***Class Set Do not Write On*** Examining Evolutionary Trees ***Class Set Do not Write On***

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| Background |

***Determining the age of a fossil:***

 Fossils are traces of organisms that lived in the past. When fossils are found they are carefully excavated and analyzed. One part of this analysis is to determine the age of the fossil. In **relative dating**, the approximate age of a fossil is determined by comparing this placement with that of fossils in other layers of rock.

 The **absolute age** of a fossil can be determined through **radiometric dating**. Naturally occurring radioactive parent elements break down into stable “daughter” elements. This is known as **radioactive decay**. For example; Carbon 14 is a radioactive parent that decays into Nitrogen 14, the daughter element. This process happens at a known rate called a **half-life**. In a rock or fossil sample, scientists measure the amount of radioactive parent and compare it to the amount of stable daughter element. Since the decay from parent to daughter occurs at a known rate, scientists can estimate the length of time the decay has been occurring based on the amount of parent vs. daughter element. This will determine the age of the fossil.



***Making an evolutionary tree:***

 The age and morphology (study of physical characteristics) of fossils enable scientists to place the fossils in a sequence that often shows a pattern of changes that have occurred over time. This relationship can be depicted in an evolutionary tree. An evolutionary tree is a diagram that shows the relationships between species over time.

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| Procedure:  |

1. Tape together the two pieces of paper. Copy the data table below onto the paper, make each row 3 inches high, except the title line, make this last (about an inch of remaining will be the title).

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| Trilobite Evolutionary Tree  |
| Triassic |  | 208-245 MYA |
| Permian |  | 245-290 MYA |
| Carboniferous |  | 290-362MYA |
| Devonian |  | 362-408 MYA |
| Silurian |  | 408-439 MYA |
| Ordovician |  | 439-510 MYA |
| Cambrian |  | 510-540 MYA |

1. Trilobites were aquatic invertebrates, similar to the present day horseshoe crab. Cut out each fossil on your sample sheet with the marked time period to which the fossil has been dated.
2. Arrange fossils by age. On your chart place each fossil next to the period identified with that fossil. DO NOT tape or glue them down at this point.

***NOTE:*** the term upper means more recent (top) part of the time period. Lower means an earlier part of the period

1. While keeping the fossils in the proper order, arrange them by morphology (physical characteristic).
	1. Observe the head, antennae, segments, tail.
	2. Center the oldest fossil at the bottom of the “fossils” column.
	3. Examine the next fossil in the sequence. If it appears to be exactly the same as the fossil before it, it should be placed in a vertical line directly above it.
	4. When a fossil appears that is different from any before it, it should be placed ½ inch to the left of the fossil directly before it creating a new branch.
	5. When a fossil appears that is not exactly like the one directly before it but is exactly like one from a previous period, here’s what to do: First place it in the correct period, then position it so that it is in a direct vertical line to the identical fossil.

**Example**

* 1. There may be certain periods when the fossils split into two branches. In other words, one fossil from the period shows one type of change, and another fossil from the same period will show a different type of change. When this occurs, place one of these fossils ½ inch to the left of the preceding fossil and place the other fossil ½ inch to the right of the preceding fossils. This creates 2 new branches. Draw a line to indicate each separate branch.
	2. Continue through all the time periods. Continue to place fossils directly above any preceding fossil it is identical to. Remember to place any branching fossils to the left or right accordingly.

New Branch

New Branch

New Branch

1

2

3

4

Original Lineage

An evolutionary tree may follow a pattern similar to this diagram

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| Pre-Lab Questions  |

1. How is the age of a fossil determined through relative dating?
2. How is the age of a fossil determined through absolute (also called radiometric) dating?
3. What is a half-life?

1. What does an evolutionary tree show?

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| Analysis Questions  |

1. Give a brief description of the evolutionary changes that occurred in the trilobites by comparing the trilobites in the original lineage with the trilobites in the last branch. Discuss changes to the structure (Such as change in antennae, body size, and appearance of exoskeleton).
2. **A.** How many different branches of trilobites existed from the Cambrian period through the Permian period (include the original lineage in your answer).

**B.** What reasons could you give for the absence of trilobite fossils in the Triassic and Jurassic Periods?