

**UM PRINTABLES**

PREMIUM EDUCATIONAL RESOURCES

GRADE 7 MATH · PROJECT-BASED LEARNING UNIT

Scale Drawings PBL

Design Your Dream Bedroom

A 5-Day Blueprint Project for CCSS 7.G.A.1

- 12-Page Student Project Packet
- 20-Item Editable Furniture Catalog
- 3 Differentiated Grid Papers (1 in, 1/2 in, 1/4 in = 1 ft)
- 4-Criterion Analytic Rubric
- Complete Solutions + Sample Exemplars
- 5-Day Teacher Pacing Guide

STANDARD 7.G.A.1 · Solve problems involving scale drawings of geometric figures

I can explain what a scale drawing is and identify the scale of a drawing using ratio language (e.g., "1/2 inch represents 1 foot").

I can compute actual lengths from a scale drawing by setting up and solving a proportion.

I can convert real-world furniture dimensions into scaled drawing dimensions for a chosen scale.

I can reproduce a scale drawing at a different scale and explain how both the linear dimensions and the area of the drawing change.

I can compute the actual area of a room and of furniture footprints from a scale drawing.

I can use area calculations to estimate real-world costs (paint, flooring) and defend my design choices mathematically.

Essential Question & Driving Question

Essential Question

How do mathematicians, designers, and builders use proportional reasoning to represent very large (or very small) things on a manageable piece of paper — and why does precision matter?

Driving Question (posted for students)

How can you design a dream bedroom that fits your furniture, looks great, and stays within a realistic budget — and prove with math that your blueprint will work in real life?

Formative Assessment Opportunities

This unit is designed so that assessment happens *during* learning, not just at the end. Each day includes at least one embedded formative check. Use these to adjust pacing and group students for the next day's work.

Day	Formative Check	What to Look For
1	Exit ticket: "Name one place you see scale drawings outside school."	Students use scale vocabulary (ratio, actual, drawing). If they say "maps" only, plan to show more examples on Day 2.
2	Partner check on conversion chart (Packet Page 5).	Units written on every measurement. Arithmetic correct. Watch for students multiplying when they should divide (or vice versa).
3	Pre- and post-drawing self-checklists (Packet Page 7).	Every rectangle labeled with name AND dimensions. Scale written and circled. Door clearance ≥ 1 ft.
4	Area ratio analysis (Packet Page 9).	Students correctly identify k^2 (not k) as the area factor. If a student writes $1/2$ instead of $1/4$, pull them for a 3-minute small-group reteach.
5	Gallery walk + presentation scoring with rubric.	Student can explain ONE conversion aloud and defend their cost total. Use the rubric scoring notes in the Solutions section.

Core Materials	Optional / Extension Materials
Pencils with erasers, colored pencils or thin markers for furniture	Timer displayed on the board for mini-lesson vs. work time transitions
Real architectural blueprints (optional but powerful — ask a local architect, contractor, or your district facilities office)	Folder or pocket for each student to store packet, grid paper, and catalog across the 5 days
Computer/projector with Google Maps access (satellite view with the measure-distance tool)	Backup copies of the catalog and grid paper (students WILL need to re-do)
Calculators (one per student — basic four-function is sufficient)	A printed classroom poster of the rubric criteria for daily reference
Optional: painter's tape to mark a 12 ft × 14 ft rectangle on the classroom floor for a kinesthetic sense of room size	Optional: invite a local architect, contractor, or interior designer as a guest speaker for Day 1

- Provide sentence frames: "The scale of my drawing is ____, which means every 1 foot in real life equals ____ on paper."
- Pair ELL students with bilingual peers when possible; the catalog images make the project accessible without heavy text.
- Allow students to label furniture in their home language with an English translation alongside.

Ready-to-Use Sentence Frames for Students

Post these frames on chart paper or project them during work time. They give every student — especially ELLs and struggling writers — the academic language they need to explain their math.

When...	Student Says...
Stating the scale	"The scale of my drawing is ____ (e.g., 1/2 inch = 1 foot). This means every 1 foot in real life is shown as ____ on my paper."
Converting actual → drawing	"The real bed is 6.25 feet long. To draw it, I multiply 6.25 by the scale factor 1/2, so I draw a rectangle ____ inches long."
Converting drawing → actual	"On my paper the dresser is 2.25 inches long. Since each 1/2 inch stands for 1 foot, the real dresser is $2.25 \div 0.5 =$ ____ feet long."
Explaining area change	"When I reproduced my drawing at the new scale, every length became half as long. Because area is length times width, the new area is one ____ of the old area."
Defending a cost calculation	"My paintable wall area is ____ square feet. One gallon covers 400 square feet, so I need $\text{ceil}(\text{____} \div 400) =$ ____ gallons. At \$35 per gallon, the paint costs \$____."

Technology Integration Ideas

These free tools can extend the project for tech-ready classrooms:

Tool	How to Use It
Google Maps (satellite + measure)	Measure real buildings or sports fields. Have students compute the scale of the satellite image by comparing a measured length to the on-screen length.
Floorplanner.com (free tier)	Students recreate their 2-D blueprint in a drag-and-drop 2-D/3-D tool and take a virtual room tour.
PhET Interactive Simulations	Use the "Ratio and Proportion" or "Area Builder" sims for a 10-minute warm-up before Day 3.
Google Slides / PowerPoint	Students photograph their grid paper, insert into a slide, and record a 60-second voiceover explaining one conversion for the presentation.

DAY 1 · PROJECT PACKET PAGE 2 OF 12

Scale Drawings in the Real World

Today's goal: Understand what a scale drawing is, see how professionals use them, and learn the language of scale. By the end of class you should be able to look at any scaled picture and say, "The scale of this drawing is _____, which means every 1 unit on the page stands for _____ units in real life."

Warm-Up: Where Have You Seen Scale Drawings?

Before your teacher explains anything, brainstorm with your table: list as many places as you can think of where someone uses a smaller (or larger) picture to represent a real thing. Think about maps, toys, models, video games, building plans, science diagrams — anywhere a picture is NOT the actual size of the real object.

Our class brainstorm list:

Mini-Lesson: The Vocabulary of Scale

Copy each term into your own words. Your teacher will discuss each one. You will use this vocabulary every day for the rest of the project, so do not skip it.

Term	What It Means	Example
Scale drawing	A drawing where every length is multiplied by the same number (the scale factor) so the picture is a smaller or larger copy of the real object.	A map of your town; a floor plan of a house.
Scale	A ratio that compares a length on the drawing to the actual length it represents. Often written with different units.	1 inch = 1 foot, or 1/2 in : 1 ft.
Scale factor	The single number you multiply every actual length by to get the drawing length (or vice versa). Always written with the SAME units.	If 1 in = 1 ft, then scale factor = 1 in / 12 in = 1/12.
Blueprint	A detailed scale drawing used in construction and engineering. Traditionally printed on blue paper with white lines.	The floor plan your contractor uses to build a house.
Dimension	A measurement of length in one direction (length, width, height). A rectangle has two dimensions.	A twin bed's dimensions: 6.25 ft by 3 ft.

Real-World Investigation: Architectural Blueprints

Your teacher will display (or hand out) a real architectural blueprint. With your partner, find the answers to these questions. If you have a projector, also open Google Maps, switch to *satellite view*, and use the measure-distance tool to find the actual length of a building you can see in the satellite image.

DAY 1 (CONTINUED) · PROJECT PACKET PAGE 3 OF 12

Scale, Scale Factor & Worked Examples

Now that you have seen real scale drawings, let's pin down the math. A scale drawing is just a proportional relationship: every length on the drawing is the same fraction of the real length. That fraction is the **scale factor**.

What a Scale Drawing Means

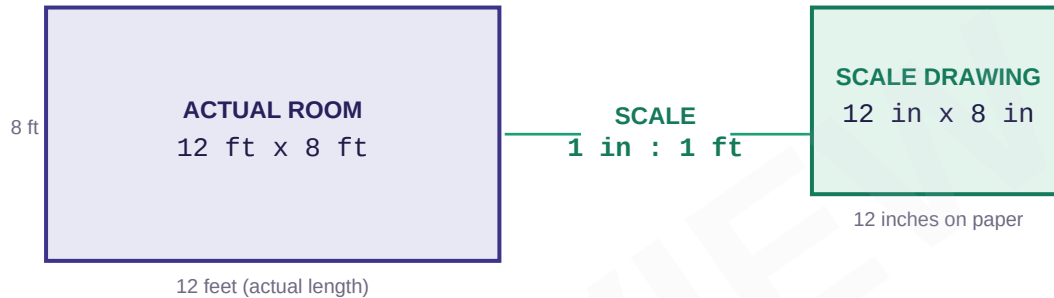


Figure 1. A scale drawing uses one consistent multiplier to shrink (or enlarge) every actual length.

Scale Factor: The Multiplier Between Drawing and Actual

$$\text{Scale Factor} = \frac{\text{Drawing length}}{\text{Actual length}}$$

Example: 1 inch on paper = 1 foot in real life → Scale factor = $1/12$

Figure 2. The scale factor is a ratio with matching units on top and bottom.

Worked Example: Reading a Scale

A drawing has the scale **1/2 inch = 1 foot**. The drawing shows a rectangle that is **3 inches long**. How long is the real object?

Step 1 — Understand the scale. Every 1/2 inch on the page stands for 1 foot in real life. Equivalently, every 1 inch on the page stands for 2 feet in real life (because $1 \div 1/2 = 2$).

Step 2 — Set up a proportion. Let L be the real length in feet. Then (drawing inches) / (actual feet) = $(1/2) / 1 = 1/2$. So $3 / L = 1/2$.

Step 3 — Solve. Cross-multiply: $1 \cdot L = 3 \cdot 2$, so $L = 6$ feet. The real object is **6 feet long**.

Step 4 — Check with common sense. 3 inches on the page, each inch = 2 feet, so $3 \times 2 = 6$ feet. The answer matches.

Worked Example: Drawing a Real Object to Scale

DAY 2 · PROJECT PACKET PAGE 4 OF 12

Measure & Select Your Furniture

Today's goal: Choose 6–10 furniture items from the catalog for your dream bedroom, and convert each item's actual dimensions into the dimensions you will draw on your grid paper. You must record every measurement with units — inches, feet, or both.

Step 1: Pick Your Room Size

Before you can pick furniture, you need a room. Pick ONE of the following bedroom sizes. Your teacher may assign one based on your scale tier. All three are realistic bedroom sizes.

Option	Room Dimensions	Area	Good For
A — Compact	10 ft × 10 ft	100 sq ft	Smaller rooms; easier fitting; modified tier friendly.
B — Standard	12 ft × 12 ft	144 sq ft	Most kids' bedrooms; balanced challenge.
C — Spacious	12 ft × 14 ft	168 sq ft	Bigger rooms; more furniture options; challenge tier friendly.

My room choice: A B C **My room is** _____ ft by _____ ft. **Area =** _____ sq ft.

Step 2: Browse the Furniture Catalog

Your teacher has given you the furniture catalog (a separate handout). Each item lists its **actual length** and **actual width** in feet. Pick between 6 and 10 items — remember, your room has limited space. Every item must physically fit. Use the empty selection chart below to record your picks. The first row is filled in for you as an example.

Step 3: Selection Chart

#	Furniture Item	Actual L × W (ft)	Actual Area (sq ft)	My Scale	Scaled L × W (in)
EX	Twin Bed (from catalog)	6.25 × 3	18.75	$\frac{1}{2} \text{ in} = 1 \text{ ft}$	3.125 × 1.5
1					
2					
3					
4					
5					
6					
7					
8					

Sample Bedroom Blueprint (Scale: 1/2 in = 1 ft)

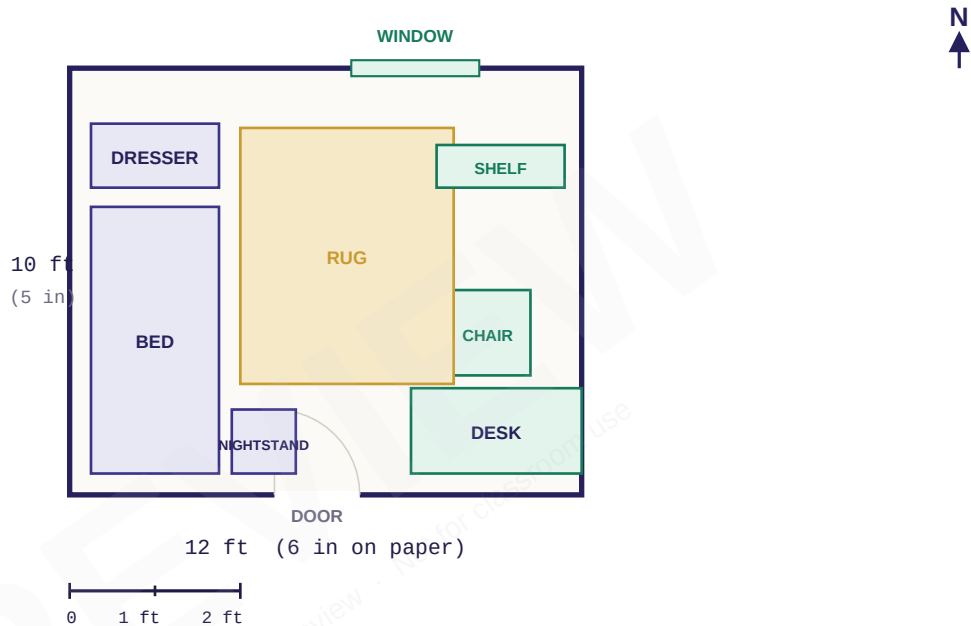


Figure 4. A model scale drawing showing room walls, door swing, window, labeled furniture, dimension labels, and a scale bar. Use this as your style guide.

My Layout Plan

Furniture	Wall it sits against	Distance from corner (ft)

Pro Designer Tips from Real Architects

- 1. Start with the bed.** The bed is usually the biggest furniture item. Place it first, against the longest wall that is not the door wall.
- 2. Anchor with a rug.** A rug "anchors" the room visually. Place it so the front legs of the bed (or the front of your main seating) sit on it.
- 3. Keep walkways clear.** Leave at least 2 ft of walking space between any two pieces of furniture. You should be able to walk from the door to every part of the room without dodging obstacles.
- 4. Group by function.** Desk + chair = study zone. Bed + nightstand = sleep zone. Keep zones separate so the room feels organized.
- 5. Measure twice, draw once.** Real carpenters say this for a reason. Check every measurement against your Day 2 chart before you commit it to paper.

DAY 4 (CONTINUED) · PROJECT PACKET PAGE 9 OF 12

Area Change Analysis

Yesterday you saw that every LENGTH on the new drawing is half as long. But what about the AREA of the drawing? Is the new drawing's area also half? Let's find out.

Area Changes With the Square of the Scale Factor

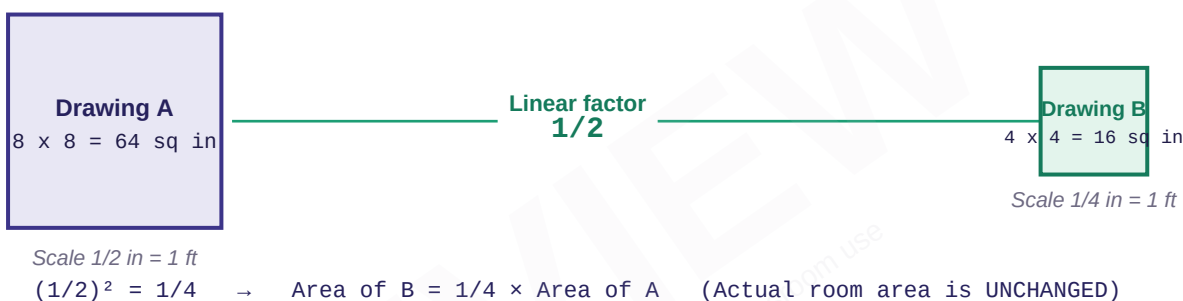


Figure 5. When the linear scale factor is $1/2$, the area scale factor is $(1/2)^2 = 1/4$.

Why Does Area Change Differently?

Area is a two-dimensional measurement — it has both length and width. If you halve the length AND halve the width, you have halved the area TWICE: once for each direction. Halving twice means multiplying by $1/2$ and then by $1/2$ again, which gives $1/4$. This is the same reason the area of a square grows as the SQUARE of its side length.

Key Formula

If the linear scale factor between two drawings is k , then the area scale factor is k^2 . Example: $k = 1/2 \rightarrow k^2 = 1/4$. The new drawing's area is $1/4$ of the old drawing's area.

Compute the Areas

Use your Day 3 and Day 4 drawings to fill in this chart. Show your work.

What	Old Drawing (Day 3)	New Drawing (Day 4)	Ratio (New ÷ Old)
Room dimensions on paper (in)	____ × ____	____ × ____	____
Room AREA on paper (sq in)	____	____	____
Bed dimensions on paper (in)	____ × ____	____ × ____	____
Bed AREA on paper (sq in)	____	____	____
One more furniture area (sq in)	____	____	____

DAY 5 · PROJECT PACKET PAGE 10 OF 12

Cost Calculator: Paint & Flooring

Today's goal: Use your scale drawing to figure out how much it would cost to actually build out your dream bedroom. You will compute the cost of (1) painting the walls and (2) installing flooring. Then you will add a few furniture prices to estimate the total.

Part A: Wall Paint Cost

To find how much paint you need, you must find the **area of the walls**, not the area of the floor. The walls form a band around the room. The formula is:

Wall Area Formula

Wall area = perimeter × ceiling height – (area of doors and windows)

Perimeter = $2 \times (\text{length} + \text{width})$. Standard ceiling height = 8 ft. Standard door = $3 \text{ ft} \times 7 \text{ ft} = 21 \text{ sq ft}$. Standard window = $3 \text{ ft} \times 4 \text{ ft} = 12 \text{ sq ft}$.

Step 1 — Perimeter. My room is _____ ft by _____ ft. Perimeter = $2 \times (\text{_____} + \text{_____}) = \text{_____}$ ft.

Step 2 — Wall area before openings. Wall area = perimeter × ceiling height = _____ × 8 = _____ sq ft.

Step 3 — Subtract openings. I have _____ door(s) and _____ window(s). Openings area = _____ × 21 + _____ × 12 = _____ sq ft.

Step 4 — Paintable wall area. Wall area – openings = _____ – _____ = _____ sq ft.

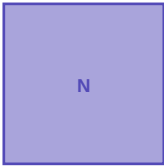
Paint Option	Coverage per Gallon	Price per Gallon	Gallons Needed	Cost
Budget latex	400 sq ft	\$28		
Premium latex (my pick: _____)	400 sq ft	\$35		
Designer finish	350 sq ft	\$52		

Math tip: Gallons needed = paintable wall area ÷ coverage per gallon. Always ROUND UP — you cannot buy a partial gallon of paint at the store.

Part B: Flooring Cost

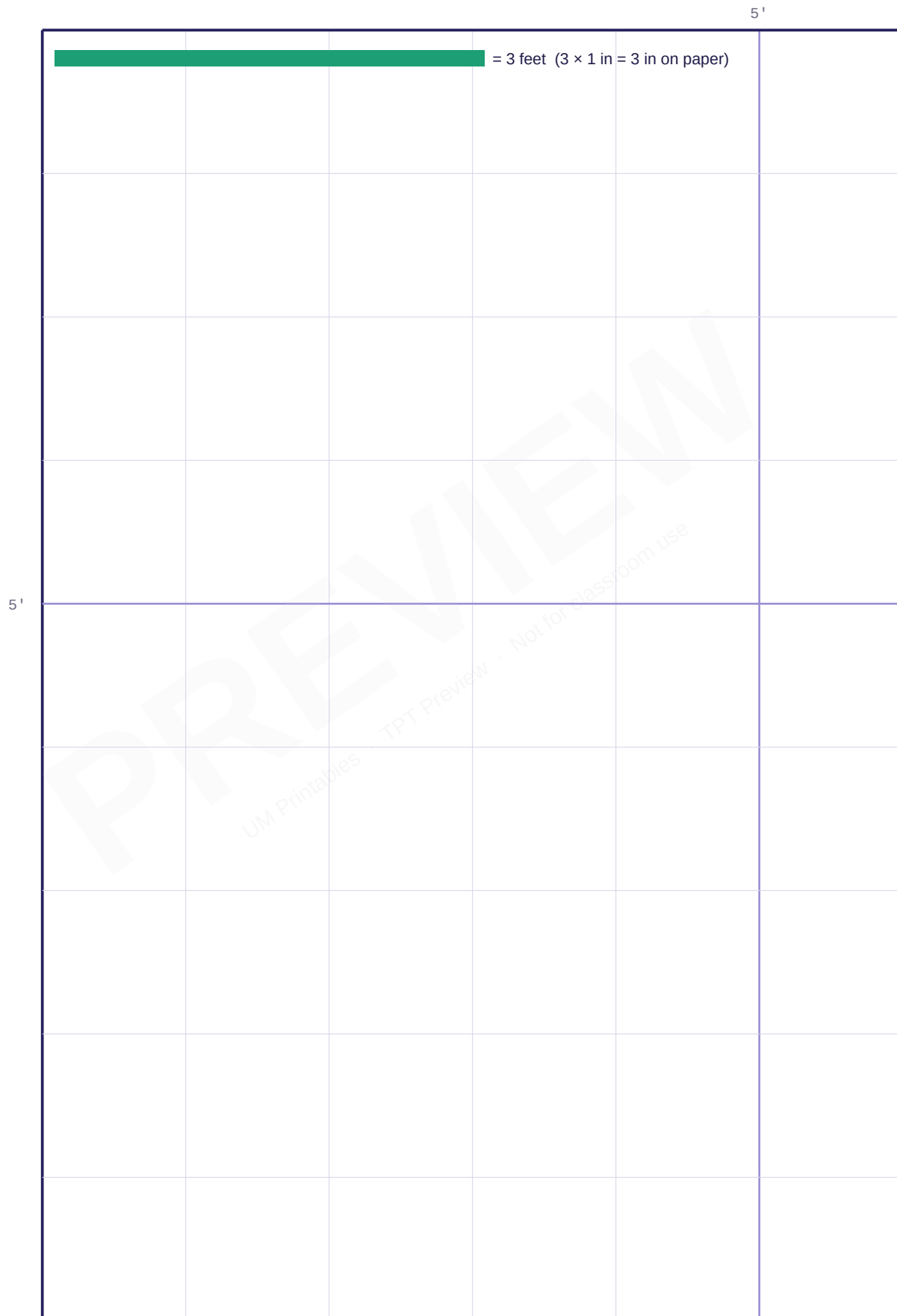
The flooring covers the entire floor (room area). Pick one flooring type and compute.

Flooring Option	Price per sq ft	Room Area (sq ft)	Cost
Laminate plank	\$2.50		
Hardwood (oak)	\$7.25		
Carpet (with pad)	\$3.75		
Luxury vinyl tile	\$4.10		

#	Item	Top-View Icon	Length (ft)	Width (ft)	Area (sq ft)	Typical Use
7	Dresser (Tall)		3	1.5	4.5	Folded clothes; takes little wall.
8	Dresser (Wide)		4.5	1.5	6.75	Folded clothes + TV on top.
9	Nightstand		1.5	1.5	2.25	Beside the bed; lamp, phone, book.
10	Bookshelf		3	1	3	Books, trophies, bins; fits a corner.

How to Use This Catalog

Choose 6–10 items for your dream bedroom. Record each item's **actual length** and **actual width** in your Day 2 selection chart (Packet Page 4). Then convert each dimension to your scale using the routine on Packet Page 3. The area column helps you check that your furniture will fit in your room area.



Total Score	Letter Grade	Descriptor
90–100	A	Exemplary — student demonstrates mastery of 7.G.A.1.
80–89	B	Proficient — student meets the standard.
70–79	C	Developing — student is approaching the standard with support.
60–69	D	Emerging — student needs significant re-teaching.
Below 60	F	Not yet — schedule a conference and re-do key sections.

Score Recording Sheet

Student Name	Scale Acc. (25)	Calc. (25)	Design (25)	Pres. (25)	Total (100)	Grade

Option	Price/sq ft	Room Area	Cost
Hardwood (oak)	\$7.25	144 sq ft	$144 \times \$7.25 = \$1,044$
Carpet (with pad)	\$3.75	144 sq ft	$144 \times \$3.75 = \$540$
Luxury vinyl tile	\$4.10	144 sq ft	$144 \times \$4.10 = \$590.40$

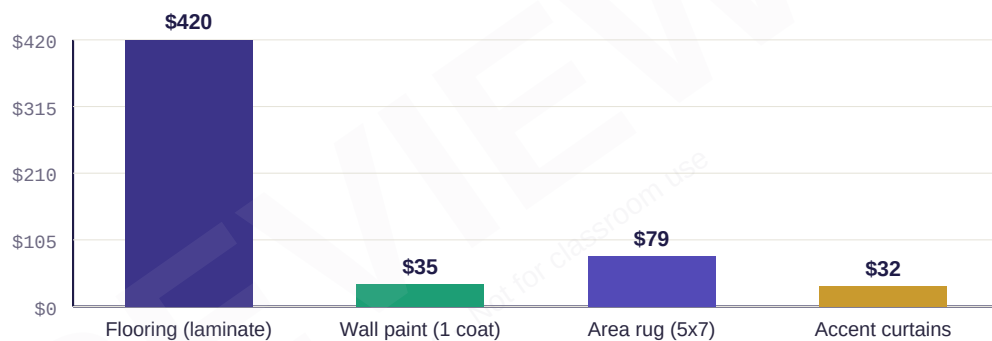
Part C — Sample totals (Premium paint + Laminate flooring):*Paint = \$35**Flooring = \$360**Total room cost = \$35 + \$360 = \$395***Sample Cost Breakdown (12 ft x 14 ft Bedroom)**

Figure 6. Cost breakdown for a sample 12 ft x 14 ft bedroom with premium paint (\$35), laminate flooring (\$420), a 5x7 rug (\$79), and accent curtains (\$32).

Exemplar 2: Jordan's Dream Bedroom (12 ft × 14 ft, Challenge Scale)

Jordan is a 7th grader working at the Challenge tier. His room is 12 ft × 14 ft (area = 168 sq ft) and his scale is 1/4 in = 1 ft. He chose 9 furniture items, including a loft bed to create extra floor space. His work below shows the challenge-tier math with quarter-inch precision.

#	Item	Actual (ft)	Area (sq ft)	Scaled (in) at 1/4 in = 1 ft
1	Loft Bed	6.5 × 3.5	22.75	1.625 × 0.875
2	Desk (under loft)	4 × 2	8	1 × 0.5
3	Desk Chair	2 × 2	4	0.5 × 0.5
4	Dresser (Wide)	4.5 × 1.5	6.75	1.125 × 0.375
5	Wardrobe	3 × 2	6	0.75 × 0.5
6	Area Rug (Large)	8 × 10	80	2 × 2.5
7	Armchair	2.5 × 2.5	6.25	0.625 × 0.625
8	TV / Media Stand	4 × 1.5	6	1 × 0.375
9	Bookshelf	3 × 1	3	0.75 × 0.25
	TOTAL FOOTPRINT	—	142.75	—

Open floor check: Room area 168 sq ft – furniture footprint 142.75 sq ft = **25.25 sq ft of open floor** (about 15% of the room is open). Note: the large rug (80 sq ft) overlaps visually with other furniture, so the ACTUAL open floor (not on the rug) is larger. This is a realistic design choice — rug area is not "covered" in the same sense as a dresser.

Loft-bed bonus: Because the desk and chair tuck UNDER the loft bed, Jordan's design "reuses" the floor space under the bed. In real life, the loft bed's footprint (22.75 sq ft) is shared with the desk (8 sq ft) and chair (4 sq ft). A sophisticated student like Jordan might note this in the presentation as a design advantage.

Jordan's Day 4 Reproduction (1/8 in = 1 ft)

Linear factor from old to new scale: $(1/8) \div (1/4) = 1/2$. Same as Exemplar 1 — every length halves, every area becomes 1/4.

Quantity	Old (1/4 in = 1 ft)	New (1/8 in = 1 ft)	Ratio
Room dimensions on paper	3 in × 3.5 in	1.5 in × 1.75 in	1/2
Room area on paper	10.5 sq in	2.625 sq in	1/4
Loft Bed area on paper	1.625 × 0.875 = 1.421875 sq in	0.8125 × 0.4375 = 0.35546875 sq in	1/4

Check: $10.5 \times 1/4 = 2.625$ sq in. $1.421875 \times 1/4 = 0.35546875$ sq in.

Jordan's Day 5 cost: Perimeter = $2 \times (12 + 14) = 52$ ft. Wall area = $52 \times 8 = 416$ sq ft. Openings (1 door + 2 windows) = $21 + 24 = 45$ sq ft. Paintable = $416 - 45 = 371$ sq ft. Designer paint: $\text{ceil}(371 \div 350) = 2$ gallons × \$52 = **\$104**. Hardwood flooring: $168 \text{ sq ft} \times \$7.25 = \$1,218$. **Total = \$104 + \$1,218 = \$1,322.**

WHAT'S INSIDE THE FULL RESOURCE?

Scale Drawings PBL - Design Your Dream Bedroom

54-page Grade 7 math project-based learning unit | CCSS 7.G.A.1

01**12 Student Packet Pages**

A 5-day project packet with scale vocabulary, worked examples, furniture selection, drawing plans, area analysis, cost calculations, reflections, and peer feedback.

02**20-Item Furniture Catalog**

A classroom-ready catalog of furniture items with actual length, width, area, top-view icons, and typical-use notes for choosing 6-10 items.

03**4 Differentiated Grid Papers**

Four printable grid-paper versions: Modified (1 in = 1 ft), On-Level (1/2 in = 1 ft), Challenge (1/4 in = 1 ft), and Challenge+ (1/8 in = 1 ft).

04**Analytic Rubric + Score Sheet**

A 4-criterion analytic rubric covering Scale Accuracy, Calculations, Design Quality, and Presentation, with a 100-point score recording sheet.

05**Complete Solutions + 2 Exemplars**

Teacher solutions and worked guidance for the main packet calculations, plus fully worked Maya and Jordan bedroom exemplars with layouts, areas, scale changes, and costs.

06**Teacher Support Across 5 Days**

Teacher introduction, 5-day pacing guide, materials, formative checks, differentiation and sentence frames, technology ideas, common errors, re-teaching guidance, and family communication template.

MATH FOCUS

Scale drawings, proportional reasoning, scaled dimensions, area change, room area, wall area, and cost calculations.

STANDARD

CCSS 7.G.A.1