ROD MEASURES

   The image shows 10 = 9 + 4 - 3.

Using 3 rods of lengths from 1 to 10 units, and not using any rod more than once, you can measure all the lengths in whole units from 1 to 10 units.

For example, with rods of lengths 3, 4, and 9 the measurements are:
$1 = 4 - 3$
$2 = 9 - 4 - 3$
3
4
$5 = 9 - 4$
$6 = 9 - 3;$
$7 = 3 + 4$
$8 = 9 + 3 - 4$
9
$10 = 9 + 4 - 3$

How many ways can you find to do all these measurements with 3 rods? To be sure that you have found ALL the solutions you need to work systematically.

Do this as a group project if possible to share the work because there are many solutions.

Using 3 rods of ANY integer lengths, what is the greatest length N for which you can measure all lengths from 1 to N units inclusive? Can you beat 10 units?

What is the greatest length that can be measured using 4 rods in this way?

HELP
It would help to cut the 10 rods of lengths 1 to 10 from scrap cardboard, and to use these strips in a similar way to that shown in the image to make the different lengths.

There are many possibilities. If you are finding it difficult to get started then have a go with 2, 3 and 7. When you have made the lengths from 1 to 10 with these three lengths and recorded your results you should look for another set of three rods that will give all the lengths.

NEXT
Can you find all the lengths 1 to 13 using 3 rods?

What about four rods?

Which combinations work/do not work and why?

What has this got to do with using old-fashioned scales to find masses?