Drosophila Anterior/Posterior Patterning Worksheet

1. Briefly describe the process of anterior/posterior axis formation in Drosophila. What are the key stages of embryogenesis involved?
2. Define maternal effect genes and explain their role in early Drosophila development.
3. How do bicoid and nanos gradients influence anterior/posterior patterning? Provide examples of their specific effects.
4. What happens if the bicoid gene is mutated? Describe the resulting phenotype.
5. Explain the function of gap genes in Drosophila segmentation. Provide examples.
6. Describe the phenotypic consequences of a hunchback mutation in Drosophila.
7. What are pair-rule genes? How do they contribute to segmentation in Drosophila?
8. Compare the roles of even-skipped and fushi tarazu genes in the development of segments.
9. What is the role of segment polarity genes in maintaining segment boundaries? Provide two examples.
10. How does the engrailed gene contribute to segment polarity?
11. Explain how homeotic (Hox) genes determine segment identity in Drosophila. Provide examples of genes from the Antennapedia complex.
12. What are the phenotypic effects of a mutation in the bithorax complex?
13. Describe how genetic mutations in maternal effect or gap genes can alter Drosophila embryonic development.
14. Given a Drosophila embryo lacking nanos expression, predict the resulting phenotype and explain why.
15. How can studying Drosophila anterior/posterior patterning contribute to understanding human developmental biology?
16. Design an experiment to investigate the effect of artificially altering bicoid gradient levels on embryonic development.

Solutions

1. **Introduction:** The anterior/posterior axis is established during early embryogenesis through the distribution of maternal effect gene products. Stages include oogenesis, fertilization, and early cleavage divisions.

2. Maternal effect genes like bicoid provide positional information by forming gradients of morphogens.

3. Bicoid specifies the anterior end, while nanos specifies the posterior end. Gradients regulate gap and pair-rule gene expression.

4. A bicoid mutation results in embryos lacking anterior structures, leading to a phenotype with posterior structures at both ends.

5. Gap genes define broad regions of the embryo. Examples: hunchback, Kruppel.

6. Hunchback mutation disrupts anterior segmentation, leading to a loss of head and thoracic structures.

7. Pair-rule genes establish alternating segment patterns. Examples: even-skipped (odd-numbered segments) and fushi tarazu (even-numbered segments).

8. Even-skipped defines odd segments, while fushi tarazu defines even segments. Both contribute to alternating segment formation.

9. Segment polarity genes maintain boundaries within segments. Examples: engrailed, wingless.

10. Engrailed defines posterior compartment cells, crucial for segment boundary maintenance.

11. Hox genes assign identities to segments. Example: Antennapedia specifies thoracic segment identity.

12. Bithorax complex mutations cause homeotic transformations, such as a haltere converting into a wing.

13. Mutations in maternal or gap genes disrupt axis formation, leading to severe developmental defects.

14. Without nanos, posterior structures fail to develop, resulting in an embryo

with duplicated anterior structures.

15. Studying Drosophila aids in understanding conserved mechanisms in vertebrates, including humans.

16. Experiment: Inject embryos with varying levels of bicoid mRNA and assess changes in head/thorax development.