## Place Value Hoola Hoop

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Place Value Hoola Hoop is a game designed to get kids active whilst practising the vital skill of renaming. Arguably, renaming (which includes rearranging and regrouping) is the most important element of Place Value. Indeed, it could be argued that as a concept, understanding it will give students the most success in mathematics, as it appears in Place Value, the four operations (when working with multi-digit numbers), in fractions as equivalent fractions and in measurement and time when converting between units. Without confidence in renaming, students will become reliant on inefficient and often ineffective strategies for working with more complex ideas.

Whilst the game can be played with any sized numbers, it is recommended to work with three- or four-digit numbers. Whilst students may be comfortable reading, writing, making, comparing and ordering numbers of a greater magnitude, the renaming concept is more complex**.** Once students are comfortable representing numbers in multiple ways, the patterns of renaming and regrouping can be extended to larger numbers.

A further consideration for teachers prior to beginning the activity is that this game uses non-proportional representations for place value. An example of a proportional model would be when students work with MABs, as each block is proportional to its value. In this game, each item used (the bean bags), is an identical representation that changes its value through its position. So when the bean bag changes hoops, it changes in value. Students should be confident working with numbers with proportional representations before beginning this game.

### Setting it up

The following equipment is required:
- Hoola hoops (1 for the bean bags and then 2 for each place used – 7 for 3-digit numbers and 9 for 4-digit numbers).
- Bean bags (at least 60 if possible).
- Workbooks.
- PV cards (one for each place, written as 1, 10, 100, 1000 etc).
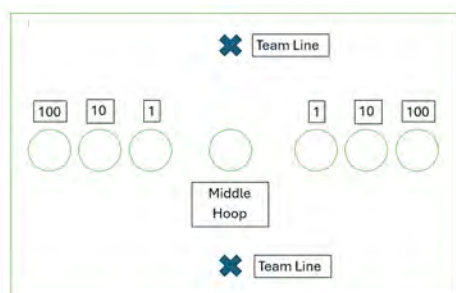- Large space (basketball court or oval)



Figure 1



Figure 2

The space is set up with one hoola hoop in the middle with the bean bags. Two lines of hoops are placed on either side of the middle hoop, one line for each team (**Figure 1**).

A hoola hoop is used for each value with a PV card next to each hoop **(Figure 2)**. The space between each hoop is dependent on the throwing ability of the children. It's good to have them at a challenging distance but having it too far away will extend the game unnecessarily and reduce the amount of time on the maths.

**How to play**

Divide the class into two teams, at either end of the middle hoop **(Figure 1)**. When the teacher says go, the first student runs in, grabs a bean bag and attempts to throw it into their hoops. If the bean bag lands in the hoop, it stays, and the next student will run in. If the student throws the bag and it misses, the student leaves it and the next student goes. Throughout the game, the teacher will go around and put the bean bags that have missed back into the middle hoop. Play continues until all the bags are in each team's hoops.

When playing the game, discussions with students could centre around "If you got 1 bean bag in the hundreds hoop, how many is that worth in the tens hoop? What about if you had 3 in the hundreds hoop?" What we are trying to do is to move the thinking from a partitioning point of view (how many are in each place) to the relationship between the places (the concept of ten of one is one of the next).

Once the game is finished, students in their teams will go and record the number of bean bags in each place and write down the number that they have made. They can either use a recording sheet **(Figure 3)** or create their own table. On the first game, if this lesson is towards the beginning of the unit, it is recommended to not demonstrate how to do this to allow for the collection of formative assessment. In particular, it will reveal which students recognise that if there is more than 9 of a place (i.e. 13 tens), that it needs to be renamed as hundreds and tens rather than recording a two digit in the middle of a number.

| Hundreds | Tens | Ones | Number |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Figure 3

| Hundreds | Tens | Ones | Number |
|---|---|---|---|
| 6 | 14 | 5 |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Figure 4

**Exploring the Maths**

We want students, through this game, to be comfortable representing numbers in multiple ways. Initially, this would be through partitioning questions to identify the number of each place in a number. For example, the number 745 has 7 hundreds, 4 tens and 5 ones. But as stated earlier in this article, this narrow way of representing numbers will hold students back from working with more complex concepts if it is the only way they have of understanding numbers.

An example of a team's score is included in **Figure** 4. Students have counted the bean bags and have 6 in the hundreds hoop, 14 in the tens hoop and 5 in the ones hoop. A common misconception students can develop is that you can't have more than 9 in a place. But rather than recognising that renaming is required, students will often simply write the number as 6145 through the creation of another place. But we can have more than 9 of a place, because 137 has 13 tens. This is a crucial concept that students need to develop.

The first step is to identify which places (at the moment) can be written, which in our example is the hundreds and the ones. So, what do we have to do with the tens? We need to rename the number. A lot of students, even those who understand 'ten of 1 is one of another', can have difficulty when working beyond 2-digit numbers. They can readily identify 60 having 6 tens or 9 tens being 90 but will have trouble identifying 14 tens as being 1 hundred and 4 tens. We want to avoid viewing the numbers as a sum of each digit multiplied by its matching place value part (100+40 or 14 tens is 140). This is because it is viewing 14 tens as 140 ones rather than 1 hundred and 4 tens.

So, once we recognise that we need to rename the 14 tens as 1 hundred and 4 tens, we can then add the hundreds together to make 7 hundred. We now have 7 hundreds, 4 tens and 5 ones, which makes 735. We will then record that number in the final column of our table **(Figure 5).**

| Hundreds | Tens | Ones | Number |
|---|---|---|---|
| 6 | 14 | 5 | 745 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Figure 5

Providing students with extensive opportunities to represent numbers in multiple ways is crucial to developing their understanding of the number system. We would advocate it is better for students to represent the same number 10 different ways then it would be to represent 10 different numbers one way.

**Taking it further**

Once we play the first game, we can continue the overall game in one of three ways. The first is to play each hand separately, so the learning focus is simply on writing and renaming numbers. The team that gets the highest number gets a point and the game continues until a team achieves a predetermined score. The second option, either for the whole class or a small group, is to explore the different ways it can be renamed. For example, 765 can be 7 hundreds, 6 tens and 5 ones, 76 tens and 5 ones, 765 ones, 6 hundreds, 17 tens and 5 ones etc. The third is to use the number achieved as the running total. This could be for the entire class or used as an extension task for a smaller group of students. The focus would then be moving to applying renaming to multi-digit addition.

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[ii] McIntosh, A., Reys, B. & Reys, J. (1992) A proposed framework for examining basic number sense, For the Learning of Mathematics, 12(3), 2-8

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[v] Booker, G., Bond, D., Seah, G. (2021) Teaching Primary Mathematics (6th Edition), Pearson, Melbourne.

[vi] Siemon, D et al, (2021) Teaching Mathematics: Foundations to Middle Years (3rd Edition), Oxford, Melbourne