

Square Mania

Grades 9-12



Introduction

In this activity students look into a pattern and diagram where their first task is to verify the number of lines and squares. This is often a great discussion between students because some of the objects they need to count are not obvious. This has been a favorite task of our students and some have spent a lot of time working on it beyond class time. That makes it a perfect low-floor high-ceiling task! Doing math doesn't mean that we must resolve a problem by the end of class time. Mathematical thinking can go on for as much time as students want to commit to the task.

Video

Mistakes are Powerful, <https://youcubed.org/weeks/week-3-grade-9-12/>

Agenda for the activity

Activity	Time	Description	Materials
Mindset Message	5 min	Play the mindset video, <i>Mistakes are Powerful</i> , https://youcubed.org/weeks/week-3-grade-9-12/	Mindset Video day # 5, <i>Mistakes are Powerful</i>
Work time	25-30 min	Introduce students to the problem. Today their role is to first verify the statements made about two different figures. After they have verified the statements they will investigate the patterns in other cases.	Square Mania handout
Whole class discussion	10 min	Invite students to come up to the board to share their findings and conjectures. Solutions are not needed at this time, any group should be encouraged to present where they are. Groups who say they have a solution should be ready to answer questions from class skeptics. (See Building Shapes for grades 9 – 12 to define the role of the skeptic)	



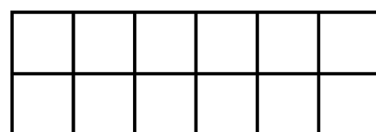
Debrief Mindset Message	5 min	Let students know that mathematicians work on problems over a long period of time. They don't find solutions to the questions they ask immediately. This is a problem that they can continue to work on over time. Solving these types of tasks where you work creatively and over time with lots of turns and pivots in your thinking is one of the joys of mathematics. We know we are in this space when individual work doesn't all look the same. Also come back to the Mindset message from the video: Mistakes are Powerful. Ask students to reflect on the video they watched and of the value of struggles they went through, or mistakes they made. If they struggled or made mistakes in this lesson, point out to students that their brains have grown and new pathways have formed!	
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Activity

Start by showing the video, Mistakes are Powerful.

Let students know that in their work on this task, they likely won't come up with a solution today. When Mathematicians work on task they don't finish tasks in a day. They spend a lot of time with them. This will be the case for this problem as well. Students will be able to work on it over time.

Give students the task page and let them get started in small groups. This is a great task for pairs of students. Students may work individually for a while before the questions start to come. We do not scaffold this task by seeing who can count the lines and squares. We leave that for individual students to figure out together. This is where mistakes and learning happens. When students start asking questions don't confirm whether they are right or wrong. Respond with another question. For example, an early question comes when





they say something like, “How did they get 17 squares” in the first figure. A possible response to this question might be, “How many squares did you count?”, “Where do you see the squares you counted?”, “What is the definition of a square?” Our goal is to always answer a question with another question. Mathematicians do not know the answers to the questions they have, they must reason and justify to find them. Mathematicians don’t have a solution manual or an expert in the room to answer their questions. Keep yourself from being the “math expert” and keeper of all answers.

While students work, enter conversations as they ask you questions. Remember, only answer a question with another question. Even if they have a correct question, play the role of the skeptic. If you don’t verify the answer, they will keep thinking.

After students have had time to work on the task, you may want to invite some to come up to the board to share their findings. Encourage students to share any questions they have about the problem. For example, one of our students started wondering what would happen if the shapes were triangles instead of squares and rectangles. No solutions need be presented, just current thinking to inspire further exploration of the problem. After the presentations students can continue work on the problem. Remind students about the mindset message and how mathematicians work. Invite your students to continue exploring this problem on their own. You can also come back to the problem and continue work on it on another day.

Return to the Mindset message from the video, Mistakes are Powerful. Ask students to reflect on the video they watched and of the value of struggles they went through, or mistakes they made. If they struggled or made mistakes in this lesson, point out to students that their brains have grown and new pathways have formed!

Extension

- What other questions to wonder about after working on this task? Choose one to explore further

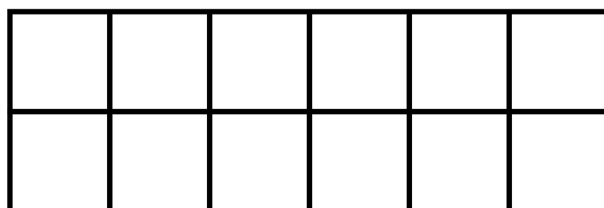
Materials

- Square Mania Handout

Square Mania Handout

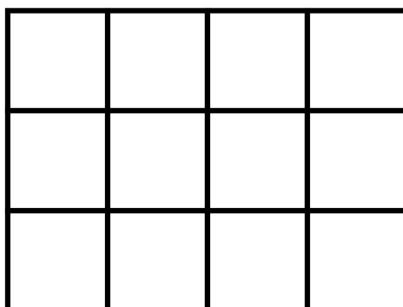


Ten line segments were used to create this figure. Now there are 17 squares. Do you agree? Justify



your answer.

Nine lines segments were used to create this figure. Now there are 20 squares. Do you agree?



What is the least number of line segments that make exactly 100 squares?

How many different ways can you make a particular number of squares?