Subtraction-There's Got to be An Easier Way!

Summary

Students will work on subtraction with regrouping.

Main Core Tie

Mathematics Grade 2
Strand: NUMBER AND OPERATIONS IN BASE TEN (2.NBT) Standard 2.NBT.7

Additional Core Ties

Mathematics Grade 2
Strand: OPERATIONS AND ALGEBRAIC THINKING (2.OA) Standard 2.OA.2
Mathematics Grade 2
Strand: NUMBER AND OPERATIONS IN BASE TEN (2.NBT) Standard 2.NBT.9
Mathematics Grade 2
Strand: MEASUREMENT AND DATA (2.MD) Standard 2.MD.8

Materials

Pictures of eight to ten major inventions on cardstock
Part A
For each pair:
Aquarium gravel or other small rocks--at least 100 rocks
Part B
Number lines
Small stickers
Containers with counters or small wrapped candies
Card set with subtraction questions and matching missing addend number sentences
Overhead money sets
Sets of money for each student
Overhead bill set
Overhead coin set
Base ten blocks
Extension Activity
Colored string
Additional Resources
Book
- *The Kid Who Invented the Popsicle*
, by Don C. Wulffson; ISBN 0141302046
Additional Media
Overhead money sets and/or sets of money for each student, available from www.enasco.com

Background for Teachers

Third grade students have been taught the subtraction with regrouping algorithm and practiced it intensively in second grade. However, many third graders still struggle with it, and the struggle often continues into the upper grades. Many adults also make computational errors when subtracting with regrouping, especially when zeros are involved.
Students should know several different strategies to solve subtraction problems. Ideally, they will develop enough number sense that they will be able to choose the strategy that best works for

individual problems. This lesson uses benchmark numbers to help students improve their ability to compute subtraction problems accurately and efficiently by using mental math strategies as much as possible. This reflects real life situations since very few of us go to the grocery store armed with calculators, math notebooks, and pencils. We need to do a lot of math "in our heads" and these strategies help develop the skills needed to become more proficient at it.

Intended Learning Outcomes

1. Demonstrate a positive learning attitude toward mathematics.
2. Become mathematical problem solvers.
3. Reason mathematically.

Instructional Procedures

Invitation to Learn

Inventions That Changed the World

Do a quick background on what inventions are--new items or methods designed to make something easier, faster, better, etc. There are several resources on inventions listed at the end of this activity that you could use for this.

Make eight to ten cards with important inventions on them. Hang them facedown on the board. Have a student come up and choose a card. Tell them to pick carefully because their choice might just change the world! Have the student show the card to the class. Have them imagine what the world would be like if this invention had never been invented. Repeat with the rest of the cards.

Ask, "Why are we talking about inventions in math class? Do you think there have been inventions made in math? Today we are going to learn about some of the inventions that people have made in the field of mathematics."

Instructional Procedures

Part A

Organize students into pairs. Give each group a container of small rocks. Tell them that they will first try math the original way it developed, before anyone invented ways to make it easier, faster, or better.

Tell students that they are all sheepherders and they need to keep track of how many sheep they have. It is hard to count the sheep because they all keep moving around. Can they think of way that rocks might have been used in counting? How could you use the rocks to show that you have eight sheep?

What would you do if a wolf came and ate two of your sheep? What could you do to show how many sheep you have now? (Take two rocks away.)

Imagine that you are a really good shepherd and your flock of sheep grows until you have 100 sheep. Would it be difficult to keep track of 100 rocks spread out all over? Could you figure out something to do with your rocks to make it easier to keep track of how many sheep you have? (Give the students a chance to discuss and organize the rocks.)

Note: Most groups will probably organize their rocks in groups of 2s, 5s, 10s, or 25s. Ask why they did this. Tell them that we have a Base 10 number system and are used to working with these familiar benchmark (easy to count) numbers. Explain that different cultures developed different number systems, some have a Base 4 or a Base 11 system.

Ask students how they would feel about constantly carrying around those 100 rocks. What if they had 1,000 sheep? What if they accidentally dropped or lost some of the rocks--would that mean they had lost the sheep, too? They will probably see that using the rocks would create some problems.

People got tired of using the rocks and started inventing ways to make counting and keeping track of things easier. So that was a math invention! Most cultures invented a way to record their counting. Whatever method and symbols they decided to use, their system had to be based on sound mathematical principles. If you had 6 sheep and 1 had a lamb, then you had 7 sheep. Not any other amount, but 7, so however you wrote the number it had to represent the number of actual sheep, (or anything else) you had left.

Explain that thinking of numbers as "nouns" can help them understand this concept and help them think about what is actually happening as we do the math operations.

Part B

Write a subtraction problem on the board. Have a student volunteer to come to board and solve it. As they do, explain that they are using a "math invention." The standard algorithms we use today were invented many years ago as ways to make doing math faster and easier. In order to be able to invent algorithms that work accurately every single time, their inventors had to understand the math principles and how numbers work. The subtraction algorithm that was just shown is one of the most difficult for us to remember how to do and do accurately every single time. Even if we memorize the algorithm, it really doesn't do us a lot of good unless we understand what is actually happening, and more importantly, why the algorithm works. Today, we are going to look at some different inventions--different algorithms and strategies for doing subtraction.

Review the basic meanings of subtraction.

Take Away--Give each student a small handful of counters (or candy, if you really want to get their attention). Go to each child and say "You have _____, I am going to take away _____, how many will you have left?" These types of problems ask *how many you have left* or *how many remain*.

Compare--Give each student/pair two number lines and some small stickers. You can make number lines with any numbers you would like to work with. For example, with a number line from 1-100 counting by 5s, you could do problems like this: Put a sticker on 87 on one number line, put a sticker on 100 on the other number line. Now find the difference between these two numbers. Show how number lines can be used to compare. These types of problems ask things like *how many more* or *how many less* does one group have than another.

Missing Addend--This allows us to use addition to solve subtraction problems. This answers problems like, "Paul needs $6 to go to the movie, he has $4 already. How much does he need to earn?" Switch it to addition by writing $4 + ____ = $6. Put the cards on the board--three subtraction questions and three missing addend number sentences. Have the class match them up.

Mental Math--Benchmark numbers; demonstrate with money Use overhead money or play money for each student to demonstrate the concept of subtraction with benchmark numbers. Give them several scenarios similar to this:

You had $5.00. You spent $3.50 on a comic book. How much do you have left?

Start counting it back in pennies and see how they react. What's wrong? That will take forever! What's a better strategy? Two quarters and one dollar. How did you know and count that? You are used to counting with coin values of nickels, dimes, and quarters. Those are familiar numbers. We can use those same benchmark numbers to help us with subtraction.

Mental math subtraction problems--Do several problems like this together. You can also construct worksheets for them to practice this skill--make sure you have students write how they figured the problem out. This also builds on the mental math addition they did recognizing how many more makes 10, 100, etc. Remind them they have practiced this so they don't think it is a new skill. It helps to have students record the problem while you work it out so they have a visual record of the problem. Use base ten blocks to show each step.

You had 80 sheep. You sold 57 of them. How many do you have left?

Think: 3 sheep would get me to 60 (just like pennies--put out 3 cubes). And 20 more sheep (like

dimes--put out two ten sticks) would get me to 80. So I have 3 + 20, or 23 sheep left.

You have 900 cows. Your neighbor has 564 cows. How many more cows do you have?

Think: 6 more would give me 70--put out 6 cubes, 30 more would give me 600--put out 3 ten sticks. 300 more would give me 900--put out three hundreds squares. Add up (teach them to start with the hundreds place in mental addition because then they end up with expanded form). 300 + 30 + 6 and you get 336, so you have 336 more cows than your neighbor.

Actually writing the problems in expanded form might be helpful for some students.

Go back to the sheep problem. How would you write it in expanded form?

If you subtract 0 - 7 you will get a negative 7, which doesn't work very well in counting sheep, even though it will be very useful later in math. Put out eight ten sticks and then exchange one ten stick for ten one cubes. Can we rename 80 as 70 + 10? Does 70 + 10 have the same value as 80? Then we are okay. Take away the blocks as you do each subtraction.

Larger numbers can get a little tricky. Talk about whether they should use this strategy or the mental math strategy, which would be a better choice?

You have to regroup so you have enough in the tens and ones columns. Model with base ten blocks again. Tell students to take one of the hundreds--that leaves 800 and split that hundred into tens and ones so you could do the problem. The easiest way is 90 + 10--nine ten sticks and ten ones cubes. Take away the blocks for each place as you do the subtraction. This leaves a problem like this:

Do several problems having them choose which strategy is best. Show overhead of sample problems that work with each strategy.

Compensation Strategy--Usethe following demonstration to introduce this strategy:

Invite two students with a noticeable height difference to come to the front of the classroom. Measure the difference in their height. Have them both stand on equal size chairs. Explain that while both of their heights were changed to make them taller, because the exact same thing was done to both, there was no change in the difference between their heights.

The same concept applies to numbers. I can make a math problem easier by changing both numbers to make them easier to subtract.

Think: I can make 593 an even 600 by adding 7. If I do that, I must add 7 to 256, which would give me 263. Write your new problem

Think: 7 more would give me 70, 30 more would give me 300, and 300 more would give me 600. So 300 + 30 + 7, or 337, is my answer.

Do the standard algorithm to prove that you get the same answer.

Compensation also works if your students are struggling with subtracting with zeros and cannot yet do it mentally.

Explain that different strategies work best for different problems. Encourage students to look at each problem and see if they can choose the best strategy. Point out that when you have problems with two zeros that you must regroup twice, it is difficult to do the standard algorithm, but much easier to use one of the mental math strategies. Some students will stick almost exclusively to the standard algorithm because that is familiar, and people do what they are most familiar with. Point out which problems they might have been able to solve more quickly and easily using one of the other strategies. It is helpful to have students practice with problems that are best suited to each strategy. This will help them become more adept at choosing the most appropriate strategy.

Extensions

The Incan people used an elaborate system of colored strings and knots called a "quipi." For more information and drawings look up www.Spanish.sbc.edu/MMLatAm/Quipus.html

Scientists and mathematicians do not agree on exactly how they used the quipi, but they do agree that it was used to count and record things.

Making their own quipus from colored string would be an interesting art project for students.
Play Salute with 10s, 100s, and 1000s, but change to subtraction.
Have sports enthusiasts bring in newspaper articles with sports scores. Hang the scores in the classroom and have students arrange them from the least to the greatest differences.

- *Subtraction Top It*

, adapted from *Everyday Mathematics Parent Handbook*. This is based on the familiar card game, War, and can be played with two to four players.

Make number cards with four of each number from 1-10 or use decks of cards and take out the face cards. You can also make decks with 2-digit numbers.
Shuffle the cards and place them face down on the desk. Each player takes two cards and turns them face up. The player with the greatest (or least) difference is the winner and takes all the cards. Play ends when there are not enough cards for all the players to draw two cards. The winner is the player with the most cards.

You can do variations of this by deciding that the winner is the one with either the greatest or least difference between their cards You can also have them draw four cards to make two 2-digit numbers. This involves them using strategies to make the numbers with the difference they are looking for.
Use familiar fairy tales or other stories and have students rewrite them using numbers. Make up subtraction problems with the story. For example:

Once upon a time, 430 years ago, there were three little pigs. The little pigs decided to go out in the world and build houses for themselves. The first little pig built his house from 743 pieces of straw. The second little pig built his house from 436 sticks of wood, and the third little pig built his house from 245 bricks. The big bad wolf came and tried to get the pigs. He huffed and puffed 176 times and blew down the straw house, but the first little pig escaped. He huffed and puffed 289 times and blew down the house of sticks, but the second little pig escaped, also. He went to the brick house and blew 643 times until he was so tired he passed out. Then he climbed on the roof and went down the chimney, but he landed in boiling water that was 212 and got boiled. The three little pigs lived happily for 50 more years.

Journaling--Write possible subtraction problems from this story.

Assessment Plan

Do a *Problem of the Day* and have students choose which strategy they think would work best and why. Have students come up and explain how they solved the problem with each of the strategies and have the class discuss which one probably was the best choice.
Write a quiz with subtraction problems. Have students show how they did each problem and indicate which method they used. To save them from writing so much you could assign each method a letter. For example: standard algorithm A, mental math B, expanded form C, and compensation D.

Bibliography

Research Basis

Raimi, R.A. (2002). On Algorithms of Arithmetic, Department of Mathematics, University of Rochester, Online at: www.nychold.org/raimi-algs0209.html
This article explores why students still need to learn to do basic mathematical operations rather than relying solely on calculators. He draws an interesting comparison between walking and driving a car. After cars were invented people did not completely quit walking. People choose whether to walk or drive by doing what makes the most sense for the situation. He suggests we teach students the same

concept in math. Use the method that makes the most sense.

Curry, D., Schmitt, M.J., & Waldron, S. (1996). A Framework for Adult Numeracy Standards: The Mathematical Skills and Abilities Adults Need to Be Equipped for the Future, Online at http://shell04.theworld.com/std/anpn/framewk.html

This is a research study conducted in 1996 that attempted to identify the critical math skills and concepts adults need to succeed in the workplace and life. It was funded by the National Institute for Literacy and conducted by the Adult Numberacy Practioners Network. Some of the important concepts they identified are:

- Use an interdisciplinary approach
- Link new math learning to previous knowledge
- Teach concepts before rules

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