

Biology of Invertebrates

Spring 2015

Homework # 3: Evolution of Eyes

Due Monday 3/23 but no later than Wednesday 3/25 in class

*This assignment is to be submitted individually. You must read the article by W.J. Dickinson (*Trends in Genetics* 11: 119-121) and T.H. Oakley (*Trends in Ecology and Evolution* 18: 623-627) posted on our [www](#) site to complete this assignment.*

Our working definition of an “eye”: an organ of vision or light sensitivity

The current debate about the evolution of image-forming eyes

In recent years there has been a fairly avid debate about the evolution of image-forming eyes. One camp in this debate highlights conserved genetic features (i.e. *pax 6* and homologous genes found in both fruitflies and vertebrate eyes) in arguing that all image-forming eyes evolved from a common ancestral prototype **image-forming** eye. That is, they support the idea that all image-forming eyes are **homologous**. The opposing camp emphasizes the great variation in animal eye structure and advocates the idea that image-forming-eyes evolved independently multiple times in many lineages. In this view, structural and similarities between image-forming eyes in distant lineages (i.e. the cephalopod and vertebrate eyes) are the result of **convergent evolution**. Any genetic similarities in development exist because the same genes from the nervous system were recruited into different eyes (i.e. **gene co-option**) in the course of separate morphological evolutionary origins.

Question #1: W. Joseph Dickinson published a short commentary in which he stated that the relationship between homology of molecules and homology of anatomical features was not a simple one. What is the key point made by Dickinson in his short commentary, and how is this point relevant to the debate about the evolution of image-forming eyes and specifically to the view that all image-forming eyes are homologous? (4 pt)

Question #2: The fundamental question posed by Todd Oakley in a subsequent paper was “How can such similar developmental genetic processes underlie such widely divergent eye morphologies”? Explain the hypothesis he proposes to answer this question. Your explanation should include an analysis of how Oakley’s hypothesis seems to “reconcile” the two opposing perspectives on eye evolution that I described in the introduction (4 pt).

Question #3: After reading these papers and thinking about the two sides of the eye argument you must have your own perspective on the debate. To which argument do you ascribe (Homology or convergence or some compromise view)? Support your ideas using evidence from the papers you read or any other sources (but cite any other sources you use). (2 pt).