



# Day 5: Growing Shapes

Text by Professor Jo Boaler

## Introduction

This lesson includes a video and a wonderful task that you may want to extend into day 6!

## Video

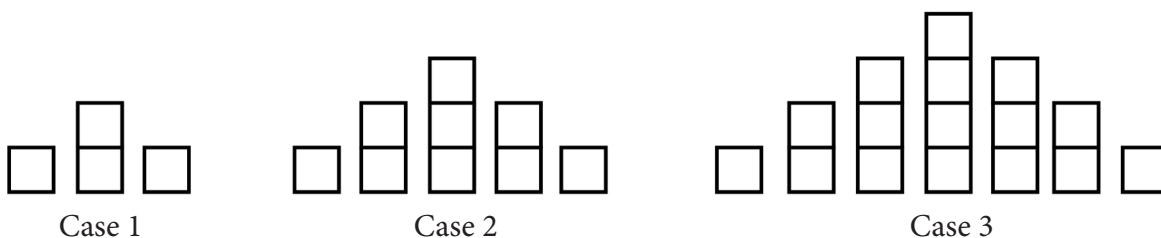
This may be your students' favorite video! It gives new research evidence on the importance of mistakes for brain growth and the need for challenge and thinking differently. It includes some really nice animations with the Stanford students.

## Activity: Growing Shapes

This is one of my favorite tasks as it asks students to look at growing cases and describe how they see the shapes growing. For older students it can lead into algebraic representations but it is a really worthwhile activity that younger students love without that part. Often, with pictures of growing cases, where students see a collection of objects that get bigger each time, students are asked questions such as “How many would there be in the 100th case?” With any age student we recommend not asking this numerical question but instead asking students how they see the shapes growing. This gives them access to a visual understanding of growth, and opportunities to think about numbers and visuals, which we know encourages powerful brain crossing.

To start the activity either show the first 3 cases with our power point slide, or, if you have time and enough snap cubes, get students to build the first 3 cases with cubes. Then ask the students:

### How do you see the shapes growing?



In case 2 there are more cubes than in case 1, and in case 3 there are more cubes again, where do you see the extra cubes? There are many different ways to answer this question as people see the shapes in lots of different ways.

I like to ask students to think alone first, as this prompts more different visual solutions. You can find out when people are ready by using a number talk strategy: Ask students to show you a “quiet thumb” when they have had enough time. Putting hands up puts other students under pressure, so a quiet thumb – one held by their chests, not waived in the air, works better.

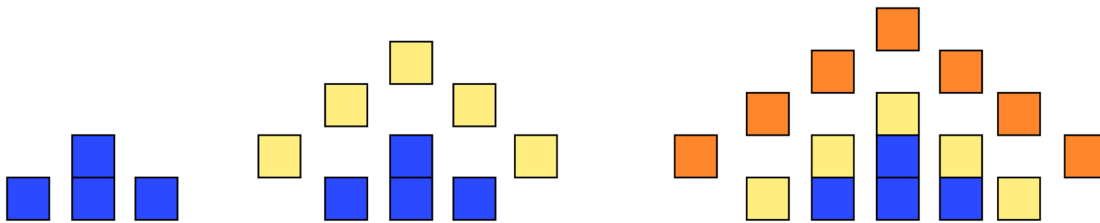


## Day 5: Growing Shapes

If you ask students to start in groups most people will end up seeing it in the 'same' way. But you could ask students to move straight to groups if you think this is better for your students, really encouraging the students to listen to everyone's perspective on how they see the shapes.

I have asked many people – teachers, students, and others how they see the shapes grow. This has shown me that there are many different ways of seeing the growth, and people are fascinated to see the different ways.

After you have asked students how they see the shape growing invite different students to share their ways of seeing at the board, for everyone to see. A nice way to do this is to project the shape onto the front board, so that students can draw around it. I always name the different methods, with the students' name and a name for the method. For example some people see the shape growing as additional cubes on the top of each column:



One of my students named this the raindrop method.

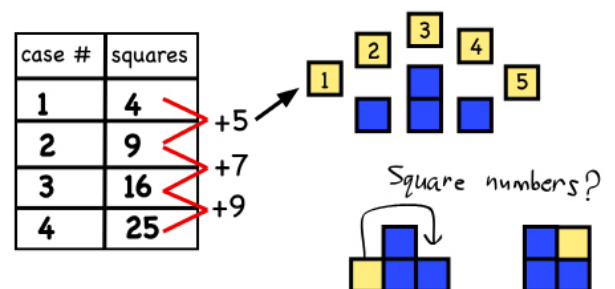
When I trialed this with 6th graders they saw the shapes grow in 8 different ways. The students were a little unsure about names at first but I helped them with the first ones and they got the hang of it.

After we looked at the different ways people saw the shapes I gave students our handout and asked them to talk in their groups finding out all the ways people saw the shape growing, drawing them on the handout. If students have snap cubes they can show each other their methods with the snap cubes and build the bigger cases. You may like students to show their different methods on posters instead of our handout.

After students have shared their different methods ask them to write down the number of squares they see in the first 3 cases, using a table, and connect this with the ways they see the shapes growing.

Ask students to use both the number pattern they see in their table and their visuals to predict how many squares there would be in the fourth case, and possible higher cases. Keep encouraging students to connect the numbers and visuals, ask them where they see the extra squares in their pictures and in the table they have made.

Explain to students that they are learning to generalize, which is





# Day 5: Growing Shapes

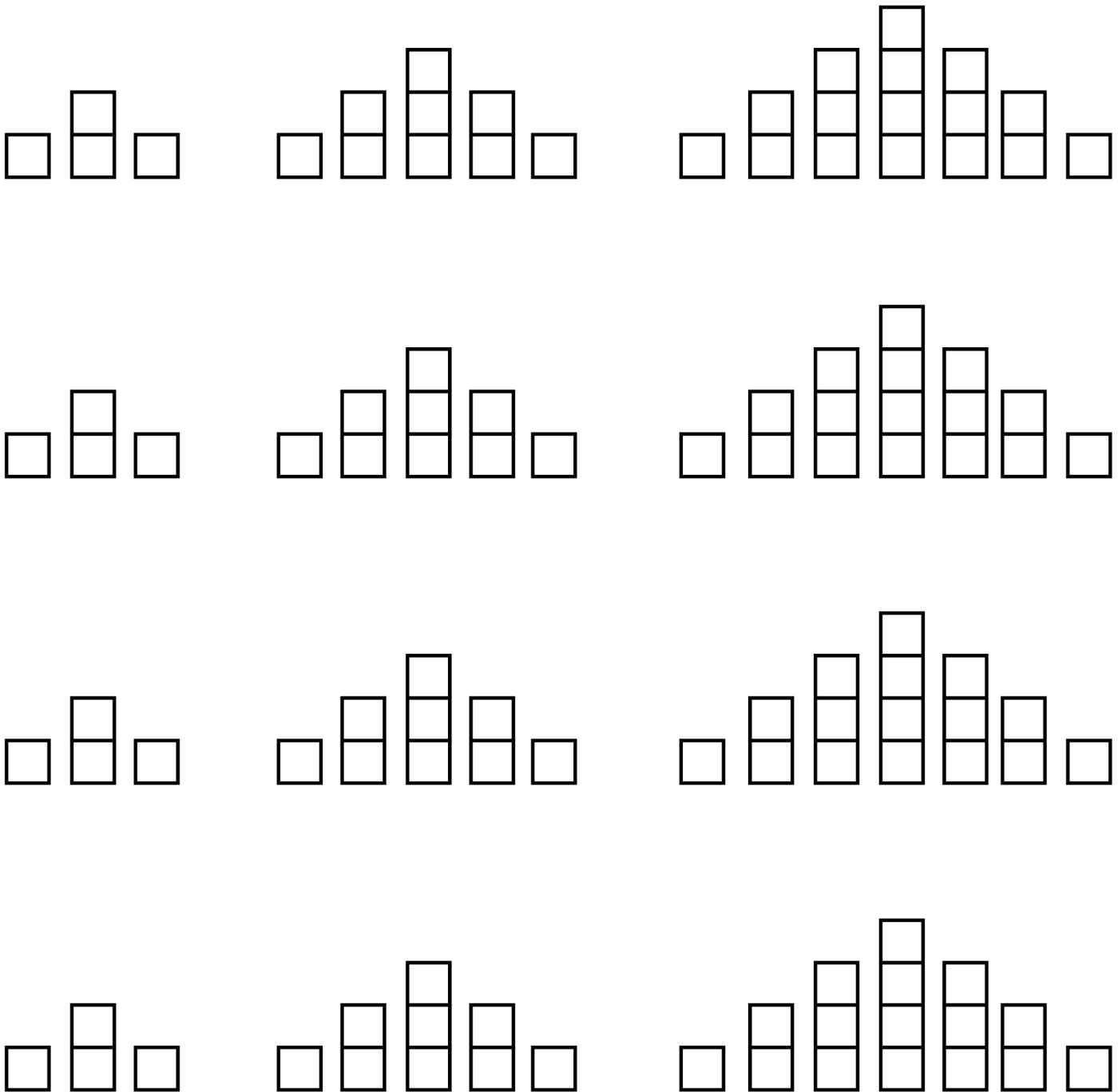
a really important part of algebra. The growing cases are representing a quadratic function and this activity helps students to see and understand functional growth, another important part of algebra.

Activity	Time	Description/Prompt	Materials
Day 5 Video: Mistakes	3 min	Video <a href="https://www.youcubed.org/wim-day-5/">https://www.youcubed.org/wim-day-5/</a>	
Growing Shapes	30 min	<ol style="list-style-type: none"> <li>1. How do you see the shapes growing? ask students to think alone at first</li> <li>2. Ask students to share their methods, drawing them on the board.</li> <li>3. Name the methods, with the students' name and possibly a method name e.g. the raindrop method</li> <li>4. Ask students to find out how their group saw the shapes growing</li> <li>5. Ask the students to construct tables and link their numbers and visuals.</li> </ol>	<ul style="list-style-type: none"> <li>• Paper, pencil/pen</li> <li>• Colored pencils/markers</li> <li>• Shapes Task, page 4. One copy per student</li> <li>• Shapes Task for display, page 5. One copy</li> <li>• One page of chart paper per group if you want to have classroom posters</li> </ul>
Group Presentations	10 min	Ask students to share any patterns or other interesting observations	
Closing	5 min	Review the key concepts: Mistakes Grow Your Brain!	

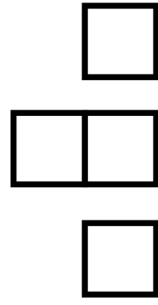


## Day 5: Growing Shapes

Different colors can be helpful in showing how people see the shapes!



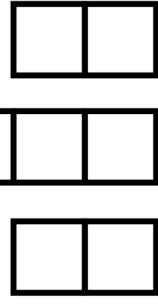
How do you see the shapes growing?



Case 1



Case 2



Case 3

