Instructor's Manual

Module 4: Multiplying Fractions, Simplifying Fractions, and Converting Between Improper Fractions and Mixed Numbers

What Students Should Gain from this Module

At the end of this module, student should be able to:

- Multiply fractions
- Simplify fractions
- Convert between improper fractions and mixed numbers

Recommended Timing for this Module   6 hours and 20 minutes

Required Equipment and Materials

- An LCD projector and a Windows computer or laptop. The computer should have high speed internet access, a recent version of PowerPoint, an updated Internet browser, and speakers
- Cords for connecting the LCD projector to the computer
- A wireless presenter which allows you to move around the room while controlling the PowerPoint presentation
- A screen visible to all in the room
- *Multiplying Fractions* PowerPoint file

- A copy of the *Multiplying Slides* handout for each student and instructor

- A copy of the *Multiplying Fractions Practice* handout for each student and instructor
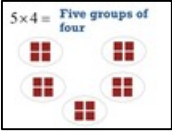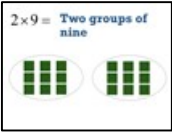
Optional Materials

At Math-Aids.com http://www.math-aids.com you can create and print a wide variety of practice problem sets (and answer keys) for students who want or need additional practice. You can also create problem sets that offer a higher degree of challenge for students who want an additional challenge. Be sure to confirm that your use of the Math-Aids resources complies with its usage guidelines.
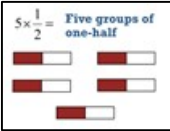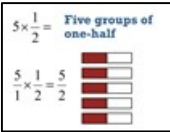
Note to the Instructor
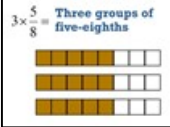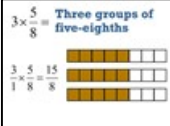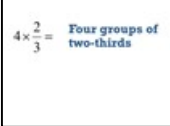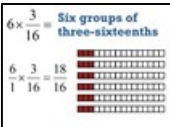
Some of the slides for this module require you to "Click" or press enter on the keyboard to reveal additional information on the slide. Especially where there is a lot of information on a slide, this will help you guide students' attention to the information you are addressing. In other cases, it engages students by giving them a chance to think through their own answer or strategy for solving a problem before the answer is revealed on the slide.
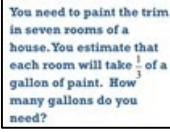
Time	Activity	Materials	What to Do
3	**Introduction**	How can you multiply two positive numbers and get a result that is smaller than either of the two numbers you are multiplying?	**Ask** how they could multiply two positive numbers and get a result that is smaller than either of the two numbers they are multiplying. **Say** that the answer is in this module.
35	**Multiplying Fractions with Whole Numbers**	**Handout:** *Multiplying Fractions Slides*	**Pass out** the slide handouts. **Review** the objective.
			Say that they will often have to multiply fractions, like when they are calculating how much material they will need.
			Or when they need to calculate the height of something, like a staircase.
			Or when you are trying to cost out a job.

Time	Activity	Materials	What to Do
		Think of multiplication like this: 5 x 2 Five groups of two 3 x 9 Three groups of nine 3 x 14 Three groups of fourteen 12 x 7 Twelve groups of seven	**Say** that when they see a multiplication problem, it can be helpful to think of it as "___ groups of ___."
		$5 \times 4 =$ Five groups of four	**Ask** how they would say 5 x 4. **Ask** if multiplying 5 x 4 would produce a result that is greater or less than 5. **Say** that visualizing problems like these can be helpful. **CLICK** **Point out** the five groups of four. **Ask** what 5 x 4 = . **Point out** the 20 objects.
		$2 \times 9 =$ Two groups of nine	**Ask** how they would say 2 x 9. **Ask** if multiplying 2 x 9 would produce a result that is greater or less than 2. **CLICK** **Point out** the two groups of nine. **Ask** what 2 x 9 = . **Point out** the 18 objects. **Say** that thinking about multiplication like this will help them understand multiplication of fractions.

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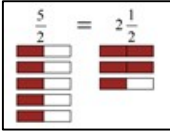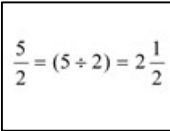
Time	Activity	Materials	What to Do
			Ask how they would say 5 x 1/2 (five groups of 1/2). **CLICK**
			Ask how many halves there are.
			Point out the five, one-halves.
			Ask if multiplying 5 by 1/2 will produce a result that is greater or less than 5.
			Ask why it is less
			Point out the difference between 5 and 5/2 on the slide
			NOTE – WILL WORK ON SIMPLIFYING FRACTIONS LATER
			Say that, when multiplying fractions, you can just multiply the two top numbers and the two bottom numbers.
			Ask what the bottom number would be for 5. **CLICK**
			Point out the 1.
			Say to remember that any whole number can be written as itself over 1.
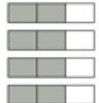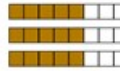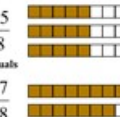
Time	Activity	Materials	What to Do
		$3 \times \frac{5}{8} =$ Three groups of five-eighths	**Ask** how they would say 3 x 5/8. **Ask** if multiplying 3 by 5/8 will produce a result that is greater or less than 3. **Ask** why it will be less. **CLICK** **Ask** how many eighths there are.
		$3 \times \frac{5}{8} =$ Three groups of five-eighths $\frac{3}{1} \times \frac{5}{8} = \frac{15}{8}$	**Say** that three groups of 5/8ths = 15/8ths. **Point out** the fifteen eighths.
		$4 \times \frac{2}{3} =$ Four groups of two-thirds	**Ask** students how they would say 4 x 2/3. **CLICK** **Invite** a student to come to the board to draw what 4 groups of 2/3 would look like, write it out as numbers, (e.g. 4 x 2/3), and find the answer. **Have the other students write** their own answer on their handout. **Review and correct the answer** as necessary.
		$6 \times \frac{3}{16} =$ Six groups of three-sixteenths $\frac{6}{1} \times \frac{3}{16} = \frac{18}{16}$	**Ask** how they would say 6 x 3/16. **CLICK** **Ask** what the bottom number would be for 6. **CLICK** **Point** out the 1.

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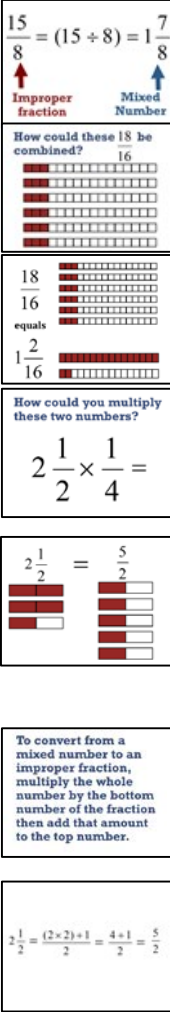
Time	Activity	Materials	What to Do
			Ask how they would say this using the "groups" phrase (six groups of 1/2 miles).
			Invite a student to come to the board to draw what 6 groups of 1/2 would look like, write it out as numbers, and find the answer.
			Have the other students write their own answer on their handout.
			Review and correct the answer as necessary.
			Point out the importance of labeling their answer (e.g. miles).
			Ask how they would say this using the "groups" phrase (7 groups of 1/3 gallons).
			Ask if they will need more or less than seven gallons of paint, and why.
			Invite a student to come to the board to draw the 7 groups of 1/3, write it out as numbers, and find the answer.
			Have the other students write their own answer on their handout.
			Review and correct the answer as necessary.
			Be sure they label their answer (e.g. gallons).
			Ask students what questions they have about multiplying fractions with whole numbers.

Time	Activity	Materials	What to Do
60	**Multiplying Whole Numbers and Fractions Practice**	Handout: *Multiplying Fractions Practice*	**Have students form groups** of 3 or 4. **Say** to remember that, in class or on the job, they will need to work as a team, which means supporting and encouraging one another. It is not enough for the group to get the right answers. Instead, they should take responsibility for helping one another until each member of the group has mastered the process and feels confident in her ability to solve the problems on her own. **Say** that they should remember the goal(s) they set for themselves, what they pledged to do to "Commit to Grit" in the *Being Gritty* handout at the beginning of the course, and the importance of maintaining a growth mindset if they have difficulty or get frustrated. **Say** that you can provide additional problem sets for students who want additional practice or additional challenge. See the information about Math-Aids under Optional Materials above. **Pass out** the *Multiplying Fractions Practice* handout and have students work through problems 1 – 10. As they do, check in with groups to answer questions and ensure that no individual(s) in the group is being left behind. **Review the answers**, answer questions, and review content students are struggling with.

Time	Activity	Materials	What to Do
10	**Multiplying Two Fractions**	Imagine that, after a party, there is $\frac{1}{2}$ of a cake left. Your roommate then eats $\frac{1}{3}$ of the leftover cake. How much of the entire cake did your roommate eat?	**Invite a student** to come to the board to write this out in numbers and find the answer. **Have the other students write** their own answer on their handout. **Review and correct the answer** as necessary. **Point out** the need to label their answer (e.g. how much of the cake).
		If it takes $\frac{1}{3}$ of a gallon of paint to cover the trim in one room, how much paint do you need to paint $\frac{3}{4}$ of the trim in one room?	**Ask** whether they will need more than 1/3 of a gallon or less than 1/3, and why. **Have students write** out the problem and their answer on their handout.
		If it takes $\frac{1}{3}$ of a gallon of paint to cover the trim in one room, how much paint do you need to paint $\frac{3}{4}$ of the trim in one room? $\frac{3}{4} \times \frac{1}{3} = \frac{3}{12}$ of a gallon	**Have students** correct their answer if necessary.
		If $\frac{5}{8}$ of your work crew are carpenters and $\frac{2}{5}$ of the carpenters are female, how many female carpenters are on your work crew?	**Ask** whether more than 5/8 are female carpenters or less than 5/8 are female carpenters, and why. **Have students write** out the problem and their answer on their handout.
		$\frac{2}{5} \times \frac{5}{8} = \frac{10}{40}$ are female carpenters	**Have** students correct their answer if necessary. **Ask** students what questions they have about multiplying two fractions.

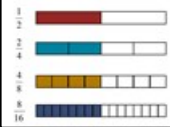| Time	Activity	Materials	What to Do
60	**Multiplying Two Fractions Practice**	**Handout:** *Multiplying Fractions Practice*	**Have students** work through problems 11 – 19 in their groups. As they do, check in with groups to answer questions and ensure that no individual(s) in the group is being left behind. **Review the answers**, answer questions, and review content students are struggling with.
45	**Converting Between Improper Fractions and Mixed Numbers**		**Review** the objective.
			Ask how these five halves could be combined. **CLICK** **Show** how the halves were combined to make two wholes. **Ask** how they would write the newly-combined visual as numbers. **CLICK**
			Say to remember that one way to think about a fraction is as division of the top number by the bottom number.

Time	Activity	Materials	What to Do
		$\frac{5}{2} = (5 \div 2) = 2\frac{1}{2}$ Improper fraction / Mixed Number	**Say** that if the top number is larger or equal to the bottom number it is an "improper fraction." **CLICK** **Say** that if the number is a whole number + a proper fraction it is called a "mixed number." **CLICK**
		$\frac{5}{5} = (5 \div 5) = 1$ Improper fraction	**Say** to remember that any number divided by itself = 1
		$\frac{8}{3}$	**Invite** a student to the board to draw how these 8/3rds could be combined. **Have the other students write** their own answer on their handout. **Review and correct the answer** as necessary.
		$\frac{8}{3} = (8 \div 3) = 2\frac{2}{3}$ Improper fraction / Mixed Number	**Show** how 8/3 converts to 2 2/3
		How could these $\frac{15}{8}$ be combined?	**Have students write** the shapes and answer on their handout.
		$\frac{15}{8}$ equals $1\frac{7}{8}$	Have students correct their answer (if necessary) on their handout.

Time	Activity	Materials	What to Do
		$$\frac{15}{8} = (15 \div 8) = 1\frac{7}{8}$$ Improper fraction → Mixed Number	**Show** how 15/8 converts to 1 7/8.
		How could these $\frac{18}{16}$ be combined?	**Have students write** the shapes and answer on their handout.
		$\frac{18}{16}$ equals $1\frac{2}{16}$	**Have students correct their** answer (if necessary) on their handout.
		How could you multiply these two numbers? $$2\frac{1}{2} \times \frac{1}{4} =$$	**Ask** how they could multiply these two numbers.
		$2\frac{1}{2} = \frac{5}{2}$	**Say** to remember that 2 1/2 is the same as 5/2. **CLICK** **Say** that, to multiply mixed numbers, you need to first convert the mixed number back to an improper fraction.
		To convert from a mixed number to an improper fraction, multiply the whole number by the bottom number of the fraction then add that amount to the top number.	
		$2\frac{1}{2} = \frac{(2\times 2)+1}{2} = \frac{4+1}{2} = \frac{5}{2}$	**Show** how the mixed number 2 1/2 was changed to **CLICK** (4+1)/2 and how that was changed to **CLICK** 5/2.

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Time	Activity	Materials	What to Do
		$2\frac{1}{2} \times \frac{1}{4} =$ Is the same as $\frac{5}{2} \times \frac{1}{4} =$	**Point out** that 2 1/2 is the same as 5/2.
		$2\frac{1}{2} \times \frac{1}{4} = \frac{5}{8}$ Is the same as $\frac{5}{2} \times \frac{1}{4} = \frac{5}{8}$	**Show** how 5/2 x 1/4 equals 5/8.
		What is the result of multiplying these two numbers? $3\frac{3}{8} \times \frac{2}{3} =$	**Say** to remember that 3 3/8 is a single number. **Invite** a student to come to the board to demonstrate how to solve this. **Have the other students write** their own answer on their handout. **Review and correct the answer** as necessary. **Ask** how the answer (an improper fraction) would be written as a mixed number. **Review and correct the answer** as necessary.
		What is the result of multiplying these two numbers? $\frac{1}{2} \times 4\frac{3}{16} =$	**Have students write** the answer on their handout.

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Time	Activity	Materials	What to Do
		$\frac{1}{2} \times 4\frac{3}{16} = \frac{67}{32} = 2\frac{3}{32}$ **Is the same as** $\frac{1}{2} \times \frac{67}{16} = \frac{67}{32} = 2\frac{3}{32}$ What is the result of multiplying these two numbers? $\frac{2}{3} \times 5\frac{3}{4} =$	**Show** how to get from 4 3/16 to 67/16. **CLICK** **Show** how 1/2 x 67/16 = 67/32. **CLICK** **Show** how 67/32 = 2 3/32. **CLICK** **Point out** that 1/2 x 4 3/16 = 2 3/32 **Have students correct their answer** (if necessary) on their handout. **Have students write** the answer on their handout.
		$2\frac{2}{3} \times 5\frac{3}{4} = \frac{184}{12} = 15\frac{4}{12}$ **Is the same as** $\frac{8}{3} \times \frac{23}{4} = \frac{184}{12} = 15\frac{4}{12}$ If it takes 10½ gallons of patching compound to patch the average ceiling in this building, how many gallons will be needed to patch six average ceilings?	**Show** how to get from 2 2/3 to 8/3. **CLICK** **Show** how to get from 5 3/4 to 23/4. **CLICK** **Show** how 8/3 x 23/4 = 184/12. **CLICK** **Show** how 184/12 = 15 4/12. **CLICK** **Point out** that 2 2/3 x 5 3/4 = 15 4/12 **Have students correct their answer** (if necessary) on their handout. **Have students write** the answer on their handout.

Time	Activity	Materials	What to Do
		$6 \times 10\frac{1}{2} = \frac{126}{2} = 63$ **Is the same as** $\frac{6}{1} \times \frac{21}{2} = \frac{126}{2} = \frac{63}{1}$	**Say to** remember that 6 is the same as 6/1. **Show** how to get from 10 1/2 to 21/2. **CLICK** **Show** how 6/1 x 21/2 = 126/2. **CLICK** **Show** how 126/2 = 63. **CLICK** **Point out** that 6 x 10 1/2 = 63. **Have students correct their answer** (if necessary) on their handout. **Ask** students what questions they have about converting between improper fractions and mixed numbers. **Before moving on to** *Simplifying Fractions* **you might choose to have students practice converting between improper fractions and mixed numbers using** *Multiplying Fractions Practice* **problems 20 - 43.**
20	**Simplifying Fractions**	At the end of this part of the module, you should be able to... simplify fractions You can write any number many different ways. $\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{8}{16}$	**Review** the objective. **Say** to remember that any number can be written in many different ways. **Point out** that these are all the same number.

Time	Activity	Materials	What to Do
			Point out how all these ways of writing the fraction are really the same number (same amount).
			Show how each is the same.
			Ask, if they were measuring or calculating something, which version of this number they would want to work with.
			Ask which is the simplest.
			Say that to simplify a fraction you need to divide the top and bottom by the same number.
			Note – do not refer to simplifying fractions as "reducing" them. "Reducing" can give students the impression that the simplified fraction is smaller than the original.
			Point out that 6 is the largest number that can be divided into both the top and bottom number to get a whole number. **CLICK**
			Show how dividing both the top and bottom by 6 will simplify the fraction to 1/2.

Time	Activity	Materials	What to Do
		It is OK if you do not find the largest common number the first time. $\dfrac{6 \div 3 = 2 \div 2 = 1}{12 \div 3 = 4 \div 2 = 2}$	**Say** that it is OK if they don't find the largest common number the first time, they might just need to simplify it more than once. **Show** how the original fraction needed to be divided twice to simplify it.
		Not all fractions can be simplified. $\dfrac{9}{16}$	**Point out** that this cannot be simplified.
		$\dfrac{12}{32}$	**Invite** a student to come to the board to demonstrate how to simplify this. **Have the other students write** their own answer on their handout. **Review and correct the answer** as necessary.
		$\dfrac{10}{64}$	**Have students write** the simplified version of this fraction on their handout.
		$\dfrac{10 \div 2 = 5}{64 \div 2 = 32}$	**Show** how 10/64 is simplified to 5/32. **Have students correct their answers** if necessary.
		$\dfrac{42}{72}$	**Have students write** the simplified version of this fraction on their handout.

Time	Activity	Materials	What to Do
		$$\frac{42 \div 6 = 7}{72 \div 6 = 12}$$	**Have students correct their answers** if necessary.
		If a correct answer is not in the simplest form it is still correct! $$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$$	**Point out** that 6/12 is correct **CLICK** But1/2 is easier to work with. **Ask** students what questions they have about simplifying fractions.
15	**Converting Between Improper Fractions and Mixed Numbers, and Simplifying Fractions Practice**	**Handout:** *Multiplying Fractions Practice*	**Have students form groups** of 3 or 4. **Say** to remember that, in class or on the job, they will need to work as a team, which means supporting and encouraging one another. It is not enough for the group to get the right answers. Instead, they should take responsibility for helping one another until each member of the group has mastered the process and feels confident in her ability to solve the problems on her own. **Say** that they should remember the goal(s) they set for themselves, what they pledged to do to "Commit to Grit" in the *Being Gritty* handout at the beginning of the course, and the importance of maintaining a growth mindset if they have difficulty or get frustrated. **Say** that you can provide additional problem sets for students who want additional practice or additional challenge. See the information about Math-Aids under Optional Materials above.

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Time	Activity	Materials	What to Do
			Pass out the *Multiplying Fractions Practice* handout and have students work through problems 44 – 48. As they do, check in with groups to answer questions and ensure that no individual(s) in the group is being left behind.
			Review the answers, answer questions, and review content students are struggling with.
10	**Planning to Apply their Learning**		**Have students reflect** on the learning from this module and note in their journal what they have learned that will be useful to them on the job, what they want to remember, tips, etc., and when they have demonstrated grit or a growth mindset.