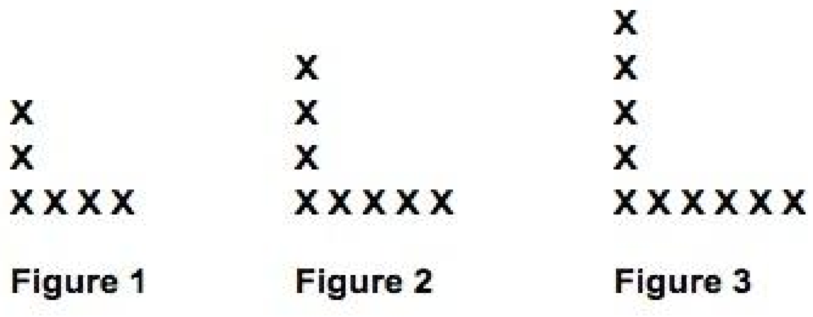


What's the same?

What's different?

The connection between recursive and functional.

Figure #	Total Xs	
1	6	6
2	8	6 + 2
3	10	(6 + 2) + 2
4	12	((6+2) +2) + 2
...		...
n	2n + 4	6 + 2 (n - 1)



The connection between recursive and functional.

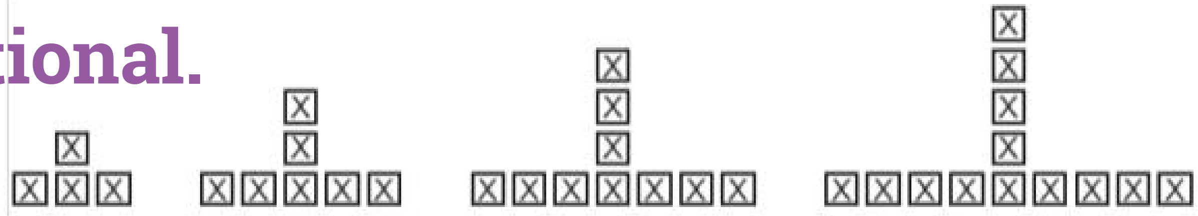


Figure #	Total Xs
1	4
2	7
3	10
4	13
...	
n	3n + 1

4 or (1 + 3)
4 + 3
(4 + 3) + 3
((4 + 3) + 3) + 3
...
4 + 3 (n - 1)

So what?

- Engagement
  - Students enjoy them and often want more challenging ones
- Discourse
  - Students have to make and defend claims
- Low floor, high ceiling
  - Multiple entry points usually begin with counting
- Many perspectives on “How does this pattern grow?”
  - Recursive thinking is allowed and
  - Functional expressions all simplify to the same expression

Connections to other topics

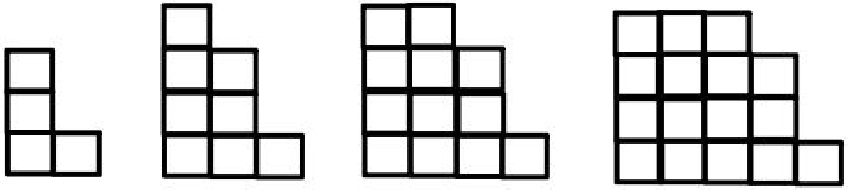
Not a lot of explicit mention in CCSS G6-8 about patterns so we may think it's not important or useful :(

- Proportional relationships
- Slope
    - y=mx+b
        - Easier for students to get a sense of slope as "for every change of 1 in x, y changes by m (we can see this in the recursive relationship
- Functions
    - Functions are defined by expressions
    - This might make for a smoother transition to functions

Practical tips for the transition from recursive thinking to functional thinking

- Don’t discourage recursive thinking. It’s the entry point!
- Do lots of drawing!
  - Draw the next and draw the 27th
  - What’s changing and what’s not?
- Teach them how to organize their thinking when they become disorganized.
- Look for and describe the connections
  - Between recursive rule and functional rule
  - Between different forms of the functional rule
- Do these often!

Which one doesn't belong?



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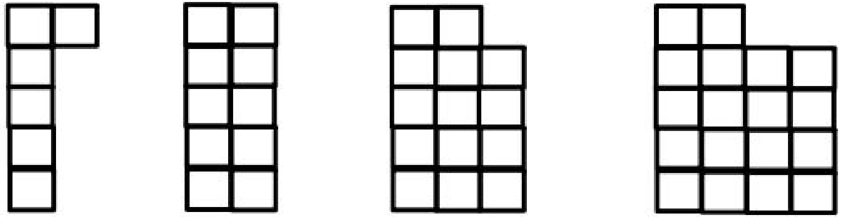

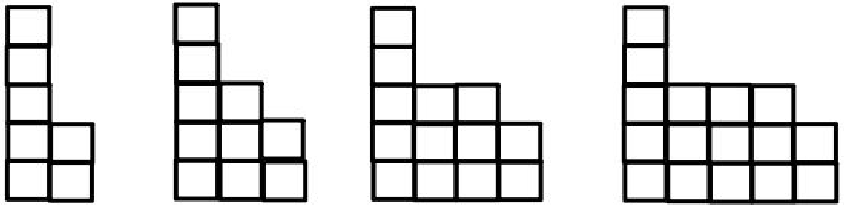

Thank you! Please keep in touch!

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