Teachers Notes – maths dice activity

Slide 1
Climate is what we expect, weather is what we get. Edward Lorenz.
What weather can we expect in spring, summer, autumn and winter in this country? Do you have experience of seasons in any other countries? This is climate – a general picture. What is the weather like today? Does it match with seasonal expectations? Is there a recent day that does/does not? This is weather- happens day to day, hour by hour. So how is climate defined?
How can we predict climate, and still get the weather forecast wrong?

Slide 2
A simple 'climatology' can be made by rolling a die 100 times and imagining that each number gives the weather for a day, each number corresponding to a different type of weather. The average number gives a measure of the climate.

Slide 3
Yes – same as first 100 was tending towards – *is this right?*
No!
13.5
No - same probability of getting each number.
This is why scientists are able to predict how climate may change even if they cannot predict what the weather is going to be like in 5 days time. The climate, or average weather, is determined by large scale features – such as how much energy the Earth is getting from the Sun. The day to day weather is much less predictable, it can be very similar, or very different, to the climate.

Extensions:
1. How many experiments are needed?
2. How much data is needed?

Slide 4
Complex computer models of the Earth's atmosphere are run for a long period of time to produce a prediction of the **climate** in the future. (For more detailed input on this view Main-Intro powerpoint).

Climateprediction.net is an experiment involving tens of thousands of PC's to run many, many of these models to produce the best possible prediction.

Two questions are often asked.
Why must a climate model be run for such a long time?
Why are so many models needed?

Pupils can get an idea of the answers to these questions using the second worksheet which creates an Excel program ‘dice climate’.

Slide 5
Climate models need to undergo an initialisation period, but after this…

Of course, no two years are identical, either because an unusually cold or unusually warm year comes along every now and then, or because of longer term warming or cooling. To avoid the vagaries of an unusual year, and to serve as a benchmark against which to judge annual mean temperatures, meteorologists have adopted a convention of calculating a 30-year mean surface temperature. As its name implies, the **30-year mean surface temperature** is arrived at in the following way:

1) The surface temperature is recorded several times a day, every day, for a period of 30 years.
2) The 30-year mean surface temperature is then calculated by adding up all the temperature values, and dividing the sum by the total number of values.

For example, suppose that at a certain location, the temperature has been measured 10 times a day for 30 years from 1961 to 1990 inclusive. Not forgetting the seven leap years, the number of days is:
$(30 \times 365$ days$) + 7$ days $= 10957$ days
and hence the number of measurements is:
$10957 \times 10 = 109570$ measurements
Suppose also that the sum of the 109570 temperature readings is 8.8613×10^5 °C. Therefore, the 30-year mean surface temperature at that location is 8.8613×10^5 °C divided by 109570, which is 8.0873 °C. Note that we have quoted the sum of the temperatures to five significant figures. However, quoting this number of significant figures for the mean temperature is not justified because uncertainties in taking readings from the thermometer used may well be about ± 0.1 °C. There will therefore be some uncertainty in the first decimal place, so we will quote the mean temperature as 8.1 °C. By calculating a mean surface temperature, we smooth out the variability of the weather at any particular location. For example, the 30-year mean surface temperature in Birmingham is 9.6 °C, but the highest recorded temperature there is a very hot 33 °C, and the lowest is a frigid –12 °C. However, here our goal is to understand what determines the *mean* temperature, and not the short-term variations above and below it.

To replicate this using a dice would require a lot of work, however results can be obtained quickly using excel…

Slide 7
The Met Office computer makes 35 million calculations for each weather forecast. A calculation represents a timestep of 30 minutes at one point on the Earth.

Slide 8
To investigate this further look at the Excel program: *The logistic equation*