Age Graphing – Student Activity

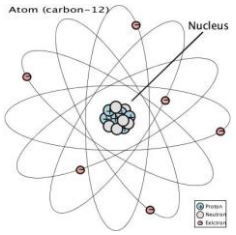
If you look at the position of the element carbon in the periodic table, you will be able to find how many electrons, protons and neutrons make an atom of carbon

Group→ / ↓Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
Lanthanides			57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
Actinides			89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

How many protons does carbon have in its nucleus? _____

If its mass number is 12, how many neutrons does carbon usually have in its nucleus? _____

How many electrons does carbon usually have in its external electron cloud? _____



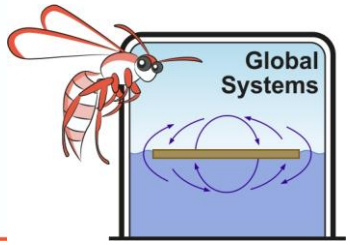
Carbon's chemical behaviour depends on the number of electrons it has within its outer shell. It can, and does have different numbers of neutrons in its nucleus.
When the average relative weight of carbon is estimated we find however that it is not 12 but **12.00096**
The measurement is precise and accurate. What could the scientific explanation for this increased number be?

_____

Isotopes have the same number of electrons and protons but differing numbers of neutrons

Carbon Isotopes

Carbon - 12 or ^{12}C has 6 neutrons	and is 99% of all carbon on Earth
Carbon – 13 or ^{13}C has 7 neutrons	and is less than 1% of all carbon on Earth
Carbon - 14 or ^{14}C has 8 neutrons	and is 1 trillionth of all carbon on Earth



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Radioactive carbon is formed in the upper atmosphere when a nitrogen atom is struck by a thermal neutron from the Sun. Write this equation below.

_____

Draw a diagram of carbon – 14 below. (HINT you can use the diagram of carbon – 12 on the previous page to help)

Carbon – 14 will react with oxygen to form carbon monoxide and subsequently carbon dioxide in the atmosphere. It will then be taken up by plants during photosynthesis and enter the food chain.

Write a balanced equation for the first reaction where carbon monoxide is formed.

_____

Write a balanced equation for the second reaction where carbon dioxide is formed.

_____

There may only be a little ^{14}C compared to ^{12}C but it is very useful. Being radioactive its path can be traced as it moves through global cycles. Its natural breakdown to more stable nitrogen occurs at a known rate and can be used to age organic materials.

Using carbon -14 to estimate age

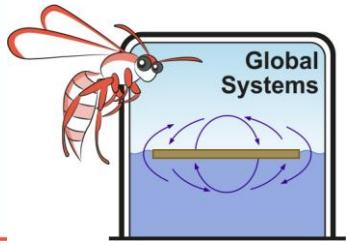
A small percentage of carbon – 14 is continuously being produced in the upper atmosphere. Plants take in carbon dioxide in the process of photosynthesis. One trillionth of this will contain carbon – 14. When the plant is later eaten by an animal, it too will have the isotope in its body.

When the plant or animal dies the unstable isotope will start to decay back to nitrogen-14. Decay occurs at a known measured rate.

The time it takes carbon – 14 to lose half of its radioactivity is 5,730 years. This is called its ***"half life".***

It will take another half-life of 5,730 years for half of the remaining carbon – 14 to break down and every 5,730 years the amount of remaining isotope will be halved. By estimating what percentage of the original amount remains we can tell how long ago the organism died.

Use the table below to estimate how much carbon- 14 remains after the first 7 half lives have passed.



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Time	Number of half lives lost	Percentage of C-14 remaining
Start	0	100%

Use the graph paper provided on the next page to draw up this data.

HINTS

Use a pencil (not 2B), ruler and eraser.
The graph should fit over most of the page and be easy to read.

What will the title of your graph be? _____

What label should you put on the X axis (horizontal axis) and which units will you use?

_____

What label should you put on the Y axis (vertical axis) and which units will you use?

_____

_____

Will this be a line graph or a bar graph? Explain your answer.

_____

_____

How much carbon – 14 remains after 9,000 years? _____

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