Mathematics: The Language of STEM
How much space?
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CONTENT AND TASK DECISIONS

Grade Level(s): 5th

Description of the Task: Students will learn about volume so that in the end, they can design their own box (rectangular prism) for a specific volume.

Indiana Mathematics Content Standards: 5.M.4 Find the volume of a right rectangular prism with whole-number side lengths

Indiana Mathematics Process Standards:
PS.1: Make sense of problems and persevere in solving them.
PS.2: Reason abstractly and quantitatively.
PS.4: Model with mathematics.

Mathematics Content Goals:
- **Students will be able to measure the edges of a box so that they can successfully calculate the volume of a rectangular prism.**
- **Students will be able to create a model of a rectangular prism so that when given a volume of a rectangular prism their model will represent a true form of that volume.**

Language Objectives:
- **Students will be able to reason why different shaped rectangular prisms can have the same volume.**

Materials: Boxes (rectangular prisms) of various sizes/volumes, packing peanuts or marshmallows, 1 cm cubes, rulers, cardboard or cardstock

THE LESSON

Before:
Activate prior knowledge: Show the classes some images of 2D rectangles and 3D rectangular prisms.
Ask: "What might be some ways you could sort these shapes into different groups?"
Have groups of students discuss and share. Hone in on the difference between 2D and 3D.
Ask: "Can you find some items in the classroom that could be identified as rectangular prisms?"
Allow students to walk around the room either writing down items or taking photos using iPads. Have students share what they found.
Be sure the problem is understood, and
Establish clear expectations: Tell students that you have a problem you need help with. You have some things you need to ship to a friend overseas. To save money on shipping, you need the box to be as small as possible to hold all of the items.
Ask: "If given this problem now, what would be a strategy you could use to tackle the problem? Write down any ideas you have on a note card."
Explain that the class will be exploring and growing our knowledge of rectangular prisms so that they

can tackle the given problem.

During:
Bring various sized boxes (rectangular prisms) to class. (case of soda, shoe box, contact lens solution packaging, Amazon box, etc) Be sure to have enough boxes so that each group of students would have one box. Place them in the front of the classroom. Label each box with a letter for identification purposes. Explain each box is made to hold stuff. Mathematicians can figure out the amount of space inside rectangular prisms. They call it VOLUME.
ASK: Try to order the boxes in the front of the room with the largest volume (most space inside) to the smallest volume (least amount of space inside).
Give students time to look at the boxes and write the letters from the boxes in greatest to least order. Discuss as a class. Start by having one student share their thinking and have other students either agree with justification or respectfully disagree with justification.

Show students a bag of either packing peanuts or marshmallows,
ASK: "What could be some ways we could use these tools to find out the order of the boxes (according to volume)?
Let go, and let students work together to grapple with the packing peanuts or marshmallows.
Once students have correctly ordered the boxes, have a whole class discussion over the pros and cons to using nonstandard units.
ASK: Do you think you could find a formula to find the volume of the boxes?
Give students time to discuss this as groups. If needed **provide support** either to groups or the whole class by revisiting the formula for area. Compare nonstandard (drawing boxes, using cheeze its) to using the formula.

Once students have identified the formula for volume (l*w*h), have group's check one of the boxes from the previous activity. Once all groups have calculated the actual area, as a class, list the volumes and boxes in the correct order from greatest volume to least volume.

When students are ready for the final challenge, revisit the original stated problem, "I have 144 cubic inches of _____. Can you build me the smallest box that will hold all of my _____?"
Let go and let students work through the challenge.

After:
Have students present their volume boxes and how they came up with the dimensions.
ASK: What do you notice about your classmates' boxes? What do you notice? What questions do you have?
Facilitate a conversation to help students make connections and go deeper.
ASK: I noticed everyone created boxes that had a volume of 144 cubic inches, but not all the boxes look identical. How is it possible to have different shaped boxes that have the same volume?
ASK: Can you think of some real life examples where volume might need to be calculated?

ASSESSMENT

Observe: Formative assessment will take place throughout the lesson. Here are some places for intentional formative assessment:

- What background knowledge do students have on 3D shapes? Do they separate 2D from 3D when grouping?

- What are their current strategies for tackling the challenge?
- What preconceived ideas do they have about volume?
- Can they see pitfalls when using nonstandard units?
- Can they come up with the formula for volume on their own?
- Can they find volume when given the formula?
- What strategies do they have for finding the length, width, and height when given a volume?
- How are students justifying their thinking?
- How are groups working together?

Ask: List the specific questions you will ask students to assess their learning. (See these dispersed throughout the lesson plan.