

## Exploring the KU Natural History Museum

### Shared Characters and Evolutionary Trees

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**Target Audience:** Middle school and above

#### Differentiated Instruction Summary

Strategy	Levels*	Content/Process/Product	Grouping(s)**
Tiering	Readiness (two versions)	Content Process	Small groups Peer partners Homogeneous Heterogeneous

\* Readiness: Different tasks rely to a greater or lesser extent on information provided explicitly in museum exhibit labels

\*\* Varied grouping options can be used for this activity, depending on student needs and chaperone ability, but pairs or small groups are probably best.

**Objective:** To observe shared characters of taxa and interpret/depict them within the context of an evolutionary tree diagram.

**Pre-assessment:** Prior to their visit, students should be familiar with the idea of phylogeny and shared characters, and have basic tree reading skills.

**Activity Description:** Tiered activity in which students observe and record shared characters and draw a tree diagram to depict relationships.

#### Version 1

Students complete a chart summarizing shared characters among a set of taxa, and draw a tree diagram that is consistent with the data they collected. In this version, characters investigated are referred to in associated exhibit text.

#### Version 2

Students complete a chart summarizing shared characters among a set of taxa, and draw a tree diagram that is consistent with the data they collected. In this version, more than one character supports some branches, characters investigated include a reversal or secondary loss of a character, and not all characters are explicitly referred to in associated exhibit text.

#### Materials Needed:

- Student
  - Shared Characters and Tree handouts (see attached)
  - Pencils or pen
- Teacher
  - Content Outline

#### Content: Evolutionary Trees

Evolutionary tree diagrams are branching diagrams (dendrograms) that depict the phylogenetic relationships between taxa based on shared derived characters (synapomorphies) that reflect common ancestry. Phylogenies depict an historical pattern of divergence and descent as series of

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branches; these branches merge at points representing common ancestry, which in turn are connected with more distant ancestors.

**Tree Diagrams.** The key parts of a tree diagram are the nodes, branches and the root. The terminal nodes or tips of the tree represent the taxa (organism or group of organisms) whose relationships are being shown; the nodes represent ancestral species; these are connected with other taxa through branches that join at internal nodes—these represent a relationship term; and the outgroup is the most distantly related taxa in the tree, and is used to root the tree and indicate the most recent common ancestor shared by all the taxa. Alternatively, the internal nodes can represent speciation events with segments of the 'main branch' from the root representing ancestral species, and branches to the tips depicting lineages evolving through time.

Shared derived characters (synapomorphies) that support these relationships can be included on the tree at relevant points. It is important to note that a shared derived character (synapomorphy) in one context can be a shared ancestral character in another (sympleisomorphy); hair would be a synapomorphy in a tree that include all vertebrates, but would be a sympleisomorphy in a tree with only mammals.

NOTE: Research indicates that explicitly including a time direction in tree diagrams is helpful.

**Tree Resources.** A comprehensive suite of information and resources about trees can be found on *The Tree Room* website ([www.treerom.org](http://www.treerom.org)) including a primer, a field guide to help you and your students read and interpret virtually any style tree, and an overview of common misinterpretations and intuitive ideas about evolutionary trees.

Exploring the KU Natural History Museum  
**Shared Characters and Trees (Version 1)**

Explore the museum exhibits in BugTown and complete both parts of this activity.

**Part A** – Find these organisms on exhibit and complete the character table below. Use a check mark or ‘X’ to indicate if that character is present in each organism.

Shared Characters	Trilobite	Spider	Grasshopper	Assassin Bug
Three body sections				
Hard exoskeleton				
One pair of antennae				
Piercing/Sucking mouthparts				

**Part B** – Draw a tree diagram in the space below that shows the relationships between the organisms in the above table and plot the characters on the diagram.

Exploring the KU Natural History Museum  
**Shared Characters and Trees (Version 2)**

Explore the museum exhibits on the 3<sup>rd</sup> Floor and complete both parts of this activity.

**Part A** – Find these organisms on exhibit and complete the character table below. Use a check mark or 'X' to indicate if that character is present in each organism.

Shared Characters	<i>Phacops</i> (trilobite)	<i>Xiphactinus</i> (fish)	<i>Clidastes</i> (mosasaur)	<i>Teleoceras</i> (wooly rhino)	<i>Smilodon</i> (sabre-tooth)	<i>Porthochelys</i> (turtle)
Forelimbs with a single bone that articulates with the body						
Lower jaw composed of a single bone						
Skull detached from pelvic girdle (shoulder bones)						
Backbone						
Teeth						

**Part B** – Draw a tree diagram in the space below that shows the relationships between the organisms in the above table and plot the characters on the diagram.

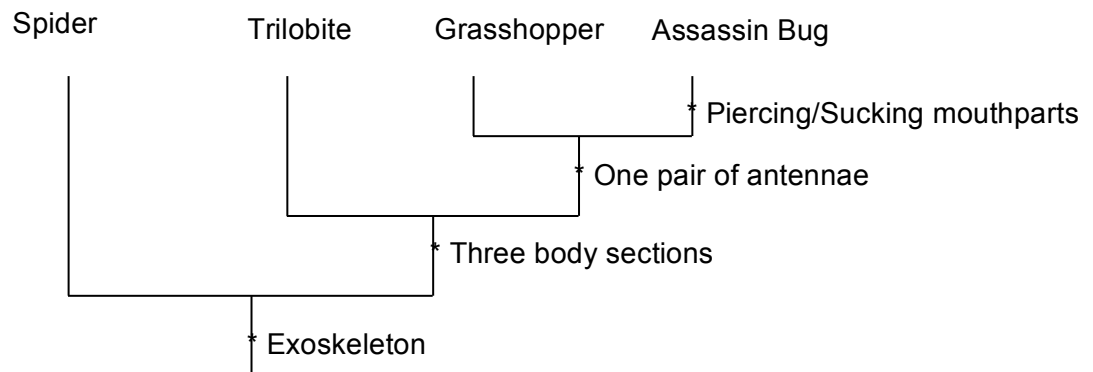
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### Rubric: Shared Characters and Trees (Version 1)

#### Part A

Shared Characters	Trilobite	Spider	Grasshopper	Assassin Bug
Three body sections	X	0	X	X
Exoskeleton	X	X	X	X
One pair of antennae	X	0	X	X
Piercing/Sucking mouthparts	0	0	0	X

#### Part B



Item	Needs further support	Meets Expectations	Exceeds Expectations
Character Chart	All characters not correctly identified	All characters correctly identified	Additional characters identified
Tree	Branching pattern correct and characters marked correctly	Branching pattern correct and characters marked correctly	Additional variables included in diagram (e.g. time direction, common ancestor labeled)

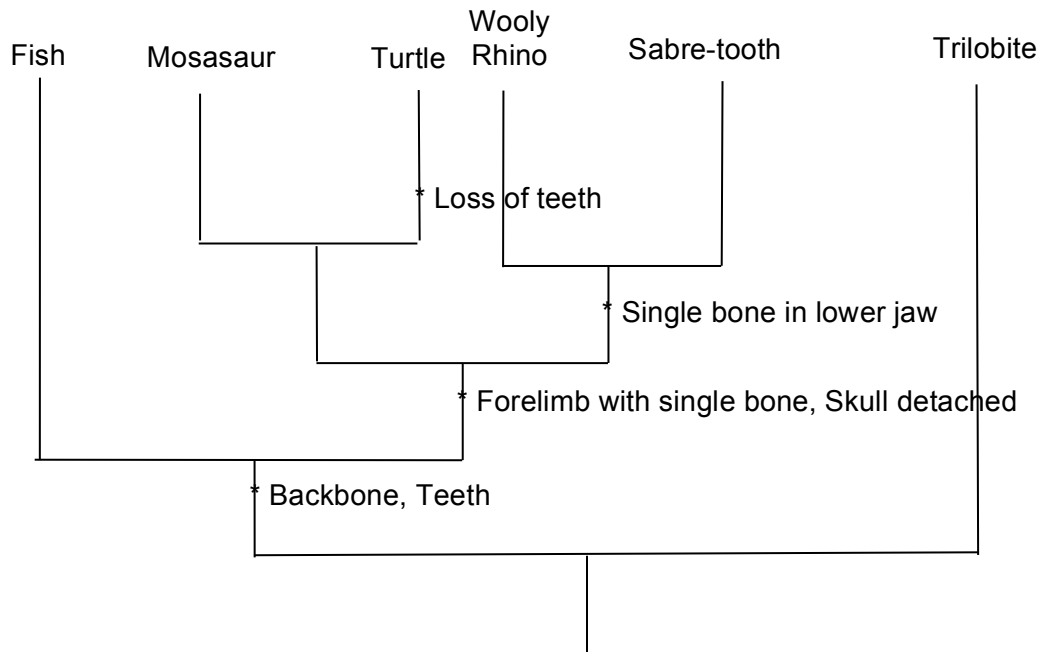
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### Rubric: Shared Characters and Trees (Version 2)

#### Part A

Shared Characters	<i>Phacops</i> (trilobite)	<i>Xiphactinus</i> (fish)	<i>Clidastes</i> (mosasaur)	<i>Teleoceras</i> (wooly rhino)	<i>Smilodon</i> (sabre-tooth)	<i>Porthochelys</i> (turtle)
Forelimbs with a single bone that articulates with the body	0	0	X	X	X	X
Lower jaw composed of a single bone	0	0	0	X	X	0
Skull detached from pelvic girdle (shoulder bones)	0	0	X	X	X	X
Backbone	0	X	X	X	X	X
Teeth	0	X	X	X	X	0

#### Part B



Item	Needs further support	Meets Expectations	Exceeds Expectations
Character Chart	All characters not correctly identified	All characters correctly identified	Additional characters identified
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