TEXAS WORKFORCE COMMISSION

esc6
Dedicated to Serve

MATHEMATICS for the CONSTRUCTION INDUSTRY

Instructor Workbook

Table of Contents

Preface

Adult Education curriculum that educates learners about construction-related math skills and provides them with opportunities to develop expertise using real-world applications can help prepare learners to successfully calculate and communicate information within the workforce.

Within the construction industry, math skills play an integral role in employee advancement. Employees that possess math skills have an increased ability to problem-solve, demonstrate efficiency, and even collaborate with coworkers. In today's growing and evolving workforce, employers recognize the importance and value of math-minded employees.

Purpose Statement

This course content is aligned with the Texas Adult Education and Literacy Content Standards 3.0 and O*NET OnLine elements.

This course is designed for you to use hands-on activities to teach your learners the basic math skills needed for working in the construction field, with a focus on fractions, decimals, and measurement.

Learning these skills will enhance employee opportunities for promotion and job-related mastery across the construction industry. Upskilling the workforce ensures employers that potential employees are equipped to participate in the evolving math-minded construction landscape.

Texas Adult Education and Literacy Content Standards 3.0

Texas Adult Education and Literacy Content Standards 3.0 (AEL) aligns Texas Adult Education and Literacy Content Standards to the knowledge, skills, and abilities required for success in high-demand entry and intermediate-level jobs. AEL standards merge employer needs with content related skills in areas of English Language Learners (ESL), Math, History, Civics, and English.

According to the Texas Workforce Commission, Standards 3.0 aims to illustrate how the standards are relevant to work while maintaining the competencies needed to prepare students for educational progress and transition to post-secondary education or training. This is accomplished by bridging the academic standards to crosswalks that define the specific knowledge, skills, abilities, and detailed work activities required for work.

The mathematics curriculum uses the Standards 3.0, which provides a clear outline of content and skills for programs to develop and align curriculum, instruction, and assessments. This curriculum supports the progress of adult education students for their education, training, and career goals.

O*NET OnLine Elements

O*NET OnLine provides the O*NET Content Model, which encapsulates the key features of an occupation into a standardized, measurable set of variables called "descriptors." The hierarchical model starts with six domains, describing the day-to-day aspects of the job and the qualifications and interests of the typical worker. This provides a framework for the development of a comprehensive, targeted curriculum for the construction workforce.

Curriculum Overview

As the instructor for this Adult Education course, you will use this guide to assist your learners in gaining knowledge about basic math skills used in the construction industry.

As shown in the Table of Contents, each lesson provides an overview and several short lessons to assist learners with building content knowledge. The instructor guide provides AEL and O*NET standard correlations along with instructional procedures and lesson guidance, including learner objectives, guiding questions, suggested instructional strategies, and engaging activities.

Each lesson is tied to math-related skills used in plumbing, electrical, or general construction settings. Instructors also have access to *Student Views* with answers to each activity.

To get the most out of this curriculum:

1. **Prepare for the lesson in advance (read the lesson, gather materials).**
2. **Know your audience.**
3. **Modify and adapt learning, based on learner needs and abilities.**
4. **Watch the pace; each lesson is designed to be completed in a 90-minute session.**
5. **However, as the instructor, you should adjust based on learner needs.**
6. **Assess learner progress; make sure to check for understanding throughout each lesson to ensure learner engagement and content retention.**
7. **Make real-world/personal connections to the content.**
8. **Use varying instructional strategies to engage learners (individual, small-group, and whole-class instruction).**

Introduction

Student View

There are many tools used in the construction industry. These include the basics, such as hammers, tape measures, and specialized tools for different types of work. Each tool requires understanding of the use and application to the work it is used for.

On a job site, you might see different tools with technology components, such as digital measuring devices. Before getting the job, you will need to have adequate math skills that allow you to evaluate, calculate, and communicate information.

This course will use hands-on activities to teach you the basic math skills needed for working in the construction field. You will focus on construction-related math skills, like working with fractions, decimals, and measurement conversions.

By the end of this course, you will be able to:

- **Perform basic math functions in construction**
- **Explain what math means in the workplace**
- **Apply mathematical thinking skills in the construction industry**

Lesson Overview: Everyday Math

As the instructor, you will facilitate activities to help learners identify key terms used in construction-related mathematical operations, review multi-digit operations in math, and solve real-world construction-related mathematical problems.

To begin the lesson, explain to learners the importance of having basic mathematical skills. The activities within the lesson will help build the foundation they need to perform mathematical-related job tasks in the workplace.

Group Discussion

Use the following guiding questions to engage learners in a discussion to introduce this lesson, then proceed to Activity 1.

- Are you familiar with different ways math is used in the work place?
- What mathematical skills have you used in your personal or work experience?
- Are you comfortable using mathematical skills to complete tasks in the workplace?

O*NET Elements

- **Active Listening**
- **Cooperation**
- **Critical Thinking**
- **Oral Comprehension**
- **Speaking**
- **Writing**

AEL Standards

Subarea 11.0
General Mathematical Processes

1 - Apply math in everyday life
2 - Problem solve using math
3 - Use mathematical tools
4 - Apply cognitive strategies
5 - Communicate concepts
6 - Analyze relationships
7 - Develop, display, explain, & justify

Subarea 11.1
Numerical Representations and Relationships

11.1a (1-3) Place value

Subarea 11.2
Computations

11.a 1-3 - Addition & subtraction, place value, operations, multi-step problem solving
11.2b 1 - Whole number problem solving
11.2c 1-3 - Add, subtract, multiply, divide, real-world application, rational expressions
11.2d 1 - Rational numbers and order of operations
11.2e 1-2 - Comprehensive relation ships to problem solve, expressions and equations to problem solve
11.2f 1-5 - Fractions and decimals

Student View

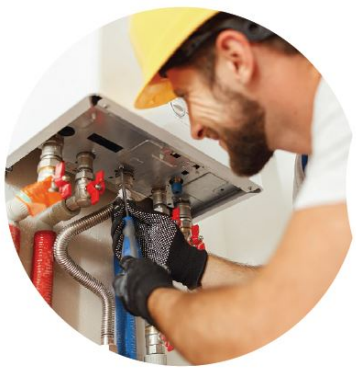
1. Everyday Math

In the construction industry, math is used for a variety of reasons. Whether your focus is general construction, plumbing, or electrical work, knowing the appropriate operations in basic math is an important part of working in construction. For example, your boss may ask you to complete estimated time logs or create an estimate for the cost of materials for a project.

The activities within this lesson will provide you with a basic understanding of multi-digit operations in math, building a foundation to be successful in your job now and in the future.

After completing this lesson, you will be able to:

1 - **Identify key terms in math operations**
2 - **Review relevant terms specific to plumbing, electrical, and general construction**
3 - **Demonstrate knowledge of multi-digit operations in math**
4 - **Solve real-world construction-related math problems**

Activity 1: Multi-Digit Addition & Subtraction

As the instructor, you will teach learners about multi-digit addition and subtraction.

Walk through one of the procedures below, then have learners open the workbook and complete Activity 1.

Learner Objective

Solve multi-digit addition and subtraction equations.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with multi-digit addition/subtraction and require less assistance.

Instructional Procedures: Option 1

1. Review multi-digit steps for solving addition and subtraction equations.
2. Divide learners into groups, and have each group work to solve the addition and subtraction equations in Activity 1 with a pencil.
3. Explain that the group must solve all addition and subtraction problems, allowing each person an opportunity to solve at least one addition and one subtraction equation. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
4. Once learners complete the activity in small groups, bring the whole group together to review the correct answers. Have learners correct any computations that are incorrect.

Instructional Procedures: Option 2

1. Review multi-digit steps for solving addition and subtraction equations.
2. Have learners work individually to complete Activity 1 with a pencil. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
3. When all learners are finished solving addition and subtraction equations, review the correct answers, and have learners correct any computations that are incorrect.

Activity 1: Multi-Digit Add. & Sub.

Student View

In the workplace, you may see various scenarios where you are required to add or subtract multi-digit numbers. For example, you may need to add together large quantities of materials, or you may need to find the perimeter of a workspace.

Practice your skills by completing the problems below.

Standard Algorithm for Addition:

$$\begin{array}{r} {\scriptstyle 1\ 1\ \ } \\ 537 \\ +\ 698 \\ \hline 1{,}235 \end{array}$$

Standard Algorithm for Subtraction:

$$\begin{array}{r} {\scriptstyle 4\ 12\ 12} \\ \not{5}\not{3}\not{2} \\ -\ 398 \\ \hline 134 \end{array}$$

Addition: Find the sum of the problems below.

1) 278 + 153 = 431	2) 437 + 248 = 685	3) 179 + 253 = 432	4) 520 + 286 = 806
5) 379 + 56 = 435	6) 647 + 206 = 853	7) 716 + 221 = 937	8) 576 + 328 = 904

Subtraction: Find the difference of the problems below.

1) 463 − 220 = 243	2) 675 − 322 = 353	3) 968 − 547 = 421	4) 643 − 523 = 120
5) 879 − 647 = 232	6) 586 − 421 = 165	7) 688 − 52 = 636	8) 759 − 417 = 342

Activity 2: Multi-Digit Multiplication

Now that learners have demonstrated the ability to solve multi-digit addition and subtraction equations, learners will work to solve multi-digit multiplication equations.

Learner Objective

Solve multi-digit multiplication equations.

Walk through one of the procedures below, then have learners open the workbook and complete Activity 2.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with multi-digit multiplication and require less assistance.

Instructional Procedures: Option 1

1. Review multi-digit steps for solving multiplication equations.
2. Divide learners into groups, and have each group work to solve the multiplication equations in Activity 2 with a pencil.
3. Explain that the group must solve all multiplication equations, allowing each person an opportunity to solve at least two equations. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
4. Once learners complete the activity in small groups, bring the whole group together to review the correct answers. Have learners correct any computations that are incorrect.

Instructional Procedures: Option 2

1. Review multi-digit steps for solving multiplication equations.
2. Have learners work individually to complete Activity 2 with a pencil. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
3. When all learners are finished solving multiplication equations, review the correct answers, and have students correct any computations that are incorrect.

Activity 2: Multi-Digit Multiplication

Student View

Now that you have practiced addition and subtraction, use your skills to practice multi-digit multiplication.

Multi-digit multiplication is important when used with a variety of formulas in the plumbing, electrical, and general construction fields, which will be a focus in later lessons.

Standard Algorithm for Multiplication:

$$\begin{array}{r} 829 \\ \times\ 11 \\ \hline 829 \\ +\ 8{,}290 \\ \hline 9{,}119 \end{array}$$

Mulitiplication: Find the product of the problems below. Be sure to show your work.

1) 463 x 34 = 15,742	2) 647 x 12 = 7,764	3) 665 x 80 = 53,200	4) 545 x 73 = 39,785
5) 408 x 61 = 24,888	6) 258 x 33 = 8,514	7) 476 x 30 = 14,280	8) 836 x 57 = 47,652
9) 756 x 651 = 492,156	10) 141 x 352 = 49,632	11) 552 x 403 = 222,456	12) 561 x 230 = 129,030
13) 592 x 333 = 197,136	14) 110 x 291 = 32,010	15) 128 x 756 = 96,768	16) 924 x 435 = 401,940

Activity 3: Multi-Digit Division

Now that learners have demonstrated the ability to solve multi-digit multiplication equations, learners will work to solve multi-digit division equations.

Walk through one of the procedures below, then have learners open the workbook and complete Activity 3.

Learner Objective

Solve multi-digit division equations.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with multi-digit division require less assistance.

Instructional Procedures: Option 1

1. Review multi-digit steps for solving division equations.
2. Divide learners into groups, and have each group work to solve the division equations in Activity 3 with a pencil.
3. Explain that the group must solve all division equations, allowing each person an opportunity to solve at least two equations. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
4. Once learners complete the activity in small groups, bring the whole group together to review the correct answers. Have learners correct any computations that are incorrect.

Instructional Procedures: Option 2

1. Review multi-digit steps for solving division equations.
2. Have learners work individually to complete Activity 3 with a pencil. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
3. When all learners are finished solving division equations, review the correct answers, and have learners correct any computations that are incorrect.

Activity 3: Multi-Digit Division

Student View

In the workplace, multi-digit division is used to calculate loads and to scale models across the plumbing, electrical, and general construction fields.

Practice your skills to ensure that you are prepared for more advanced scenarios in later lessons.

Standard Algorithm for Division:

$$\begin{array}{r} 176 \\ 3\overline{)528} \\ -\ 3\downarrow \\ \hline 22 \\ -\ 21\downarrow \\ \hline 018 \\ -\ 18 \\ \hline 0 \end{array}$$

Division: Find the quotient of the problems below. Use the space provided to show your work.

1) $12\overline{)816}$ = 68	2) $68\overline{)1020}$ = 15	3) $12\overline{)564}$ = 47	4) $29\overline{)1334}$ = 46
5) $51\overline{)1632}$ = 32	6) $69\overline{)3450}$ = 50	7) $19\overline{)323}$ = 17	8) $81\overline{)5184}$ = 64
9) $23\overline{)2047}$ = 89	10) $28\overline{)1708}$ = 61	11) $42\overline{)2688}$ = 64	12) $75\overline{)6750}$ = 90
13) $14\overline{)1036}$ = 74	14) $88\overline{)1584}$ = 18	15) $75\overline{)7275}$ = 97	16) $39\overline{)3159}$ = 81

Learner Resources & Assessment Tools

Learner Resources

Learners have been exposed to math-based vocabulary specific to *Everyday Math* skills within the activities they completed for this lesson.

As the instructor, it is important that you refer back to this vocabulary list as you move through the Mathematics unit.

Assessment (Check Your Understanding)

Now that learners have reviewed how to correctly solve multi-digit addition, subtraction, multiplication and division equations, learners will complete the unit by demonstrating their understanding of the content as it applies to the construction industry. Learners should complete the *Check Your Understanding* assessment at the end of this unit. This assessment is not intended to be graded, but instead used to identify areas of strength and weakness within the learner's knowledge related to *Everyday Math* skills.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with basic math knowledge and require less assistance.

Option 1

Have learners work individually or with a partner to complete the *Check Your Understanding* assessment. Once learners have completed the assessment, go over each question with the whole group. Make sure to clarify misunderstandings or questions students may have about the content.

Option 2

As an Exit Ticket to end the class, please have learners complete the *Check Your Understanding* assessment within their workbook individually. As the instructor, you should review each learner's answers prior to beginning the next class session.

Vocabulary Word Clues

Student View

There are a variety of word clues used to help identify whether to add, subtract, multiply, or divide.

Addition (+)
In All
Increased by
More than
Combined
Altogether
Total
Sum
Plus
Added to
Greater than

Subtraction (-)
Minus
Decreased By
Less
Take away
Difference
Less than
Fewer than
Left or Left over
Smaller than
Remaining

Multiplication (x)
Times
Multiplied by
Product of
Twice as much, (Three) times as much
In each
Every
Groups of
Rows of
By
At

Division (/)
Per
Out of
Ratio of
Quotient of
Percent
Equal (pieces, amount)
Split
Average
Share
Fraction of

Assessment: Math in the Workplace

Most math in the workplace will come in the form of written or verbal problems. Test your understanding by answering the questions below.

1. A plumber has the following lengths of PVC pipe: 3 feet, 9 feet, 8 feet, 13 feet, and 11 feet. What is the total length of PVC pipe?

Operation used: Addition **Answer: 44 feet**

2. A PVC pipe that is 242 feet long is to be cut into 2 foot pieces. How many pieces can a plumber get out of this length pipe?

Operation used: Division **Answer: 121 pieces**

3. If 4 electricians can complete a job in 8 hours, how long will it take 3 electricians to complete the same job?

Operation used: Multiplication **Answer: 10 hours**

4. An electrician needs 2 rolls of electrical wire to wire each room in a house. How many rooms can the electrician wire with 39 rolls of wire?

Operation used: Division **Answer: 19.5 rooms**

5. What is the square footage of a room 26’ x 52’?

Operation used: Multiplication **Answer: 1,352 sq. ft.**

6. It takes about 70 minutes to install a bathroom sink. You have already worked for 25 minutes. How many more minutes before you complete the job?

Operation used: Subtraction **Answer: 45 minutes left**

7. Luke has 220 feet of ½” pipe. He has used 105 feet of the pipe. How many feet does he have left?

Operation used: Subtraction **Answer: 115 feet of pipe left**

8. You are building a house and worked 50 hours last week and 42 hours this week. How many more hours did you work last week?

Operation used: Subtraction **Answer: 8 hours more last week**

9. You need a total of 662 bricks for your house project. You have 412 bricks. How many more bricks do you need?

Operation used: Subtraction **Answer: 250 more bricks needed**

10. A construction crew is replacing windows on two buildings. They will replace 32 windows on Monday, 41 windows on Tuesday, 38 windows on Wednesday, and 56 windows on Thursday. What is the total amount of windows that will be replaced throughout the week?

Operation used: Addition **Answer: 167 windows**

Check Your Understanding

Student View

In the construction industry, no matter what your job is, you might need to use math. Reflect on the importance of math in your field by answering the questions below.

Reflection

Do you feel comfortable with addition, subtraction, multiplication, and division? What do you feel like you need extra practice with?

What are two ways you use math in your current job?

Think of a future job you would like to have. Will you use math in the same way? If not, what will be different? What else do you need to learn?

Lesson Overview: Fractions and Decimals

As the instructor, you will facilitate activities to help learners develop a clear understanding of fractions and decimals and their importance in the workplace.

To begin the lesson, review with learners the importance of having basic math skills as well as the connection it has to the construction industry. The activities within this lesson will continue to build the foundation they need to perform math-based job tasks in the workplace.

Group Discussion

Use the following guiding questions to engage learners in a discussion to introduce this lesson, then proceed to Activity 1.

- What are fractions and decimals?
- How are fractions and decimals used in the workplace?
- Are you comfortable working with fractions and decimals on the job?
- What is your experience using fractions and decimals within the workplace?

O*NET Elements

- **Active Listening**
- **Cooperation**
- **Critical Thinking**
- **Oral Comprehension**
- **Speaking**
- **Writing**

AEL Standards

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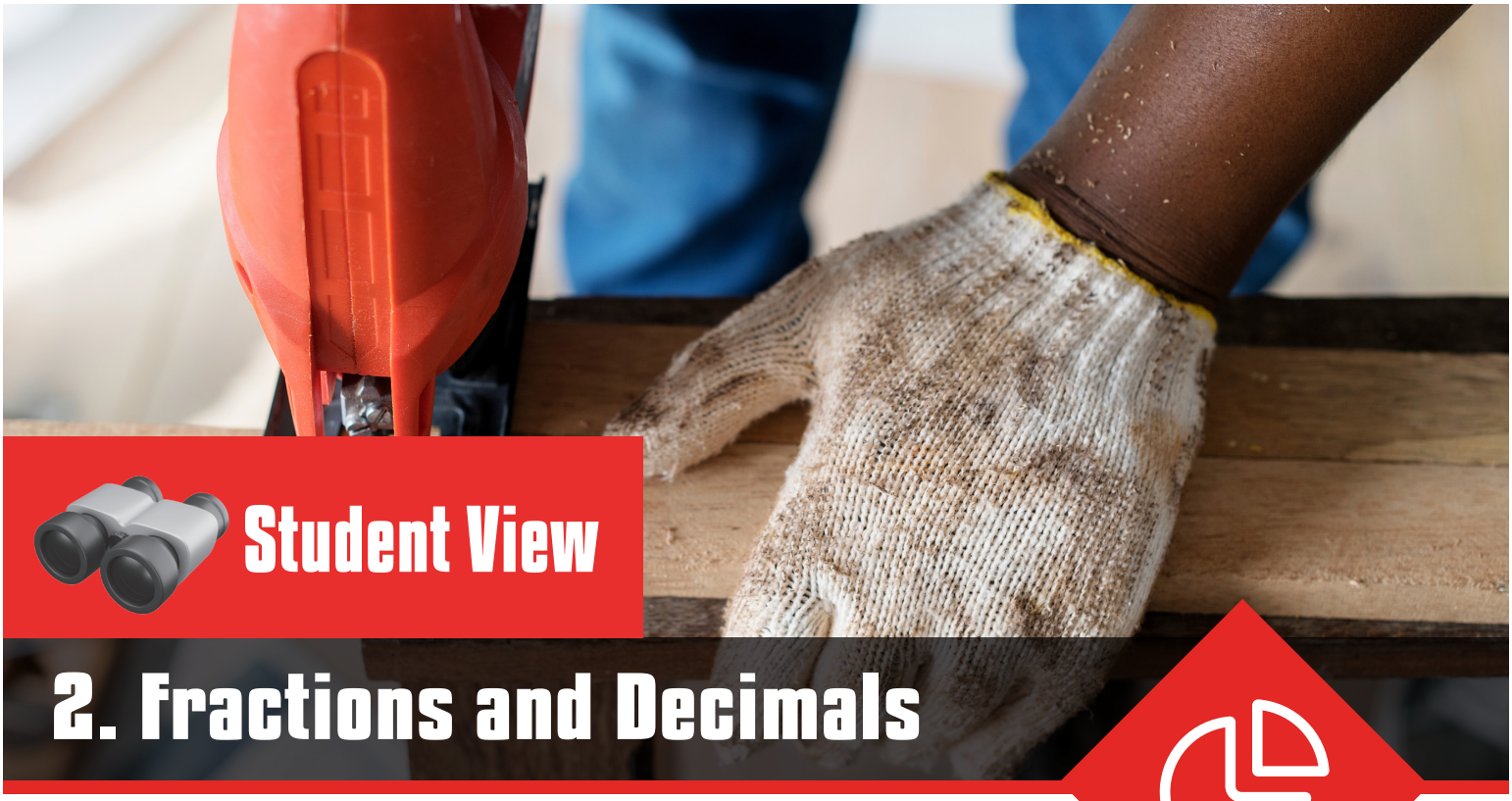
11.2f 1-5 - Fractions and decimals



Student View

2. Fractions and Decimals

Fractions and decimals appear everywhere in general construction, as well as in design-related plumbing and electrical problems. Whenever one quantity is broken down into a number of smaller quantities, the resulting smaller quantities represent fractions of the original. Measurements that cannot be expressed as whole numbers are commonly written in fraction or decimal form, for example, 2 and 3/4, or 2.75, which is between 2 and 3.

After completing this lesson, you will be able to:

1 - Use models to understand benchmark fractions and decimals
2 - Convert fractions to decimals
3 - Convert decimals to fractions
4 - Use construction scenarios to calculate ratios, rates, and proportions

Activity 1 Part A: Using Models

Now that the learners have familiarized themselves with the basic math skills, they will take a closer look at fractions.

As the instructor, you will facilitate the activities as the learners work to calculate equivalent fractions.

Learner Objective

Demonstrate an understanding of benchmark fractions and decimals.

To begin the lesson, use the following guiding questions to facilitate a brainstorming discussion to introduce the lesson, then proceed to Activity 1 Part A.

- What does it mean to have an equivalent fraction?
- How are fractions and decimals part of your everyday life?

Please note: Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with fractions and require less assistance.

Instructional Procedures: Option 1

1. Review the fraction/decimal model, define equivalent fractions, and discuss steps to solve for equivalent fractions.
2. Divide learners into groups and have each group work to complete the fraction/decimal model in Activity 1 Part A with a pencil.
3. Explain that the group needs to fill out the fraction/decimal model, allowing each person an opportunity to fill out a section of the model.
4. When all learners are finished completing the model, review correct answers, and have students correct any computations that are incorrect.

Instructional Procedures: Option 2

1. Review the fraction/decimal model, define equivalent fractions, and discuss steps to solve for equivalent fractions.
2. Have learners work individually to complete Activity 1 Part A with a pencil.
3. When all learners are finished completing the model, review correct answers and have students correct any computations that are incorrect.

Activity 1 Part A: Using Models

Student View

In this activity, you will use models to benchmark fractions and decimals. In the workplace, you may need to divide a whole number into fractional parts. Those parts have equivalent (equal) decimals. Practice your skills by filling in the chart below.

1.00 = 1/1

.5	1/2

.33333	1/3	1/3

.25	1/4	1/4	1/4

.2	1/5	1/5	1/5	1/5

.167	1/6	1/6	1/6	1/6	1/6

.142	1/7	1/7	1/7	1/7	1/7	1/7

Activity 1 Part B: Using Models

Now that the learners have familiarized themselves with the fraction/decimal model, they will work to solve equivalent fractions. As the instructor, you will facilitate the activities as the learners work to calculate equivalent fractions.

Learner Objective

Calculate equivalent fractions.

To begin the lesson, use the following guiding question to facilitate a brainstorming discussion to introduce the lesson, then proceed to Activity 1 Part B.

- How are equivalent fractions/decimals used in your workplace?

Please note: Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with fractions and require less assistance.

Instructional Procedures: Option 1

1. Review the fraction/decimal model, define equivalent fractions, and discuss steps to solve for equivalent fractions.
2. Divide learners into groups and have each group work to solve the fraction equations in Activity 1 Part B of the workbook with a pencil.
3. Explain that the group must solve all fraction equations, allowing each person an opportunity to solve at least one equation. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
4. When all learners are finished solving fraction equations, review correct answers and have students correct any computations that are incorrect.

Instructional Procedures: Option 2

1. Review the fraction model, define equivalent fraction, and discuss steps to solve for equivalent fractions.
2. Have learners work individually to complete the Activity 1 Part B with a pencil. Remind learners to show their work. Space is provided within the activity for learners to work out the equations.
3. When all learners are finished solving fraction equations, review correct answers and have students correct any computations that are incorrect.

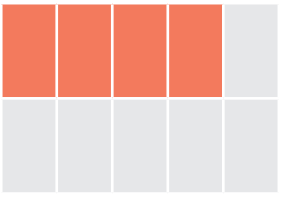
Activity 1 Part B: Using Models

Student View

To calculate equivalent (equal) fractions, simply multiply or divide the numerator and the denominator by the same number. See the examples below:

$$\frac{1}{2} \overset{\times 4}{=} \frac{4}{8}$$

$$\frac{4}{10} \overset{/ 2}{=} \frac{2}{5}$$



Practice by filling in the chart below:

1. $\frac{1}{3} \overset{\times 3}{=} \frac{3}{9}$

2. $\frac{2}{3} \overset{\times 2}{=} \frac{4}{6}$

3. $\frac{8}{12} \overset{/ 4}{=} \frac{2}{3}$

4. $\frac{4}{4} \overset{/ 2}{=} \frac{2}{2}$

5. $\frac{3}{5} \overset{\times 2}{=} \frac{6}{10}$

6. $\frac{6}{12} \overset{/ 6}{=} \frac{1}{2}$

7. $\frac{4}{8} \overset{/ 2}{=} \frac{2}{4}$

8. $\frac{5}{10} \overset{/ 5}{=} \frac{1}{2}$

Activity 2: Writing Fractions as Decimals

Now that the learners have identified ways in which fractions and decimals are used in the construction industry and solved for equivalent fractions, they will examine how to convert fractions to decimals.

Begin the lesson by discussing the following probing questions with learners:

Learner Objective

Convert fractions to decimals using division.

- Why is it important to understand how to write fractions as decimals?
- When do you use this math skill in your current workplace?

Instructional Procedures:

1. Using probing questions, establish a working list of the important reasons for understanding how to write fractions as decimals and the current experience of learners for this math skill.
2. Discuss with the group the parts of a fraction and the steps for using division to convert fractions into decimals.
3. Break learners into small groups to work collaboratively on the fraction to decimal practice in Activity 2.
4. Make sure to reinforce the expectation that everyone should solve at least three equations by themselves. Also encourage learners to show their work. Space is provided within the activities for learners to work out the equations.
5. Once learners complete the activity in small groups, bring the whole group together to review the correct answers. Have learners correct any incorrectly worked equations.

Activity 2: Writing Fractions as Decimals

Student View

In the previous activity, you learned about equivalent fractions and decimals. Once you learn about those, it is important to know how to write fractions as decimals.

To convert a fraction to a decimal:

Fractions have numerators and denominators. Numerators are the top number of a fraction, and denominators are the bottom numbers. In the fraction to the right, **2** is the numerator and **6** is the denominator.

$$\frac{\textit{numerator}}{\textit{denominator}} \rightarrow \frac{2}{6}$$

Part of writing fractions is simplifying them by finding a common factor, the largest number the numerator and denominator can be divided by. In this case, the common factor is 2.
Here is how the fraction simplifies:

$$\frac{2}{6} \begin{matrix} /\,2 \\ /\,2 \end{matrix} \rightarrow \frac{1}{3}$$

Fractions can also demonstrate division problems. In this case, the numerator will be called the dividend, and the denominator will be called the divisor (since it is the value being divided). If we were to divide the fraction above, the answer would not be a whole number because 1 is smaller than 3. Instead, we would get its decimal form:

$$\frac{1}{3} = .333$$

Activity 2: Writing Fractions as Decimals

Student View

Practice your skills by converting the fractions below to decimals.
Use the space provided to show your work.

1. $\frac{1}{5} = .2$

2. $\frac{3}{4} = .75$

3. $\frac{3}{8} = .375$

4. $\frac{4}{9} = .444$

5. $\frac{5}{8} = .625$

6. $\frac{7}{16} = .4375$

7. $\frac{2}{10} = .2$

8. $\frac{11}{3} = 3.67$

Activity 2: Writing Fractions as Decimals

Student View

Practice your skills by converting the fractions below to decimals.
Use the space provided to show your work.

9. $\frac{7}{8} = .875$

10. $\frac{8}{15} = .533$

11. $\frac{8}{3} = 2.67$

12. $\frac{14}{20} = .7$

13. $\frac{7}{12} = .583$

14. $\frac{14}{10} = 1.4$

15. $\frac{7}{9} = .78$

16. $\frac{7}{11} = .64$

Activity 3: Converting Decimals to Fractions

Now that the learners know the importance of converting fractions to decimals using division, they will take a closer look at converting decimals to fractions.

Learner Objective

Convert decimals to fractions.

Activity Setup

Using a large Post-it sheet, write each sample guiding question found below on a poster. Place the posters around the room for the learners to answer the questions. The number of posters needed will depend on the size of your class.

Instructional Procedures:

1. Using the selected guiding questions, learners will begin a *Graffiti Wall* activity.

   Sample guiding questions:

   - When is it necessary to convert decimals to fractions?
   - How will you use this in your workplace?
   - What challenges do you have when converting decimals to fractions?

2. Depending on the size of your class, divide students into partners or small groups.
3. Allow each group 3 to 5 minutes at each poster to write a response.
4. After 3 to 5 minutes, groups will rotate to each poster and have an opportunity to add to each poster. Use different colored markers or small sticky notes to help distinguish each group.
5. Assess the room during the activity. If you observe learners not participating or completing the activity sooner than expected, then you should adjust your time at each poster. Walk around during the activity and encourage participation using probing questions about the topic to help guide responses.
6. After the *Graffiti Wall* activity is completed, have a class discussion with learners regarding the information written on the posters. Take this opportunity to discuss/answer the questions for the group and make connections to real-world examples in the workplace.
7. Review the steps for Activity 3 with the whole group. Have learners practice converting decimals to fractions using the equations in Activity 3: Practice. This can be done with a partner. Remind learners to show their work. Extra space is provided for this in the workbook.
8. Once learners complete the practice in small groups, bring the whole group together to review the correct answers. Have learners correct any incorrectly worked equations.

Activity 3: Converting Decimals to Fractions

Student View

In the previous activity, you learned to use division to convert fractions to decimals. You might find that there are also instances where you have numbers presented in decimals that need to be converted to fractions.

To convert a decimal to a fraction:

Step 1: Write down the decimal divided by 1, like this: $\frac{\text{Decimal}}{1}$

Step 2: Multiply the numerator and the denominator by 10 for every number after the decimal point.

For example, if there are two numbers after the decimal point, then use 100, if there are three, then use 1000, etc.

Step 3: Simplify (or reduce) the fraction.

Example: Convert 0.75 to a fraction

Step 1: Write down the decimal (0.75) divided by 1:

$$\frac{0.75}{1}$$

Step 2: Multiply the numerator and the denominator by 100:

(since there are 2 digits after the decimal point, that is 10 x 10 =100)

$$\frac{0.75}{1} \begin{matrix} \text{x } 100 \\ = \\ \text{x } 100 \end{matrix} \frac{75}{100}$$

Hint: Notice how it turns the numerator into a whole number.

Step 3: Simplify the fraction:

(in this case, it takes two steps)

$$\frac{75}{100} \begin{matrix} /\,5 \\ /\,5 \end{matrix} = \frac{15}{20} \begin{matrix} /\,5 \\ /\,5 \end{matrix} = \frac{3}{4}$$

Activity 3: Practice

Student View

Practice your skills by converting the decimals below to fractions.
Use the space provided to show your work.

1. $0.5 = \frac{1}{2}$

2. $0.667 = \frac{667}{1000}$

3. $0.625 = \frac{5}{8}$

4. $0.8 = \frac{4}{5}$

5. $0.3 = \frac{3}{10}$

6. $0.6 = \frac{3}{5}$

7. $0.375 = \frac{3}{8}$

8. $0.333 = \frac{333}{1000}$

Activity 3: Practice

Student View

Practice your skills by converting the decimals below to fractions.
Use the space provided to show your work.

9 $0.25 = \frac{1}{4}$	10 $0.2 = \frac{1}{5}$
11 $0.125 = \frac{1}{8}$	12 $0.8125 = \frac{13}{16}$
13 $0.5624 = \frac{9}{16}$	14 $0.6875 = \frac{11}{16}$
15 $0.15625 = \frac{5}{32}$	16 $0.875 = \frac{7}{8}$

Activity 4: Adding & Subtracting Decimals

After becoming proficient in converting fractions to decimals and decimals to fractions, learners will now learn to add and subtract decimals.

To begin the lesson, ask learners the following two guiding questions:

Learner Objective

Add and subtract using decimals.

- What experience do you have adding and subtracting decimals?
- How is understanding this skill important to the construction industry?

Instructional Procedures:

1. Divide learners into groups.
2. Have each group discuss the two guiding questions listed above.
3. Once their small group discussions are complete, have learners share with the large group.
4. As the instructor, make sure to reinforce correct responses and clarify any response that does not align with information included in Activity 4. It is important to make relatable connections to the construction industry for the learners.
5. As the instructor, make sure to discuss the steps for adding and subtracting decimals as listed in Activity 4. It is important that you model both the addition and subtraction of decimals for learners.
6. Once the discussion is complete, make sure to refer learners to Activity 4 as a reference tool.
7. Using Activity 4: Practice, have learners work with adding and subtracting decimals either individually or with a partner.
8. Once learners have completed the practice make sure to review the correct answers. Have learners correct any incorrectly worked equations.

Activity 4: Adding & Subtracting Decimals

Student View

Since using fractions and decimals is common in many work environments, the next step is learning how to add and subtract fractions and decimals. To add and subtract decimals, line up the decimals and add or subtract as you normally would. Review the instructions, then practice your skills.

Adding and Subtracting Decimals:

Example 1: Add 1.5 + 2.14

Step 1: Line up the decimal points.

```
 1.5
+2.14
```

Step 2: Insert zeros to have the same number of digits for both numbers.

```
 1.50
+2.14
```

Step 3: Add, starting with the hundreds place.

```
 1.50
+2.14
    4
```

Step 4: Continue with the tenths place.

```
 1.50
+2.14
   64
```

Step 5: Place the decimal point so that it lines up vertically.

```
 1.50
+2.14
  .64
```

Step 6: Add the ones place.

```
 1.50
+2.14
 3.64
```

Example 2: Subtract 4.67 - 2.15

Step 1: Line up the decimal points.

```
 4.67
-2.15
```

Step 2: Subtract, starting with the hundreds place.

```
 4.67
-2.15
    2
```

Step 3: Continue with the tenths place.

```
 4.67
-2.15
   52
```

Step 4: Place the decimal point so that it lines up vertically.

```
 4.67
-2.15
  .52
```

Step 5: Subtract the ones place.

```
 4.67
-2.15
 2.52
```

Activity 4: Practice with Decimals

Student View

Addition: Find the sum of the problems below.

1. 1 + 0.02 = 1.02
2. 0.2 + 0.1 = 0.3
3. 0.4 + 0.2 = 0.6
4. 1 + 6 = 7
5. 0.06 + 4 = 4.06
6. 6 + 0.5 = 6.5
7. 0.00 + 3 = 3.00
8. 0.4 + 5 = 5.4
9. 0.3 + 0.4 = 0.7
10. 0.05 + 0.2 = 0.25
11. 1 + 0.1 = 1.1
12. 0.05 + 0.4 = 0.45

Activity 4: Practice with Decimals

Student View

Subtraction: Find the difference of the problems below.

1) 4 - 3.4 = 0.6	2) 7 - 0.051 = 6.949
3) 9 - 0.068 = 8.932	4) 10 - 0.084 = 9.916
5) 6 - 1.7 = 4.3	6) 60 - 5.3 = 54.7
7) 2 - 0.062 = 1.938	8) 7 - 0.086 = 6.914
9) 5 - 0.037 = 4.963	10) 50 - 0.94 = 49.06
11) 4 - 0.082 = 3.918	12) 40 - 0.97 = 39.03

Activity 5: Adding & Subtracting Fractions

After learning about adding and subtracting decimals, learners will now learn to add and subtract fractions

Learner Objective

Add and subtract fractions.

To begin the lesson, ask learners the following two guiding questions:

- What experience do you have adding and subtracting fractions?
- How is understanding this skill important to the construction industry?

Instructional Procedures:

1. Divide learners into groups.
2. Have each group discuss the two opening questions listed above.
3. Once their small group discussions are complete, have learners share with the large group.
4. As the instructor, make sure to reinforce correct responses and clarify any response that does not align with information included in Activity 5. It is important to make relatable connections to the construction industry for the learners.
5. Make sure to discuss the steps for adding and subtracting fractions as listed in Activity 5. It is important that you model both the addition and subtraction of fractions for learners.
6. Once the discussion is complete, refer learners to Activity 5 as a reference tool.
7. Using Activity 5: Practice, have learners work with adding and subtracting fractions individually or with a partner.
8. Once learners have completed the practice, make sure to review the correct answers. Have learners correct any incorrectly worked equations.

Activity 5: Adding & Subtracting Fractions

Student View

Adding and subtracting fractions uses the same idea as adding and subtracting decimals: Ensure you have the same denominator, then add or subtract the numerators, keeping the denominator the same.

Adding and Subtracting Fractions:

Example 1: Adding

Jason has 2/8 of a pack of wire and Ernie has 4/8 of the same pack. How much of the pack do they have altogether?

$$\frac{2}{8} \quad \frac{4}{8}$$

Jason Ernie

Since the denominators are the same, we can just add the numerators. (2 + 4 to get 6)

$$\frac{2}{8} + \frac{4}{8} = \frac{6}{8}$$

Jason Ernie

Tip: Do not add the denominators by accident.

Jason and Ernie have **6/8** of the pack altogether.

$$\frac{6}{8}$$

Example 2: Subtracting

Jason has 9/6 of a pack of wire and Ernie used 4/6 of the pack. How much wire does Jason have left?

$$\frac{9}{6} \quad \frac{4}{6}$$

Jason Ernie

We have the same denominator, so we can subtract numerators. (9 – 4 to get 5)

$$\frac{9}{6} - \frac{4}{6} = \frac{5}{6}$$

Jason Ernie

Jason has **5/6** of the pack of wire left.

$$\frac{5}{6}$$

When the denominators aren't the same, find the least common denominator using the steps you learned earlier with equivalent fractions.

Adding and Subtracting Fractions:

Example 3: Finding a Common Demoninator, Comparing and Adding

Kenny painted 1/3 of a fence on Monday and 2/5 of the same fence on Tuesday. On which day did he paint more of the fence? How much of the fence did Kenny paint altogether?

$$\frac{1}{3} \quad \frac{2}{5}$$

Monday Tuesday

- This question is asking us to compare and then add two fractions.
- List out multiples of the denominators and look for the first one that's the same for both numbers. This is called the common denominator.

	x 1	x 2	x 3	x 4	x 5
3	3	6	9	12	15
5	5	10	15	20	25

- Then, convert each fraction to the shared common denominator.

$$\frac{1}{3} \begin{matrix} \times 5 \\ = \\ \times 5 \end{matrix} \frac{5}{15}$$

Monday

$$\frac{2}{5} \begin{matrix} \times 3 \\ = \\ \times 3 \end{matrix} \frac{6}{15}$$

Tuesday

Kenny painted 5/15 of the fence on Monday and 6/15 on Tuesday. To compare the fractions, we compare the numerators (5 and 6). 6 is larger, meaning Kenny painted more of the fence on Tuesday. Finally, we add the two fractions to see how much he painted on both days.

$$\frac{5}{15} + \frac{6}{15} = \frac{11}{15}$$

Monday Tuesday

Remember:
Do not add the denominators.

Activity 5: Practice with Fractions

Student View

Addition: Find the sum of the fractions below.

1. $\frac{2}{9} + \frac{5}{3} = 1\frac{8}{9}$

2. $\frac{2}{10} + \frac{5}{10} = \frac{7}{10}$

3. $\frac{3}{5} + \frac{4}{1} = 4\frac{3}{5}$

4. $\frac{6}{7} + \frac{1}{4} = 1\frac{3}{28}$

5. $\frac{5}{2} + \frac{2}{5} = 2\frac{9}{10}$

6. $\frac{5}{3} + \frac{1}{6} = 1\frac{5}{6}$

Activity 5: Practice with Fractions

Student View

Addition: Find the sum of the fractions below.

7. $\frac{1}{9} + \frac{6}{7} = \frac{61}{63}$

8. $\frac{7}{11} + \frac{7}{4} = 2\frac{17}{44}$

9. $\frac{2}{9} + \frac{11}{3} = 3\frac{8}{9}$

10. $\frac{8}{3} + \frac{3}{4} = 3\frac{5}{12}$

11. $\frac{1}{9} + \frac{3}{5} = \frac{32}{45}$

12. $\frac{3}{10} + \frac{8}{2} = 4\frac{3}{10}$

Activity 5: Practice with Fractions

Student View

Subtraction: Find the difference of the fractions below.

1. $\frac{3}{4} - \frac{5}{12} = \frac{1}{3}$

2. $\frac{13}{15} - \frac{8}{15} = \frac{1}{3}$

3. $\frac{4}{5} - \frac{7}{20} = \frac{9}{20}$

4. $\frac{2}{3} - \frac{1}{9} = \frac{5}{9}$

5. $\frac{9}{16} - \frac{1}{4} = \frac{5}{16}$

6. $\frac{17}{21} - \frac{11}{21} = \frac{2}{7}$

Activity 5: Practice with Fractions

Student View

Subtraction: Find the difference of the fractions below.

7. $\frac{13}{21} - \frac{2}{7} = \frac{1}{3}$

8. $\frac{6}{7} - \frac{5}{14} = \frac{1}{2}$

9. $\frac{17}{18} - \frac{5}{6} = \frac{1}{9}$

10. $\frac{2}{3} - \frac{2}{15} = \frac{8}{15}$

11. $\frac{7}{9} - \frac{6}{27} = \frac{5}{9}$

12. $\frac{5}{8} - \frac{7}{32} = \frac{13}{32}$

Instructor Notes

Activity 6: Ratios, Rates, & Proportions

Now that the learners have familiarized themselves with fractions and decimals, they will learn to calculate ratios, rates, and proportions.

Learner Objective

Calculate ratios, rates, and proportions.

To begin the lesson, ask learners the following two guiding questions:

- What experience do you have using ratios, rates, and proportions?
- How is understanding this skill important to the construction industry?

Instructional Procedures:

1. Divide learners into groups.
2. Have each group discuss the two opening questions listed above.
3. Once their small group discussions are complete, have learners share with the large group.
4. As the instructor, make sure to reinforce correct responses and clarify any response that does not align with information included in Activity 6. It is important to make relatable connections to the construction industry for the learners.
5. As the instructor, make sure to discuss the definitions of ratios, rates, and proportions, as well as to make real-world connections to how each is used in the construction industry. It is important that you model how to solve for rates, ratios, and proportions.
6. Once the discussion is complete, make sure to refer learners to Activity 6 as a reference tool.
7. Using Activity 6: Practice, have learners work with ratios, rates, and proportions, individually or with a partner. The practice includes real-world application for all three skills.
8. Once learners have completed the practice make sure to review the correct answers. Have learners correct any incorrectly worked equations.

Activity 6: Ratios, Rates, & Proportions

Student View

Once you have mastered fractions, you can move into calculating ratios, rates, and proportions. A ratio is a comparison of 2 quantities using division, for example, 2 nails to 1 board. You can write it in the following ways: 2/1, 2 to 1, or 2:1. Like fractions, ratios can be reduced.

Understanding the difference in each term:

- **A rate** is simply a ratio that compares quantities measured in different units: **5 ft per 30 sec** OR $\frac{\text{5 feet}}{\text{30 seconds}}$
- **A unit rate** is a rate whose denominator is 1: **55 mph** OR $\frac{\text{55 miles}}{\text{1 hour}}$
- **A proportion** is an equation that shows 2 ratios are equal: $\frac{3}{5} = \frac{9}{15}$

Practice: Ratios

1. If your company won 70 bids and lost 40 bids, which of the following ratios is representative of this fact?

a. 7:2 b. 7:4 c. 7:5 d. 7:6

2. In your small business, 40 of the employees are men and 30 of the employees are women. What is the ratio of women to men?

3 to 4 OR **3:4** OR **3/4**

3. The length of a concrete pad is 20 feet and the width is 15 feet. What is the ratio of length to width?

20 to 15 OR **20:15** OR **20/15** OR **4 to 3** OR **4:3** OR **4/3**

4. The recommended mixing ratio for mortar is 3 parts of sand to 1 part of cement for each gallon. What is the ratio of sand to cement for 5 gallons?

15 to 5 OR **15:5** OR **15/5** OR **3 to 1** OR **3:1** OR **3/1**

Practice: Rates and Unit Rates

1. A forklift can go 400 miles on 8 gallons of gas. How far can the forklift go with 1 gallon of gas?

50 miles per gallon

2. Your project uses 330 linear feet of PVC pipe for the 5-day work week. How much PVC pipe do you need per day?

66 feet of PVC per day

3. You are wiring a building for electricity and need 210 feet of wire to run the wire throughout the 7-room building. Approximately how many feet of wire is being used in each room?

30 feet per room

4. You purchased 212 sinks for a new apartment building project. Your total bill was $30,952. What is your cost per sink?

$146 per sink

5. Your company spends $455 to produce 50 switches. What is the cost per switch?

$9.10 per switch

Practice: Proportions

1. If 2 cubic feet of water is 15 gallons, then how many gallons is 3.5 cubic feet of water?

26.25 gallons

2. An 8 foot 2 x 4 weighs 9 lbs. on average, then how much does a 12 foot 2 x 4 weigh?

13.5 lbs.

3. If the pitch of a pipe with a run of 96 feet is a 1 foot drop, how many feet is the drop for a 384 foot run?

4 feet

4. A Journeyman and an apprentice complete 200 five-inch joints in 8 hours. How many five-inch joints do they complete in 24 hours?

600 joints

5. A 4-man job costs $1,200 per day in labor. How much would a 6-man job cost per day in labor?

$3,150 per day

Learner Resources & Assessment Tools

Learner Resources

Learners have been exposed to fractions, decimals, ratios, rates, and proportions within the activities they completed for this lesson. Learners have also made real-world connections to these math skills and applications to their current workplaces.

As the instructor, it is important to reinforce the importance of reflection and application of these math skills as they relate to each learner.

Assessment (Check Your Understanding)

Now that learners have worked with fractions, decimals, rates, ratios, and proportions, they will demonstrate their understanding by completing a *Check Your Understanding* assessment. This assessment is not intended to be graded, but instead used to identify areas of strength and weakness within the learner knowledge.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with the math skills and require less assistance.

Option 1

Have learners work individually or with a partner to complete the *Check Your Understanding* assessment. Once learners have completed the assessment, discuss their responses with the whole group. Make sure to clarify misunderstandings or answer questions learners may have about the content.

Option 2

As an Exit Ticket to end the class, have learners complete the *Check Your Understanding* assessment within their workbooks individually.

As the instructor, you should review each learner's answers prior to beginning the next class session.

Check Your Understanding

Student View

Reflect on the importance of fractions and decimals by answering the questions below.

Reflection

Do you remember how to convert between a fraction and a decimal? When might you need to do this in your workplace?

Describe a relationship between two quantities (a ratio) you might see in your industry.

Write a rate to represent a situation in your workplace or field. What does that rate mean?

Lesson Overview: Measurement

As the instructor, you will facilitate activities to help learners identify how measurement is used in the workplace.

To begin the lesson, explain to learners the importance of using measurement to complete tasks within the workforce. Whether seeking a new job or performing daily construction-related tasks within their current job, understanding how to properly utilize measurement skills are important skills to possess.

Group Discussion

Use the following guiding questions to engage learners in a discussion to introduce this lesson, then proceed to Activity 1.

- Are you familiar with different types of measurement skills used in construction? If so, how are you using these skills in your work life?
- Are you comfortable using measurement within the workplace?

O*NET Elements

- Active Listening
- Cooperation
- Critical Thinking
- Oral Comprehension
- Speaking
- Writing

AEL Standards

Subarea 11.0
General Mathematical Processes

1 - Apply math in everyday life
2 - Problem solve using math
3 - Use mathematical tools
4 - Apply cognitive strategies
5 - Communicate concepts
6 - Analyze relationships
7 - Develop, display, explain, & justify

Subarea 11.1
Numerical Representations and Relationships

11.1a (1-3) Place value

Subarea 11.2
Computations

11.2c 1-3 - Add, subtract, multiply, divide, real world application, rational expressions

11.2e 1-2 - Comprehensive relationships to problem solve, expressions and equations to problem solve

11.4a 1 - Understand units of measure

11.4b 1-7 - Measuring length, area, volume, and weight/mass in different measuring systems

11.4c 1-3 - Represent and solve problems with perimeter, area, and volume

Student View

3. Measurement

Accurate measurements are important in any area of the construction field. For example, a carpenter needs to use a tape measure to measure, mark, and cut wood. A plumber needs to understand the different sizes of fittings and fixtures and measure the correct length of a pipe. This unit will prepare you to understand various measurement concepts and tools used in construction.

After completing this lesson, you will be able to:

1 - **Identify measurement tools used in the plumbing, electrical, and general construction fields**
2 - **Convert units with a metric system**
3 - **Calculate squares, cubes, and square root**
4 - **Calculate perimeter, area, and volume**

Activity 1: Basic Measurement

As the instructor, you will teach and review with learners about basic measurement skills and measuring tools. As well as the importance of using them correctly in the workplace.

Learner Objective

Identify different types of measurement tools used in the construction industry.

Instructional Procedures:

1. Divide learners into groups.
2. Have each group create a list of tools they currently use on the job for measuring.
3. Use the tools listed in Activity 1 to guide a discussion about the various measurement tools used in plumbing, electrical, and general construction.
4. Have learners discuss the uses of the tools and the importance of knowing how to properly use each tool relevant to their field of work.
5. Discuss with learners the problems associated with incorrect use of the tools or with incorrect calculations of measurements.
6. Once learners have identified the tools used in measuring, proceed to Activity 2.

Activity 1: Basic Measurement

Student View

The first step in measurement is to be familiar with the different types of measurement tools used in your field. In this activity, review the measurement tools used in plumbing, electrical, and general construction.

Straight Edge
A straight edge differs from a ruler because it has no marking for measurement. Instead, a straight edge is a long wooden or metallic instrument with a perfectly flat edge, used to check the straightness of lines or to maintain an undeviating linear path. Straight edges can come in different materials, sizes, weights and lengths.

Steel Rule
Also known as a ruler, this steel rule is a measuring tool that helps make accurate measurements using predefined markings, like inches and centimeters. A steel rule can be rigid or flexible and can be used as a guide for laying out lines. A very rigid steel rule could even be used as a guide for cutting.

Scriber
A scriber is a tool used when measuring metal to mark lines to show where to cut. It is made of a rod with a tip of cast steel that has been hardened and sharpened to a point. It leaves a mark by dragging the point over the metal to create a shallow scratch. A scriber is used instead of a pen or pencil because regular ink lines are hard to see and too easily erased.

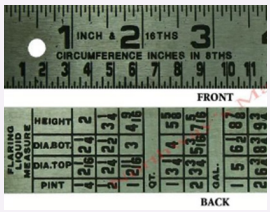
Scribing Compass & Divider
These terms are often interchanged, but technically, a divider has two sharp points, and a compass has one pencil or pen point and one sharp point. Both tools help accurately mark and measure and draw circles and arcs.

Activity 1: Basic Measurement

Student View

Trammel
A trammel is a tool used to draw circles and arcs that are larger than can be drawn with a divider or compass. They can also be used to bisect lines and angles.

Circumference Rule
Also known as a tinner's rule, the circumference rule has a regular measuring scale on the top edge like a steel rule, with the added functionality of circumference measurements on the bottom edge.



Try Square
A try square is a tool used for measuring and marking a square piece of material. The square can be used to determine the accuracy of a 90-degree angle.

Multimeter
A multimeter is a tool used to measure three basic electrical characteristics (voltage, current, and resistance).

Oscilloscope
An oscilloscope is a tool used to measure the voltage level of an electronic circuit.

Clamp Meter
A clamp meter is a tool used to measure the electric current on a cable or any media.

Activity 1: Basic Measurement

Student View

ESR Meter
An ESR meter is a tool used to measure the internal resistance level of a capacitor in an electronic circuit.

Wattmeter
A wattmeter is a tool used to measure the electric power of a circuit or electronic device.

Tape Measure
A tape measure is used to find exact measurements.

Measuring Wheel
A measuring wheel is used to measure a lot, a plot of land, or a foundation. Measuring wheels move with you as you walk.

Diameter Tape
A diameter tape measure is used to measure around objects like pipes, trees, and other round objects.

Level
A level is used to measure and determine at a glance if something is level with .5 mm/m, .0005 in/in, and .029.

Activity 2: Measurement

Now that learners have identified the different tools used in construction for measurement, they will review how to correctly record measurements using a ruler.

Learner Objective

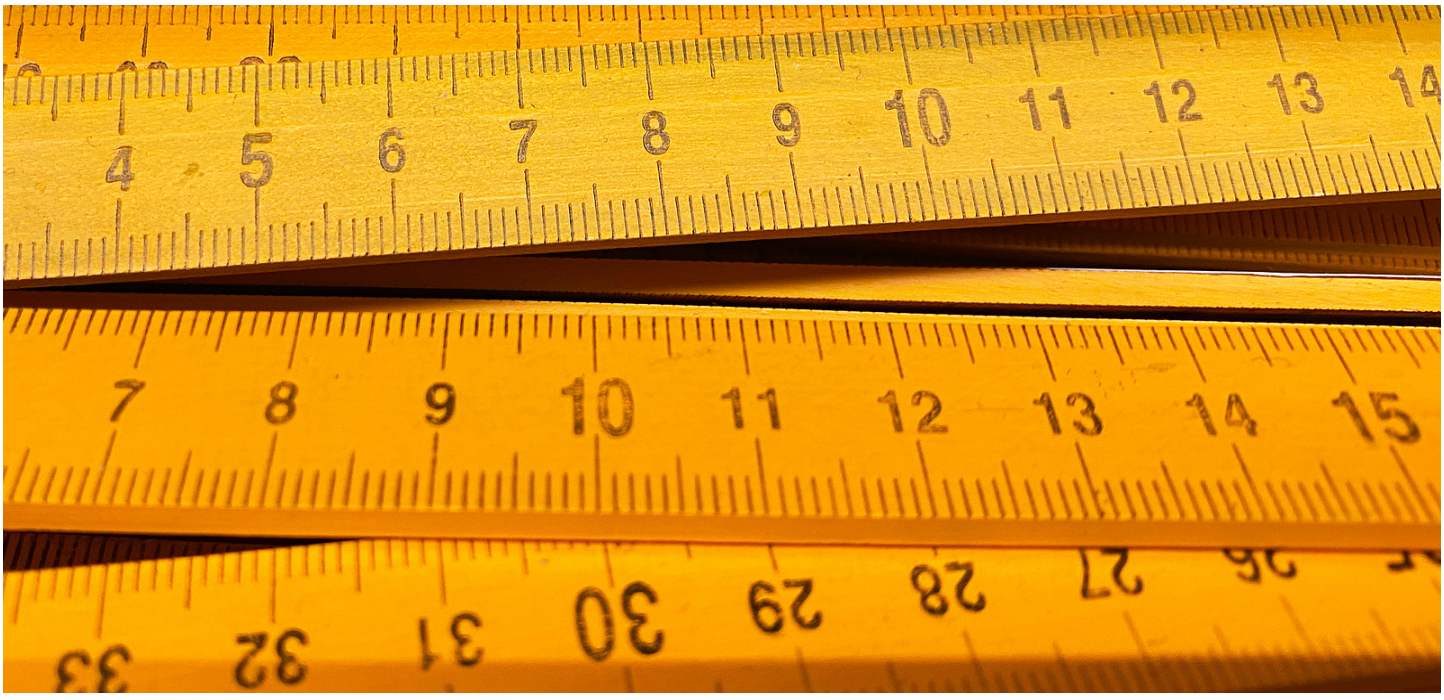
Record measurements with the use of a ruler.

To begin the lesson, ask learners the following two guiding questions:

- How are fractions and decimals used in measurement?
- Are you familiar with millimeters and centimeters?

Instructional Procedures:

1. After learners have had an opportunity to discuss the guiding questions, discuss the expectations for completing Activity 2.
2. Review with learners the millimeters and centimeters on the ruler.
3. Allow learners to either work individually or with a partner to complete Activity 2.
4. Once learners have completed the activity, review each measurement recording as a whole class.
5. Have learners correct any incorrect responses.
6. After corrections are made and the discussion is complete, move on to Activity 3.

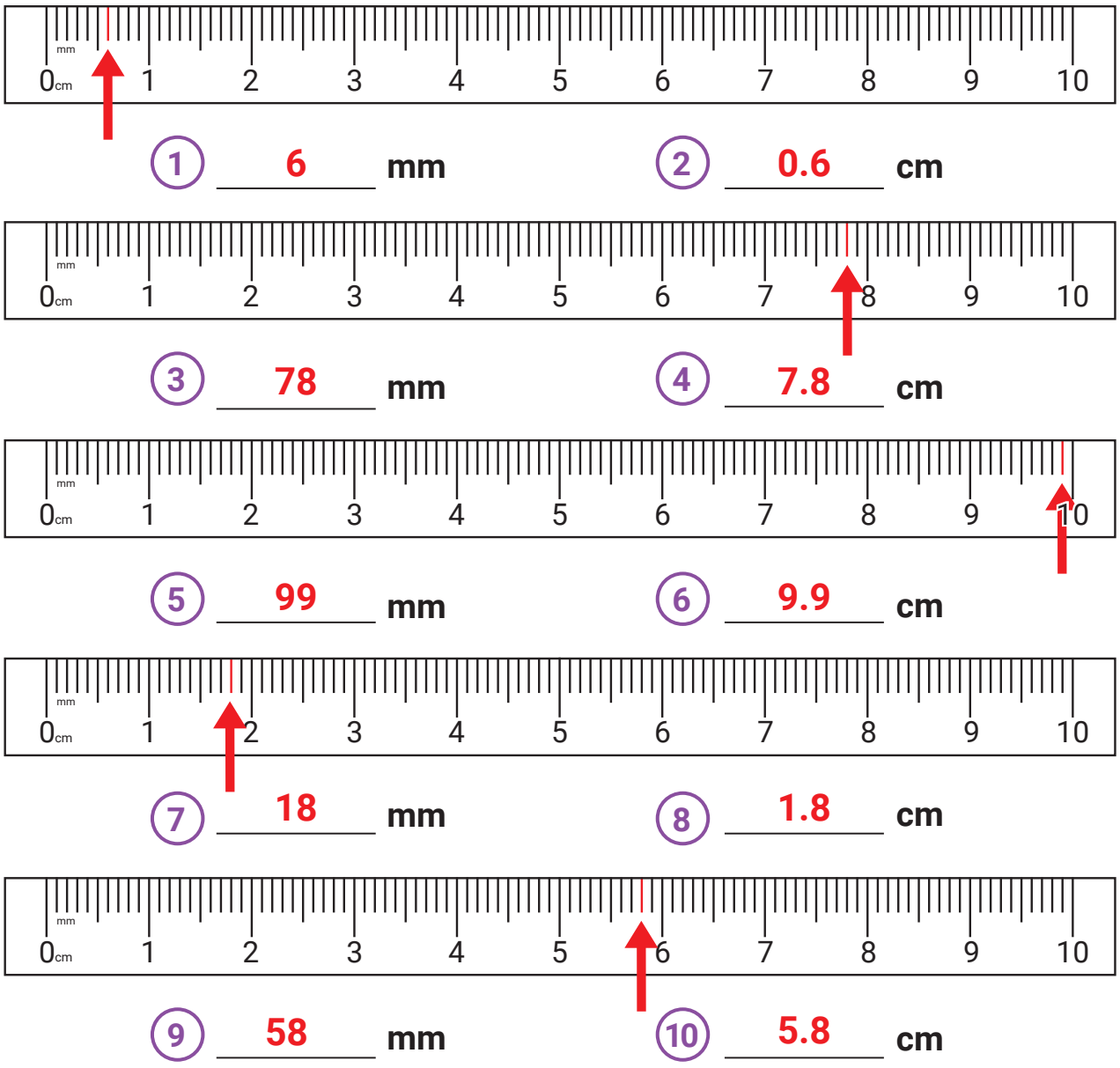


Activity 2: Measurement

Student View

Although many different tools are used to measure across industries, the basic goal is the same: to obtain accurate measurements. Whether your industry uses standard or metric measurements, it is important to be accurate because measurements can impact safety, stability, and cost. Using your previous knowledge of fractions and decimals, practice recording accurate measurements below.

Record the length measurement at the point marked by the arrow in both millimeters and centimeters.



1. 6 mm
2. 0.6 cm
3. 78 mm
4. 7.8 cm
5. 99 mm
6. 9.9 cm
7. 18 mm
8. 1.8 cm
9. 58 mm
10. 5.8 cm

Activity 3: Converting Measurements

Now that learners have read and recorded measurements from a ruler, they will learn how to convert measurements.

As the instructor, you will facilitate the activities as the learners work to convert measurements.

Learner Objective

Convert measurements for length, capacity, mass/weight, and time.

Activity Setup

Using a large Post-it sheet, create a poster for each topic listed below.
Place the posters around the room for the learners to use.

Instructional Procedures:

1. Learners should have a basic understanding of measurement. Now, let's combine that understanding with converting measurement for length, capacity, mass/weight, and time.
2. Create a Post-it sheet for each of the following topics:
   - *Mass & Weight*
   - *Length*
   - *Capacity*
   - *Time*
3. Divide learners into four groups. Have each group write what they know about each poster topic. Use different colored markers or small sticky notes to help distinguish each group.
4. After all groups have had an opportunity to rotate through each poster, discuss each poster with the whole group.
5. It is important to point out the differences between each conversion unit of measure.
6. As a whole class, discuss equations or steps used to convert each unit of measure. As the instructor, be sure to model several problems for each conversion.
7. After the whole group discussion is complete, have learners complete Activity 3. This can be done with a partner or individually. Remind leaners to show their work.
8. After all learners have completed the conversion activity, review each question as a whole class. Have learners correct any incorrect responses.
9. After corrections are made, move on to Activity 4.

Activity 3: Converting Measurements

Student View

Now that you have familiarized yourself with reading measurements, it is time to practice converting measurements. Many times once measurements are taken, you are required to convert the measurement into a different unit (either standard or metric).

Mass & Weight
1 ton = 2,000 pounds
1 pound = 16 ounces

Length
1 mile = 5,280 feet
1 yard = 3 feet
1 foot = 12 inches

Capacity
1 gallon = 4 quarts
1 quart = 2 pints
1 pint = 2 cups
1 cup = 8 fluid ounces

Time
1 year = 365 days
1 year = 52 weeks
1 hour = 60 minutes
1 minute = 60 seconds

Use the tables provided to convert each unit of measurement.

1. **2 yards =** 6 feet
2. **18 inches =** 1.5 feet
3. **0.5 miles =** 2,640 feet
4. **310 yards =** 11,160 inches
5. **5 gallons =** 20 quarts
6. **2 gallons =** 16 pints
7. **18 cups =** 9 pints
8. **4 quarts =** 8 pints
9. **6 cups =** 48 fluid oz
10. **32 fluid oz =** 4 cups
11. **1 ton =** 32,000 ounces
12. **192 ounces =** 12 pounds
13. **3 pounds =** 48 ounces
14. **2.5 tons =** 5,000 pounds
15. **14 weeks =** 98 days
16. **19 minutes =** 1,140 seconds

Convert each customary unit of measurement.

17. **3 cups + 2 fluid ounces =** 26 fluid ounces
18. **2 feet + 3 inches =** 27 inches
19. **4 feet + 3 inches =** 51 inches
20. **75 inches =** 6 feet **+** 3 inches

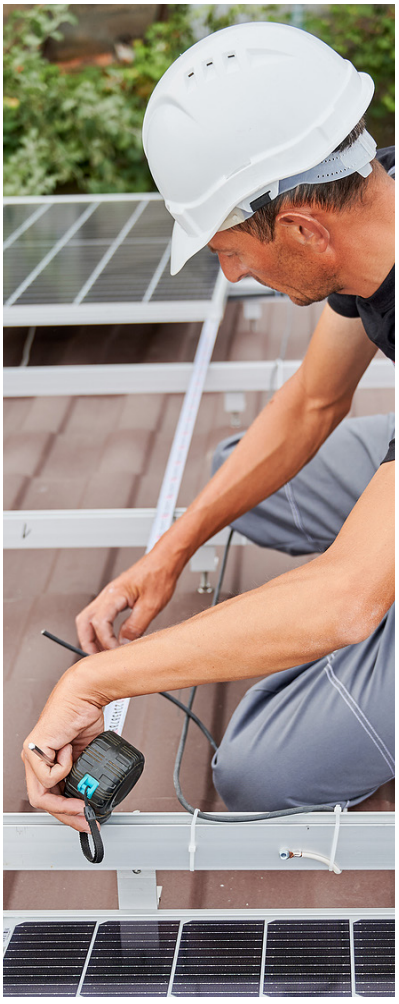
Activity 4: Comparing Measurements

Now that learners have read and recorded measurements from a ruler, they will learn how to convert measurements.

As the instructor, you will facilitate the activities as the learners work to compare measurements.

Learner Objective

Compare various units of measurement.



Instructional Procedures:

1. Learners should have a basic understanding of converting units of measurement. Now, let's combine that understanding with comparing measurements for mass & weight, length, capacity, and time.
2. When reading measurements in different units, it is important to understand how the units compare.
3. Ask learners to discuss with a partner the reasons when and why they would need to compare measurements in the construction industry. Do they have experience comparing, if so what examples can they provide?
4. As a whole class, discuss how to compare each unit of measure. Remember to review the symbols used for comparison (<, >, =). As the instructor, be sure to model several problems for each comparison. Use real-world construction-related examples to help learners make connections.
5. After the whole group discussion is complete, have learners complete the comparison activity for Activity 4. This can be done with a partner or individually.
6. After learners have completed the comparison activity, review each question as a whole class. Have learners correct any incorrect responses.
7. After corrections are made, move on to Activity 5.

Activity 4: Comparing Measurements

Student View

When reading measurements in different units, it is important to understand how the units compare. Use the table below to practice comparing each measurement as either less than (<), greater than (>), or equal to (=).

Mass & Weight
1 ton = 2,000 pounds
1 pound = 16 ounces

Length
1 mile = 5,280 feet
1 yard = 3 feet
1 foot = 12 inches

Capacity
1 gallon = 4 quarts
1 quart = 2 pints
1 pint = 2 cups
1 cup = 8 fluid ounces

Time
1 year = 365 days
1 year = 52 weeks
1 hour = 60 minutes
1 minute = 60 seconds

1. 30 inch **<** 1 yard
2. 1 gallon **=** 8 pints
3. 4.5 pounds **>** 70 ounces
4. 18 ounces **<** 3 pounds
5. 4 pints **>** 6 cups
6. 20 gallons **>** 40 quarts
7. 4 pounds **>** 40 ounces
8. 2.5 yards **>** 60 inches
9. 5 feet 2 inches **<** 65 inches
10. 2 cups **<** 1 quarts
11. 16 cups **>** 4 pints
12. 5 pounds **=** 80 quarts

Compare each set of customary measurements using <,>, or =:

13. 8 quarts + 1 pint **>** 32 cups
14. 68 pints **<** 8 gallons + 2 quarts
15. 48 feet **>** 1 yard + 9 inches
16. 2 pints + 8 ounces **=** 5 cups
17. 72 inches **<** 5 yards + 10 inches
18. 10 cups + 16 ounces **>** 5 pints + 1 cup

Activity 5: Perimeter

Now that learners have converted and compared measurements, they will learn how to measure the perimeter of two-dimensional shapes.

As the instructor, you will facilitate the activities as the learners work to measure the perimeter of various two-dimensional shapes.

Learner Objective

Solve for perimeter of two-dimensional shapes.

Activity Setup

Using a large Post-it sheet, draw each of the designated two-dimensional shapes listed below. Provide measurements for each shape. Place the posters around the room.

Instructional Procedures:

1. Learners should have a basic understanding of measurement. Now, let's combine that understanding with the skills necessary to solve for the perimeter of two-dimensional shapes.
2. Create a Post-it sheet for each of the following two-dimensional shapes:
   - Parallelogram
   - Triangle
   - Rectangle
   - Square
   - Trapezoid
   - Kite
   - Rhombus
   - Hexagon
3. For each shape, assign measurements to as many sides necessary for learners to be able to apply the formula and solve for perimeter.
4. Divide learners into four groups. Have the groups solve for the perimeter of two of the shapes on each poster. Remind them to show their work.
5. After all groups have had an opportunity to solve for the perimeter of the two shapes, discuss each poster with the whole group.
6. As a whole class, discuss how each group solved for the perimeter of the identified shape. As the instructor, be sure to make connections to solving for perimeter in real-world construction-related examples to help learners strengthen their understanding of the content.
7. After the whole group discussion is complete, have learners complete the perimeter activity for Activity 5. This can be done with a partner or individually.
8. After all learners have completed the perimeter activity, review each question. Have learners correct any incorrect responses.
9. After corrections are made, move on to Activity 6.

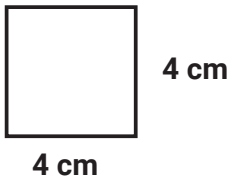
Activity 5: Perimeter

Student View

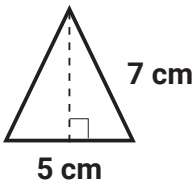
Perimeter measures the outside boundary of a two-dimensional shape. There are many instances where you may need to measure around an object or figure. Sometimes those objects and figures may be irregularly shaped. Practice the exercises below. Be sure to apply the appropriate formula to the shape. Remember, the perimeter is simply adding the outside edge of a two-dimensional shape, so the formulas are just shortcuts to adding all the sides.

Shape	Perimeter Formula	Terms
Parallelogram	2(Base + Height)	-
Triangle	a + b + c	a, b, and c being the side lengths
Rectangle	2(Length + Width)	-
Square	4a	a = Length of a side
Hexagon	6a	a = Length of a side

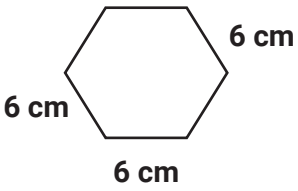
Solve: Find the perimeter for each shape below.

1. 

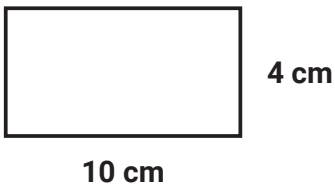
Perimeter = 16 cm

2. 

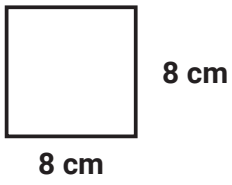
Perimeter = 19 cm

3. 

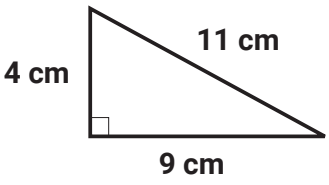
Perimeter = 36 cm

4. 

Perimeter = 28 cm

5. 

Perimeter = 32 cm

6. 

Perimeter = 24 cm

Activity 6: Area

Now that learners have measured perimeter, they will learn how to measure the area of two-dimensional shapes.

As the instructor, you will facilitate the activities as the learners work to measure the area of various two-dimensional shapes.

Learner Objective

Solve for the area of two-dimensional shapes.

Activity Setup

Using a large Post-it sheet, draw each of the designated two-dimensional shapes listed below. Provide measurements for each shape and place the posters around the room.

Instructional Procedures:

1. Learners should have a basic understanding of perimeter. Now, let's combine that understanding with the skills necessary to solve for the area of two-dimensional shapes.
2. Create a Post-it sheet for each of the following two-dimensional shapes:
   - Circle
   - Triangle
   - Square
   - Rectangle
   - Parallelogram
3. For each shape, assign measurements to as many sides necessary for learners to be able to apply the formula and solve for area.
4. Divide learners into four groups. Have each group solve for area of two of the two-dimensional shapes on the posters. Remind learners to show their work.
5. After all groups have had an opportunity to solve the area of the assigned shapes, discuss each poster with the whole group.
6. As a whole class, discuss how each group solved for the area of the identified shape. As the instructor, be sure to make connections to solving for area in real-world construction-related examples to help learners strengthen their understanding of the content.

7. After the whole group discussion is complete, have learners complete Activity 6: Practice. This can be done with a partner or individually.
8. After all learners have completed the activity, review each question as a whole class. Have learners correct any incorrect responses.
9. After corrections are made, move on to Activity 7.

Activity 6: Area

Student View

Perimeter and area are very different but often get confused. Perimeter is described as the outside edge of a shape while area is the "stuff inside" the shape. In general, the area of shapes can be defined as the amount of paint required to cover the surface with a single coat. Calculating the area of each shape has its own unique formula.

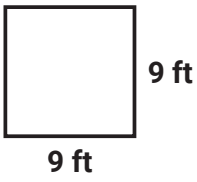
Shape	Area Formula	Terms
Circle	πr^2	π = 3.14, r = Radius of the circle
Triangle	1/2(bh)	b = Base, h = Height
Square	a^2	a = Length of side
Rectangle	lw	l = Length, w = Width
Parallelogram	6a	a = Length of side
Trapezium	1/2(a+b) x h	a and b = Length of parallel sides h = Height

Solve: Find the area for each shape below.

1

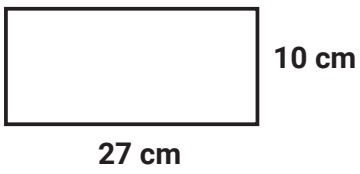
Area = 420 m^2

2



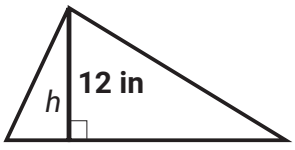
Area = 81 ft^2

3



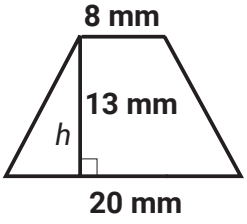
Area = 270 cm^2

4



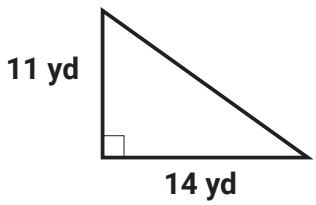
Area = 108 in^2

5



Area = 182 mm^2

6



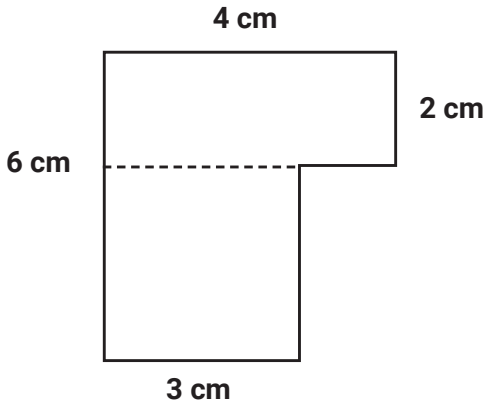
Area = 77 yd^2

Activity 6: Area

Student View

Solve: Practice calculating the area AND the perimeter for the shapes below.

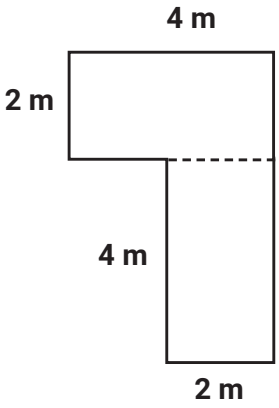
1



Perimeter = 20 cm

Area = 20 cm^2

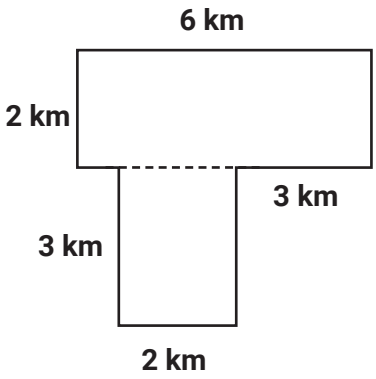
2



Perimeter = 20 m

Area = 16 m^2

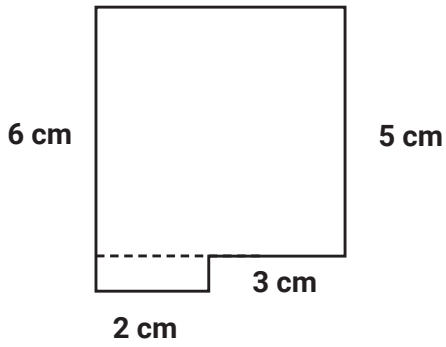
3



Perimeter = 22 km

Area = 18 km^2

4



Perimeter = 22 cm

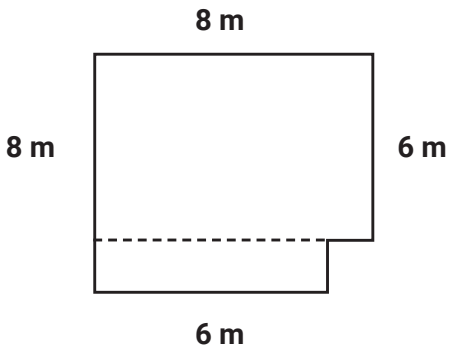
Area = 27 cm^2

Activity 6: Area

Student View

Solve: Practice calculating the area AND the perimeter for the shapes below.

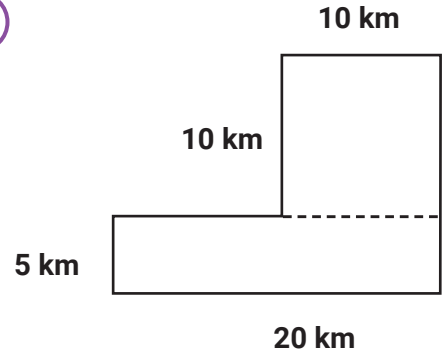
5



Perimeter = 32 m

Area = 60 m^2

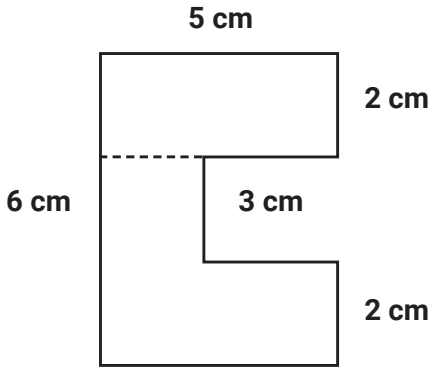
6



Perimeter = 70 km

Area = 200 km^2

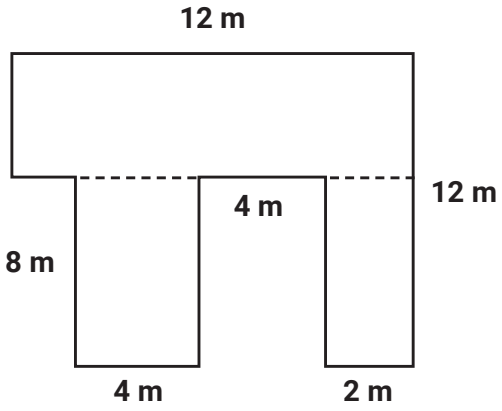
7



Perimeter = 28 cm

Area = 24 cm^2

8



Perimeter = 64 m

Area = 104 m^2

Activity 7: Volume

Now that learners have calculated the area of two-dimensional shapes, they will learn how to calculate volume measurements.

To begin the lesson, ask learners the following guiding questions:

Learner Objective

Calculate volume of three-dimensional shapes.

- How are volume measurements used in the construction industry?
- Are you familiar with the various formulas used to solve volume for different three-dimensional shapes? If so, what is your experience?

Instructional Procedures:

1. After learners have had an opportunity to discuss the guiding questions with a partner, discuss how volume measurements are calculated, the uses related to the construction industry, and the importance of proper calculation.
2. As a whole class, discuss how to solve each volume equation. Remember to review the different formulas associated with each shape.
3. As the instructor, be sure to model several problems for each volume measurement. Use real-world construction-related examples to help learners make connections.
4. After the whole group discussion is complete, have learners complete the volume activity for Activity 7. This can be done with a partner or individually.
5. After all learners have completed the volume activity, review each question with the whole class. Have the learners correct any incorrect responses.
6. After corrections are made, move on to *Check Your Understanding* to conclude the lesson on measurement.

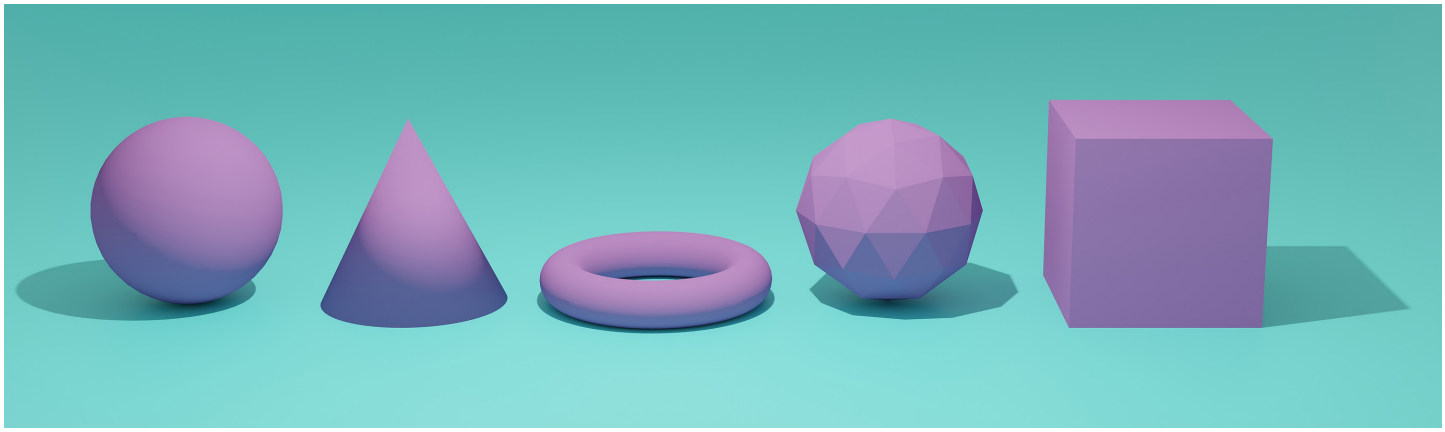
Activity 7: Volume

Student View

Volume is defined as a capacity occupied by a three-dimensional solid shape. In any shape, it is hard to visualize but can be compared between shapes. For example, the volume of a toolbox is greater than the volume of a tape measure placed inside it. As we learned in the last lesson, for calculating the area of any two-dimensional shape, we divide the portion into equal square units. Similarly, while calculating the volume of solid shapes we will divide it into equal cubical units.

Every object in our surroundings has a nature of occupying space. These real-life objects can be easily compared with the basic 3-D shapes. Like perimeter and area, calculating the volume of each shape has its own unique formula. Using the formulas below, practice calculating the volume of each shape.

Shape	Volume Formula	Terms
Cube	a^3	a = Length of a side
Cuboid	lbh	l = Length, b = Base, h = Height
Cone	$(1/3)\pi r^2 h$	π = 3.14, r = Radius, h = Height
Cylinder	$\pi r^2 h$	π = 3.14, r = Radius, h = Height
Sphere	$(4/3)\pi r^3$	π = 3.14, r = Radius
Hemisphere	$(2/3)\pi r^3$	π = 3.14, r = Radius
Prism	bh	b = Base, h = Height
Pyramid	(1/3)bh	b = Base, h = Height

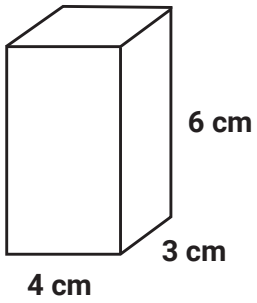


Activity 7: Volume

Student View

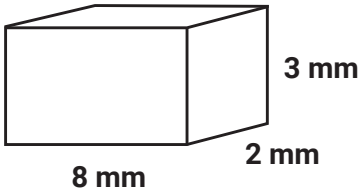
Solve: Practice calculating the volume for the shapes below.

1



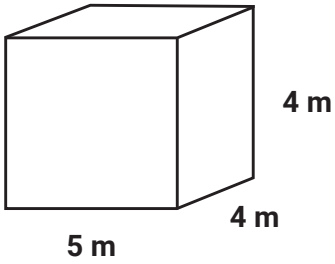
Volume = 72 cm^3

2



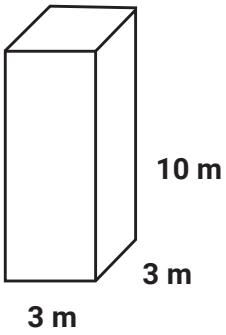
Volume = 48 mm^3

3



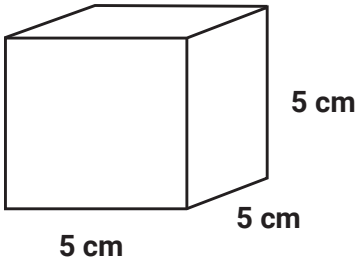
Volume = 80 m^3

4



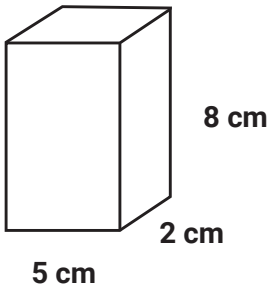
Volume = 90 m^3

5



Volume = 125 cm^3

6



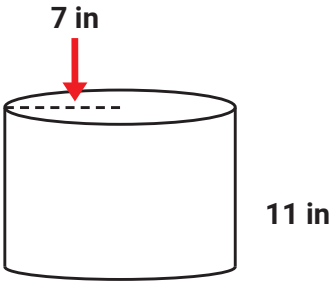
Volume = 80 cm^3

Activity 7: Volume

Student View

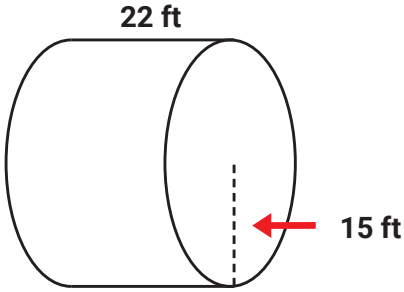
Solve: Practice calculating the volume for the shapes below.

7



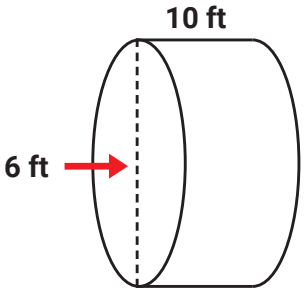
Volume = 1,693.32 in^3

8



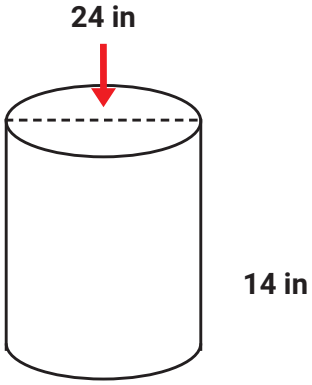
Volume = 15,550.88 ft^3

9



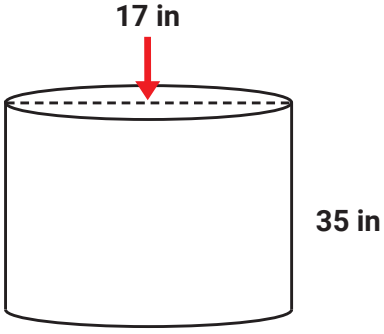
Volume = 282.74 ft^3

10



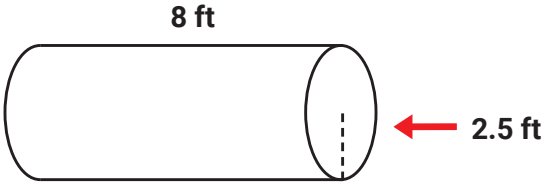
Volume = 6,333.45 in^3

11



Volume = 7,944.30 in^3

12



Volume = 157.08 ft^3

Learner Resources and Assessment Tools

Learner Resources

Learners have been exposed to math-based vocabulary specific to measurement within the activities they completed for this lesson. This lesson contains a vocabulary list to assist learners. Inform learners that they can refer back to the list if they need help remembering.

Assessment (Check Your Understanding)

Now that learners have reviewed basic measurement, recorded measurement readings, and solved for perimeter, area, and volume, they will demonstrate their understanding by completing the *Check Your Understanding* assessment. This assessment is not intended to be graded, but instead used to identify areas of strength and weakness within the learner knowledge.

Option 1 is designed for learners who need more assistance, and Option 2 is designed for learners who may have more familiarity with basic measurement knowledge and require less assistance.

Option 1

Have learners work individually or with a partner to complete the C*heck Your Understanding* assessment. Once learners have completed the assessment, go over each question with the whole group. Make sure to clarify misunderstandings or answer questions students may have about the content.

Option 2

As an Exit Ticket to end the class, have learners complete the *Check Your Understanding* assessment within their workbooks individually.

As the instructor, you should review each learner's answers as they complete them and leave the classroom.

Vocabulary

Student View

Some of the vocabulary words you learned in this lesson are listed below.
Refer back to this page if you need help remembering.

Vocab Word	Definition
Amperes	The basic unit of electrical current in the International System of Units (SI).
Analog	Displaying a readout by a pointer or hands on a dial rather than by numerical digits.
Angle	The space within two lines or three or more planes diverging from a common point, or within two planes diverging from a common line.
Area	The quantitative measure of a plane or curved surface; two-dimensional extent.
Capacity	The maximum amount or number that can be received or contained; cubic contents; volume.
Celsius	Pertaining to or noting a temperature scale (Celsius scale) in which 0° represents the ice point and 100° represents the steam point.
Circumference	The outer boundary, especially of a circular area; perimeter.
Deep/Depth	A dimension taken through an object or body of material, usually downward from an upper surface, horizontally inward from an outer surface, or from top to bottom of something regarded as one of several layers.
Diagonal	Connecting two nonadjacent angles or vertices of a polygon or polyhedron, as a straight line.
Diameter	A straight line passing through the center of a circle or sphere and meeting the circumference or surface at each end, the width of a circular or cylindrical object.
Digital	Displaying a readout in numerical digits rather than by a pointer or hands on a dial.
Fahrenheit	Noting, pertaining to, or measured according to a temperature scale (Fahrenheit scale) in which 32° represents the ice point and 212° represents the boiling point.

Vocabulary

Student View

Vocab Word	Definition
High/Height	The extent or distance upward; distance upward from a given level to a fixed point.
Horizontal	At right angles to the vertical; parallel to level ground.
Long/Length	The measure of the greatest dimension of a plane or solid figure.
Linear	Involving measurement in one dimension only; pertaining to length.
Load	A measure of the warmth or coldness of an object or substance with reference to some standard value.
Mass	A collection of incoherent particles, parts, or objects regarded as forming one body.
Metric	Pertaining to the meter or to the metric system.
Ohms	The standard unit of electrical resistance in the International System of Units (SI).
Parallel	Extending in the same direction, equidistant at all points, and never converging or diverging.
Perimeter	The border or outer boundary of a two-dimensional figure.
Pressure	The exertion of force upon a surface by an object, fluid, etc.
PSI	The abbreviation for pressure, (Pound per Square Inch).
Radius	A straight line extending from the center of a circle or sphere to the circumference or surface, radius is half the diameter.
Standard/English	Norms of spelling, grammar, and usage in written and spoken contexts, and neutralizing nonstandard dialectal variation.

Vocabulary

Student View

Vocab Word	Definition
Temperature	A straight line extending from the center of a circle or sphere to the circumference or surface, radius is half the diameter.
Thick/Thickness	Measured, as specified, between opposite surfaces, from top to bottom, or in a direction perpendicular to that of the length and breadth; (of a solid having three general dimensions) measured across its smallest dimension.
Units	Any specified amount of a quantity, as of length, volume, force, momentum, or time.
Vertical	Being in a position or direction perpendicular to the plane of the horizon; upright.
Volts	The standard unit of potential difference and electromotive force in the International System of Units (SI).
Volume	The amount of space, measured in cubic units, that an object or substance occupies.
Watts	The standard unit of power in the International System of Units (SI).
Weigh/Weight	A unit of heaviness or mass.
Wide/Width	The extent from side to side.

Check Your Understanding

Student View

Now that you have practiced measurement, perimeter, area, and volume, practice using those skills. First, download a measurement app on a mobile phone. Some examples are provided below.

Android Measuring and Conversion Apps:

US-Metric/Imperial Converter
MobiSys
4.9 ★

Ruler
NixGame
4.6 ★

Metric Conversions
metric-conversions.org
4.6 ★

Unit Converter
Digit Grove
4.5 ★

Ruler App: Camera Tape Measure
Grymala
3.9 ★

Ruler
Xalpha Lab
4.5 ★

Apple Measuring and Conversion Apps:

Measure 4+
Apple
3.4 • 746 Ratings
Free

Convert Any Unit Lite 4+
Units & Currency Converter
Cider Software LLC
4.7 • 43.2K Ratings
Free

Tape Measure™ 4+
Measure with your phone
Level Labs, LLC
#127 in Utilities
4.4 • 69.7K Ratings
Free · Offers In-App Purchases

Unit Converter Calculator Pro 4+
Simple With Metric & Imperial
Rome Rock LLC
Designed for iPad
4.7 • 599 Ratings
Free · Offers In-App Purchases

Check Your Understanding

Student View

Use the measurement app(s) you downloaded to complete the tasks below.

Apps in practice:

1. Measure 5 objects in your workspace. Be sure to measure all sides.
2. Calculate the perimeter of each object.
3. Calculate the area of each object.
4. Calculate the volume of each object.
5. Create a spreadsheet in Excel to record your results.

Object	Measurements	Perimeter	Area	Volume

Additional Notes:

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