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PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

South Carolina Department of Education
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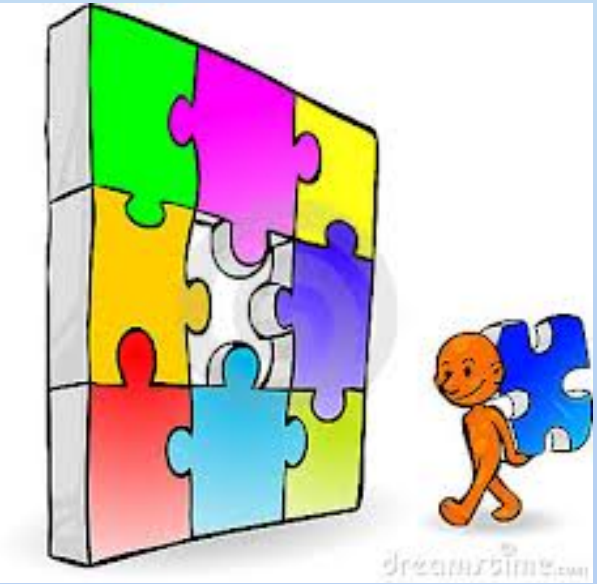
Learning Mathematics Through Problem Solving



Nov. 27-29, 2012

Dale Smith
Math Coach
Newberry County

Traditional Approach to Math Instruction

- Tasks come mainly from examples and homework exercises in the textbook or on a work sheet;
- predominately short, out of context, symbolic;
- emphasis on mastering and maintaining procedural skills.

Traditional Role of the Teacher

- Works examples for the students using direct teaching
- Expects students to listen and learn to apply the same procedures the teacher demonstrates

The Traditional Role of the "Successful" Student

Students who develop proficiency in using the procedural strategies given in the textbook and demonstrated by the teacher are rewarded with praise and high grades.

It has been all about memorized PROCEDURES, and it hasn’t worked.

Why hasn’t it worked?

The Traditional Role of Problem Solving

If any applications of these procedures to real-world problems are included, they are briefly stated and straightforward "word problems" presented immediately after the procedures that students are expected to use to solve the problems.

The nature of the students' thinking and the strategies, both mathematically valid and invalid, that they might have tried for solving problems are generally of much less interest than getting the right answer using the practiced method.

Consequence of Traditional Instruction

Too often students leave school with at best a command of a set of facts, procedures, and formulas they have no notion of how they might use.

Today's Goals

- Describe a classroom that fosters understanding of mathematical concepts and methods.
- Practice problematic tasks in which the mathematics to be learned is embedded.
- Discuss how students develop mathematical habits of mind that are useful ways to think about any mathematical situation.

Task 1

I like to buy red velvet cakes for a treat. Sometimes I like a smaller piece, or I might buy one piece for two of us to share.

Mr. George makes these cakes, and he likes to cut the cakes differently each day of the week.

I have representations of this week’s cakes. Mr. George is selling the cakes for $10 each. Your task is to determine the fraction for each piece of cake and how much each piece costs.

Work with your group to communicate your thinking on poster paper.

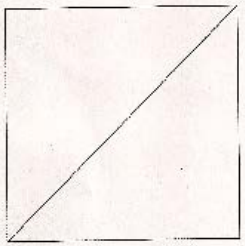
Name _____

The Unusual Baker

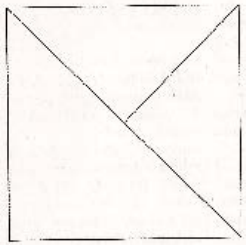
George is a retired mathematics teacher who makes cakes. He likes to cut the cakes differently each day of the week. On the order board, George lists the fraction of the piece, and next to that, he has the cost of each piece. This week he is selling whole cakes for $10 each.

Determine the fractions of each piece of cake and how much each costs if the whole cake is $10.

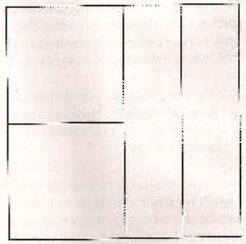
Monday's cake



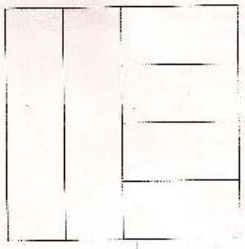
Tuesday's cake



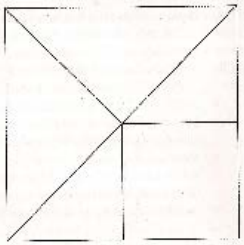
Wednesday's cake



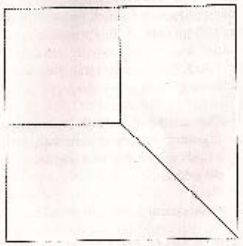
Thursday's cake



Friday's cake

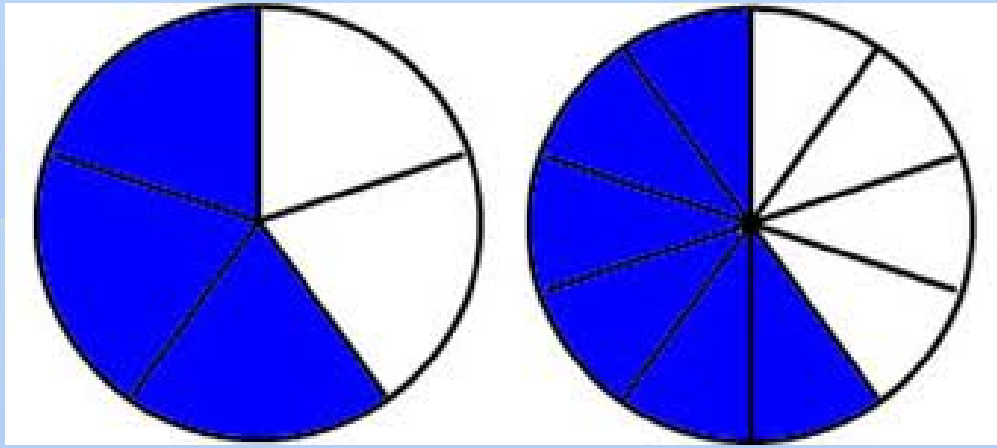


Saturday's cake



From the December 2011/January 2012 issue of teaching children mathematics

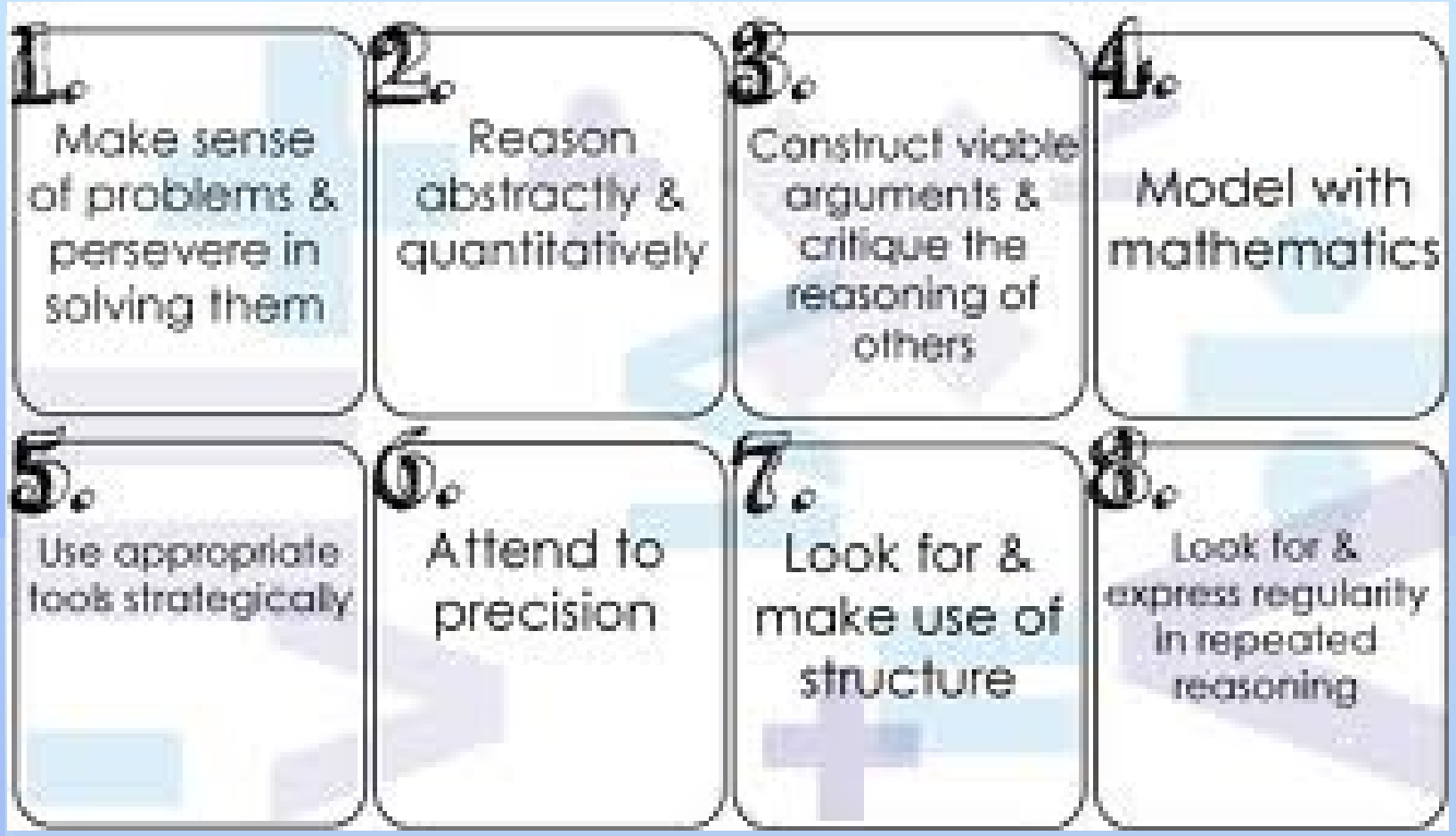
What essential understandings about fractions does this task address?



Why teach using problem solving?

1. **Justification** - PS puts procedures in context.
2. **Motivation** – Students are more interested.
3. **Recreation** – Students enjoy it!
4. **Vehicle** (way of learning) – Students can draw a picture, create a graph, etc.
5. **Practice** invented procedures
6. **Skill** builder based on what student understands
7. Supports the intent of the CCSS

CCSS 8 Standards for Mathematical Practice



Problem solving is not a unit to be taught or an add-on at the end of a chapter. It is a skill, an ***art*** that must be developed.

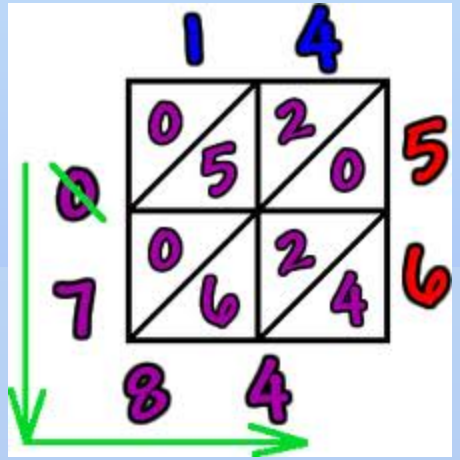
Problem solving is a way of learning.

How do we begin the process of change?

We begin with simple arithmetic. Even it must be taught insightfully, not mechanically.

Basic Multiplication

$$\begin{array}{rr} & 12 \\ \times & 34 \\ \hline & 48 \\ + & 360 \\ \hline & 408 \end{array}$$

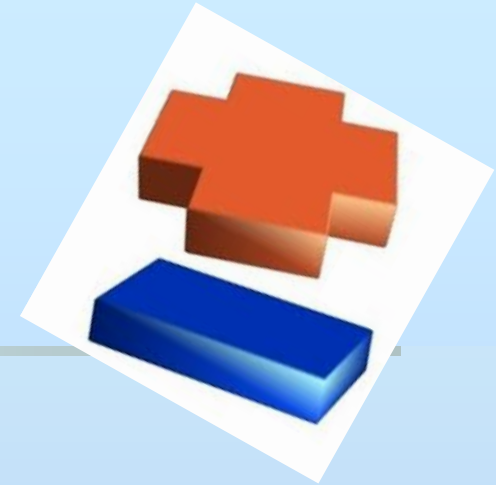


Basic Operations Before 3rd Grade

Kindergarten

- Compose/decompose numbers to 19
- Write equations to represent thinking
- +/- within 10
- Fluently +/- within 5
- Solve word problems using common +/- situations

Basic Operations Before 3rd Grade



1st Grade

- Compose/decompose numbers to 19
- Understand 2-digit place value
- Write and solve +/- equations with unknowns to represent thinking
- +/- within 20 using a variety of strategies
- Fluently +/- within 10
- Solve word problems using common +/- situations

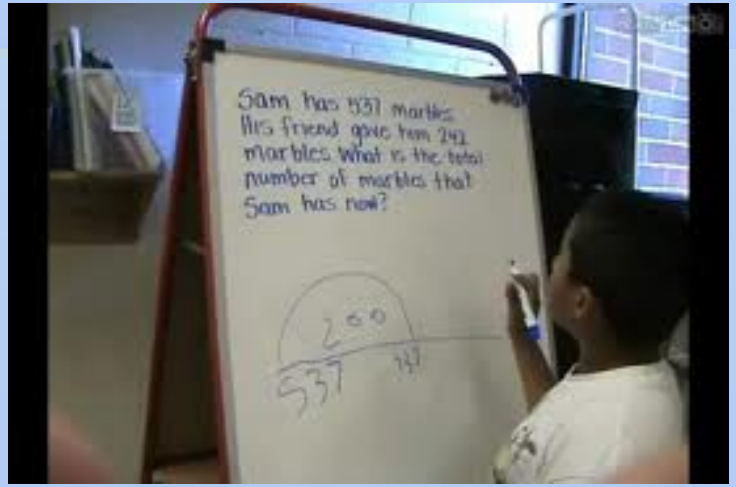
Basic Operations Before 3rd Grade

2nd Grade

- Compose/decompose numbers to 99
- Write/solve equations with unknowns to represent thinking
- +/- within 100 using a variety of strategies (including properties)
- Fluently +/- within 20
- Solve word problems using common +/- situations

What 2nd Graders Can Do

- Read word problems
- Write an equation to match the story
- Solve for the unknown
- Explain their thinking



1. P + 13 = 28

28 − 13 = P

(20 − 10) + (8 − 3)

(10 + 5)

15 People

2. □ + 34 = 35

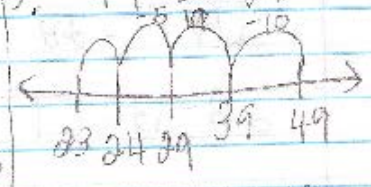
35 + 34 = □

(30 + 30) + (5 + 4)

(60 + 9)

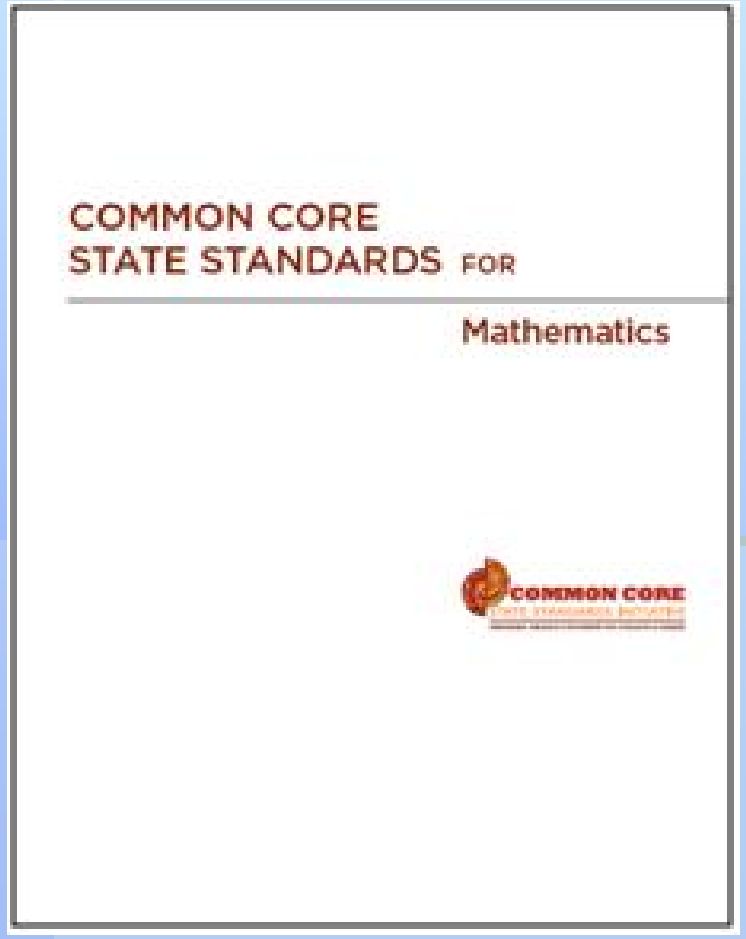
69 marbles

3. 49 − □ = 26



□ = 23 skittles

Problem Situations
Pages 88 - 89



Investigate all types of situations <u>multiple</u> times.

Sticky Situations

Work with your team to write an example of a “sticky situation problem” in the form written on your slip of paper.

The other teams will write an equation to tell the story you wrote.

Multiplication and Division Progression

Unwrapping the 3rd – 5th Standards

Task 2

On a trip to Myrtle Beach this summer Chase bought 21 tokens for rides at the amusement park.

The amusement park has large rides and small rides. The larger rides require 3 tokens and the smaller rides require 2 tokens.

What is the least number of rides Chase can take?

What is the greatest number of rides he can take?

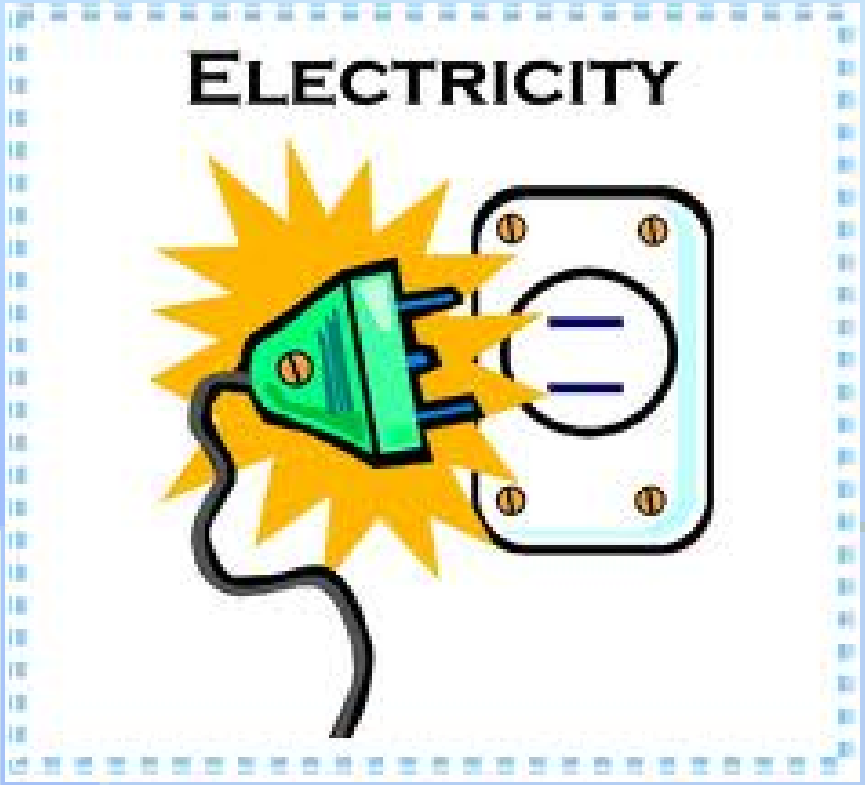
Graham delivers newspapers in his community. Last week he delivered 17 newspapers each school day, 28 on Saturday, and 35 on Sunday. If he delivers the same number this week and next week, how many newspapers will he have delivered after the third week?

Grandma baked 14 dozen gingerbread men cookies, and took 30 to her church dinner. She plans to fill baskets with the rest of the cookies as gifts for the 9 families in her neighborhood. If she gives each family the same number of cookies, will she have any cookies left over for us to eat?

Problematic Task 3

At the state fair, Felipe bought 2 T-shirts and two soft drinks for $44.00. Heather bought one T-shirt and 3 soft drinks and paid $30.00. How much does a T-shirt cost? How much is a soft drink? Explain how you got your answers.

Problematic Task 3

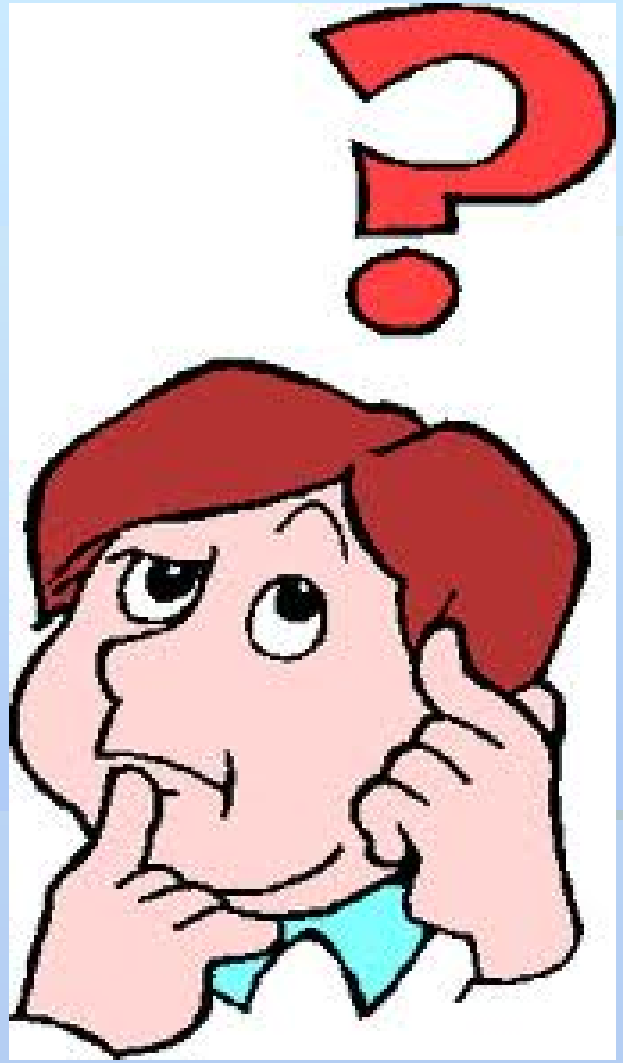


One day while I was at school, the electricity went out at home. When I left that morning, all the clocks were working and agreed that the time was 6:30. When I got home they all said different times.

The wind-up clock, which was unaffected by the electricity, read 5:21.

The analog electric clock stops running when you unplug it from the wall, and it starts back up where it left off when you plug it back in. The clock said it was 3:50.

My digital electric clock, which resets itself to midnight when the electricity goes out, flashes until you correct the time. It was flashing 6:03 a.m.



Assuming the electricity went out just once, what time did it go out, and how long was it off?

Final Thoughts

1. Let the students struggle.
2. Let them do most of the work and most of the talking.
3. Listen to what they say.
4. Be patient.
5. Make math interesting and enjoyable.

The primary goals of mathematics learning are understanding and problem solving.

If students can’t solve problems with the mathematics they learn, what good is it?

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