Up & down multiples

Ready-made spreadsheets to explore mathematical ideas

Prerequisite knowledge

- Number bonds
- Experience of thinking systematically

Why do this unit?

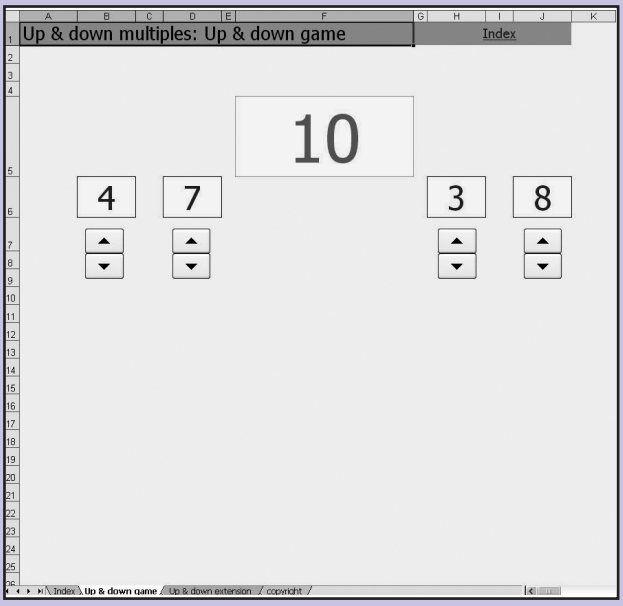
This unit offers opportunities to make and test hypotheses concerning effective strategies for winning the 'Up & down game'.

Time

One lesson

Resources

CD-ROM: spreadsheet
NRICH website (optional): www.nrich.maths.org, November 2007, 'Up & down multiples'



Introducing the unit

Use the 'Up & down game' on the spreadsheet.

Click the spinner buttons to show how the total changes. An up arrow adds the number above it to the total in the blue box and a down arrow subtracts. When demonstrating the spreadsheet make sure that the total at some point becomes a multiple of 10 so that pupils see the change in colour that this causes.

Next, click on one of the numbers above the spinner buttons (not on the buttons themselves). Use the keyboard to type in a different value and press **Enter**. Click the up and down arrows a few times to see the total change by this new amount.

Check that pupils understand how the sheet works by asking them how to get the total to zero. Check their suggestions using the spreadsheet.

The rules of the game

The 'Up & down game' is played between two people or two teams. The objective is for a team to make the total a multiple of 10 after two clicks of their spinner buttons. When a positive multiple of 10 is reached the game continues without a return to zero. The first side to achieve a multiple of 10 three times wins the game.

Each team chooses a single-digit number (excluding 5) which is typed above one of the spinner buttons on their side of the screen. Each team then chooses one more spinner button number, but this time for their opponents. That number is typed above the second button on their opponents' side.

On a turn a team must always make two clicks somewhere on their spinner buttons. For example, they might go up twice on the same button, or might make one click on each of their buttons. However, their two clicks cannot be up and down on the same button because that is equivalent to not taking a turn.
A game might start like this:

Team A with spinner button numbers 4 and 7 is playing against team B with spinner button numbers 3 and 8. The total is zero.
Team A starts and chooses 'up 4, up 4' so the total is now 8.
Team B then chooses 'up 8, down 3' and the total becomes 13.
Team A then chooses 'up 4, up 7' making the total 24.

Team B scores with 'up 3, up 3' (total 30).
The game continues from 30.

Play a game

Play the game once or twice with the whole group.

Main part of the unit

You could continue the game as a whole-class activity, but by playing in pairs or small groups pupils can identify and justify strategies to share later in the lesson and in the plenary. Encourage the class to stay focused by exploring strategic questions.

- What numbers make good combinations? [Some pairs of spinner button numbers create options that are more useful than others. For example, having both numbers even or both odd only allows the total to be changed by an even amount.]
- Why is 5 not allowed? [After an opponent scores, two clicks on 5 make an immediate return score.]
- How would you defend against particular moves? [Work out the complete set of moves that are possible. Any two spinner button numbers will give a limited set of possibilities. It is only the units (last) digit that matters – a total of 21 and 51 present the same challenge.]
- Extend the game and your strategies by scoring on multiples of other numbers (see 'Up & down extension' on the spreadsheet). What is the same and what is different?

It may be useful to stop the class from time to time to share ideas and challenge strategies. This will help pupils move on in their thinking and prepare them to offer feedback in the plenary.

Plenary

Pupils with strategies to share can use and explain them. Others can consider and challenge the justifications offered for the choice of strategies and talk about how they would play to defend themselves (defensive strategies) in response.

Playing the game once or twice as teams at the end of the lesson enables pupils to see whether they have improved their performance and are thinking more strategically.

Solution notes

Some number pairs allow more flexibility. For example, 4 and 7 allow changes to the total of 3, 8, 11 and 14 so a score is possible from a previous total ending in any digit but 5.