



The Big Dinner

*Multiplication with
the Ratio Table*

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DAY THREE

Charts for the Grocer—Turkey

Today's math workshop begins with a warm-up minilesson on multiplication, using a string of related problems designed to encourage the use of the ratio table and facilitate the automatizing of the multiplication tables. Students then begin an investigation (using the ratio table) to produce charts that the grocer can display to help customers as they shop. Today students will work on a chart for turkey. On subsequent days they will work on charts for carrots, apples, and potatoes. The numbers on the charts have been carefully chosen to support students in moving away from repeated addition strategies toward more efficient grouping strategies.

Day Three Outline

Minilesson: A Multiplication String

- ☀ Work on a string of related problems designed to encourage students to use facts they know in order to figure out more difficult problems.
- ☀ Record student strategies on a t-chart.

Developing the Context

- ☀ Explain that students will develop charts that list the prices of turkeys of various sizes.
- ☀ Do the first two problems in Appendix C as a whole group and then have students work with partners to complete the chart.

Supporting the Investigation

- ☀ Encourage students to think about how the numbers in the chart might be helpful as they work.

Preparing for the Math Congress

- ☀ Plan to focus the congress on the development of more efficient strategies.

Facilitating the Math Congress

- ☀ Fill in Appendix C as students share and discuss their strategies.

Materials Needed

The turkey poster
(or Appendix B)

Student recording
sheet for the turkey
chart (Appendix C)—
one per pair of students

*Before class, prepare an
overhead transparency of
Appendix C (or draw the
t-chart on chart paper).*

Overhead projector
and overhead marker

Money—various amounts
of quarters, dimes, nickels,
and pennies

Large chart pad and
easel (or chalkboard
or whiteboard)

Markers

Minilesson: A Multiplication String (10–15 minutes)

- ☀ Work on a string of related problems designed to encourage students to use facts they know in order to figure out more difficult problems.
- ☀ Record student strategies on a t-chart.

The problems in this string have been chosen to encourage students to use facts they know as helper partial products in solving more difficult problems. The big idea underlying this strategy is the distributive property. The ratio table is a good model for illustrating this. It is helpful to represent the problems in a context, such as a number of cars and a number of tires, to help students realize the meaning of what they are doing. It is assumed that students working on this unit have not automatized the multiplication facts yet, and the strings in this unit are designed to help them do so by focusing on relationships.

Behind the Numbers

The first problem in this string will probably be easy for your students. Even if they don't know the answer automatically, they can use addition to figure it out. The first product can now be used to solve the second problem. Some students may still need to think of this as repeated addition, $4 + 4 + 4 + 4$. Some may even still need to use their fingers. The string is designed to encourage the use of more efficient strategies, so ask students to share a few strategies. If no one has thought to use the first problem to solve the second, encourage them to consider how it might be helpful—how $4 \times 4 = 2 \times 2 \times 4 = 2 \times 8$. The third problem may be more difficult, but the product of the second problem can now be used to help solve it. The fourth problem may be easy if students know the pattern of multiplication by ten. If a student says, "I just added a zero," encourage the class to recognize that putting a zero down is not adding, since $4 + 0 = 4$, not 40. Encourage them to realize that 10×4 is equivalent to 4×10 (which means that there are 4 tens; hence the zero is placed to bump the 4 over to the tens place). Other students may not know about the place value pattern that results when multiplying by ten, but they may think to use the third and first problems in the string. Adding the products of these problems produces ten groups of four, as well. Similarly, the next three problems can be solved by using others in the string. For example, 5×4 can be solved by halving the product of 10×4 . The last problem can be solved by adding another group of four to the product of the previous problem.

Number of Cars	Number of Tires
2	4
8	16

Do one problem at a time, giving students some think time before you start discussion. Record student strategies on a t-chart next to where you write the problem. Invite students to discuss the connection with their work on Day Two.

String of related problems:

$$2 \times 4$$

$$4 \times 4$$

$$8 \times 4$$

$$10 \times 4$$

$$9 \times 4$$

$$12 \times 4$$

$$5 \times 4$$

$$6 \times 4$$

■ Assessment Tips

It is helpful to keep a pad of sticky notes or some index cards near you when you do strings. If you can, jot down notes as you see students use interesting strategies and develop flexibility with the ratio table. Use one note or card for each student. At the end of the day, you can copy the string, attach your note, and place it in the student's portfolio. Make notes about the strategies and big ideas described in the introduction to this unit (pages 6–8).

Developing the Context

Begin by telling the students how amazed you were at all the wonderful strategies they used to determine the price of the 24-pound turkey. Suggest that it might be helpful if grocers posted charts to let customers know what their purchases would cost and invite students to make some charts with you. Use the overhead transparency of the turkey chart to demonstrate what you have in mind. Do the first two problems (two pounds and four pounds) with the whole group and then have students work in pairs to solve the remaining problems. Pass out one recording sheet (Appendix C) to each pair of students and have coins available should students need to use them.

Supporting the Investigation


As students work, walk around and take note of the strategies you see. Confer as needed to support and challenge their investigation. Do not tell students what strategy to use, but do encourage them to reflect on how the information on the chart might become helpful as they work. Remember to work with the mathematician, instead of trying to fix the mathematics! Focus not on the answer but on the thinking—on the strategies your students are trying out. Support students to think creatively and flexibly by encouraging them to think about how they might use one problem to help with another.

It is assumed that one day is sufficient for students to complete this chart and to have a math congress on strategies they found helpful. Depending on their number sense, however, they may need more time. Some students may still need to use repeated addition strategies, thus taking much longer to solve the problems. It may be only after solving the problems that they notice patterns in their answers.

- ☀ Explain that students will develop charts that list the prices of turkeys of various sizes.
- ☀ Do the first two problems in Appendix C as a whole group and then have students work with partners to complete the chart.

Appendix C Student recording sheet for the turkey chart

Name _____ Title _____



Number of Pounds	Cost
1	\$1.25
2	
4	
	\$10
10	
20	

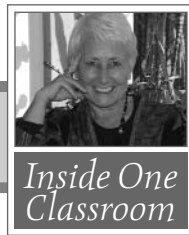
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- ☀ Encourage students to think about how the numbers in the chart might be helpful as they work.

Behind the Numbers

The recording sheet is designed as a t-chart with missing numbers in order to encourage the use of the ratio table and grouping strategies based on distributivity. The numbers on the chart have been chosen carefully. For example, \$10.00 can be figured out by repeated addition until 10 is reached, or the 4 pounds for \$5.00 can be doubled. Ten pounds can also be solved by adding the cost of 2 pounds and 8 pounds, etc.

Conferring with Students at Work



Author's Notes

(Diana (the teacher) joins a group of students but at first just listens to their conversation as they work.)

Diana begins by just listening.

Holly (*Talking to Carolina*): Four pounds was easy because we just doubled the 2 pounds. But what do we do with the tens? Why is that 10 over there (pointing to the 10 dollars) and this 10 is here (pointing to the 10 pounds)? Ten is there twice.

Rather than answering their question directly, Diana wonders aloud with them, while encouraging them to consider what the numbers mean in context.

Carolina: Yeah. That's weird.

Diana: Hmm...that's interesting. What does each mean? Since they are in a different place on the chart, I wonder if they mean something different. What else does it say on the chart?

Developing students' ability to read charts and tables is as important as calculation.

Carolina: Oh, I get it. That 10 is the money, and this 10 is the 10 pounds. (*Points to headings on the t-chart.*) See...it says here, pounds, and there...cost.

Holly: But I don't get it. Don't you have to know how many pounds to figure out the cost?

By using the pronouns we and us, instead of you, Diana implicitly places herself in the inquiry. She does not make the students feel that she knows the answer and that they have to figure out her answer—a power dynamic that can destroy the desire to inquire. Instead, she models the joy of puzzlement while encouraging them to continue pondering.

Diana: Well, let's see. What do we know so far? One pound is \$1.25, 2 pounds is \$2.50, and 4 pounds is \$5.00. Hmm...4 pounds for \$5.00. I wonder if that would help us.

Holly: But this is \$10.00—oh, I get it! The money doubled. So double the pounds!

Carolina: Yeah!

The students now have a strategy they own and feel comfortable with, and Diana celebrates with them even while she challenges them to reflect further.

Diana: That's a great strategy! Wow! What a good idea. I bet you could use that strategy to figure out \$20.00, even though it isn't on the chart.

Holly: Yeah, I bet we could!

Carolina: Yeah. We're great!

Preparing for the Math Congress

☀ Plan to focus the congress on the development of more efficient strategies.

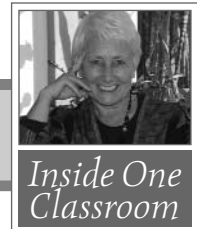
The math congress today will not require the making of large posters; you can use the overhead transparency of the turkey chart for this class discussion. You will want to focus on just a few of the strategies students are proud of and excited about sharing. Think about the many strategies you have seen your students using. Some students are probably still doing repeated addition, while others may already be using the ratio table very efficiently. Noting the strategies that students are using now will help you plan the discussion to continue supporting students who are still struggling.

Facilitating the Math Congress

Use the overhead transparency of the turkey chart and fill it in as students share their strategies. Start with the third problem (since you and the class did the first two problems together when you developed the context). Ask a student who used doubling to share (illustrated in Inside One Classroom, below). If some students have used repeated addition, make sure that you bring them into the conversation and help them understand the doubling strategy. You can do this by writing down the repeated addition on chart paper and circling the 2 groups of 4 pounds, marking them as \$5.00 each. Then move to the 10 pounds. Have a variety of strategies shared here, such as adding the costs of 8 pounds and 2 pounds, or figuring out the cost of 5 pounds (perhaps adding the costs of 4 pounds and 1 pound) and doubling it. Continue to find and circle the groups discussed in the repeated addition. Then discuss strategies for figuring out the cost of 20 pounds. Once the overhead chart is filled in, ask students to consider how customers might use it to figure out numbers not on the chart, such as 6 pounds or 19 pounds.

☀ Fill in Appendix C as students share and discuss their strategies.

A Portion of the Math Congress



Author's Notes

Diana (the teacher): So now we've filled in the chart, but I'm wondering about customers who want to buy a turkey that's not listed on the chart, like a turkey that weighs 9 pounds, or 6, or 19. Turn to the person next to you and discuss this for a few minutes. Could customers use our chart to figure out the cost of other turkeys? (After several minutes of pair talk and listening in to a few conversations, Diana starts discussion.) Vicki? What did you and Carlos decide?

Vicki: Yep. We decided they could! Six pounds you could do by adding the 2 and the 4. That's \$2.50 plus \$5.00.

Carlos: And 5 pounds is just \$1.25 plus \$5.00.

Diana: What about 9 pounds? Noreen?

Noreen: That is just \$1.25 less than the 10 pounds.

Diana: Wow! It seems we made a great chart! Could it be used for all of the numbers up to 24?

Pair talk provides important thinking and reflection time. Starting discussion on this important question prematurely would most likely result in only a few voices. Pair talk ensures that all students are involved.

At the heart of doing mathematics is generalizing. Asking students to consider all the cases pushes them to generalize.

■ Assessment Tips

You might find it helpful to make copies of the graphic of the landscape of learning provided in the overview of this unit (page 11). As you continue with the unit, you can color in the big ideas and strategies you see students developing. Make one copy for each student's portfolio and map out the pathways each student is making.



Reflections on the Day

Today students were challenged to move beyond repeated addition strategies. The minilesson encouraged them to see relationships in the facts as they worked mentally with multiples of 4. It also formally introduced the ratio table with the context of cars and tires. The investigation pushed them to think about this tool further and to use it with even larger, less friendly amounts such as \$1.25.