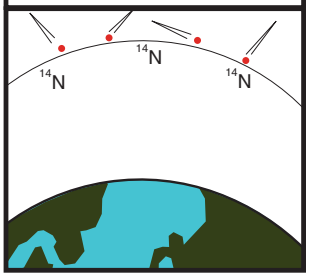
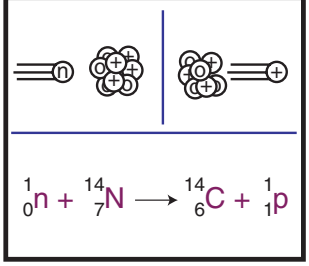
FLINN SCIENTIFIC

Answer Key—Carbon Dating Activity

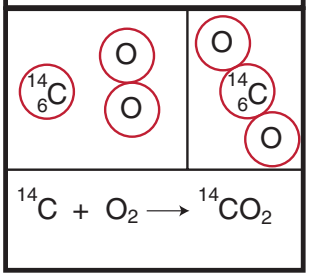
High energy neutrons from space collide with atoms in the Earth's upper atmosphere. I



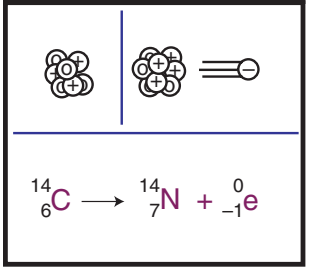
The collision of high energy neutrons with ^{14}N produces ^{14}C atoms. A proton is also ejected in the process. I



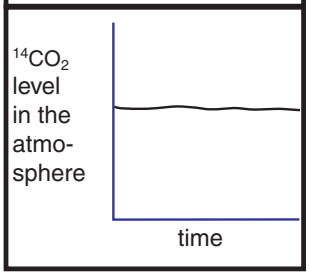
Carbon reacts with oxygen in air to produce carbon dioxide. Both $^{14}CO_2$ and $^{12}CO_2$ are produced. I



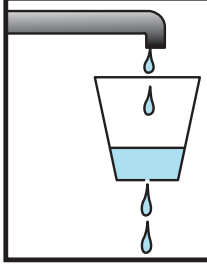
The ^{14}C in the CO_2 decays back into ^{14}N by emitting a beta particle. This decay process is very slow since ^{14}C has a long half-life (5730 years). I



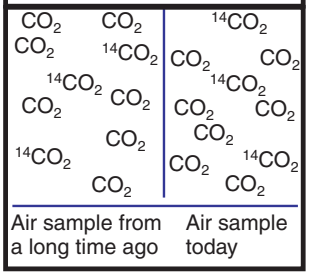
Because ^{14}C is constantly being produced (by bombardment) and depleted (by decay), it reaches a steady-state concentration in the atmosphere. I



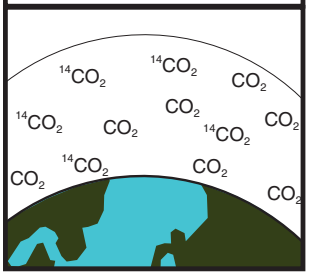
This equilibrium is comparable to water trickling into a cup with a small hole in it. The water will eventually reach a constant, stable level in the cup. I



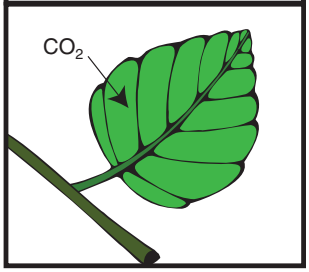
The ratio of ^{14}C to ^{12}C in atmospheric carbon dioxide remains fairly constant over time. I



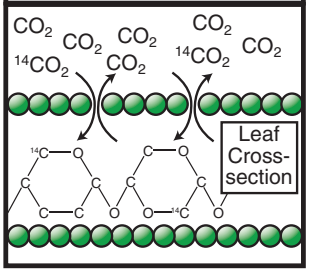
Carbon dioxide is evenly distributed throughout the entire atmosphere, even at ground level! I



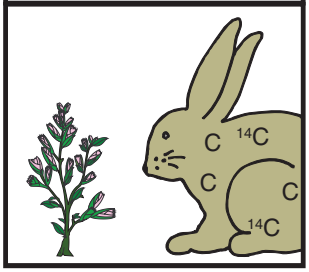
Plants consume atmospheric carbon dioxide (CO_2) during photosynthesis. II



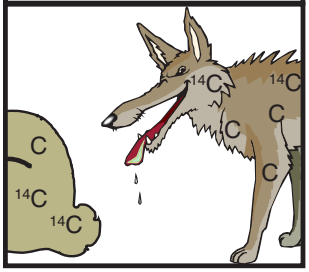
The $^{14}C/^{12}C$ ratio in carbohydrates produced during photosynthesis is equivalent to the ratio of these two isotopes in the atmosphere. II



An herbivore eats plants. It incorporates some of the carbon atoms from starch and carbohydrates into its tissue and exhales some carbon atoms in the form of carbon dioxide. II

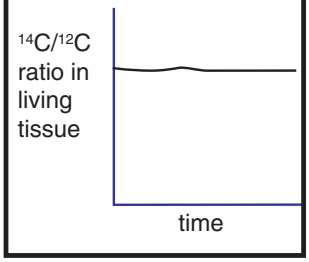


Carnivores eat herbivores and incorporate the ^{14}C stored in herbivores into their own tissues. II

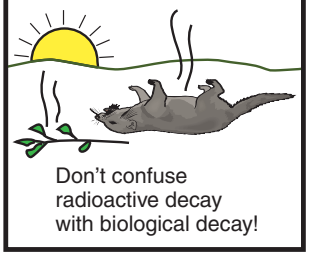


Answer Key (continued)

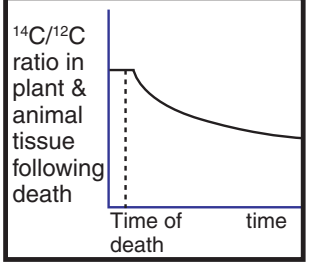
As long as an organism consumes carbon-containing materials, it will maintain a constant $^{14}C/^{12}C$ ratio. II



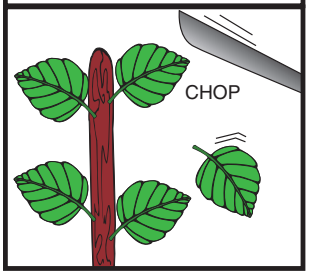
Organisms die and decay through natural processes. Any decrease in the total amount of carbon due to decomposition will not affect the $^{14}C/^{12}C$ ratio. II



The $^{14}C/^{12}C$ ratio in dead tissues decreases over time because ^{14}C decays but ^{12}C does not. II

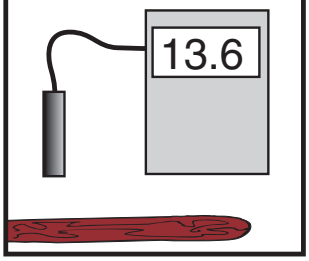


An ancient ancestor cut down a tree and carved it to make a spear. III

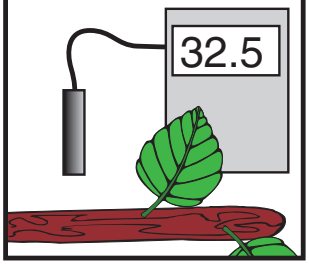


An archeologist discovers a spear or a similar carbon-based artifact. III

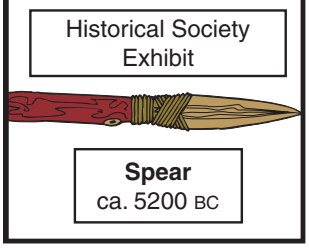
Using a Geiger counter, the radioactivity of the artifact can be measured. From this, the ratio of $^{14}C/^{12}C$ in the artifact can be calculated. III



The radioactivity can then be compared with the activity level in comparable living tissue. III



By knowing how much this ratio has decreased, we can determine how old the artifact is. This is known as carbon-14 dating. III



Modern methods of ^{14}C dating utilize mass spectrometry, which detects the number of ^{14}C and ^{12}C atoms. III