This task was developed by high school and postsecondary mathematics and design/pre-construction educators, and validated by content experts in the Common Core State Standards in mathematics and the National Career Clusters Knowledge & Skills Statements. It was developed with the purpose of demonstrating how the Common Core and CTE Knowledge & Skills Statements can be integrated into classroom learning – and to provide classroom teachers with a truly authentic task for either mathematics or CTE courses.

TASK: FRAMING A HOUSE

TARGET COMMON CORE STATE STANDARD(S) IN MATHEMATICS:
N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
G.MG.3 Apply geometric methods to solve design problems (*e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).**
7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.
7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error*
6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

TARGET STANDARDS FOR MATHEMATICAL PRACTICES:
MP.1 Make sense of problems and persevere in solving them.
MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.
MP.6 Attend to precision.

TARGET COMMON CORE STATE STANDARD(S) IN ELA/LITERACY:
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

TARGET CAREER AND TECHNICAL EDUCATION (CTE) KNOWLEDGE & SKILLS STATEMENTS:
ACC01.01.01.06 Conceptualize a three-dimensional form from a two-dimensional drawing to visualize proposed work.
ACC02.01.02 Identify the physical properties present when using common construction materials in order to use the materials safely, effectively and efficiently.
ACC.03.01.03 Estimate resources/materials required for a specific project or problem.
ACC10.01.01 Interpret drawings used in project planning.
ACC10.01.04 Use architect's plan, manufacturer's illustrations and other materials to communicate specific data and visualize proposed work.
ACC10.02.03 Demonstrate use of tools, machinery, equipment and other resources commonly used in design and construction.
ACPA03.01.01 Describe building systems and their interrelationships.
ACPA06.03.01 Select building materials and assemblies upon evaluation that meet project specifications.
ACPA06.01.01 Identify client requirements.
ACPA06.01.03 Draw and sketch by hand to communicate ideas effectively.
ACPA06.01.04 Learn to read and produce technical drawings, understanding the significance of each line in a drawing.

RECOMMENDED COURSE:
Algebra I, Geometry; Integrated Math I, Integrated Math II; Applications in Design & Pre-Construction
ADDITIONAL INSTRUCTIONS:
Completion of the drawing for this task will take multiple class periods. The calculations should be able to be completed in one class period.

* Modeling standards appear throughout the CCSS high school standards and are indicated by a star symbol (*).

About the Common Core State Standards in Mathematics
The Common Core State Standards (CCSS) for Mathematics are organized by grade level in grades K–8. At the high school level, the standards are organized by conceptual category (number and quantity, algebra, functions, geometry, and probability and statistics), showing the body of knowledge students should learn in each category to be college and career ready, and to be prepared to study more advanced mathematics. The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. www.corestandards.org

About the Common Core State Standards in English Language Arts/Literacy
The Common Core State Standards (CCSS) for ELA/Literacy are organized by grade level in grades K–8. At the high school level, the standards are organized by 9-10 and 11-12 grade bands. Across K-12 there are four major strands: Reading, Writing, Speaking and Listening, and Language. The CCSS also include Standards for Literacy in History/Social Studies, Science, and Technical Subjects, with content-specific (Reading and Writing) literacy standards provided for grades 6-8, 9-10, and 11-12, to demonstrate that literacy needs to be taught and nurtured across all subjects. www.corestandards.org

About the Career Cluster Knowledge and Skill Statements
As an organizing tool for curriculum design and instruction, Career Clusters™ provide the essential knowledge and skills for the 16 Career Clusters™ and their Career Pathways. It also functions as a useful guide in developing programs of study bridging secondary and postsecondary curriculum and for creating individual student plans of study for a complete range of career options. As such, it helps students discover their interests and their passions, and empowers them to choose the educational pathway that can lead to success in high school, college and career. www.careertech.org/career-clusters/resources/clusters/architecture.html. Although not included in this template, all Clusters and Pathways have Foundational Academic Expectations and Essential Knowledge & Skills Statements, which, in some cases, overlap with the Common Core State Standards.

KEY TERMS

- Sole plate, double plate
- Header, stud, cripple, trimmer, nailer, etc.
- Linear feet

FRAMING A HOUSE – *The Task*

The plans below show an addition to a house in red, with exterior walls identified in a brighter red than the red of the interior walls. Use the plans to solve the problem. After the chalk lines locating the walls are marked on the subfloor, the next step is to lay out the wall plates. Wall plates are the horizontal components of a framed wall.
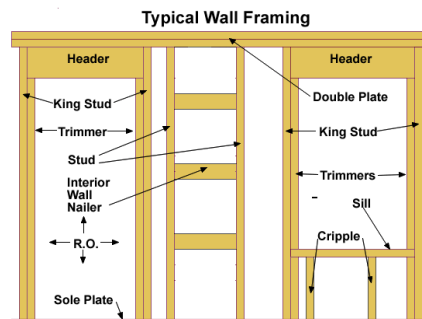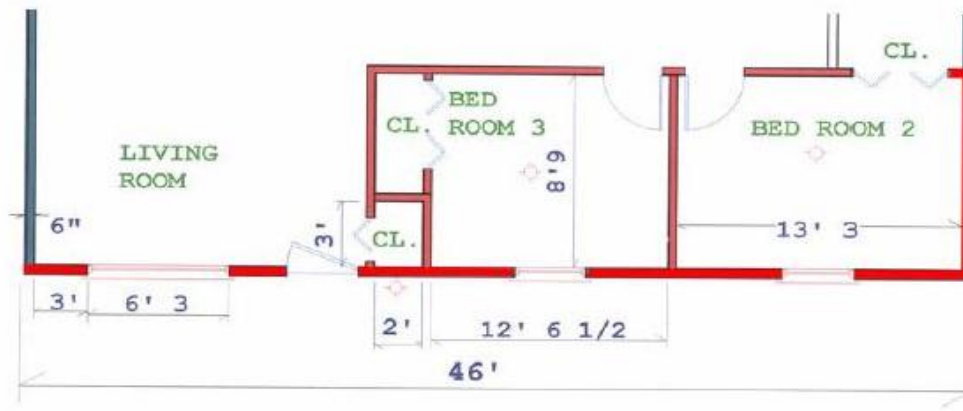
1. Using an architecture scale or a regular ruler and graph paper, create a scaled drawing of the plans below.

2. How many linear feet (L.F.) of wall plate material do you need for both the interior and exterior addition walls in the plan below? Add 10% for waste. Remember wall plates are made up of a sole plate at the bottom and a double plate at the top (see **Typical Wall Framing** diagram below). Do not reduce the amount for openings or wall finish materials. All interior and exterior walls are framed using 2''x 4'' construction (finished lumber will be 1 ½'' by 3 ½'').

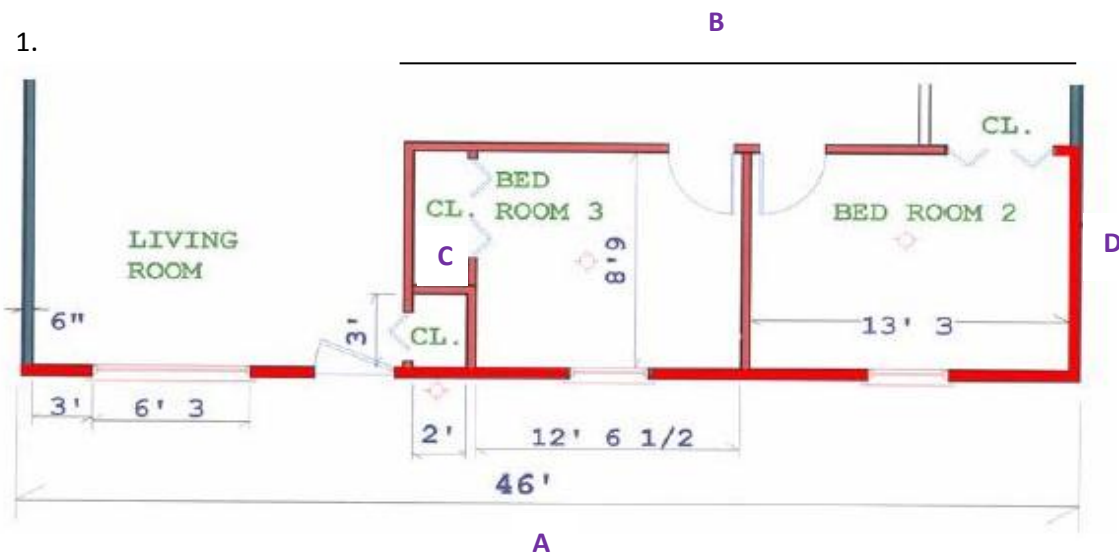L.F. of wall plate =   _____

Amount for waste (in L.F.) =   _____

Total L.F. of wall plate =   _____

Total 16 ft 2"x 4"s needed to be purchased for the wall plate =   _____

Typical Wall Framing

3

Source: Adapted from Hawai'i American Diploma Project Work

1.

2. On the diagram above there are some walls that are represented as vertical line segments in the plan diagram and some as horizontal line segments. Horizontal lengths are noted with the letters A, B, C, and the vertical lengths with the letter D.

Horizontal Distance = A + B + C

A = 46'

B = 3 ½ " + 2' 0" + 3 ½ " + 12' 6 ½ " + 3 ½ " + 13' 3" + 3 ½ " = 28' 11 ½ "

C = 2'

Total horizontally represented distance = 76' 11 ½ "

Vertical Distance = D + D + D + D:

D = 8' 9"

4(D) = 4(8' 9") = 32' 36" = 35'

Total vertically represented distance = 35'

Total Linear Distance = 76' 11 ½ " + 35' 0" = 111' 11 ½ "

Linear Footage of Wall Plate (Multiply by 3) = 333' 34 ½ " = **335' 10 ½ "   Rounds to 336' 0"**

Add for Waste (10% of total) = 33.6' – 0"   **Rounds to 34' – 0"**

Total Linear Footage of Wall Plate Lumber= 370' - 0"

NOTE: Students might round earlier in the computation process, which may have an effect on the level of precision of the final answer.

FRAMING A HOUSE – *Possible Extensions*

The extensions below represent potential ways in which mathematics and/or CTE teachers can build on the task above. All of the extensions are optional and can be used in the classroom, as homework assignments, and/or as long-term interdisciplinary projects.

1. Using the plans, draw elevations of the walls for each room.

2. Sketch a to-scale net for each room, including the ceiling to determine the number of sheets of dry wall (½ " x 4' x 8') for walls and ceiling. Remember to include sheetrock for the inside of the closets and both sides of the interior walls.

3. Find total length of (4" x 12") beam to be used for window and door headers in the addition walls.

4. Find the total number of 2" x 4" x 10' boards needed to frame the walls of the addition.

5. For each bedroom the building code requires a minimum of 5 square feet of clear egress for the windows. Determine the dimensions of each window and show that they meet the minimum code.

6. Find the number of boxes of pre-finished wood flooring needed for each bedroom, given each box will cover 50 square feet.

7. Compare two or more lumberyards to minimize cost for the project.

The rating system used in the following charts is as follows:

3 EXCELLENT ALIGNMENT:

The content/performance of the task is clearly consistent with the content/performance of the Common Core State Standard.

2 GOOD ALIGNMENT:

The task is consistent with important elements of the content/performance of the CCSS statement, but part of the CCSS is not addressed.

1 WEAK ALIGNMENT:

There is a partial alignment between the task and the CCSS, however important elements of the CCSS are not addressed in the task.

N/A:

For Mathematical Practices a content rating does not apply.

In the charts **C = Content Rating** and **P = Performance Rating**

COLOR KEY

- **Black** = Part of CCSS/K&S Statement aligned to task
- **Gray** = Part of CCSS/K&S Statement *not* aligned to task

Task-to-Mathematical Practice Alignment Recording Sheet

Task Name	Aligned CCSS Mathematical Practice Standards	C	P	Alignment Comments	Task Comments
FRAMING A HOUSE	**MP.1** Make sense of problems and persevere in solving them	N/A	3	For this task students analyze givens, constraints, relationships, and goals. They must make conjectures about the form and meaning of the solution and plan a solution pathway. They must check the reasonableness of their solution, continually asking themselves, "Does this make sense?"	This is a multi-stage problem with real life applications and considerations. Students must create a scale drawing and identify measurements and lengths to determine the total number of linear feet of lumber for the project. Students use visualization, abstract reasoning, and quantitative calculations.
	MP.2 Reason abstractly and quantitatively	N/A	3	This task requires that students make sense of quantities and their relationships in the problem situation. They must attend to the meaning of the quantities and pay attention to units as they represent and operate with the quantities and measures.	
	MP.5 Use appropriate tools strategically	N/A	3	The student is asked to use an architecture scale (or ruler) for their scale drawing.	
	MP.6 Attend to precision	N/A	3	The student is required to convert inches to feet and back again. Rounding is a key part of the measurement computations.	

Task-to-Common Core State Standards Alignment Recording Sheet

Task Name	Aligned CCSS Content Standards	C	P	Alignment Comment	Task Comments
FRAMING A HOUSE	**N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	**3**	**3**	Sums of measures must be estimated for the purposes of purchasing.	This task requires a scale drawing and calculations for the concrete project. Dimensions are fractional requiring the use of rational numbers and estimation for reporting.
	G.MG.3 Apply geometric methods to solve design problems (*e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios*).*	**3**	**3**	The student must use the plan to determine the number of linear feet of wall plate needed.	
	7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.	**3**	**3**	This task involves addition and multiplication of measurement using fractions, which could easily be changed to decimals.	
	7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	**2**	**3**	In this task there is no requirement to find area.	
	7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*	**2**	**3**	There is no requirement to solve ratio problems in this task**.** However students must add 10% to their measurements for waste of materials.	
	6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	**3**	**3**	This task requires unit conversion involving fractions of inches and feet.	

* Modeling standards appear throughout the CCSS high school standards and are indicated by a star symbol (*).

Task-to-National Career Cluster Knowledge & Skills Statements Alignment Recording Sheet

Task Name	Aligned Cluster/Pathway Knowledge/Skill	C	P	Alignment Comments (Standards selection, partial alignments, reasons for rating, etc)
FRAMING A HOUSE	**ACC01.01.01.06** Conceptualize a three-dimensional form from a two-dimensional drawing to visualize proposed work.	3	3	
	ACC02.01.02 Identify the physical properties present when using common construction materials in order to use the materials safely, effectively and efficiently.	3	3	
	ACC.03.01.03 Estimate resources/materials required for a specific project or problem.	3	2	
	ACC10.01.01 Interpret drawings used in project planning.	3	3	The student is required to interpret a drawing/plan to estimate materials.
	ACC10.01.04 Use architect's plan, manufacturer's illustrations and other materials to communicate specific data and visualize proposed work.	3	3	The student is required to interpret a drawing/plan to estimate materials.
	ACC10.02.03 Demonstrate use of tools, machinery, equipment and other resources commonly used in design and construction.	2	2	
	ACPA03.01.01 Describe building systems and their interrelationships.	2	2	The task focuses on the systems of walls.
	ACPA06.03.01 Select building materials and assemblies upon evaluation that meet project specifications.	1	1	The materials have already been selected; the quantity of materials must be calculated.
	ACPA06.01.01 Identify client requirements.	3	3	
	ACPA06.01.03 Draw and sketch by hand to communicate ideas effectively.	3	3	
	ACPA06.01.04 Learn to read and produce technical drawings, understanding the significance of each line in a drawing.	3	3	The student must draw/sketch by hand, learn to read and produce technical drawings, understanding each line.