EDUCATOR'S GUIDE

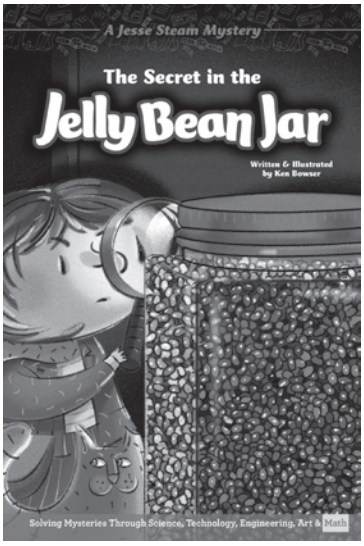
Jesse Steam: Solving Mysteries through Science, Technology, Engineering, Art & Math

Title: The Secret in the Jelly Bean Jar

Series Overview

Ten-year-old Jesse Steam's curiosity about how the world works leads her to one mystery after another as she pedals around town, often with Mr. Stubbs, her tabby cat, keeping her company in the bike basket. Using simple scientific tools and their powers of observation, Jesse and her friends analyze, test hypotheses, and conduct experiments. If the kids get stuck, they know they can count on Professor Peach, a retired college science educator, to step in with a clear explanation.

Each title in the Jesse Steam series focuses on one **STEAM** subject: Science, Technology, Engineering, Art, or Math.



Lexile: 760L GRL: R 4,359 words

About This Book

In *The Secret in the Jelly Bean Jar,* Jesse discovers that knowing how to estimate volume correctly can save time and avoid sticky situations—literally. And it can sometimes even pay off in a cool reward! Readers will come away with a better understanding of the relationship between volume and capacity, and how important it is to give everything on Earth the space it needs.

This title focuses on **math**.

Next Generation Science Standards Alignments and Activities

The activities and learning ideas in this guide have been correlated with the **Next Generation Science Standards (NGSS): https://tinyurl.com/y649p73f**

These standards were developed by the National Research Council (NCR) of the National Academy of Sciences. The NCR's Framework for K-12 Science Education combines practices, crosscutting concepts, and disciplinary core ideas to address relevant science, technology, engineering and math (STEM) concepts that students should learn.

For this book, **https://bit.ly/2m0PrkV** the standards called Engineering Practices: Using Mathematics and Computational Thinking is particularly applicable.

Background and Key Concepts

Seed Volume and capacity are the big ideas in ***The Secret in the Jelly Bean Jar***, with an explanation of how to compute cubic measurement. You may find these definitions and explanations helpful:

- **Volume:** The space something takes up.
- **Capacity:** The amount of volume in a container.
- **Estimate:** An approximate calculation of distance, size, cost, etc.
- **Formula to measure volume (of a solid):** The length of an object (L) times its width (W) times its height (H). These measurements can be multiplied in any order.

Class Discussion

Assess what students already know about volume and capacity by asking them for definitions. Write their ideas on the board or easel. Now briefly review Jesse's three mishaps at the beginning of the book:

- She spills grape juice when she pours it from a large container into a small glass.
- She keeps running out of bags to hold the leaves she's raking.
- She pumps too much air into her bike tire and it bursts.

Invite students to explore how all three of Jesse's situations show what can happen when the capacity of a container doesn't match the volume of what you need to put into it.

- *The capacity of the glass couldn't hold the volume of juice, so it overflowed and made a mess.*
- *The capacity of the number of leaf bags couldn't hold the volume of raked leaves; the task took more time and effort because she had to keep going back for more.*
- *The capacity of her bicycle tire couldn't hold the volume of air she pumped in, so it burst.*

Reinforce the idea that everything on Earth, no matter how small, takes up space. Invite students to share experiences they've had or have witnessed others having in over- or underestimating how much space something would take up in a container or limited area. What were the consequences? (Try to draw out examples that include solids, liquids, and gases to parallel Jesse's situations.)

BOXING MATCH: Classroom Activity

How does your classroom measure up? This activity will give students practice in estimating and measuring volume and capacity using uniformly sized square or rectangular objects. (It is designed to complement the MakerSpace activity on p, 64 of the student book, which shows how to determine volume of randomly sized individual pieces.)

Materials and Preparation

Assemble and prepare everything in advance, following these steps:

I. The container (volume and capacity)

- You'll need one medium-size square or rectangular storage item—a milk carton, storage bin, shoe box.
- Measure the item's length, height and width in inches. **Please note: In this activity we recommend rounding down all dimensions and solutions to the nearest whole numbers so calculations are as simple as possible.**
- Write the rounded-down dimensions and apply the formula **L**ength x **W**idth x **H**eight on the board or easel to get the total.

II. The items to be contained (volume)

- You'll need **one** rectangular or square item for **each team of 3-5 students.** Choose a variety of ordinary classroom supplies such as boxes of pencils, pens or markers; packages of printer paper; books; Post-It note stacks, etc.
- Again using inches, and again rounding down to the nearest whole number, measure the dimensions of each item and multiply to find volume. Write your calculations on the board or easel, but keep them covered. You won't share them with students immediately.

III. Materials to record results

You'll need **one** data sheet **per student.** Copy our form on p. 4, or students can write on other paper.

Instructions

1. Divide students into groups of 3-5. Distribute the data sheets. Tell students they're going to figure out volume and capacity using items in your classroom.
2. Show students the storage item you've selected and measured. Share the measurements and the **L**ength x **W**idth x **H**eight formula. Walk them through the multiplication you did and point out the superscript that denotes cubic measurement. Clarify that they understand this figure represents the container's total volume and capacity. Have them write the information on their data sheets.
3. Now distribute one of the small items to each team. Have teams inspect their item carefully and compare it visually with the the container. You can move from group to group with the container or have them come up for a closer look. Encourage them to place their item inside or next to it for a better idea of relative size.
4. When they're ready, invite them to write down individual estimates of how many items they think can fit in the container. Then give teams time to discuss their individual estimates and reach agreement on one team estimate.
5. When the team estimates are recorded, share your measurements and calculations of their items. Guide students through the process you used. Invite them to write down all the data.

Last step: Teams should divide their item's volume into the total capacity of the storage container. If there is a remainder, explain they should round down to the nearest whole number.

How did they do? Which team's estimate came closest to their actuals? Did more students overestimate than underestimate? Were they surprised by differences between estimates and actuals? Encourage teams to share their results and process. Depending on time, you can have teams swap items when they've finished and try again.

Collect the data sheets and review later for any computational errors.

TAKE ME TO YOUR LITER Research Project

Invite students to find images online or cut out ads from magazines or flyers for examples of products sold in one- and two-liter containers: soda pop, water, cleaning products. They can also include empty storage bins and bottles. Encourage them to find as many different shapes and sizes as they can. They can then prepare a short report of what they found and illustrate with the visuals.

Design Challenge

As a class, brainstorm ideas about why shapes, sizes, and designs of containers that hold the same amount of liquid look so different. Suggestions:

- Marketing—to appear to hold more volume, and thus have more value, than they really do
- Convenience—to fit better onto a shelf or refrigerator
- Functionality—to be easier to use for the intended purpose.
- Sustainability -- to use recyclable or more environmentally friendly packaging

Working in pairs, ask students to sketch out a design that improves a container for their favorite drink in one of the categories above.

Additional Online Resources:

Education.com offers numerous leveled worksheets and downloadable handouts free to teachers for classroom, **noncommercial** use only. Check out this volume-related activity and browse their many resources. https://www.education.com/activity/article/understand-volume-sugar-cubes/

PBS Learning Media is another rich source for educators. https://bit.ly/2kwpwRO

Videos

This illustrates some basic ideas about liquid volume and capacity.
https://www.youtube.com/watch?v=GKCE8ohIBqE

This engaging video demonstrates how gas expands to change the shape of its container and create more volume. You could also use it to introduce the principles of water displacement.
https://www.youtube.com/watch?v=gk1R51psXvs

Guide written by Jacqueline A. Ball

Data Sheet

BOXING MATCH

Students Name _____ Date _____

CONTAINER	
Multiply Length (L) × Width (W) × Height (H)	_____
Total volume/capacity	_____
YOUR TEAM'S ITEM (write its name)	_____
Your estimate of how many will fit in the container	_____
Team estimate of how many will fit in the container	_____
Multiply Length (L) × Width (W) × Height (H)	_____
Total actual volume of your items	_____
Divide container volume by your item's volume	_____
How many items will fit in the container	_____

Round **down** to the nearest whole number if your division came out with a remainder)