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SCALE MODEL BUILDING Student Day Resource Packet

Pre & Post Visit Activities ▪ Vocabulary & Resource Lists ▪ Curriculum Connections

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Before Your Visit :

Prepare your students for their visit with these introductory pre-visit activities.

1	Ensure that students understand how to measure distance and ***area*** by documenting the dimensions of your classroom and calculating the area. Students will be asked to share this information at the Scale Model Building workshop.
2	Introduce the concept of ***scale*** by having students measure and draw themselves at two different scales using the *Scale Practice* sheet provided on Page 4. During the workshop, we will be using a ½" = 1' scale.
3	Designers use ***plan*** (top-view) and ***elevation*** (side-view) drawings to describe three-dimensional spaces and objects. Students will create their own plan and elevation drawings during the workshop. To help them understand how these 2-D drawings work together, have students create a simple ***model*** of a room using the template provided on Page 5. Copy this template onto cardstock, if available. Assemble the template by cutting it out and folding along the dotted lines to create a three-dimensional diagram with the plan on the bottom, elevations on the sides, and a ceiling at the top.

During Your Visit :

The program begins by introducing students to scale drawings as tools for communicating design ideas, from popular products to complex, architectural spaces. Students will learn how to read an architectural floorplan, using a drawing of the space they are in to become familiar with the architectural symbols for doors, windows, walls, etc. Students will also be introduced to elevation (side-view) drawings and how they are used in architecture.

Students will then design their own 300 square foot apartment. As a class, we will estimate and measure possible configurations for this area, noting dimensions needed to create this square footage. Using a ½" scale ruler and graph paper, students will draw their own floorplans to scale. Students will then measure and construct walls with doors and window openings to complete their scale model.

After Your Visit :

Continue the learning by facilitating these suggested extension activities.

1	**Scale Furniture:** Using the ½" scale templates provided on Page 6, students can add furniture to their models. Print this template on cardstock and direct students to finish numbering the scale feet on the ½" scale ruler. Assemble the templates by cutting the solid lines and folding along the dotted lines. Encourage your students to construct their own designs for other furniture and decorative items by drawing these items to scale using the ½" scale ruler.
2	**Real World Math:** Use the *Plan Practice* activity sheet on Page 7 to help students build their architectural literacy. This worksheet demonstrates how scaled drawings can be used for real world applications such as measuring a room, calculating area, and estimating the cost of flooring. Answer sheet on Page 8. As an extension, students can use this activity as an example to create and solve their own word problems based on the drawing and model they created at the Center for Architecture.

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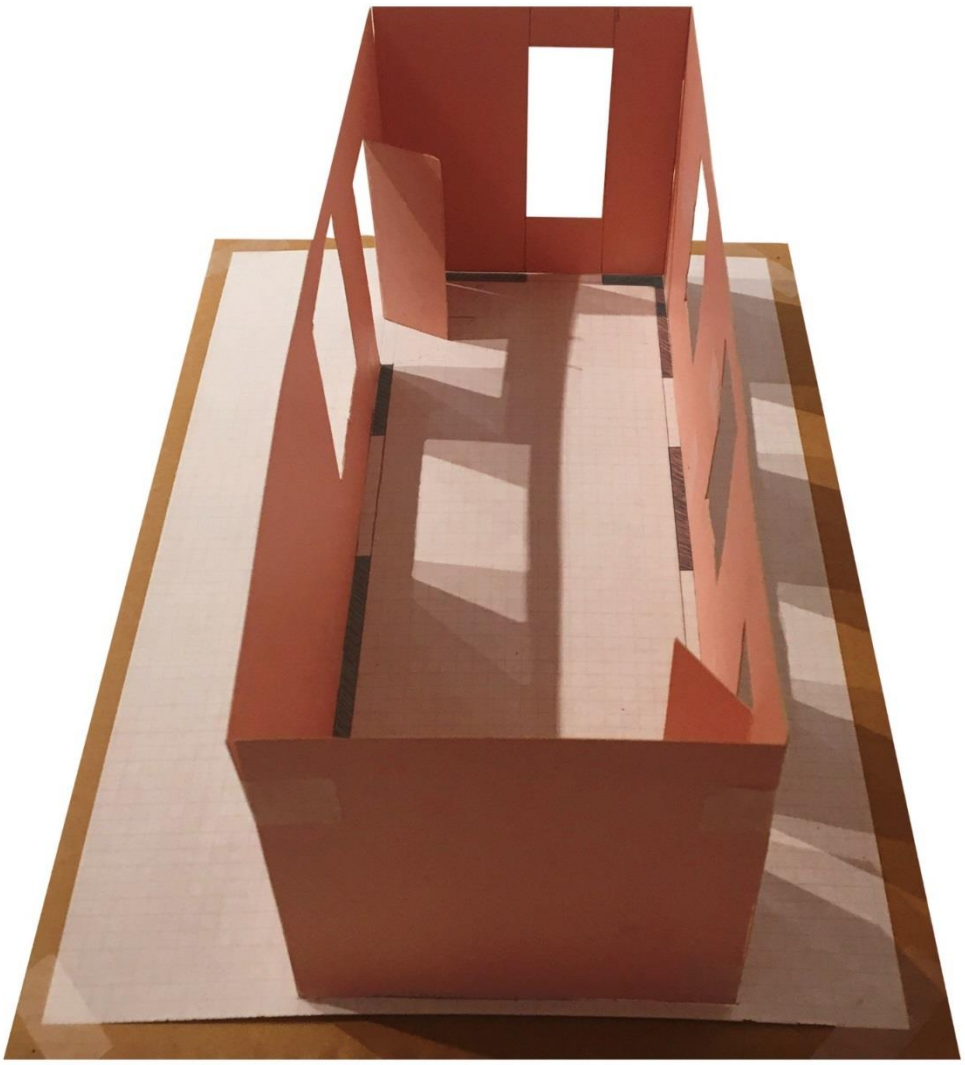
After Your Visit (continued)

3	**Made to Measure:** Students can continue their exploration of ***ratio***, proportion, and scale by completing the *Made to Measure* activity sheet on Page 9. This activity asks students to measure and calculate the ratios inherent in the human body, which were documented by Leonardo da Vinci over 500 years ago.



Student Model from the Scale Model Building Workshop

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Scale Model Building Vocabulary List

Area	The measurement of a surface describing the amount of space within a defined boundary, measured in square units. The area of a rectangular form is measured by multiplying its length by its width.
Elevation	A side-view drawing showing a building or object as viewed from the front, back, or side. This is a two-dimensional, measured drawing and does not show perspective.
Model	A three-dimensional representation of a proposed object, structure, or building used for observation and communication.
Plan	A top-view drawing showing a building and its parts from above. This is a two-dimensional, measured drawing and does not show perspective.
Ratio	The relationship between two amounts, showing the number of times one value contains or is contained by the other.
Scale	The ratio of the size of a model or drawing to the actual size of the object or building it represents.

Additional Resources

Architectural Graphics by Frank Ching

Architecture In Education: A Resource of Imaginative Ideas and Tested Activities by the Center for Architecture, Philadelphia

Architecture Is Elementary: Visual Thinking Through Architectural Concepts by Nathan B. Winters

The Aspiring Architect: An Activity Book for Kids by Travis Kelly Wilson

Buildings: How Homes, Monuments, Cathedrals and Skyscrapers are Built by Alessandro Vignozzi

Math-Kitecture (www.math-kitecture.com) by Charles Bender

Why Design?: Activities And Projects from the National Building Museum by Anna Slafer and Kevin Cahill

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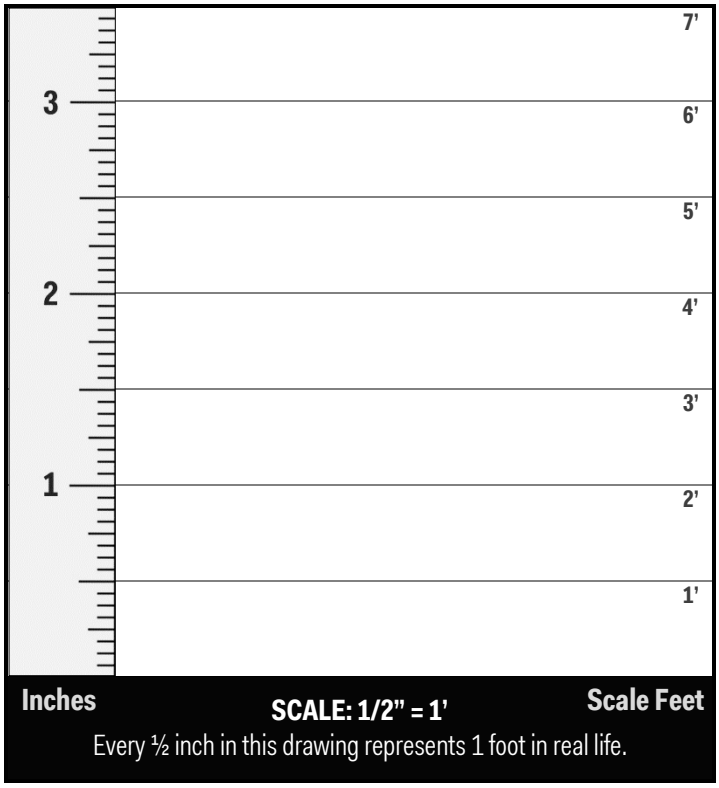
Scale Practice Sheet

Architects and designers change scale to represent things that are either too large to fit on a page or too small to be drawn clearly. It might be helpful to think about this as zooming in or zooming out of a building. Practice this skill by drawing how big or little a person would be in each picture below.

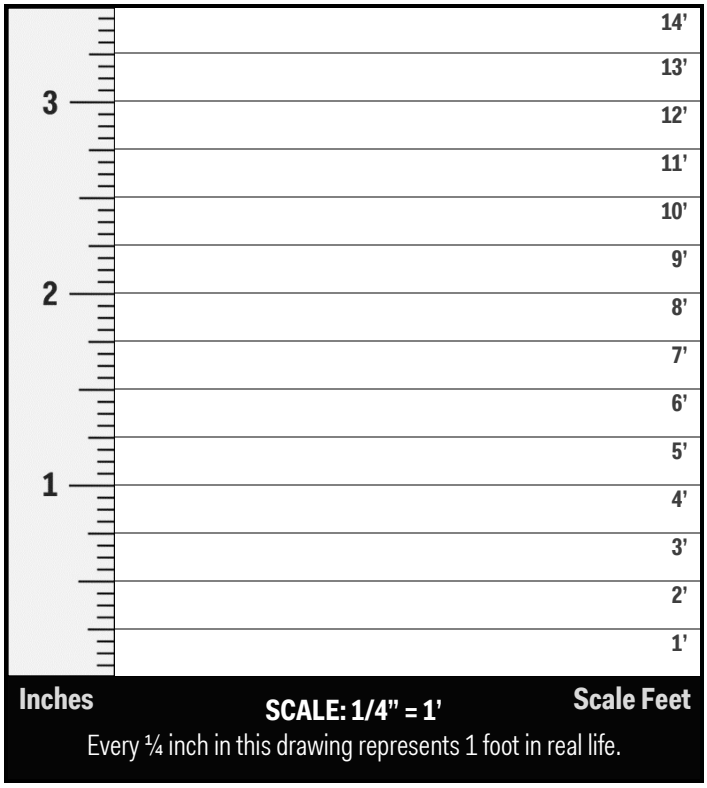
Drawing to Scale

To make a scale drawing, architects need to determine the proportion of their drawing compared to real life. In the drawings below, a foot in real life is shrunk down to ½" and ¼". Measure and draw yourself using these scales below.

Rounded to the nearest foot, my height is: _____ feet.



Every ½ inch in this drawing represents 1 foot in real life.



Every ¼ inch in this drawing represents 1 foot in real life.

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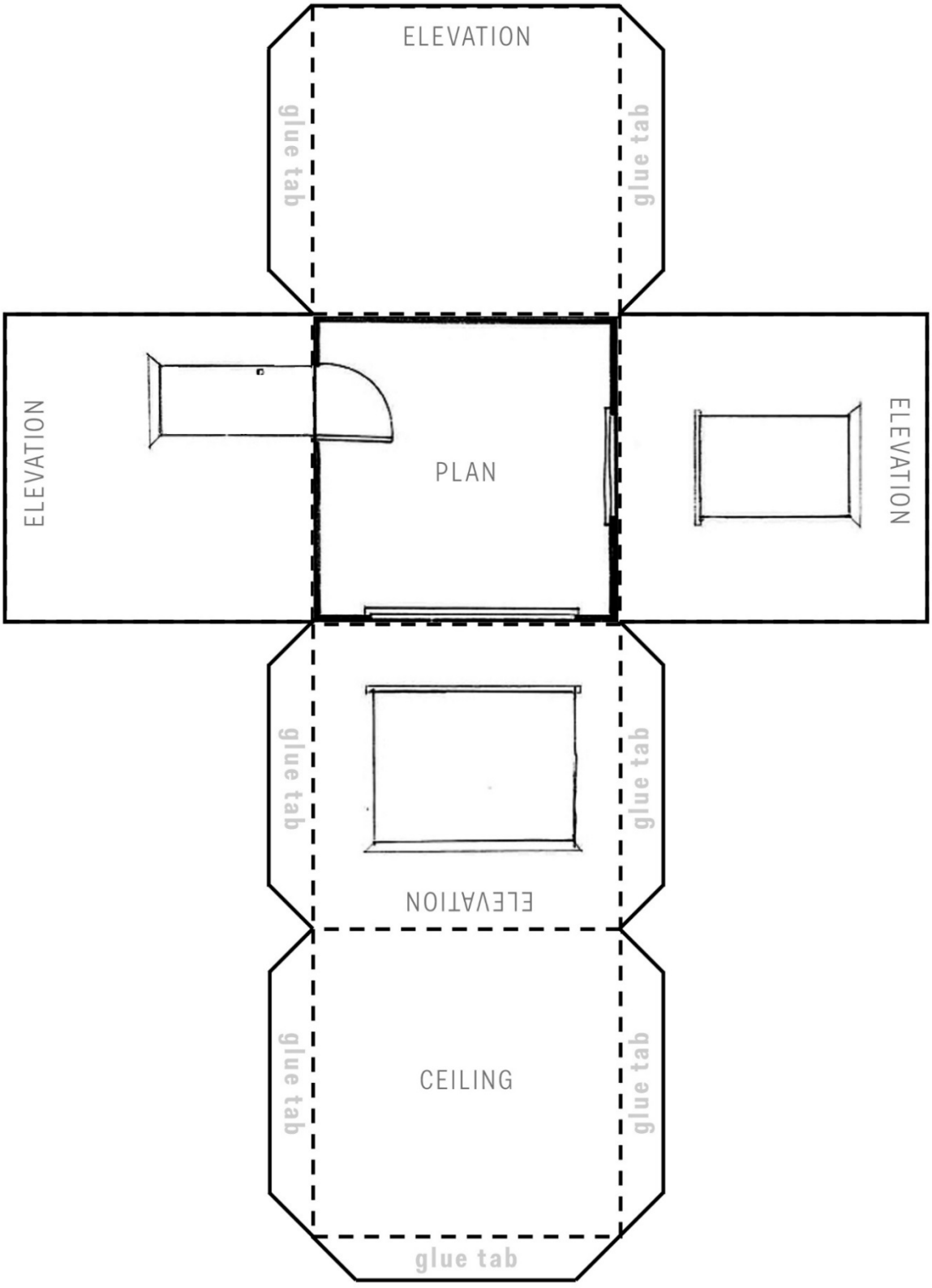
Plan and Elevation Diagram Template

Cut out the template along the solid black lines. Fold along the dotted lines and assemble the cube by gluing the tabs to the adjacent sides. Notice how doors, walls, and windows are drawn differently in plan and in elevation.



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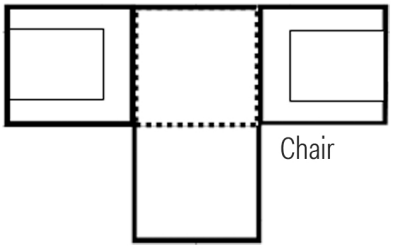
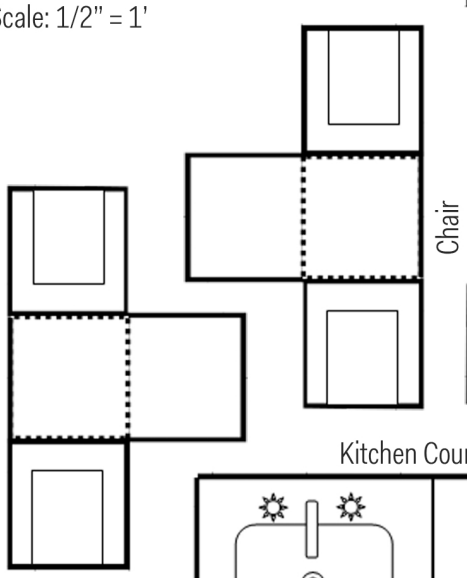
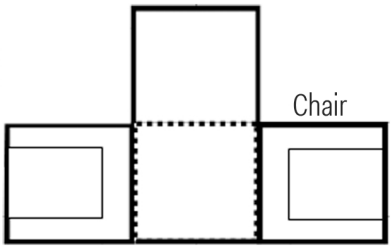
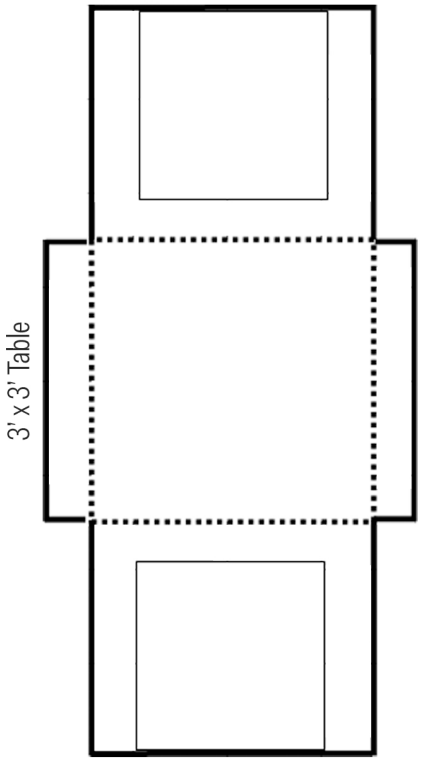
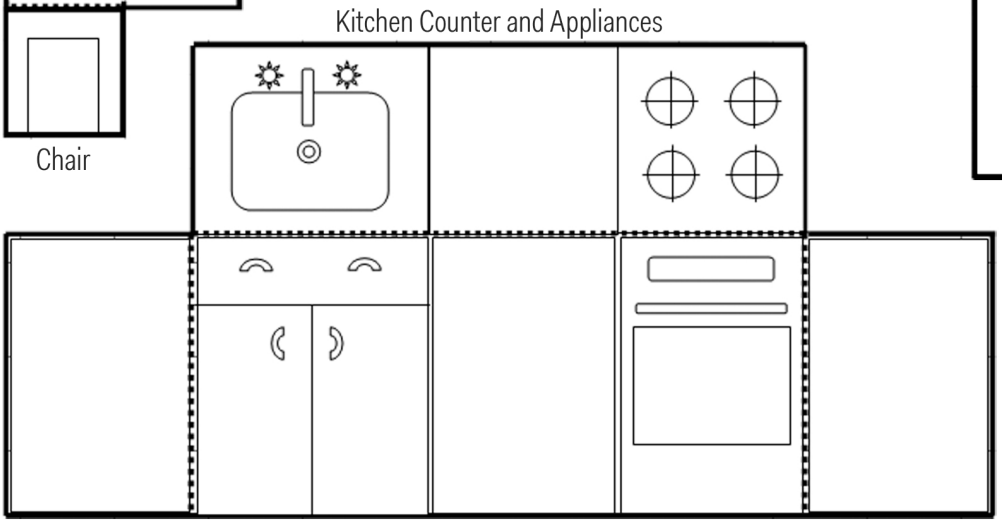
Scale: 1/2" = 1'

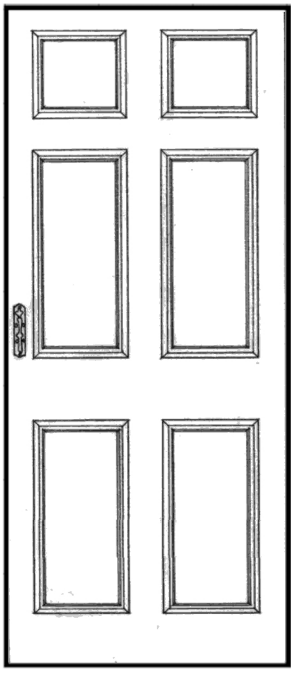


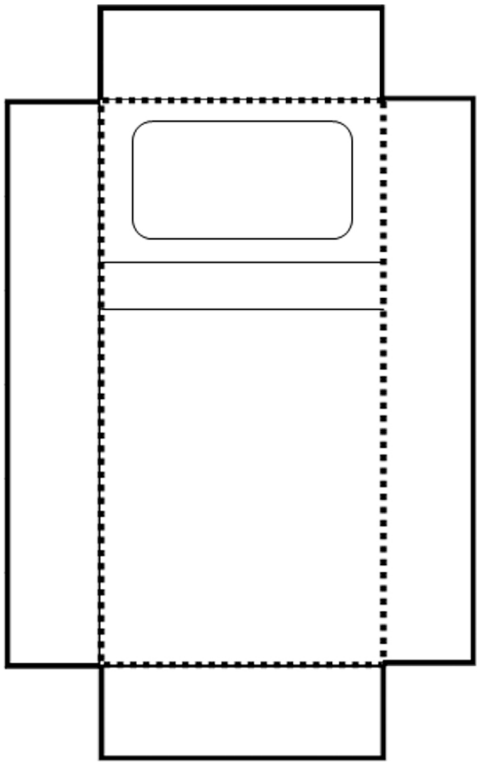


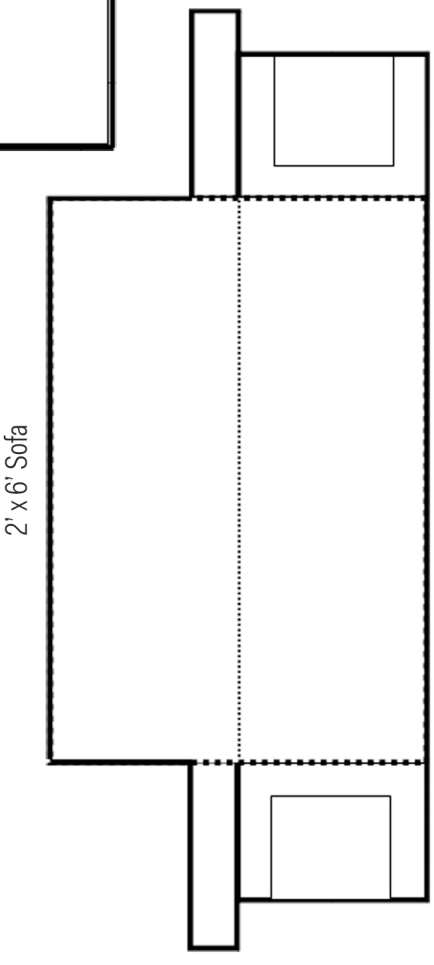












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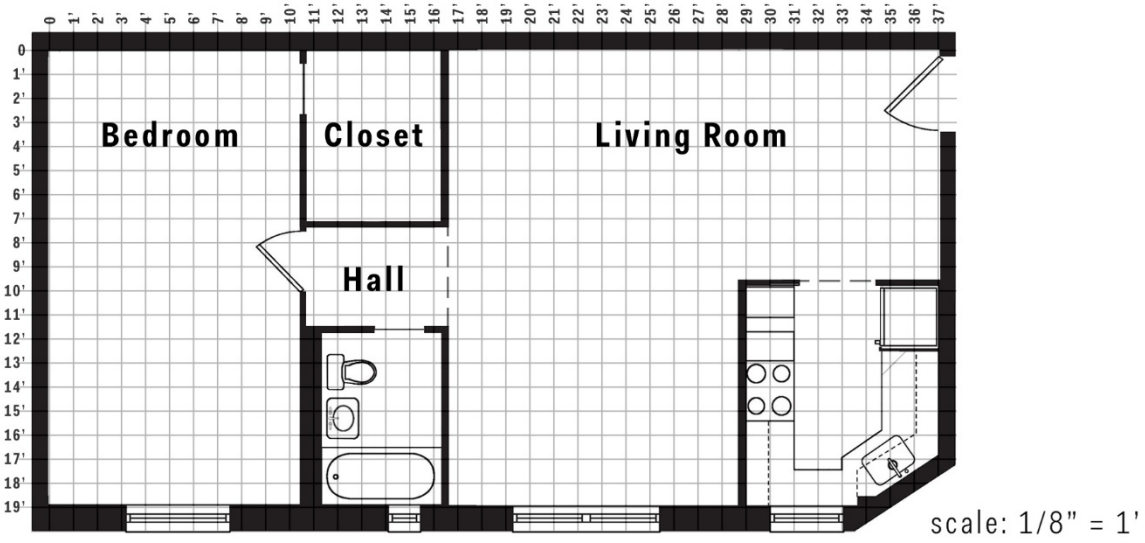
Plan Practice



Calculating Area – Part 1

This floorplan is drawn at a 1/8" = 1' scale. That is, every eighth of an inch in the drawing represents one foot in real life and each box represents one square foot. Use this drawing to calculate the area of each room listed below, rounding dimensions up to the nearest foot.

Bedroom	Closet	Living Room

Applying Square Footage – Part 2

Use your calculations from Part 1 to estimate the cost of flooring for each room if the price of carpeting is $12 per square foot and the price of tiling is $8 per square foot.

Bedroom	Closet	Living Room
Floor Material:	Floor Material:	Floor Material:

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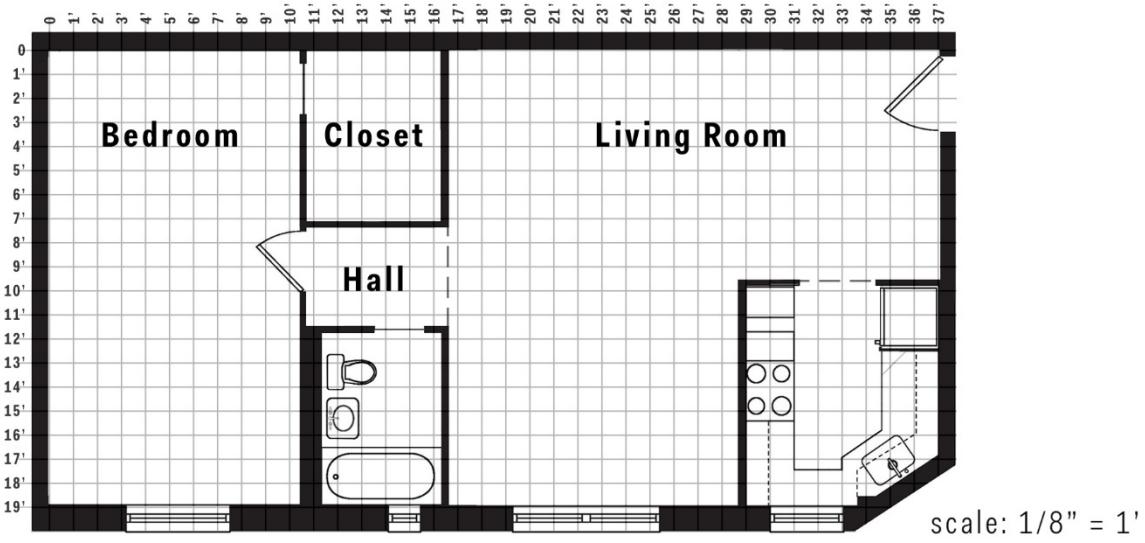
Plan Practice Answer Key



Calculating Area – Part 1

This floorplan is drawn at a 1/8" = 1' scale. That is, every eighth of an inch in the drawing represents one foot in real life and each box represents one square foot. Use this drawing to calculate the area of each room listed below, rounding dimensions up to the nearest foot.

Bedroom	Closet	Living Room
Area = Length x Width Area = 19' x 11' **Area = 206 ft²**	Area = Length x Width Area = 7' x 6' **Area = 42 ft²**	Area = (Length x Width) + (Length x Width) Area = (21' x 10') + (13' x 9') Area = 210 + 117 **Area = 327 ft²**

Applying Square Footage – Part 2

Use your calculations from Part 1 to estimate the cost of flooring for each room if the price of carpeting is $12 per square foot and the price of tiling is $8 per square foot.

Bedroom	Closet	Living Room
Floor Material: **Carpeting Price: $2,472** **Tiling Price: $1,648**	Floor Material: **Carpeting Price: $504** **Tiling Price: $336**	Floor Material: **Carpeting Price: $4,464** **Tiling Price: $2,616**

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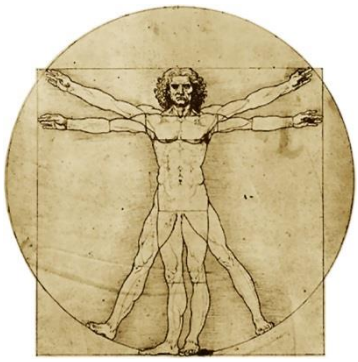
Made to Measure



In 1490, Leonardo DaVinci created this drawing to show what he believed to be the ideal proportions of the human body. His ratios were based on proportions calculated by the ancient Roman architect Vitruvius who lived from about 80 BC – 15 BC. Both men believed that these ratios could be used to determine the sizes of different building parts such as doors, windows, and rooms. They hoped that this would create architecture that was in harmony with the human form.

How do you measure up to these ancient ratios?

Defining the Ratio

Start by measuring your total height and converting this to a measurement in inches. For example, a height of 5'-7" can be expressed as 67 inches. This dimension will be the basis for your ratios.

Height: ___ feet ___ inches = _____ total inches.

Measuring your body

Fill in the chart below with your own measurements. Simplify the ratios so that the first number is 1 and the second number is rounded to the nearest tenth. For example, a ratio of 8":60" can be expressed as 1:7.5 by dividing both sides by 8.

Body Segment	Length (in)	Ratio of Body Segment : Height		DaVinci's Ratio
		Ratio in Inches	Simplified Ratio	Body Segment : Height
Wingspan measured from fingertip to fingertip		:	1 :	1:1 (equal to your height)
Just below your knee to the ground		:	1 :	1:4 (1/4 of your height)
Width of your shoulders		:	1 :	1:4 (1/4 of your height)
Elbow to your fingertips		:	1 :	1:4 (1/4 of your height)
Length of your foot		:	1 :	1:7 (1/7th of your height)
Bottom of your chin to the top of your forehead		:	1 :	1:8 (1/8 of your height)
Wrist to fingertips		:	1 :	1:10 (1/10 of your height)

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Student Day Curriculum Connections

New York State Learning Standards for the Arts: Learning Standards for the Arts at Three Levels		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
1	Creating, Performing and Participating in the Arts	■	■	■	■	■	■	■
2	Knowing and using Arts Materials and Resources	■	■	■	■	■	■	■
3	Responding to and Analyzing Works of Art	■	■	■	■			■
4	Understanding the Cultural Dimensions and Contributions of the Arts	■	■	■	■			■

NYC Blueprint For Teaching and Learning in Visual Arts: Five Strands of Art Learning		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
I.	Art Making	■	■	■	■	■	■	■
II.	Literacy in Visual Arts	■	■	■	■	■	■	■
III.	Making Connections	■	■	■	■	■	■	■
IV.	Community and Cultural Resources	■	■	■	■	■	■	■
V.	Careers and Lifelong Learning	■	■	■	■	■	■	■

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Common Core State Standards for Mathematics: Standards for Mathematical Practice		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
1	Make sense of problems and persevere in solving them.	■	■	■		■	■	■
2	Reason abstractly and quantitatively.					■	■	
3	Construct viable arguments and critique the reasoning of others.			■	■	■		
4	Model with mathematics.	■	■		■	■	■	■
5	Use appropriate tools strategically.	■				■	■	
6	Attend to precision.	■				■	■	

NYC K-5 Science Scope & Sequence + NYC 6-12 Science Scope & Sequence		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
K Unit 2	**Exploring Properties** How do we observe and describe objects and the physical properties of objects?				■			
Grade 1 Unit 2	**Properties of Matter** How do we describe the properties of matter?				■			
Grade 2 Unit 2	**Forces & Motion** What causes objects to move?	■						■
Grade 3 Unit 2	**Energy** How does the use of various forms of energy affect our world?			■				
Grade 3 Unit 3	**Simple Machines** How do simple machines help us in our daily lives?	■						■
Grade 6 Unit 4	**Interdependence** What factors affect the interdependence of living and nonliving things?			■				
Grade 7 Unit 2	**Energy & Matter** What materials are best to conserve and efficiently use energy?			■				
Grade 8 Unit 4	**Humans and the Environment: Needs and Tradeoffs** How can energy resources affect the future planning for the continuity of life on Earth?			■				

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New York State P-12 Science Learning Standards		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
DIMENSION 1: SCIENTIFIC AND ENGINEERING PRACTICES								
1	Asking questions (for science) and defining problems (for engineering)	■	■	■	■	■	■	■
2	Developing and using models	■	■	■	■	■	■	■
3	Planning and carrying out investigations	■	■	■	■	■	■	■
4	Analyzing and interpreting data	PV		PV		PV		
5	Using mathematics and computational thinking	PV		PV		■	■	
6	Constructing explanations (for science) and designing solutions (for engineering)	■	■	■		■	■	■
7	Engaging in argument from evidence	■		■				■
8	Obtaining, evaluating, and communicating information	■		■		■		
DIMENSION 2: CROSSCUTTING CONCEPTS								
1	Patterns	■	■	■	■			■
2	Cause and effect: Mechanism and explanation	■		■				■
3	Scale, proportion, and quantity	■	■	■	■	■	■	■
4	Systems and system models	■	■	■		■		■
5	Energy and matter: Flows, cycles, and conservation			■				
6	Structure and function	■	■	■	■	■	■	■
7	Stability and change	■	■	■				■

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New York State P-12 Science Learning Standards (continued)		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
DIMENSION 3: DISCIPINARY CORE IDEAS								
Physical Sciences								
PS1.A	Structure and Properties of Matter				■			
PS2.A	Forces and Motion	■						■
PS2.C	Stability and Instability in Physical Systems	■	■					■
PS3.A	Definitions of Energy			■				
PS3.B	Conservation of Energy and Energy Transfer			■				
PS3.D	Energy in Chemical Processes and Everyday Life			■				
Life Sciences								
LS2.A	Interdependent Relationships in Ecosystems			■				
LS2.C	Ecosystem Dynamics, Functioning, and Resilience			■				
LS2.D	Social Interactions and Group Behavior					■		
Earth & Space Sciences								
ESS1.B	Earth and the Solar System			■				
ESS2.A	Earth Materials and Systems			■				
ESS2.D	Weather and Climate			■				
ESS3.A	Natural Resources			■				
ESS3.B	Natural Hazards							■
ESS3.C	Human Impacts on Earth Systems			■				
ESS3.D	Global Climate Change			■				

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New York State P-12 Science Learning Standards (continued)		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
DIMENSION 3: DISCIPINARY CORE IDEAS (continued)								
Engineering, Technology, and Applications of Science								
ETS1.A	Defining and Delimiting and Engineering Problem	■	■	■				■
ETS1.B	Developing Possible Solutions	■	■	■	■	■	■	■
ETS1.C	Optimizing the Design Solution		■	■	■	■	■	■
ETS2.A	Interdependence of Science, Engineering, and Technology	■	■	■	■	■	■	■
ETS2.B	Influence of Engineering, Technology, and Science on Society and the Natural World	■	■	■	■	■	■	■

Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
COLLEGE AND CAREER READINESS ANCHOR STANDARDS FOR READING *								
1	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textural evidence when writing or speaking to support conclusions drawn from the text.	■		■	■		■	■
2	Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.			■	■			
7	Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.	■	■	■	■	■	■	■
COLLEGE AND CAREER READINESS ANCHOR STANDARDS FOR WRITING								
1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.				PV	PV		

**At the Center for Architecture, we consider visual representations (i.e., photos, drawings, models, etc.) to be texts with their own set of vocabulary. Through this lens, we practice "reading a building" to consider its design and purpose.*

PV These standards are met by completing the suggested extension activities found in the Student Day Resource Packet.

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Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects (continued)		Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
COLLEGE AND CAREER READINESS ANCHOR STANDARDS FOR WRITING (continued)								
2	Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.			PV	PV	PV		
7	Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.	PV	PV	PV	PV	PV		PV
COLLEGE AND CAREER READINESS ANCHOR STANDARDS FOR SPEAKING AND LISTENING								
1	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.	■	■	■	■	■	■	■
2	Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.	■	■	■	■	■	■	■
4	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.					■		
5	Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.					■		
COLLEGE AND CAREER READINESS ANCHOR STANDARDS FOR LANGUAGE								
4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.	■	■	■	■	■		■
6	Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.	■	■	■	■	■	■	■

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New York State K-8 Social Studies Framework: Social Studies Practices	Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
A Gathering, Using, and Interpreting Evidence	■		■	■			■
B Chronological Reasoning and Causation	■						■
C Comparison and Contextualization				■			
D Geographic Reasoning	■		■	■	■		■
F Civic Participation					■		

NYC K-8 Social Studies Scope & Sequence + NYC 9-12 Social Studies Scope & Sequence	Building Bridges	Geodesic Dome	Green Architecture	Language of Arch.	Neighborhood Design	Scale Model Building	Skyscrapers
K Unit 3 **Geography, People and the Environment** What makes a community?				■			
Grade 1 Unit 3 **The Community** What is a community?				■			
Grade 2 Unit 2 **New York City Over Time** How and why do communities change over time?	■						■
Grade 2 Unit 3 **Urban, Suburban and Rural Communities** How are communities the same and different?	■			■			■
Grade 8 Unit 2 **A Changing Society and the Progressive Era** How do people, policies and technological advances shape a nation?							■
Grade 10 Unit 6 **Globalization and the Changing Environment** Is globalization a force for progress and prosperity?			■				

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This educational resource was made possible by generous funding from Deutsche Bank Americas Foundation.