How Many Days Will It Take? Eating to 6,972!

Partial Quotients

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Grade Level	3rd Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	75 minutes

Essential Question

How are partial quotients similar to or different from partial products? How can partial products help us better understand and use partial quotients?

Summary

In this lesson, students will use questions, a book, and their favorite foods to explore multi-digit division with tools and strategies they already know. Students will also practice making conjectures (or reasonable estimated solutions). After students find a solution to the main problem, the teacher will use the students' strategies to facilitate a discussion that connects to and teaches a lesson on partial quotients.

Snapshot

Engage

Students use Andrea Menotti's *How Many Jelly Beans?* to review rounding large numbers and multiplying those numbers to find approximate solutions.

Explore

Students work in small groups to estimate a solution to a multi-digit division problem. Then they find the exact solution.

Explain

Students share their groups' strategies and solutions. The class connects those strategies to division with partial quotients.

Extend

Students extend multi-digit division with partial quotients to problems where a quotient may contain a remainder.

Evaluate

Students answer questions to apply and reflect on their personal understanding of partial quotients.

Standards

Oklahoma Academic Standards for Mathematics (Grade 3)

3.N.2.4: Recognize when to round numbers and apply understanding to round numbers to the nearest ten thousand, thousand, hundred, and ten and use compatible numbers to estimate sums and differences.
3.N.2.8: Use strategies and algorithms based on knowledge of place value, equality and properties of addition and multiplication to multiply a two-digit number by a one-digit number.

Oklahoma Academic Standards for Mathematics (Grade 3)

4.N.1.3: Multiply 3-digit by 1-digit or a 2-digit by 2-digit whole numbers, using efficient and generalizable procedures and strategies, based on knowledge of place value, including but not limited to standard algorithms.
4.N.1.4: Estimate products of 3-digit by 1-digit or 2-digit by 2-digit whole numbers using rounding, benchmarks and place value to assess the reasonableness of results. Explore larger numbers using technology to investigate patterns.
4.N.1.6: Use strategies and algorithms based on knowledge of place value, equality and properties of operations to divide 3-digit dividend by 1-digit whole number divisors. (e.g., mental strategies, standard algorithms, partial quotients, repeated subtraction, the commutative, associative, and distributive properties).

Oklahoma Academic Standards for Mathematics (Grade 3)

5.N.1.1: Estimate solutions to division problems in order to assess the reasonableness of results.
5.N.1.2: Divide multi-digit numbers, by one- and two-digit divisors, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms.
5.N.1.4: Solve real-world and mathematical problems requiring addition, subtraction, multiplication, and division of multi-digit whole numbers. Use various strategies, including the inverse relationships between operations, the use of technology, and the context of the problem to assess the reasonableness of results.

Materials

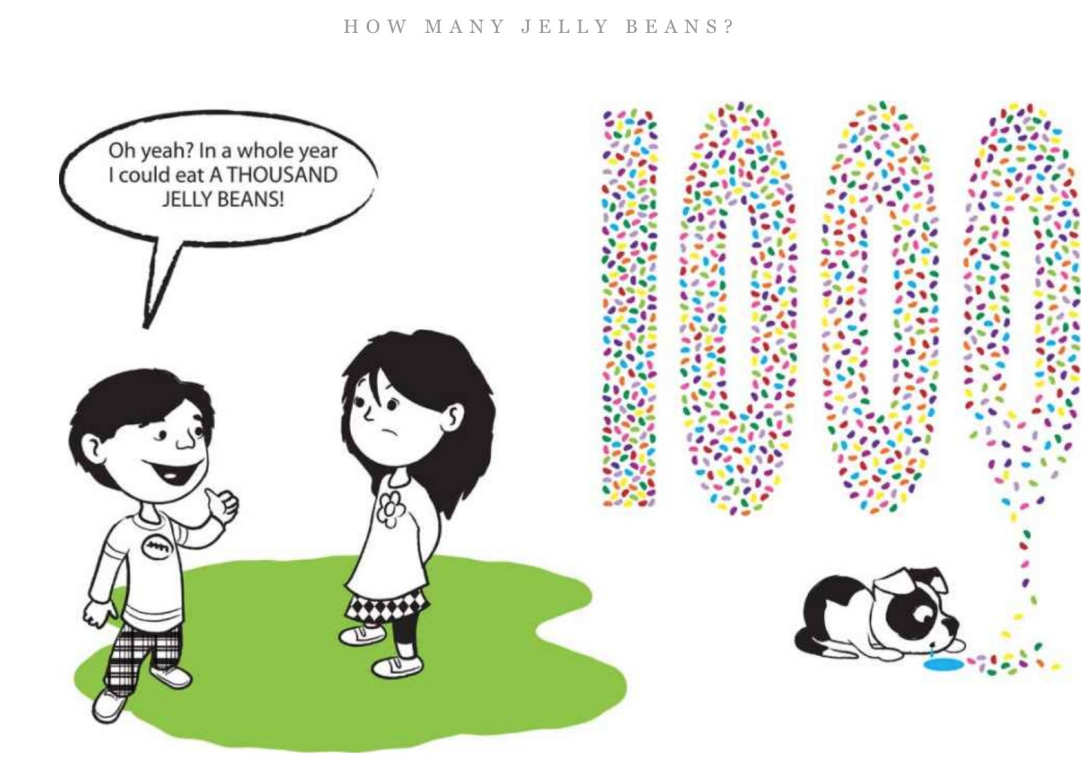
- *How Many Jelly Beans?* by Andrea Menotti
- Paper and pencil

Engage

Begin by reading *How Many Jelly Beans?* by Andrea Menotti. Read to the page where the brother says, "In a whole year I could eat A THOUSAND JELLY BEANS!" and stop before the sister gives the answer. Ask students to use a Think-Pair-Share strategy and estimate how many jelly beans would be eaten per day.

Teacher's Note: Prompting Students Who Are Having Difficulty

Some students may struggle with estimation. If so, prompt them with questions such as, "How many days are in a year?" and "Can you round that number?" Rounding should play an important role in this estimation.



How Many Jelly Beans? by Andrea Menotti (36 of 76)

Possible Student Responses:

Students could respond by saying, "I could round 365 to 300. 300 x 3 is 900 and 300 x 4 is 1,200, so they might eat between 3 or 4 a day." They might also say, "I rounded 365 to 360. 360 times 2 is 720 and 360 times 3 is 1,080, so they could eat about 2 to 3 a day." Or they could say, "I know that rounding 365 down to 300, and multiplying that times 3 is 900. 900 is rounded down from 1,000. That's close, so they should eat about 3 each day."

If students offer more than one strategy and solution, ask students, *Which strategy do you think would give us a closer estimate?* Consider having students use the Think-Pair-Share strategy again if time allows.

Teacher's Note: Preparing For The Explore Phase

Remember, the current phase (Engage) sets up the Explore phase because it reviews strategies for rounding numbers, rewriting numbers, and multiplying partial products. Try not to rush through these strategies. Consider asking "what if" questions to prompt students to connect ideas from previous learning to this lesson.

Ask students to share their answers with the class. Then continue reading the story.

Throughout the rest of the story, periodically pause and ask students to estimate how many jelly beans someone would have to eat each day to hit 5,000 in a year. How about 10,000? 100,000? One million? Consider also asking students, *How many per day is too many for you?*

Optional: Practice Rounding Numbers

If students need more practice rounding numbers, consider using context from the story to ask, *How many jelly beans would the brother or sister need to eat each day?* Give students a few problems to practice individually, in pairs, or in small groups. Examples of rounding could include rounding 553 to 550; 9345 to 9000 or 9300; and 762 to 800 or 760.

Explore

Ask students, *What is your favorite thing to eat?* and have students write their answers on notebook paper.

Possible Student Responses:

Students might write down pizza, candy, spaghetti, tacos, hotdogs, peas, etc.

Now, ask students to imagine they eat that item six times a day, every day. How would they figure out how many days it would take for each student to eat that item 6,972 times?

Have students work in pairs of groups of three. Invite each group to make a conjecture or an estimate of how many days they think it would take them to eat 6,972 of their favorite food. Then, ask each group to decide whether the actual solution will be more or less than their estimated solution. After students have decided, invite them to determine exactly how many days it will take them to eat their item 6,972 times.

Possible Student Responses:

Students could respond by saying, "6,972 is about 6,000 rounded down, and 6,000 = 6 x 1,000. So, it will be more than 1,000 days." They could also say, "6,972 is about 7,000, and I know that 6 x 12 = 72, so 6 x 1,200 = 7,200. Therefore, it will take less than 1,200 days to reach 6,972."

While students work, travel around the room and help groups who may be struggling. Use guiding and probing questions as needed.

Optional: Guiding And Probing Questions

Consider asking any of the following questions: "Do you see a pattern?"; "What might happen if you broke 6,972 into smaller, more friendly numbers to find multiples of 6 (such as 6,000+600+300+72 or 6,000+300+300+300+72)?"; "Could you break this number up or rewrite it to make it easier for you to work with?"; "Show me some other ways to represent 6,972, and consider the place value of each digit (for example, 6,000+900+70+2).''; "What did you do to get this number or estimate?"; "How might it be changed to create a pattern?"; "Would listing your multiples of 6 (1 through 9) help you get to a solution? Think about using this strategy in tandem with breaking the digits up by place value."

Explain

Using a Strategy Harvest, ask each group to join with another group and share their solution strategy. Students could also share what did not work, but explain how their mistakes lead to finding their solution.

Ask each group what strategy they used. Have a volunteer from each group share the group's strategy. If possible, call on volunteers in an order selected to best lead into partial quotients. If any groups used a strategy involving partial products, connect this back to the lesson using its inverse, partial quotients.

Optional: Possible Strategies For Students To Share In Order

Examples of the class' strategies shared in order include: 1) patterns with numbers building up to 6,972; 2) base 10 and place value; 3) friendly numbers for multiples of 6; 4) partial products.

6 ⟌	6972	
	- 6000	1000
	972	
	- 12	2
	960	
	- 60	10
	900	
	- 600	100
	300	
	- 300	50

1000
100
50
10
+ 2
1162

A sample of partial products and its inverse, partial quotients.

Walk the class through another division problem using partial quotients. Examples include 721 divided by 3; 955 divided by 5; or 748 divided by 4.

Check with Partial Products

$$1162 \times 6$$

$$\begin{aligned} 1000 \times 6 &= 6000 \\ 100 \times 6 &= 600 \\ 60 \times 6 &= 360 \\ 2 \times 6 &= 12 \\ \hline & 6972 \end{aligned}$$

Checking the example problem with partial products.

Teacher's Note: Flexible Strategies

Remind students that they do not always have to start with the largest place value and work left to right. They may be able to break the dividend into chunks that are easier to work with. The partial quotient strategy is intended to help students be flexible when dividing larger numbers and to build number sense.

Extend

Ask students to consider that none of the problems the class has worked on so far had anything left over—each dividend was divided equally by the divisor. What would they do if the dividend did not divide by the divisor equally?

Have students work with an Elbow Partner. Ask each group to select one division problem written on the board, write their own word problem, find a solution, and decide what to do with the remaining parts of the dividend. How will they represent those extra parts?

Depending on your classroom needs, either have students share solutions with the class or turn in their problems as a formative assessment. If choosing the latter option, consider selecting one or two problems for the class to evaluate and discuss.

Evaluate

Have students complete the reflection questions below as homework or as an Exit Ticket. Each answer should be detailed and require three or more sentences.

1. Why are estimating solutions helpful when working with large numbers?
2. How is the partial quotient strategy similar or different from partial products?
3. Describe a mistake or a misconception that you or a classmate had in class today. What did you learn from this mistake or misconception?
4. How could the ideas from today's lesson be used in life (Boaler, 2016, p. 109)? Give an example that could take place at home or in life.

Teachers' Note: Fostering Mathematical Mindsets

Discuss the above questions as a class, but be sure not to single out any specific student in a negative way. Jo Boaler's book *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages, and Innovative Teaching* is an excellent guide resource for further reading. She encourages us to use mistakes and misconceptions as a platform for students to learn from, not as something to be embarrassed about. Remind the class that creating mathematical mindsets requires growth from our mistakes and that recognizing misconceptions is a cause for celebration (Boaler, 2016).

Resources

- Boaler, J. (2016). *Mathematical mindsets unleashing students' potential through creative math, inspiring messages and innovative teaching*. San Francisco: Jossey-Bass.
- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505d6f2
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