



National Numeracy
for everyone, for life

FOUNDATIONS

User Guide version 1.0

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Introduction

This User Guide is aimed at teachers and other people supporting adult learners using National Numeracy's **Foundations** app for iPad, which is available as a free download from the App Store.

What's in the User Guide

We start with a brief discussion of the educational thinking that underpins the app, before going on to explain the seven individual activities that are provided. We also provide a brief overview of the app interface and navigation.

About the app

Foundations is one of a number of resources developed by [National Numeracy](#) to support adults in assessing and developing their numeracy skills. [Our online assessment tool, the Challenge](#), allows anyone to check their performance across a range of everyday numeracy topics, and to identify areas that need improvement. Adults who complete the Challenge can achieve 'the Essentials' of numeracy if they score sufficiently well, and our website identifies many resources and other sources of support for people who have not yet achieved the Essentials.

Foundations is primarily aimed at adult learners who are working at very low levels of numeracy. This is a large and often neglected group of people, who often find it difficult to access appropriate support. These learners may struggle to make progress because they lack some of the fundamentals of number sense, such as understanding the relative size of numbers, or the value of the digits in a two-digit number. The resources typically aimed at these levels of numeracy are often not age appropriate, and many do not tackle the fundamental number concepts that these adult learners need to address.

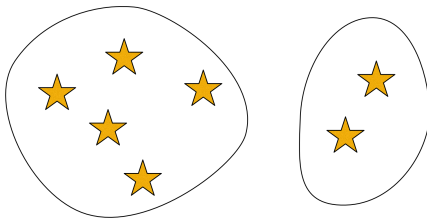
Foundations aims to change this. Our approach builds on successful insights into number teaching developed using structured apparatus like [Numicon™](#). This is a complex area, but the example below shows how the basic ideas are powerful and easy to grasp.

One calculation - three representations

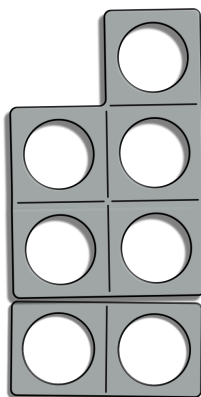
What is the total of 5 and 2? Here are three different ways in which this question could be represented.

$$\begin{array}{r} 5 \\ +2 \\ \hline \end{array}$$

Here the calculation is presented as a vertical sum. For many learners, this is a compact, standardised format that helps to pave the way for more complicated calculations involving several columns of numbers. However, for learners who lack basic number concepts, there is little support here; the calculation has already become quite abstract, and the learner is assumed to know what to do when the numbers and symbols are presented in this way. Simply practising examples set out in this way will not necessarily help to build the required understanding of how the number system really works.

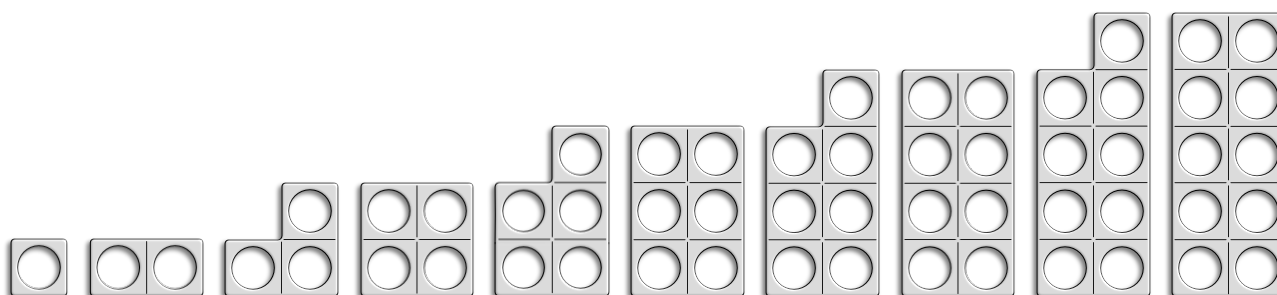


This form of presentation is quite common, and has some advantages for our target learners. Addition is seen as a real-world process - in this case, combining two groups of objects. However, the process by which the learner might reach the answer is likely to be quite pedestrian - for example, counting all of the stars. There is nothing about the arrangement of the objects in the individual groups that provides any clear visual cue about the number of them, or the relationship between the numbers.



This example uses the structured representation of number that features in **Foundations**, and which is described in more detail below. For now, notice that for a learner familiar with the tiles, a 'five' is not just 'a collection of things that happens to come to five', as in the previous representation. Instead, it is one more than four, one less than six, or half of ten; and the 'one sticking out' confirms that it is an odd number. In this example, the addition can be read as 'a five and a two make a seven'.

The representation that we are using is sometimes called the 'pairwise tens frame' - it depicts the numbers 1 - 10 as the following sequence of shapes.



This set of images makes number structures and properties much clearer.

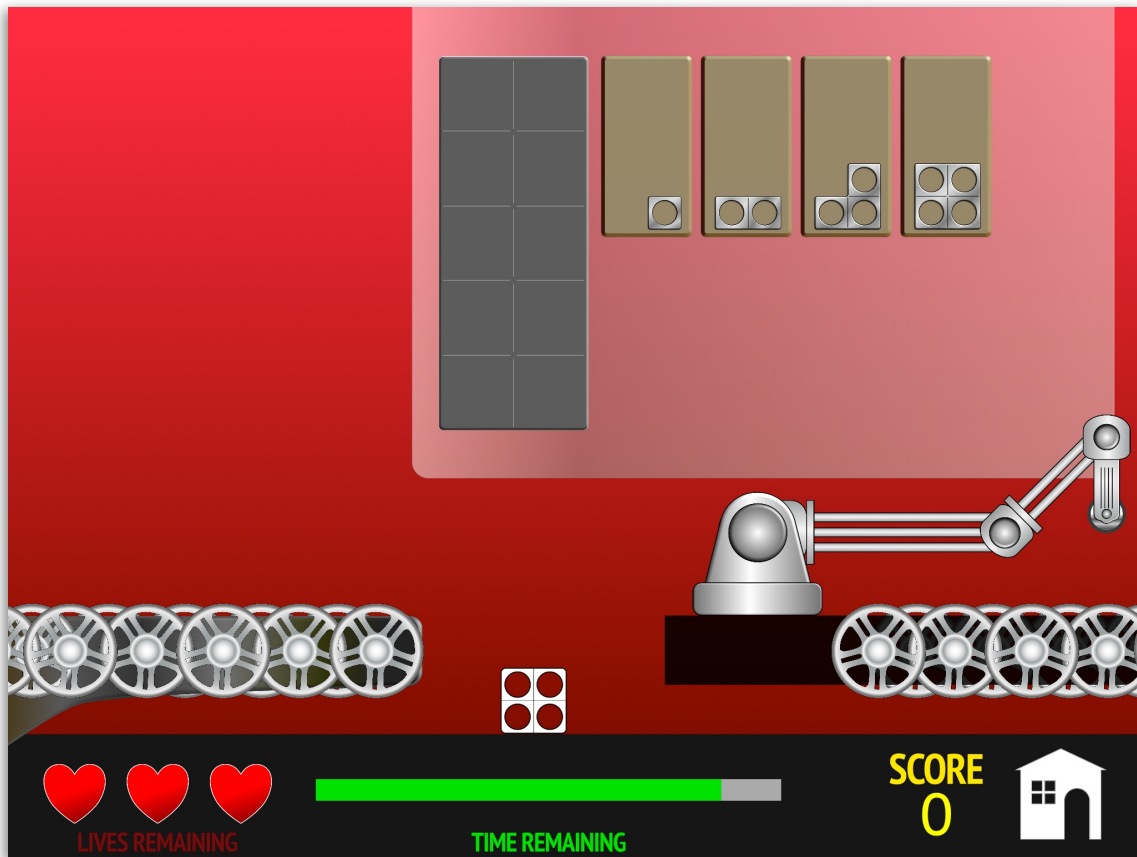
For example:

- We can see how the numbers grow, combine, and can be split into parts
- We can confirm relationships like 'odd + odd = even'
- We can represent numbers larger than 10 as a stack of tens and 'an extra tile' - laying the foundations of place value.

It is important to note that we are not proposing that the structured approach shown here should be the only representation that learners see. In the longer term, learners will need to count unordered sets of objects and deal with numbers in a variety of formats. However, we do believe that the structured approach shown is invaluable in developing a fundamental understanding of the number system, which will provide the firm foundations on which more advanced understanding can be built. The notes on individual activities describe the mathematical ideas in more detail.

Each of the seven activities uses our structured representation in a different way, to focus on a range of number skills and understanding. Although the seven individual activities can be tackled in any order, some are more challenging than others and this guide presents the activities in (approximate) order of difficulty.

Activity 1: Matching Shapes



About this activity

This activity aims to build familiarity with the number shapes. At this stage, we are trying to draw users' attention to the shapes, so that they learn to discriminate between them. Note that users do not need to explicitly associate each shape with a number name at this stage - that will be tackled in the variation on this game in Activity 2.

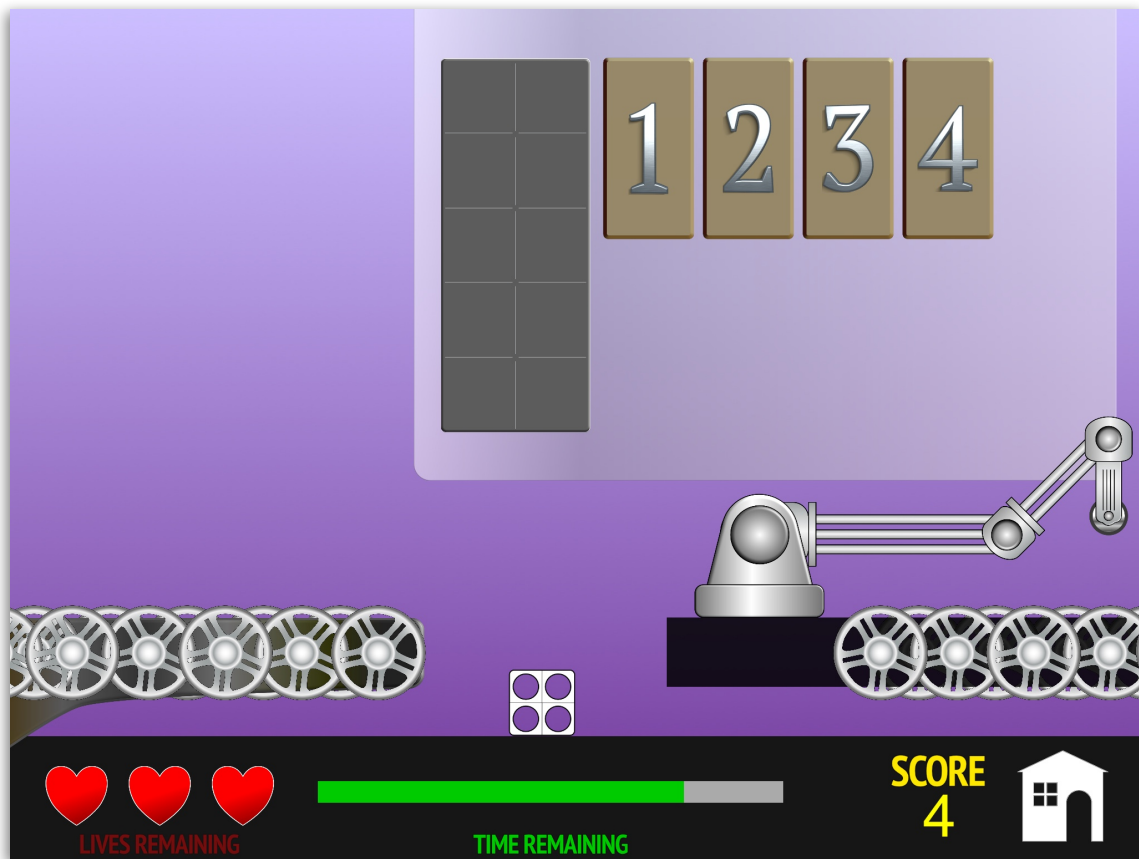
Playing the game

- Number tiles appear at the left of the screen, and are carried to the right by the rotating wheels.
- Each tile falls onto the 'floor' where the user gets an opportunity to inspect it, and find the matching shape among the tiles at the top of the screen.
- The user then taps the appropriate shape at the top of the screen; a set of lights will be displayed in the grey panel to show the selected number, and the robot arm swings over and picks up the tile from the floor.
- If the correct number was chosen, the tile is dropped on the right-hand set of wheels and the score is incremented by the number value of the tile.
- If a wrong number was chosen, the tile is dropped and disappears, and a life is lost.
- As the player progresses through the levels, the range of available numbers increases.

Where to go from here

Activity 2, 'Shapes and Digits' uses exactly the same game play, except that the number shapes at the top of the screen are replaced by digits.

Activity 2: Shapes and Digits



About this activity

This activity is a variation on Activity 1, 'Matching Shapes'. It aims to help users to associate the shapes with the corresponding number names - for example, knowing that a '4 tile' is associated with the digit 4.

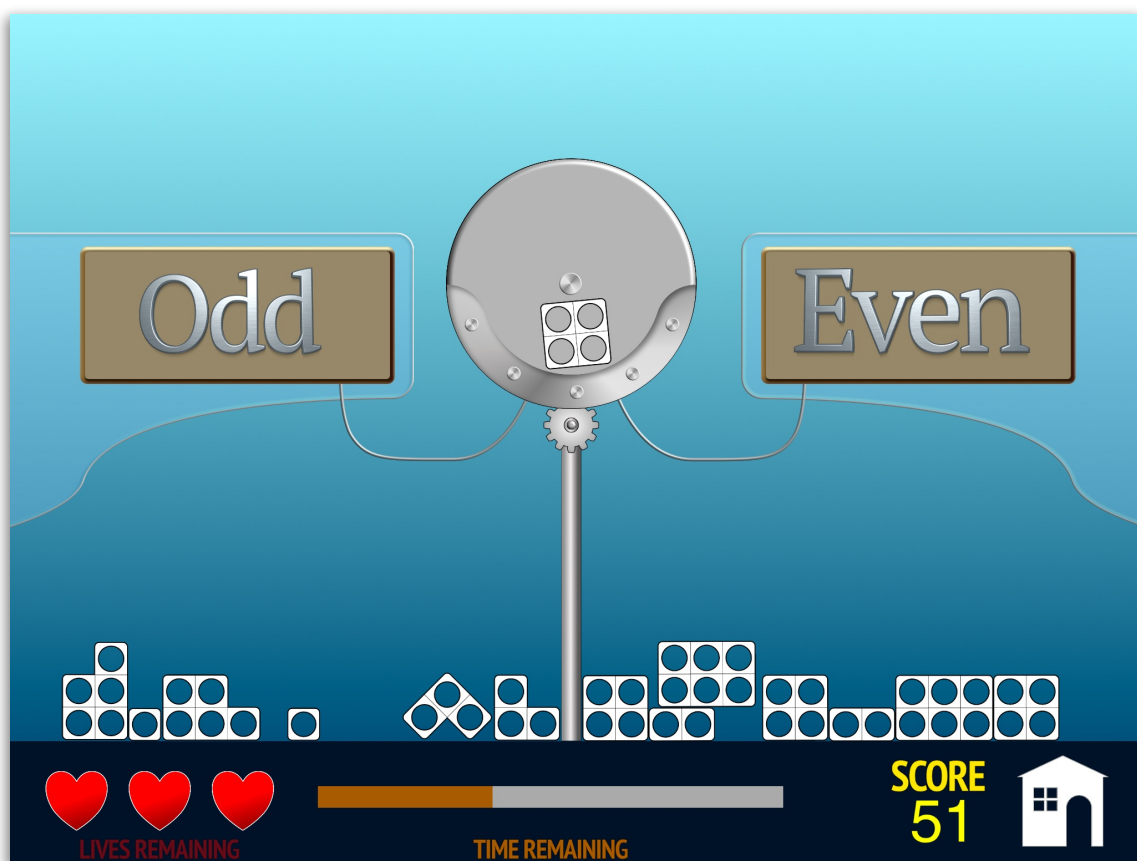
Playing the game

- As with the previous activity, number tiles appear at the left of the screen, and are carried to the right by the rotating wheels.
- Each tile falls onto the 'floor' where the user gets an opportunity to inspect it, and find the matching digit at the top of the screen.
- The user then taps the appropriate digit at the top of the screen; lights will be displayed in the grey panel to show the selected number, and the robot arm swings over and picks up the tile from the floor.
- If the correct number was chosen, the tile is dropped on the right-hand set of wheels and the score is incremented by the number value of the tile.
- If a wrong number was chosen, the tile is dropped and disappears, and a life is lost.
- As the player progresses through the levels, the range of available numbers increases.

Where to go from here

Activity 3, 'Odd or Even?', takes a closer look at the number shapes, and builds users' understanding of odd and even numbers.

Activity 3: Odd or Even?



About this activity

This is a simple and fast-paced activity where users have to discriminate between odd and even number tiles.

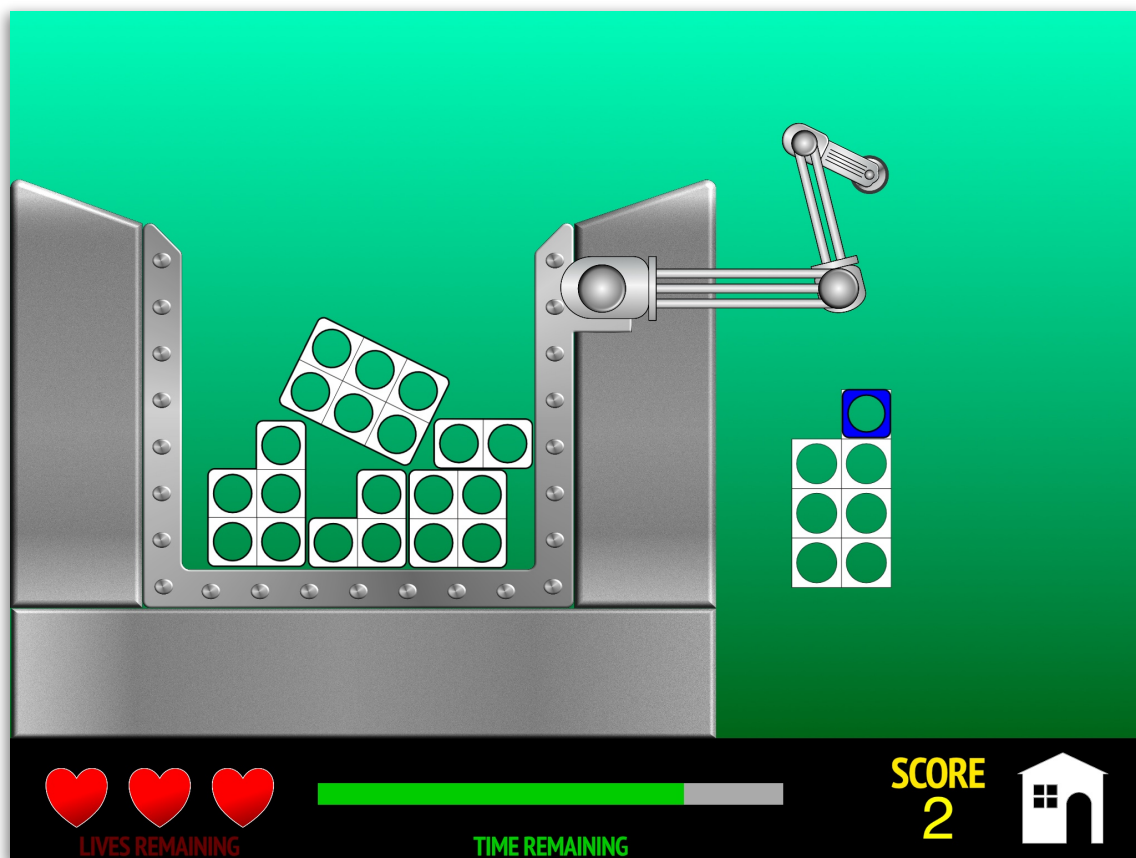
Playing the game

- Tiles fall into the screen from above and are caught in the central holder.
- The user then has the opportunity to inspect the tile, and decide whether it represents an odd or even number.
- The user taps the 'Odd' or 'Even' button, and the tile is dumped onto the corresponding side of the floor.
- Correctly placed tiles are rewarded by adding to the score; incorrect tiles are removed, and result in the loss of a life.
- The range of incoming tiles increases as the user progresses through the game levels.

Where to go from here

An understanding of odd and even numbers will be particularly useful in activities 4 (Number Bonds), 6 (Make 100) and 7 (Totals).

Activity 4: Number Bonds



About this activity

This is the first activity that involves combinations of different number tiles: users have to identify the tile needed to complete a shape. This is an important step towards building knowledge of number bonds - the simple additions (like $6 + 1 = 7$) that represent ways of making a number out of smaller parts.

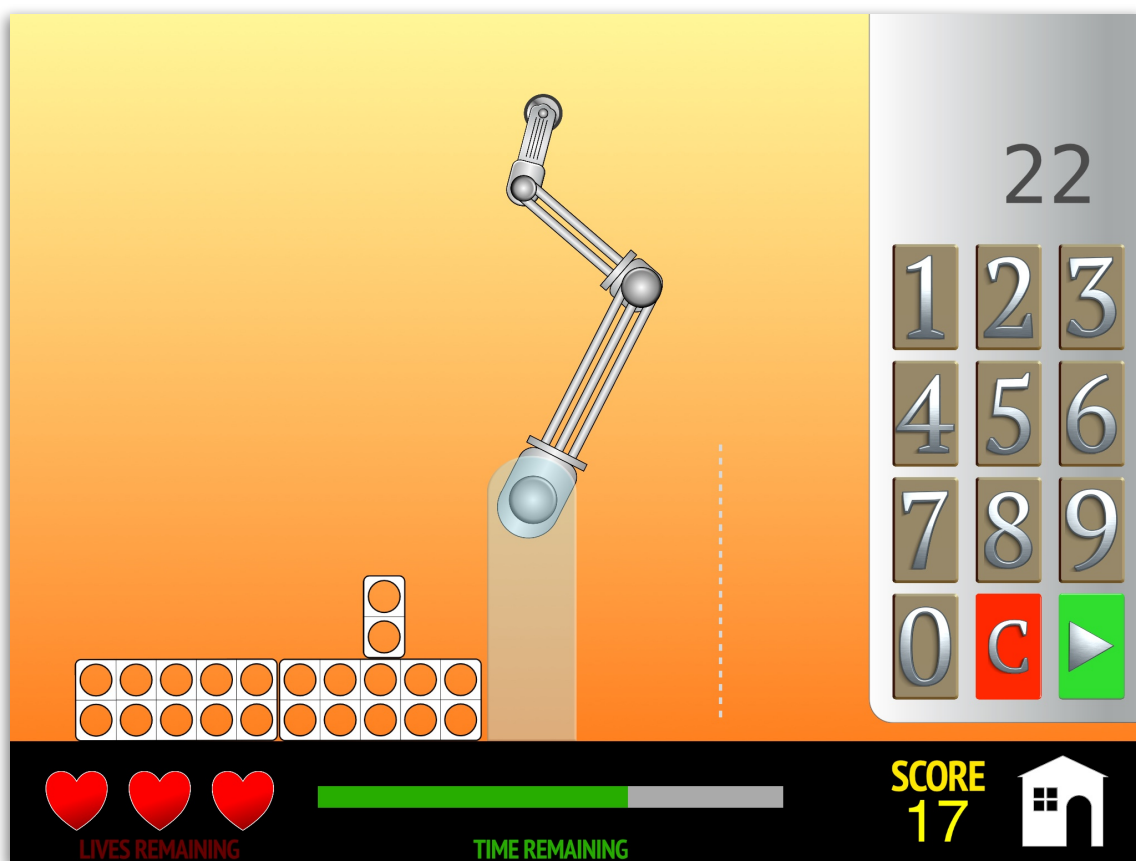
Playing the game

- A shape appears on the right of the screen - this represents the total that has to be made (seven in the example shown above).
- Tiles fall in from above and are collected in the container on the left of the screen.
- The robot arm picks up one of the tiles, and moves it to the right to cover up part of the target shape.
- The user then needs to tap on the correct tile on the left to complete the target shape.
- Correct tiles give the corresponding increase in score, while incorrect ones are returned, and result in the loss of a life.

Where to go from here

An understanding of number bonds will be important when users go on to Activity 7, 'Totals'.

Activity 5: Counting



About this activity

This activity focuses on place value - the important idea that the position of a digit in a number determines its value. Users are required to find the numerical representation of the total represented by a set of tiles.

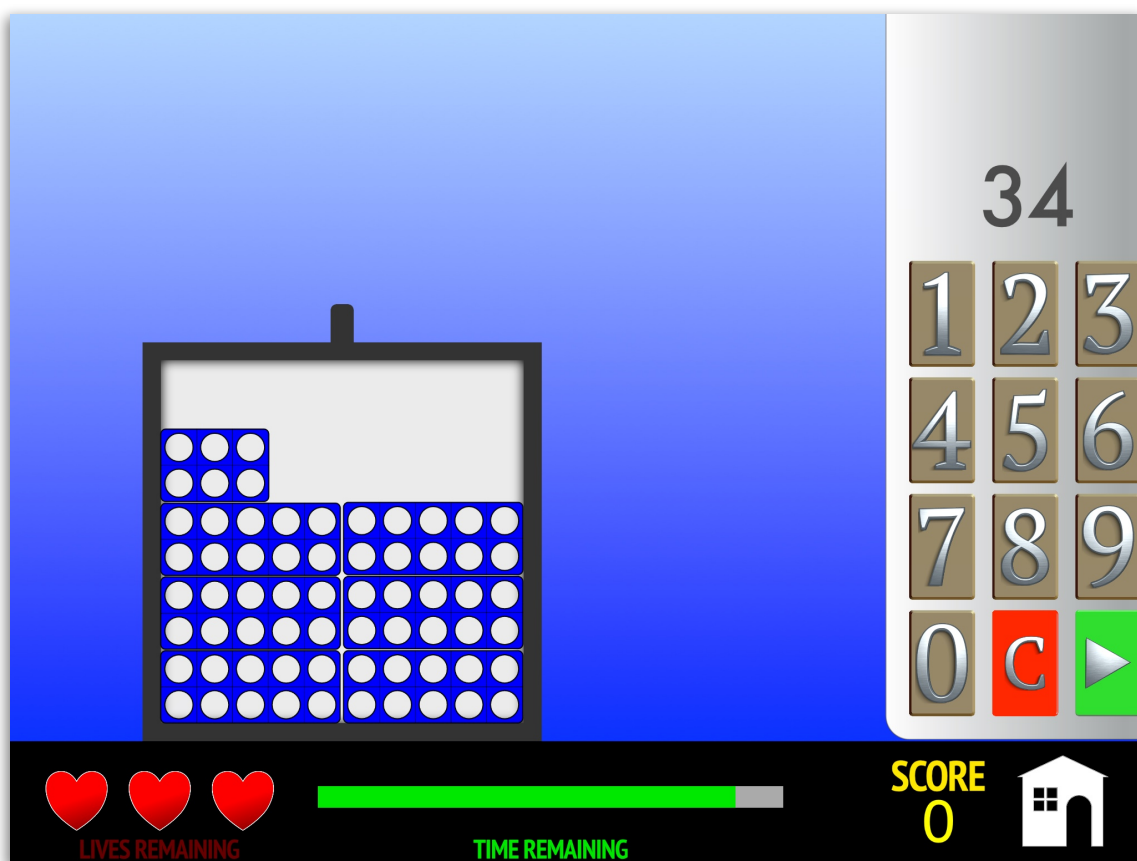
Playing the game

- A set of tiles falls into the left side of the screen. This will generally consist of a number of 'ten tiles' and a single smaller tile (although at the initial level the total may be less than 10; and the total may be a multiple of 10).
- The user uses the number keys on the right to form the corresponding number, which will appear above the keypad.
- Once the user is satisfied with the number entered, they should press the green key (or clear the current input by pressing the red key, and start again).
- Once the green key is pressed, the robot arm will collect the tiles and group them into 'tens and units' on the right side of the screen.
- If the total entered is correct, the score is incremented by the total. Incorrect totals result in the loss of a life.
- The range of totals to be found increases as the user progresses through the levels.

Where to go from here

An understanding of place value will be important when users go on to Activities 6 (Make 100) and 7 (Totals).

Activity 6: Make 100



About this activity

Users have to fill a crate with a total capacity of 100. This models the mathematics of finding 'complements to 100' - which means answering the question, 'what do we need to add to this number to make a total of 100?' The activity helps to draw attention to the links between addition and subtraction.

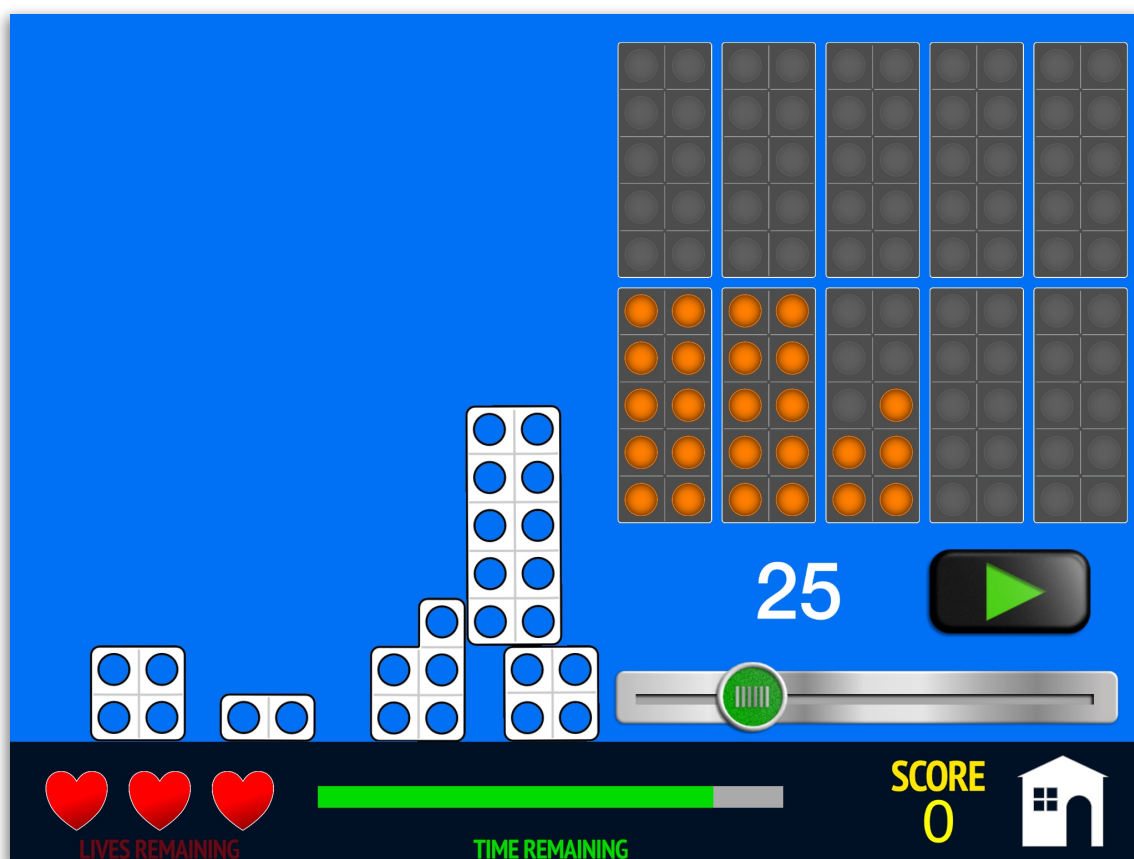
Playing the game

- A crate appears at the left of the screen, partly filled with blue number tiles.
- The user needs to use the keypad on the right to enter the number needed to fill the crate (the total capacity of the crate is always 100).
- Once the number is entered, the player presses the green button, and the corresponding tiles (coloured red) will fall into the crate.
- If the total is correct, the complete crate will be hoisted out of the screen, and the score will be incremented by the number added.
- If the total is wrong, the crate and additional tiles will be removed and a life will be lost.

Where to go from here

Both Activity 5 (Counting) and this activity involve dealing with relatively large numbers where most of the tiles are 'tens'. Activity 7 goes on to deal with large mixed sets of tiles - which quickly becomes much more challenging.

Activity 7: Totals



About this activity

This is the most challenging activity, and involves finding the total of a set of number tiles. Unlike the 'tens and units' of Activities 5 and 6, the tiles here are randomly generated. Users need to use their knowledge of number bonds and place value to find the required totals.

Playing the game

- A set of tiles drops into the left side of the screen.
- Users need to determine the total of the tiles, and use the green slider button to enter the appropriate number. The orange lights on the 'boards' at the top of the screen will light up to represent the number entered.
- Once the user is satisfied with the number entered, they should press the green arrow. The tiles will then be matched to the number displayed on the boards. Tiles will be split and combined automatically as required.
- If the total entered is correct, the score is incremented by total; if it is wrong, a life is lost.
- Note that while working out the tile total, the user can tap on any of the tiles to colour them yellow (or tap again to clear the colour). This is solely intended to make it easier to avoid double-counting or missing out tiles; the colours are cleared when the green arrow is pressed, and they have no effect on the result.

Where to go from here

This is the final activity, and probably the most challenging. Learners who successfully complete this activity may wish to try the [National Numeracy Challenge](#).

App Navigation

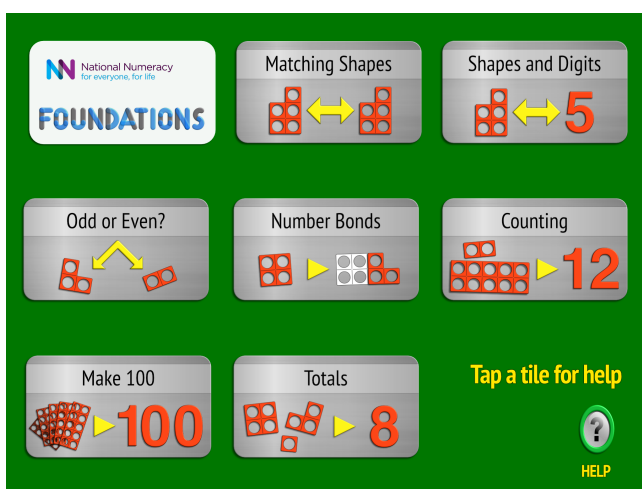


On launching the app, the Home Screen above is shown, with a large grey button for each of the seven activities.

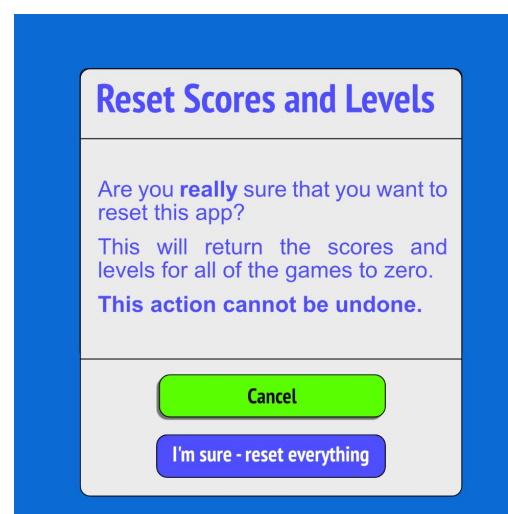
- Tapping any of these buttons will launch the corresponding activity; tapping the white 'house' icon at the bottom right of any game screen returns the user to the Home Screen.
- Below each activity button, the current level (0 - 5) is indicated by a set of stars.
- The current high score for each activity is shown below the button.

There are three other options available from the Home Screen:

- Pressing the large white button at the top left of the screen will launch the National Numeracy website, where more help and resources - including the Challenge - can be accessed.
- The buttons at the bottom right of the screen allow access to Reset and Help options, as described below.



With the Help button pressed, tap on any of the activity buttons to show a short animation explaining the activity.



Tapping the Reset button gives you the option of resetting all of the scores and levels to zero. Note that this cannot be undone.