

PROBLEM SET #7 (lectures 34-36)

1. Understand the following terms regarding the evolution of animal form.

homeotic	segmentation	gene complex
homology	cluster duplication	Hox zones
serial homology	cephalochordate	forelimb
Urbilateria	tetrapod	coordinate systems
homolog	genetic toolkit	paralog
Pax-6	ortholog	lobopodian

2. Many vertebrate *Hox* genes resemble each other in sequence as well as insect *Hox* genes. Describe an experiment that would test whether certain vertebrate *Hox* genes are more similar to one particular insect *Hox* gene than to other insect *Hox* genes.
3. The *tinman* gene controls heart formation in flies and a homologous family of genes controls heart formation in vertebrates. What are two alternative explanations for the similar roles of similar genes in these vastly different animals?
4. The position of the second stripe of *even-skipped* gene expression is determined by various trans- or cis-acting factors. What are these factors? What are two different kinds of genetic mutations that would cause the stripe not to form? What kind of mutation could cause the stripe to expand?
5. You have cloned a newly discovered gene, called *Bucky*, from a badger.
- How would you find out if this gene exists in other animals?
 - You discover one copy of the *Bucky* gene in a sponge, a sea urchin, and an earthworm and four copies in a chicken and six copies in a gorilla. Explain the evolutionary history of this gene in light of metazoan phylogeny. Draw a diagram mapping the evolution of gene number onto a tree of these animals.
6. Some insects have a long proboscis for drinking nectar, others have a pointed proboscis for piercing prey and sucking the juices out of them. All developing probosci express the *pb Hox* gene. How would you explain the morphological diversity of these structures?
7. A protein X is postulated to directly control the expression of a gene Y. How would you test this hypothesis: a) *in vitro*; b) *in vivo*?
8. A human patient presents with polydactyly, six fingers on each hand. Why is this likely to be a regulatory mutation and not due to a change in a protein?

9. Hox proteins have been called “micromanagers”. Explain