

Math-in-CTE Lesson Plan Template

Lesson Title: United States Standard Measurement		Lesson #1
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Occupational Area: Engineering/Drafting		
CTE Concept(s): Measurement		
Math Concepts: measurement, fractions, exponents, number bases, addition, subtraction, least common denominator (LCD), mixed numbers, improper fractions, reducing, long division		
Lesson Objective	Students will understand the units of measure in the standard system. They will be able to use a ruler/scale to perform simple linear measurement. Students will be able to reduce fractional measurements.	
Supplies Needed:	Ruler(Scale), Paper, Pencil, white board/chalk board.	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
<p>1. Introduce the CTE lesson.</p> <p>Ask two students to come to the front of the classroom (preferably a very large student, and one who is noticeably smaller). Tell them that you are planning on getting new furniture for the classroom, and you need to establish what will fit. Explain that you are going to ask these two students to help you figure it out. Tell the class that as a first step, you are going to try to establish the dimensions of the room. Ask the smaller student to walk heel to toe from one end of the room to the other, and record their steps; then walk from side to side (length and width), and record the number of steps. Ask the larger student to do the same exercise.</p> <p>Ask the class if they feel that the students have accurately measured the classroom. Ask them if there is repeatability to their measurement. Now ask them to write the number of steps they counted on the board. Compare the two and ask the class why they are different. The class will note that it is because the length of their feet is different.</p>	<p><i>We will cover standard measurement using a ruler, reduction of fractions, addition, subtraction of fractions, simple division, improper to mixed number.</i></p> <p>Standard – an object that can be used as a check for consistency. Something used as a basis of measurement.</p> <p>Linear – In straight lines, or distances between locations on one plane.</p> <p><i>Accuracy - the extent to which a given measurement agrees with the standard value for that measurement</i></p> <p><i>Repeatability – the ability to duplicate a test accurately.</i></p> <p><i>Replicable – a test or measurement that can be duplicated by other individuals in a different place, with the same results.</i> (pertaining to something that may be repeated in an experiment, able to be copied or reproduced)</p>

You will explain that they came up with different answers because they were not using a common standard. Only with a common standard are measurements repeatable and replicable.

Explain that measurement is fundamental to the engineering process. The ability to measure an object is necessary to be able to improve it, use it combination with other things, plan around its' space requirements, and to completely understand it. To give your measurements value, they need to be made in a format that other people can replicate or use. Because of this, we use standardized measurement systems that are based on either a standard (the metric system), or commonly agreed upon values (standard).

Today we are going to discuss United States Standard System (USS) Linear Measurement

2. Assess students' math awareness as it relates to the CTE lesson.

Q: Which systems for linear measurement are commonly used?

Q: Does anyone know what the basic Standard system units of length are?

Q: What are the relationships between these units?

Build a chart for them.

Explain that over one mile, measurements are done in multiple miles.

A: United States Standard /US Customary/ Imperial/ English
Metric SI - (System International)

A: Inch, Foot, Yard, Mile.

A: They can be used to convert from one unit of measure to another.
1 mile = 1760 yards = 5280 feet = 63360 inches

USS Standards

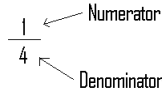
12 inches = 1 foot

3 feet = 1 yard

1 mile = 5280 feet

1 mile, 2 miles, 3 miles,....., 10,000 miles, etc.

Briefly review the components of a fraction:

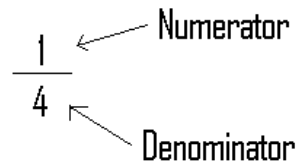


Explain that under one inch, measurements are done in fractional inches.

Demonstrate that the only acceptable denominators for standard fractions are **powers of 2**. Explain that fractional inches are always reduced. Show students that measurements that are greater than one inch are written as mixed numbers.

Introduce the ruler. Show the students that different fractional denominators have different length lines.

Introduce additional vocabulary from worksheet.



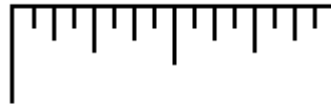
1/16", 1/8", 1/4", 1/2", 3/4", etc

Base 2 numbers (also Binary)

(1, 2, 4, 8, 16, 32, 64, 128)

Powers of 2 , exponents

2⁰ = 1, 2¹ = 2, 2² = 4, 2³ = 8, 2⁴ = 16, etc.

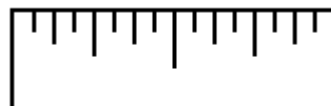


Shortest lines match the highest numerical denominator (16ths on a standard ruler), and that the lines get longer as the denominator decreases (longest line for whole inches)

See attached vocabulary worksheet.

3. Work through the math example *embedded* in the CTE lesson.

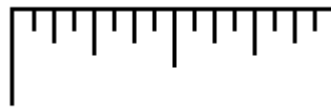
Draw the lines for 1 **fractional inch** (16 lines), and label them all in 16ths. Have the students help you **reduce** them.



0, 1/16, 1/8, 3/16, 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1

4. Work through *related, contextual* math-in-CTE examples.

Erase the **measurements** that are shown on the lines, and have the students determine the **measurements** at several points on the **fractional inch** you have drawn.



5. Work through *traditional math* examples.

Use several **fractions**, and then **reduce** them.

Ex: Simplify the following **proper fractions**:
10/20 (1/2), 6/10 (3/5) , 10 / 100 (1/10),

Give students a set of **fractions**, and ask them which ones could be valid **USS fractional measurements** (only the ones with valid **denominators**, and that are properly **reduced**)

Give them **improper fractions**, and have them make them into proper **mixed numbers**.

i.e. 17/16 is incorrect it should be 1 1/16

Give them **mixed numbers**, and have them use the math cycle in order to convert into **improper fractions**.

2 / 6 (1/3) , 4/12 (1/3) ,4/16 (1/4), 4/30 (2/15)
16 / 50 (8/25) , 16/32 (1/2) , 3 / 9 (1/3).

Ex: Which ones could be valid **USS fractional measurements**.

12/8 , $\frac{1}{2}$, 3/17, 15/8, 15/16, 1/8, 1/6, 1/4

Ex: Simplify the following **improper fraction**:

$\frac{72''}{32}$ show them how to **divide the numerator** by the **denominator**

$$= 32 \overline{) 72''} = 32 \overline{) 72''} = 32 \overline{) \begin{array}{r} 72'' \\ -64'' \end{array}}$$

$$= 32 \overline{) \begin{array}{r} 72'' \\ -64'' \\ \hline 8'' \end{array}} = 2 \frac{8}{32}'' = 2 \frac{1}{4}''$$

Additional examples:

5/2 (2 $\frac{1}{2}$), 7/4 (1 $\frac{3}{4}$) , 15/2 (7 $\frac{1}{2}$),

75/ 16 (4 $\frac{11}{16}$), 30/16 (1 $\frac{7}{8}$), 24/16 (1 $\frac{1}{2}$),

50/4 (12 $\frac{1}{2}$)

Ex: Simplify the following **mixed numbers**.

Write $8 \frac{2}{3}$ which is a **mixed number** into an **improper fraction**.(Hint: use the math cycle)

$$3*8 = 24 ; 24 + 2 = 26 = 26/3$$

See worksheet for additional practice

<p>Give them some fractions to add and subtract. Point out that adding and subtracting fractions are very similar.</p>	<p>Ex: To add fractions with a common denominator, you simply add the two numerators and keep the same denominator.</p> $\frac{1}{3} + \frac{1}{3} = \frac{(1 + 1)}{3} = \frac{2}{3}$ <p>Ex: When adding fractions with different denominators, we do all the steps.</p> $\frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{(3 + 2)}{6} = \frac{5}{6}$ <p>http://www.helpwithfractions.com/index.html</p>
<p>6. Students demonstrate their understanding. Have students use either the attached worksheets, or the web pages listed to help them practice and demonstrate their ability to measure using the Standard System.</p>	<p>www.rickyspears.com/rulergame/ www.funbrain.com/measure Crossword Puzzle Math Worksheet1</p>
<p>7. Formal assessment. Have the students demonstrate a knowledge of the vocabulary, and that they can measure a set of lines/objects. Use either the prepared worksheets, or, give them rulers and an assortment of objects to measure, and have them record their results.</p>	<p>See attached assessment. Assessment Assessment Key</p>

_____ 5. Which fraction is already in lowest terms?

a. $\frac{2}{5}$

b. $\frac{3}{6}$

c. $\frac{2}{8}$

d. $\frac{5}{10}$

_____ 6. Which fraction is NOT in lowest terms?

a. $\frac{3}{4}$

b. $\frac{1}{8}$

c. $\frac{15}{20}$

d. $\frac{2}{13}$

_____ 7. Which fraction is already in lowest terms?

a. $\frac{24}{40}$

b. $\frac{5}{25}$

c. $\frac{7}{8}$

d. $\frac{12}{16}$

_____ 8. Write $3\frac{3}{4}$ as an improper fraction.(Hint: use the math cycle)

a. $\frac{12}{3}$

b. $\frac{5}{25}$

c. $\frac{7}{8}$

d. $\frac{15}{4}$

_____ 9. Write $8\frac{2}{3}$ as an improper fraction.(Hint: use the math cycle)

a. $\frac{26}{2}$

b. $\frac{5}{25}$

c. $\frac{26}{3}$

d. $\frac{15}{4}$

_____ 10. Which of the following shows the numbers in order from **least to greatest**?

a. $\frac{1}{3}$, 0.03, 0.35, 30%

b. 0.03, 30%, $\frac{1}{3}$, 0.35

c. 30%, 0.35, 0.03, $\frac{1}{3}$

d. 0.35, $\frac{1}{3}$, 30%, 0.03

_____ 11. Which of the following numbers is 10 times as great as 20?

a. 20,000

b. 2,000

c. 200

d. 2

_____ 12. Which of the following shows the numbers in order from **greatest to least**?

a. $\frac{5}{6}$, $\frac{3}{5}$, $\frac{1}{4}$, $\frac{2}{3}$

b. $\frac{5}{6}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{1}{4}$

c. $\frac{1}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{5}{6}$

d. $\frac{1}{4}$, $\frac{3}{5}$, $\frac{2}{3}$, $\frac{5}{6}$

Fraction Worksheet Answer Section

MULTIPLE CHOICE

- | | |
|------------|-----------------|
| 1. ANS: D | STO: MA.A.1.3.2 |
| 2. ANS: B | STO: MA.A.1.3.2 |
| 3. ANS: B | STO: MA.A.1.3.2 |
| 4. ANS: A | STO: MA.A.1.3.2 |
| 5. ANS: A | STO: MA.A.1.3.2 |
| 6. ANS: C | STO: MA.A.1.3.2 |
| 7. ANS: C | STO: MA.A.1.3.2 |
| 8. ANS: D | STO: MA.A.1.3.2 |
| 9. ANS: C | STO: MA.A.1.3.2 |
| 10. ANS: B | STO: MA.A.1.3.2 |
| 11. ANS: C | STO: MA.A.1.3.2 |
| 12. ANS: B | STO: MA.A.1.3.2 |
| 13. ANS: A | STO: MA.A.1.3.2 |
| 14. ANS: A | STO: MA.A.1.3.2 |
| 15. ANS: D | STO: MA.A.1.3.2 |
| 16. ANS: A | STO: MA.A.1.3.2 |
| 17. ANS: C | STO: MA.A.1.3.2 |

United States Standard Measurement Using a Ruler/Scale

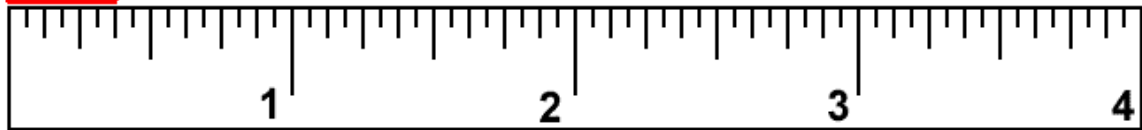
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Date _____

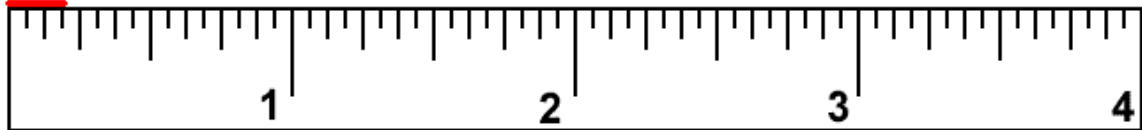
Period _____

Instructions: Using the pictures of a ruler below, write the measurement marked by the red line. All numbers should be reduced to their lowest form.

1)



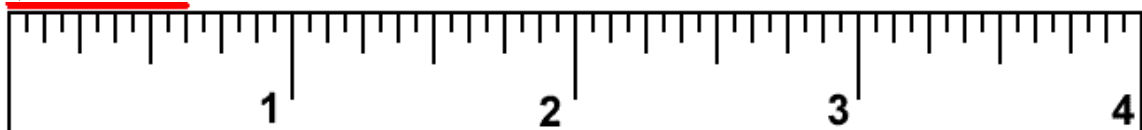
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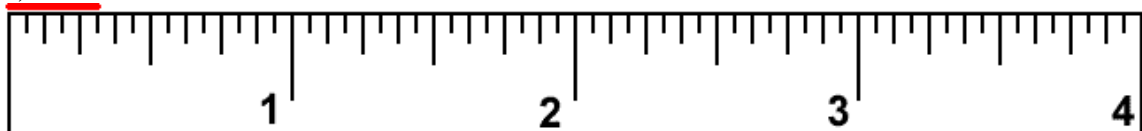
3)



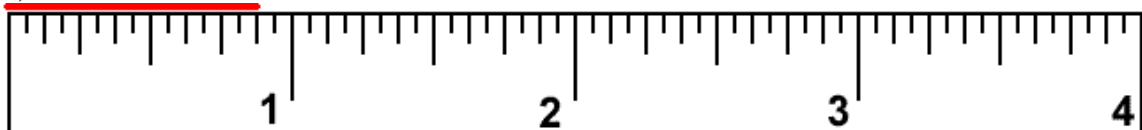
4)



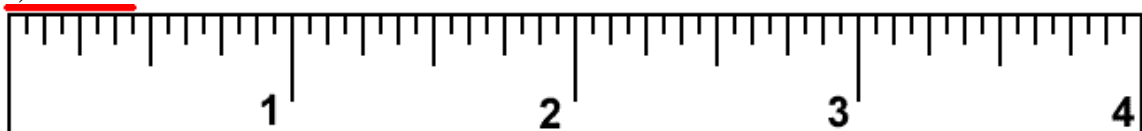
5)



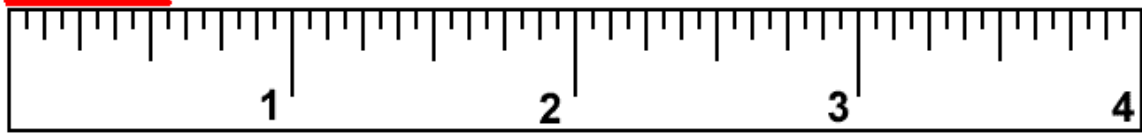
6)



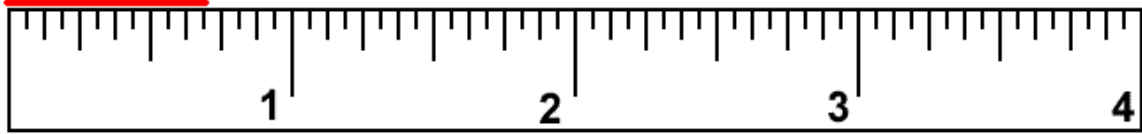
7)



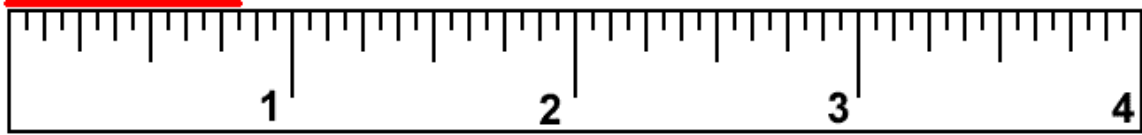
8)



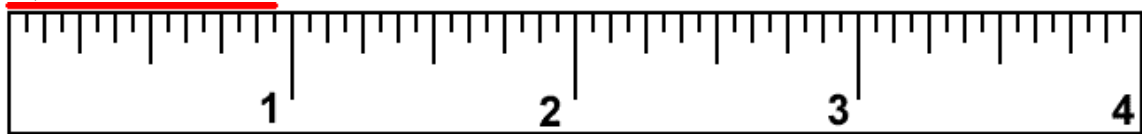
9)



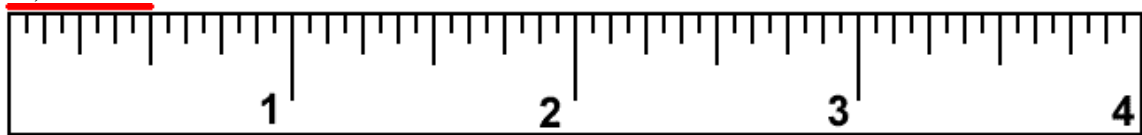
10)



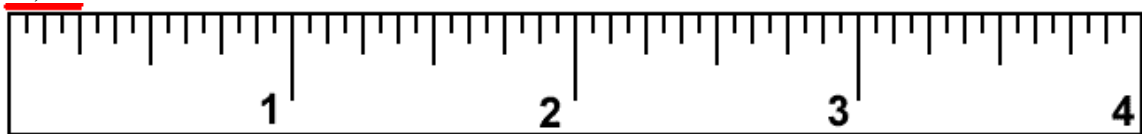
11)



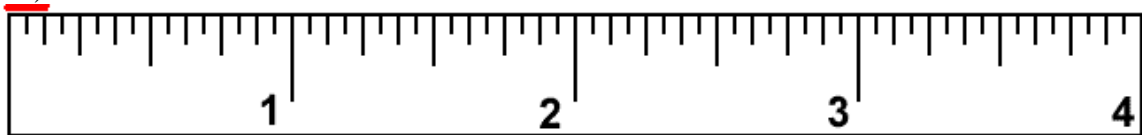
12)



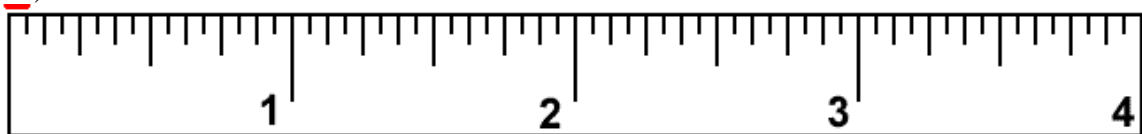
13)



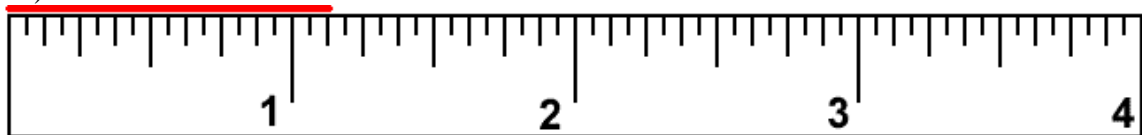
14)



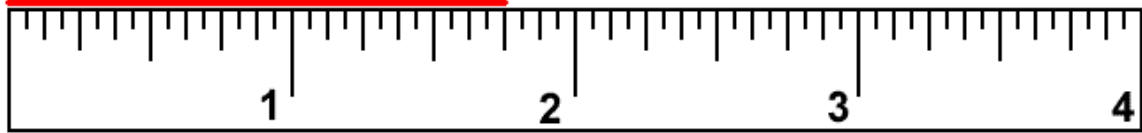
15)



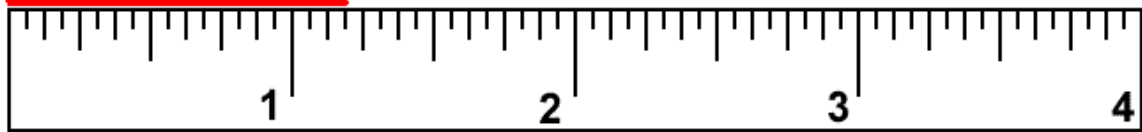
16)



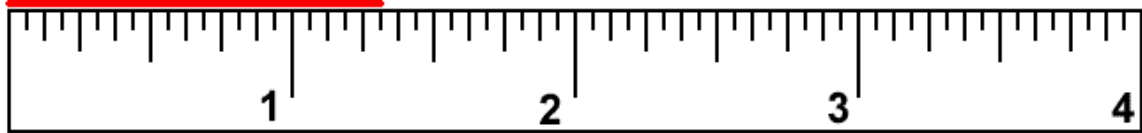
17)



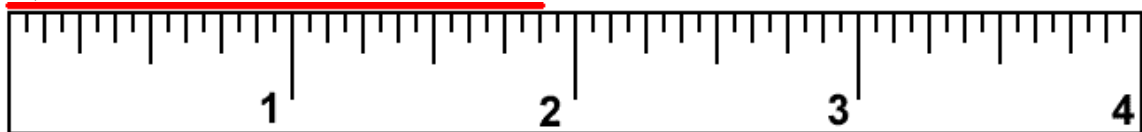
18)



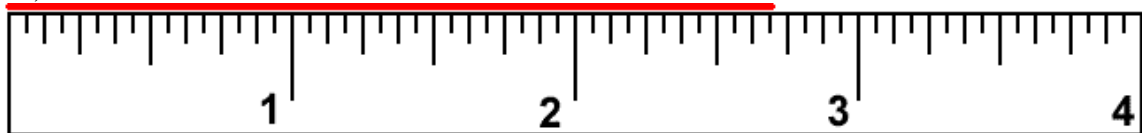
19)



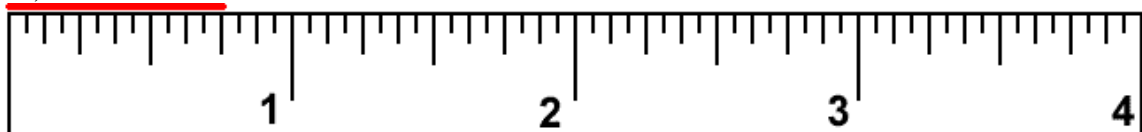
20)



21)



22)



23) How are you supposed to label a file before you place it in the drop box? Write it below EXACTLY as you would in the filename.

United States Standard Measurement Using a Ruler/Scale

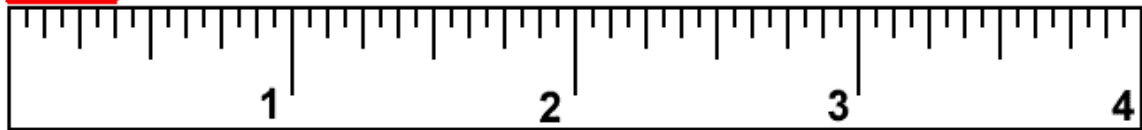
Name _____

Date _____

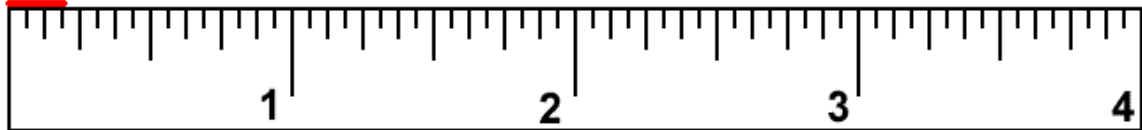
Period _____

Instructions: Using the pictures of a ruler below, write the measurement marked by the red line. All numbers should be reduced to their lowest form.

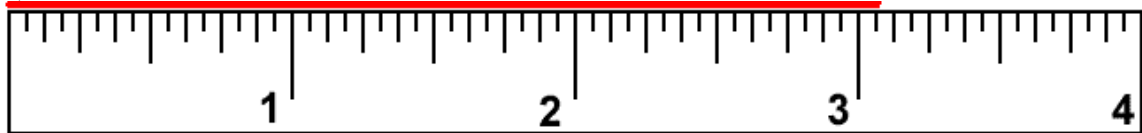
1) $\frac{3}{8}$ "



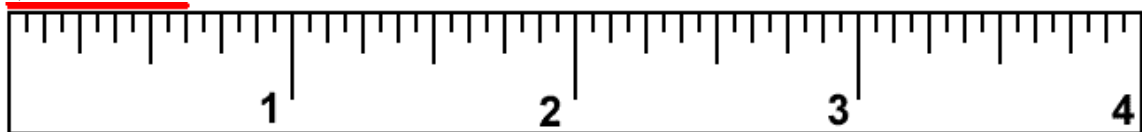
2) $\frac{3}{16}$ "



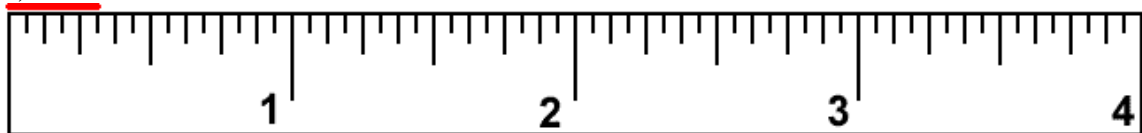
3) $3 \frac{1}{16}$ "



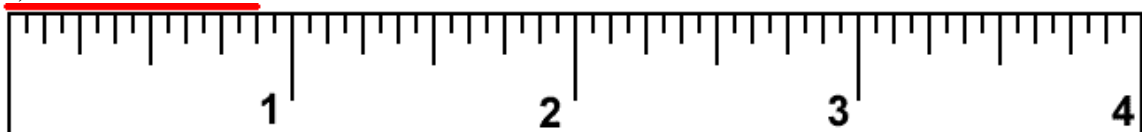
4) $\frac{5}{8}$ "



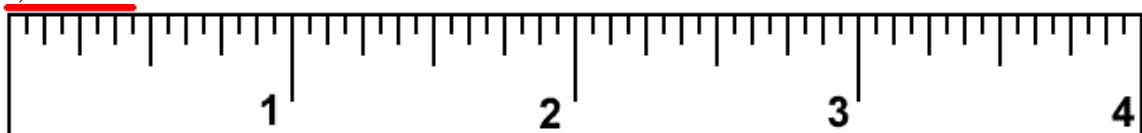
5) $\frac{5}{16}$ "



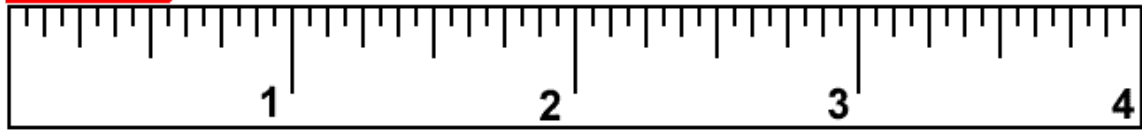
6) $\frac{7}{8}$ "



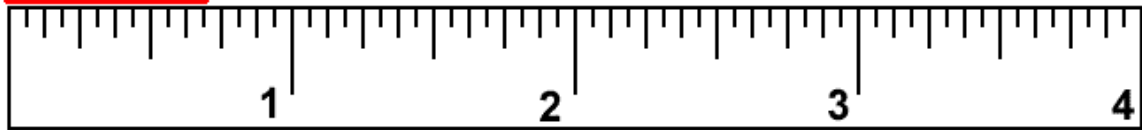
7) $\frac{7}{16}$ "



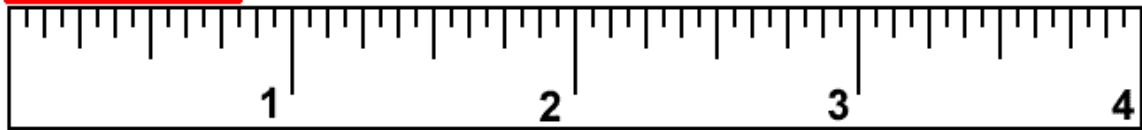
8) $9/16''$



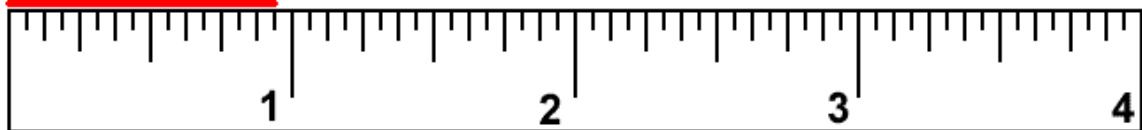
9) $11/16''$



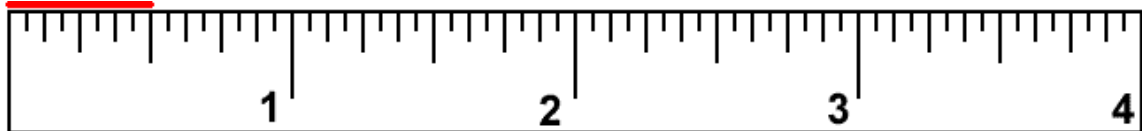
10) $13/16''$



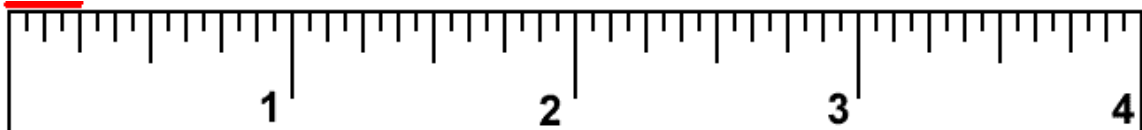
11) $15/16''$



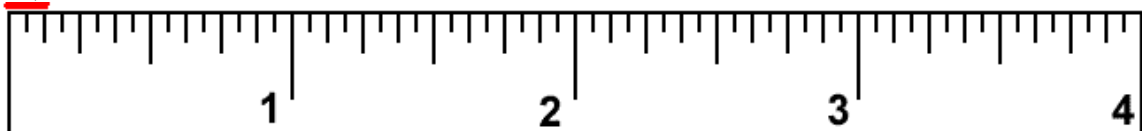
12) $1/2''$



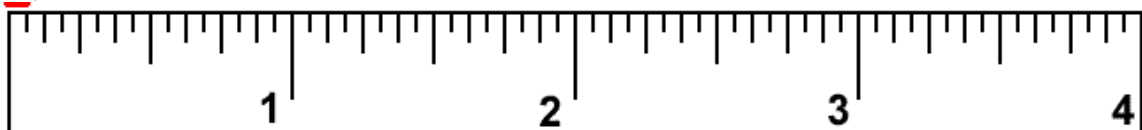
13) $1/4''$



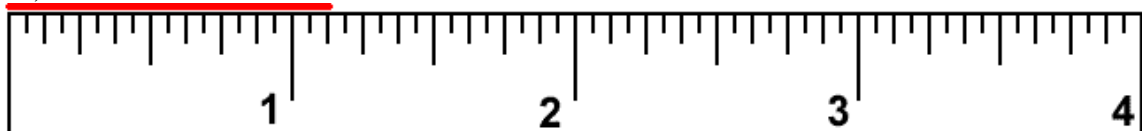
14) $1/8''$



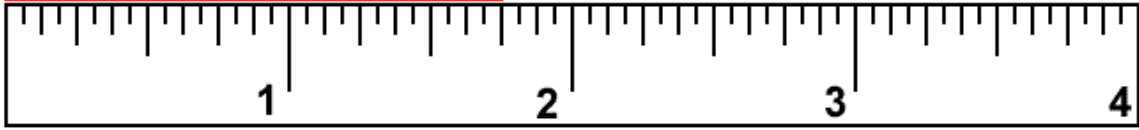
15) $1/16''$



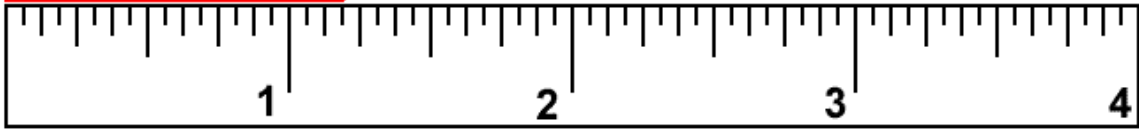
16) $1 \frac{1}{8}''$



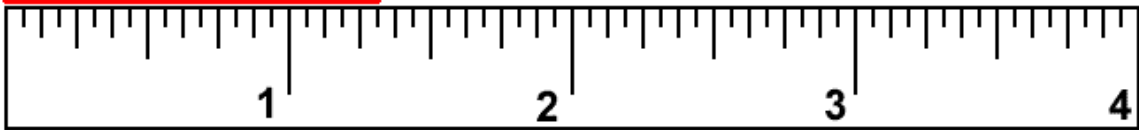
17) $1 \frac{3}{4}$ "



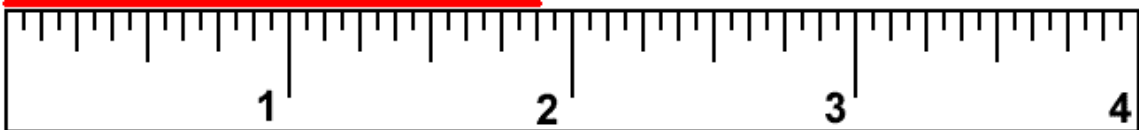
18) $1 \frac{3}{16}$ "



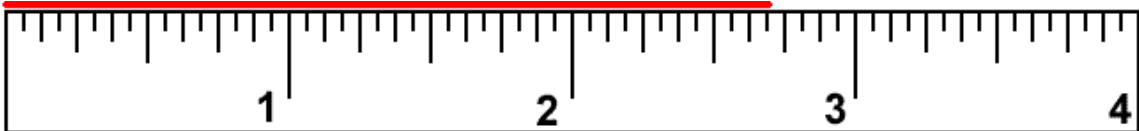
19) $1 \frac{5}{16}$ "



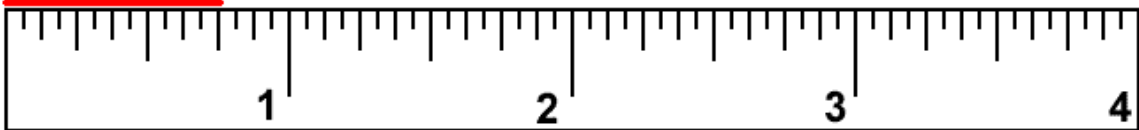
20) $1 \frac{7}{8}$ "



21) $2 \frac{11}{16}$ "



22) 3



Name _____

Date _____

Period _____

Student Vocabulary Crossword

T O O F D S X K T M M N S L Y A L F J Y
N M I R D K X O E H W L T M O Z X X S X
N D R N K E B T D J K M A I E Q C D B I
R I A C L B R M B H I L N G J A Z X M P
J T R I K I C K T Z T S D I I K D P O A
M F M O C L A I V D U V A L C C R X I H
J W R O T Z N W F B D S R H E O D O N L
W I J A L A M O S B Y T D G P E O C A Y
Z G N L C G R W T N X M M E N I K I U R
D W O P X T L E I P I Y R O E T R I A M
X L I S F Z I W M X W F M F A E F H B H
S F S G G M M O E U R I R J P N R P E B
W U I E F X S D N A N A M M X A S F D D
Q G V D K F N W C A C T I D E V O R S H
B N I J Q U U T T T L W N N A A A J U C
U T D M M Q I O I P W I I L O Y I K A N
X V V B X O R O U Y D L N C K T R O W I
K G E W N A N V V A R M A C O H Q M B V
Q R X F K Q R I V O P L Y S H D W O X R
R E B W A E C T N E N O P X E E C A Z D

denominator
division
exponent
foot
fraction
fractional inch
imperial
improper fraction
inch

linear
metric
mile
mixed number
numerator
standard
USS
yard

Teacher Answer Key

T O O F D S X K T M M N S L Y A L F J Y
 N M I R D K X O E H W L S L M O Z X X S X
 N D R N K E B T D J K M A I E Q C D B I
 R I A C L B R M B H I L N G J A Z X M P
 J T R I K I C K T Z T S D I I K D P O A
 M F M O C L A I V D U V A L C C R X I H
 J W R O T Z N W F B D S R H E O D O N L
 W I J A L A M O S B Y T D G P E O C A Y
 Z G N L C G R W T N X M M E N I K I U R
 D W O P X T L E I P I Y R O E T R I A M
 X L I S F Z I W M X W F M F A E F H B H
 S F S G G M M O E U R I R J P N R P E B
 W U I E F X S D N A N A M M X A S F D D
 Q G V D K F N W C A C T I D E V O R S H
 B N I J Q U U T T T L W I N N A A A J U C
 U T D M M Q I O I P W I I L O Y I K A N
 X V V B X O R O U Y D L N C K T R O W I
 K G E W N A N V V A R M A C O H Q M B V
 Q R X F K Q R I V O P L Y S H D W O X R
 R E B W A E C T N E N O P X E E C A Z D

denominator
 division
 exponent
 foot
 fraction
 fractional inch
 imperial
 improper fraction
 inch

linear
 metric
 mile
 mixed number
 numerator
 standard
 USS
 yard