Unit 1 – Tape Measure Math

Objective

Each student will learn to measure accurately with a measuring tape and to understand fractions and how they are applied in the workplace. Students should become familiar enough with reading a tape so that it becomes second nature.

Skills

Each student will gain the following skills from this unit:

a. Read and use a tape measure to determine measurements.
b. Add, subtract, multiply and divide whole numbers and fractions with and without a calculator.
c. Understand the difference between the English system and metric system of measurements.

Instructor Preparation

Study Unit 1 – Tape Measure Math. Consider the several activities that are provided in this unit. Determine how to best present the several sections of the unit. You may find that your students learn better by breaking up the unit and mixing it into several other units and/or activities. This unit may require more one-on-one time with students. Be prepared to keep each student working on a related activity while you take time to assess each student's progress.

Materials & Equipment

It is suggested that each classroom be equipped with the following:

a. Hard hat & safety glasses.
b. Tape measure with 1/16" markings.
c. Various pieces of wood in varying lengths and widths. Label the pieces of wood from A to Z.
d. Calculator.

Suggested Unit Development

This unit includes several activities. You may choose to work these problems as a group or individually. However you choose to teach the material, have the students read aloud the written sections and discuss the principles taught as you go. You may want to prepare some additional problem sets in case you observe the students needing additional time to understand the material.

2.1.0 Introduction

Using the 10 to 20 pieces of wood available, have the students work in groups to determine the length and width of each piece. This unit has a number of activities and exercises to help you learn to use a tape measure and understand some basic math skills.

2.1.1 How to Read a Tape Measure

Step 1. Look at the big number that is nearest to, but before the mark you are trying to read. It will be a whole number. That is how many inches you are measuring. If the mark you are reading falls on a whole number, then that number is all the information you need.

Step 2. Count how many marks there are in between each inch if the mark you are reading does not fall on a whole number. Most tape measures will divide an inch into 16 equal parts, or sixteenths, but some only go down to eighths of an inch.

Step 3. Start at the whole number you found nearest your desired mark and count the number of marks between the whole number and the spot you are trying to read.

Step 4. Read the final number as inch and fraction. For example, if your nearest whole number is two and there are five marks between your spot and the whole number, then your measurement would be 2-5/16, or two and five-sixteenths (on a tape measure with inches divided into 16 equal parts).

Step 5. Simplify the number, if necessary. Fractions are expressed in the smallest numbers possible, so twelve-sixteenths would be reduced to three-fourths.

Understand what 1/16 is. 1/16 (one-sixteenth) of an inch is usually the smallest measurement on a tape measure. The distance between every line on the tape measure is 1/16 of an inch.

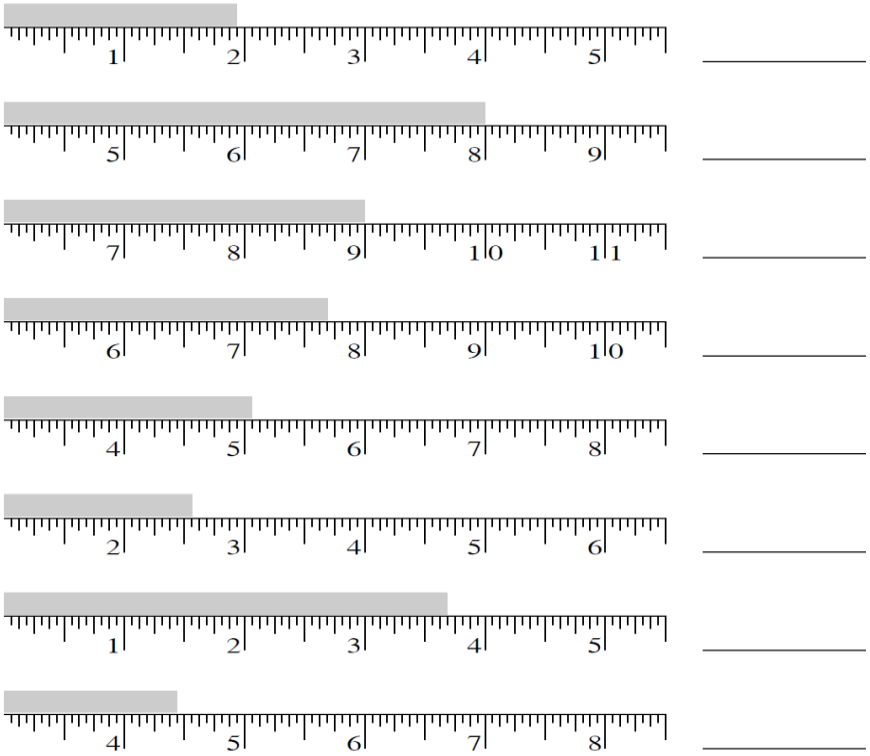
Understand what 1/8 is. 1/8 (one-eighth) of an inch is twice as big as 1/16 of an inch. It is every other mark. Notice we have dotted every other one. 1/8 is twice as big as 1/16.

Understand what 1/4 is. 1/4 (one-quarter) of an inch is twice as big a 1/8 of an inch. It is every fourth mark. Also note 1/4 is 4 times as big as 1/16.

Understand what 1/2 is. 1/2 (one-half) of an inch is twice as big as 1/4. It is four times as big as 1/8 and eight times as big as 1/16.

Understand what an inch is. The large markings on the tape measure are inches. They are numbered to proceed (from the left) the mark. An inch is twice as big as 1/2, 4 times as big as 1/4, 8 times as big as an 1/8, and 16 times as big as 1/16. Do you see the pattern?

Read these tape measurements.



2.1.2 Equivalent Fractions

Notice that 1/2 = 2/4 = 4/8 = 8/16. Each is just multiplying by 2/2, which is the same as 1. Multiplying anything by 1 gives you the same amount.

Notice if 1/2 is twice as big as 1/4, then two 1/4 added together is 1/2 of an inch.

2 x 1/4 = 1/2, or we could write 2/4 = 1/2
Other examples:
2/16 = 1/8
4/16 = 2/8 = 1/4
8/16 = 1/2

Identify as many equivalent fractions as possible on the board. Do you have them all?

Conversions: Notice that 5/4 = 1-1/4.

10/4 = _____

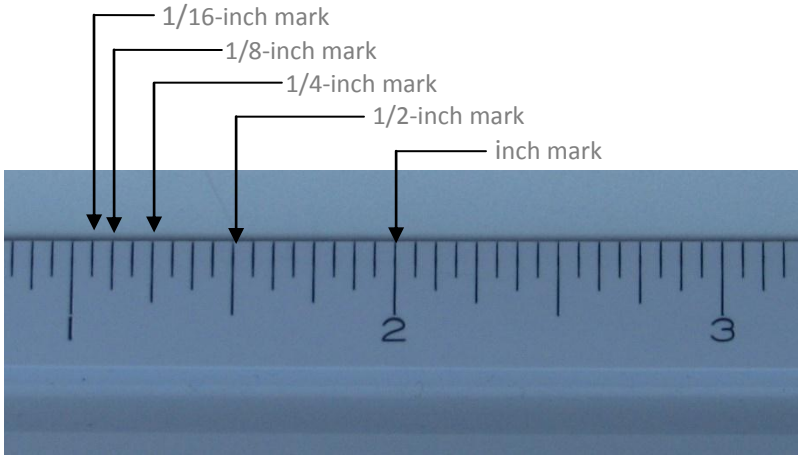
1-15/16" = ___/16"

12/8 = _____"

1' 8" = _____"

98" = _____' _____"

Here is a ruler divided into 16 equal parts. The meaning of each mark is indicated:



As the marks go down in size, the denominator of the fraction doubles. The biggest mark between two inch marks is the half inch mark. The next biggest is the quarter inch, and so on. To find eighths, go down the scale finding 1/2, then 1/4, then 1/8. All the marks that are that size or bigger are 1/8, 2/8 (which is the same as 1/4), 3/8, 4/8 (which is the same as 1/2), 5/8 and so on. You can count all the marks that are the same size, counting only the odd numbers, 1/8, 3/8, 5/8, 7/8.

2.1.3 Lab Activity:

Proceed to the floor layout in the lab.

Identify the floor joists. How long is each one to the nearest 1/16-inch? _____

Are they all the same length? _____

Measure each one

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

_____feet _____inches

How many board feet of floor joists are there? _____

How far apart are the floor joists? _____

How far apart are the centers of each floor joist?

Fact:

Have you noticed there is a small diamond (or triangle depending on the brand) on all tape measures every 16 and 19.2 inches? The 16-inch mark is for marking the placement of studs at 16" on center.

The 19.2-inch diamond (or triangle) is for placing five studs in a wall over an 8-foot space rather than four or six studs.

If you divide five into 96 inches, it will give you 19.2 inches. In other words, 4 into 96" = 24", 5 into 96" = 19.2", and 6 into 96" = 16". These are the measurements for centering wall studs.

2.1.4 Fun with a Tape

A tape measure is a number line. You can move forward (adding) or backwards (subtracting). Pick a point, say the 5' line, and call that zero; show that you can move left to explain how we get negative numbers. Draw a point on the wall board and measure +10 inches and -10 inches, explaining on a number line that negative numbers are left of center.

http://www.youtube.com/watch?v=FVfHERxg9mE

The picture describes simple addition. Where the numbers cross over, the end of the tape provides the answer.

For example: 43+5 = end of tape 48. 44+4 = end of tape 48.45+3 = end of tape 48 and so on.

Warning: Do not to permanently bend the tape measure by bending too sharply.

Try something a little more challenging: 39-5/8 + 6-9/16 = 46-3/16. Play with this technique in subtraction. You can become quite proficient in a short while.

Within the inch: 3/8 + 3/8 = 6/8 or 3/4, right? 60" is the starting point. Go to 60-3/8. Put the lower tape on any start point. We're using 13 in this photo. Go over 3/8 towards the 12, now 'cross' to the top for the answer: 3/4. No long hand needed when you are familiar with a tape.

The tape measure will allow you to introduce mixed numbers quickly into the classroom and also to frame the discussion of adding unlike fractions and equivalent fractions.

2.1.5 Addition with a Tape

To add with a tape, we mark the first number, move our tape to that mark, and measure off the second number in the same direction. Addition when we have only feet, inches, or fractions is just addition. It becomes much more interesting when we are measuring and end with a mixed number which could be in feet, inches and a fraction. Handle the parts separately beginning with the largest unit, and then you may need to clean up the answer. Example:

```
   5' 6"
+ 9' 3"
  14' 9"
```

Simple enough, but what happens when you have more inches than there are in a foot?

```
   5' 6"
+ 9' 11"
  14' 17"
```

In this case, we need to carry across the units to convert the answer from 14' 17" to 15' 5".
The same thing can happen with a fraction.

```
  3' 7-1/2"
+2' 5-3/4
 5' 12-5/4"   This answer would convert to: 6' 1-1/4"
```

Exercise:

5-1/16 + 4-1/14 = _____

3-1/8 + 8-1/2 = _____

1' 8-3/4" + 5' 4-1/2" = ____' _____"

12' 9' + 3' 4-1/2" + 7' 3-1/16" = ____' _____"

2.1.6 Carry and Borrow

When we first learned to add, we learned about units: Ones, tens, hundreds, thousands, and so forth. Whenever we have a sum greater than 9 in any column, we will need to carry over into the next column. Example:

```
  17
+ 14
= 31
```

In order to get the answer (31), we had to carry the one after we added 7 + 4. The sum from the "ones" column added up to 11. We leave the 1 from the "ones" column and carry the 1 from the "tens" column over. We then have three 1s in the "tens" column which adds up to 3.

Try these:

```
  13        219        42
+ 62      + 188      + 159
```

When using a tape measure, this comes up often. 12" = 1', so 13" is the same as 1' 1".

A fraction of an inch works the same way. 8/16 + 9/16 = 17/16, which is the same as 1-1/16".

Try these:

```
  7/8       3/16       3/4
+ 5/8     + 9/16     + 3/4
          + 7/16
```

When the fractions do not share the same denominators (the bottom number in the fraction), we make the problem easier if we convert them to have a common denominator.

Example:
Add 1/2 and 1/4. First convert 1/2 to share a common denominator with 1/4.
1/2 = 2/4, so simply add 2/4 and 1/4 to get 3/4.

Try these:

```
  7/8       3/16       6/8
+ 1/4     + 3/8      + 3/4
          + 1/2
```

Hint: Remember to convert so that 9/8 is written as 1-1/8.

Next, we are going to learn subtraction. It works the same as carrying over in addition only we shift to the right (borrow). It is easiest if we borrow what we need in advance.

Example:

```
   12
 - 3-1/8
```

This is the same as if we had written:

```
   11-8/8
 - 3-1/8
```

Solve the fraction first: 8/8 – 1/8 = 7/8

Then, complete the problem by subtracting the whole numbers: 11 – 3 = 8

The answer is 8-7/8.

Try these:

```
   35          42          11          1'
 - 12-1/4    - 6-1/2     - 9-15/16   - 3-1/4"
```

Just as in addition, sometimes the problem is mixed, and to make it easier we need to rewrite it using easier terms, like this:

```
   35-1/4
 - 27-1/8
```

Remember to use a common denominator for addition and subtraction. The problem can be rewritten like this:

```
   35-2/8
 - 27-1/8
   8-1/8
```

Try these:

```
   35-15/16    42-3/4      11-1/4
 - 12-1/4    - 6-1/2     - 9-15/16
```

Hint: Remember to borrow what you need.

2.1.7 Subtraction with a Tape

Now we are ready to look at subtraction with the tape measure. Subtraction is the opposite of addition, moving left on the number line (tape measure). Mark off the first value and move the tape to this mark. When you subtract you measure back to where you started.

Example:
40-3/16 – 8-1/16 = 32-2/16 or 32-1/8

32-1/8 – 8-1/8 = 24"

Exercise:
8' 3" – 6' 2" = _____' _____"

8' 3" – 6' 1-1/2" = _____' _____"

8' 3" – 4' 1-1/2" = _____' _____"

8' 3" – 4-3/4" = _____' _____"

Try some more on the board.

Problems

12' 8-1/2" + 13' 6" = _____' _____"

6' 0-3/16" + 2' 8-1/4" = _____' _____"

9' 0-1/8" + 2' 0-1/2" = _____' _____"

9' 0-1/8" + 2' 0-2/3" = _____' _____" 2/3 is not on a measuring tape. How do we handle this?

3' 11-1/8" + 2' 8" + 6' 4-1/4" = _____' _____"

The challenge comes when we have to borrow across units

5' 6" - borrow 12 inches from the 5' making this 4' 18", then subtract
-3' 7"
1" 11"

2.1.8 Multiply with the Tape

You are asked for three boards measuring 3' 2" each. How many board feet are needed? Use the tape to repeatedly add by marking off the first, moving the tape to the mark and marking off the second, and then move the tape to the second mark and measure the third 3' 2". You may see this as time consuming. Is there a better way? Handle the feet first, then the inches, then the overflow.

3' 2" X 3

3' 2" + 3' 2" + 3' 2" = 9' 6"

3' 8" X 3 = 9' 24" = 11'

What about multiplying with a fraction?

What is 1/2 of 12"? 1/2 of 10"? 1/2 of 13"?

What is 1/2 of 1/2"? 1/2 of 1/4"? 1/2 of 1/8"? Do you see the pattern?

What is 1/2 of 4"?

Is this division or multiplication? How are they similar? Dividing by 2 is the same as multiplying by 1/2
Dividing by 5 is the same as _____?

What is 1/2 of 4' 10"? 1/2 of 6' 6"?

Measure a 2x4. How much would be 1/4 of it?

What about a mixed problem?

4-1/8 x 12-1/4 = (4-1/8 x 12) + (4-1/8 x 1/4)

Problems

4-1/2" x 4 = ____' ____"

6' 3-1/8" x 4 = ____' ____"

8' 3-1/16" x 6 = ____' ____"

2.1.9 Division with a Tape

How many boards, each 3' 3", can I cut from an 8' board? From a 10' board?

How many quarters are in an inch?
How many eighths are in an inch?
How many eighths are in two inches?

1 same as 1 ÷ ¼ = 4
1/4

2 same as 2 ÷ ¼ = 8
1/4

1 same as 1 ÷ 1/8 = 8
1/8

1 same as 1 ÷ 1/16 = 16
1/16

Looking at your measuring tape, this is easy. Try this one:

2 same as 2 ÷ 2/3 = 3
2/3

4 same as 4 ÷ 1/16 = 64
1/16

You begin to see a pattern develop.

8 same as 8 ÷ 2/3 = 3
2/3

Or $\frac{8 \times 3}{2}$

Division is the opposite of multiplication.
Always invert the second number.

Works with whole numbers as well 8 ÷ 5 = 8 ÷ 5/1 = 8 X 1/5

What is 1/2 of 8/8? 8/16.

What is 1/2 of 16/16? 16/32.

1/2 is the same as 2/4 is the same as 4/8 is the same as 8/16 is the same as 16/32.

Try these (with or without your tape):

3-5/16" + 2-3/16" = _____ convert _____

3-5/16" – 2-3/16" = _____ convert _____

5-1/8" + 3-7/8" + 4-3/8" = _____ convert _____

Assessment

Use the following math assessment to help determine if the students understand the concepts of adding, subtracting, multiplying and dividing fractions.

Math Assessment 1

Measure each board (Boards should be labeled A through E).

A _____

B_____

C_____

D_____

E_____

Addition

1. A + B = _____
2. B + D = _____
3. A + B + C = _____
4. What is the total board length in feet and inches? _____

Subtraction

1. E – A = _____
2. D – C = _____
3. E – B – A = _____

Write each problem above as it would appear on paper. For example, if board A is 6-1/2", and board B is 14-1/4", write the problem as:

```
   6-1/2
+  14-1/4
```

Math Assessment 2

Measure each board (Each board should be labeled A through E).

A _____

B_____

C_____

D_____

E_____

Write each of the following out as a math problem.

Multiplication

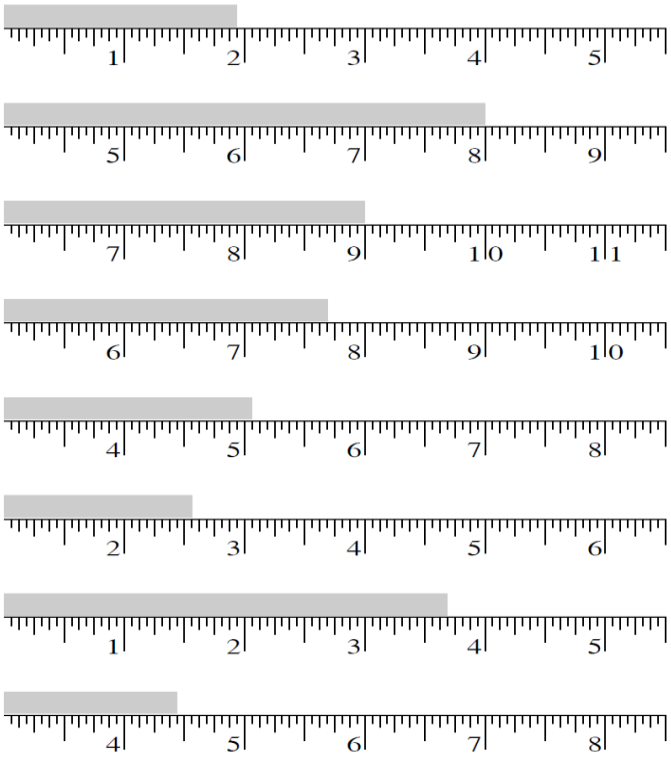
1. If I needed 5 pieces the length of board A, how many board feet do I need in total?
2. If I needed 3 pieces the length of board B, how many board feet do I need in total?
3. If I needed 11 pieces of wood the length of board C, how many board feet do I need?
4. If I needed 4 pieces of A, 3 pieces of B and one of C, what is the total board feet needed?

Division

1. How long is each piece if I cut board E in half? _____
2. How long is each piece if I cut board D in quarters? _____
3. How many A's can I cut from board E? _____ (Assume same width.)
4. How many A's can I cut from board C? _____ (Assume same width.)

Math Assessment 3

Read these tape measurements.



Conversion Table:
12 inches = 1 foot
3 feet = 1 yard
5280 feet = 1 mile

Fractions

12' 8-1/2" + 13' 6" =	____' ____"	3-5/16" + 2-3/16" =	____' ____"
6' 0-3/16" + 2' 8-1/4" =	____' ____"	3-5/16" – 2-3/16" =	____' ____"
9' 0-1/8" + 2' 0-1/2" =	____' ____"	5-1/8" + 3-7/8" + 4-3/8" =	____' ____"
8' 3" – 6' 2" =	____' ____"	1-1/4" X 12 =	____' ____"
8' 3" – 6' 1-1/2" =	____' ____"	8' 3-1/16" X 6 =	____' ____"
8' 3" – 4' 1-1/2" =	____' ____"	6' 3-1/8" X 4 =	____' ____"
8' 3" – 4-3/4" =	____' ____"	4-1/2" x 4 =	____' ____"