Radioactive dating

Dating techniques are procedures used by scientists to determine the age of a specimen. 2 types of Dating: *Relative Dating *Absolute Dating Relative Dating -methods tell only if one sample is older or younger than another sample. -They do not provide an age in years. Stratigraphy -Main Relative Dating Method -is the study of layers of rocks or the objects embedded within those layers. -based on the assumption that deeper layers were deposited earlier, and thus are older than more shallow layers. Seriation is the ordering of objects according to their age.

James Ford - used seriation to determine the chronological order of American Indian pottery styles in the Mississippi Valley. Absolute dating * any method of measuring the age of an event or object in years. * To determine the absolute ages of fossils and rocks, * scientists analyze isotopes of radioactive elements. Isotopes * atoms of the same element that have the same number of protons but different numbers of neutrons. * Most isotopes are stable, meaning that they stay in their original form. * Other isotopes are unstable. * Scientists call unstable isotopes radioactive.

Radioactive decay * Radioactive isotopes tend to break down into stable isotopes of the same or other elements. * Refers to the process in which a radioactive form of an element is converted into a decay product at a regular rate. - This dating is not a single method of absolute dating but instead a group of related methods for absolute dating of samples. * Because radioactive decay occurs at a steady rate, * Scientists can use the relative amounts of stable and unstable isotopes present in an object to determine the object’s age. Dating Rocks — How Does It Work? In radioactive decay, an

unstable radioactive isotope of one element breaks down into a stable isotope.

* The stable isotope may be of the same element or of a different element. Parent isotope * The unstable radioactive isotope. Daughter isotope * The stable isotope produced by the radioactive decay of the parent isotope. * The rate of radioactive decay is constant so scientists can compare the amount of parent material with the amount of daughter material to date rock. The more daughter material there is the older the rock is. Absolute Dating Methods Cation-Ratio Dating – used to date rock surfaces such as stone artifacts and cliff and ground drawings.

-this technique can only be applied to rocks from desert areas, where the varnish is most stable. *Thermoluminescence Dating – very useful for determining the age of pottery. Has the advantage of covering the time interval between radiocarbon and pottasium-argon dating or 40, 000, 000 years. *Optically Stimulated Luminescence (OSL) - very similar to thermoluminescence dating, both of which are considered “ clock setting”. * This technique can be used to determine the age of unheated sediments les than 500, 000 years old. a disadvantage to this technique is that in order to get accurate results, the sediment to be tested cannot be exposed to light, making sampling difficult. Radiometric Dating Determining the absolute age of a sample, based on the ratio of parent material to daughter material. If you know the rate of decay for a radioactive element in a rock you can figure out the absolute age of the rock. Half-life * the time needed for half of a sample of a radioactive substance to undergo radioactive decay.

After every half-life, the amount of parent material decrease by one-half. Types of Radiometric Dating Scientists use different radiometric-dating methods based on the estimated age of an object. * There are four radiometric-dating techniques. 1. Potassium-Argon Method * Potassium-40 has a half-life of 1. 3 billion years, and it decays leaving a daughter material of argon. * This method is used mainly to date rocks older than 100, 000 years. * Relies on the fact that when volcanic rocks are heated to extremely high temperatures, they release any argon trapped in them. 2. Uranium-Lead Method * Uranium-238 is a radioactive isotope with a half-life of 4. 5 billion years.

Uranium-238 decays in a series of steps to lead-206. * The uranium-lead method can be used to date rocks more than 10 million years old. 2 types of Uranium-Lead Dating *Daughter deficiency methods *Daughter excess methods * In daughter deficiency situations, the parent radioisotope is initially deposited by itself, without its daughter (the isotope into which it decays) present. * In the case of daughter excess, a larger amount of the daughter is initially deposited than the parent. 3. Rubidium-Strontium Method * The unstable parent isotope rubidium-87 forms a stable daughter isotope strontium-87.

The half-life of rubidium-87 is 49 billion years * This method is used for rocks older than 10 million years. 4. Carbon-14 Method * used to date charcoal, wood, and other biological materials. * Carbon is normally found in three forms,, the stable isotopes carbon-12 and carbon-13 and the radioactive isotope carbon-14. * Living plants and animals contain a constant ratio of carbon-14 to carbon-12. 1. Once a plant or animal dies, no new carbon is

taken in. 2. The amount of carbon-14 begins to decrease as the plant or animal decays. 3. The half-life of carbon-14 is 5, 730 years.

The carbon-14 method of radiometric dating is used mainly for dating things that lived within the last 50, 000 years. - Radiocarbon (14C) is a radioactive form of the element carbon. It decays spontaneously into nitrogen-14 (14N). Fossils: evidence of past life Fossils are the preserved remains or traces of animals (also known aszoolites), plants, and other organisms from the remote past. The totality of fossils, both discovered and undiscovered, and their placement in fossiliferous (fossil-containing) rock formations and sedimentary layers (strata) is known as the fossil record. -Fossilization processes proceed differently according to tissue type and external conditions:-- 1. Permineralization is a process of fossilization that occurs when an organism is buried. .

2. Casts and molds The remaining organism-shaped hole in the rock is called an external mold. If this hole is later filled with other minerals, it is a cast. An endocast or internal mold is formed when sediments or minerals fill the internal cavity of an organism. 3. Authigenic mineralisation This is a special form of cast and mold formation. he organism (or fragment of organism) can act as a nucleus for the precipitation of minerals such as siderite, resulting in a nodule forming around it. 4. Replacement and recrystallization Replacement occurs when the shell, bone or other tissue is replaced with another mineral. A shell is said to be recrystallized when the original skeletal compounds are still present but in a different crystal form, as from aragonite to calcite. 5. Adpression (compression-impression) Compression Fossils, such

as those of fossil ferns, are the result of chemical reduction of the complex organic molecules composing the organism's tissues.

However, the phytoleim is lost and all that remains is an impression of the organism in the rock-an impression fossil. 6. Carbon films are thin film coatings which consist predominantly of the chemical element carbon. 7. Bioimmuration occurs when a skeletal organism overgrows or otherwise subsumes another organism, preserving the latter, or an impression of it, within the skeleton Palaeontologists rely on stratigraphy to date fossils. Stratigraphy is thescienceof deciphering the " layer-cake" that is the sedimentary record.

If a fossil is found between two layers whose ages are known, the fossil's age is claimed to lie between the two known ages. Types of Fossils: 1. Index - (also known as guide fossils, indicator fossils or zone fossils) are fossils used to define and identify geologic periods (or faunal stages). 2. Trace - consist mainly of tracks and burrows, but also include coprolites (fossil feces) and marks left by feeding. - are particularly significant because they represent a data source that is not limited to animals with easily-fossilized hard parts, and they reflect animal behaviours.

Transitional - is any fossilized remains of a life form that exhibits traits common to both an ancestral group and its derived descendant group. This is especially important where the descendant group is sharply differentiated by gross anatomy and mode of living from the ancestral group. 4. Microfossils a descriptive term applied to fossilized plants and animals whose size is just at or below the level at which the fossil can be analyzed by the

naked eye. 5. Resin Fossil resin (colloquially called amber) is a natural polymer found in many types of strata throughout the world, even the Arctic.

Derived A derived, reworked or remanié fossil is a fossil found in rock made significantly later than when the fossilized animal or plant died: it happens when a hard fossil is freed from a soft rock formation by erosion and redeposited in a currently forming sedimentary deposit. 7. Wood -wood that is preserved in the fossil record. Wood is usually the part of a plant that is best preserved (and most easily found). Fossil wood may or may not be petrified. The fossil wood may be the only part of the plant that has been preserved: therefore such wood may get a special kind of botanical name.