

Building a Bookshelf

Lesson Overview

In this lesson, students will use Engineering Design (Ask, Imagine, Plan, Create, Improve) to design a bookcase based on various parameters of measurements and materials/costs.

SC Standards Addressed

6.NS.1 Compute and represent quotients of positive fractions using a variety of procedures (e.g., visual models, equations, and real-world situations).

6.NS.2 Fluently divide multi-digit whole numbers using a standard algorithmic approach.

NOTE: Students worked with operations of whole numbers and fractions in 5th grade, as prerequisites to division. This lesson will include working knowledge of all whole number and fraction operations.

Disciplinary Literacy

Strategy Used: Collaborative Grouping, Table Talk, Gallery Walk

Computational Thinking

Tools:

Engineering Design

Cornerstone(s) Addressed:

- Pattern Recognition: Students will find patterns in the design elements.
- Algorithmic Design: Students will develop algorithms for calculating dimensions and cost analyses.
- Abstraction: Students will need to ignore information they do not need for their design.

Lesson Plan

Time required: One 70-minute class period

Focus Question(s): How might you design a bookcase given various requirements and parameters?

Disciplinary Vocabulary: fraction, whole number, operations, dimensions (length, width, height)

Materials needed:

- Chart Paper
- Design Sheet Handout
- Cost List Handout
- Post-it Notes (several per group)
- Measuring tapes
- Rulers
- Yardsticks
- Calculators
- Shelving board 1" x 12" x any length – for an example
- 12"x10" binder and 15"x15" book (if available) for reference
- Cardboard and cardboard boxes (any size) for prototypes if needed
- Tape

Engage

Students should be in collaborative groups of 3 - 4.

Ask: (Present the situation to be resolved) "The media center in Very-Fine School is currently being remodeled. The new design has created a recessed space in one wall that will require a

custom-built bookshelf. This bookshelf must meet specific design parameters AND use approved materials to help minimize cost and waste. As you think about designing a custom-built bookshelf for this space, what questions do you have?"

Students should compile a list of questions to acquire the information they need to create the design. Students will do a table talk to determine and record their questions then share with the whole group. The teacher may make any clarifications needed.

Distribute the [Design Sheet](#) handout and the [Materials Price List](#) handout to groups of students. These handouts may answer many of the questions designed by students.

Imagine: Students should brainstorm or imagine the appearance of the bookshelf (the design). What is important to keep in mind? What materials might be used in the design? What shape might it become?

Explore

Plan: Students must demonstrate a plan before they start creating specifics. A sketch should be made of the design before any measurements or design is created on chart paper. The sketch may be on a sheet of scratch paper or copy paper. The students should share their design sketch with the teacher for questions, clarifications, and approval. Students may use sample building materials to plan.

Create: Students must use mathematical thinking and tools to create the specifics of their design. The specifics should include measurements, materials, costs, etc. The specifics of their design should be determined and recorded to create a blueprint (final design). The blueprint includes the design sketch (the overall appearance from the Plan phase), specific measurements, necessary materials and a cost analysis. The blueprint should be recorded on chart paper.

Explain

The chart paper posters/blueprints will explain each design. Students will display their group's blueprint charts on the wall. Students will participate in a gallery walk to examine each design and its materials/cost analysis. Students should note similarities and differences of the various designs. Students should write any questions or comments (feedback) they have on post-it notes and leave them on the appropriate blueprint chart for group members to consider.

Students will return to their own design poster and discuss any similarities and differences they noted during the gallery walk. They should also discuss any comments or questions left by other groups.

Elaborate

Improve: Students should be given the opportunity to make any improvements/changes to their design. They may note those improvement/changes on their blueprint posters or redo the work on a separate chart. This choice will depend on the number of improvements they want to make and/or the complexity of the original blueprint.

Evaluate

The teacher will review the blueprints/designs for accuracy of content and analysis of thinking. The teacher will grade the designs based on accuracy and analysis (thinking).

Assessment Notes: There is no one right solution. Students should be awarded points/grades for accurate work as well as for justifications of the criteria for their design. Accurate work includes the measurements and dimensions, and the cost analysis based on materials. This could be used as a formative assessment leading to class discussion and reteaching or enrichment opportunities for students prior to a summative assessment.

Teacher Biographical Information

Margaret Lorimer

B. S. Elementary Education

M.Ed. Administration and Supervision

After teaching mathematics for many years, Margaret is currently an Education Specialist with S²TEM Centers SC since 2003.

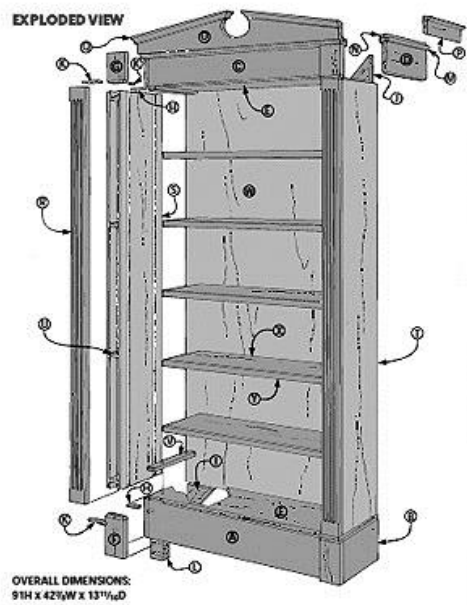
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Dana Thompson

B. S. Mathematics

M.Ed. Administration and Supervision

After teaching mathematics for many years, Dana is currently a Regional Coordinator with S²TEM Centers SC/SCCMS since 2002.



Design a Bookshelf

Create a blueprint for a bookshelf that meets the following conditions:

- Must fit in a recessed area that is 18 inches deep and 4 ½ feet wide and 10 feet tall (floor to ceiling)
- Must have at least 5 shelves
- At least 2 shelves must be tall enough for standard sized binders (12" x 10")
- At least 1 shelf must be tall enough for large picture books (15" x 15")

Choose materials which help minimize cost and waste.

Design a Bookshelf – Approved Materials Price List

shelving board	
1 in. x 12 in. x 4 feet	\$10.75
1 in. x 12 in. x 8 feet	\$19.84
1 in. x 12 in. x 10 feet	\$29.95
1 in. x 12 in. x 12 feet	\$31.84

finish nails	
1 lb. box of 2 in. nails	\$3.47

finishing	
16 oz. painter's putty	\$5.48
1 qt. oil-based stain	\$7.77
1 qt. quick dry poly	\$10.77