PRACTICE TASK: Exploring with Boxes

Adapted from K-5 Math Teaching Resources

STANDARDS FOR MATHEMATICAL CONTENT

MCC5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.

b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

MCC5.MD.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

MCC5.MD.5 Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

a. Find the volume of a right rectangular prism with whole- number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.

b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.

c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

STANDARDS FOR MATHEMATICAL PRACTICE

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

BACKGROUND KNOWLEDGE

Students should have experience with drawing boxes on grid paper. They also need to understand how to cut and fold the patterns to make boxes. Teachers may need to model and let students practice before the task.

Common Misconceptions:
Students may need to be reminded that none of the centimeter cubes can be overlapping as they fill the open cube.

ESSENTIAL QUESTIONS

- What is the relationship between the size of the box and the number of cubes it will hold?
- How does the volume change as the dimensions of the box change?

MATERIALS

- cube patterns
- scissors
- tape
- cm cubes
- ruler
- recording sheet

GROUPING

Individual/Partners

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

In this task, students will create boxes and discover how volume is related to the length, width, and height of cubes.

Comments: To introduce this task, show the cube pattern and ask this question? What could be done to this pattern so that the top of the cube will be open? Students should be able to tell that the top square could be cut off. Tell students that they will be building open cubes of different sizes and filling them with cubes. Explain that they will need to measure the dimensions of each cube to complete the chart.

Once students have completed the task, lead a class discussion about the patterns they noticed. Allow students to explain their findings and any relationships they noticed. Also, allow students to share their conclusions about the relationships between volume and the dimensions of cubes. Finally, allow students to write about their findings in their math journals.

Task Directions: Using the open cube pattern, have students construct cubes of different dimensions and fill them with cm cubes. Have them measure the dimensions and record them in the appropriate boxes on the recording sheet. Then they will count the number of cubes it took to fill the cube and record the volume of each cube. Have students discuss their findings to generalize statements about the relationship between the dimensions of the cubes and their volume.

FORMATIVE ASSESSMENT QUESTIONS

- What do you notice about the size of the open cubes and the number of cm cubes they can hold?
- Could you predict how many cm cubes a container can hold, based on its measurements?

DIFFERENTIATION

Extension:

- Students may create their own open cubes with grid paper.
- Students may present a demonstration on drawing cubes to the class.

Intervention:

- Students may work with partners.
- Students may need support to measure dimensions accurately.
- Students may need support with differentiating between the length, width, and height on an open cube.

_____ _____
(Name) (Date)

Exploring With Boxes

Materials: open cube patterns, scissors, tape, cm ruler, cm cubes, recording sheet

Directions:

1. Work with a partner. Cut out the patterns for the open cubes, fold up the sides, and tape them together.

2. Measure each open cube and record your findings in the chart below.

3. Fill each box (open cube) with cm cubes and count them to find the volume.

4. Record your findings in the chart below.

5. Write in your math journal and describe how the size of the box is related to its volume.

Box (Open Cube)	Length of Base	Width of Base	Height of Cube	Volume
A				
B				
C				

Findings_____

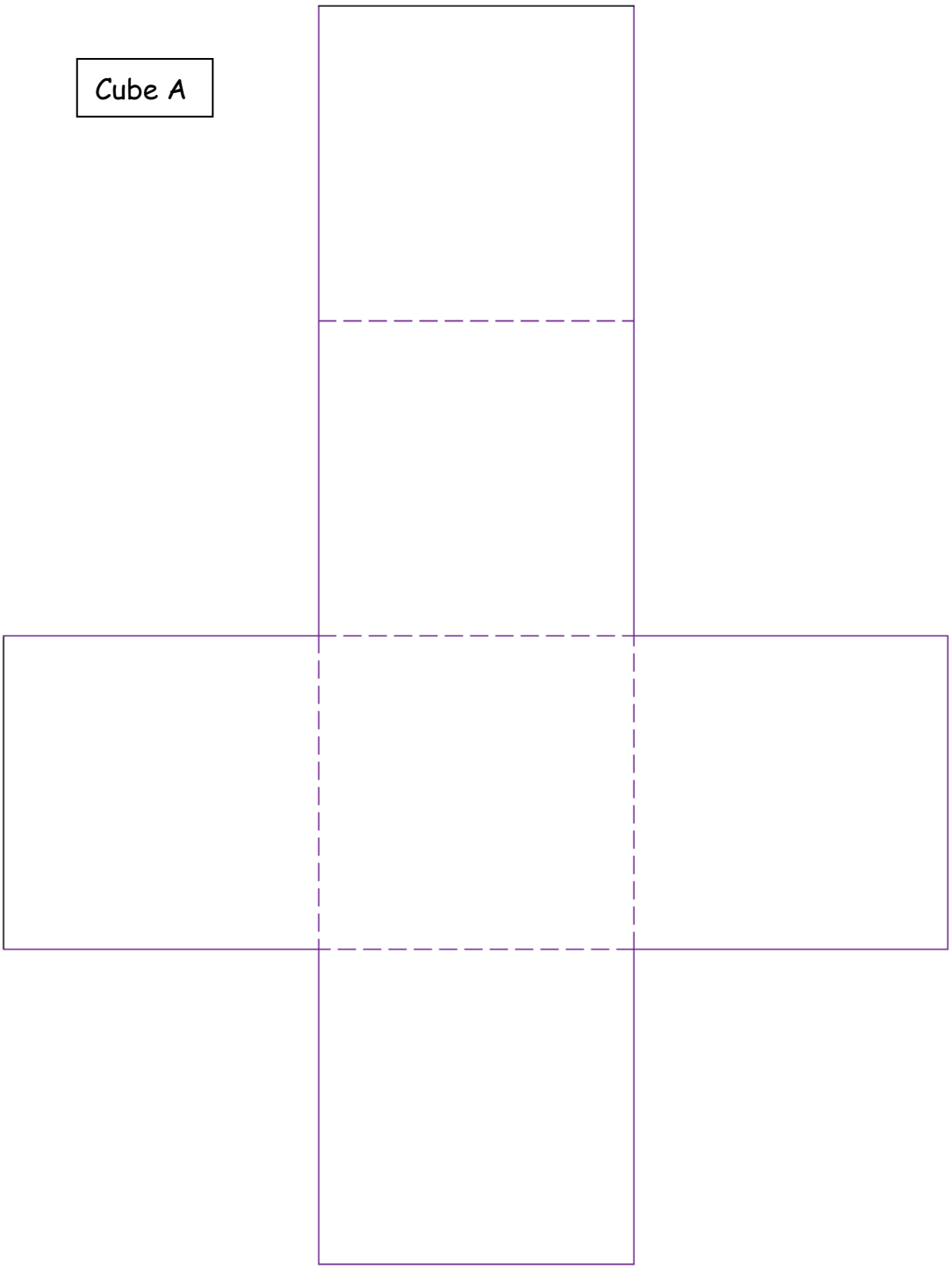
_____

_____

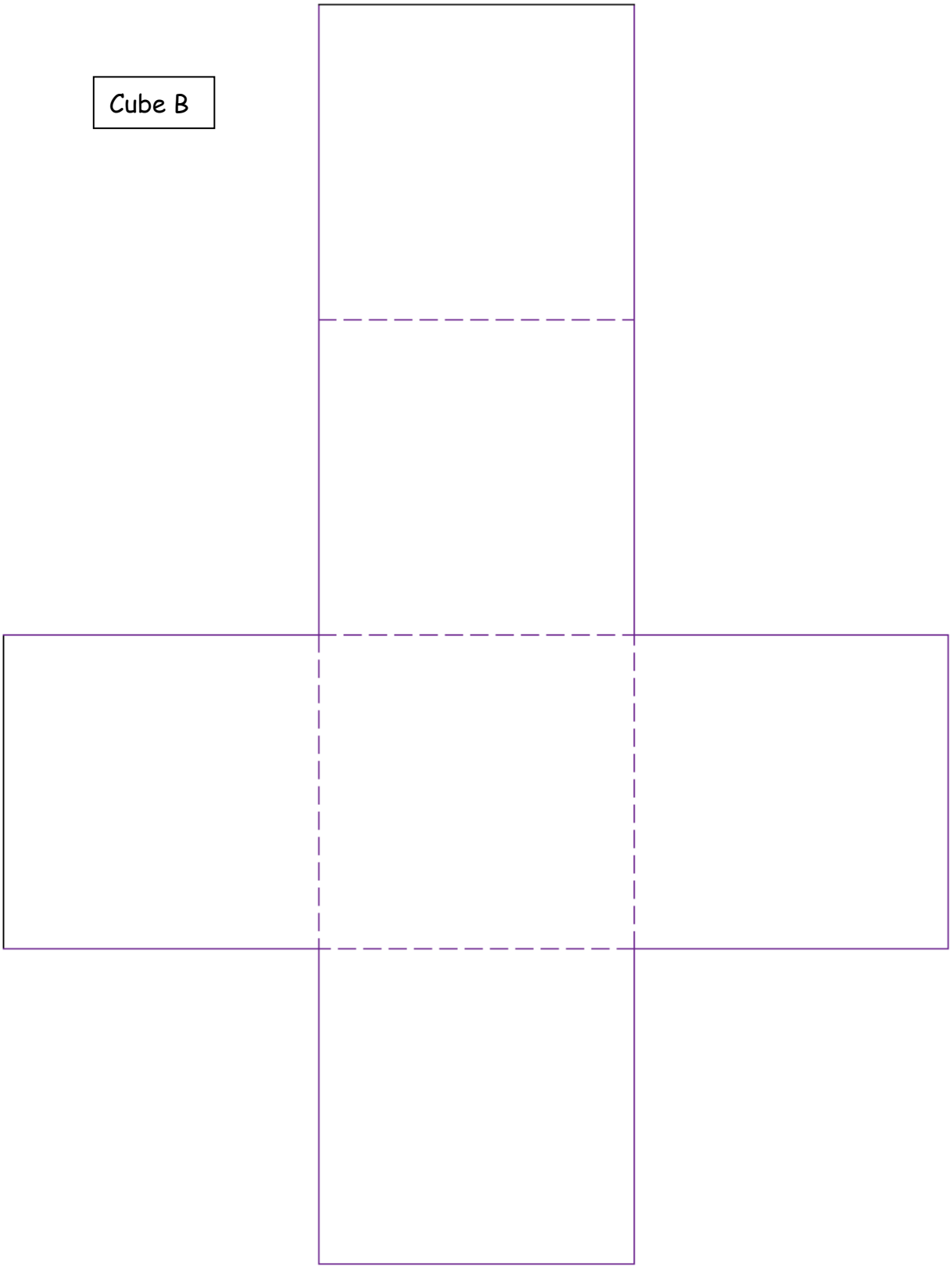
_____

_____

Cube A



Cube B



Cube C