Multiply a Fraction and a Whole Number

Find 12 \times \frac{1}{4}.

12 \times \frac{1}{4} is the same as dividing 12 by 4.

12 ÷ 4 = 3

12 \times \frac{1}{4} = 3

Find \frac{3}{5} of 15, or \frac{3}{5} \times 15.

15 ÷ 5 = 3, so \frac{1}{5} \times 15 = 3

Since \frac{3}{5} is 3 times \frac{1}{5},

\frac{3}{5} \times 15 = 3 \times \left(\frac{1}{5} \times 15\right) = 3 \times 3 = 9.

\frac{3}{5} \times 15 = 9

Find each product.

1. \frac{4}{5} \times 20 = \boxed{16}
2. \frac{5}{6} of 14 = \boxed{12}
3. 24 \times \frac{3}{4} = \boxed{18}
4. \frac{2}{5} of 15 = \boxed{6}
5. 400 \times \frac{3}{8} = \boxed{150}
6. \frac{7}{10} of 80 = \boxed{56}

7. Reasoning Can you use division and mental math to find \frac{2}{3} of 24? Why or why not?

Yes, because 3 is the greatest common factor of 3 and 24. \frac{2}{3} of 24 = 16

The chart shows the average high temperatures for different months in Phoenix, Arizona.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average High</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>70°F</td>
</tr>
<tr>
<td>May</td>
<td>93°F</td>
</tr>
<tr>
<td>July</td>
<td>105°F</td>
</tr>
</tbody>
</table>

8. What is \frac{4}{5} the average temperature in July?
   \boxed{84°F}

9. What is \frac{1}{2} the average temperature in February?
   \boxed{35°F}

10. What is \frac{2}{3} the average temperature in May?
    \boxed{62°F}
### Multiplying a Fraction and a Whole Number

Find each product.

1. \( \frac{3}{4} \times 16 = 12 \)
2. \( \frac{5}{6} \times 30 = 25 \)
3. \( 42 \times \frac{5}{6} = 35 \)
4. \( \frac{1}{8} \text{ of } 72 = 9 \)
5. \( 900 \times \frac{2}{3} = 600 \)
6. \( \frac{13}{20} \text{ of } 100 = 65 \)

7. **Reasoning** Without multiplying, tell which is greater, \( \frac{5}{6} \) of 81 or \( \frac{9}{10} \) of 81. Explain.

\( \frac{9}{10} \) of 81 because \( \frac{9}{10} \) is greater than \( \frac{5}{6} \).

### Driving Distances

<table>
<thead>
<tr>
<th>Departure City</th>
<th>Destination City</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittsfield, Massachusetts</td>
<td>Providence, Rhode Island</td>
<td>132 mi</td>
</tr>
<tr>
<td>Reno, Nevada</td>
<td>Wendover, Utah</td>
<td>400 mi</td>
</tr>
</tbody>
</table>

8. Mike drove \( \frac{1}{3} \) of the distance between Pittsfield, Massachusetts, and Providence, Rhode Island. How far did he drive?

\( 44 \text{ mi} \)

9. Bimal drove \( \frac{3}{5} \) of the distance between Reno, Nevada, and Wendover, Utah. How far did he drive?

\( 240 \text{ mi} \)

10. **Estimation** How many more miles does Bimal have to drive to get to Wendover, Utah?

\( 160 \text{ mi} \)

11. There are 25 students in Mr. Fitch’s sixth-grade class. If \( \frac{3}{25} \) of the students are girls, how many girls are in Mr. Fitch’s class?

A 5 girls  
B 10 girls  
C 15 girls  
D 20 girls  

12. **Writing to Explain** Explain how you would find the product of 36 and \( \frac{2}{3} \).

Write the problem as \( 36 \times \frac{2}{3} \).

\[ 36 \div 3 = 12, \text{ so } \frac{1}{3} \times 36 = 12. \]
\[ \frac{2}{3} \times 36 = 2 \times (\frac{1}{3} \times 36) = 2 \times 12 = 24. \]
Estimating Products

When you are working with fractions and mixed numbers, you can estimate using rounding, compatible numbers, or compatible benchmark fractions.

Estimate \( \frac{3}{10} \times 21 \) using a whole number that is compatible with the denominator.

\[
\begin{align*}
\frac{3}{10} \times 21 & \quad \text{Change 21 to the nearest whole number that is compatible with 10.} \\
\downarrow & \quad \downarrow \\
\frac{3}{10} \times 20 = 6 & \quad \text{Think: } 20 \div 10 = 2. \\
\frac{3}{10} \times 21 \approx 6 & \quad 3 \times 2 = 6.
\end{align*}
\]

Estimate \( \frac{3}{10} \times 12 \) using a compatible benchmark fraction.

\[
\begin{align*}
\frac{3}{10} \times 12 & \quad \text{Round } \frac{3}{10} \text{ to a compatible benchmark fraction. Since } \frac{3}{10} \text{ is close to } \frac{1}{4} \text{ and 4 is a factor of twelve, use } \frac{1}{4}. \\
\downarrow & \quad \downarrow \\
\frac{1}{4} \times 12 = 3 & \quad \text{Think: } 12 \div 4 = 3. \\
\frac{3}{10} \times 12 \approx 3 & \quad 1 \times 3 = 3.
\end{align*}
\]

Estimate each product by using compatible numbers or benchmark fractions.

1. \( \frac{1}{6} \times 19 = \) \underline{3} 2. \( \frac{4}{7} \times 10 = \) \underline{5} 3. \( \frac{5}{8} \times 23 = \) \underline{15} 4. \( 31 \times \frac{2}{5} = \) \underline{12} 5. \( \frac{7}{12} \times 18 = \) \underline{9} 6. \( \frac{9}{16} \times 90 = \) \underline{45} 7. \( 43 \times \frac{2}{7} = \) \underline{12} 8. \( 35 \times \frac{5}{12} = \) \underline{15} 9. \( 16 \times \frac{4}{3} = \) \underline{8}

Estimate each product by rounding each factor to the nearest whole number.

10. \( 6\frac{2}{3} \times 5\frac{1}{8} \rightarrow \text{Round } 6\frac{2}{3}: \) \underline{7} \( \text{Round } 5\frac{1}{8}: \) \underline{5} \( \text{Multiply: } \) \underline{35} 11. \( 10\frac{5}{9} \times 4\frac{5}{6} = \) \underline{50} 12. \( 2\frac{7}{8} \times 3\frac{3}{4} = \) \underline{12} 13. \( 4\frac{1}{5} \times 2\frac{4}{10} = \) \underline{8}

14. Reasonableness Carlotta estimated that \( \frac{3}{7} \times 20 \) is about \( \frac{3}{7} \times 14 = 6 \). Is her estimate reasonable? Why or why not?

No, a better choice for a number compatible to 20 is 21: \( \frac{3}{7} \times 21 = 9 \).

15. Critical Thinking Why are the estimates of \( \frac{6}{10} \times 18 \) shown below different? Is one estimate better than the other?

\[
\begin{align*}
\frac{6}{10} \times 18 & \approx \frac{6}{10} \times 20 = 12 \\
\frac{6}{10} \times 18 & \approx \frac{1}{2} \times 18 = 9.
\end{align*}
\]

Sample answer: The first estimate uses a compatible whole number to estimate and the second uses a compatible benchmark fraction. Both are reasonable ways to estimate, and in this case, one method is not better than the other.
Estimating Products

Estimate each product. Sample answers are shown.

1. \( \frac{5}{8} \times \frac{1}{3} = \) 2
2. \( \frac{3}{4} \times \frac{1}{5} = \) 6
3. \( \frac{6}{10} \times \frac{3}{4} = \) 3

4. \( \frac{7}{9} \times \frac{2}{5} = \) 12
5. \( \frac{6}{2} \times \frac{2}{3} = \) 14
6. \( \frac{7}{8} \times \frac{2}{8} = \) 2

7. \( 38 \times \frac{3}{8} = \) 15
8. \( \frac{1}{4} \times 17 = \) 4
9. \( \frac{3}{5} \times 51 = \) 30

10. \( \frac{4}{9} \times \frac{6}{7} = \) 42
11. \( \frac{12}{25} \times 8 = \) 4
12. \( 11 \times \frac{1}{2} = \) 6

13. \( \frac{8}{9} \times 6\frac{4}{10} = \) 6
14. \( \frac{1}{7} \times 2\frac{2}{3} = \) 21
15. \( \frac{5}{12} \times 13 = \) 5

16. Show three ways to estimate \( \frac{3}{5} \times \frac{3}{8} \). Identify each method you use.

Sample answer: Compatible numbers: \( \frac{3}{5} \times 5 = 3; \)
Rounding: \( 1 \times 6 = 6; \) Compatible benchmark: \( \frac{1}{2} \times 6 = 3. \)

17. Explain It Mr. Simpson lives 11\( \frac{3}{10} \) miles from his office. He estimates that he commutes \( 11 \times 2 \times 5 \), or 110 miles each week. Is his estimate an overestimate or an underestimate? Explain.

Sample answer: 110 is an underestimate because Mr. Simpson rounded the number of miles for each trip to the lower whole number before he multiplied.

18. Which benchmark fraction could you use to estimate the product of \( 38 \times \frac{7}{12} \)? \( \frac{1}{2} \)

19. Geometry Which is the best estimate for the area of a square with sides equal to \( 3\frac{1}{5} \) inches?

A 3 sq in.
B 6 sq in.
C 9 sq in.
D 16 sq in.

20. Joyce and Marianne have money jars. Joyce has 54 dimes in her jar. Marianne has \( \frac{9}{10} \) as many dimes as Joyce. Estimate the number of dimes that Marianne has in her jar.

A 60 dimes
B 45 dimes
C 6 dimes
D 5 dimes
Multiplying Fractions

Find $\frac{3}{4} \times \frac{2}{5}$.

Draw a picture.
Shade the squares.
There are 20 squares in all.
6 squares have overlapping shading.

\[
\frac{3}{4} \times \frac{2}{5} = \frac{6}{20}.
\]

Simplify: $\frac{6}{20} = \frac{3}{10}$

Use the denominators to determine the number of squares: 5 tall and 4 wide.

Multiply the numerators and the denominators. Simplify if possible.

\[
\frac{3}{4} \times \frac{2}{5} = \frac{(3 \times 2)}{(4 \times 5)} = \frac{6}{20} = \frac{3}{10}
\]

Simplify first. Divide a numerator and a denominator by their GCF. Then multiply.

\[
\frac{3}{4} \times \frac{2}{5} = \frac{3}{(4 ÷ 2)} \times \frac{(2 ÷ 2)}{5} = \frac{3}{2} \times \frac{1}{5} = \frac{3}{10}
\]

Draw a picture to solve.

1. \( \frac{1}{3} \times \frac{4}{5} = \frac{4}{15} \)

2. \( \frac{3}{4} \times \frac{3}{5} = \frac{1}{4} \)

3. \( \frac{1}{2} \times \frac{7}{8} = \frac{7}{16} \)

Write an equation for each picture.

4. \( \frac{1}{3} \times \frac{1}{2} = \frac{1}{6} \)

5. \( \frac{3}{4} \times \frac{2}{3} = \frac{1}{2} \)

Find each product. Simplify if possible.

6. \( \frac{5}{7} \times \frac{3}{10} = \frac{3}{14} \)

7. \( \frac{1}{2} \times \frac{6}{15} = \frac{1}{5} \)

8. \( \frac{4}{7} \times \frac{1}{2} = \frac{2}{7} \)

9. \( \frac{5}{6} \times \frac{3}{8} = \frac{5}{16} \)

10. \( \frac{6}{7} \times \frac{5}{12} = \frac{5}{14} \)

11. \( 8 \times \frac{3}{4} = \frac{6}{1} \)

12. \ Bold Number Sense \  Can you simplify before multiplying \( 14 \times \frac{4}{7} \)? Explain.

Yes. Rewrite 14 as a fraction with 1 in the denominator. Then simplify the 14 and the 7 using their GCF of 7: \( \frac{14}{1} \times \frac{4}{7} = \frac{2}{1} \times \frac{4}{1} = \frac{8}{1} = 8 \).
Multiplying Fractions

Write an equation for each picture.

1. \[
\frac{3}{8} \times \frac{4}{7} = \frac{12}{56} = \frac{3}{14}
\]

2. \[
\frac{2}{9} \times \frac{1}{3} = \frac{2}{27}
\]

Find each product. Simplify if possible.

3. \[
\frac{7}{10} \times \frac{13}{14} = \frac{13}{20}
\]

4. \[
\frac{4}{5} \times \frac{7}{8} = \frac{7}{10}
\]

5. \[
\frac{3}{7} \times \frac{4}{9} = \frac{4}{21}
\]

6. \[
\frac{3}{4} \times 16 = 12
\]

7. \[
\frac{2}{5} \times \frac{3}{10} = \frac{3}{25}
\]

8. \[
\frac{5}{6} \times 42 = \frac{35}{5}
\]

9. \[
\frac{3}{5} \times \frac{17}{21} = \frac{17}{35}
\]

10. \[
\frac{1}{8} \times 72 = 9
\]

11. \[
\frac{15}{9} \times \frac{24}{25} = \frac{8}{5} = 1\frac{3}{5}
\]

12. \[
\frac{13}{20} \times 100 = 65
\]

13. \[
\frac{3}{8} \times \frac{4}{9} = \frac{1}{6}
\]

14. \[
\frac{1}{2} \times \frac{13}{16} = \frac{13}{32}
\]

Pamela spent \(\frac{2}{3}\) of an hour doing homework. She solved math problems for \(\frac{2}{5}\) of that time and read her science book for \(\frac{3}{5}\) of that time. What fraction of one hour did Pamela spend:

15. solving math problems? \(\frac{4}{15}\)

16. reading her science book? \(\frac{2}{5}\)

17. Of the students in Mr. Moore’s room, \(\frac{7}{13}\) live within a mile of school. Of those students, \(\frac{4}{7}\) live within half a mile of school. What fraction of all students in Mr. Moore’s class live within half a mile of school?

A \(\frac{3}{13}\)

B \(\frac{4}{13}\)

C \(\frac{3}{15}\)

D \(\frac{4}{15}\)

18. Writing to Explain Without multiplying, tell which is greater:

\(\frac{55}{6} \times 81\) or \(\frac{9}{10} \times 81\). Explain.

\(\frac{55}{6} \times 81\) is greater because \(\frac{55}{6}\) is more than \(9\) and \(\frac{9}{10}\) is less than \(1\). Eighty-one times \(9\) is greater than \(81 \times 1\).
Multiplying Mixed Numbers

How to find the product of two mixed numbers: Find $3\frac{2}{3} \times 4\frac{1}{2}$.

Step 1
Estimate the product by rounding.
Round $3\frac{2}{3}$ to 4 and $4\frac{1}{2}$ to 5:
$4 \times 5 = 20$

Step 2
Write each mixed number as an improper fraction.
$3\frac{2}{3} = \frac{11}{3}$ and $4\frac{1}{2} = \frac{9}{2}$

Look for common factors and simplify.
$3\frac{2}{3} \times 4\frac{1}{2} = \frac{11}{3} \times \frac{9}{2} = \frac{11}{1} \times \frac{3}{2}$

Step 3
Multiply the numerators and denominators.
$\frac{11}{1} \times \frac{3}{2} = \frac{33}{2}$

Write the product as a mixed number.
$\frac{33}{2} = 16\frac{1}{2}$

16$\frac{1}{2}$ is close to 20, so the answer is reasonable.

Find each product. Simplify if possible.
1. $2\frac{3}{4} \times 3\frac{1}{2}$
   $\frac{11}{8}$
2. $2\frac{1}{5} \times 2\frac{2}{3}$
   $\frac{13}{15}$
3. $6 \times 3\frac{1}{4}$
   $19\frac{1}{2}$
4. $1\frac{2}{5} \times 3\frac{1}{4}$
   $\frac{41}{20}$
5. $4\frac{1}{2} \times 16$
   72
6. $1\frac{3}{8} \times 2\frac{1}{2}$
   $3\frac{7}{16}$

Evaluate each expression for $K = 2\frac{1}{3}$.
7. $12K$
   28
8. $1\frac{3}{4}K$
   $\frac{4}{12}$
9. $2\frac{2}{3}K$
   $\frac{6}{9}$

10. Reasonableness What is a reasonable estimate for $7\frac{3}{4} \times 2\frac{2}{3}$?
   Explain. $24$, since $7\frac{3}{4}$ rounds to 8 and $2\frac{2}{3}$ rounds to 3 and $8 \times 3 = 24$.

11. The cups of mushrooms in a recipe is $2\frac{1}{2}$ times the cups of onions.
   The cups of onions is $1\frac{1}{2}$. Solve $c = 1\frac{1}{2} \times 2\frac{1}{2}$ to find $c$, the cups of mushrooms.
   $3\frac{3}{4} \text{ c of mushrooms}$
Multiplying Mixed Numbers

Find each product. Simplify if possible.

1. \(3\frac{1}{2} \times 1\frac{2}{3}\) \(= \ \frac{5}{6}\)  
2. \(1\frac{1}{8} \times 2\frac{1}{3}\) \(= \ \frac{5}{8}\)  
3. \(7 \times 1\frac{1}{4}\) \(= \ \frac{3}{4}\)  
4. \(2\frac{1}{6} \times 1\frac{1}{5}\) \(= \ \frac{3}{5}\)  
5. \(3\frac{1}{6} \times 18\) \(= \ 57\)  
6. \(1\frac{1}{8} \times 2\frac{1}{2}\) \(= \ \frac{13}{16}\)  
7. \(1\frac{2}{3} \times 2\frac{1}{4}\) \(= \ \frac{3}{4}\)  
8. \(10 \times 1\frac{1}{3}\) \(= \ 13\frac{1}{3}\)

Evaluate each expression for \(S = 1\frac{4}{5}\).

10. \(2\frac{1}{3}S\) \(= \ 4\frac{1}{5}\)  
11. \(3\frac{3}{4}S\) \(= \ 6\frac{3}{4}\)  
12. \(5\frac{1}{6}S\) \(= \ 9\frac{3}{10}\)

Use the table to answer the questions.

13. If Berkeley receives \(1\frac{1}{2}\) times its average January rainfall, how much rain will it receive?

\[
\frac{45}{8} \text{ in.}
\]

14. How much rain will Berkeley receive if it is \(2\frac{1}{3}\) times the October average?

\[
3\frac{1}{2} \text{ in.}
\]

15. Which month has about twice the rainfall as April?

January

16. Jessie stacked photographs of 6 zoo animals on top of each other to create a display. Each photo is \(14\frac{1}{4}\) in. high. How high is the display?

A 84\(\frac{2}{3}\) in.  
B 85\(\frac{1}{2}\) in.  
C 86\(\frac{3}{4}\) in.  
D 87 in.

17. Writing to Explain Explain how you would find \(2 \times 2\frac{1}{3}\) using the Distributive Property.

Multiply \(2 \times 2\) and \(2 \times \frac{1}{3}\), and then add the products to get \(4 + \frac{2}{3}\) or \(4\frac{2}{3}\).
Problem Solving: Multiple-Step Problems

Some word problems have hidden questions that must be answered before you can solve the problem.

A paved trail is 8 miles long. Rita runs \(\frac{3}{8}\) of the length of the trail and walks the rest of the way. How many miles of the trail does Rita walk?

**What do you know?** Rita runs \(\frac{3}{8}\) of an 8-mile trail.

**What are you asked to find?** How many miles of the trail that Rita walks.

**How can you find the distance that Rita walks?** Subtract the distance Rita ran from the length of the trail.

**What is the hidden question?** The hidden question will help you find data you need to solve the problem.

To answer, find \(\frac{3}{8} \times 8 = 3\).

Use the data to solve: \(8 - 3 = 5\), so Rita walked 5 of the 8 miles.

Write and answer the hidden question(s) in each problem. Then solve the problem.

1. April surfed for \(\frac{1}{3}\) of the 6 hours she was at the beach. She spent the rest of the time building a sand castle. How many hours did she spend building the castle?

   **Hidden question:** How many hours did April surf? \(\frac{1}{3} \times 6 = 2\)

   **Solution:** \(6 - 2 = 4\); 4 hours

2. Bill put gasoline in 2 of his 5-gallon cans and 4 of his 2-gallon cans. He filled all the cans to the exact capacity. How many gallons of gasoline did he buy?

   **Hidden question 1:** How many gallons are in two 5-gallon cans? \(2 \times 5 = 10\)

   **Hidden question 2:** How many gallons are in four 2-gallon cans? \(4 \times 2 = 8\)

   **Solution:** \(10 + 8 = 18\); 18 gallons of gas

3. It costs Le Stor $20 to buy a shirt. The store sells the shirt for \(2 \frac{1}{2}\) times its cost. What is the profit for 100 of these shirts? Hint: Profit equals sales minus cost.

   **Hidden question 1:** What is the selling price of the shirt? \(2 \frac{1}{2} \times $20 = $50\)

   **Hidden question 2:** What is the profit for one shirt? \(\$50 - \$20 = \$30\)

   **Solution:** \(100 \times \$30 = \$3,000\)
Problem Solving: Multiple-Step Problems

Write and answer the hidden question(s) in each problem. Then solve the problem.

1. Tiwa spent $1\frac{1}{2}$ hours setting up her computer. It took her 3 times as long to install the software. How long did it take Tiwa to set up the computer and install software?

   **Hidden question(s):**
   3 × $1\frac{1}{2} = 4\frac{1}{2}$
   $1\frac{1}{2} + 4\frac{1}{2} = 6; 6$ hours

2. Lon bought 40 ounces of sliced ham. He used $\frac{3}{4}$ of the ham to make sandwiches for his friends and $\frac{1}{5}$ of the ham in an omelet. How many ounces of ham were left?

   **Hidden question(s):**
   How many ounces of ham were used to make sandwiches? $3/4 \times 40 = 30$; How many ounces of ham were used in the omelet? $40 \times \frac{1}{5} = 8$
   $40 - 30 - 8 = 2; 2$ ounces

3. Lionel cut off $\frac{1}{6}$ of a 48-inch piece of rope. Marsha cut off $\frac{1}{4}$ of a 36-inch piece of rope. They compared their cut pieces. Whose piece is longer? How much longer?

   **Hidden question(s):**
   How long is Lionel’s cut piece? $\frac{1}{6} \times 48 = 8$;
   How long is Marsha’s cut piece? $\frac{1}{4} \times 36 = 9$
   Marsha’s rope is 1 inch longer: $9 - 8 = 1$.

4. Melanie bought 3 CDs. The country music CD cost $15. The rock music CD cost $\frac{2}{3}$ as much as the country music CD. The platinum edition CD cost twice as much as the rock CD. What was the cost of the three CDs?

   **Hidden question(s):**
   How much did the rock CD cost? $\frac{2}{3} \times 15 = 10$;
   How much did the platinum CD cost?
   $2 \times 10 = 20$
   $15 + 10 + 20 = 45$

5. Writing to Explain  Choose one of the problems above. Explain how you determined the hidden question and why it was necessary to answer that question in order to solve the problem.

   **Sample answer:** In Problem 1, the question asks for the time spent on two tasks, so I needed to add the two times to answer the question. Only the time for one task was given in the problem, so the hidden question had to be to find the other time.