

Title: Climate Creations using Dragonflies

HS-LS4-1 Biological Evolution: Unity and Diversity

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, fossils, and order of appearance of structures in embryological development.]

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

Objectives:

- How do we define **climate**? How is climate different from **environment**?
- How can change in climate affect how life evolves?
(Specifically, what was the effect of extra atmospheric oxygen on insects?)

Activities:

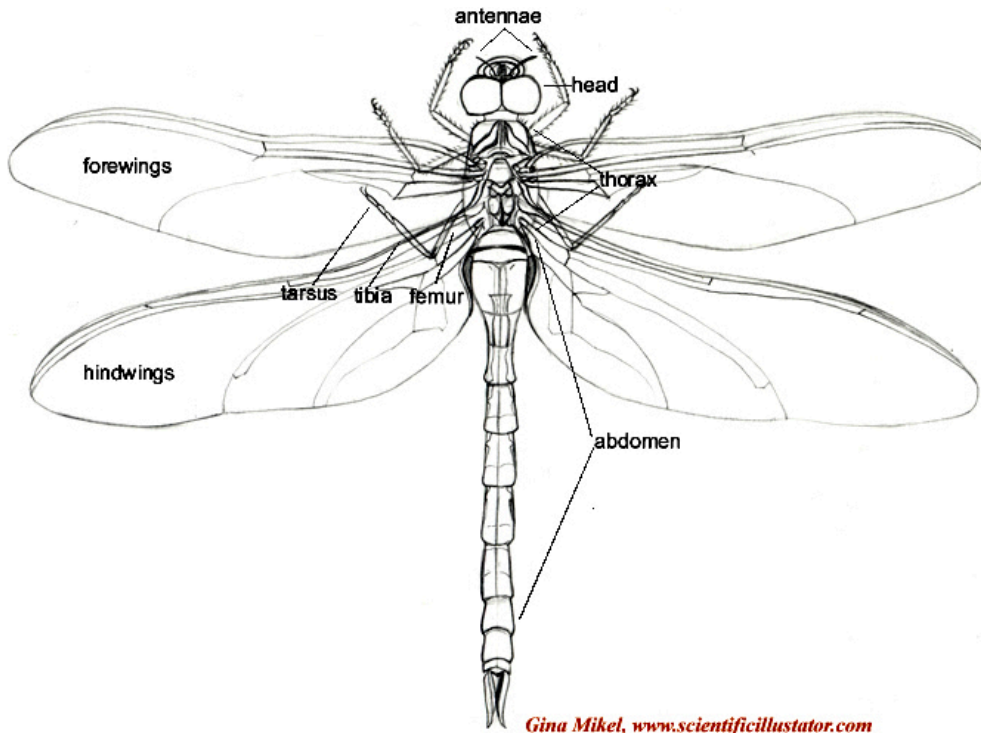
1. Climate Creations: Compare today with the Carboniferous. How do the climates and environments differ? Identify specific climatic differences.
 - i. Teacher prepares and shares a graph of atmospheric O₂ and CO₂ over the past 400 million years such as [this](#) simple oxygen graph.
 - ii. HHMI: EarthViewer available for mobile devices [here](#)
 - iii. or for laptops - <http://www.hhmi.org/biointeractive/earthviewer>
 - a. After discussion around climates and environments of today and carboniferous lead to [Glossopteris](#)(gigantic plant producing lots of O₂ and not a lot of other animals eating plants. Temperature changes? [\(need link for this\)](#)
- [Meganeuropsis \(dragonfly-like\)](#) example of Carboniferous.

QFocus: Animal evolution is a result of resources available in the environment.

2. Fossil and Modern Species Measurements:

What is the size ratio of wing width and length to body length? [Need fossil pictures of dragonfly wing and measured photos of modern dragonflies] We would want to have several different species (multiple specimens of each) of dragonflies so that student groups could select a specific species to explore and extrapolate data for the model building. Measure the fossil wing's width and length. Choose a modern species and collect data on wing length and width as well as body length. Calculate an average ratio of wing length and width to body length.

Labeled structural image of a dragonfly:



3. Modeling of Ancient Dragonfly-What was the size of the ancient dragonfly? Build a model of the Carboniferous form of dragonfly based on the selected modern species of dragonfly/related species. How can mathematics help to determine the proper scale of the insects' ancient form?

* we need this picture with a scale for measuring and any other pictures of the same species!

4. Student Conclusion/Summary: (guiding questions) Why the size difference in the ancient versus modern dragonflies? What was the advantage to each version of the organism in terms of survival? Discuss the potential body structures of the ancient forms based on the modern species used to collect data. Explain how the varying functions/ lifestyles of the modern species affect the interpretation of the ancient species.

Resources:

<http://www.ucmp.berkeley.edu/seedplants/pteridosperms/glossopterids.html>

<http://news.nationalgeographic.com/news/2007/07/070730-giant-insects.html>

Extension activity:

Honors project to investigate the sources of fossil fuels, and the implication of rapidly releasing carbon that was stored over tens of millions of years.

Going further...

Nat Geo article about oxygen toxicity:

<http://news.nationalgeographic.com/news/2011/08/110808-ancient-insects-bugs-giants-oxygen-animals-science/>

Items we need:

Odonata (scale needs to be added to existing modern image on iDigPaleo)



Added to iDigPaleo: Harvard Image of Meganeuropsis whole wing:

<https://www.idigbio.org/portal/mediarecords/e4815d24-7fb7-430c-b9e7-40daec091177>

More Odonata images, both modern and fossils

Background section(?)