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**.
 | 1032SE2 |

1. Look at the 3 × 2 base.
	1. How many total squares do you see? \_\_\_\_\_\_\_ This number is the **area** of the base.
	2. What does 3 × 2 equal? \_\_\_\_\_\_\_\_
	3. What do you think is the area of a 5 × 4 base? \_\_\_\_\_\_\_\_ Check this in the Gizmo.
	4. If you know the length and width of a rectangle, how do you find its area? \_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 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*).
	1. What are the dimensions of this rectangular prism? *l*: \_\_\_\_\_ *w*: \_\_\_\_\_ *h*: \_\_\_\_\_
	2. 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
2. 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*): \_\_\_\_\_\_\_\_\_\_\_\_\_

1. What will the volume be if you stack 5 layers of blocks on the 3 × 2 base? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Use the Gizmo to check your answer.

1. 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.
 | 1032SE3 |

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.
	* + 1. How many blocks do you have? \_\_\_\_\_\_\_\_\_\_ Click **Count** to check.
			2. 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 |  |
|  |  |  |
|  |  |  |

1. Look at your table. In general, how do you calculate the volume of a rectangular prism if you know its length, width, and height? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. 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*): \_\_\_\_\_\_\_\_\_\_\_\_\_

1. 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.
 | 1032SE4 |

 

 **Level 1 Level 2**

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.
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. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 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.
	1. 23 blocks on a 5 × 2 base Possible Impossible
	2. 16 blocks on a 3 × 3 base Possible Impossible
	3. 19 blocks on a 1 × 5 base Possible Impossible
	4. 20 blocks on a 2 × 3 base Possible Impossible
2. Now make some general rules by stating which are possible and which are impossible.
	1. An even number of blocks on a base with an even area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. An even number of blocks on a base with an odd area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. An odd number of blocks on a base with an even area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. An odd number of blocks on a base with an odd area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_