*Institute for Research in Schools*Worksheet KS3.1

Using maths to help us track a disease

1. We use the R-number of a disease to help us work out how quickly it might spread. Why do you think it is useful to have an idea of how many people might get ill with a disease and how quickly?



Knowing how many people might get ill helps health services plan to look after them. Hospitals may need to free up bed space and staff may need to be trained. If too many people get ill at the same time then hospitals might not have enough staff and equipment. Action might need to be taken to reduce the R-rate of the disease.

1. The R-number or reproduction number of a disease is the number of people one ill person infects.

If R=1, then each ill person infects one other

If R=2, then each ill person infects two others

If R=3 then each ill person infects three others

… and so on.

Each infection cycle of a person infecting the next person is called an ‘iteration’.

When R=1, it takes 100 iterations to infect 100 people.

1. How many iterations do you guess it would take to infect 100 people when the R-rate is 2?

Many students will guess fifty. The actual answer is 7 iterations (at the 7th iteration when R=2, 128 people would be infected)

1. How many iterations when the R-rate is 3?

Many students will guess 33. The answer is less than 5. At the fifth iteration with an R of 3, 243 people would be infected.

1. i) Fill in this chart. Use a dot to represent an infected person. The first row and some boxes on the second row are completed for you. Use a pencil!

**Hint: once you get to the last two rows you might prefer to put the number rather than draw all the dots!**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| R-number | First iteration | Second iteration | Third iteration | Fourth iteration | Fifth iteration | Total number infected by first ill person |
| 1 |  |  |  |  |  | 5 |
| 2  (each infected person infects two others) |  |  |  | 16 dots | 32 dots | 62 (add all the boxes together) |
| 3  (each infected person infects three others) | 3 dots | 9 dots | 27 dots | 81 dots | 243 dots | 363 |
| 4  (Each infected person infects four others) | 4 dots | 16 dots | 64 dots | 256 dots | 1,024 dots | 1364 |

1. Look back at your answers to 2 i) and ii)

Do you agree with your predictions? After filling in the table above, explain why an R-number over one can be a problem.

Most students will notice that the numbers for R-values over 1 went up much more quickly than they thought they would. This is because over an R of 1, the disease spreads rapidly due to exponential growth. There are some great animations about this available on you tube, for example.