Measurement and Data

Students in third grade learn a variety of concepts pertaining to measurement and data. They measure physical objects with standard measuring tools, such as rulers, and "measure" time by telling and writing time to the nearest minute and by solving problems pertaining to elapsed time.

Students gain foundational understanding of measurement concepts, such as *partitioning* (units can be subdivided), *iteration* (a unit can be repeated to make a measurement), and *compensation* (the size of a unit affects the number of units needed). They explore the concept of using "unit squares" to measure area. They also develop understanding of perimeter as the distance around a two-dimensional shape.

Third graders also measure mass and volume and use standard rulers with half and quarter marks to determine linear measurement. They connect their understanding of fractions to measure to the closest one-half and one-quarter inch. They show data by making line plots with a horizontal scale marked off in whole numbers, halves, and quarters.

Students read and solve problems using scaled graphs, such as picture and bar graphs. They solve one- and two-step "how many more" and "how many less" problems using information presented in the graphs. While exploring data, students pose questions and collect, analyze, and interpret data relevant to their lives.

The Grade 3 Common Core State Standards for Measurement and Data specify that students should–

- Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.
- Represent and interpret data.
- Geometric measurement: understand concepts of area and relate area to multiplication and to addition.
- Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

The following hands-on activities will provide students with experiences to help them understand concepts in measurement and data. Mathematically proficient third graders reason abstractly and quantitatively. They connect quantities to written symbols and create logical representations of the problems at hand, considering appropriate units and the meaning of the quantities.

Measurement and Data

Contents

LESSON 1

Objective

Tell time to the hour, half hour, quarter hour, and minute on analog and digital clocks.

Common Core State Standards

- **3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

Telling Time

Time is a very abstract concept. We live in a digital world; therefore, students have less and less exposure to analog clocks. Teachers can help make the concept more understandable if they incorporate time into their classes on a daily basis. Experience using an analog clock helps a student see how time is divided up into smaller units.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Review the terms *quarter after* and *half past.* **Ask:** *What do you think it means if the time is a quarter to 12:00?* Have students compare $\frac{1}{4}$ Deluxe Rainbow Fraction® Circles to Write-On/Wipe-Off Student Clocks and identify and model 11:45.
- **Ask:** *How can we tell if a written time is in the morning or at night?* Discuss the difference between A.M. and P.M. Have students model and write 9:00 A.M. and then 9:00 P.M. on their clocks.

Solve It

With students, reread the problem. Have students make a schedule of picture times. They should list each in digital form and draw a picture of a clock face to show each in analog form. **Say:** *Mrs. Kennedy wants to add another picture time at a quarter to 11:00 in the morning.* Have students add this time in analog and digital forms to their picture schedules.

More Ideas

For other ways to teach about telling time—

- Have students create their own movie schedule with at least seven movies. On the schedule, there must be at least one movie in the morning, one in the afternoon, one that starts before the half hour, one that starts past the half hour, one that starts at a quarter after the hour, and one that starts at a quarter to the hour. After students write their schedule using digital forms, have them model each time on the Write-On/Wipe-Off Clocks.
- Have students work in pairs to take turns quizzing each other about telling time. One student models a time on the analog clock, and the other writes the time in digital form. Then the first student provides a digital time and the partner models the analog. Then students switch roles.

Formative Assessment

Have students try the following problem.

Mrs. Barnes told her class that lunch is at a quarter after twelve. What is another way to write the time for lunch?

A. 11:45 A.M. **B.** 12:15 P.M. **C.** 12:30 P.M. **D.** 12:45 P.M.

Try It! 30 Minutes | Groups of 4

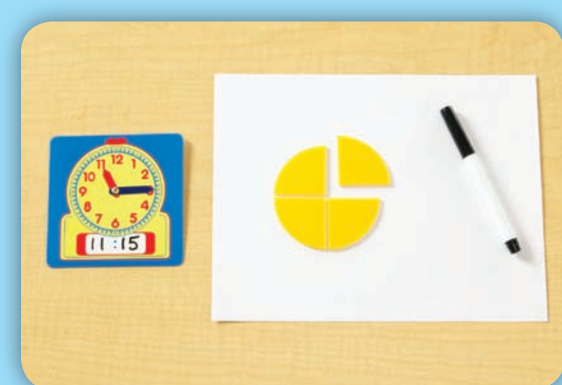
Here is a problem about telling time.

Mrs. Kennedy's class is going to have their school pictures taken. The first group will go at a quarter after 11:00 A.M., the second will go at half past 1:00 P.M., and the third will go at 2:55 P.M. How can the students tell the picture times on both the round clock on the wall and the digital clock on Mrs. Kennedy's desk?

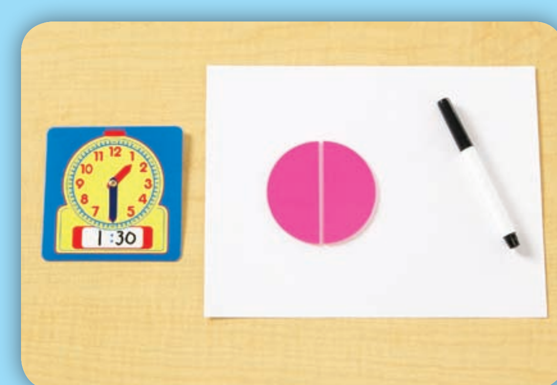
Introduce the problem. Then have students do the activity to solve the problem. Distribute Write-On/Wipe-Off Clocks and Fraction Circles to students. Write the three picture times on the board: *a quarter after 11:00 A.M., half past 1:00 P.M.,* and *2:55 P.M.*

Materials

- Write-On/Wipe-Off Student Clock (1 per student)
- Deluxe Rainbow Fraction® Circles (1 set per group)
- paper (1 sheet per group)
- dry erase markers (1 set per group)



1. Say: *"Quarter after" is a way of saying that one quarter, or one-fourth, of an hour has passed.* Have students compare the $\frac{1}{4}$ circle pieces to the clock face. **Ask:** *Where should the minute hand on the clock be when one quarter of an hour has passed?* (on 3) **Ask:** *If the time is a quarter after 11:00, where should the hour hand be?* (just past 11) Guide students to write the time in digital form under the clock: 11:15.



2. Ask: *What do you think "half past 1:00 P.M." means?* Have students compare the $\frac{1}{2}$ circle pieces to the clock to see that *half past 1:00 P.M.* means that one half of an hour has passed since 1:00. **Ask:** *Where should the hands be to show half past 1:00?* Help students model and write 1:30 on their clocks.

3. Ask: *Where should the minute hand be for 2:55? Where should the hour hand be?* Have students model and write 2:55 on their clocks.

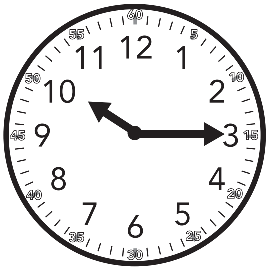
⚠ Look Out!

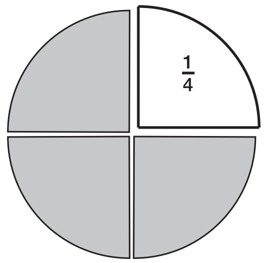
Watch out for students who successfully move the minute hand but do not correctly advance the hour hand to correspond. For example, when showing 1:30, students may move the minute hand to the 6 but point the hour hand directly at the 1 instead of midway between the 1 and the 2. Help students identify the correct placement of the hour hand. Point out that 1:30 is halfway between 1:00 and 2:00, so the hour hand should be halfway between the numbers 1 and 2 on the clock.

Answer Key

Use a Write-On/Wipe-Off Clock to model the time on each clock. Use Fraction Circles to model the number of minutes shown by the minute hand. Write the time in standard form and then using the words *quarter* or *half*. (Check students' work.)

1.

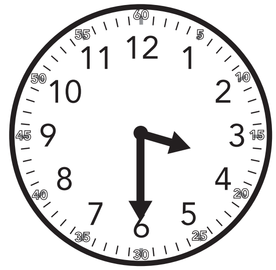


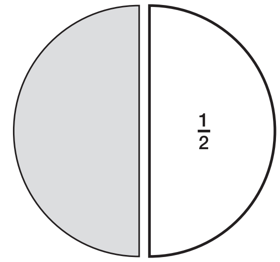


Time: 10:15

quarter after 10

2.



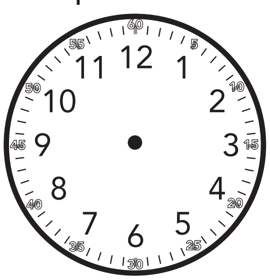


Time: 3:30

half past 3

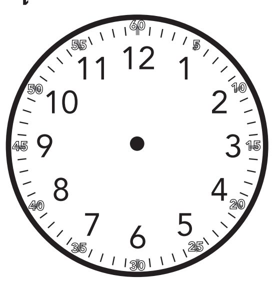
Using a Write-On/Wipe-Off Clock and Fraction Circles, model each time given. Sketch the minute and hour hands on the clock. Write the time using numbers. (Check students' models.)

3. half past noon



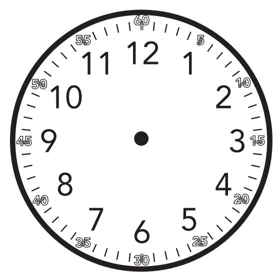
12:30

4. quarter after 5



5:15

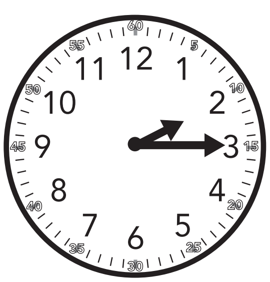
5. 20 minutes after 8



8:20

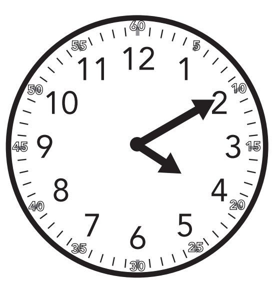
Write the time shown on each clock.

6.



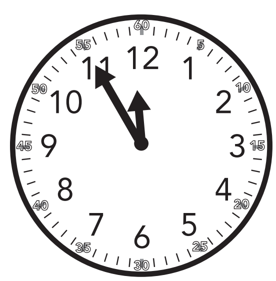
2:15

7.



4:10

8.



11:55

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Answer Key

Challenge! What number on the face of a clock corresponds to the phrase "a quarter after"? What number on the face of a clock corresponds to the phrase "half past"? What number on the face of the clock corresponds to "a quarter to" the hour? Draw pictures to help.

Challenge: (Sample) The number on the clock that makes a quarter after the hour is 3. The number on the clock that makes half past the hour is 6. The number on the clock that makes a quarter to the hour is 9.

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LESSON 2

Objective

Find elapsed time.

Common Core State Standards

- **3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

Measurement and Data

Elapsed Time

In grade 3, students begin to deepen their understanding of time. They start to move from simply telling time to calculating elapsed time. Since the school day is driven by a schedule, real-life opportunities arise during the day for students to calculate elapsed time.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Tell students that the time between a start time and an end time is called *elapsed time*. **Ask:** *Why do we need to be able to figure out elapsed time?* Discuss with students the importance of knowing how long activities last.
- **Ask:** *When you have a start time and an end time, how can you figure out elapsed time?*
- **Ask:** *When you have a start time, and you know how long something lasts, how can you find the end time?*
- **Ask:** *If we know the time something ends and how long it lasts, how can we figure out what time it starts?* Guide students to use a Write-On/Wipe-Off Student Clock to model.

Solve It

With students, reread the problem. Have students write a paragraph telling how they found the elapsed time of the three movies and which movie the students decided to see at the museum.

More Ideas

For other ways to teach about elapsed time—

- Have students make a schedule of their evening activities for a specific day of the week and use Write-On/Wipe-Off Clocks to find the amount of time spent doing each activity. Students should identify start time, end time, and elapsed time and use the clocks to model each.
- Have students keep track of a whole day at school and use Write-On/Wipe-Off Clocks to figure out the amount of time spent doing each activity.
- Have students work in pairs. One partner uses a Write-On/Wipe-Off Clock to show a start time. The other partner models an end time on a second clock. Partners look at both clocks to find the elapsed time.

Formative Assessment

Have students try the following problem.

The baseball game started at 4:30 P.M. It lasted for 1 hour and 15 minutes. What time did the game end?

A. 3:15 P.M. **B.** 4:45 P.M. **C.** 5:30 P.M. **D.** 5:45 P.M.

Try It! **30 minutes | Pairs**

Here is a problem about finding elapsed time.

Miss Gabowski took her class to a science museum on a field trip. The students were allowed to spend 1 hour and 15 minutes watching a movie at the museum. They looked at a movie schedule. Weather Mysteries *was playing from 12:45 to 2:30.* The Moon *was playing from 1:30 to 2:30.* Trees, Trees, Trees *was playing from 2:15 to 3:30. The students decided to see the movie that was exactly 1 hour and 15 minutes long. Which movie did they see?*

Introduce the problem. Then have students do the activity to solve the problem. Distribute Write-On/Wipe-Off Clocks to students. Model for students how to use the clocks.

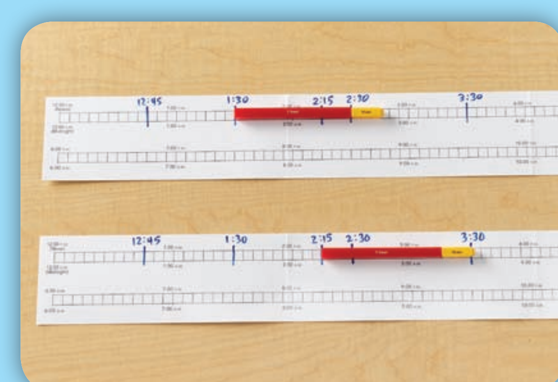
Materials

- Write-On/Wipe-Off Student Clock (1 per student)
- Time Interval Rods ($\frac{1}{2}$ set per pair)
- Time Work Mats (1 per student)
- dry erase markers (1 set per group)

1. Have one partner set their clock to the 12:45 start time and the other to the 2:30 end time of the *Weather Mysteries* movie. Guide students to compare the two clocks and rotate both hands of the start time clock to match the end time, counting by fives to track the elapsed time.

2. Ask: *How long is the movie* The Moon? *Use your clocks to find out.* Students should use the clocks to find the elapsed time from 1:30 to 2:30. Then have students find the length of *Trees, Trees, Trees* (2:15 to 3:30).

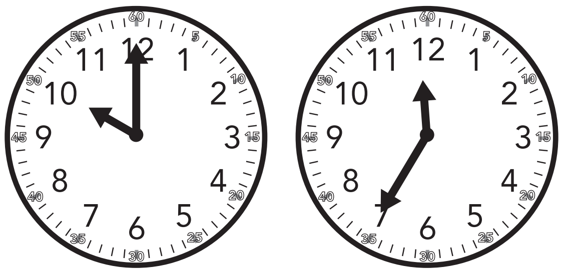
3. Ask: *What if* Trees, Trees, Trees *started at 2:15 and lasted 2 hours? What time would the movie end?* Have students use the clocks to count ahead 2 hours to find the end time (4:15).



4. Have students mark and label all the start and end times on their Time Work Mats. Then have students make a rod train that measures 1 hour and 15 minutes and use it to test the duration of each movie. Ask students what they find.

Use a Write-On/Wipe-Off Clock to model the times shown on each clock. Write the starting time and ending time. Find the elapsed time. (Check students' work.)

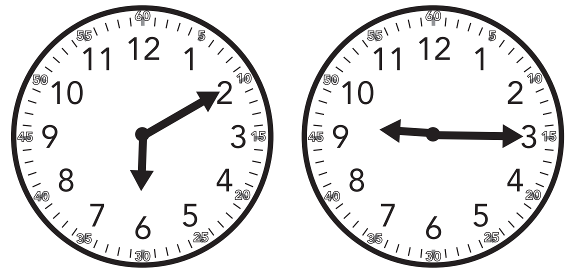
1.



Start 10:00 End 11:35

Elapsed time: 1:35

2.

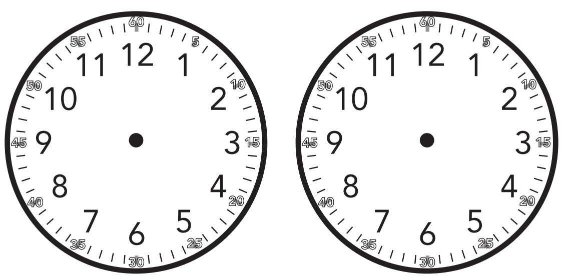


Start 6:10 End 9:15

Elapsed time: 3:05

Using a Write-On/Wipe-Off Clock, model the starting and ending times given. Sketch the minute and hour hands on the clocks below. Find the elapsed time. (Check students' models.)

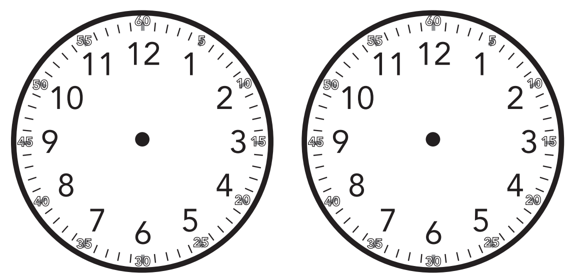
3.



Start: 8:20 End: 10:00

Elapsed time: 1:40

4.



Start: 4:45 End: 9:00

Elapsed time: 4:15

Find each elapsed time.

5. 11:15 A.M. to 2:15 P.M. — 3:00

6. 5:15 P.M. to 7:00 P.M. — 1:45

7. 1:45 A.M. to 4:30 A.M. — 2:45

8. 8:30 A.M. to 10:45 A.M. — 2:15

9. 3:50 P.M. to 6:00 P.M. — 2:10

10. 12:00 P.M. to 4:30 P.M. — 4:30

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Answer Key

Challenge! Explain why Problem 5 was easier to answer than Problem 6. Explain why Problem 10 was easier to answer than Problem 9.

Challenge: (Sample) In Problem 5, the minutes are the same, so you only have to find the difference in the hours. In Problem 6, the minutes are not the same. In Problem 10, the starting time is at the hour with 0 minutes. So, the minutes of the elapsed time are the minutes in the ending time. In Problem 9, the starting time is not on the hour.

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LESSON 3

Objective

Add intervals of time.

Common Core State Standards

- **3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

Add Intervals of Time

In the early grades, students acquire a variety of experiences with measurement. These experiences are focused in large part on measuring the lengths of objects. Their first experiences with time are in learning how to tell time, which they might not interpret as a kind of measurement. But when students learn to work with intervals of time in third grade, they will appreciate the similarities to measuring lengths of objects.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say**: *We can use a number line to show time intervals.*
- **Ask**: *What time would we have as the starting time on the number line?* Draw a number line on the board, starting at 7:00, and have students draw a similar number line on a piece of paper. **Say:** *Now draw marks to show 5-minute intervals up to 8:00.* **Ask:** *How much time did each of Toby's activities take?* **Say:** *Let's mark them on the number line to show how long they take.*

Solve It

With students, reread the problem. Using the number line on the board, have students count out the elapsed times for each of Toby's morning activities and find out what time Toby would be ready for school. **Ask:** *What time will Toby be ready for school?* Have students write two sentences explaining how they determined the amount of time Toby needed to get ready for school and what time he was ready to leave.

More Ideas

For other ways to teach about adding intervals of time—

- Have students work in pairs to create time stories. Have one student select a starting time. Have the other student pick Time Interval Rods to represent the times passing in the story. Then have the pairs work together to create their stories, using Write-On/Wipe-Off Student Clocks to show the start times, time intervals, and end times.
- Have pairs work with Time Interval Rods. Starting at 12:00, have them take turns pulling a Time Interval Rod from a bag and placing it on the Time Work Mat to add time. Have them write each time interval, the sum of the intervals, and the end time.

Formative Assessment

Have students try the following problem.

It is 6:15. If 15 minutes pass, then 10 minutes more, what time will it be?

A. 5:15 **B.** 6:25 **C.** 5:25 **D.** 6:40

Try It! 20 minutes | Groups of 4

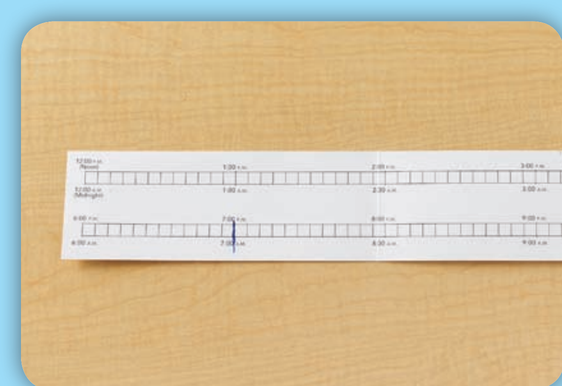
Here is a problem about adding intervals of time.

Toby wakes up at 7:00. It takes him 15 minutes to eat breakfast, 5 minutes to pack a lunch, and 10 minutes to get himself and his belongings ready for school. How much time will Toby need before leaving for school? What time will he be ready to leave?

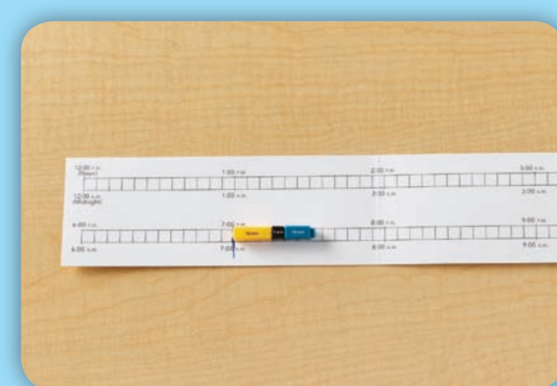
Introduce the problem. Then have students do the activity to solve the problem. Distribute Time Interval Rods, Write-On/Wipe-Off Clocks, Time Work Mats, and markers to students.

Materials

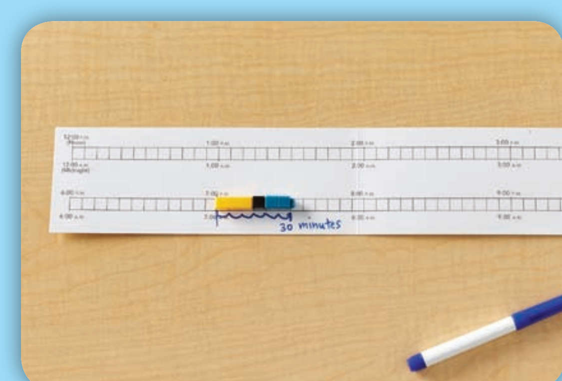
- Time Interval Rods (1 set per group)
- Time Work Mats (1 per student)
- Write-On/Wipe-Off Student Clock (1 per student)
- dry erase markers (1 set per group)



1. Ask: *What does Toby need to do before he goes to school?* Briefly review Toby's activities and tell students they will be adding up the amounts of time it takes Toby to complete them. **Ask:** *What time does Toby wake up?* **Say:** *Locate the time Toby wakes up on your work mat.*



2. Say: *Let's go through the activities Toby does.* **Ask:** *What's first?* Have students place a Time Interval Rod on their work mats to show the time Toby spends eating breakfast. Then have them do the same for the time he spends packing his lunch and for the time he spends getting himself and his belongings ready.



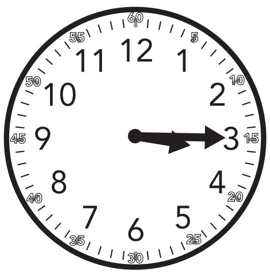
3. Say: *To find out how much time it takes Toby to go through his morning activities we will add the interval pieces together.* Have students count by 5s as they follow the scored intervals on the Time Interval Rods.

4. Say: *Now use your clocks to show what time Toby is ready to leave.* **Ask:** *What time did Toby wake up? How much time does he spend completing his morning activities?* Have students count out the time in 5-minute intervals, moving the clock hands while counting. Have them write the time Toby leaves on their clocks.

Answer Key

Use a Write-On/Wipe-Off Clock to model the start time and add the time intervals. Write the end time. (Check students' work.)

1. Start at 3:15. Add 15 minutes, then 10 minutes.


Start


End

End time: 3:40

2. Start at 1:45. Add 5 minutes, then 15 minutes.

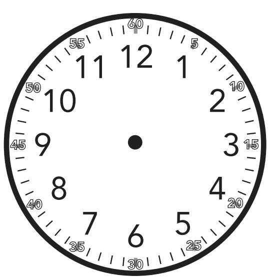

Start

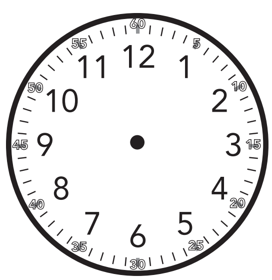

End

End time: 2:05

Using a Write-On/Wipe-Off Clock, model the start time and given time intervals. Draw the clock hands to show the start and end times. Write the end time. (Check students' models.)

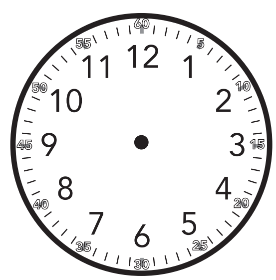
3. Start at 6:30. Add 30 minutes, then 15 minutes.

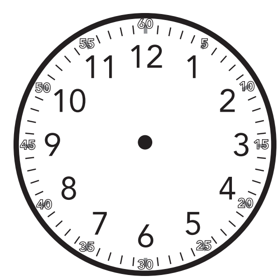

Start


End

End time: 7:15

4. Start at 9:10. Add 10 minutes, then 20 minutes.


Start


End

End time: 9:40

Find the end time.

5. Start at 2:00. Add 40 minutes, then 10 minutes.

2:50

6. Start at 7:20. Add 15 minutes, then 20 minutes.

7:55

7. Start at 4:10. Add 25 minutes, then 10 minutes.

4:45

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Answer Key

Challenge! Model Problems 5, 6, and 7 using Time Interval Rods with Time Work Mats. Do you prefer to use rods or clocks when adding times? Explain.

Challenge: Answers will vary. Look for explanations to match stated preferences.

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LESSON 4

Objective

Use elapsed time to find times after.

Common Core State Standards

- **3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

Measurement and Data

Finding Times After

In third grade, students expand their study of time beyond just telling time. They start to work with elapsed time to describe a more complex variety of situations. Most of the practical work that students will do with time in math and science will involve elapsed time, so students must develop the ability to work flexibly with this basic concept.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How can you count off 15-minute intervals on the clock? How can you count off 15-minute intervals on the Time Work Mat?*
- **Ask:** *How many 15-minute intervals are there between 4:45 and 5:30?* **Say:** *We know that there are three 15-minute intervals.* **Ask:** *How can you find the total time Cheyenne has to wait?* Direct discussion to include skip-counting by 15s (15, 30, 45), or multiplying 15 × 3 = 45.

Solve It

With students, reread the problem. Have them draw a clock and show the elapsed time. Then have them write a sentence telling how they determined the number of minutes Cheyenne has to wait.

More Ideas

For other ways to teach about using elapsed time to find times after—

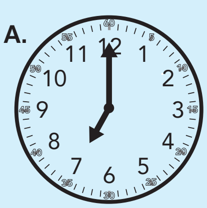
- Have pairs use Time Interval Rods and Time Work Mats. Ask one student to select a start time on the work mat and pick rods from a bag. Then have the other student place the rods on the work mat to determine the elapsed time and the end time. Switch roles and repeat.
- Have pairs use Write-On/Wipe-Off Student Clocks. Ask one student to set a time on his/her clock and allow the other student to see it. Then have the other student set a later time on his/her clock and have both find the elapsed time. Switch roles and repeat.

Formative Assessment

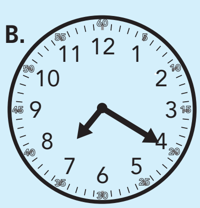
Have students try the following problem.

Which shows 20 minutes after 7:20?

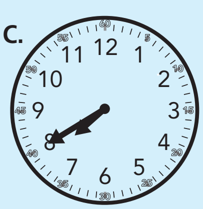
A.



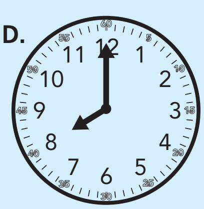
B.



C.



D.



Try It! 20 minutes | Groups of 4

Here is a problem about using elapsed time to find times after.

Cheyenne knows of a new TV show she wants to watch. The show starts at 5:30. It is now 4:45. How much time must Cheyenne wait to watch her show?

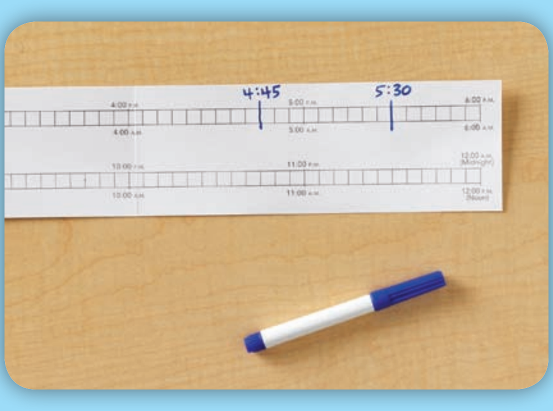
Introduce the problem. Then have students do the activity to solve the problem. Distribute Time Interval Rods, Write-On/Wipe-Off Clocks, Time Work Mats, and markers to students.

Materials

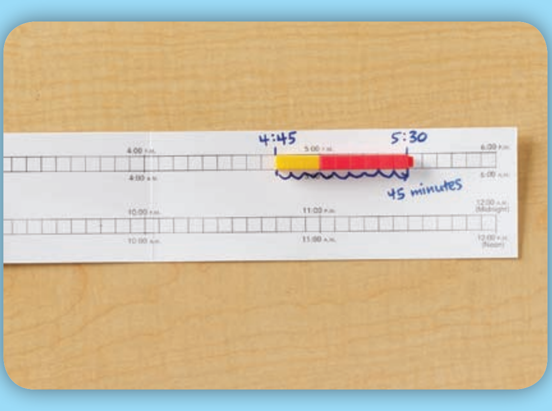
- Time Interval Rods (1 set per group)
- Time Work Mats (1 per student)
- Write-On/Wipe-Off Student Clock (1 per student)
- dry erase markers (1 set per group)

1. Ask: *In the problem, what time is it now?* **Say:** *Set the hands on your clock to show the time, and write the time in the space below the clock.* Students should set the hands to show 4:45 and write the time.

2. Say: *Let's count the minutes until the show starts at 5:30.* **Ask:** *What is the best way to count the minutes between 4:45 and 5:30?* Discuss counting by hours (no), 5 minutes (best), and single minutes (yes, but not best). **Say:** *Now place a finger where the minute hand is at 4:45. Count by 5s until you get to 5:30.*



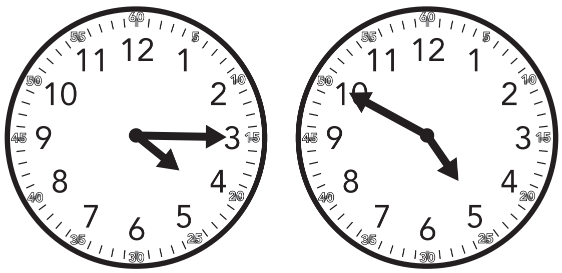
3. Say: *We also can use the Time Interval Rods and Time Work Mats to find the time Cheyenne has to wait.* Have students find 4:45 on the work mat. Ask them to mark and label it with their marker. Then have them mark and label 5:30.



4. Have students fill in the time between 4:45 and 5:30 with Time Interval Rods and count the elapsed minutes.

Use a Write-On/Wipe-Off Clock to model the start time and elapsed times. Write the end time. (Check students' work.)

1. Taylor started her run at 4:15. She ran for 35 minutes. What time did Taylor finish running?

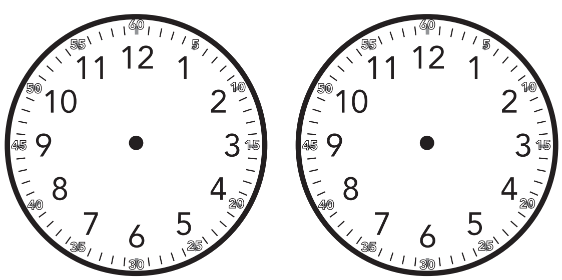


Start End

End time: 4:50

Using a Write-On/Wipe-Off Clock, model the start time and end time. Draw the hands on the clocks. Write the elapsed time.

2. Bob started reading at 9:35. He stopped reading at 10:20. How long did Bob read?



Start End

Elapsed time: first clock should show 9:35, second clock should show 10:20, elapsed time: 45 minutes

Find the end time.

3. Rosa rode her bike for 50 minutes. If she started at 4:05, what time did she finish?

End time: 4:55

4. Saul swam for 55 minutes. If he started at 6:10, what time did he finish?

End time: 7:05

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Answer Key

Challenge! Jason took a nap. When he lay down, the clock said 5:10. When he woke up, the clock said 6:25. How long did Jason nap? Write how much time passed while Jason was napping. Explain how you know.

Challenge: Jason napped for 1 hour and 15 minutes; 5:10 to 6:10 is one hour, and 6:10 to 6:25 is 15 minutes.

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LESSON 5

Objective

Use elapsed time to find times before.

Common Core State Standards

- **3.MD.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

Measurement and Data

Finding Times Before

In the previous lesson, students worked with elapsed time to find times after, given a start time. A variation on this activity is to work with elapsed time to find times before, given an end time. To find times before, students need to count backward, or subtract, from a given time.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How did you know that you had to count backward?* Discuss the term *ago* and how it refers to something that has already happened.
- **Say:** *Remember that if you count backward and go past the 12, the hour hand needs to go back to the previous hour. You can check your answer by beginning at your found starting time, and counting forward to see if you end at the given time in the problem.*

Solve It

With students, reread the problem. Have them draw a clock and show the elapsed time. Then have students write a sentence telling how they know when the game actually started.

More Ideas

For other ways to teach about using elapsed time to find times before—

- Have pairs use Time Interval Rods and Write-On/Wipe-Off Student Clocks. Have one student set a time on his/her clock and pick a rod from a bag. Then have the other student count backward that many minutes from the given time and set the start time on his/her clock. Switch roles and repeat.
- Have pairs use Time Interval Rods and Time Work Mats. Have one student pick an end time on the work mat and pick rods from a bag. Then have the other student show the earlier time on the work mat with the rods. Have both students find the elapsed time. Switch roles and repeat.

Formative Assessment

Have students try the following problem.

Luis made brownies. The brownies had to cook for 45 minutes. He took them out of the oven at 1:05. What time did he put them in the oven?

A. 12:20 **B.** 12:45 **C.** 1:45 **D.** 1:50

Try It! 20 minutes | Groups of 4

Here is a problem about using elapsed time to find times before.

At 5:35, Nora saw her brother watching a soccer game she also wanted to watch. "I thought the game started at 5:30," Nora said. Her brother explained, "So did I, but it actually started 35 minutes ago." What time did the game start?

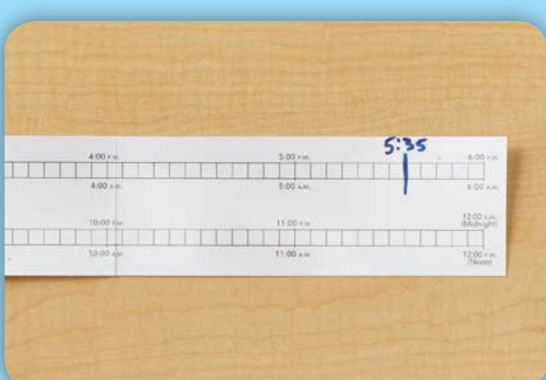
Introduce the problem. Then have students do the activity to solve the problem. Distribute Time Interval Rods, Write-On/Wipe-Off Clocks, Time Work Mats, and markers to students.

Materials

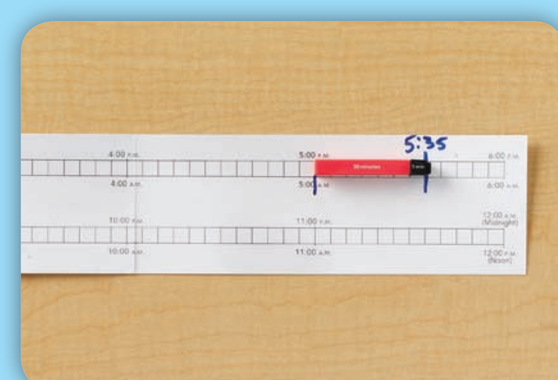
- Time Interval Rods (1 set per group)
- Time Work Mats (1 per student)
- Write-On/Wipe-Off Student Clock (1 per student)
- dry erase markers (1 set per group)

1. Ask: *What time did Nora arrive to watch the game?* **Say:** *Move the hands on your clock to show the time Nora joined her brother to watch the game.*

2. Say: *Nora's brother said the game started 35 minutes ago.* **Ask:** *What do we need to do to find the start time?* Help students understand that they need to count backward by 5-minute intervals until they reach 35 minutes. **Ask:** *What time is it when you count back 35 minutes? What time did the game actually start?*



3. Say: *We also can use the Time Interval Rods and Time Work Mats to find the start time.* Have students find and mark 5:35 on their work mats.



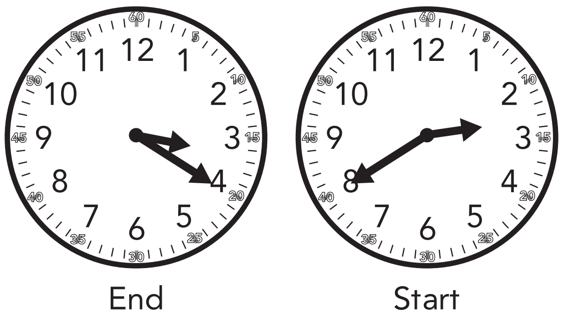
4. Have students use Time Interval Rods to fill time backward 35 minutes. **Ask:** *What time did the game start? Does that time match the time you found using your clocks?*

Answer Key

Use a Write-On/Wipe-Off Clock to model the elapsed time. Write the start time.

(Check students' work.)

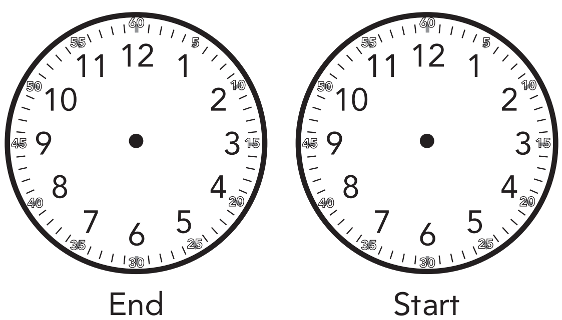
1. Jared practiced his drum for 40 minutes. He finished practicing at 3:20. What time did he start practicing?



Start time: 2:40

Using a Write-On/Wipe-Off Clock, model the elapsed time. Draw the hands on the clock. Write the start time.

2. It took Gene 25 minutes to mow the lawn. He finished at 5:30. What time did he start mowing the lawn?



Start time: first clock should show 5:30, second clock should show 5:05, start time: 5:05

Find the start time.

3. Ashley has gymnastics for 40 minutes. Her class is over at 6:45. What time does her gymnastics class start?

Start time: 6:05

4. Sonia's softball practice was over at 4:10. Her practice lasted 50 minutes. What time did her practice start?

Start time: 3:20

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Answer Key

Challenge! The soccer game ended at 6:30. There were two 20-minute halves and a 5-minute halftime. Use a clock or number line to find what time the second half started, when halftime started, and when the game started. Then write the times.

Challenge: Second half started at 6:10, halftime started at 6:05, and the game started at 5:45.

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LESSON 6

Objective

Use metric units to estimate and measure weight (grams).

Common Core State Standards

- **3.MD.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.

Measure Weight

Estimation is an important mathematical skill for students to develop. Establishing benchmarks by which students can compare the weights of items is a strategy that will help them make more reasonable estimates. Students also need opportunities to work with a variety of measurement tools and to recognize that slightly different measurements may be found for the same items. It is important for students to experience both customary and metric units of measurement.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *Why do you think it's important to put the Centimeter Cubes into the balance one at a time?*
- **Ask:** *How many grams did the Papa Bear™ Counter weigh? Mama Bear™ Counter? Baby Bear™ Counter? Did anyone find a different weight for any of these?*
- **Say:** *Grams are a good unit of measurement for small items like the Three Bear Family® Counters.* **Ask:** *Do you think grams would be practical for measuring the weights of larger items, such as your desk? Why or why not?*

Solve It

With students, reread the problem. Have students explain in writing how Jessica should measure each Bear Counter to find its weight.

More Ideas

For other ways to teach about estimating and measuring weight—

- Provide a balance and Centimeter Cubes at the math center. Instruct students to find items they believe to weigh approximately 1, 50, 100, and 500 grams. Have students use the balance and cubes to check the weights of the items and select new items as needed. Instruct students to list the items discovered for each of the target weights.
- Challenge students to use the weights of the Three Bear Family Counters and the Centimeter Cubes to create problem-solving opportunities (1 Baby Bear = 4 grams, 1 Mama Bear = 8 grams, and 1 Papa Bear = 12 grams). Example: What combination of Bear Counters weighs 24 grams (cubes)? What other combinations of Bear Counters weigh 24 grams (cubes) total?

Formative Assessment

Have students try the following problem.

Which item weighs about 5 grams?

A. a pencil **B.** an apple **C.** a box of crayons **D.** a dictionary

Try It!

20 minutes | Groups of 4

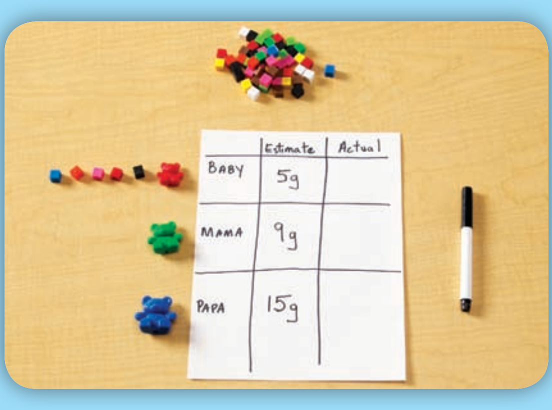
Here is a problem about using metric units to estimate and measure weight.

Jessica's teacher says that a Papa Bear™ Counter, a Mama Bear™ Counter, and a Baby Bear™ Counter all have different weights. How can Jessica measure them to find out how much each one weighs?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Three Bear Family Counters and Centimeter Cubes to groups. Groups may have to share balances. Explain that a gram is a metric unit used to measure the weight of an object. Hold up one cube and explain that each cube weighs one gram.

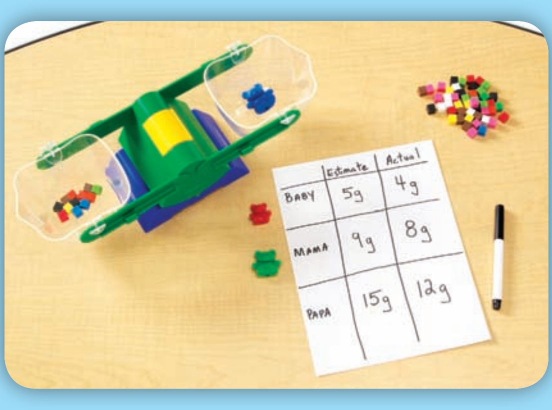
Materials

- Three Bear Family® Counters (20 per group)
- Centimeter Cubes (100 per group)
- bucket balance (1 per group or station; not included in kit)
- paper and pencils (1 each per group)



1. Have students select three Bear Counters, one of each size. **Say:** *A paper clip weighs about 1 gram. A textbook weights about 435 grams.* **Ask:** *How much do you think each of the Bear Counters weighs?* Have students make a chart with one column for the bear name, one for their estimate, and one for the actual weight. Then have them fill in their estimates.

2. Have students measure the Baby Bear first. Tell them to put the Baby Bear in one bucket and then place cubes in the other bucket, one at a time. **Say:** *When the buckets are balanced, count the cubes and record the weight in your chart.*

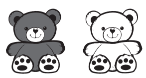


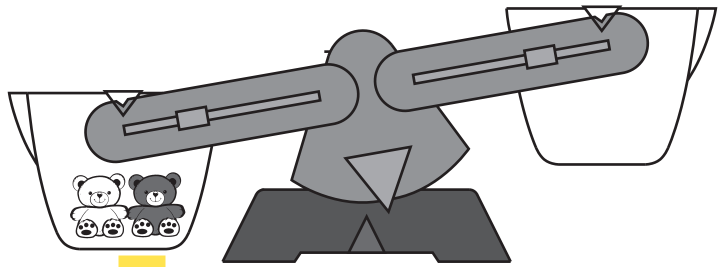
3. Have students continue by measuring the other two bears and then comparing their estimated weights with their actual weights.

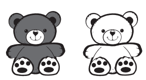
⚠ Look Out!

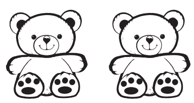
Students may use arbitrary numbers when estimating the weights of classroom objects. Remind students of the weights of the textbook and the paper clip discussed in Step 1. Give students one cube to hold and use as they start to estimate. Then have them hold 10, and then 20, and compare how the different weights feel. Also, watch that students' buckets are balanced before they begin weighing. Have students check that the buckets are level, and discuss how having unlevel buckets can affect their measurements.

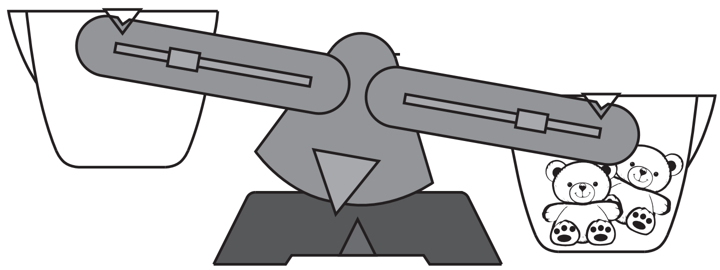
Use Three Bear Family Counters, Centimeter Cubes, and a balance to model weight. Find the weight, in grams, of each group of counters. (Each cm cube = 1 gram.) (Check students' work.)

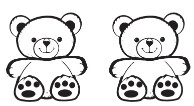
1. 

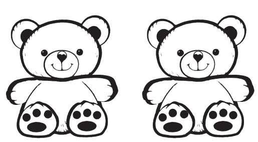


 = **8** cubes = **8** grams

2. 



 = **16** cubes = **16** grams

3.  = **24** cubes = **24** grams

Locate each item named. Use a balance to find each weight in grams.

4. pencil Sample:

15 cubes = **15** grams

5. empty envelope Sample:

5 cubes = **5** grams

6. paper clip Sample:

1 cube(s) = **1** gram(s)

7. penny Sample:

3 cubes = **3** grams

8. quarter Sample:

7 cubes = **7** grams

9. dollar bill Sample:

1 cube(s) = **1** gram(s)

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Answer Key

Challenge! Use your answers to Problems 7 and 8 to find the weight of a stack of each coin that would be worth $1.00. Show your work.

Challenge: (Sample) One hundred pennies equals $1.00, so $1 in pennies weighs 300 g. Four quarters equal $1.00, so $1 in quarters weighs 28 grams.

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LESSON 7

Objective

Use tallies to collect data and construct a pictograph.

Common Core State Standards

- **3.MD.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

Measurement and Data

Pictographs

Students need regular opportunities to perform investigations in which they collect, analyze, display, and interpret data. They should also explore different ways of displaying this data, such as creating pictographs.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *During which week were the most teddy bears collected? The least? How can you tell?* Students should recognize that they can compare the number of teddy bears collected each week by identifying the rows with the greatest and least number of Baby Bear™ Counters.
- **Ask:** *What if 8 teddy bears, not 5, were collected during Week 1? How could you show that?* Students should conclude that they could draw one full Bear Counter and a partial Bear Counter to represent 8 teddy bears.

Solve It

With students, reread the problem. Have students write out directions to Miss Roberts's class, telling the class how to show the number of teddy bears collected during each week of the toy drive on a pictograph. Then have students use Graphing Grids (BLM 4) to draw pictographs to show the data.

More Ideas

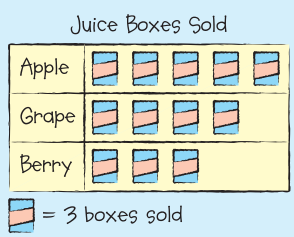
For other ways to teach about collecting data and constructing a pictograph—

- Provide students with the following data about a school doughnut sale: Class A sold 39 doughnuts, Class B sold 36, and Class C sold 42. Have groups create pictographs using Pattern Blocks, where 1 hexagon equals 6 doughnuts sold. Have students trace the hexagons and color their graphs. Tell students to use $\frac{1}{2}$ or $\frac{1}{4}$ hexagons to show amounts of doughnuts smaller than 6.
- Divide the class into four groups and assign each group a number. Poll groups to find how many books the students in the group read altogether during a week. Display the data in a tally chart, and have individuals use it to make pictographs using Color Tiles. Tell students to make a key, such as 1 tile equals 3 books read, before they begin.

Formative Assessment

Have students try the following problem.

How many apple juice boxes were sold during lunch?



A. 5

B. 9

C. 12

D. 15

Try It! 30 minutes | Groups of 4

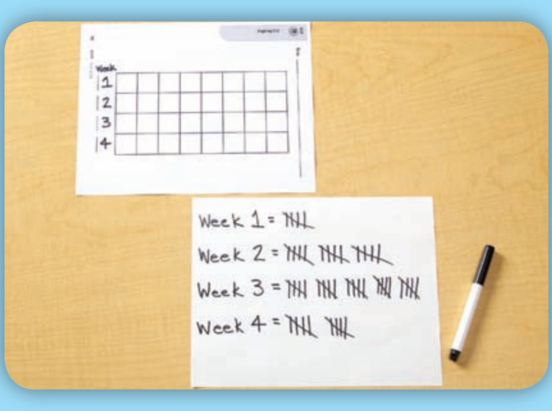
Here is a problem about collecting data and constructing a pictograph.

Miss Roberts's class had a month-long toy drive. Students collected 5 teddy bears during the first week, 15 during the second week, 25 during the third week, and 10 during the fourth week. How can Miss Roberts's students make a pictograph to show how many teddy bears were collected each week?

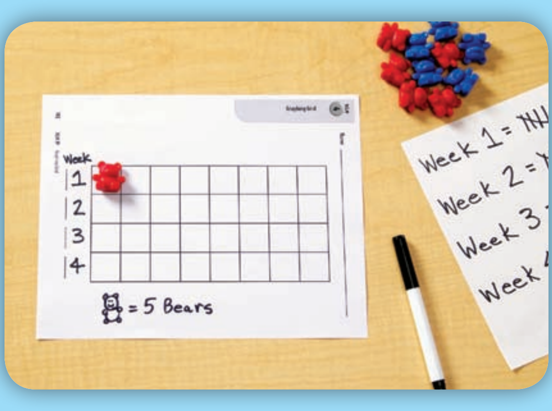
Introduce the problem. Then have students do the activity to solve the problem. Distribute Graphing Grid (BLM 4) and Baby Bear Counters to groups.

Materials

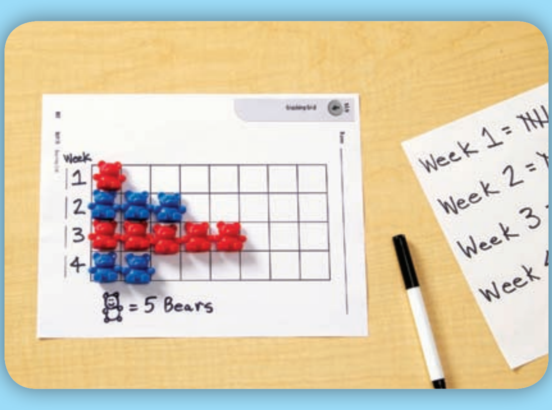
- Three Bear Family® Counters (15 Baby Bear™ Counters per group)
- Graphing Grid (BLM 4; 1 per group)
- paper (1 sheet per group)
- pencils (1 per group)



1. Instruct students to make a tally sheet to show how many teddy bears were collected during each week. Tell students that they will use Bear Counters to construct a pictograph horizontally on the Graphing Grid. Students should label four rows on the grid with the week numbers.



2. Explain that pictographs use pictures to represent data. Have students study their tally sheets to see that the teddy bear collection numbers are already grouped into 5s. **Say:** *Let's use 1 Bear Counter to represent every 5 bears collected in the toy drive.* Have students make a key for their pictograph to show that each Bear Counter represents 5 bears collected in the toy drive. **Ask:** *How many Bear Counters should go in the first row?* Have students complete the first row of the pictograph. Then they should place the appropriate number of Bear Counters in each row.



3. Point out that the color of the Bear Counters isn't important in this pictograph, only that there is 1 Bear Counter to represent every 5 teddy bears collected. Instruct students to complete their pictographs by filling in all of the rows.

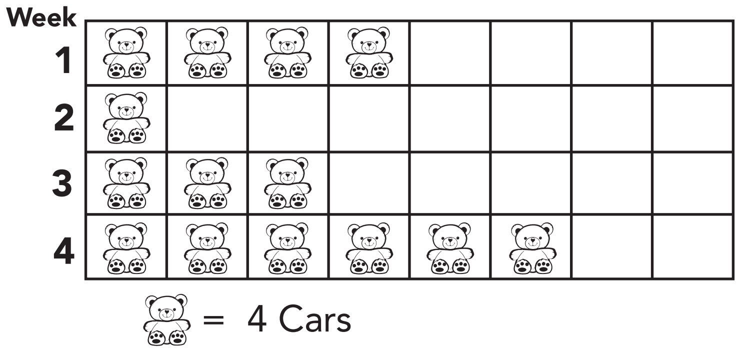
⚠ Look Out!

Watch for students who think that 1 Bear Counter equals 1 teddy bear from the toy drive. Remind students that they created a key to show that each Bear Counter represents 5 teddy bears. Reinforce by having students compare their completed pictographs with their tally sheets.

Answer Key

Use Three Bear Family Counters to model the pictograph. Make a tally chart from which the pictograph was made. (Check students' work.)

1.



Week 1	16 tally marks
Week 2	4 tally marks
Week 3	12 tally marks
Week 4	24 tally marks

Using Three Bear Family Counters, model a pictograph using the data in the tally chart. Sketch your graph below. Write the number of bears for each week. (Check students' models.)

2.

Week 1	卌 卌 卌
Week 2	卌
Week 3	卌 卌 卌 卌 卌
Week 4	卌 卌

= 5 Runs Scored

Number of bears for Week:

1 3 Bears 2 1 Bear 3 5 Bears 4 2 Bears

Make a pictograph for each set of data. W stands for Week.

3. W1: 3, W2: 9, W3: 12, W4: 21

Week 1: 1 Bear
Week 2: 3 Bears
Week 3: 4 Bears
Week 4: 7 Bears

= 3 Flowers

4. W1: 10, W2: 20, W3: 5, W4: 15

Week 1: 2 Bears
Week 2: 4 Bears
Week 3: 1 Bear
Week 4: 3 Bears

= 5 Baseball Cards

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Answer Key

Challenge! Explain how to decide the number that each bear will represent.

Challenge: (Sample) Find a common factor for the numbers given for each week.

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LESSON 8

Measurement and Data

Bar Graphs

Objective

Make and interpret a bar graph.

Common Core State Standards

- **3.MD.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

Students need to be given opportunities to collect, display, compare, and interpret data on a regular basis in order to become familiar with the process of gathering and analyzing information. The results of these investigations should be represented using a variety of graphs and tables. Students' involvement in the collection of data and the creation of the graphs will help them see the connection between the information and the way it is displayed.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Invite students to look at their bar graphs. **Ask:** *What does the graph show? Which type of shoe was worn the most? The least? How can you tell?*
- **Ask:** *If students in another class made a graph of their shoes, would the graph look the same or different from the one you made? Why?*
- **Ask:** *Why is it important to have a title on a graph? Why is it important to label each bar? What would happen if these were left out?*

Solve It

With students, reread the problem. Then have students write directions for Tomas. They should tell him how to gather the information, how to keep track of it, and how to show it on a bar graph.

More Ideas

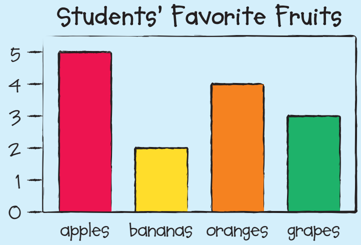
For other ways to teach about bar graphs—

- Ask several teachers from a variety of grade levels if your students can collect data from their classes. Then send pairs of students to ask what the students' favorite after-school activities are. Choices could include *reading, playing sports, riding bikes,* and *playing video games.* Have students pose the questions, tally the results, and make a bar graph using Color Tiles to display the results. Compare the results gathered from each class.
- Pose a survey question to the class and give four answer choices. Have students write their choices on slips of paper, and then collect them and tally the results. Then have each student create a bar graph using Color Tiles. Remind students to label their graphs.

Formative Assessment

Have students try the following problem.

Which fruit is the favorite of the most students?



A. apples **B.** bananas

C. oranges **D.** grapes

Try It! 30 minutes | Pairs

Here is a problem about bar graphs.

Tomas wants to find out what kinds of shoes the students in his class are wearing. He asks the students what shoes they are wearing. The choices are "sneakers," "sandals," "boots," and "other." How can Tomas show what kinds of shoes the class is wearing by using a bar graph?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Color Tiles and Graphing Grids (BLM 4) to pairs. Explain that students will make a graph to show the types of shoes they are wearing.

Materials

- Color Tiles (60 per pair)
- Graphing Grid (BLM 4; 2 per pair)
- paper (1 sheet per pair)
- pencils (1 per pair)

1. Instruct students to label the columns on the Graphing Grid with the following shoe types: sneakers, sandals, boots, other. Have students write a title at the top of the graph.

2. Have students collect data about shoe type from their classmates and tally the results on a tally chart. Then students should use tiles to construct a bar graph to display the data.

3. Point out that each tile represents one student wearing one type of shoe. **Ask:** *What if we had colored in bars instead of using tiles?* Lead students to conclude that they should also label the side of the graph with numbers. Have students do so. Then have them discuss their data.

⚠ Look Out!

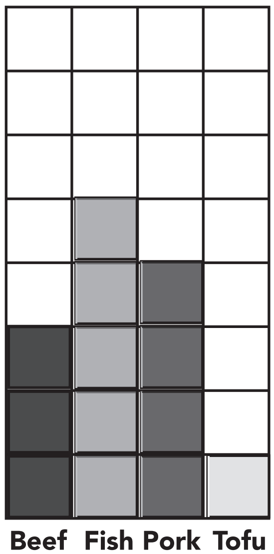
Students may not remember to label the graph and include a title. Explain the importance of including this information so that readers correctly understand and interpret the data displayed.

Answer Key

Use Color Tiles to model each bar graph. Record the number for each type of data.

(Check students' work.)

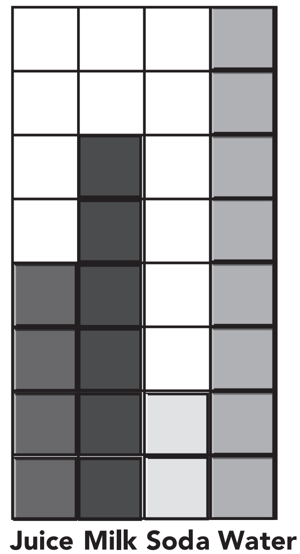
1. **Types of Proteins**



Beef 3 Fish 5

Pork 4 Tofu 1

2. **Favorite Drinks**

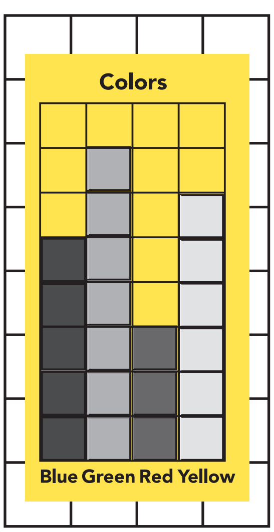


Juice 4 Milk 6

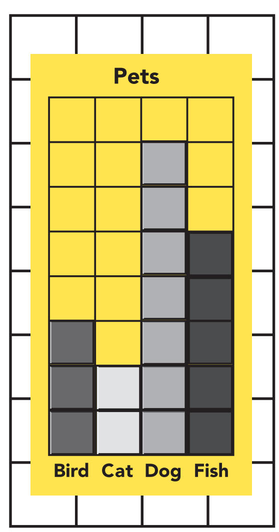
Soda 2 Water 8

Using Color Tiles, model a bar graph for each set of data. Sketch the graph below.

3. Blue: 卌 Green: 卌 II
Red: III Yellow: 卌 I



4. Bird: III Cat: II
Dog: 卌 II Fish: 卌



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Answer Key

Challenge! If you were making a bar graph about five types of flowers, how would you have to change the graphing grid from the grids provided on the previous page? If one of the flowers had 12 tally marks, what would you have to do to be able to use the graphing grids on the previous page?

Challenge: (Sample) For five types of flowers, I would have to add one more column to the grid. For a bar that has a height of 12, I would have to add 4 more rows to the grid.

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LESSON 9

Objective

Find the area of a shape using a Geoboard.

Common Core State Standards

- **3.MD.5a** Understand that a square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
- **3.MD.5b** Understand that a plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.
- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Measurement and Data

Finding Area

Students have already had some experience with the ideas of shape, perimeter, and area in their geometry lessons, although they may not have learned the terminology or formally addressed the concepts. Area is an aspect of measurement that is connected to other areas of math, such as geometry and algebra. Here students explore finding a shape's area by simply counting the square units that make it up, but this lays the groundwork for using formulas and calculations such as multiplication to measure and find area and perimeter.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How did you check to make sure the shape you made had an area of 6 units?*
- Have pairs of students form groups to compare the shapes they made on their Geoboards. **Ask:** *Can shapes that look different have the same area?*
- **Ask:** *Do you think a shape could have an area that includes half units?* Guide students to model a shape with an area of $5\frac{1}{2}$ units on their Geoboards.

Solve It

With students, reread the problem. **Ask:** *What if Ms. Liu wanted the nametags to be a different size?* Display a Geoboard with a rubber band stretched in a rectangle with an area of 8 square units. Have students replicate the shape on their Geoboards and then calculate its area in square units.

More Ideas

For other ways to teach about finding the area of a shape—

- Have students take turns with partners using their Geoboards to explore making figures that have half-square units. Challenge students to each make a shape that includes at least two half square units. **Say:** *When you count the square units, don't forget to add the two halves to make one.*
- Tell students that Color Tiles are also square units. Have students build shapes from tiles and count tiles to find the shapes' areas. Remind students to describe a shape's area by saying how many "square units" it has.

Formative Assessment

Have students try the following problem.

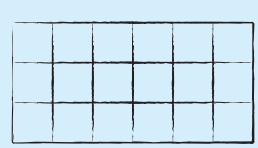
What is the area of this shape?

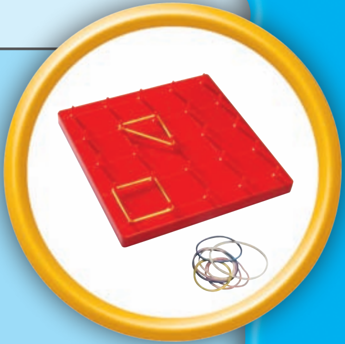
A. 16 square units

B. 18 square units

C. 20 square units

D. 22 square units





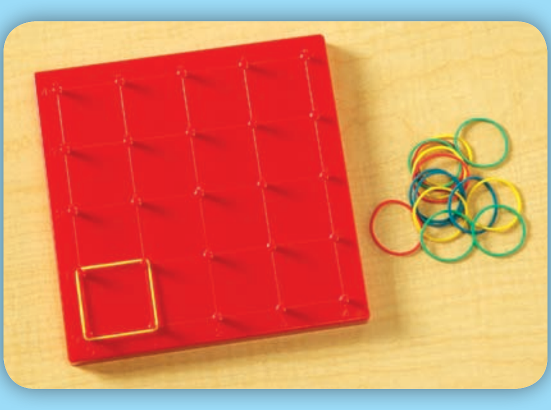
Try It! 25 Minutes | Pairs

Here is a problem about finding the area of a shape.

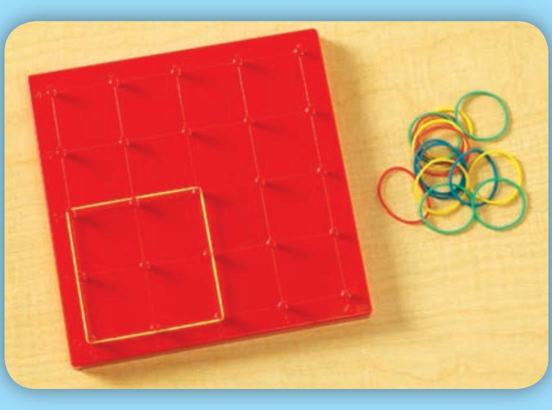
A new student is joining Ms. Liu's class tomorrow, so she asks every student to make a nametag to wear. To show the size the nametags should be, Ms. Liu makes a rectangle on a Geoboard by stretching a rubber band around 2 rows made of 3 units each. How many square units will make up the area of each nametag?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Geoboards and rubber bands to students.

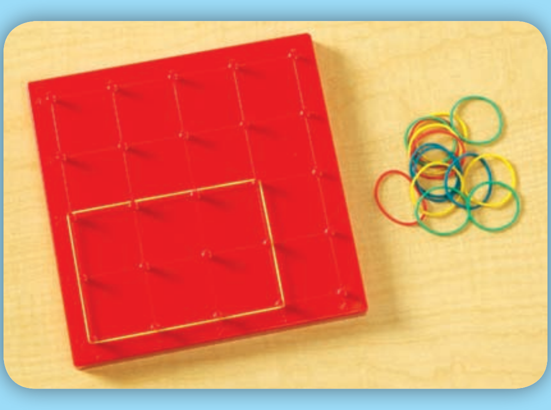
Materials
- Geoboard (1 per pair)
- rubber bands (1 per pair)



1. Model 1 square unit on a Geoboard by stretching a rubber band around 4 pegs, and guide students to do the same. **Say:** *The area of the square is the part inside the rubber band. The area of this square is 1 square unit.*



2. Move the rubber band to stretch around 2 rows of 2 units each. **Ask:** *How many square units is this shape?* Help students see there are now 4 square units in this shape. Have students replicate the shape on their Geoboards and trace over the 4 square units with their fingers.



3. Say: *With your partner, make a rectangle on the Geoboard that is 2 units high and 3 units wide.* Have students work with their partners to create the rectangles. **Ask:** *How many square units make up the area of your rectangle?* Students should count to find that the area of their rectangles is 6 square units.

Look Out!

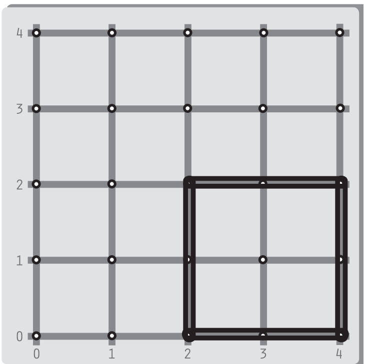
Watch for students who confuse area with perimeter. Make a square on a Geoboard and point out that the rubber band is the shape's perimeter, and that all the red space enclosed by the rubber band is the shape's area. Have students draw several shapes. Then have them use one color marker or crayon to trace each shape's perimeter and another color to shade in its area.

Answer Key

Use a Geoboard to model each shape. Find the area of the shape.

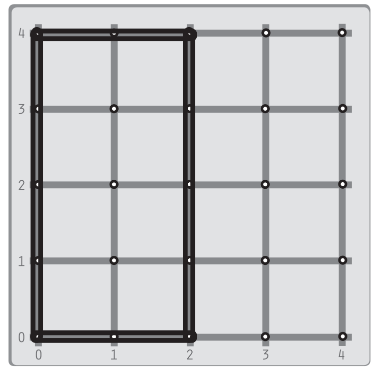
(Check students' work.)

1.



4 square units

2.

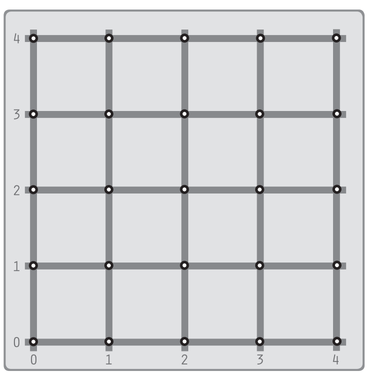


8 square units

Using a Geoboard, model a shape with the given dimensions. Sketch the shape below. Find the area of the shape.

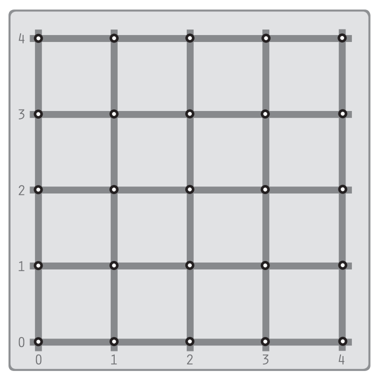
(Check students' models.)

3. 4 units by 4 units



16 square units

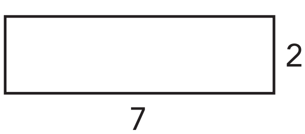
4. 1 unit by 3 units



3 square units

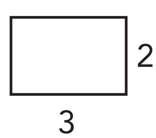
Find the area of each rectangle, given the dimensions.

5.



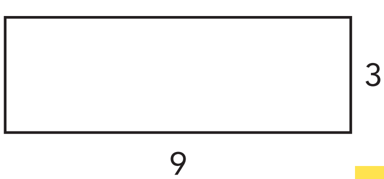
14 units

6.



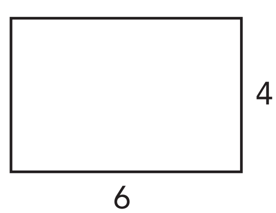
6 units

7.



27 units

8.



24 units

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Answer Key

Challenge! If you rotate the shape in Problem 2, would the area change? Draw a picture to help. Explain your answer.

Challenge: (Sample) The area of the shape would not change. The shape would still have two sides that are 4 units long and two sides that are 2 units long.

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LESSON 10

Objective

Estimate and find the area of irregular figures.

Common Core State Standards

- **3.MD.5a** Understand that a square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Measurement and Data

Area of Irregular Figures

Students should already be familiar with standard measurement tools, such as rulers or metersticks, used to measure linear distances. However, students must develop strategies for measuring with nonstandard tools, as well as for measuring the area of regular and irregular figures. Students need to understand that familiar measurement tools and strategies may not be appropriate for every situation, especially for irregular figures. Estimating and finding the area of irregular figures offers students the opportunity to discover techniques for finding area when a standard measure cannot be applied, and it will deepen their understanding of measurement and area.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *Look at your hand tracing.* **Ask:** *Why do we call this an "irregular figure"?*
- **Ask:** *How is finding the area of an irregular figure similar to finding the area of a rectangle? How is it different?*

Solve It

With students, reread the problem. Have students explain in writing how they used Centimeter Cubes to find the area of a hand tracing. Then have the class work together to order their tracings from smallest to largest.

More Ideas

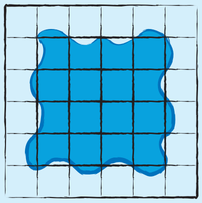
For other ways to teach about finding the area of irregular figures—

- Have students make a design using a Geoboard and then estimate the area. Tell students to count the units in the design to check their estimates.
- Have students estimate and then measure to find the number of Centimeter Cubes necessary to cover various Attribute Blocks. Point out that some of the cubes will probably hang over the edge of the block. Have students count these as $\frac{1}{2}$ or $\frac{1}{4}$ units, depending on how much is on the block.

Formative Assessment

Have students try the following problem.

If each square is 1 square inch, what is the estimated area of this puddle?



A. 10 square inches

B. 16 square inches

C. 21 square inches

D. 25 square inches

Try It! 20 minutes | Pairs

Here is a problem about finding the area of an irregular figure.

Your class is making a wall display of handprints. Each student will trace, cut out, and decorate his or her handprint. Your teacher wants to measure the area of each handprint and display them from smallest to largest. How large do you think the area of your handprint is? How can you find the area?

Introduce the problem. Then have students do the activity to solve the problem. Distribute materials to students. Introduce and discuss the term *irregular figure* and explain that a handprint is an example of an irregular figure.

Materials

- Centimeter Cubes (80 per pair)
- Centimeter Grid (BLM 5; 2 per pair)
- paper (2 sheets per pair)
- pencils (2 per pair)

1. Ask: *How many cubes do you think it will take to cover your hand?* Introduce and discuss the term *estimate.* Have students write down their estimates. Then instruct them to trace their hands onto the Centimeter Grid.

2. Have students take turns using cubes to find the area of their hands on the Centimeter Grid.

3. Have students write down the actual number of cubes it took to cover their hand tracings. **Ask:** *How does your estimate compare to the actual area of your hand?*

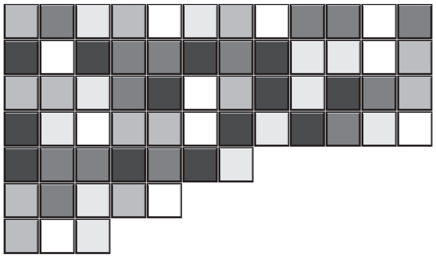
Look Out!

When finding the area of irregular figures using Centimeter Grids, students will discover that many of the squares have been split by the outline of the figure. Watch out for students who disregard these partial squares. Explain that to accurately find the area, students will need to decide whether enough of the square is included to be counted. Encourage students to count halves of squares as $\frac{1}{2}$ and to combine parts of squares when possible to count as one whole.

Answer Key

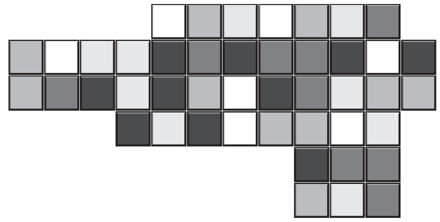
Use Centimeter Cubes to model each irregular shape. The face of each cube equals 1 square centimeter. Find the area of the shape. (Check students' work.)

1.



63 square centimeters

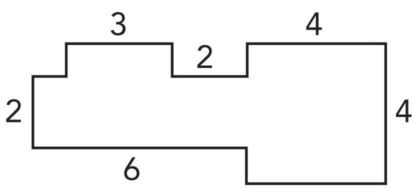
2.



45 square centimeters

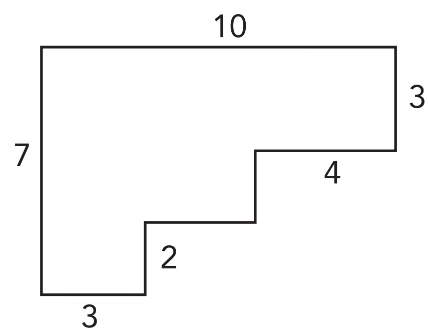
Using Centimeter Cubes, model the shape given. Find the area of the shape. (Check students' models.)

3.



31 square centimeters

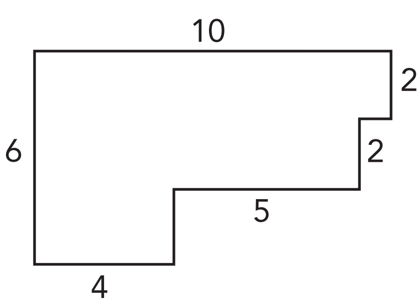
4.



48 square centimeters

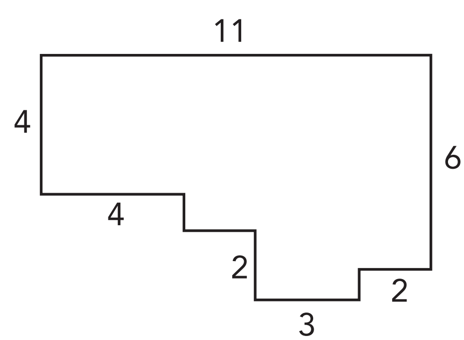
Find the area of each shape.

5.



46 square centimeters

6.



59 square centimeters

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Challenge! Describe two ways you can find the area of the shape in Problem 5 using Centimeter Cubes. Draw pictures to help. Which way is useful for finding the area without using the cubes?

Challenge: (Sample) One way is to build the shape using the cubes dimension by dimension and count the cubes. Another way is to build rectangles using the cubes and then put the rectangles together to form the shape. The second method is helpful for finding the area without cubes because you can find the areas of the parts of the shape and then add the areas together.

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LESSON 11

Objective

Find the area of squares.

Common Core State Standards

- **3.MD.5b** Understand that a plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.
- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Measurement and Data

Area of Squares

Area, the amount of space a plane figure takes up, can be hard for children to grasp, unless they can see the object broken up into equal measures. Children should begin exploring the concept of area by placing objects such as Color Tiles next to one another to create shapes and then counting the number of units to find the area. As they get older, they can find area by tiling a space and counting the number of tiles.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *What do you notice about the number of tiles in each row and column on each square?*
- **Ask:** *When might it be important to know how much space a shape takes up?*
- **Say:** *Suppose we have a large square.* **Ask:** *If we want to know what it measures all around the outside, what do we measure?* Lead children to define *perimeter*. **Ask:** *If we want to know how much space it takes up, what do we measure?* Lead children to discuss *area*. Discuss how in this activity, children measured area using tiles as units.

Solve It

With children, reread the problem. Have children create a mosaic out of 1-inch squares of colored paper. Have them glue the mosaic onto a sheet of paper to make a design that is a 4 × 4 square. Have them record the area of their mosaic in squares (16).

More Ideas

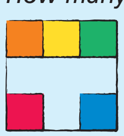
For other ways to teach about finding the area of squares—

- Have children use Geoboards and rubber bands to create squares and then count the square units inside to find the area.
- Have children use Base Ten Blocks (units) to build large squares. Then have them count the units to determine the area of each.

Formative Assessment

Have children try the following problem.

How many square units in all will fill this large square?



A. 3 square units **B.** 6 square units **C.** 9 square units **D.** 12 square units

Try It! 25 minutes | Pairs

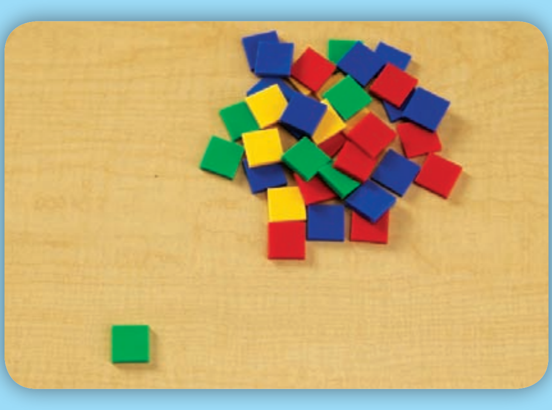
Here is a problem about finding the area of squares.

Mrs. Fiene, the art teacher, is having the class make mosaics, which are designs made of Color Tiles. The children practice their design using 1-inch tiles. The children need to arrange their tiles to make a 4 × 4 square. How many tiles will be in each design?

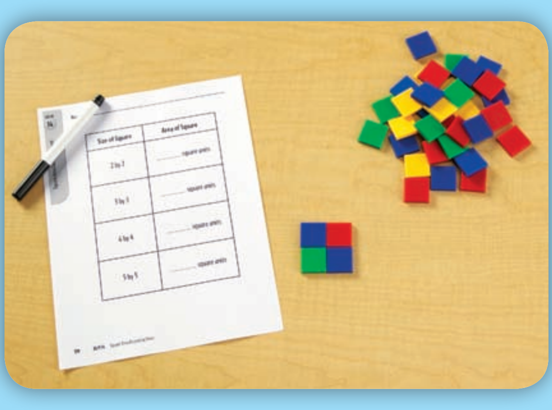
Introduce the problem. Then have children do the activity to solve the problem. Distribute a Square Area Recording Sheet (BLM 6) and Color Tiles to students.

Materials

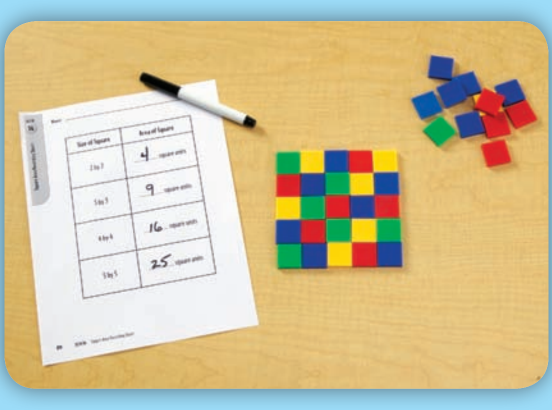
- Color Tiles (25 per pair)
- Square Area Recording Sheet (BLM 6; 1 per pair)



1. Use tiles to make a 2 × 2 square. **Say:** *I am making a square. We are going to find the area of the square.* Area *is the amount of space taken up by the tiles that fill up the shape, and it is measured in square units.* Display one tile and explain that one tile equals one square unit. **Ask:** *How might we find out the area of this square?* Explain how to count the number of units.



2. Say: *Now build a 2 × 2 square. Remember that the tiles must touch each other, but not overlap. Find the area and write it on your Square Area Recording Sheet.* Have one partner build the square and the other count the tiles to find the area and record the answer on the recording sheet.



3. Have partners work together to build the other squares listed on the recording sheet. For each square, they count the tiles to find the area and record each answer on the recording sheet.

⚠ Look Out!

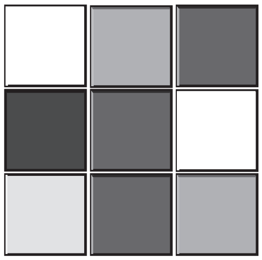
Some students might confuse area with perimeter. Stress that area is like a rug that covers a surface, and perimeter is like a fence that goes around the outside of something. You might say that perimeter shows how far one needs to walk around the shape. For concrete practice with area, you might have students fill in predefined boxes on paper or silhouettes, or measure the perimeter and area of squares and compare the measurements.

Answer Key

Use Color Tiles. Build each square. What is the area of the square?

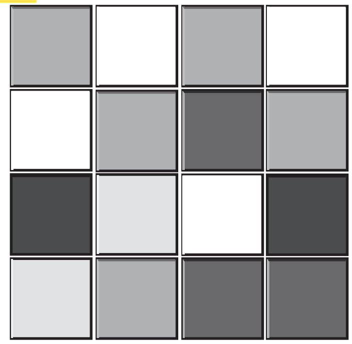
(Check students' work.)

1.



9 square inches

2.



16 square inches

Use Color Tiles. Build each square. Draw the square. Find the area.

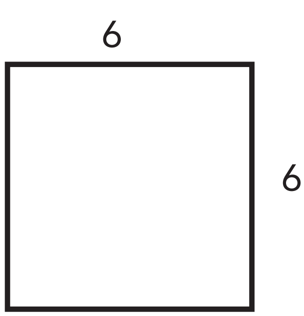
(Check students' work.)

3. 5 inches × 5 inches

25 square inches

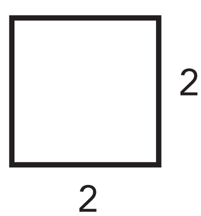
Find each area.

4.



36 units

5.



4 units

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Answer Key

Challenge! How is finding the perimeter of a square different from finding its area?

Challenge: (Sample) To find the perimeter of a square, count the number of units on the outside of the square. To find the area of a square, count the number of square units that make the inside of the square.

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LESSON 12

Objective

Find the area of rectangles.

Common Core State Standards

- **3.MD.5b** Understand that a plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.
- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Measurement and Data

Area of Rectangles

The concept of area ties together several strands of mathematics. Students are measuring the amount of space a plane figure takes up, but in order to do so, they need to draw on their knowledge in other areas of math. Understanding attributes of shapes and having a sense of numbers are necessary to understand the idea of area. Moreover, using arrays to model area leads to the development of multiplication skills.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *If I turned a rectangle, would it take the same number of Color Tiles to fill it?*
- **Say:** *When we find area, we see how many tiles it takes to fill something up.* **Ask:** *How is filling rectangles with tiles the same or different from filling squares?*
- **Ask:** *Is there a faster way to count the tiles in a rectangle?* Review skip-counting and repeated addition.

Solve It

With students, reread the problem. Have students draw a picture of the hallway, showing how many rug tiles are needed to cover the 6- by 4-unit floor.

More Ideas

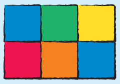
For other ways to teach about finding the area of rectangles—

- Invite students to use Color Tiles to find the area of classroom objects such as book covers.
- Have students use Snap Cubes® to make several trains of the same length. Direct them to arrange the trains in even rows. Then have students tell how many cubes are in each row and how many rows there are. Have students draw a rectangle around the perimeter and then tell how many cubes are within it.

Formative Assessment

Have students try the following problem.

How many tiles make up the area of this rectangle?



A. 4 **B.** 5 **C.** 6 **D.** 9

Try It!

30 minutes | Pairs

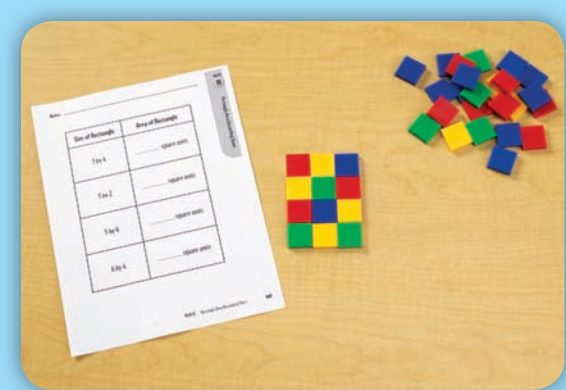
Here is a problem about finding the area of rectangles.

On snowy days, the hallway floor at Pleasant Hill Elementary School gets wet and slippery. The principal wants to put square rug tiles on the floor so the students won't fall. The hallway measures 6 units long by 4 units wide. Each rug tile measures 1 unit on each side. How many rug tiles will fill this area?

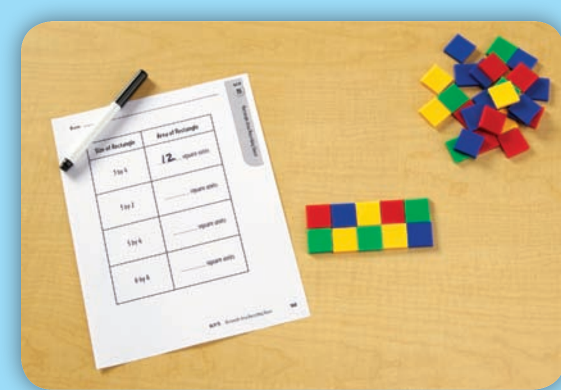
Introduce the problem. Then have students do the activity to solve the problem. Distribute a Rectangle Area Recording Sheet (BLM 7) and Color Tiles to students.

Materials

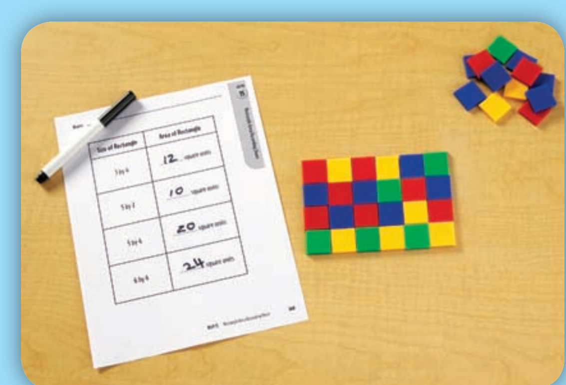
- Color Tiles (30 per pair)
- Rectangle Area Recording Sheet (BLM 7; 1 per pair)



1. Say: *Let's find out how many squares we need to fill an area that has sides of different lengths.* Draw a rectangle on the board and show what we mean by "long" (from left to right) and "wide" (from top to bottom). **Say:** *Use tiles to make a rectangle that is 3 units long by 4 units wide. Write the number of squares on your recording sheet.*



2. Have one partner use tiles to model a rectangle that is 5 units long by 2 units wide. Ask the other partner to count the tiles and write the number of squares on the recording sheet.



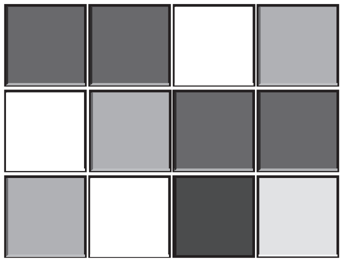
3. Have partners take turns describing the rectangles. One partner tells the length and width while the other builds the rectangle and records the area on the recording sheet.

⚠ Look Out!

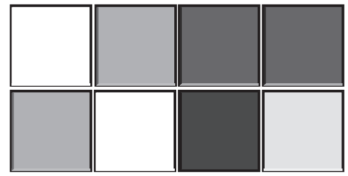
Watch for students who do not count tiles in order. Emphasize that they should count all the tiles across each row before they start counting tiles down the sides or in other rows.

Use Color Tiles. Build each rectangle. What is the area of the rectangle?

(Check students' work.)

1. 

12 square inches

2. 

8 square inches

Use Color Tiles. Build each rectangle. Draw the rectangle. Find the area.

(Check students' work.)

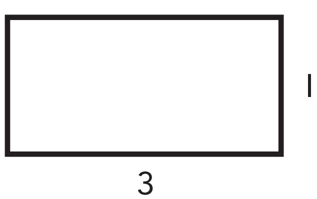
3. 2 inches × 3 inches

6 square inches

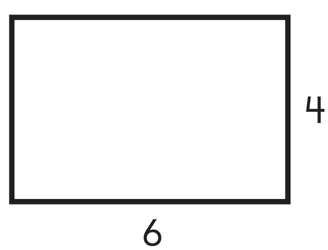
4. 4 inches × 5 inches

20 square inches

Find each area.

5. 

3 units

6. 

24 units

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Answer Key

Challenge! How do Color Tiles help you find the area of a rectangle? Draw a picture.

Challenge: (Sample) Area is measured in square units. Once the shape is built, count the tiles.

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LESSON 13

Objective

Build a shape with a given area.

Common Core State Standards

- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).
- **3.MD.7a** Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.

Measurement and Data

Building Area

Students benefit from having concrete experiences working with measurement before being expected to comprehend measurement formulas, such as *l* × *w* for finding area. By building shapes with a given area, students are able to explore ways to manipulate figures so that their appearance is altered but their area remains constant. They will discover that as some measurements increase, others must decrease if the area of the figures is to stay the same. Such generalizations provide the foundation for later understanding of the standard formula for area.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many Color Tiles did you use to cover 4 square inches? What about the shapes you made that had areas of 6 and 10 square inches?*
- **Say:** *Remember, you also can find the area of squares and rectangles by multiplying the length of the shape times the width.* Have students make several square and rectangle shapes and check the area using the *l* × *w* formula.
- **Say:** *Suppose you used blocks to make a figure with an area of 12 square inches. Then you rearranged those blocks into a different design without adding or removing any blocks.* **Ask:** *Would the area change?* Have students model the two shapes using blocks and find the area of both.

Solve It

With students, reread the problem. Have students describe in writing how they used tiles to fill up 6 square inches. They should then explain how they can check the area of their shapes using length times width if their design was a perfect square or rectangle.

More Ideas

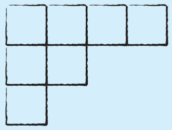
For other ways to teach about building shapes with a given area—

- Distribute Geoboards to the class. Have students work with a partner to make 4 different shapes or designs with the same area.
- Have students use Pattern Blocks and Inch Grid Paper (BLM 8) to try to create patterns given a target area (i.e., make a design that covers 8 square inches).

Formative Assessment

Have students try the following problem.

What is the area of the shape?



A. 5 square units **B.** 7 square units

C. 9 square units **D.** 12 square units

Try It! 25 minutes | Pairs

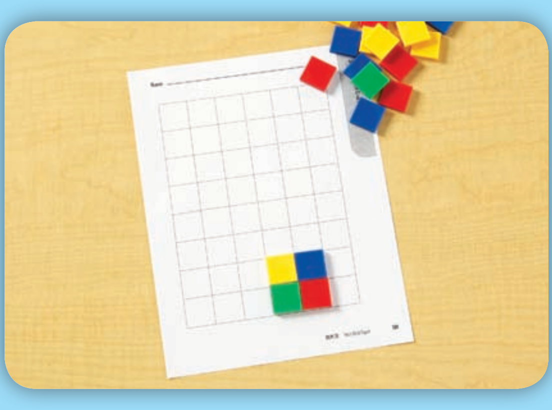
Here is a problem about building a shape with a given area.

The students in Miss Ling's class are going to make a mosaic using square tiles. Each student will have about 6 square inches to fill with a design. How can the students use squares to fill up 6 square inches?

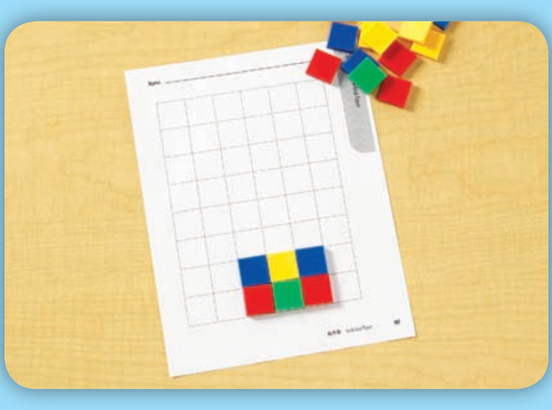
Introduce the problem. Then have students do the activity to solve the problem. Distribute Color Tiles and Inch Grid Paper (BLM 8) to students.

Materials

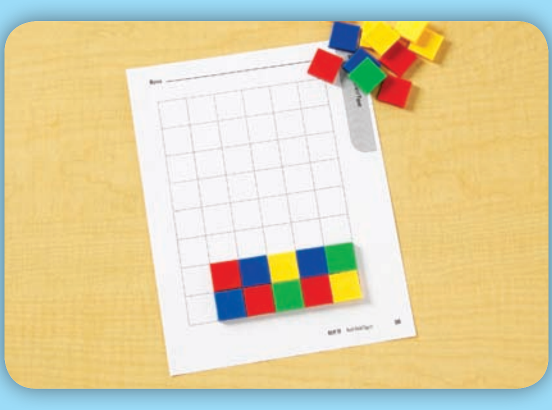
- Color Tiles (24 per pair)
- Inch Grid Paper (BLM 8; 1 per pair)



1. Have students place a tile on the Inch Grid Paper. **Ask:** *How long is one side of the square?* Have students use tiles to make a larger square that has an area of 4 square inches.



2. Instruct students to use tiles to create a design on the grid paper that has an area of 6 square inches. Have students compare designs to see the various ways the area can be shown.



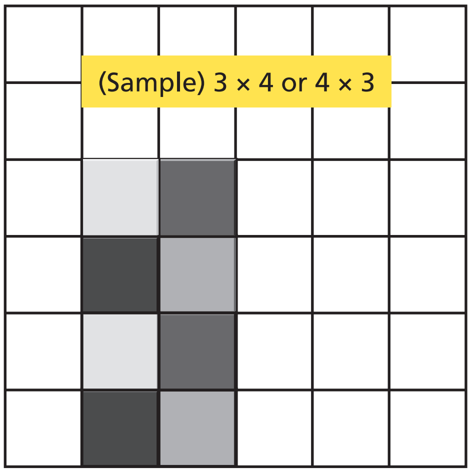
3. Next have students use tiles to create a rectangle with an area of 10 square inches on the grid paper. Have students compare their designs with that of another set of partners and check each other's designs to verify the area. Then guide students to use the formula $l \times w$ to check the area of their rectangles.

⚠ Look Out!

Watch for students who confuse perimeter and area. Remind students that perimeter is the distance around a shape, whereas area measures the space inside the shape. Have students use squares to build a shape and find both the perimeter and the area.

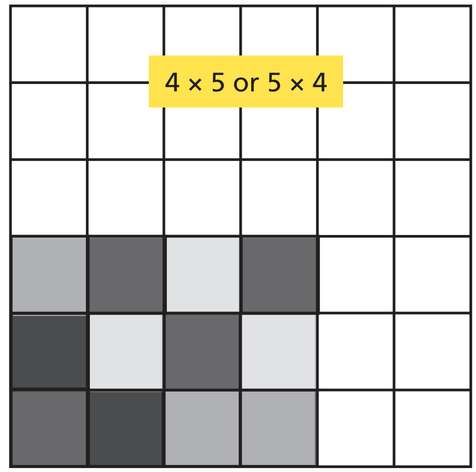
Use Color Tiles to build each model. Expand the rectangle so that it has the given area. Write the dimensions. (Check students' work.)

1.



A rectangle with an area of 12 square units is ______ × ______.

2.



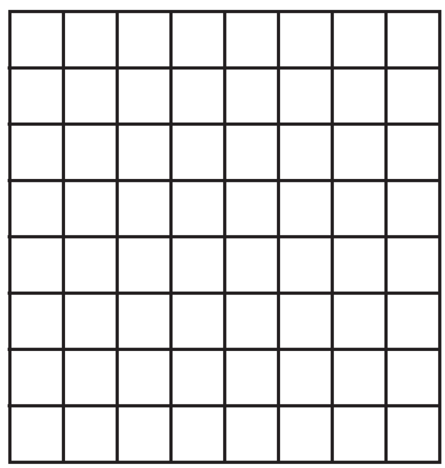
A rectangle with an area of 20 square units is ______ × ______.

Using Color Tiles, model a rectangle with an area of 24 square units. Sketch the model. Write the dimensions. (Check students' models.)

3. A rectangle with an area of 24 square units is

________ × ________.

4 × 6 or 6 × 4 or 8 × 3 or
3 × 8 or 12 × 2 or 2 × 12



Find the area of each rectangle.

4. length: 6 units, width: 3 units

___18___ square units

5. length: 4 units, width: 9 units

___36___ square units

6. length: 5 units, width: 6 units

___30___ square units

7. length: 2 units, width: 7 units

___14___ square units

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Answer Key

Challenge! Describe the relationship between the dimensions of a rectangle and the area of the rectangle. Draw a picture to help. Write a formula for finding the area of a rectangle.

Challenge: (Sample) The area of a rectangle is the product of the dimensions. A formula for the area of a rectangle is Area = length × width.

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LESSON 14

Objective

Distinguish between perimeter and area.

Common Core State Standards

- **3.MD.7b** Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.
- **3.MD.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Perimeter and Area

Students need to have concrete experiences discovering perimeter and area. Such opportunities will help them develop strategies for finding these measurements and build a deeper understanding of their meaning. Through hands-on exploration, students will come to understand that perimeter is one-dimensional, whereas area is two-dimensional. Looking for patterns in measuring the perimeter and area of shapes allows students to make generalizations about such measurements and prepares them for recognizing that their methods of measuring can be explained as mathematical formulas.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *Look at the information you recorded about the perimeter and area of the squares.* **Ask:** *What pattern did you notice in the perimeters as the squares were increased by 1 Color Tile? What pattern did you notice in the areas? If we continued to add to the 6 by 6 square, what would happen to the perimeters and areas of the new squares?*
- **Ask:** *Was there a square you built that had the same number for both area and perimeter? Which square was it?*
- **Say:** *Explain how you found the area and perimeter of each square.* **Ask:** *Were the equations helpful? Why or why not?*

Solve It

With students, reread the problem. Then have students use Inch Grid Paper (BLM 8) to draw a mural like the one the students were making in art class, and label the length of each side. Have students explain in writing how they found the area of the mural.

More Ideas

For other ways to teach about perimeter and area—

- Have students work in pairs using Geoboards to explore area and perimeter. One student should make a square or rectangle on the Geoboard, and the other student should use equations to find the perimeter and area. Students then switch roles and repeat the activity.
- Have students work in groups using Color Tiles to measure the perimeter and area of classroom objects, such as the covers of books or the top of a desk. For each object, they should write down perimeter and area equations.

Formative Assessment

Have students try the following problem.

Draw a square that is 4 units long on each side. What is the perimeter of the square? What is the area?

Try It! 25 minutes | Groups of 4

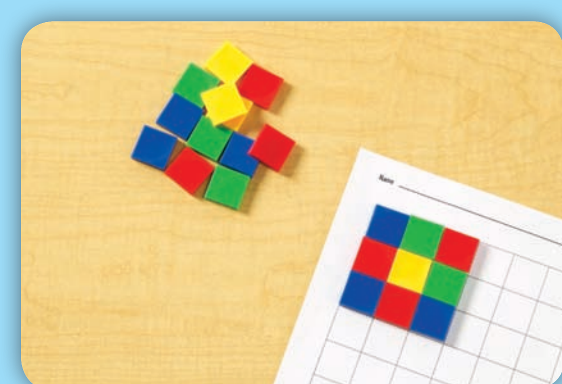
Here is a problem about perimeter and area.

In art class, students are making a mural. The mural will be a square shape. They want the perimeter to be 24 feet. How many feet across will the mural be? How many feet from top to bottom? What will be the area of the mural?

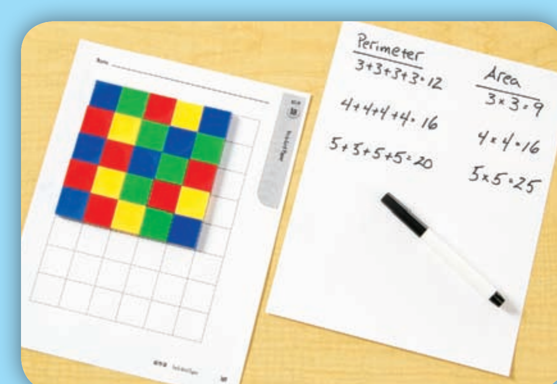
Introduce the problem. Then have students do the activity to solve the problem. Distribute Color Tiles and Inch Grid Paper (BLM 8) to each group. Have students build a square that is 2 tiles by 2 tiles on the grid paper. Explain that the perimeter equation for this square is 2 + 2 + 2 + 2 = 8 (side length + side length + side length + side length = perimeter), and the area equation is 2 × 2 = 4 (side length × side length = area).

Materials

- Color Tiles (100 per group)
- Inch Grid Paper (BLM 8; 1 per group)
- paper (1 sheet per group)
- pencil (1 per group)



1. Have students make another square that is 3 tiles by 3 tiles on the grid paper. **Ask:** *What is the perimeter equation for this square? What is the area equation?* Remind students that they must add all the sides for the perimeter equation and multiply to find the area.



2. Have students grow the sides by 1 tile each time to build a 4 by 4 square, then a 5 by 5 square. They should write down the perimeter and area equations for both.

3. Finally, have students build a 6 by 6 square. They should write down the perimeter and area equations. Have groups check each other's squares and compare equations.

⚠ Look Out!

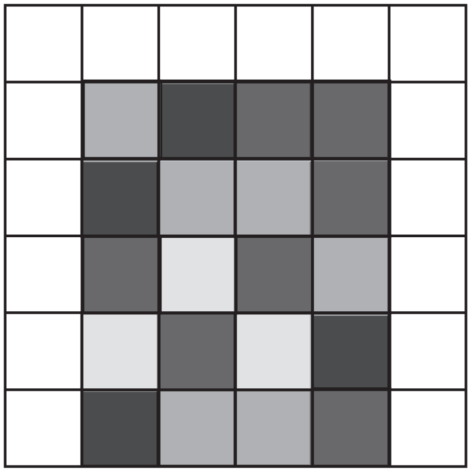
Watch for students who start to think perimeter and area are just for shapes with four sides (L + L + L + L = P). Guide students to make L-shaped figures and calculate perimeter using the formula to account for all sides. For area, have students divide the figure into two smaller rectangles or squares and combine the areas of each using the area formula twice.

Answer Key

Use Color Tiles to model each rectangle. Write its area equation and perimeter equation.

(Check students' work.)

1.



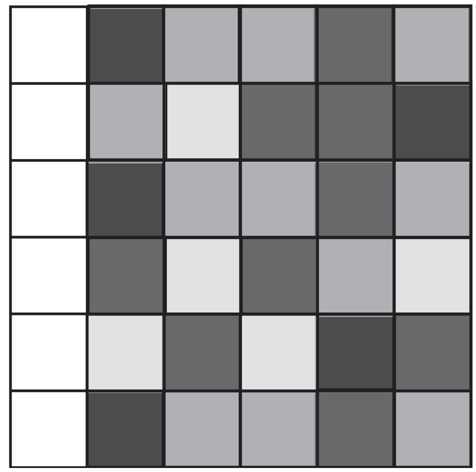
area equation:

4 × 5 = 20

perimeter equation:

4 + 4 + 5 + 5 = 18

2.



area equation:

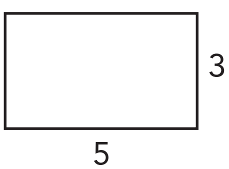
5 × 6 = 30

perimeter equation:

5 + 5 + 6 + 6 = 22

Write the area and perimeter equations for each rectangle.

3.



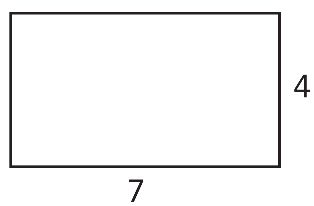
area equation:

3 × 5 = 15

perimeter equation:

3 + 3 + 5 + 5 = 16

4.



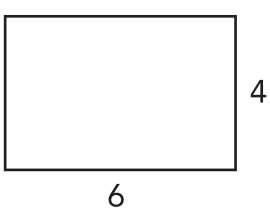
area equation:

4 × 7 = 28

perimeter equation:

4 + 4 + 7 + 7 = 22

5.



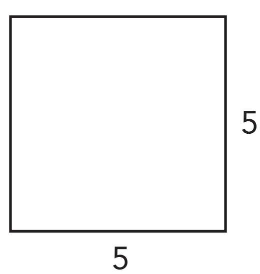
area equation:

4 × 6 = 24

perimeter equation:

4 + 4 + 6 + 6 = 20

6.



area equation:

5 × 5 = 25

perimeter equation:

5 + 5 + 5 + 5 = 20

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Answer Key

Challenge! What is the shape in Problem 6? Write a sentence for the perimeter of the shape in Problem 6 that is different from your answer on the previous page. Explain why both sentences work.

Challenge: (Sample) Square; 4 × 5 = 20; All four sides of a square are the same length.

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LESSON 15

Objective

Explore the concept of perimeter.

Common Core State Standards

- **3.MD.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Measurement and Data

Exploring Perimeter

Exploring perimeter involves both geometry and number sense. Through geometry, students begin to understand attributes of shapes. In addition, an understanding of numbers, along with hands-on exploration of linear measurement, makes exploring perimeter more concrete. As students begin to build a foundation for measurement, they can apply their knowledge to find the perimeter of shapes.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many units long was each side of the first square you made? How did you know?*
- **Ask:** *How many units around was the whole first square you made? How did you find the total number of units?*
- **Ask:** *When could it be important to measure how many units around something is?*

Solve It

With students, reread the problem. Have students look at the square on their Geoboards that is 3 units long on each side. Then ask them to find how many units around the square is. Invite students to write a sentence telling how many units of fencing the school will need to go around its new playground.

More Ideas

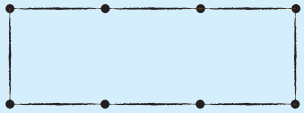
For other ways to teach about exploring perimeter—

- Have students use Geoboards to build bigger squares and rectangles and determine perimeter.
- Have students use Color Tiles to build squares of different perimeters. For example, ask students to build a square that has 3 tiles on each side and find the perimeter in number of tiles. Remind students that they only need to count around the outside of the shape, so the inside should not be filled in with tiles.

Formative Assessment

Have students try the following problem.

How many units around is this rectangle? Circle the answer.



A. 3 units **B.** 4 units **C.** 6 units **D.** 8 units

Try It! 20 minutes | Pairs

Here is a problem about exploring perimeter.

Wilson Elementary School is building a new, square-shaped playground that measures 3 units on each side. The school wants to build a fence around the playground. How much fencing will they need?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Geoboards and rubber bands to students.

Materials
- Geoboard (1 per pair)
- rubber bands (several per pair)

1. Hold up the Geoboard and demonstrate how to place a rubber band on it. Tell students that 1 unit equals the distance from one peg to the next. Let students practice putting rubber bands on the pegs to make shapes. Then have students place a rubber band on their boards to make one side of a square 2 units long.

2. Have students continue making the square with each side 2 units. Remind students to think of the number of sides a square has, so they know how many rubber bands to use. When students have built a square, have them count aloud the length of sides in the model. As they are counting, they should touch each side with their finger. Write the equation $2 + 2 + 2 + 2 = 8$ on the board and discuss.

3. Say: *Now we need to make a square with 3 units on each side.* Show students how to stretch each rubber band to extend across 3 units. When students have built the square, have them count aloud the number of units for each side. As they are counting, they should touch each side with their finger. Write the equation $3 + 3 + 3 + 3 =$ _____ on the board.

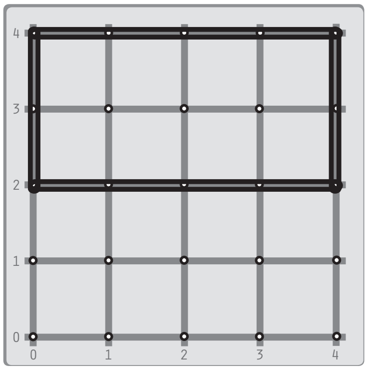
⚠ Look Out!

Some students might equate 1 rubber band with 1 unit instead of 2 or 3 for this problem. To help make the 1 to 1 connection, you might have students use smaller rubber bands to connect 1 unit at a time, versus stretching a large rubber band to make 2 units.

Some students forget where they began counting the sides when finding perimeter. When using a Geoboard, they can keep one finger on the side they begin with. You can also encourage starting at the top and moving clockwise around a shape.

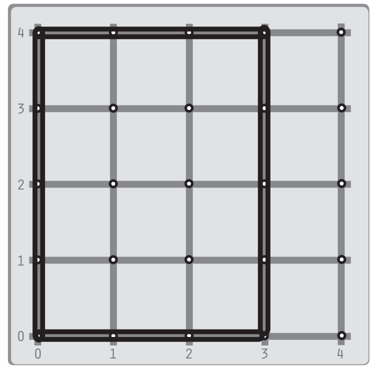
Use a Geoboard and rubber bands. Make each rectangle. Find the perimeter of the rectangle. (Check students' work.)

1.



12 units

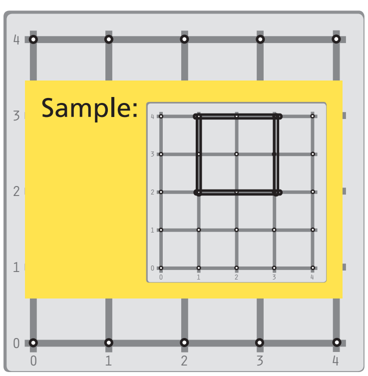
2.



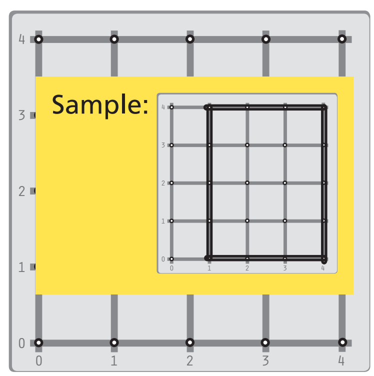
14 units

Use a Geoboard and rubber bands. Make a rectangle with the given perimeter. Draw the rectangle. (Check students' models.)

3. 8 units



4. 14 units



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Answer Key

Challenge! What number sentence do you use to find the perimeter of a rectangle that is 3 units long and 1 unit wide? Draw a picture.

Challenge: (Sample) 3 + 1 + 3 + 1 = 8

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LESSON 16

Objective

Find the perimeter of a shape using a Geoboard.

Common Core State Standards

- **3.MD.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Measurement and Data

Perimeter of Shapes

Perimeter is the distance around a two-dimensional shape. When finding perimeter, students use geometry by relying on their knowledge of shape attributes while measuring. Once they have had a lot of hands-on exposure, they start to create formulas for finding perimeter. In this lesson, students will find the perimeter of a shape using a Geoboard.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How can we figure out the perimeter of a rectangle or square without using a Geoboard?* Discuss how rulers and other tools can be used to measure the perimeter of shapes that are not made on a Geoboard.
- **Ask:** *What if the shape was 3 units by 4 units? What would the perimeter be then?* Have students model the new shape and find the perimeter.
- **Ask:** *When might it be important to figure out the perimeter of something?* Discuss real-life situations involving perimeter, such as making a frame or building a fence.

Solve It

With students, reread the problem. Have students explain in writing how many inches of ribbon are needed and how they found the perimeter of the invitation.

More Ideas

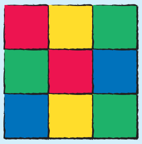
For other ways to teach about finding the perimeter of a shape—

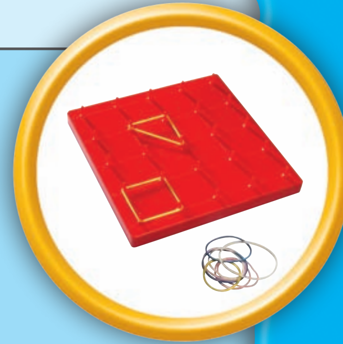
- Students can use Centimeter Cubes to find the perimeter of a book cover, box top, or similar object using standard metric units. Make sure students understand that 1 cube equals 1 centimeter. Have students estimate the perimeter of each object before measuring.
- Students can use Color Tiles to find the perimeter of classroom items such as a piece of paper or folder using standard customary units. Make sure students understand that each tile equals 1 inch. Have students estimate perimeters before measuring. Also watch that students only measure edges, not corners, using tiles.

Formative Assessment

Have students try the following problem.

What is the perimeter of a 3 inch by 3 inch square?





Try It! 25 Minutes | Pairs

Here is a problem about finding the perimeter of a shape.

The students in Mr. Woodley's class are having a play. The students made invitations to send home to their parents. The invitations are 4-inch by 4-inch squares. The students decided to put ribbon around the edges of the invitations. How many inches of ribbon are needed for one invitation?

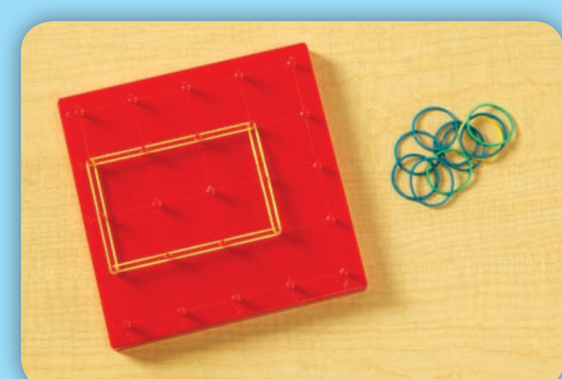
Introduce the problem. Then have students do the activity to solve the problem. Distribute Geoboards and rubber bands to students.

Materials

- Geoboard (1 per pair)
- rubber bands (4 per pair)
- paper (1 sheet per pair)
- pencils (1 per pair)

1. Say: *Place a rubber band around two pegs to show 1 unit. Now stretch the rubber band to show 2 units.* Guide students to repeat the process for 3 and 4 units, identifying the number of units each time the rubber band moves.

2. Say: *I want you to make a square that is 2 units by 2 units.* Students work with their partners to make the shape. **Ask:** *How do we find the perimeter of this shape?* Remind students, if needed, that *perimeter* is the distance around a two-dimensional shape.



3. Have students find the perimeter of the shape. Repeat the activity for a 3-unit by 2-unit rectangle and a 3-unit by 3-unit square. Guide students to write number sentences representing the perimeters they calculated on the Geoboards.

⚠ Look Out!

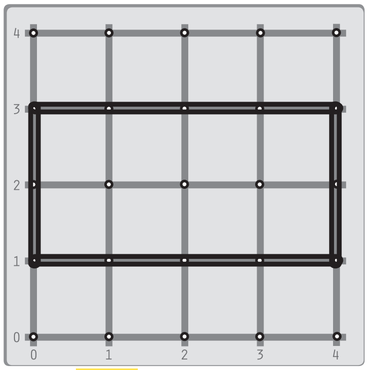
Watch for students who count the number of pegs versus the space between pegs as a unit. If students are confused by this, have them put two fingers on the two pegs to show 1 unit, and move the fingers along as they count. Stress that the unit is the space between the two fingers. Also watch for students who call the units inches. Use Color Tiles to show that Geoboard units are not equal to inches. In addition, some students may attempt to calculate area (length times width) instead of perimeter. Emphasize that students should be measuring the distance around the shape, not the number of square units inside the shape.

Answer Key

Use a Geoboard to model each shape. Find the perimeter of the shape.

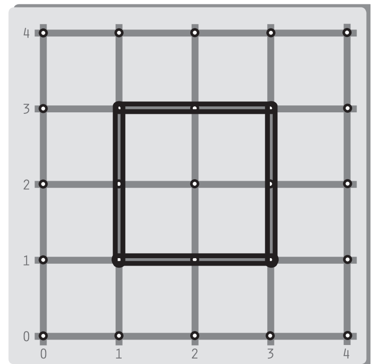
(Check students' work.)

1.



12 units

2.

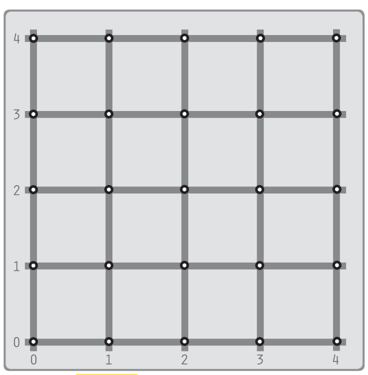


8 units

Using a Geoboard, model a shape with the given dimensions. Sketch the shape. Find the perimeter of the shape.

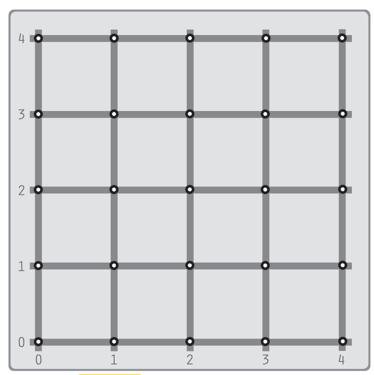
(Check students' models.)

3. 4 units by 3 units



14 units

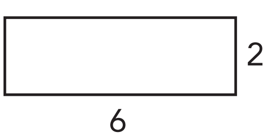
4. 3 units by 3 units



12 units

Find the perimeter of each rectangle given the dimensions.

5.

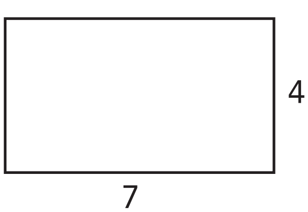


16 units

6.

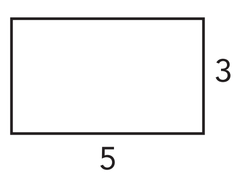
20 units

7.



22 units

8.



16 units

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Answer Key

Challenge! Write an addition sentence that you could use to find the perimeter in Problem 5. Draw a picture to help. Explain each of the addends.

Challenge: (Sample) 6 + 2 + 6 + 2 = 16; The length of the rectangle is 6 units. There are two sides that are 6 units long. The width of the rectangle is 2 units. There are two sides that are 2 units long.

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LESSON 17

Measurement and Data

Building Perimeter

Objective

Build a shape with a given perimeter.

Common Core State Standards

- **3.MD.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Having a student measure the perimeter of a shape is the first step in understanding the concept of perimeter. The next step is requiring students to apply their knowledge in order to create a shape with a given perimeter. This shows a higher level of understanding. In this lesson students will use Pattern Blocks to create a shape with a given perimeter.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *Everyone made a shape with a perimeter of 8, but groups made different shapes.* **Ask:** *How is it possible for different shapes to have the same perimeter?*
- **Ask:** *As the size of the perimeter increased, did the number of Pattern Blocks in the shape increase? Why or why not?*
- **Ask:** *What if you kept the same blocks in your design but moved them around to make a different design? Would you still have the same perimeter?*
- **Ask:** *What if you measured the last shape you made using a different tool, such as a ruler? Would it still have a perimeter of 30? Why or why not?* Stress that when measuring anything, it is important that units are established.

Solve It

With students, reread the problem. Distribute a Centimeter Grid (BLM 5) to each student, and have them use it to draw a possible shape for the garden. Explain that in this case 1 cm—or one edge of one square in the grid—equals 1 unit (foot), so the perimeter should be 30 cm.

More Ideas

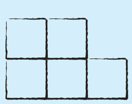
For other ways to teach about building a shape with a given perimeter—

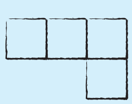
- Direct students to use Geoboards to create irregular shapes and find the perimeter. The space between two pegs equals 1 unit.
- Have students make shapes using Centimeter Cubes and find the perimeter. Then have students measure the shapes using Color Tiles, where one edge of one tile equals 1 unit. Have students compare the measurement in cubes to the measurement in tiles.

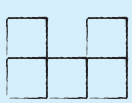
Formative Assessment

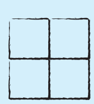
Have students try the following problem.

Which arrangement of blocks has a perimeter of 12 units?

A. 

B. 

C. 

D. 

Try It! 30 Minutes | Groups of 4

Here is a problem about building a shape with a given perimeter.

Washington School decided to plant a garden. The students want to put a fence around the garden to keep out rabbits. They have 30 feet of fence. How can the students make a garden that measures 30 feet around?

Introduce the problem. Then have students do the activity to solve the problem. Pass out an assortment of Pattern Blocks with at least one square and one triangle to each group.

Materials

- Pattern Blocks (150 assorted per group)

1. Say: *For this activity, one side of the green triangle equals 1 unit.* **Ask:** *What is the perimeter of the triangle? What is the perimeter of a square?* Have students establish that the triangle has a perimeter of 3, and the square has a perimeter of 4.

2. Say: *With your group, make a shape that has a perimeter of 8 units.* Students should work with their groups to make shapes. Remind students that only the outside edges count in the perimeter. **Say:** *Let's see the different shapes you made.* Draw some of the different shapes students made on the board, and count to establish each shape's perimeter. Repeat the process, having students create shapes with perimeters of 20 units.

3. Say: *Now, create a shape that has a perimeter of 30 units.* Have groups create a shape. Encourage students to use many different blocks to make their shape. **Say:** *Take a green triangle. Find a group that made a different design. Use the green triangle to check the perimeter of the other group's design.*

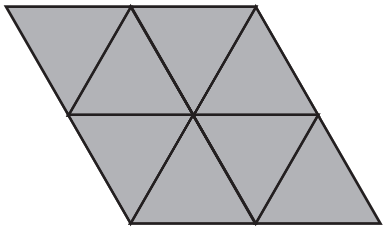
⚠ Look Out!

Some students think that a triangle included in the shape they make automatically adds three sides to the perimeter, or that a square adds four sides to the perimeter. Point out that not all of the sides are on the outside of the shape, so they are not all part of the perimeter. Remind students that perimeter is the distance around the outside edges of the shape only. Also, look out for students who think you can only measure perimeter on squares or triangles. Model how an irregular shape can have the same perimeter as a regular square or rectangle.

Answer Key

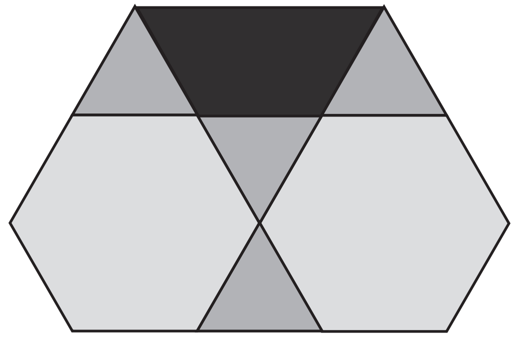
Use Pattern Blocks to build each model. One side of a green triangle equals 1 unit. Find the perimeter of each shape. (Check students' work.)

1.



8 units

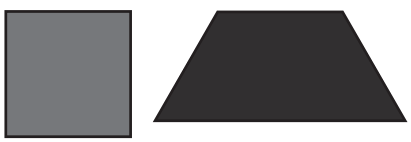
2.



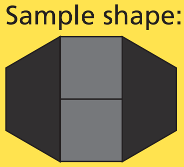
11 units

Using Pattern Blocks, model a shape with the given perimeter. Use as many of the two blocks given as you need. Sketch the shape below. (Check students' models.)

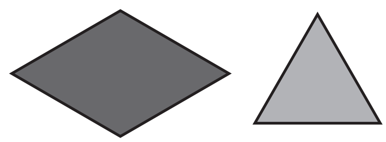
3. 8 units



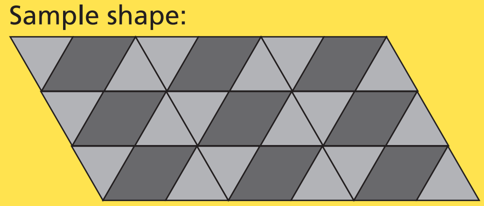
Sample shape:



4. 18 units

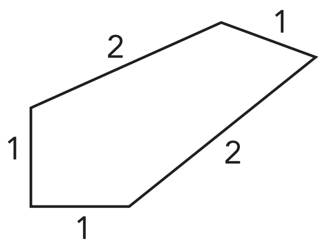


Sample shape:



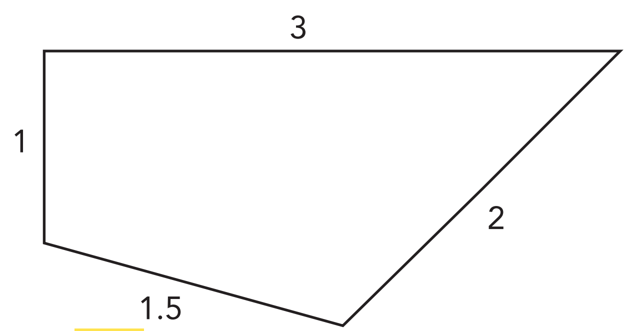
Find the perimeter of each shape.

5.



7 units

6.



7.5 units

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Answer Key

Challenge! Write directions for how to find the perimeter of a figure when you do not have a Geoboard.

Challenge: (Sample) Add the lengths of all the sides of the figure.

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