



## Toothpick Squares Grades 6-8

### Introduction

This activity allows students to see a growth pattern in different ways. We use the number talk approach to debrief the way students are ‘seeing’ the toothpicks so others have an opportunity to see different ways of looking at the problem. This helps students realize that there are different strategies for solving problems in maths and that maths is about generalizing how we see patterns. In this problem students will have an opportunity to generalize the number of toothpicks needed to make any size square. Some may choose to take this pattern further by using toothpicks and marshmallows to consider a 3-D pattern.

### Agenda

Activity	Time	Description	Materials
Mindset Message	5 min	Play the mindset video.	Mindset Video
Toothpick Squares Number Talk	15 min	<ul style="list-style-type: none"> <li>Show the picture of 3 by 3 toothpick square to the class and ask students to figure out how many toothpicks are used to make the square without counting each toothpick individually.</li> <li>On the white board, record students ways of seeing in the style of a number talk: write the student’s name, create a visual of the student’s way of seeing, record their arithmetic for their total number of toothpicks.</li> <li>Remind students that when we do maths there are many different ways to see problems</li> </ul>	Toothpick Squares Visual, pg. 6



<p>Toothpick Squares Work Time</p>	<p>20 min</p>	<p>Ask students to build and draw the previous and the next square in the pattern, a 2x2 and a 4x4. They should record how they saw the toothpicks on their paper. Ask them to complete the following questions on the task sheet</p> <ul style="list-style-type: none"> <li>• How would you describe how many toothpicks you would need to make a 13 by 13 square?</li> <li>• If you have a box of 250 toothpicks, what is the largest sized square you could build?</li> <li>• How many toothpicks would you need to make any sized square?</li> </ul> <p>Record your process and work in response to these questions on a poster</p>	<ul style="list-style-type: none"> <li>• Toothpicks</li> <li>• Toothpick Squares Handout, pg. 5</li> <li>• Paper for recording work</li> <li>• Poster paper</li> <li>• Colored pens/pencils</li> <li>• Small marshmallows (for extension)</li> </ul>
<p>Toothpick Squares Gallery Walk and Debrief</p>		<p>Have students walk around the room and see how different groups approached the questions in the task.</p> <ul style="list-style-type: none"> <li>• What was similar and what was different about how different groups approached the problem?</li> <li>• How are these methods similar and different to the strategies your group used?</li> </ul> <p>Whole class debrief with freedom to explore student interests and ideas:</p> <ul style="list-style-type: none"> <li>• What did you notice?</li> <li>• What was similar to what your group did? What was different?</li> <li>• How did students respond to the last question: How many toothpicks would you need to make any sized squares? Ask students which method from the beginning of class match with different responses to this question.</li> <li>• Are the expressions that students made for the total toothpicks in any size square the same or different? How do you know?</li> <li>• Are there different ways we can write the expressions? Can they all be written in the same way?</li> </ul>	



Debrief Mindset Message	5 min	Debrief the mindset messages for this activity.	
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### Activity

Show the picture to the class. ‘Individually, without counting one at a time, how many toothpicks are used to make this 3 by 3 square?’ Have students think individually to come up with a number of toothpicks. When students have had plenty of time to think, ask students how they saw the toothpicks. Collect students’ strategies on the board and record different methods like you would a number talk: write their name, sketch a picture of how they saw it and write the arithmetic they did to get their total. Highlight the fact that students were able to see this problem in so many different ways. In maths there are many ways of seeing a problem and many different strategies for solving a problem. This year in maths class we want to focus on hearing different students strategies and the many different methods for solving a problem.

After students have shared out all of their different methods, give students toothpicks and the Toothpick Squares Handout (pg. 5). Invite them to build and draw the two by two and four by four toothpick squares that come before and after the three by three in the pattern. Have them sketch and color code a picture of the method they used. Then ask the students to work with their group and consider three additional questions. Have students record their work for these questions on a poster.

- How would you describe how many toothpicks you would need to make a 13 by 13 square?
- If you have a box of 250 toothpicks, what is the largest sized square you could build?
- How many toothpicks would you need to make any sized square? Create an expression and color code the diagram that matches and shows how you counted toothpicks.



Once students have had an opportunity to respond to these questions allow students to walk around the room and look at other groups' posters. What do you notice? What is similar or different from how your group thought about the problem?

There are many different directions you can take the whole class debrief. We have included some different questions you could ask the class below. Consider where your students are in their thinking and give yourself and your students the freedom to explore questions or ideas that come up as you are debriefing their work.

As a class share out different strategies students used to think about these questions. What did students notice as they were looking at different students' posters? How did students respond to the last question: How many toothpicks would you need to make any sized squares? Ask students which methods from the beginning of class match the different responses to this question. Are the expressions that students made the same or different? How do they know?

There are many interesting extensions to this problem as well if students have additional time.

### Extensions

- If there were marshmallows connecting the toothpicks, how many marshmallows would you need for different sized squares?
- What if this were toothpick cubes? How many toothpicks would you need to build a 3 by 3 by 3 toothpick cube? How many marshmallows or gumdrops? How many toothpicks would you need for any size cube?

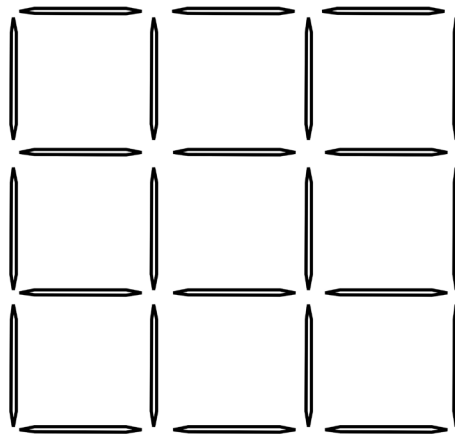
### Materials

- Toothpicks Squares Visual (pg. 6)
- Toothpicks
- Toothpick Squares Handout (pg. 5)
- Paper for recording work
- Poster paper
- Colored pens/pencils
- Small marshmallows (for extension)



# Toothpick Squares Talk Handout

This square is made of toothpicks.



Build and draw the previous square and the next square in the pattern. A 2 by 2 and a 4 by 4. Sketch how you grouped the toothpicks:

- How would you describe how many toothpicks you would need to make a 13 by 13 square?
- If you have a box of 250 toothpicks, what is the largest sized square you could build?
- How many toothpicks would you need to make any sized square? Create an expression and color code the diagram that matches and shows how you counted toothpicks.

## Extensions

- If there were marshmallows connecting the toothpicks, how many marshmallows would you need for different sized squares?
- What if this were toothpick cubes? How many toothpicks would you need to build a 3 by 3 by 3 toothpick cube? How many marshmallows? How many toothpicks would you need for any size cube?



# Toothpick Squares Talk Visual

