

Mathematics: The Language of STEM
Problem Solving Focus: How Many Toothpicks?

CONTENT AND TASK DECISIONS

Grade Level(s): 3rd

Description of the Task:

Students will determine the number of toothpicks it takes to build 1 through 6 squares. Students will then use the information to generate a rule of how many toothpicks it takes to make any number of squares.

Indiana Mathematics Content Standards:

3.AT.2: Solve real-world problems involving whole number multiplication and division within 100 in situations involving equal groups, arrays, and measurement quantities (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem).

Indiana Mathematics Process Standards:

PS.1: Make sense of problems and persevere in solving them.

PS.4: Model with mathematics.

Mathematics Content Goals:

- Students will determine the number of toothpicks it takes to build one through six squares.
- Students will use that information to generalize a rule of how many toothpicks it takes to make any number of squares.

Language Objectives: Students will create models of squares to help them recognize patterns that will lead to discovery to a mathematical rule.

Materials:

Toothpicks

THE LESSON

Before:

Introduction – Today’s task is to figure out how many toothpicks are needed to build any number of squares with each side of the square 1 toothpick long. Who can explain to me what a square is?

Before we begin this task, you will be working individually for this first part, but will eventually pair up to finish the tasks. Each of you will get 24 toothpicks.

Part 1 of Task

- Distribute the tally sheet and 24 toothpicks to each student.
- Our key question is to try to figure out how many toothpicks are needed to build any number of squares. Remember – each side of the square is one toothpick long.
- With the toothpicks you have, let us begin by figuring out how many toothpicks it takes to make one square? Then try two, three, four, five, and six squares.

- Once you have your answers by modeling with the toothpicks draw/write your work on the tally sheet.
- Have kids turn and talk with a partner to share their results. Have partners share out their findings and reflections.

Part 2 of Task

- Now, I would like everyone to pair up. Your partner and you will be using the work that you used from part 1 to help you with part 2. **Our key question is how many toothpicks are needed to build any number of squares? How many toothpicks would be needed for 43? 120? 265?**
- On your paper, write down patterns, equations, models, drawings, or tables to show you get an answer of the number toothpicks to build any number of squares.

During

- **Part 1** of task is critical for all students to understand the patterns of growing the number of squares with toothpicks. After part 1, spend time for discussion and have kids share with one another their strategies and findings.
 - Discuss - How many toothpicks did it take to build each square one through six? What patterns did you notice when building squares with four toothpicks in each square? (The number of toothpicks is always 4 times the number of squares.)
- **Part 2**
 - As you are walking around facilitating groups, help students notice patterns and connections.
 - Questioning –
 - What pattern do you notice? (The number of toothpicks is always 4 times the number of squares.) How can we use that information to figure out any number of squares without actually building them?
 - What are some of the ways you can describe the relationship between of the number of toothpicks and the number of squares?

After:

- To conclude this lesson, student pairs will share their thinking of ways that might show the relationship between the squares and toothpicks. There are many ways for students to share their work, but here are a few ways that might be common for kids to discover.
 - In addition, four rule- Students can figure out the answer of any number of squares by skip counting by 4's.
 - Toothpicks = four times the squares.
 - If S represents the number of squares and t represents the number of toothpicks, then $4S = T$
 - A table

Number of squares	0	1	2	3	4	5	6	N
Number of toothpicks	0	4	8	12	16	20	24	4n

ASSESSMENT

Observe: The purpose of this task is for kids to persevere and work cooperatively. Students should be engaged in mathematical conversations to find a rule to help them solve their problem. During the share time, praise students for their work either if it is right or wrong.

Try using the kids' rules to figure out other number of squares that could be made.
Did their rule work? Why or why not?

Extension Activities: Try the same problem by having kids make triangles instead of squares.

Part 1

How many toothpicks would it take to build 1 through 6 squares with each side being one toothpick long?

Show Your Work:

Part 2

How many toothpicks would you need to build 43 squares? What about 120 squares?

Can you find a rule that will work for any number of squares?

Describe the relationships between the squares and toothpicks in as many ways as you can. Share your methods with the class.