I bet you didn't know...

How to calculate the age of a shark

Prof. Dudley Shallcross, PSTT CEO, links **cutting edge research** with the **principles of primary science**

"392 YEAR OLD GREENLAND SHARK DISCOVERED!"

But how did scientists know the age?

If sharks had birthday parties you could count the number of candles on their cakes (assuming you were invited to their parties) but in reality, how can we work out their age?
This is something that we can ask our primary school children, and it would be interesting to hear their answers.

Teeth may be a good indicator: their size, number or length may be a measure of age, or perhaps they can be dated in some other way?

Would height be a good measure of children's age in your class or the whole school? If we lined everyone up according to height, would it be the same as their relative ages? Could we make a calibration curve? Would the curve work for adults or older children?

It turns out that sharks renew their teeth and even if the teeth can be dated, they will only provide a minimum age for the shark (we may want to ask the children why this is a minimum age). This may be an important factor in age determination and it is possible to extract a shark's tooth without killing the shark.

Maybe sharks have rings (like trees) and these can be used to determine age? Vertebrae (back bones) contain concentric pairs of opaque and translucent

CAN YOU CALCULATE THE AGE OF A SHARK BY LOOKING AT ITS TEETH?

bands and these band pairs can be counted to provide an estimate of the age. For example, if there are ten band pairs we may assume that the shark is ten years old. However, these rings can only be measured if the shark is dead and this is not ideal.

We may want to discuss how valid this assumption is with the children. It turns out that very careful studies of each species of shark are needed to determine their growth rate (they are all different) and that growth rate may change with time for each shark (later growth may be much slower).

We could just measure the length of the shark to provide an estimate of its age. Sharks continue to grow (as far as we know) for the whole of their lives. Measuring the length is a non-destructive way of gathering data. However, we still need some data that is reliable to calibrate the length against age (we may want to ask why).

In the 1950s and 1960s there were many nuclear bomb tests and this released a lot of ^{14}C (carbon-14) into the atmosphere. ^{14}C is the heavier sibling of the much more common ^{12}C (99% of carbon weighs in at 12 atomic mass units) and once released in the atmosphere, it forms $^{14}CO_2$ which is taken up by the oceans and vegetation and will become incorporated into food webs. We know very accurately the amount of ^{14}C that was in the atmosphere in any given year from the start of the bomb tests. So, any shark alive from the 1950s onwards will show evidence of this increase in ^{14}C. However, if there is a part of the body that it is not altered biologically from birth and retains the ^{14}C at birth, then we can work out precisely (to within a year) when the shark was born. One part of the body, the inner eye lens, is sealed off from the rest of the eye (this is true for humans too) and remains unchanged, unlike the rest of the lens. Analysis of the ^{14}C level in this inner eye lens gives a good estimate of the age of sharks born during or after the nuclear tests. So what? Well, Greenland sharks are caught inadvertently and those that cannot be saved have been killed humanely, their lenses analysed and a whole range of other parameters measured, including length. It turns out that a rather good calibration curve can be generated (length versus age) for the sharks born post-1950 and using this curve, estimates of the pre-1950 sharks can be made using their length. Although the uncertainty increases the further away from the data that was used to construct the curve, the longest shark caught was estimated to be 392 years old. Now, the length of a shark can be used to estimate its age and this can be done without killing a shark. This also means that sharks live for a very long time, much longer than previously thought. The oldest sharks may have been swimming under the ships that took the first pilgrims to the USA.

Why might sharks live so long? It would be very interesting to hear the children's views on this. An obvious reason would be that they are the top predator and apart from being caught inadvertently by humans, they have nothing that would kill them. Another may be that they have a plentiful supply of food. What other suggestions might children give?

CAN YOU CALCULATE THE AGE OF A SHARK BY MEASURING ITS LENGTH?