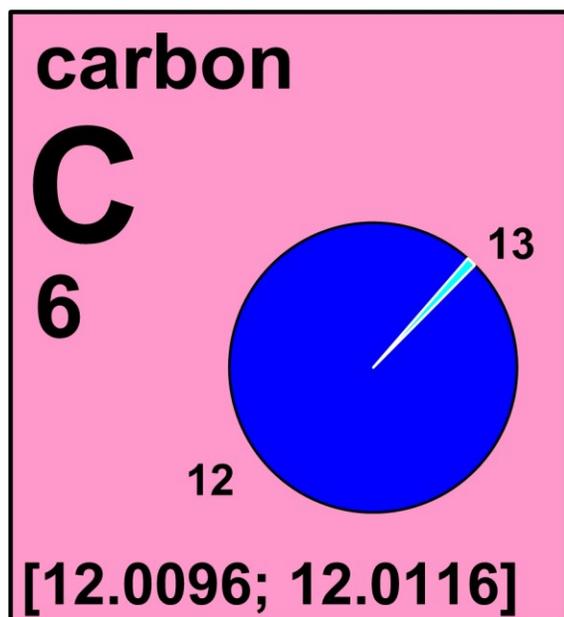


carbon

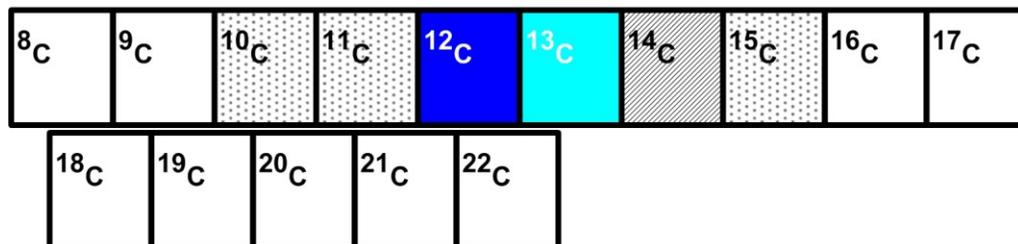


Stable isotope	Atomic mass*	Mole fraction
^{12}C	12	0.9893
^{13}C	13.003 354 8378	0.0107

* Atomic mass given in unified atomic mass units, u.

Half-life of radioactive isotope

Less than 1 second 
 Between 1 second and 1 hour 
 Greater than 1 hour 



Important applications of stable and/or radioactive isotopes

Isotopes in earth sciences

- 1) The ^{12}C isotope has been given the atomic weight of exactly 12.000 amu and provides the relative scale upon which the atomic weight of other isotopes is determined.

Isotopes in the environment

- 1) ^{14}C is the basis for the radio-carbon dating method of determination of ages of carbon bearing materials.
- 2) $^{13}\text{C}/^{12}\text{C}$ ratios in tree rings and $^{13}\text{C}/^{12}\text{C}$ ratios of CO_2 trapped in ice cores can be used to study past concentrations of atmospheric CO_2 .
- 3) The $^{13}\text{C}/^{12}\text{C}$ ratio of surface ocean waters can be used to trace the absorption of CO_2 in the ocean.

Carbon-14 Dating

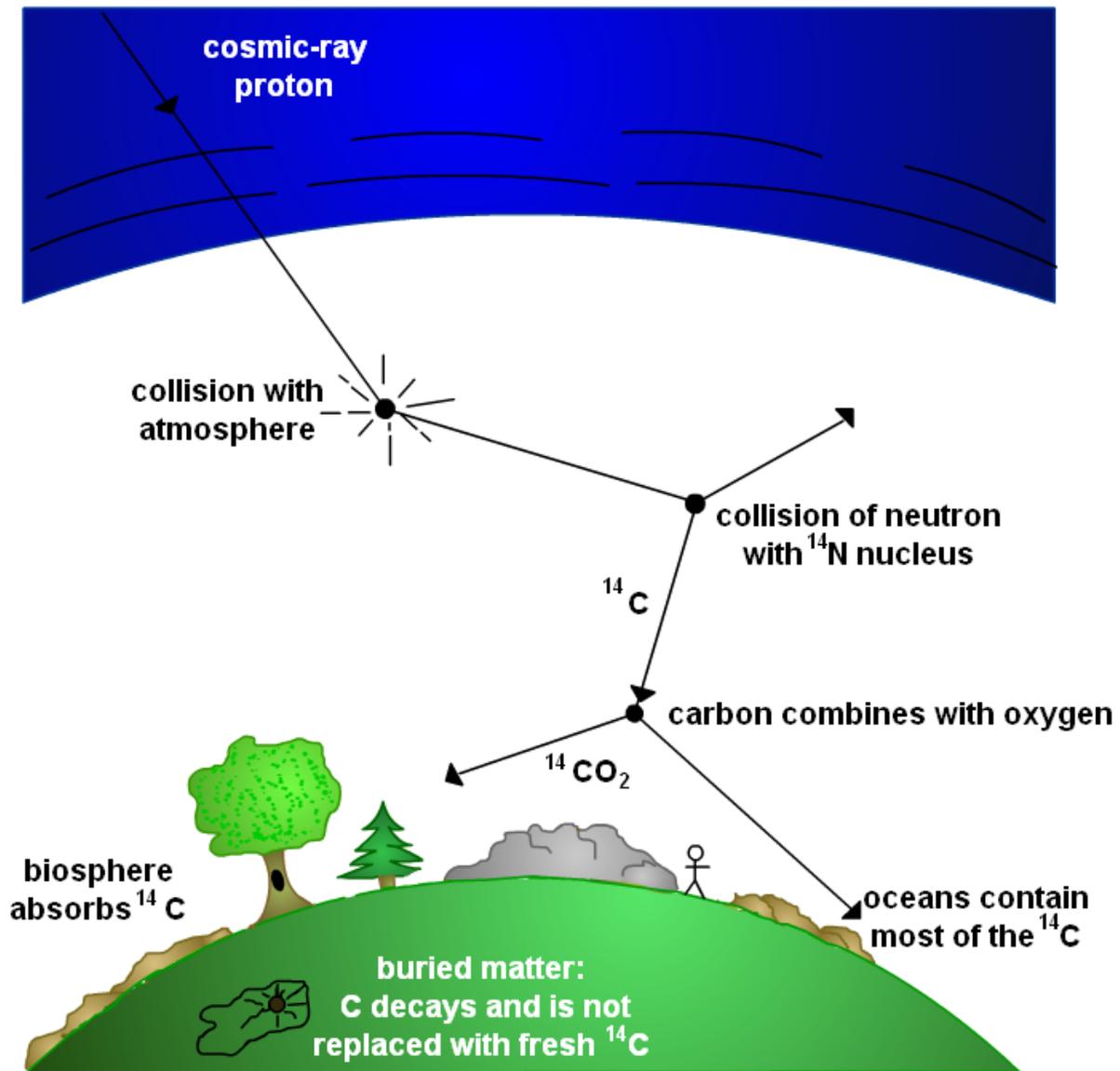


Figure 1: Schematic of ^{14}C production and decay in the atmosphere. (Diagram Source: NDT Resource Center).

Isotopes in medicine

- 1) ^{14}C is used in diagnostic medical procedures to study abnormalities of metabolism that cause gout, acromegaly, diabetes, and anemia.
- 2) ^{14}C can be used to trace the metabolism of new drugs.
- 3) ^{13}C can be used in breath tests to detect helicobacter pylori bacteria, which cause stomach ulcers.

4) ^{13}C can be used for the production of the PET radioisotope ^{13}N .

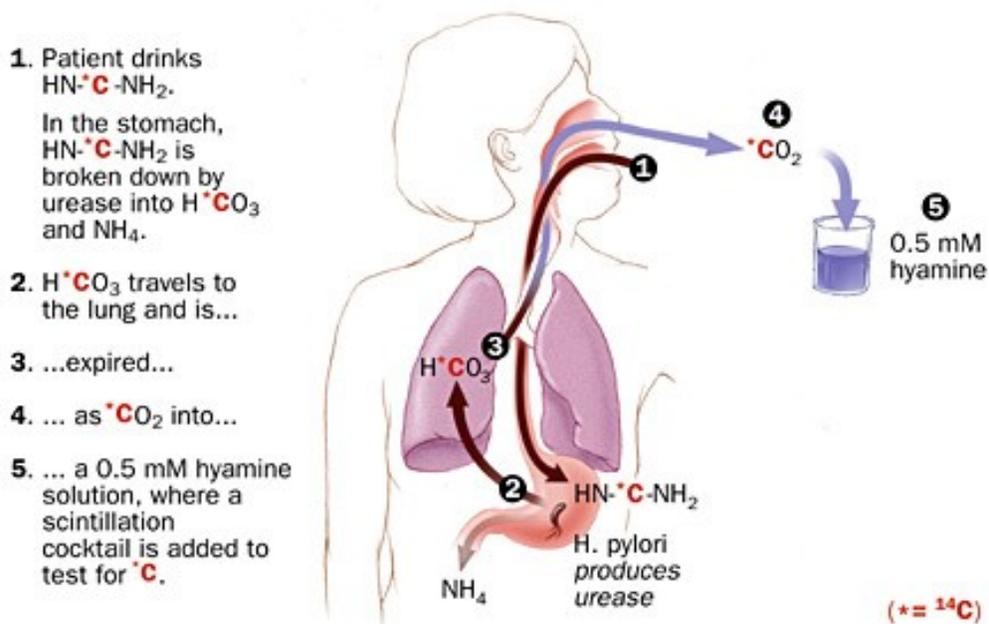


Figure 2: Diagram of Urea Breath test. (Diagram Source: Johns Hopkins Gastroenterology and Hepatology).

Isotopes in organic chemistry

- 1) Nuclear Magnetic Resonance spectroscopy (NMR) uses ^1H and ^{13}C for molecular structure determination.
- 2) Carbohydrate metabolism can be studied through in vivo ^{13}C and ^{19}F NMR spectroscopy.
- 3) There is interest in using ^{13}C NMR in DNA and RNA structure studies.