

Differentiating with Tiered Lessons and Small-Group Instruction

Dr. Carrie S. Cutler
University of Houston
carriecutler@hotmail.com
NCTM 2015 Boston

(many ideas came from *Good Questions: Great Ways to Differentiate Mathematics Instruction* by Marian Small, NCTM, 2009)

Create Open Questions

1. Turn around a question. Example: What is 8 plus 10? → The answer is 18. What is the question?
2. Ask for similarities/differences. Example: How are the numbers 85 and 100 alike/different?
3. Replace a number with a blank. Example: There are 12 boys and 13 girls in our class. How many students altogether? → There are 25 students in our class. Twelve of them are boys. How many are girls?
4. Ask for a number sentence. Have students create a sentence that includes certain words and numbers. Example: Use 3 and 4 along with the words “and” and “more.”
5. Change the question. Example: What number has 3 hundreds, 2 tens, and 6 ones? → You have 11 base ten blocks. What numbers can you create?

Design Parallel Tasks

- Sets of tasks, usually two or three,
- Designed to meet the needs of students at different developmental levels
- Get at the same learning goal
- Close enough in context that they can be discussed simultaneously

Option One: An object has a length of 5 paper clips. What might it be?

Option Two: An object has a length greater than 5 paper clips. What might it be?

Incorporate Differentiated Learning Centers

- Plan tasks that introduce, solidify, or extend a concept. Also good for review/revisiting previously taught topics. Not just for preschool!
- Intentional Organization
 1. Heterogeneous Grouping
 - a. Group Participation
 2. Homogenous Grouping
 - b. Individual Accountability
- Balance between: 1. Valuing the outcome of the lesson (product) and the mathematical processes involved (process) and 2. Competition and Cooperation

Provide Small-Group Instruction in a Teacher-led Center

What to Do in the Teacher-led Center

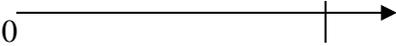
- Pull out a group for reteaching/revisiting a lesson.
- Extend a previous lesson.
- Assess (performance-based, alternative).
- Give students forum to report on projects.
- Monitor mathematical dispositions, social climate of groups.
- Resist the temptation to grade papers, answer email, input grades, etc. Take advantage of this time to work with a small group in focused, differentiated learning.

Which Students Meet with the Teacher?

- Plan to meet with each student at least once a month (or as often as possible).
- Use scores: Pull students who earned lower than 80% on an assignment.
- Use interests: Pull students who share a common interest in a mathematical topic.
- Use personalities: Pull a homogeneous group of mathematically-hesitant students.
- Be purposeful.

Sample Number Tasks that are Easily Differentiated

(Adapted heavily from Small, 2009)

<p>1. The answer is 55. What is the question?</p>	<p><i>Variation:</i> Change the answer number to a three-digit number.</p>	<p><i>Variation:</i></p>
<p>2. Tell about a time when you would use the number $\frac{1}{2}$.</p>	<p><i>Variation:</i> Provide a picture of a sandwich cut in half.</p>	<p><i>Variation:</i></p>
<p>3. Ellen ran in a race with some other students. She did not win, but she was not last.</p> <ul style="list-style-type: none"> • Draw a picture that shows how she did in the race. • Tell or show on the picture how many people were ahead of her. • Tell or show on the picture how many people were behind her. • What word describes her position? 	<p><i>Variation:</i> Add a condition such as that there were the same number of runners ahead of and behind Ellen. Or that the total number of racers was 32. Or that there were more than 15 racers altogether.</p>	<p><i>Variation:</i></p>
<p>4. Choose a number for the second mark on the number line.</p>  <p>Mark a third point on the line. Tell what number name it should have and why.</p>	<p><i>Variation:</i> The teacher can name the second point 5, and then the student chooses a third point.</p>	<p><i>Variation:</i></p>
<p>5. Create a sentence that uses each of the four numbers and words shown below. Other words or numbers can also be used.</p> <p style="text-align: center;"><i>3, more, 5, and</i></p>	<p><i>Variation:</i> Ask the students to combine the digits 3 and 5 to create a 2-digit number to be used in the sentence.</p>	<p><i>Variation:</i></p>
<p>6. How are the numbers 10 and 15 alike? How are they different?</p>	<p><i>Variation:</i> Ask students to come up with at least 8 ways the numbers are alike or different.</p>	<p><i>Variation:</i></p>
<p>7. A two-digit number has more tens than ones. What could the number be? How do you know your number is correct?</p>	<p><i>Variation:</i> Color only the numbers on the hundreds chart that show more tens than ones.</p>	<p><i>Variation:</i></p>

Parallel Tasks

Helpful Tip: Mix up the complexity of Option One and Option Two; don't always list the easier problem as Option One. Remember: Observing the choice a student makes when a choice is offered provides valuable information to the teacher.

(These ideas adapted heavily from Small, 2009).

Number Power Option One: Choose a number that could tell how many flowers fit in a vase. Tell why that number makes sense.	Number Power Option Two: Choose a number that could tell the number of families who have children at our school. Tell why that number makes sense.
Coin Combos Option One: What coin combinations can you use to show 12 cents?	Coin Combos Option Two: What coin combinations can you use to show 60 cents?
Number Line Sense What number on the number line does the dot represent? Option One: 	Number Line Sense What number on the number line does the dot represent? Option Two: 
Number Ideas Option One: A number is about 10, but it's not 10. What is the most it might be? What is the least it might be?	Number Ideas Option Two: A number is about 125, but it's not 125. What is the most it might be? What is the least it might be?
Markers Problem Option One: Ian had some markers. When he put them in groups of 3, there were 2 left over. If he had fewer than 15 markers, how many could he have had?	Markers Problem Option Two: Andrea had some markers. When she put them in groups of 3, there was 1 left over. When she put them in groups of 4, there were 3 left over. If she had fewer than 20 markers, how many could she have had?
Patterns Option One: Use your pattern blocks. Create a shape pattern where the 10 th shape is a green triangle.	Patterns Option Two: Use your pattern blocks. Create a shape pattern.
Toothpicking Option One: Use 20 toothpicks to make three shapes. None of the shapes can use the same number of toothpicks. Describe your shapes.	Toothpicking Option Two: Use 20 toothpicks to make at least four shapes. Describe your shapes.
Creatures Option One: Use 2-D shapes to make two different creatures. Describe the two creatures you made.	Creatures Option Two: Use 3-D shapes to make two different creatures. Describe the two creatures you made.
Decide Which is Longer Option One: The distance from your shoulder to your wrist or the distance around your head.	Decide Which is Longer Option Two: The distance from your elbow to your wrist or the length of your foot.
Thinking about Size Option One: Describe an object that is very small but weighs a lot.	Thinking about Size Option Two: Describe an object that is very tall but is not very wide.
Weighing on a Scale Use a pan balance to make a modeling clay ball with the same mass as a toy car. Option One: Make a clay ball with the mass of four toy cars.	Weighing on a Scale Use a pan balance to make a modeling clay ball with the same mass as a toy car. Option Two: Make a small clay ball so that four of them, altogether, have the same mass of the toy car.
Cube Patterns Option One: Make a pattern using blue and green cubes.	Cube Patterns: Option Two: Make a pattern using blue and green cubes. There must be more blue cubes than green cubes.

Tasks for Differentiated Learning Centers

Primary Colors Cuisenaire Rod Trains

Materials: Cuisenaire rods (red, yellow, blue), traditional die, die programmed with red, yellow, and blue sides

Instructions: The goal is to make the longest train with the rods. Take turns rolling the two dice. If you roll a 4 and a RED, take 4 red rods and make a train. On your next turn, add to your train. Continue rolling until each player has had three turns.

Compare the lengths. The player with the longest train wins. Write about it in your math journal. What strategy did you use to find the winner of the game?

Differentiation: Play again with the shortest train being the winner. Write in your math journal about how the two games were the same and different from one another.

Shoe Comparisons

Materials: children's shoes

Instructions: Take off one shoe. Find one thing in the room that is shorter than the shoe. Work with a partner to trace your shoe onto graph paper. Write a sentence to describe how your shoes compares to the object you found. Use the terms *length*, *shorter*, *longer*, *measure*. Repeat the activity but find one object that is longer than the shoe.

Differentiation: Find an object that is exactly as long as the shoe.

Straw Triangles

Materials: straws, clay, scissors

Instructions: Cut straws to different lengths. Make as many different triangles as possible. In your math journal:

- Draw sketches of the triangles you made.
- Tell how many straws you used.
- Tell how many balls of clay you used.
- Tell two important ideas about triangles.

Differentiation: Sort your triangles into groups. How are the triangles alike? Different? Write about it in your math journal.

Missing Dot Triangles

Materials: dot stickers, paper, ruler

Teacher preparation: On several sheets of paper, place two dots. The dots may be in the same position on each sheet of paper or you may vary the position.

Instructions: Choose a sheet of paper. Place a third dot on the paper. Connect the dots to form a triangle. Use the ruler to make the lines straight. Choose another card. Place the third dot in a different spot. Compare the triangles. Write about it in your math journal:

- Draw sketches of the two triangles.
- Tell how many lines and dots each triangle has.
- Tell two important ideas about triangles.

Differentiation: Write about it in your math journal: How are the two triangles alike? How are they different? Make your own triangles using the ruler to make your lines straight. See if you can make a triangle that looks different from the other two.

Greater Than/Less Than Game

Materials: counters, two dice, spinner with sections labeled *equal*, *two less*, *five more*, *ten more*, paper clip for spinner

Instructions: Work with a partner. Player A rolls both dice and adds the numbers. Player B makes a set of counters showing the sum. Player A spins the spinner. Player B changes the set of counters by following the directions on the spinner. Change jobs and play again.

Differentiation: Program the dice with larger numbers. Or have students choose one die to be the number of groups and the other die to be the number of counters in each group (multiplication). Use base ten blocks, if desired.

Coin Trading Game

Materials: one dice, pennies, nickels, dimes, coin board for each player (three columns labeled: pennies, nickels, dimes)

Instructions: Work with a partner. Each partner needs a coin board. Put the coins in a pile in the center of the table. Take turns rolling the dice and adding coins to your board. For instance, if Player A rolls a 4, he takes 4 pennies and puts them on his board in the penny column. The idea of the game is to show, in any column, the least number of coins possible. So as soon as you have enough to "trade up" 5 pennies for a nickel—do it. As soon as you have enough to "trade up" 2 nickels for a dime—do it. The first player to have 5 dimes in the dime column is the winner.

Differentiation: Use two dice and add them together before adding the coins to your board.

Snappo

Materials: Uno cards (numbers only: 0-10)

Instructions: Play with a partner. Divide cards evenly among players. Players lay their cards face down in a pile. Player A flips top card over and lays it on the table. Player B flips his card over. If he can make 10, he captures both cards and says "Snappo!" If he can't, he lays his card face up on the table. Players keep taking turns, flipping cards, trying to make 10. A new card that is turned over can be matched with any card to make 10. Any player recognizing a pair that makes 10 can call "Snappo" and take the set. Game ends when there are no matches left. The player who captured the most cards wins.

Differentiation: Players can pick up sets of 5 or 10.

Go Fish for Sums of Ten

Materials: Uno cards or playing cards with face cards removed (numbers 0-10 only)

Instructions: Play in a group of four. Deal five cards to each player. Put the extra cards face down on the table. Look through your cards to find sets of two cards that, when added together, make ten. If you have a set, show it to the other players and place the two cards face down in front of you. Choose one card from your hand. Think about what number added to it would make ten. Ask one friend for that card. If the player you ask has the card you asked for, she must give it to you. You get another turn. If your friend does not have an 8, you must “go fish” by drawing a card. If you happen to draw the card you asked for, show it to the other players and take another turn. However, if you draw a card that's not what you asked for, you keep the card and it becomes the next player's turn. When you collect a set of two cards that add to ten, show the set to the other players and place the two cards face down in front of you. The player with the most sets wins.

Differentiation: Players can ask for sets of 5 or 10.

How Big Is Your Kiss?

--adapted from *Measurement Investigations*, Dale Seymour, 1992

Materials: Vaseline, marker, split peas, index card

Instructions: Put a dab of Vaseline on your lips. Kiss the index card. Trace around your kiss with a marker. Cover your kiss with split peas. Make sure you lay the peas flat, edge to edge. Count the number of peas to find the area of your kiss. Record it beside the kiss.

Differentiation: Order the kiss areas for the members of your group from smallest to largest. Make a graph to show the area of the kisses of each member of your group.

Teacher-Led Centers

Bunches of Wildflowers

Materials: silk or plastic flowers, paper

Instructions: The goal is to make a bouquet that has the greatest number of flowers. Teams choose two bunches of flowers. They count the flowers on each bunch and write the number sentence that reflects the number of flowers on each bunch. The team with the greatest number of blossoms wins that round. Continue playing until all teams show competence at writing the number sentences.

Differentiation: For an added challenge, play Bunches of Blossoms. The goal is to make a bouquet that has the greatest number of blossoms. Teams choose two bunches of flowers. They count the blossoms on each bunch and write the number sentence that reflects the number of blossoms on each bunch. They may use a calculator to find the total.

Money in a Sock Game

Materials: coins, sock; extra supplies for second grade: shopping list with small items marked with value up to \$.25, extra coins for making change in a bag marked STORE CHANGE

Instructions: Put all of the coins in the sock. Have one student reach in to feel a coin and describe how the coin feels (ridges along the edge, large). Have child guess what type of coin it is then take it out of the sock and show it to the group. The group says aloud the name of the coin and how much it is worth. Put the coin back in the sock and pass the sock to the next student. Repeat until all children have had a turn.

Differentiation: Play the game just as the Game One directions show. However, when Player One pulls a coin from the sock, he sets the coin aside. Save coins until you have enough money to buy an item you want from the shopping list. Fill out your shopping list by writing the cost of the item, the amount of money you paid, and the money you received for change from the store. Use the coins in the baggie labeled STORE MONEY to make any change you need from your shopping list. Continue until all players have had three turns.

Domino Number Bonds

--adapted from NCTM *Illuminations* “Do It With Dominoes”

Materials: dominoes

Instructions: Work with children to find four dominoes with the same number of total spots. Place dominoes where all can see them. Cover one side of a domino with your finger covering the dots. Remind children of the total number of dots on the domino, and then ask how many dots are covered. Repeat with all four dominoes. Next, take two of the dominoes. Stack them so that one domino is crossed over the other and both parts of the upper domino are visible but only one part of the bottom domino is visible. Now tell the children that both dominoes have the same total number of spots and that they are to guess how many spots are covered on the bottom domino. When a correct response is given, display the domino and ask the students to explain how they knew. Model the activity a few more times. Then place the students in pairs and have them take turns being the teacher. Observe which students have fluency with the number bonds. Conduct a quick exit interview with each child. Ask:

- What is missing when I say “ $2 + \text{‘something’} = 5$?”
- What is missing when I say “ $6 + \text{‘something’} = 6$?”
- How would you write the complete addition sentence?
- What addition sentence would show that?
- If you know the top domino has seven total spots, and you can see two on the bottom domino, how many spots on the bottom domino are covered?

Heavy to Light

Materials: Six potatoes (use a marker to label each potato with a letter A-F), pan balance, fruits

Instructions: Show the students the potatoes. Allow them to handle them and make observations about the attributes of the potatoes (they're dirty, rough, smooth, light, heavy, etc.). Tell the students that you are making baked potatoes for dinner and want to give each person at dinner one potato. You want the children to eat the lighter potatoes and the adults to eat the heavier potatoes. Ask the children how they could help you figure out which potato is the heaviest. Have the students use informal strategies to order the potatoes from heaviest to lightest. Discuss the strategies used. Lay the potatoes on the desk in order from heaviest to lightest. Have the children write down their guess about the order of the potatoes. Bring out the pan balance. Allow children to explore with the pan balance. Use the balance to check the estimates by setting the heaviest potato in one pan and the next heaviest in the other and so forth. When the order of the potatoes has been verified, lay the potatoes on the desk in order from heaviest to lightest and have the children fill out the record sheet with the checked order. Bring out a selection of items that the children can use to extend their understanding of ordering objects according to weight. Have the children select four fruits to order from heaviest to lightest. Have them record their guess and their checked orders on the recording sheet. Wrap up with a discussion of strategies used and allow children to share their thinking about measurement and comparison of weights.

Button Button Fractions

Materials: assorted buttons

Instructions: Allow students to explore the assorted buttons. Listen for students' comments about the buttons' attributes (ie. the number of holes, color, thickness, metal or plastic, etc.) Gather the buttons in a pile and select four buttons that share some attribute. Have students guess what the buttons have in common. Continue to look for similarities in different sets of four or five buttons. Play *One of These Things Is Not Like the Other* with the buttons. Select four or five buttons—one of which is dissimilar in some way. Have students guess which button doesn't belong. Build vocabulary by saying, "Four out of five buttons are made of plastic. One out of five buttons is made of metal." Let each of the students take turns creating a *One of These Things Is Not Like the Other* set and try to stump their friends. Encourage students to use appropriate language to describe the fractional makeup of the sets of buttons. Have students record their descriptions of at least two sets of buttons. They may draw a picture of the set of buttons and write, "Four out of five buttons are blue. One out of five buttons is white."

To Regroup or Not to Regroup

Materials: one regular die, one die (labeled 4, 5, 6, 7, 8, 9), base ten blocks (optional)

Instructions: Children work with a partner. Player A rolls the dice and uses the numbers on the dice to make a 2-digit number. For instance, if a 2 and an 8 are rolled, Player A may call out either 28 or 82. Both players write this number on their papers. Player A then rolls both dice again and makes another 2-digit number. Both players decide which number is larger and write the numbers vertically on a sheet of paper to set up a subtraction problem. Both players then decide if the subtraction problem requires regrouping. Students may use the base ten blocks if desired. Player B then rolls the dice and the game is repeated. After you've played five rounds, look back over the problems to look for a pattern that shows when you had to regroup. Write about the pattern you saw.

Adding Up the Beats

Materials: drum (can be made from an oatmeal canister or other household object), counters, chart paper, markers

Instructions: Explain to children that you will hit a drum and they should show you the number of beats using one hand, i.e. if you hit two beats, they should show two fingers on one hand. Repeat this using the other hand and have them show the number of beats. Ask the children to add the number of beats shown on each hand and tell you the total number of beats in all. 4 left hand + 2 right hand = 6 beats on the drum. Repeat several times until all students are accurate in displaying the number of beats and adding the beats to tell how many in all. Place a set of counters in the middle of the table. Choose a student to beat the drum. Ask the chosen student to then strike the drum and the rest of the group to use the counters to show the number of beats. When children are competent with showing the beats with counters, introduce the written number sentence for the beats. Have a student beat the drum, the students show the beats with the counters, then record the accompanying number sentence on the chart paper. Ask each student to join their two sets of counters (from the two sets of beats) to model the joining process of an addition operation. Work together to find the total number of beats in the joined sets. Write the answer on the number sentence. After students are competent with helping you write the number sentence to match the beats, change the order of the activity. This time, write a number sentence and ask all the students to beat out the sentence. For instance, if you write $2 + 3$, students will beat a set of 2 and a set of 3. Then solve the addition problem together by repeating the beats and counting all.

Remember: "Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students." (NCTM, 2000, p. 12)

Thank you so much for coming today. Please don't hesitate to email me with any questions you might have. I'd love to hear about your experiences using these ideas. – *Carrie*