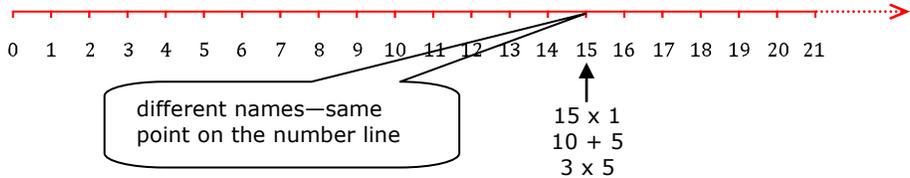


## Race for a Thousand (and back)

<b>Goal</b>	Fluency in composing and decomposing (adding and subtracting with regrouping—carrying and borrowing) in positional base 10 numeration.												
<b>Standard</b>	Compose and decompose with regrouping in base 10 to 1,000 2.1.3 “compose and decompose whole numbers less than one thousand by place value”												
<b>Task</b>	Race games using base 10 blocks (centimeter “unit” cubes (ones), 1x1x10 cm “longs” (tens), 10x10x1 cm “flats” (hundreds), and big 10x10x10 cm (thousands). see “Race Games” at <a href="http://www.soesd.k12.or.us/math/math_resources">www.soesd.k12.or.us/math/math_resources</a>												
<b>Materials</b>	<table style="border: none;"> <tr> <td style="padding-right: 20px;">base 10 blocks</td> <td></td> <td></td> </tr> <tr> <td style="padding-right: 20px;">    ones</td> <td style="padding-right: 20px;">30</td> <td rowspan="4" style="font-size: 3em; vertical-align: middle;">}</td> </tr> <tr> <td style="padding-right: 20px;">    tens</td> <td style="padding-right: 20px;">30</td> </tr> <tr> <td style="padding-right: 20px;">    hundreds</td> <td style="padding-right: 20px;">20</td> </tr> <tr> <td style="padding-right: 20px;">    thousands</td> <td style="padding-right: 20px;">1</td> </tr> </table> <p>for each group of 2 players racing to 1,000. (Higher numbers will require more blocks, lower numbers fewer.)</p> <p>base 10 mat (optional) dice (2): a 0...9 “ones” die and a 00...90 “tens” die</p>	base 10 blocks			ones	30	}	tens	30	hundreds	20	thousands	1
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thousands	1												
<b>Set the Stage (racing up)</b>	<p>Students are in groups of 3: 2 players and 1 banker</p> <p><b>Players</b> are the ones who do the racing: they roll the dice, collect/build the numbers on the base 10 mat, “trade” with the Banker 10 of one denomination for 1 of the next bigger denomination (racing up) and “trade” with the Banker 1 of one denomination for 10 of the next smaller denomination (racing down).</p> <p>The <b>Banker</b> is the most important role—the teacher’s eyes and ears. The Banker monitors and manages the game, checking for accuracy in the trades and making sure both players are rolling the dice properly (not cheating).</p> <p>To decide who starts, each player rolls both dice and states the number. The player with the greatest number gets to start—which means that player will need to roll once again.</p> <p>Players take turns. One player rolls the dice, says the number, the banker builds the number with the blocks and gives the blocks to the player, who then assembles them on a base 10 mat. If the player has more than 10 blocks of any denomination, s/he trades them to the banker for 1 of the next higher denomination.</p> <p>The first player to reach or exceed 1000 (or whatever’s being raced up to) wins: the race-up immediately ends and the race-down begins. Both players keep the numbers they have built—which gives the “loser” a nice head-start.</p>												
<b>Set the Stage (racing down)</b>	<p>The “loser” of the race-up begins the race-down to zero, rolls the dice and then gives the quantity rolled back to the banker, removing the number shown on the dice from her/his collection on the base 10 mat.</p> <p>If the the player doesn’t have the right blocks to build the number shown, s/he trades in a block of a higher denomination for 10 blocks of the next smaller denomination.</p> <p>The first player to reach zero, or be “busted” (roll a number greater than the quantity of blocks remaining), wins.</p>												

<p><b>Anticipate Student Responses</b></p>	<p><b>Base 10 mat.</b> It's important that students get the positional base 10 convention we use: units to the right, larger denominations to the left. If you have any doubt this is not second nature to all your students, make everybody use the mats.</p> <p><b>Bankers.</b> These people should have experienced the game enough to be veteran players. The Banker keeps the game flowing smoothly and stays on top of the trading. The Banker also makes sure players aren't cheating on their rolls and makes sure the trades are accurate and slow enough for players and spectators (if there are any) to understand the action.</p> <p><b>Rolls.</b> The dice should only be rolled once (some players may be tempted to abort a roll that looks unfortunate. The roll should be public so everybody can enjoy the thrill and suspense of randomness.</p> <p><b>Trading.</b> Bankers need to make sure students trade up when they have 10 or more of any denomination on the way up.</p>
<p><b>Monitor Student Work</b></p>	<p>In order to develop the elite corps of bankers on which the game depends, the teacher should probably be the banker for a few games among her/his top students. By "top" I mean in both behavior and mathematical understanding. Starting with the top students has the added benefit of defining the game as rich, rather than remedial. Once the classroom has some dependable bankers, the games can begin.</p> <p>Make sure bankers are staying on top of the trading—especially in the race up (see above.)</p> <p>Remind the bankers to ask students to say the numbers—the number rolled and the number they have in their collection: "So, how much do you have now?"</p> <p>"Who's ahead? How much do you have to roll to win?"</p> <p>And to spectators, "Who do you think will win?"</p> <p>"How far are you from the next hundred?"</p>
<p><b>Connect to Key Ideas</b></p>	<p><b>Polynomials in ten</b> (see Roger Howe's "Taking Place Value Seriously" <a href="http://www.maa.org/PMET/resources/PVHoweEpp-Nov2008.pdf">http://www.maa.org/PMET/resources/PVHoweEpp-Nov2008.pdf</a>. Numbers in our positional base ten system can be written in expanded notation: <math>937 = 9 \times 10^2 + 3 \times 10^1 + 7 \times 10^0</math>. So digits (we only have 10: 0...9) have different values depending on their <i>position</i> in a number.</p> <p><b>Iconic</b> mental image. Thanks to playing race games a lot—and extensions to race games, like diffies and rolling your own addition summands to be calculated, students come to have a conventional picture/image/icon in their minds for what any number looks like. You can picture 213, for example, as <math>\square \mid \bullet\bullet</math></p> <p><b>Composition.</b> When you have 10 of any denomination, you can trade it in for one of the next bigger denomination.</p> <p><b>Decomposition.</b> When you want 10 more of any denomination, you can trade in 1 of the next larger denomination.</p> <p><b>Equivalent representations.</b> These anticipate 2.1.4: <math>\mid \bullet\bullet \quad \bullet\bullet \bullet\bullet \quad \bullet\bullet\bullet\bullet</math></p> 

<p><b>Web links</b></p>	<p><b>National Library of Virtual Manipulatives</b> (in English, Spanish, or French) has several base 10 activities that complement race games and diffies:</p> <p>Base Blocks Addition <a href="http://nlvm.usu.edu/en/nav/frames_asid_154_g_1_t_1.html">http://nlvm.usu.edu/en/nav/frames_asid_154_g_1_t_1.html</a></p> <p>Base Blocks Subtraction <a href="http://nlvm.usu.edu/en/nav/frames_asid_155_g_1_t_1.html">http://nlvm.usu.edu/en/nav/frames_asid_155_g_1_t_1.html</a></p> <p>Base Blocks Decimals <a href="http://nlvm.usu.edu/en/nav/frames_asid_264_g_1_t_1.html">http://nlvm.usu.edu/en/nav/frames_asid_264_g_1_t_1.html</a></p> <p>Diffy <a href="http://nlvm.usu.edu/en/nav/frames_asid_326_g_1_t_1.html">http://nlvm.usu.edu/en/nav/frames_asid_326_g_1_t_1.html</a></p> <p><b>Arcytech</b> has a "Base 10 Blocks" javascript program—with a hammer for decomposing—at <a href="http://arcytech.org/java/b10blocks/">http://arcytech.org/java/b10blocks/</a></p>
<p><b>Formative Assessment</b></p>	<ol style="list-style-type: none"> <li>1. <b>Addition.</b> Roll dice to create addition problems: roll dice, record (write) summands, build numbers, make collections, put the collections together, trade as necessary, record (write) the result.</li> <li>2. <b>Subtraction.</b> Do a diffy (you could even use the other side of the addition paper) by rolling dice for the corner numbers, then taking the smaller number away from the larger and recording the difference in the middle. These four numbers give you the corners for four new subtractions. Find the differences again and keep going, with differences of differences, until you ratchet down to zero.</li> </ol> <p>Use the Diffy link, above, to check your work, if you like. Get more details and download a blank diffy from the "Race Games and Diffies" section of <a href="http://www.soesd.k12.or.us/math/math_resources">www.soesd.k12.or.us/math/math_resources</a></p>