

Measurement

A Unit for Tech Prep Mathematics Courses

**Produced by the Mathematics Education
Development Center at Indiana University**

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(Small-Group Activity)

Activity Summary: Students will conjecture about possible solutions to problems using data collected by measuring length, weight, etc. Students estimate and measure small and large objects. Use with S1 and R1.

Objectives

- To estimate, make, and use measurements to collect data, describe and compare phenomena, and apply to real-world problems.
- To select appropriate units and tools to measure to the degree of precision required in a particular situation.
- To distinguish among attributes that we measure and among units used to measure those attributes.
- To look at the role of estimation and precision in measurement.

Answer Key

Part A

1. *Students should measure diameter, thickness, circumference, weight, and coin value. A discussion might also look at tensile strength, or ease of bending a coin. The similarity of the quarter and the Susan B. caused inconvenience and mistakes in choosing the correct coin as people made change.*
2. *Sample attributes/units follow.*

<u>Attribute</u>	<u>Units</u>
weight	g, mg, kg, lb, oz, ton
distance	m, km, dm, mm, cm, in, yd, mile
time	hours, minutes, hours, years
temperature	degrees Fahrenheit or Celsius
volume	cc, in ³ , ft ³ , cup, pint, gallon, liter
value	dollars, cents, pesos, francs, marks
area	in ² , cm ² , yd ² , or acres
rotation	degrees, radians, mils
sobriety	blood alcohol level
speed or velocity	mph or fps

3. mm—thickness of a dime, cm—width of a book or stamp, dm—width of a desk, m—height of the room, km—distance to Indianapolis, furlongs—horse race, inch—length of a sheet of paper, foot—width of a room, yard—length of fabric, mile—distance to Paris, light years—distance to stars
4. Answers will vary depending on the objects and units chosen. Note that finger length, arm length, etc. should be accepted as "objects."
5. Students will need to go outside and measure the height of one part of the school to arrive at the estimate. Their written estimates should show how the height of the school is based on their measurements (e.g., 10 bricks are 24" high, the school is 200 bricks high [20 groups of 10], so its height is about $20 \times 2'$ or 40 feet).

Part B

The point of the two tape measures is the issue of precision. A greater number of marks used to subdivide a unit makes it possible to refine a measurement. Although a more precise answer can be obtained by using an instrument with more subdivisions, students should realize that an exact answer is impossible. Answers will vary.

Part C

1. It is better to come up with a good estimate when a measurement is not necessary or appropriate. Examples are how much food to serve for dinner, how long it will take to drive to school, and how many miles you can drive before you must fill up the family car with gasoline. If I am paying for fabric, I expect the material to be measured, probably to the nearest inch. If I am laying carpet or putting up drapes, rounding to the nearest inch may cause the carpet to buckle or leave a gaping hole.
2. Answers will vary. All jobs include some form of estimation.

Closing Discussion

Did your estimates improve as you got more experience? Hopefully, students will find that their estimates get better as they go along.

Collection of data often includes measurement. How does decision-making require the use of data and hence measurement in determining who plays center on the basketball team? Some considerations might be player height, player arm span, number of shots taken and percentage made from within a given distance of the basket, jumping ability, and rebounding average.

Materials

penny, nickel, dime, quarter, half dollar, silver dollar, Susan B. Anthony dollar
ruler (cm with mm marked)
a postal scale or balance
calipers
tape measure (English) or yardstick or meter stick
Reference Sheet R1

Part A

1. Several years ago, when the prices of items in vending machines increased, it seemed like a good idea to mint a new silver dollar that was smaller than the silver dollar for use in these machines. The design for a Susan B. Anthony coin was commissioned and it was introduced with much fanfare. As you probably have noticed, however, we don't use the coin much today.

Measure the coins in as many ways as you can think of and offer some reasons for the failure of this coin. Justify your conjecture by using the measurements you made. If you had been commissioned to design the coin, what would you have done differently?

2. When we measure something, we are finding a number to describe something that is present in varying amounts but which we can't just count like we would count twenty dimes. One reason we measure is so that we can compare two items. It is difficult to tell how much two similar hams should cost just by lifting them. If I pay a fair price, the value or cost of a ham is tied to its weight. Cost, weight, length, and temperature are attributes that we measure. Dollars, pounds, centimeters, and degrees are units used to tell how much of the attribute an object has.

Make a list of attributes we commonly measure, and tell what unit or units are used to measure each attribute.

3. Sometimes many units are invented to measure the same attribute. For example, the weight of a pill is in milligrams, and the weight of a serving of spaghetti is in ounces. The weight of a person in America is in pounds. In England it used to be in stones and in France it is in kilograms. The weight of quarried stone is in tons.

Make a list of units in both the English and the metric system that are used in measuring the attribute of length. For each, tell what type of attribute you might measure with that unit. List at least ten different units.

4. Most of us don't carry around measuring tools. When a volleyball player wants to check the height of the net, she or he stands in the center of the court and raises their arm. Although it will vary from player to player, a spiker will know where the top of net should touch her or his arm (and will complain if the net is too high).

Use a ruler and tape measure to find objects in your classroom that you could use to approximate a millimeter, centimeter, decimeter, meter, inch, foot, and yard. Using the objects, estimate the width of a sheet of paper, the length of a car key, the length of the hall and the height of the desk. Check by using an appropriate measuring tool.

Estimating and Measuring Large Objects

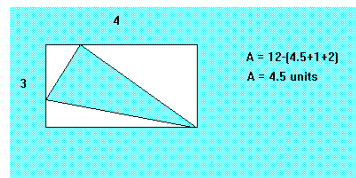
Record each measurement (including the unit of measure) in the table below. Measure 2 should be done using the tape measure with more precision.

Object	Estimate	Measure 1	Measure 2
length of classroom			
width of classroom			
height of classroom			
perimeter of classroom floor			
diagonal across classroom floor			
circumference of a person's head			
height of a person			

(Small-Group Activity)

Activity Summary: Students measure area and perimeter of various shapes.
Use with S2 and R2.

Introduction: Make a unit square on a geoboard. Ask students what its perimeter and area are. Make several other figures on the geoboard and help students find the area of each. (Note that for very unusual figures, it is often easiest to find the area by making a rectangle around the figure, calculating the area of that rectangle, and then subtracting the areas of the pieces of the rectangle that the figure does not enclose. See example below.) Also ask about perimeters, although if you have any non-rectangular figures, you will have to use the Pythagorean Theorem or settle for estimated lengths of diagonal sides. Continue until students are comfortable at finding the area of figures that are made and are able to approximate the perimeter.



Objectives

- To estimate, make, and use measurements to describe and compare phenomena.
- To extend understanding of the concepts of perimeter and area.
- To develop an appreciation of geometry as a means of describing the physical world.
- To understand and apply geometric properties and relationships.

Answer Key

Part A

1. The area is the length of one side multiplied by itself. The perimeter is 4 times the length of a side.
2. There are many possible answers; one is a 4 x 1 rectangle with a unit square sitting on top of it.
3. There are many possible answers; one is a square with sides 2 units long with a unit square attached.
4. The area is 0.5 square units. The perimeter is 3.4 units.
5. Another triangle with area 0.5 square units can easily be constructed by simply moving a vertex to the right or the left so that the base and height are still 1 unit. See following examples.

Part B

The scaling on R2 for the shapes drawn is 1 inch represents 10 meters. Students' answers should be in meters.

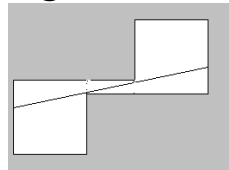
Shape	Area	Perimeter
A	1 in ² is 100 m ²	4 in is 40 m
B	0.5 in ² is 50 m ²	3.41 in is 34.1 m
C	0.5 in ² is 50 m ²	3.25 in is 32.5 m
D	0.25 in ² is 25 m ²	2.62 in is 26.2 m
E	2.1875 in ² is 218.8 m ²	6 in is 60 m
F	0.5 in ² is 50 m ²	4.09 in is 40.9 m

Part C

Designs and maximum weight tolerances will vary from group to group. One very effective method of creating a bridge is to simply fold the paper accordion style.

Closing Discussion

[Have students cut out the figure on R2 that is like the one below.]



Find the area of this shape. The area is 63 square units.

[Next, have students cut the shape out and also cut along the diagonal line to produce 4 pieces.] Make a square with these 4 pieces. What would you say that the area is? The area of the 8 x 8 square-like figure will appear to be 64.

Next, make a rectangle from the 4 pieces. What would you say that the area is now? The area of the 5 x 13 rectangular-like figure will appear to be 65.

Is it possible for the area to keep changing like this? Why does the area appear to be changing? Of course, it is not possible for the area to keep changing. The illusion is due to the fact that the shapes that are along cut edges on the interior of the larger square and rectangle look like squares but are not really squares.

Materials

- geoboard and rubber bands
- calculator
- ruler (English)
- 3 sheets of 22 cm x 28 cm paper (regular notebook paper)
- scissors
- glue or tape
- centicubes or other unit of mass
- Reference Sheet R2

Part A

1. On your geoboard, the horizontal (or vertical) distance between any two adjacent pegs is 1. Make three different squares of any size. For each, record the length of one side, the area and the perimeter.

SIDE = AREA = PERIMETER =

SIDE = AREA = PERIMETER =

SIDE = AREA = PERIMETER =

2. Find a shape with an area of 5 square units and with a perimeter of 12 units. Draw the shape below.

3. Find a shape with an area of 5 square units and with a perimeter of 10 units. Draw the shape below.

4. On your geoboard, make a triangle that is half the size of a unit square. What is its area? Now, use the Pythagorean Theorem and your calculator to find the perimeter (round your answer to the nearest tenth).

AREA = PERIMETER =

5. Now, find another triangle with an area of $\frac{1}{2}$ square units. Draw the shape below and record its perimeter.

PERIMETER =

Part B

You may have seen floor plans or other objects that are drawn to scale. In many occupations, a large object must be pictured in proportion to its actual shape and size. The Reference Sheet (R2) has scale drawings of several shapes. Suppose these shapes are really drawings of floors that are to be carpeted and new baseboards are to be installed.

You see a scale (the line labeled 10 m) on R2 that represents 10 meters. Use this scale to find measurements of the shapes and then to complete the table below. You may use a ruler. For each shape, find the area to be carpeted and the perimeter measurement for new baseboards. Round final answers to the nearest tenth of a meter.

Shape	Area	Perimeter
A		
B		
C		
D		
E		
F		

Part C

You may have noticed that construction materials come in a variety of sizes and shapes. Your task is to construct three bridge designs from regular notebook-sized paper and to see which design is the sturdiest. Build a structure from each sheet of paper that is at least 5 cm wide and spans the 15 cm between tables.

After creating a bridge design, determine how much weight it will hold as follows:

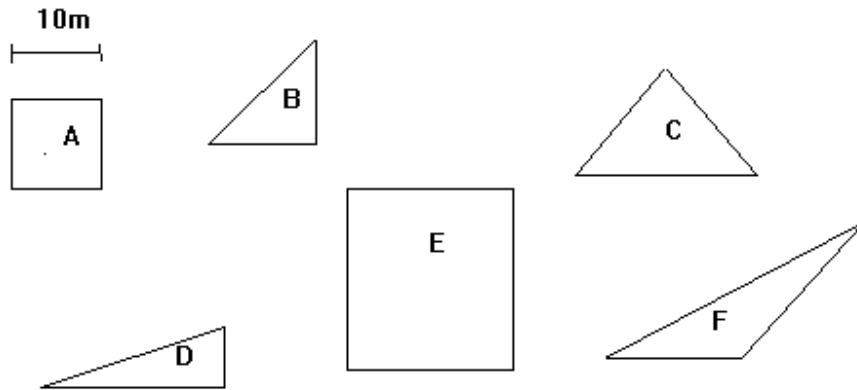
1. Place two flat tables 15 cm apart.
2. Place the design between the 15 cm space made with the desks.
3. Gently, put one unit mass at a time in the center of the structure.
4. The number of units the structure holds before buckling is its maximum loading.

Record your results in the table below.

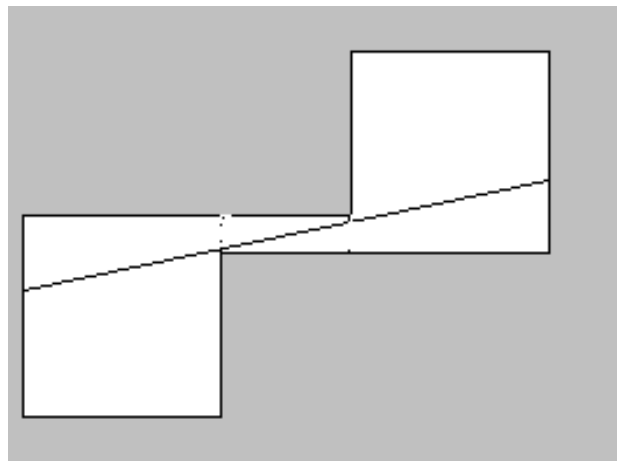
Design	Cross-Sectional Sketch	Maximum Loading (grams)
#1		
#2		
#3		

Part B: Scale Drawings of Shapes

The scale is indicated below.



Closing Discussion



(Small-Group Activity)

Activity Summary: Students compute the volume and surface area of objects. Use with S3 and R3.

Introduction: You have found the length, width, perimeter and area of different objects. Suppose you are interested in how much combined area the walls, floor, and ceiling of your classroom occupy. How would you determine this? This is known as surface area. Name some other examples of surface area. *Examples include the outside surface of an object like a globe, a book, a person.* What is the surface area of a box without a lid? *The surface area is the inside and outside of all the sides and bottom.* What is the volume of an object? *Volume is the amount of space an object occupies.*

Objectives

- To estimate, make, and use measurements to describe and compare phenomena.
- To extend understanding of the concepts of area and volume.

Answer Key

Part A

1. Surface area measurement is in square units (e.g., cm^2 or ft^2).
- 2a. The surface area to paint is 3754 cm^2 . See individual calculations below:
 - 2 side pieces ($57 \text{ cm} \times 9 \text{ cm}$ each) = 1026 cm^2
 - 2 end pieces ($34 \text{ cm} \times 9 \text{ cm}$ each) = 612 cm^2
 - 1 bottom piece ($57 \text{ cm} \times 34 \text{ cm}$) = 1938 cm^2
 - 4 top rims (2 at 57 cm^2 and 2 at 32 cm^2) = 178 cm^2

The area above assumes that the box edges are angled so that there is no overlapping. Student answers may vary depending on how the construction of the box is defined.

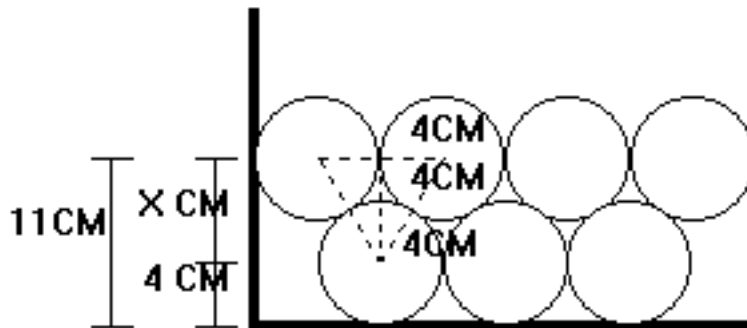
- 2b. The total surface area of the box is 6906 cm^2 . The outside surface area was calculated in #2a. The individual inside calculations follow. The inside measurements for length and width are 2 cm less than the outside (55 cm and 32 cm respectively); the inside bottom measures $55 \text{ cm} \times 32 \text{ cm}$. The height is 1 cm less than the outside (8 cm).

- 2 side pieces with inside area ($55 \text{ cm} \times 8 \text{ cm}$ each) = 880 cm^2
- 2 end pieces with inside area ($32 \text{ cm} \times 8 \text{ cm}$ each) = 512 cm^2
- 1 bottom piece with inside area ($55 \text{ cm} \times 32 \text{ cm}$) = 1760 cm^2

3. Answers may vary since there will be some overlap needed when wrapping the paper around the box. A piece of paper that will go completely around the box with an extra 2 cm to tape it shut and enough to cover the sides is 88 cm x 68 cm.
4. The inside dimensions of the side and end of the box are 55 cm and 32 cm, so 1760 one-centimeter cubes fill the bottom of the box.
5. There are 8 layers needed to fill the box, so the volume of the box is 8 cm x 55 cm x 32 cm or 14,080 cubic cm.
6. The biggest ball that will fit in the box without rising above the rim is 8 cm in diameter since the height of the box is 8 cm.

In all, 27 such balls can fit in the box; 6 rows with 4 balls to a row and one row with 3 balls. Explanation: It is easy to see that 4 balls will fit along the 32 cm width of the box and that 6 such rows will fill 48 cm in length. The remaining 7 cm can accommodate 3 balls that fit between adjacent balls in the last row of 4 balls. See diagram below.

Top of the view



The distance from the center of the last row of 4 balls to the end of the box, $x + 4$ cm, must be less than 11 cm for the balls to fit. To find x , use the Pythagorean Theorem, . Since, , the last 3 balls just fit.

Closing Discussion

How many balls and of what size do you think would fit in the box if packing material is to be used around the sides of the balls. Answers will vary depending on the packing material used (bubble wrap, Styrofoam peanuts).

Plain Wooden Box

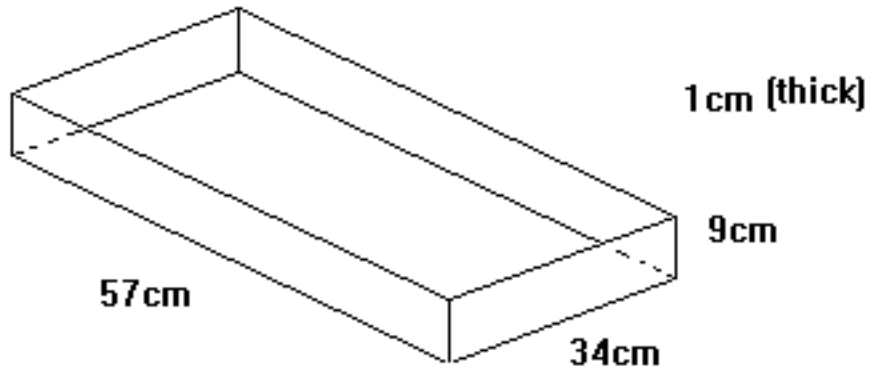
Outside Dimensions:

Height: 9 cm

Length: 57 cm

Width: 34 cm

Wall thickness: 1 cm



(Small-Group Activity)

Activity Summary: Students learn about scale while working with scale drawings of floor plans. Use with S4 and R4.

Introduction: Obtain pairs of items where one can be considered a scaled version of the other. Flower pots, picture frames, and objects that students know the dimensions of work well. Start the discussion with something like the following. I have two flower pots. One is 10 cm high, the other is 30 cm high. How many times higher is the larger pot? What is the scale to get from the larger to the smaller pot? I have a toy car that is 20 cm long. A real car is about 6 meters long. What is the scale to get from the smaller to the larger car? Put another way, how many centimeters represent each meter.

As part of this lesson, students convert square feet to square yards, so you may wish to discuss how to do this. Drawing a square yard on the blackboard (or identifying one on your floor if you have a tile floor) and showing why you divide by 9 to convert will be helpful to students.

Objectives

- To extend understanding of the process of measurement.
- To understand the concept of a scale for scale drawings.

Answer Key

Part A

Room	Length (ft)	Width (ft)	Floor Area (ft ²)
Bedrooms	1. 14.5	1. 15	1. 217.5
	2. 10.1	2. 13.7	2. 138.4
	3. 11.9	3. 9	3. 107.1
Bathrooms	A. 8	A. 8	A. 40
	B. 5	B. 5	B. 40
Living Room	11.3	23.7	267.8
Kitchen	8	8	64
Storage	4	5	20
Balcony	12	6	72

1. The area to be carpeted is 730.8 sq. ft. The cost for this amount of carpet is \$2030. In practice, however, measurements are often rounded; the cost will actually be higher. Allow answers that take rounded measurements into account.
2. The cost of 144 sq. ft. of linoleum is \$160. The cost of 12 boxes is \$96.
3. The surface area of the wall is about 560 sq. ft.
4. The apartment appears to be about 23.7 feet by 52.8 feet for a total of about 1251 sq. ft. Therefore, the balcony is not part of the advertised living space of 1253 sq. ft.

Part B

1. The scale is displayed on the floor plan as $\frac{3}{8}'' = 1'$.
2. Including the balcony, the living space is about 928 sq. ft. The living space can be divided into 3 rectangles and a triangle, less a small rectangle in the upper right. Rectangle #1 includes the den, master bedroom, bathroom, and closet for about 429 sq. ft. (less the rectangle in the upper right). Rectangle #2 includes the living room, kitchen, and part of the den for about 324 sq. ft. Rectangle #3 includes the rest of the den and space above the living room for about 56 sq. ft. The triangle includes the storage area, entry, and miscellaneous space for about 119 sq. ft.

Room	Length (ft)	Width (ft)
Bedroom	12.5	18
Living Room	12	13.5
Bathroom	8	12
Walk-in Closet	7	7
Dining Room	9	9
Kitchen	8	8
Den	9	10
Storage	9	9
Balcony	4	13.5

Room	Implied Area (ft ²)	Actual Area (ft ²)
Bedroom	225	$225 - 7.5 - 20 = 197.5$
Living Room	162	-----
Bathroom	108	$108 - 15 = 93$
Walk-in Closet	49	-----
Dining Room	81	-----
Kitchen	64	-----
Den	90	$90 - 7.5 = 82.5$
Storage	40.5	-----
Balcony	54	-----

Closing Discussion

Suppose that the toy car actually belongs to an elf. How tall is the elf? How would you estimate the elf's height without actually seeing her or him? *One possibility is to consider the scale of the car and find the size of the elf using the same scale.* The discussion could be extended with other objects. For example, suppose your largest flower pot was a coffee cup for a giant. How tall is the giant?

Materials

- ruler (English)
- calculator
- Reference Sheet R4

Part A

Find the 3-bedroom floor plan on the Reference Sheet, R4 (page 1). Fill in the table with the dimensions of each room. Round measurements to the nearest tenth.

Room	Length (ft)	Width (ft)	Floor Area (ft ²)
Bedrooms	1. _____	1. _____	1. _____
	2. _____	2. _____	2. _____
	3. _____	3. _____	3. _____
Bathrooms	A. _____	A. _____	A. _____
	B. _____	B. _____	B. _____
Living Room			
Kitchen			
Storage			
Balcony			

1. If you wanted to carpet the bedrooms and living room, how much area would you tell the store you have? If the carpet you want is \$25 per square yard, how much would you have to pay? (Remember to convert square feet to square yards.)

Area to be carpeted: _____ sq. yds. Cost for new carpet:

2. Suppose you wanted to replace the flooring for the bathrooms and kitchen with either linoleum or tile. Linoleum is \$10 per square yard. Tile, in one-foot squares, is \$8 per box of 12 tiles. What is the cost for each material?

Cost of linoleum: _____ Cost of tile: _____

3. The ceiling is 8 feet high. Ignoring windows and doors, find the wall area of the living room.

Living room wall area: _____

4. The apartment advertisement says that the total area is 1253 sq. ft. Does this include the balcony? Explain your reasoning.

Part B

Find the 1-bedroom floor plan on the Reference Sheet, R4 (page 2).

1. What is the scale of the floor plan drawing?

_____ in. = _____ ft.

2. Estimate the number of square feet in this apartment. Explain how you made your estimate.

Using the 1-bedroom floor plan, fill in the tables below. In the first table, simply record the dimensions of each room as it is written in the scale drawing. Find the "Implied Area" of each room for the second table by using the dimensions you already recorded. You will notice that this area is often greater than the actual area of the room because of irregular shapes. Use a ruler to find the "Actual Area" of the bedroom, bathroom, and den.

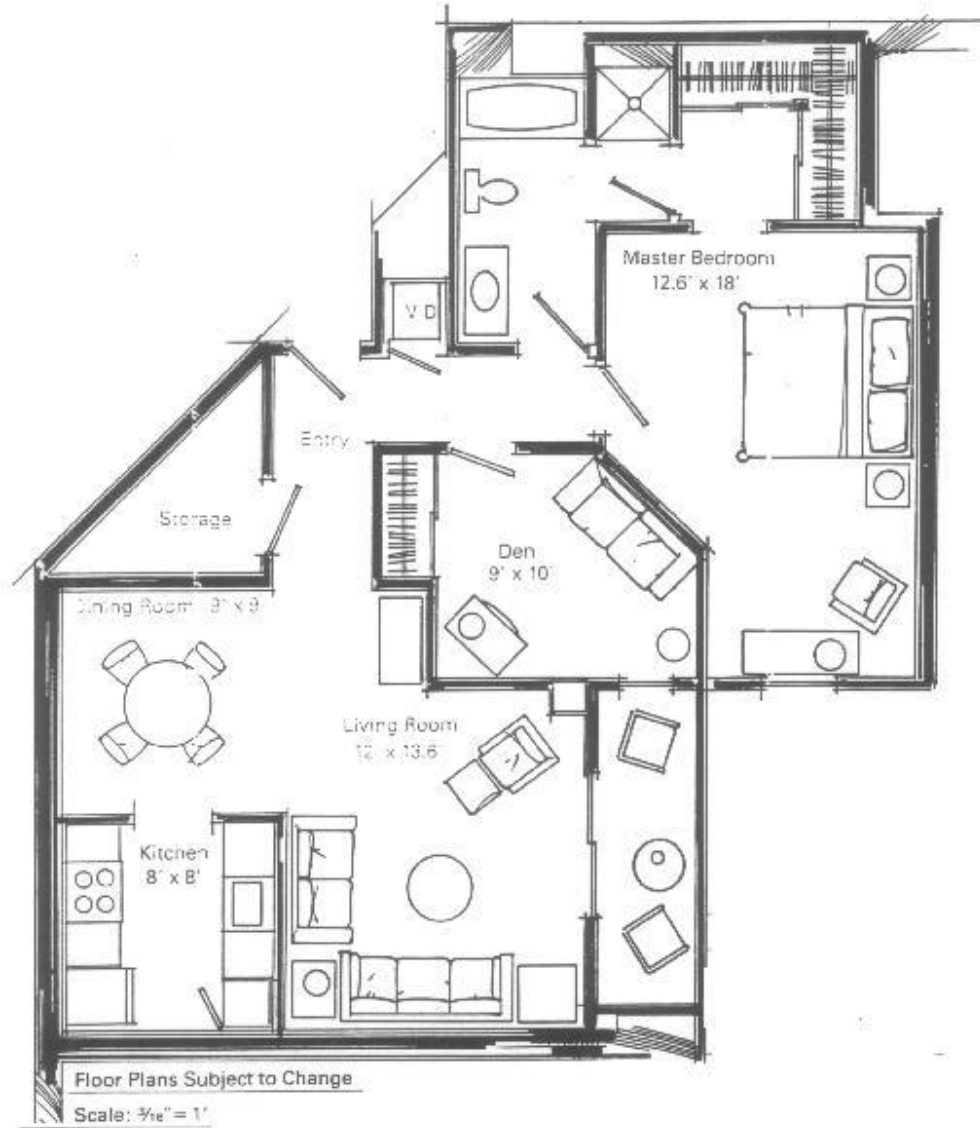
Room	Length (ft)	Width (ft)
Bedroom		
Living Room		
Bathroom		
Walk-in Closet		
Dining Room		
Kitchen		
Den		
Storage		
Balcony		

Room	Implied Area (ft²)	Actual Area (ft²)
Bedroom		
Living Room		-----
Bathroom		
Walk-in Closet		-----
Dining Room		-----
Kitchen		-----
Den		
Storage		-----
Balcony		-----

3-Bedroom Floor Plan



1-Bedroom Floor Plan



(Small-Group Activity)

Activity Summary: Students estimate the cost of refurbishing the locker room at their school. Use with S5 and R5.

This activity requires several days to complete. A previous trial of this activity took 8 partial class periods, in addition to outside class time. It is recommended that at least 3 students be assigned to a group so that the work can be adequately divided.

Note: The student sheets have been prepared so that you can have students estimate the cost of refurbishing a room other than a locker room. Labor costs have not been included in the report because it is difficult for students to make valid estimates of the time needed to complete remodeling work. If a local remodeler were available to give students an idea of labor costs for a given project, labor costs could be added to the project.

Introduction: Discuss remodeling projects with the students, focusing on how they estimate materials needed and where they might go to buy materials. Discuss how to determine quality of materials, for example, consideration of paint that comes with a 5-year versus a 3-year warranty. *Answers will vary and it is doubtful that you will come to any firm conclusions other than that more expensive materials usually last longer.* Discuss how contractors make decisions about how much they should bid to do a job. If available, show students a Contractor's Means Book for your area and discuss how it helps in bidding remodeling projects. (A Means book lists prices for various building materials and gives estimates of the time it takes to do various construction tasks.)

Objectives

- To extend understanding of the process of measurement.
- To solve measurement-related problems from everyday life.
- To collect data from sources outside of the classroom.

Answer Key

Part A

1. *The measurements must be rounded up so that enough paint or carpet is purchased. Be careful not to round up too much because you have to pay for the unused material. With carpet, it is also important to consider how the seams will run (most carpet is sold in 12-foot widths). You don't want to have a seam running across the path students use to enter the room!*

2. *Rounding to estimate area can be done before finding wall or floor area (e.g., round an 11-foot 8-inch wall to 12 feet), or after finding area. The latter is more exact, but rounding before you multiply usually results in easier numbers to work with (e.g., you can work with whole numbers of feet).*
3. *5 one-gallon cans of paint are needed. Assuming that the paint covers 450 sq. ft. as the label suggests, one can will not be completely used.*
4. *A square that is one yard long on each side is 1 square yard (1 yard x 1 yard = 1 sq. yd.). The same square is 3 feet on a side and so it is 9 square yards (3 feet x 3 feet = 9 sq. ft.). Divide square yards by 9 to get square feet since there are 9 square feet per square yard.*

Part B

According to the Locker Room Remodeling Project Scoring page (see R5, p. 14), six tasks (or groups of tasks) will be graded. Measurements will vary by group and estimates will depend on the materials used; consideration should be given to a variety of responses. However, the following scoring rubric is recommended for the six tasks.

Grade

- A** - These projects have the following characteristics: measurements are accurate and rounded appropriately; calculations are accurate; group/individual shows excellent evidence of planning and attention to detail; assumptions and procedures are clearly expressed; proposals are realistic, creative, and appropriate.
- B** - These projects have the following characteristics: information is not as clear, accurate, inventive, well-planned, detailed, or appropriate, but the overall proposal is good.
- C** - These projects have the following characteristics: information is deficient in some respect, such as clarity, creativity, planning, or detail, but the overall proposal is adequate.
- D** - These projects have the following characteristics: major problems with proposal task that make it unsatisfactory, but the task has some redeeming qualities.
- F** - These projects have the following characteristics: little or no effort extended toward the proposal task, or completely inadequate proposal.

Closing Discussion

Have groups make an oral presentation.

Use the Written Proposal Guidelines (see R5, p. 13) as a catalyst for discussion. Have students determine the reasons for their different cost estimates.

Materials

tape measure
calculator
quarter-inch graph paper
Reference Sheet R5

Part A

1. The first major task in painting and carpeting a room is to determine how much paint and carpet are needed. When you measure the room, is it appropriate to round your calculations for area to be painted and carpeted up or down? Explain your reasoning.
2. Could the area to be carpeted be found by rounding up after multiplying the original measurements for length and width?
3. A one-gallon can of paint covers 450 sq. ft. If 2 rooms, each 28 ft. by 36 ft. and 8 ft. high, are to be painted, how many cans of paint are needed?
4. Explain why it is necessary to divide square feet by 9 to get square yards? (see R5, p. 3)

Part B

The Athletic Department has decided to remodel the locker room. The walls are to be painted, the floors are to be carpeted, and new lockers are to be installed. Part of the locker room is to be fixed up as a meeting room. Your group is to make a bid to do the remodeling. Your group must measure to see how much paint and carpet is needed, decide on the number and arrangement of lockers, and suggest any special features that should be added. You will visit local stores to gather information for your bid.

This activity will be done over several days. There are a number of activities for you to complete.

- I. Get room measurements.
- II. Plan (make a scale drawing).
- III. Gather data about paint, carpet, lockers, and special features.
- IV. Make decisions about materials.
- V. Prepare a bid (report your results).

Since you will have others in your group, you should divide the work fairly. The reference sheets will be used to gather and analyze data for your bid. For some activities, there are different tasks to be done. You should have a different person perform each task (the person doing the measurement should not be the one rechecking its accuracy). Use the following guidelines when completing the activities:

- I. Get Room Measurements
 - A. Each group must get its own measurements (ignore shower and restroom areas).
 - B. Make a rough sketch of the floor.
 1. Label each wall with a letter.
 2. Label each floor area with a number.
 - C. Record the floor and wall measurements on R5, page 1.
 - D. Record window and door measurements on R5, page 1.
 - E. Record rounded wall measurements on R5, page 2.
 - F. Record rounded floor measurements on R5, page 3.
- II. Plan (make a scale drawing).
 - A. Get a sheet of graph paper ($\frac{1}{4}$ " paper will work well).
 - B. Decide on a scale for your scale drawing.
 - C. Put the scale on the graph paper (1 in = ? ft.).
 - D. Use your rough floor drawing to make an accurate drawing to scale.

- III. Gather data about paint, carpet, lockers, and special features.
 - A. Decide who will fill out R5, pages 4-11.
 - B. Follow directions on R5, pages 4, 6, 8, and 10 (fill out these pages).
 - C. Complete the scale drawing with lockers and special features (lockers, tables, mirrors, etc.).

- IV. Make decisions about materials.
 - A. With your group, fill out R5, pages 5, 7, 9, and 11.
 - B. Summarize your bid by filling out R5, page 12.

- V. Prepare a bid (report your results).
 - A. Record your costs on R5, page 13 (bottom).
 - B. Use the instructions on R5, page 13, to report on your proposed bid.

The points used to score these activities are listed on R5, page 13.

**Room Measurements
 (Paint & Carpet)**

Date: _____ Building: _____ Location:

Team Members:

Recorded by: _____ Measured by:
 _____ Checked by: _____

Record the length and height of each wall in feet. For each wall, also record the measurements of any large windows or other features of the room that will not be painted.

Wall	Length (ft)	Height (ft)	Windows, etc.
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			

**Wall Calculations
(Paint)**

Date: _____ Building: _____ Location:

Team Members:

Recorded by: _____ Measured by:
_____ Checked by: _____

Round all measurements up from the Room Measurements page and record the results below.

Wall	Rounded Length (ft)	Rounded Height (ft)	Area = L x H (sq ft)
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			

Total Painted Area (square feet):

--

**Floor Calculations
 (Carpet)**

Date: _____ Building: _____ Location:

Team Members:

Recorded by: _____ Measured by:
 _____ Checked by: _____

Round all measurements up from the Room Measurements page and record the results below.

Area	Wall & Length (ft)	Wall & Width (ft)	Area = L x W (sq ft)
1			
2			
3			
4			
5			
Total Carpeted Area (square feet)			
Calculated Area (square yards) [divide area in square feet by 9]			
Rounded Carpeted Area (square yards)			

**Paint Supplier Report Page #1
 (Paint)**

Visit at least two paint stores and talk with a salesperson for their advice, assistance, and price quotations. During your data gathering, consider the following questions: Why were certain paints identified while others were ignored? Are the paints reported a reasonable cross-section of those available? How do you know?

Total area to be painted (from calculation page): _____ sq. ft.

Date: _____ Contacted by:

Business #1 _____ Telephone #

Business #2 _____ Telephone #

Bus. #1 or #2	Type of Paint	Brand	Color(s)	Coverag e	Cost Per Gallon	Qty. Needed	Total Cost

Other information (durability, guarantees, special instructions, preparation, clean-up):

**Paint Supplier Report Page #2
 (Paint)**

Team Members:

Your group must select the type of paint to use. Businesses often decide on which materials to use by rating the attributes of the competing materials. How will fairness in your selection process be assured? Will ratings of attributes apply to all brands?

Attribute	Order of Importance	How will this attribute be assessed?
Cost		
Color selection		
Type of paint		
Durability		
Preparation		
Clean-up		
Number of coats		
Drying time		
?		
?		

Describe how you evaluated each attribute. What was the rating for each paint?

Type of paint chosen	
Reason for its choice	

**Carpet Supplier Report Page #1
 (Carpet)**

Visit at least two carpet stores and talk with a salesperson for their advice, assistance, and price quotations. During your data gathering, consider the following questions: Why were certain carpets identified while others were ignored? Are the carpets reported a reasonable cross-section of those available? How do you know?

Total area to be carpeted (from calculation page): _____ sq. yds.

Date: _____ Contacted by:

Business #1 _____ Telephone #

Bus. #1 or #2	Type of Carpet	Brand	Color(s)	Special Features	Cost Per Sq. Yd.	Qty. Needed	Total Cost

Other information (durability, warranties, special features, preparation, etc.):

**Carpet Supplier Report Page #2
 (Carpet)**

Team Members:

Your group must select the type of carpet to use. Businesses often decide on which materials to use by rating the attributes of the competing materials. How will fairness in your selection process be assured? Will ratings of attributes apply to all brands?

Attribute	Order of Importance	How will this attribute be assessed?
Cost		
Color selection		
Type of carpet		
Durability		
Warranty		
Special features		
Padding required		
?		
?		

Describe how you evaluated each attribute. What was the rating for each carpet?

Type of carpet chosen	
Reason for its choice	

**Locker Supplier Report Page #1
 (Lockers)**

Review at least two locker supply catalogs. During your data gathering, consider the following questions: Why were certain lockers identified while others were ignored? Are the lockers reported a reasonable cross-section of those available? How do you know?

Date: _____ Contacted by:

Business #1 _____ Location

Business #2 _____ Location

Bus. #1 or #2	Type of Locker	Brand	Color(s)	Dimension s	Cost Per Unit	Qty. Neede d	Total Cost

Other information (warranties, installation, preparation, etc.):

**Locker Supplier Report Page #2
 (Lockers)**

Team Members:

Your group must select the type of locker to install. Businesses often decide on which materials to use by rating the attributes of the competing materials. How will fairness in your selection process be assured? Will ratings of attributes apply to all brands?

Attribute	Order of Importance	How will this attribute be assessed?
Cost		
Color selection		
Type of locker		
Durability		
Warranty		
Installation		
Size		
?		
?		

Describe how you evaluated each attribute. What was the rating for each type of locker?

Type of locker chosen	
Reason for its choice	

**Special Feature Supplier Report Page #1
 (Special Features)**

Use this form to specify special features in your plan, such as seating, mirrors, and tables. You may visit a vendor or refer to catalogs. During your data gathering, consider the following questions: Why were certain brands identified while others were ignored? Are the brands reported a reasonable cross-section of those available? How do you know?

Date: _____ Contacted by:

Business #1 _____ Location

Business #2 _____ Location

Bus. #1 or #2	Feature	Brand	Color(s)	Dimension s	Cost Per Unit	Qty. Neede d	Total Cost

Other information (warranties, installation, preparation, etc.):

**Special Feature Supplier Report Page #2
 (Special Features)**

Team Members:

Your group must select the brand to use. Complete this sheet for each special feature included in your bid. How will fairness in your selection process be assured? Will ratings of attributes apply to all brands?

Special feature: _____

Attribute	Order of Importance	How will this attribute be assessed?
Cost		
Warranty		
?		
?		
?		
?		

Describe how you evaluated each attribute. What was the rating for each brand?

Type chosen	
Reason for its choice	

Measurement Unit

Project Cost Summary Page

Date: _____ Building: _____ Location:

Team Members:

Recorded by: _____ Measured by:
_____ Checked by: _____

Summarize the cost of all features in your plan.

Material Costs (Itemize)	From R5, Page #	Total Material Cost
Paint		
Carpet		
Lockers		
Special Features		
Total Project Cost		

Written Proposal Guidelines

Using the packet you have developed, write a one- or two-page proposal for the project. Attach the packet of material to this proposal. Write your proposal to sell your services and to win the contract for the project. The report should include separate paragraphs for the following:

Paragraph 1: Tell which business you would buy the paint from, how many gallons would be purchased, what color would be used, what type of paint, the manufacturer of the paint, and the total cost of the paint.

Paragraph 2: Tell which business you would buy the carpet from, how many square yards would be purchased, what color would be used, the type of carpet, the manufacturer of the carpet, and the cost.

Paragraph 3: Tell which business you would buy the lockers from, how many lockers, the color, the type of locker, the manufacturer of the lockers, and the total cost of the lockers.

Paragraph 4: Give the details for special feature #1 telling which business you would buy it from, state what the item is, its color and dimensions, how many you will purchase, and the total cost.

Paragraph 5: Give details for special feature #2; see guidelines for paragraph 4.

Paragraph 6: What did your group learn? Do you think it was worthwhile? What could have been done differently?

Project Cost Summary: Write this out at the end of your report and fill in the numbers using the last page of your packet.

Project Cost Summary

Paint	\$ _____
Carpet	\$ _____
Lockers	\$ _____
Special feature #1	\$ _____
Special feature #2	\$ _____
Total project cost	\$ _____

