



A Mathematical Inquiry of Oak Ridge Cemesto Homes

Submitted by: Nick Corrigan, Math
Jefferson Middle School, Oak Ridge, TN

Target Grade: 5th Grade Math

Time Required: 3 days, 50 minute lessons

Standards

Common Core Math Standards:

- CCSS.MATH.CONTENT.5.NF.A.1: Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
- CCSS.MATH.CONTENT.5.NF.B.3: Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem.
- CCSS.MATH.CONTENT.5.NF.B.5.A: Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.
- CCSS.MATH.CONTENT.5.NF.B.6: Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

Lesson Objectives

Students will be able to:

- Solve and create real-world problems involving multiplication of fractions and whole numbers.
- Solve and create real-world problems involving multiplication with mixed numbers.
- Solve real-world problems involving measurement conversions.
- Add, subtract, multiply, and divide decimals to the hundredths place.

Central Focus

This is a project based lesson that encourages students to inquire about the historical cemesto homes in the Oak Ridge, TN community. Students will use their knowledge of fractions, measurement, scaling, and their own environment to investigate the structure of Type “A” cemesto Homes in Oak Ridge, TN. This lesson is intended to be used as an opportunity to review what they have learned and explore a real-world example. The expectation is to find the area of the home on the blueprint and then convert the



measurements using scaling and multiplication to the actual size. Day two of the lesson requires students to complete an invoice for the price of new flooring in the home.

Key Terms: add, subtract, divide, mixed numbers, scaling, fractions, whole numbers

Background Information

For this lesson, students will need to have a basic understanding of doing calculations with fractions, measurements, and converting units. It would also be beneficial for students to have prior experience applying mathematical principles to solving real-world problems.

This lesson plan will use mathematics to study cemesto homes in Oak Ridge, TN. On the student's packet, they will be given the following information about Oak Ridge and cemesto homes:

The city of Oak Ridge: The town of Oak Ridge, Tennessee, did not exist until 1942, when it was created by the U.S. Army to house staff developing materials for a highly secret weapon, the atomic bomb as part of the Manhattan Project. About 4,000 people were removed from this remote part of the state to make space for the laboratory facilities and a new planned community. Originally designed to house 8,000, Oak Ridge would eventually employ more than 80,000 people, many of whom lived on-site in single family homes, apartments, dormitories, and temporary housing like hutments and trailers. Many workers were women, and African American workers lived segregated facilities divided by gender, though there was early pressure to integrate and Oak Ridge desegregated its schools in 1955 under the authority of the U.S. Atomic Energy Commission.

Taking advantage of the electricity generated by the TVA's nearby dams, the site included three facilities (K-25, S-50, and Y-12) to separate the fissible isotope uranium-235 from natural uranium, as well as the X-10 site, a graphite reactor for separating plutonium. Following World War II, the Atomic Energy Commission took over the site, which now includes the Oak Ridge National Laboratory and the Y-12 nuclear weapons facility. Since the late 1980s, anti-nuclear and anti-war activists have targeted the Y-12 facility for peaceful protest. Today, portions of Oak Ridge are part of the Manhattan Project National Historical Park.

Cemesto homes in Oak Ridge: Materials were in short supply, so the first houses were built of prefabricated panels of cement and asbestos or cemesto board. They were known as "alphabet houses" because each of the handful of home designs was assigned a letter of the alphabet. There were small, two bedroom "A" houses, "C" houses with extra bedrooms, "D" houses with a dining room, and so forth for a total of 3,000 cemesto-type homes. Later, thousands of prefabricated houses were sent to Oak Ridge in sections complete with walls, floors, room partitions, plumbing and wiring. Workers turned over 30 or 40 houses to occupants each day.

<http://cumberlandvistas.blogspot.com/2011/12/alphabet-houses.html>



Lesson Vocabulary

- Scaling
- Area
- Numerator
- Cemesto
- Scale Factor
- Length
- Denominator
- Oak Ridge
- Ratio
- Width
- Mixed Number
- Remodel
- Conversion
- Square Foot
- Simplify
- Laminate Floor

Materials

- U.S. Atomic Energy Commission, Type A Cemesto Description Sheet
 - <http://cumberlandvistas.blogspot.com/2011/12/alphabet-houses.html>
- Rulers
- iPad & Belkin tablet stage
- Class set of pickers
- Student packet

Instruction

Day 1:

- Teacher will display the blueprint layout of a Type A Oak Ridge Cemesto Home on the board.
- Ask students what they notice and at least one question they wonder about the picture.
 - Students should write their answers on a sheet of paper.
- After completing the notice & wonder task, students should crumple their paper up into a ball and, upon a signal from the teacher, toss the paper balls around the room until teacher tells them to stop and pick up or hold on to one paper.
- Students should take the paper they end up with and share the ideas that are described on their “caught” paper to the class.
- Next, pass out A Mathematical Inquiry of Oak Ridge Cemesto Homes sheet and have students read the information on Cemesto Homes in Oak Ridge, TN.
- Guide them through the 3-2-1 Activity on the student packet when they are finished reading.
- The activity asks the following:
 - 3 things I found interesting
 - 2 math or science facts
 - 1 question I have from the reading is
- Drawing with the iPad, the teacher will model how to find the area of each living space using the example provided on the student packet.
 - Be sure to point out $1/16$, $1/8$, $1/4$ measurements on the ruler.
 - Remind students length x width = area in square units
 - Discuss that the rooms have door openings and closet space that are not part of the room’s area.



- Next place students into groups of 2-3 to complete their A Mathematical Inquiry of Oak Ridge Cemesto Homes sheet.
- Using the iPads, the students will determine the area of listed living spaces based on the given scale.
- They will be required to show all calculations and conversions.
- During this time, the teacher should circulate to ensure groups are completing the task as modeled.

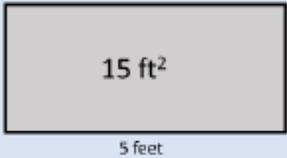
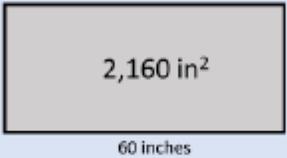
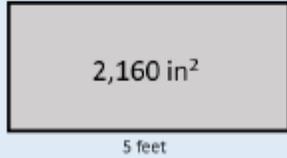
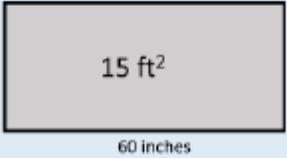
Day 2:

- Have students complete any unfinished work from the day before.
- Students should pick someone in their group to present their work and findings to the class.
 - They will explain their answers and reasoning on their worksheet to the class.
 - Have each group answer a different question on the sheet so student can see each group's mathematical reasoning.
- The presenting students should be prepared to answer questions from their peers and the teacher.
- Students should be prepared to defend their findings and present respectful disagreements if the opportunity arises.

Day 3:

- Have students complete the Which One Doesn't Belong activity on a sheet of paper.

Which one doesn't belong?

 <p>15 ft²</p> <p>5 feet</p> <p>3 feet</p> <p>A</p>	 <p>2,160 in²</p> <p>60 inches</p> <p>36 inches</p> <p>B</p>
 <p>2,160 in²</p> <p>5 feet</p> <p>3 feet</p> <p>C</p>	 <p>15 ft²</p> <p>60 inches</p> <p>36 inches</p> <p>D</p>

- Students can submit their answers with the pickers.
- Next, using Day 3 in the packet, discuss with the students the task for the day and model how students should use the quote they've been given for flooring to complete the invoice based on their choices.
- Working in the same groups, the students will complete the second part of the packet (Day 3).



- In the packet, the students will be asked to purchase a flooring for different living spaces of their choice.
- Once the students are finished, encourage each group to report their findings and mathematical reasoning to the class.
- Lead a short class discussion on which method is most cost efficient.
- The teacher should ask probing questions helping to encourage students to agree and disagree with each other to spark discussion.

Extensions

- Have students complete the project with information for a larger home in Oak Ridge.
- Use blue painter's tape on the floor of the classroom to provide a visual of the actual size of some of the bedrooms.
 - Discuss scaling and the conversion factors impact on the blueprint measurements versus what is actually built.
- Use FlipGrid to record student findings and only select a few in order to save classroom time. This program also allows students to respond to one another's recordings online. Discussions are thereby continued outside the classroom.
 - FlipGrid.com

Differentiation

- The assignment can be easily shortened allowing the teacher to require a student to find the area of a smaller amount of rooms.
- Google translate and speech to text is available online and may be utilized for students with special needs or ELL.
- The lesson can be taught without iPads, by printing out each work sheet. When needed, the teacher can display their paper onto the board to draw on.
- Students should be grouped in heterogeneous groups to supply support to students.
- The teacher can chose to provide a lesson schedule to the student, so individuals can keep track of lesson pacing and prepare for future steps.
- Prior to the lesson, provide vocabulary sheets to student with key words that will be used through the lesson. If needed, also provide translations in student's primary language.
- If needed, students can be provided with calculators.
- Allow extend time on different parts of lesson when needed.
- Provide feedback on students spelling and grammar, but do not take off points.
- Allow students to work in larger or smaller groups if more support is needed.

Assessment

Formative assessment:

- Commit & Toss and Which One Doesn't Belong activities provide opportunities to better understand students' prior knowledge and what they are thinking when starting the lesson.



- Teacher observations during circulation while groups are working will help teacher to gauge student understanding.
- Responses to questions throughout the lesson and during class discussions will allow the teacher to alter the pace of the lesson to ensure that all students are learning.
- The teacher may also request students to complete a peer evaluation within their group to make sure each group member is working together to complete the sheet.
- Student's reported results of their A Mathematical Inquiry of Oak Ridge Cemesto Homes sheet will allow for the teacher to check for any misconceptions and understanding on the topic.
- If needed, encourage kids to complete their own Type A Cemesto Description Sheet which can be submitted at the end of the lesson to check for full class participation.

Summative assessment:

- This skill can be measured for each student on the final unit test.

A Mathematical Inquiry of Oak Ridge Cemesto Homes

Background: Congratulations! You have just bought your first home in Oak Ridge, TN. You are new to the area but have been told that many of the homes in Oak Ridge have a story that dates all the way back to World War II. The home you purchased has not been updated since it was originally built around 1942. First, read the description of the home you purchased below. Since you have not yet moved into the home, you will need to use the blueprint provided to determine the measurements of each room. This will help you determine the cost of the new flooring you want to install prior to moving in.

Historical Information

The City of Oak Ridge: The town of Oak Ridge, Tennessee, did not exist until 1942, when it was created by the U.S. Army to house staff developing materials for a highly secret weapon, the atomic bomb as part of the Manhattan Project. About 4,000 people were removed from this remote part of the state to make space for the laboratory facilities and a new planned community. Originally designed to house 8,000, Oak Ridge would eventually employ more than 80,000 people, many of whom lived on-site in single family homes, apartments, dormitories, and temporary housing like hutments and trailers. Many workers were women, and African American workers lived segregated facilities divided by gender, though there was early pressure to integrate and Oak Ridge desegregated its schools in 1955 under the authority of the U.S. Atomic Energy Commission.

Taking advantage of the electricity generated by the TVA's nearby dams, the site included three facilities (K-25, S-50, and Y-12) to separate the fissible isotope uranium-235 from natural uranium, as well as the X-10 site, a graphite reactor for separating plutonium. Following World War II, the Atomic Energy Commission took over the site, which now includes the Oak Ridge National Laboratory and the Y-12 nuclear weapons facility. Since the late 1980s, anti-nuclear and anti-war activists have targeted the Y-12 facility for peaceful protest.

Today, portions of Oak Ridge are part of the Manhattan Project National Historical Park.

(Information from <https://tennesseehistory.org/oak-ridge/>)

Life at Oak Ridge: Materials were in short supply, so the first houses were built of prefabricated panels of cement and asbestos or cemesto board. They were known as "alphabet houses" because each of the handful of home designs was assigned a letter of the alphabet. There were small, two bedroom "A" houses, "C" houses with extra bedrooms, "D" houses with a dining room, and so forth for a total of 3,000 cemesto-type homes. Later, thousands of prefabricated houses were sent to Oak Ridge in sections complete with walls, floors, room partitions, plumbing and wiring. Workers turned over 30 or 40 houses to occupants each day. The Roane-Anderson Company administered all housing facilities.

Part of Oak Ridge's appeal to Manhattan Project planners was nearby Knoxville with its population of 111,000. However, the top-secret project was not warmly welcomed in Knoxville, arousing both suspicion and resentment. Many saw the people flooding into East Tennessee from all over the country—and the world—as "furriners" [foreigners] who could not be questioned. In a time of austerity and rationing, others resented Oak Ridge residents arriving with unlimited ration stamps and fistfuls of cash. Oak Ridgers who ventured into Knoxville were easy to spot. The quickly constructed secret city was blanketed in a thick layer of mud. As a result, its residents' muddy shoes were a dead giveaway as to their origin.

(Information from Atomic Heritage Foundation <https://www.atomicheritage.org/location/oak-ridge-tn>)

TYPE A CEMESTO

UNITED STATES
ATOMIC ENERGY
COMMISSION

OAK RIDGE
TENNESSEE



BACK VIEW, TYPE A, CEMESTO

PLAN One-story, single family dwelling unit.

FOUNDATIONS Concrete block.

EXTERIOR WALLS Cemesto board over wood frame.

ROOF Celo-Rok strip roofing.

FLOORS Matched hardwood over wood sub-flooring, with linoleum over the kitchen and bathroom floors, and concrete floor in utility room.



INTERIOR PARTITIONS Partitions and ceilings are painted gypsum board over wood studs. Bathroom walls are finished with glazed wallboard.

HEATING SYSTEM Coal-fired, hot air furnace, thermostatically controlled.

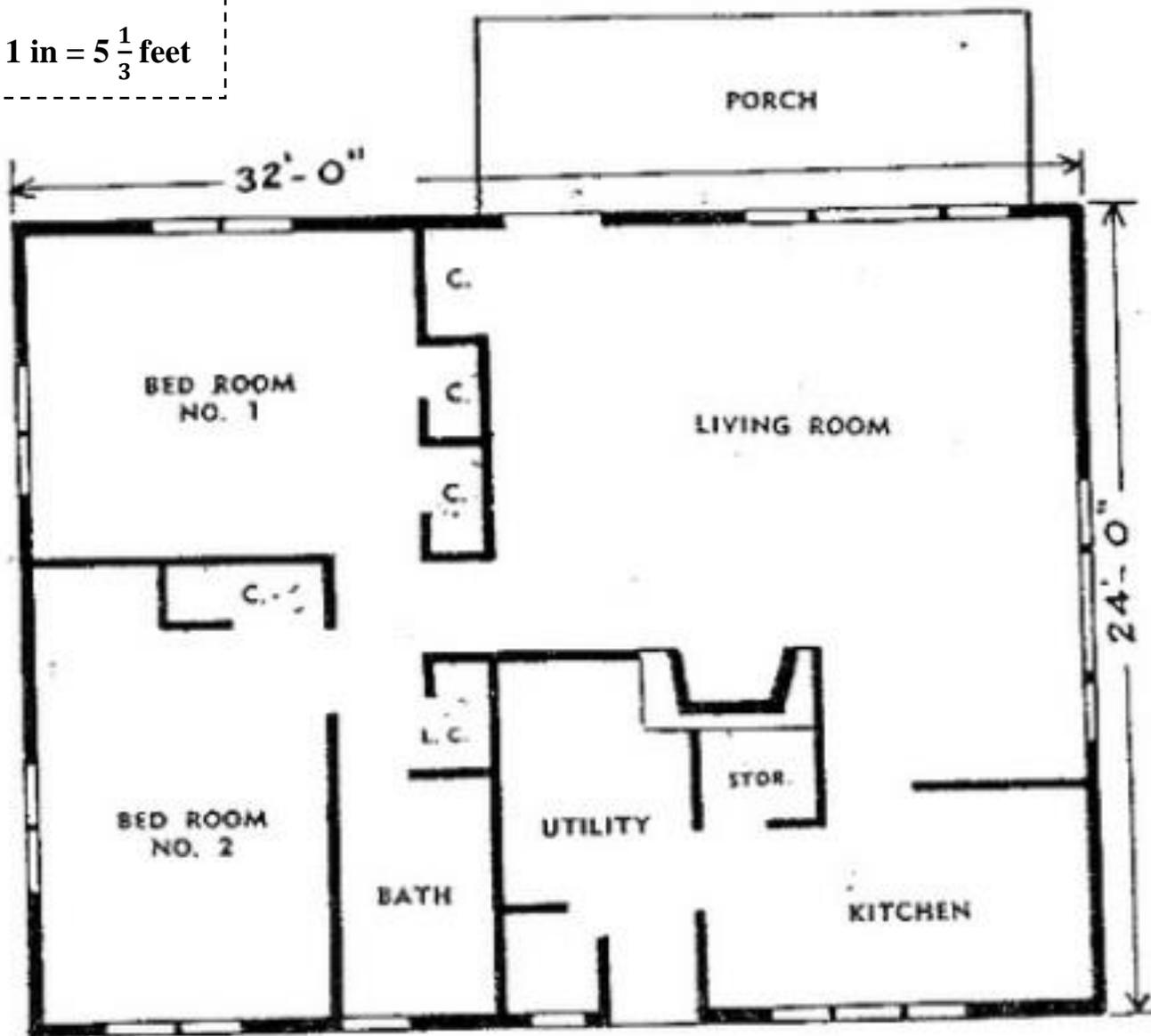
MISCELLANEOUS Each unit consists of living room with wood burning fireplace, two bedrooms, kitchen, bath (with shower over tub), utility room, and open porch. Each unit is furnished with an electric range and an electric water heater. Gross area 819 sq. ft. Net area 768 sq. ft. — exclusive of open porch.

3-2-1 Activity

Complete the chart below based on what you read about Oak Ridge Cemesto Homes.

3 things I found interesting	<ol style="list-style-type: none"> 1. 2. 3.
2 math or science facts	<ol style="list-style-type: none"> 1. 2.
1 question I have from the reading is	<ol style="list-style-type: none"> 1.

SCALE
1 in = 5 $\frac{1}{3}$ feet



Day 1 Directions: Use the home's blueprint to help you determine the area of each of the major living spaces listed below. You will need to use the scale in order to convert your measurements to determine the square feet of each major living area.

	Length x Width (inches)	Length x Width (feet)	Area (square feet) <i>Round to the nearest whole</i>
Entire Home	6 in x $4\frac{1}{2}$ in	32 ft x 24 ft	768 ft ²
Bedroom No. 1			
Bedroom No. 2			
Bathroom			
Kitchen			
Living Room			

Work Space: Use the space below to as space to show your work for each of the living spaces. An example has been given of how to complete the table above using the dimensions for the entire home.

Step 1 (measure length & width): 6 inches long and $4\frac{1}{2}$ inches wide

Step 2 (use scaling to convert to feet): $6\text{ in} \times 5\frac{1}{3}\text{ ft/in} = 32\text{ feet}$ & $4\frac{1}{2}\text{ in} \times 5\frac{1}{3}\text{ ft/in} = 24\text{ feet}$

Step 3 (determine the area in square feet): $32\text{ ft} \times 24\text{ ft} = 768\text{ ft}^2$

Day 3 Directions: You are interested in purchasing new flooring for each of the living spaces you looked at yesterday. You got a quote from a local hardware store for the different types of flooring. The pricing for the quote you received is below. Fill out the invoice based on your choices for each room to determine the total cost.

	Cost per square foot	Labor & Installation Cost
Carpet	\$5.49 per sq. ft.	\$0.78 per sq. ft.
Hardwood (laminated)	\$3.40 per sq. ft.	\$1.25 per sq. ft.
Tile	\$4.09 per sq. ft.	\$5.00 per sq. ft.

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Date: _____

	Cost of Flooring Materials			Cost of Labor & Installation			TOTAL
	Square Feet of Room	Cost per sq. ft.	Cost of Flooring Material	Square Feet of Room	Cost per sq. ft.	Cost of Labor & Installation	Cost of Labor & Material
Bedroom 1							
Bedroom 2							
Bathroom							
Kitchen							
Living Room							
Total Cost							\$

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FOUNDATIONS Concrete block.

EXTERIOR WALLS Cemesto board over wood frame.

ROOF Celo-Rok strip roofing.

FLOORS Matched hardwood over wood sub-flooring, with linoleum over the kitchen and bathroom floors, and concrete floor in utility room.



INTERIOR PARTITIONS Partitions and ceilings are painted gypsum board over wood studs. Bathroom walls are finished with glazed wallboard.

HEATING SYSTEM Coal-fired, hot air furnace, thermostatically controlled.

MISCELLANEOUS Each unit consists of living room with wood burning fireplace, two bedrooms, kitchen, bath (with shower over tub), utility room, and open porch. Each unit is furnished with an electric range and an electric water heater. Gross area 819 sq. ft. Net area 768 sq. ft. — exclusive of open porch.

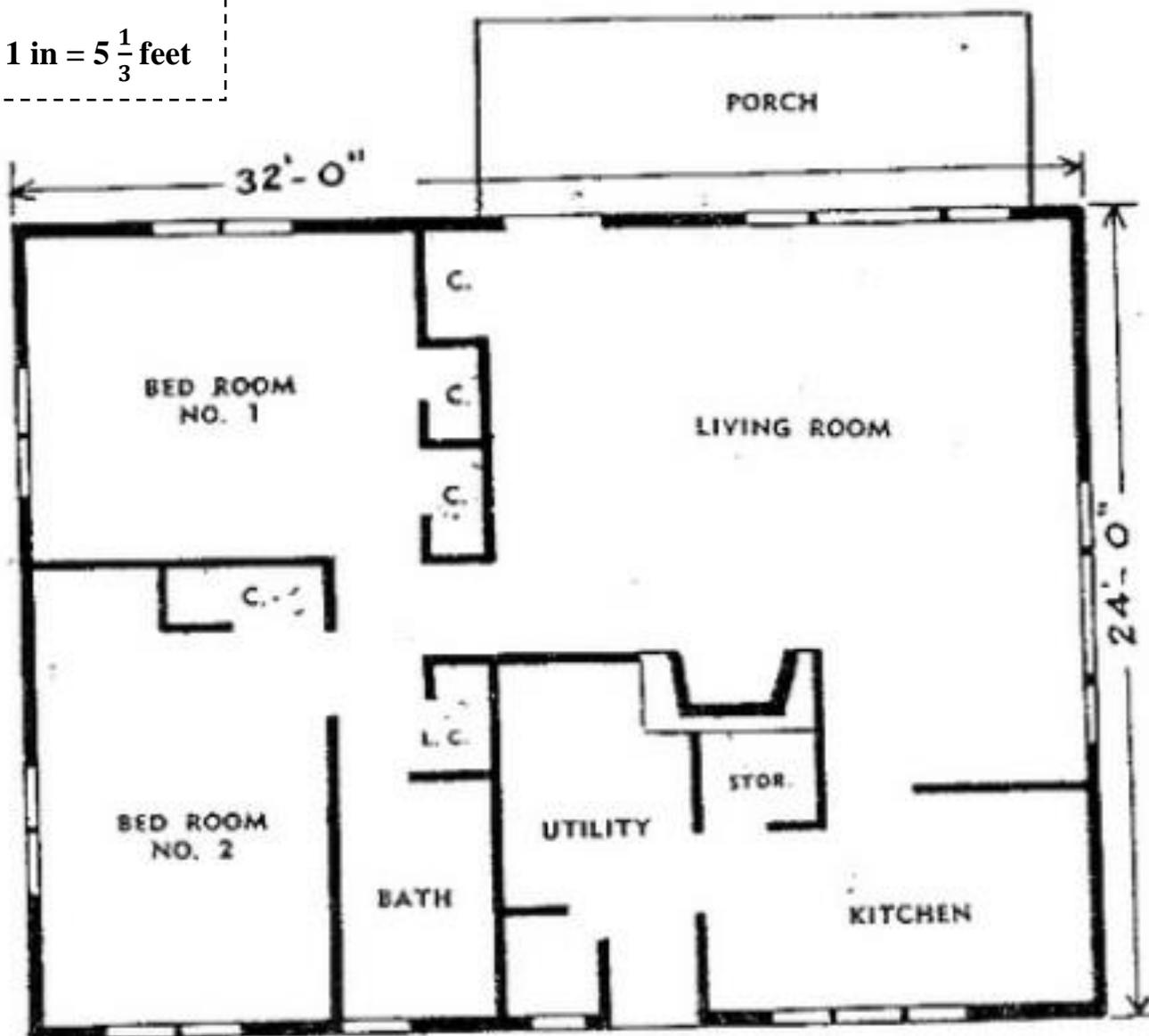
3-2-1 Activity

Complete the chart below based on what you read about Oak Ridge Cemesto Homes.

3 things I found interesting	<ol style="list-style-type: none"> 1. 2. 3. <p style="color: red; font-size: 1.2em; margin-left: 20px;"><i>Answers will vary.</i></p>
2 math or science facts	<ol style="list-style-type: none"> 1. 2.
1 question I have from the reading is	<ol style="list-style-type: none"> 1.

SCALE

1 in = $5\frac{1}{3}$ feet



Day 1 Directions: Use the home's blueprint to help you determine the area of each of the major living spaces listed below. You will need to use the scale in order to convert your measurements to determine the square feet of each major living area.

	Length x Width (inches)	Length x Width (feet)	Area (square feet) <i>Round to the nearest whole</i>
Entire Home	6 in x $4\frac{1}{2}$ in	32 ft x 24 ft	768 ft ²
Bedroom No. 1	$1\frac{7}{8}$ in x $2\frac{1}{4}$ in	10 ft x 12 ft	120 ft ²
Bedroom No. 2	$2\frac{5}{8}$ in x $1\frac{11}{16}$ in	14 ft x 9 ft	126 ft ²
Bathroom	$1\frac{3}{8}$ in x $\frac{15}{16}$ in	$7\frac{1}{3}$ ft x 5 ft	$36\frac{2}{3}$ ft ² \approx 37 ft ²
Kitchen	$1\frac{5}{16}$ in x $2\frac{1}{4}$ in	7 ft x 12 ft	84 ft ²
Living Room	$2\frac{7}{16}$ in x $3\frac{5}{16}$ in	13 ft x $17\frac{2}{3}$ ft	$229\frac{2}{3}$ \approx 230 ft ²

Work Space: Use the space below to as space to show your work for each of the living spaces. An example has been given of how to complete the table above using the dimensions for the entire home.

Step 1 (measure length & width): 6 inches long and $4\frac{1}{2}$ inches wide

Step 2 (use scaling to convert to feet): $6 \text{ in} \times 5\frac{1}{3} \text{ ft/in} = 32 \text{ feet}$ & $4\frac{1}{2} \text{ in} \times 5\frac{1}{3} \text{ ft/in} = 24 \text{ feet}$

Step 3 (determine the area in square feet): $32 \text{ ft} \times 24 \text{ ft} = 768 \text{ ft}^2$

Day 2 Directions: You are interested in purchasing new flooring for each of the living spaces you looked at yesterday. You got a quote from a local hardware store for the different types of flooring. The pricing for the quote you received is below. Fill out the invoice based on your choices for each room to determine the total cost.

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Tile	\$4.09 per sq. ft.	\$5.00 per sq. ft.

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Answers will vary based on choice.

Date: _____

	Cost of Flooring Materials			Cost of Labor & Installation			TOTAL
	Square Feet of Room	Cost per sq. ft.	Cost of Flooring Material	Square Feet of Room	Cost per sq. ft.	Cost of Labor & Installation	Cost of Labor & Material
Bedroom 1	120	5.49	\$658.80	120	0.78	\$93.60	\$752.40
Bedroom 2							
Bathroom							
Kitchen							
Living Room							
Total Cost							\$