Trilobite Lab

The class Trilobita, an extinct group of arthropods, form a widely diverse set of successful animals. Though now extinct they survived from the early Paleozoic (524 Ma, early-mid Cambrian) till the end of the Paleozoic (250 Ma, late Permian). Their fossil forms are cosmopolitan and abundant in many areas. Paleontologists have described 20,000 species, comprising ten orders and over 150 families. Trilobites were present near the beginning of early Cambrian radiation of early animals. They are also amongst the best known of all extinct groups. Some of the earliest trilobites known belong to the Order Redlichiida, with the Suborder Olenellina, within Redlichiida, being considered rather primitive in traits (ancestral type). Though having all the **derived** characters that fit the Redlichiida into the class Trilobita, many of these traits became highly modified in other trilobite groups. Trilobite sizes ranged from just under a millimeter to over 70 cm in length. Ecologically, trilobites are known to occupy a great variety of feeding niches. Fortey (2004) lists five major feeding habitats for 11 contemporaneous species of trilobites from a local quarry in Whitland, South Wales.

In this lab you will be using character states of the animals provided to determine a potential phylogenetic tree (a branching of possible ancestral history). The organisms are actual organisms, but no longer extant (no longer living, so they won't sue you if you provide an improper family for them). You will need to learn their anatomy and make quantitative (measured) and qualitative assessments to determine how the traits apply (if present) to each of your representative samples. Build in the tree (on your own lab notebook you can label it with the names of the organisms (or glued pictures and names if enough pictures are available).

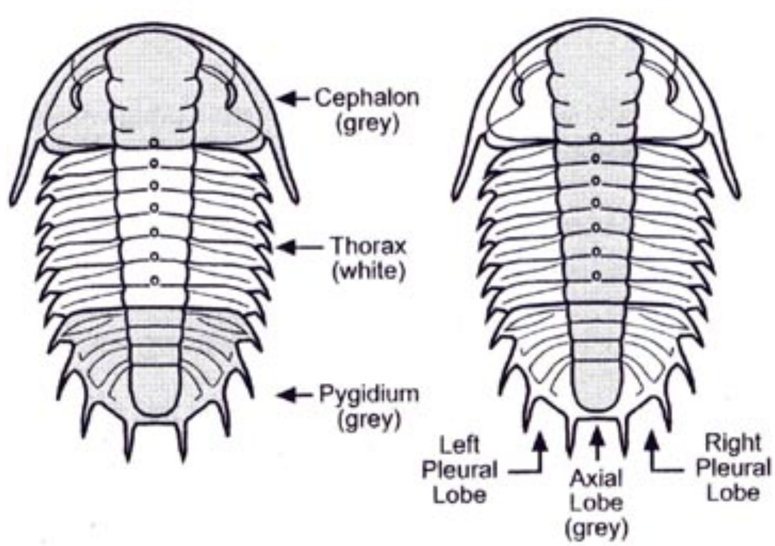

Figure from: http://palaeo.gly.bris.ac.uk/palaeofiles/fossilgroups/trilobites/page2.htm

Trilobite anatomical features of the dorsal area that you should know:

Cephalon (head region)

1) Glabella, center of cephalon
2) Compound eyes (placed on either side of the glabella
3) Occipital ring – behind the glabella, joins the cephalon to the first of the axial rings of the thorax
4) Fixed cheek – medial to the eyes, and free cheek, lateral to the eyes
5) Genal spine – posterior facing corners of the lateral margins of the cephalon (present in many species

Thorax (central region)

1) Axial rings (2-several dozen) – central segments. These were flexible and allowed the animal to move and even roll it's body into a protective ball.
2) Pleurae or pleural spines – lateral attachments to the axial rings.

Pygidium (posterior body section)

1) Number of segments and ornamentation is quite varied. These segments are fused into a single rigid shield that could be used when rolled into a defensive ball position.

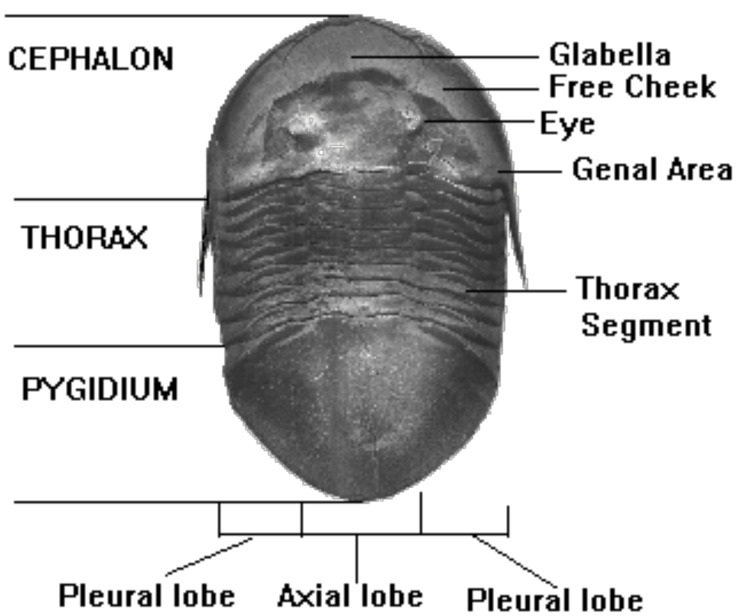

Figure from: http://drydredgers.org/fragiso1.htm

Trilobite Dorsal Anatomy

Character traits that have been used to classify the trilobite orders include the following:

Facial sutures

Glabellar shape and pattern

Eyes

Thoracic features and number of segments [# segments varies from 2 to 30]

Pygidial shape, size and segmentation [pygidium is the last of the three major body parts of a trilobite]

Spinosity – development of spinal processes in many areas of the skeleton.

Additional modifications of characters in evolutionary trends for trilobites include the following:

Ornate body patterns: numerous fenestrations or pitted cephalic region [porous openings] and spinal elaborations from any of the three major body parts (cephalon, thorax, pygidium) – though this modification is useful in determining species and genera relationships, it has been observed in more than one order and can not be considered a true derived trait to distinguish ordinal clades.

Elongate form: body is extended in an anterior-posterior direction and thinner in the lateral directions.

Transverse form: body is shortened, so that the lateral sides appear bloated outwards.

Increased segments

Reduced segments

Shape and placement of the eyes and eye ridges

If you are comparing relative sizes of specific structures between individuals then compare a proportional ratio. Ex. the ratio of the length/width (of first thoracic segment)

Many evolutionary trends in morphology developed in unrelated clades, so that homoplasic forms (convergent forms) were frequently produced. Many of these homeomorphic trends include effacement (loss of furrows between major body segments), increased spinosity, reduction in body size, streamline shape, and loss (or reduction) of eyes. These traits can not be used reliably to discriminate evolutionary relationships and are most likely a result of similar selection pressures in different trilobite lineages.

Methods:

Become familiar with trilobite body form and dorsal anatomy. Determine which structures are going to be used as possible derived traits in the non- Redlichiida trilobites. Use the Redlichiida specimen as your model for the most primitive character states. Make a table that lists the trilobites and the character traits being used. Work out a possible phylogenetic tree, based upon your character evaluations for the representative trilobites given to you.

Trilobite #									
1									
2									
3									
4									
5									
6									
7									

(You may consider cutting and pasting the table above into your lab notebook)

Questions:

Can you be certain the traits used are homologous (derived) or homoplasic (convergent)? Give an example of each definition using the trilobite traits.

How would increasing the number of specimens (say to 100) available make the phylogeny easier and more difficult? Would the phylogeny be a more accurate depiction of the evolution of this group with more specimens? Why?

References:

Fortey, R. A. 2000. Trilobite! Eyewitness to Evolution. New York: Knopf. 284 pg.

Fortey, R. A. 2004. The Lifestyles of the Trilobites. Am. Sci., Vol. 92: 446-453.

Gon III, S. "A Guide to the Orders of Trilobites." www.trilobites.info

Levi-Setti, R. 1993. Trilobites. Chicago and London: University of Chicago Press. 342 pg.