1. The dorsal-ventral patterning of the Drosophila embryo begins with the dorsal-ventral patterning of the oocyte. Nurse cells produce a maternal mRNA called gurken that contains a 3' UTR localization signal causing it to become associated with the oocyte nucleus.

2. The localized gurken mRNA encodes an EGF signaling molecule that preferentially interacts with dorsal follicle cells. This localized EGF signaling results in the restricted activation of pipe expression in ventral follicle cells, which in turn, results in the localized activation of the Spaetzle ligand and Toll receptor in ventral regions of the early embryo.

3. Localized activation of Toll signaling leads to the formation of a broad Dorsal nuclear gradient. The Toll-Dorsal signaling pathway is highly conserved in higher animals, and is used for innate immunity and the differentiation of mammalian blood cells.

4. In Drosophila, the Dorsal gradient controls the dorsal-ventral patterning of the early embryo by regulating about 50 target genes in a concentration-dependent manner. The resulting expression patterns establish a number of embryonic tissues, including the mesoderm, ventral neurogenic ectoderm and dorsal neurogenic ectoderm.

5. The affinities of Dorsal binding sites play a role in establishing different DV (dorsal-ventral) expression patterns. The mesoderm is specified by two Dorsal target genes, Twist and Snail, which contain low affinity binding sites. Only high levels of Dorsal can bind these sites and activate gene expression, thereby restricting Twist and Snail expression to ventral regions.

6. The ventral neurogenic ectoderm depends on the localized expression of rhomboid (rho) in ventral-lateral regions where there are intermediate levels of the Dorsal protein. The rho enhancer contains a mixture of low and high affinity Dorsal binding sites. The increased affinities of Dorsal binding sites allow lower levels of Dorsal to activate rho expression.

7. Finally, the entire neurogenic ectoderm, both ventral and dorsal regions, depends on the expression of a number of developmental patterning genes, including Sog, which is related to the vertebrate Chordin inhibitor of BMP signaling. The sog intronic enhancer contains a series of optimal and evenly spaced Dorsal binding sites that can bind high, intermediate, and even low levels of the Dorsal gradient. As a result, sog expression is broadly activated throughout the neurogenic ectoderm.

8. The boundary between the mesoderm and neurogenic ectoderm is formed by the localized expression of snail. The encoded Snail protein functions as a sequence-specific repressor that binds to the sog and rho enhancers, and keeps their expression off in the ventral mesoderm and restricted to lateral regions that form the neurogenic ectoderm.

9. Practice question: Predict the phenotype of mutant embryos derived from females that express pipe in all follicle cells in both dorsal and ventral regions of the egg chamber.