# Unit 5 Introduction

In this unit's Excursions, students use their understanding of 2-digit multiplication to solve problems and explore patterns. Students will also explore divisibility rules for 2, 4, and 8. In this unit's Adventures, students apply their understanding of divisibility rules to solve puzzles. Additionally, whole number multiplication continues to be a focus, and is paired with problems involving factorization and place value knowledge.

| Excursions | | |
|---|---|---|
| **Task** | | **Targeted Concepts** |
| **A** | Delivering Roses | Multiplying whole numbers by fractions |
| **B** | A Fifth Grade Classroom | Fractions of whole numbers; connecting to area of a rectangle |
| **C** | Class Accounts | Multiplying fractions; ordering fractions |
| **D** | Eating Peaches 1<br>*Required before Adv. C* | Fractions of whole numbers |
| **E** | Doggone It | Multiplication and division with fractions and whole numbers, or fractions and fractions |
| **F** | Measuring Marine Mammals | Multiplication and division with fractions and whole numbers; "sharing" context for division |

| Adventures | | |
|---|---|---|
| **Task** | | **Targeted Concepts** |
| **A** | Vegetable Garden | Dimensions of a square; multiplication of mixed numbers and fractions; division of fractions by a whole number |
| **B** | Chocolate | Using sharing to yield fractional amounts; ordering fractions |
| **C** | Eating Peaches 2 | Trial and improvement; fractions |
| **D** | Rides at the Fair | Adding fractions with different denominators |
| **E** | The Greedy Algorithm | Adding and subtracting fractions with different denominators |
| **F** | ABC | Standard algorithm for multiplication |

# Unit 5

## Excursions

| Task | | Task Complete | Teacher Initials |
|---|---|---|---|
| A | Delivering Roses | | |
| B | A Fifth Grade Classroom | | |
| C | Class Accounts | | |
| D | Eating Peaches 1<br>*Required before Adv. C* | | |
| E | Doggone It | | |
| F | Measuring Marine Mammals | | |

## Adventures

| Task | | Task Complete | Teacher Initials |
|---|---|---|---|
| A | Vegetable Garden | | |
| B | Chocolate | | |
| C | Eating Peaches 2 | | |
| D | Rides at the Fair | | |
| E | The Greedy Algorithm | | |
| F | ABC | | |

# Delivering Roses

Tomás has 600 roses to deliver for Valentine's Day. There are red, pink, white, and yellow roses. One-fourth of the roses are white, 180 roses are pink, and $\frac{2}{5}$ of the roses are red.

a. What fraction of the roses are pink?

b. What fraction of the roses are yellow?

c. How many of each color rose does Tomás have to deliver?



# A Fifth Grade Classroom

Ms. Pearson is setting up a new classroom at Redwoods Elementary School. The classroom is a rectangle with an area of 48 square yards, and it will be divided into five smaller rectangular sections:

- Student worktables will take up $\frac{1}{2}$ of the space.
- A computer area will take up $\frac{1}{12}$ of the space.
- The carpet area will take up $\frac{1}{6}$ of the space.
- The classroom library will take up $\frac{1}{8}$ of the space.
- A math center will be given the remainder of the space.

a. What fractional part of the classroom will the math center receive?

b. What is the area of each space in the classroom?

c. Show two possible ways that Ms. Pearson's classroom may be arranged.



# Class Accounts

The second, third, fourth, and fifth grade classes have the same amount of money in their class donation accounts. Each class has taken out a different amount of money to spend on recess equipment. Each class took out either $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{6}$, or $\frac{1}{8}$ of their money from their accounts.

- Fifth grade took out the most money and spent $\frac{1}{3}$ of it on jump ropes.
- Second grade took out the least amount of money and spent $\frac{2}{3}$ of it on jump ropes.
- Third grade took out more money than fourth grade and spent $\frac{1}{2}$ of it on jump ropes.
- Fourth grade spent $\frac{3}{4}$ of their money on jump ropes.

What fraction of the money in their class accounts did each grade spend on jump ropes?



# Eating Peaches 1

A little monkey had 60 peaches.

- On the first day, he decided to keep $\frac{3}{4}$ of his peaches. He gave the rest away. Then he ate 1.
- On the second day, he decided to keep $\frac{7}{11}$ of his peaches. He gave the rest away. Then he ate 1.
- On the third day, he decided to keep $\frac{5}{9}$ of his peaches. He gave the rest away. Then he ate 1.
- On the fourth day, he decided to keep $\frac{2}{7}$ of his peaches. He gave the rest away. Then he ate 1.
- On the fifth day, he decided to keep $\frac{2}{3}$ of his peaches. He gave the rest away. Then he ate 1.

How many peaches did the monkey have left at the end of the fifth day?

# Doggone It

Solve each problem below. Write a multiplication or division equation for each problem that uses the numbers provided *or* use a model to show your thinking.

a. Maxwell's dog eats $2\frac{1}{2}$ cups of food each day. How many cups of food will Maxwell's dog eat in one week?

b. Maxwell's dog isn't feeling well and needs to take some medicine. The veterinarian said to give the dog $1\frac{2}{3}$ medicine tablets each day. If Maxwell has 15 tablets, how long will the medicine last?

c. If Maxwell's dog drinks $\frac{3}{4}$ cup of water every hour, how long will it take the dog to drink the $7\frac{1}{2}$ cups of water that Maxwell put in the water bowl this morning?

d. At the park, Maxwell and the dog see 35 other dogs. Two-sevenths of the dogs they see are female, and the rest are male. How many female dogs do they see? What fraction of the dogs that they see are male?



# Measuring Marine Mammals

Solve each problem below. Write a multiplication or division equation for each problem that uses the numbers provided OR use a model to show your thinking.

a. The pectoral fins on a humpback whale are approximately $\frac{1}{3}$ the length of the whale. If a humpback whale is 39 feet long, how long might its pectoral fins be?

b. An orca may be $\frac{1}{3}$ the length of a right whale. If an orca is 18 feet long, how long might a right whale be?

c. A 6-foot person is approximately $\frac{1}{11}$ the length of an average fin whale. How long is an average fin whale?

d. A humpback whale may be $\frac{2}{5}$ the length of a blue whale. If a humpback whale is 39 feet long, how long might a blue whale be?

e. A beluga whale is approximately $\frac{2}{7}$ the length of a gray whale. If a beluga whale is 14 feet long, how long might a gray whale be?

f. An 8-foot-long Pacific white-sided dolphin is $\frac{4}{9}$ the length of a pilot whale. How long is the pilot whale?



# Vegetable Garden

Students at Shepherd Elementary School are planning a vegetable garden. They have 10 yards of fencing for the exterior of a square garden. The interior of the garden will then be divided equally into squares so that each student can choose one type of vegetable for their square. There are 25 students in the class.

a. Find the dimensions and area of each student's square garden space.

b. What are the dimensions and area of the whole vegetable garden?

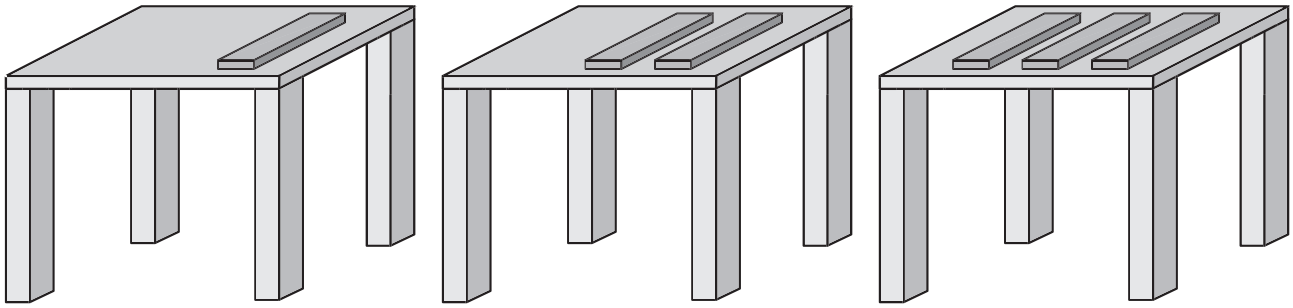


# Chocolate

Imagine that everyone involved in this challenge enjoys chocolate and wants to have as much as possible!

There is a room in a school that has three tables in it with plenty of space for chairs. Table 1 has one block of chocolate on it, Table 2 has two blocks of chocolate on it, and Table 3 has three blocks of chocolate on it. All the chocolate blocks are the same size.



Outside the room is a class of 26 students. The students are allowed to come in one at a time and can only enter when the person in front of them has sat down. When each student enters the room, they sit at the table that would award them the most chocolate if the chocolate were shared equally as soon as they sat down.

However, the chocolate isn't shared out until all 26 students have been seated. Determine the tables where students 1–26 will be seated. How much chocolate will each student get when the chocolate is equally shared between the students at each table?

# Eating Peaches 2

A little monkey had 75 peaches. Each day, she kept a fraction of her peaches, gave the rest away, and then ate 1.

These are the fractions she decided to keep on a given day:

$$\frac{1}{2} \quad \frac{1}{4} \quad \frac{3}{4} \quad \frac{3}{5} \quad \frac{5}{6} \quad \frac{11}{15}$$

In which order did she use the fractions so that she was left with just 1 peach at the end of 6 days?

# Rides at the Fair

Andre has some tickets to use on three rides at the fair.

- Each ride on the Ferris wheel costs $\frac{1}{16}$ of the tickets.
- Each ride on the sky swing costs $\frac{1}{12}$ of the tickets.
- Each ride on the roller coaster costs $\frac{1}{8}$ of the tickets.

After riding 10 rides and riding each ride at least once, Andre is out of tickets. How many times did Andre ride each ride?



# The Greedy Algorithm

You have investigated how the Egyptians expressed fractions as the sum of different unit fractions. A famous mathematician, Fibonacci, found a strategy for generating Egyptian fractions called the Greedy Algorithm.

At every stage of the algorithm, find the largest possible unit fraction that is smaller than the fraction you're working on. Consider the fraction $\frac{11}{12}$. The largest unit fraction that is smaller than $\frac{11}{12}$ is $\frac{1}{2}$, and $\frac{11}{12} - \frac{1}{2} = \frac{5}{12}$:

$$\frac{11}{12} = \frac{1}{2} + \frac{5}{12}$$

The largest unit fraction that is smaller than $\frac{5}{12}$ is $\frac{1}{3}$, and $\frac{5}{12} - \frac{1}{3} = \frac{1}{12}$:

$$\frac{11}{12} = \frac{1}{2} + \frac{1}{3} + \frac{1}{12}$$

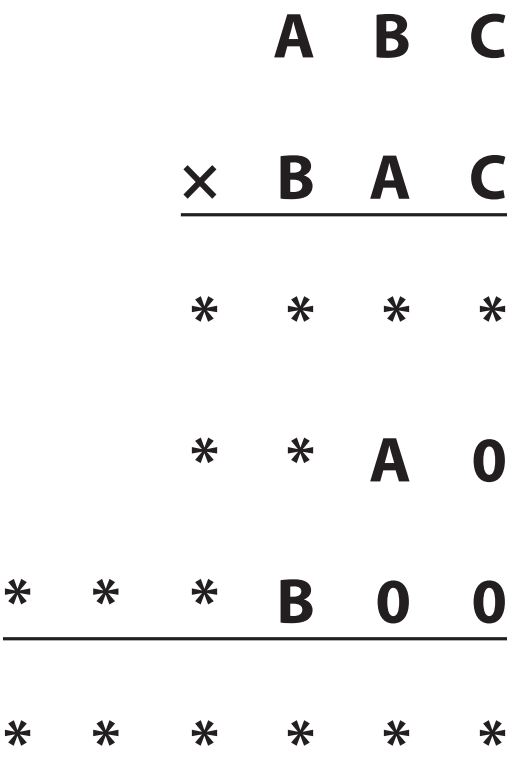
Since $\frac{11}{12}$ is now expressed as the sum of unit fractions, we are done!

Use the Greedy Algorithm for the following fractions:

$$\frac{9}{10} \quad \frac{3}{7} \quad \frac{14}{15} \quad \frac{5}{14} \quad \frac{7}{9}$$

# ABC

In the multiplication problem below, some of the digits have been replaced by letters and others by asterisks. Where a digit has been replaced by a letter, the same letter is used each time, and different letters have replaced different digits. Reconstruct the original multiplication problem.



# Concept Quests

## Grade 5, Unit 5 – Answer Key

## Excursion 5A: Delivering Roses

a. Pink roses account for $\frac{3}{10}$ of the 600 roses.

b. Yellow roses account for $\frac{1}{20}$ of the roses.

c. There are 150 white roses, 180 pink roses, 240 red roses, and 30 yellow roses.

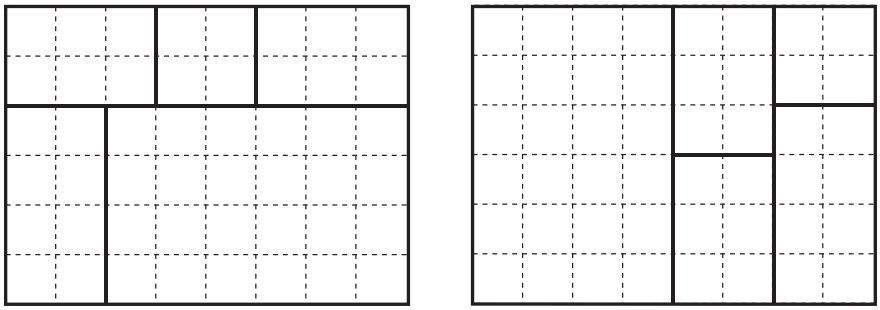
## Excursion 5B: A Fifth Grade Classroom

a. The fractional part of the classroom for the math center is $\frac{1}{8}$.

b. The area of each space is:

- student worktables – 24 square yards
- computer area – 4 square yards
- carpet area – 8 square yards
- classroom library – 6 square yards
- math center – 6 square yards

c. Two possible arrangements, although students' responses will vary:



## Excursion 5C: Class Accounts

Fifth grade spent $\frac{1}{9}$ of the money on jump ropes.

Second grade spent $\frac{2}{24}$ or $\frac{1}{12}$ of the money on jump ropes.

Third grade spent $\frac{1}{8}$ of the money on jump ropes.

Fourth grade spent $\frac{3}{24}$ or $\frac{1}{8}$ of the money on jump ropes.



## Excursion 5D: Eating Peaches 1

Day 1: Monkey keeps 45 peaches; he eats 1, so he has 44 left.
Day 2: Monkey keeps 28 peaches; he eats 1, so he has 27 left.
Day 3: Monkey keeps 15 peaches; he eats 1, so he has 14 left.
Day 4: Monkey keeps 4 peaches; he eats 1, so he has 3 left.
Day 5: Monkey keeps 2 peaches; he eats 1, so he has 1 left.
Monkey has 1 peach left at the end of the fifth day.

## Excursion 5E: Doggone It

a. $2\frac{1}{2} \times 7 = (2 \times 7) + (\frac{1}{2} \times 7) = 14 + 3.5 = 17.5$ cups of food

b. $15 \div 1\frac{2}{3} = \frac{45}{3} \div \frac{5}{3} = 45 \div 5 = 9$

The medicine will last 9 days.

*Students will probably use methods other than this algorithm.*

c. $7\frac{1}{2} \div \frac{3}{4} = \frac{15}{2} \div \frac{3}{4} = \frac{30}{4} \div \frac{3}{4} = 30 \div 3 = 10.$

Maxwell will need to refill the water bowl after 10 hours.

d. $\frac{2}{7} \times 35 = 10$ dogs are female; $1 - \frac{2}{7} = \frac{5}{7}$ of the dogs are male.

## Excursion 5F: Measuring Marine Mammals

a. $\frac{1}{3} \times 39 = 13$; the pectoral fins might be 13 feet long.

b. $18 \div \frac{1}{3} = 54$; the right whale might be 54 feet long.

c. $6 \div \frac{1}{11} = 66$; the average fin whale would be 66 feet long.

d. $39 \div \frac{2}{5} = 97.5$; the blue whale might be 97.5 feet long.

e. $14 \div \frac{2}{7} = 49$; the gray whale might be 49 feet long.

f. $8 \div \frac{4}{9} = 18$ feet; the pilot whale is 18 feet long.

*Models for d–f might demonstrate dividing the whole number by the numerator of the fraction and then multiplying the result by the denominator of the fraction.*

# Adventure 5A: Vegetable Garden

a. The dimensions of the vegetable garden are a 2.5-yard × 2.5-yard square. The total area is 6.25 square yards.

b. Each of the 25 squares within the vegetable garden will have a side length of 0.5 yards and an area of $\frac{1}{4}$ square yards.

Students might benefit from drawing the vegetable garden on grid paper.

# Adventure 5B: Chocolate

*This table shows a possible order for students choosing the table with the most amount of chocolate at the time. The shaded cells represent instances where there are multiple options. For example, Student 4 could go to any table for 1 block of chocolate. Once Student 4 chooses a table, it impacts the choices of Students 5 and 6. They will choose a table with 1 block until all three tables have been occupied at that distribution quantity. Notice the pattern that emerges in the lists below.*

| Table 1 (1 block) | Table 2 (2 blocks) | Table 3 (3 blocks) |
|---|---|---|
| | | Student 1 (3 blocks) |
| | Student 2 (2 blocks) | |
| | | Student 3 ($1\frac{1}{2}$ blocks) |
| | Student 4 (1 block) | |
| | | Student 5 (1 block) |
| Student 6 (1 block) | | |
| | | Student 7 ($\frac{3}{4}$ block) |
| | Student 8 ($\frac{2}{3}$ block) | |
| | | Student 9 ($\frac{3}{5}$ block) |
| | Student 10 ($\frac{1}{2}$ block) | |
| | | Student 11 ($\frac{1}{2}$ block) |
| Student 12 ($\frac{1}{2}$ block) | | |
| | | Student 13 ($\frac{3}{7}$ block) |
| | Student 14 ($\frac{2}{5}$ block) | |
| | | Student 15 ($\frac{3}{8}$ block) |
| | Student 16 ($\frac{1}{3}$ block) | |
| | | Student 17 ($\frac{1}{3}$ block) |
| Student 18 ($\frac{1}{3}$ block) | | |
| | | Student 19 ($\frac{3}{10}$ block) |
| | Student 20 ($\frac{2}{7}$ block) | |
| | | Student 21 ($\frac{3}{11}$ block) |
| | Student 22 ($\frac{1}{4}$ block) | |
| | | Student 23 ($\frac{1}{4}$ block) |
| Student 24 ($\frac{1}{4}$ block) | | |
| | | Student 25 ($\frac{3}{13}$ block) |
| | Student 26 ($\frac{2}{9}$ block) | |

### Final students at each table

Table 1: 1, 3, 4/5/6, 7, 9, 10/11/12, 13, 15, 16/17/18, 19, 21, 22/23/24, 25

Table 2: 2, 4/5/6, 8, 10/11/12, 14, 16/17/18, 20, 22/23/24, 26

Table 3: 4/5/6, 10/11/12, 16/17/18, 22/23/24

### Final distribution of chocolate

Table 1: $\frac{1}{4}$ block of chocolate each

Table 2: $\frac{2}{9}$ block of chocolate each

Table 3: $\frac{3}{13}$ block of chocolate each

## Adventure 5C: Eating Peaches 2

The fractions were used in the following order: $\frac{11}{15}, \frac{5}{6}, \frac{3}{4}, \frac{1}{2}, \frac{3}{5}, \frac{1}{4}$.

## Adventure 5D: Rides at the Fair

Andre has ridden the Ferris wheel 2 times ($\frac{2}{16} = \frac{1}{8}$ of the tickets), the sky swing 3 times ($\frac{3}{12} = \frac{1}{4}$ of the tickets), and the roller coaster 5 times ($\frac{5}{8}$ of the tickets). This accounts for all the tickets, since $\frac{1}{8} + \frac{1}{4} + \frac{5}{8} = 1$.

## Adventure 5E: The Greedy Algorithm

Because this is a particular algorithm for finding these Egyptian fractions, these are the ONLY solutions that are correct:

$$\frac{9}{10} = \frac{1}{2} + \frac{1}{3} + \frac{1}{15}$$

$$\frac{3}{7} = \frac{1}{3} + \frac{1}{11} + \frac{1}{231}$$

$$\frac{14}{15} = \frac{1}{2} + \frac{1}{3} + \frac{1}{10}$$

$$\frac{5}{14} = \frac{1}{3} + \frac{1}{42}$$

$$\frac{7}{9} = \frac{1}{2} + \frac{1}{4} + \frac{1}{36}$$

## Adventure 5F: ABC

$$\begin{array}{cccccc} & & & 2 & 8 & 6 \\ & & \times & 8 & 2 & 6 \\ \hline & & 1 & 7 & 1 & 6 \\ & & 5 & 7 & 2 & 0 \\ 2 & 2 & 8 & 8 & 0 & 0 \\ \hline 2 & 3 & 6 & 2 & 3 & 6 \end{array}$$

A = 2 B = 8 C =6