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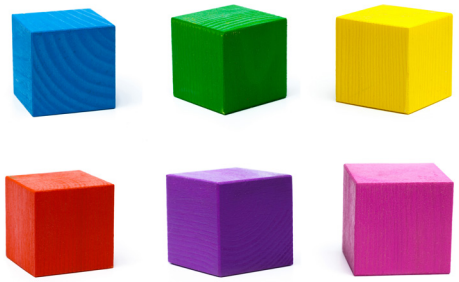
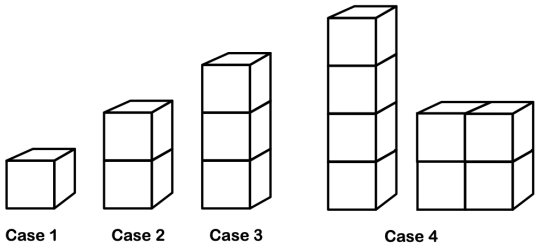


30 Cubes

Introduction:

This task is intended to support students building their own identity as a mathematics explorer. They will generate their own data and look for patterns within a sequence. They should work to determine ways to organize their findings so they can make convincing arguments and conjectures. Students are asked to think in cubes by building, drawing, and quantifying their results. "How many different rectangular prisms, which Jo calls cuboids, can you make using 1 cube, 2 cubes, 3 cubes and onwards to 30 cubes?"



Activity	Time	Description/Prompt	Materials
Data talk	5 min	Show the 4x3x3 rectangular prism image with the class. Ask students, "What do you notice?" "What do you wonder?" Asking students what they see and wonder about will help you determine where they may be with ideas that are critical for the investigation.	Rectangular prism image on page 3
Investigation	30 - 40 min	Share the handout on page 4. Students should work in groups. Provide students time to explore the question in groups. This provides you the opportunity to see where they are with organization, record keeping, counting different ways, volume, shape building and more. We have purposefully not said whether the shape is solid, we leave that for the explorers to decide.	Handout from page 4, one per group of 4. Materials: Have supplies ready for students to choose if they think they are needed. - snap cubes or square cubes - colore pens or markers - graph paper - computer or some way for recording data. ie. google sheets, excel, CODAP or ?
Discussion	10^{+} min	Ask student groups to share their findings.	
Reflection	5 min	Ask students to reflect on the activity. A few ideas are, "What did you learn from this activity?", "What questions do you have?", "What tools did you find most helpful?"	

Data Talk

On page 3 we have included a formative 'Notice and Wonder'. Students may question how many cubes are in the 4x3x3 rectangular prism. A great question to ponder as a class, "Is the figure solid or hollow?" If it is solid, "How many cubes are on the inside?" We love questions that might have different answers depending on the assumptions students make. This activity may provide you information about where students are with volume, surface area, length, width, height and visualizing a 3-D image in 2-D space.

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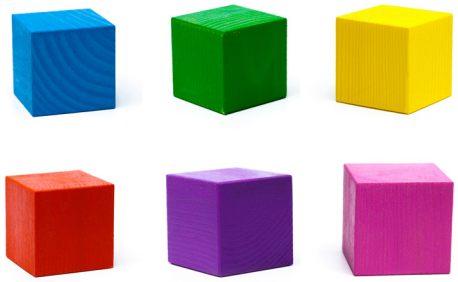

30 Cubes

Investigation

Launch the investigation by giving one copy of the task on page 3 to groups of 3-4 students. Ask them to review the task as a group and let you know what tools they might need to study the problem. Students may want to use technology tools, ie. google sheets or excel, for entering the data they collect, blocks or snap cubes to build the different versions, and colored pens and markers for drawing.

One of the first conversations you will most likely observe is when students try to determine what makes a different way. We love this idea of counting. What makes a different way for case number 12, with 12 blocks? How many different cases are there? For example, a student might have a 12x1x1 prism and ask if it counts as 1 way when it is flat on a table and a different, second way when it is standing upright on its end. Wait for this question to come up and listen as students determine how to count the number of different rectangular prisms, or cuboids, that have equal volumes. At some point you might want to pause group work and have a whole class discussion around, "What makes a rectangular prism different from another one that is built from the same number of cubes?" This is a time for students to discuss and come to consensus on what makes a different way and is an important point for student debate. Counting is an important idea in data science. Determining 'how many' incorporates different ideas and is an imporant idea to practice. At some point students may recognize that the dimension of a 12x1x1 prism is the same as other 12x1x1 prisms no matter how it is rotated in 3-D space - the number of cubes are a product of the length, width, and height and the number of cubes represents the volume of the rectangular prism. Data explorations can support mathematics learning too. Keep a record of all the different ways students are mathematical during their exploration.

During this activity you may want to discuss different attributes of rectangular prisms. What does it mean for a rectangular prism to be solid? What are the properties of rectangular prisms?

We have purposefully not included a graphic organizer for students to use to collect and organize their data. Our intent is for them to record their findings in their journals. An important activity for students is to determine a way to organize their work so they can see patterns. At some point you may want to pause and have a whole class discussion about different ways students are organizing and color coding their work. To complete the investigation, ask students to make a visual display that communicates their findings.

Discussion

The final discussion should consider the different ways students organized and collected their data. What assumptions did they make and what patterns did they find. The focus should be on the process and not so much about the answer. We do love when students come up with different answers. Ask students to justify their work and share their findings with the class. Often there are different answres if students have gone about the task in different ways. Students should be able to clearly communicate how they interpreted the question, determined a process for investigation and found solutions.

Reflection

To conclude the lesson ask students to reflect on the activity by asking, "What did you learn from this activity? What questions do you have? What tools and ways of organzing your work did you find most helpful?

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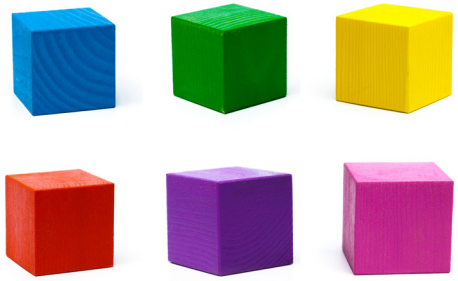
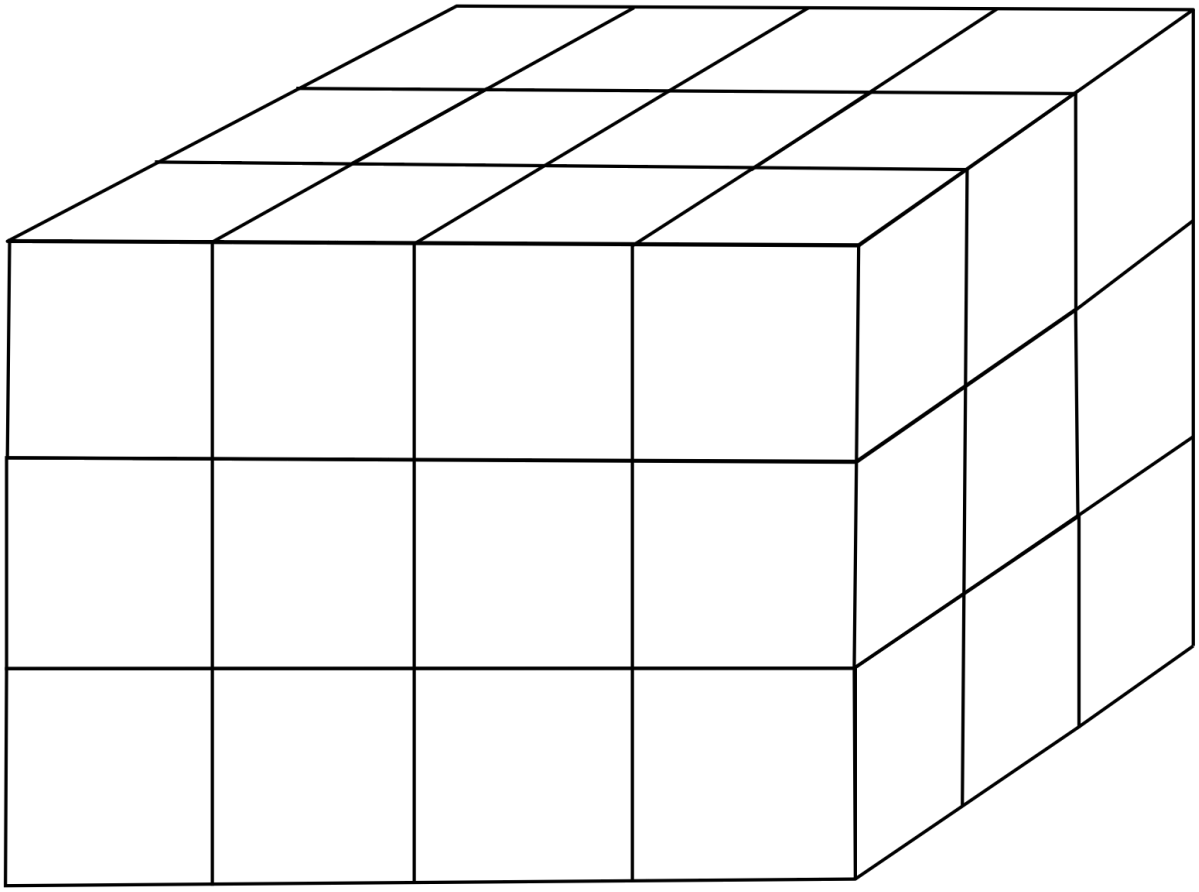


What do you notice?
What do you wonder?



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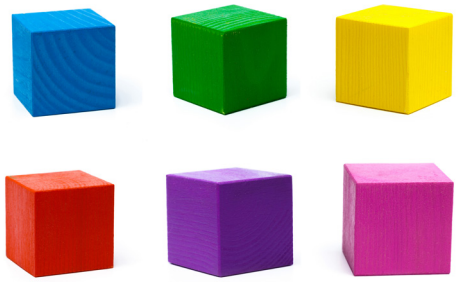

30 Cubes

Task:
Your role is to explore and find patterns. You will need to keep careful records by drawing, color-coding, and describing your work so a reader can understand what you have discovered. For this task you have 30 cubes.

- How many different rectangular prisms can you build with 1 cube? How many different prisms can you build with 2 cubes? With 3 cubes?
- How many different rectangular prisms can you build using 30 cubes?
- What makes rectangular prisms of 24 cubes different from each other?
- Record your findings in a way that helps you see patterns in your data.
- Make sure to illustrate all your different methods and make connections between them.
- Organize your work so a reader can understand your findings.
- Create a convincing argument to justify your findings.
- What questions do you have that you would like to explore?