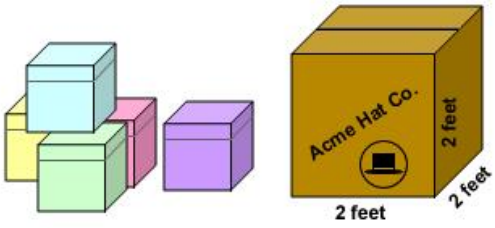
Name: _____ Date: _____

Student Exploration: Balancing Blocks

Vocabulary: area, balance, dimension, prism, product, rectangular prism, volume

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

Lucille works at the Acme Hat Factory. Each hat fits in a box that measures 1 foot on each side. Lucille's job is to put the hat boxes into a larger box that measures 2 feet long, 2 feet wide, and 2 feet tall.



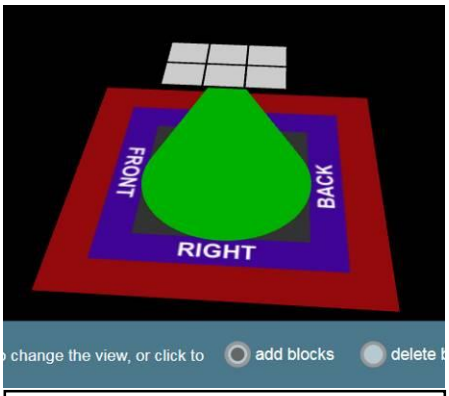
1. How many hat boxes will cover the bottom of the larger box? _____

2. How many hat boxes will fit into the larger box, total? _____

Gizmo Warm-up

The *Balancing Blocks* Gizmo gives you the challenge of balancing a collection of blocks on the point of a cone. To get started, practice using the Gizmo.

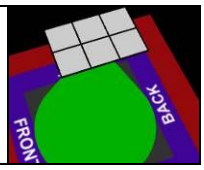
- Change your viewpoint by clicking and dragging the blue mat that the cone sits on.
- Select **add blocks** at the bottom of the Gizmo and click the model to add blocks. Notice that the model tilts when you add blocks. When the blocks are in **balance**, the cone turns green.
- Select **delete blocks** and click the model to remove blocks.



1. Next to **GOAL**, click **Show**. Can you balance 12 blocks on the 3 × 2 platform? _____ Click **Count blocks** to check. Then sketch your blocks to the right.

2. Under **BASE**, use the ▲ or ▼ arrows to set the base **dimensions** (measurements) to 3 × 3. Can you balance 12 blocks now? _____ How? _____

_____

Activity A: **Volume of small prisms**	Get the Gizmo ready: • Under **BLOCKS**, click **Clear**. • Set the **BASE** dimensions to 3 × 2. • Next to **GOAL**, turn off **Show**.	

1. Look at the 3 × 2 base.

   A. How many total squares do you see? _____ This number is the **area** of the base.

   B. What does 3 × 2 equal? _____

   C. What do you think is the area of a 5 × 4 base? _____ Check this in the Gizmo.

   D. If you know the length and width of a rectangle, how do you find its area? _____

   _____

2. Set the **BASE** dimensions back to 3 × 2. Under **BLOCKS**, click **Stack** to stack one layer of blocks. You have created a shape called a **rectangular prism**, like a box or a brick. A rectangular prism can be described by three dimensions: length (*l*), width (*w*), and height (*h*).

   A. What are the dimensions of this rectangular prism? *l*: _____ *w*: _____ *h*: _____

   B. The **volume** (*V*) of an object is equal to the number of unit blocks that can fit inside.

   Count the blocks. What is the volume of this rectangular prism? _____ blocks

3. Set **Stack** to **2 layers**. In the spaces below, list the dimensions and volume of the prism.

   Length (*l*): _____ Width (*w*): _____ Height (*h*): _____ Volume (*V*): _____

4. What will the volume be if you stack 5 layers of blocks on the 3 × 2 base? _____

   Use the Gizmo to check your answer.

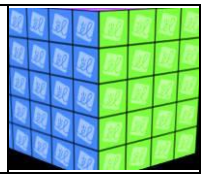
5. Next to **GOAL**, turn on **Show** and check that **Difficulty 1** is selected. Solve three challenges by building and balancing rectangular prisms with the given volumes. Feel free to change the dimensions of the base. Click **New** for a new challenge.

   Write the volumes and dimensions of each prism below.

   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

Activity B: **Volume of large prisms**	Get the Gizmo ready: • Under **BLOCKS**, click **Clear**. • Set the **BASE** dimensions to 4 × 5. • Next to **GOAL**, turn off the **Show** checkbox.	

1. Look at the 4 × 5 base. What is its area? _____ squares

2. Set **BLOCKS** to **2 Layers** to make a rectangular prism of blocks.

   A. How many blocks do you have? _____ Click **Count** to check.

   B. What is the **product** of the dimensions of the prism, 4 × 5 × 2? _____

3. Try different combinations of base dimensions and stacked layers. Record the volume of each rectangular prism. For the last two, choose your own dimensions.

Base	Height	Volume (blocks)
4 × 5	3	
4 × 5	4	
4 × 5	5	
2 × 4	1	
2 × 4	2	

Base	Height	Volume (blocks)
2 × 4	3	
2 × 4	4	
2 × 4	5	

4. Look at your table. In general, how do you calculate the volume of a rectangular prism if you know its length, width, and height? _____

5. Calculate the volumes of the following rectangular prisms. Use the Gizmo to check answers.

   Length (*l*): 2 Width (*w*): 3 Height (*h*): 5 Volume (*V*): _____

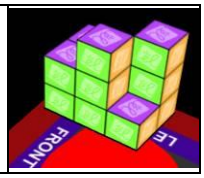
   Length (*l*): 5 Width (*w*): 5 Height (*h*): 3 Volume (*V*): _____

6. Next to **GOAL**, turn on **Show** and check that **Difficulty 2** is selected. Solve three challenges by building and balancing rectangular prisms with the given volumes. Write down 3 goal volumes and your solutions.

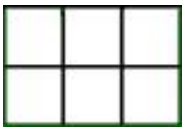
   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

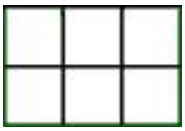
   Volume (*V*): _____ Length (*l*): _____ Width (*w*): _____ Height (*h*): _____

Activity C: **Odd shapes**	Get the Gizmo ready: • Under **BLOCKS**, click **Clear**. • Set the **BASE** dimensions to 3 × 2. • Next to **GOAL**, turn off the **Show** checkbox.	

1. On the 3 × 2 base, try to create a balanced stack of 10 blocks that is no more than 2 layers high. On the diagrams at right, color in the blocks you placed on level 1 and level 2.



Level 1



Level 2

2. On your computer, open a new document in a word-processing program. Add your name and a title, such as "Balanced Blocks."

3. Next to **GOAL**, turn on **Show**. Select **Difficulty 3**. Try at least three challenges. (Feel free to change the dimensions of the base.) When you build and balance each one, click the **camera** in the upper left corner. **Copy** the image and then choose **Paste** in your document.

4. Turn off **Show**. Find at least three different ways to balance 28 blocks. Take a snapshot of each, and paste each one in your document.

5. Try to make a balanced stack of 11 blocks on a 2 × 2 base. Can you do it? _____

   Explain. _____

6. For each challenge below, circle "Possible" if it is possible to create a balanced stack, and "Impossible" if it isn't. If it is possible, paste a snapshot of your solution into your document.

   A. 23 blocks on a 5 × 2 base — Possible — Impossible

   B. 16 blocks on a 3 × 3 base — Possible — Impossible

   C. 19 blocks on a 1 × 5 base — Possible — Impossible

   D. 20 blocks on a 2 × 3 base — Possible — Impossible

7. Now make some general rules by stating which are possible and which are impossible.

   A. An even number of blocks on a base with an even area: _____

   B. An even number of blocks on a base with an odd area: _____

   C. An odd number of blocks on a base with an even area: _____

   D. An odd number of blocks on a base with an odd area: _____