BIMA52 **Tentamen i utvecklingsbiologi**	
Namn:	**G** ☐ **UK** ☐
Personnummer:	**Points:** ***(Erasmus grading:)***

You can write your answers either in English or Swedish.
IMPORTANT: write your name on the bottom of each side.

Short questions:
Answer these questions using words only, or a short sentence.

1. a) Which is the inhibitory system (composed of 2 key proteins) that mutually inhibits the sex fate determination of the other sex during primary sex determination in mammals? (1p)

b) Is the Turner syndrome associated with males or females? Which is the chromosomal composition of a Turner individual? (1p)

c) How many cleavage cycle does the early *Drosophila* embryo undergo before gastrulation and how long do the early cleavage cycles last?

d) What cell biological phenomenon does the sperm entry trigger in the *C. elegans* embryo? (1p)

2. a) Briefly explain the role of *nanos* during patterning of the *Drosophila* embryo? Mention molecular function, its target and its effect on embryonic pattern. (1p)

b) There are several different families of proteoglycan core proteins. Mention the difference in protein structure between at least two families. (1p)

c) How is the cell surface receptor that specifies the terminal regions (anterior and posterior end) of the Drosophila embryo activated? (1p)

d) Give an example of a gene that could be mutated (homozygous mutant) in an embryo that is missing several non-adjacent body segments. (1p)

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3. a) Which morphological structure in the fish blastula is functionally equivalent to the amphibian Spemann organizer. (1p)

b) Explain two important functions that are characteristic for all tissue organizers. (1p)

c) What is the first morphologically visible sign of gastrulation in the amphibian embryo and where does this sign occur? (1p)

d) Explain the consequences that occur when a fertilized *Xenopus* egg is UV-irradiated. (1p)

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4. a) Hedgehog is produced as an inactive precursor. Which post-translational modifications must occur to create the active Hedgehog signaling molecule. (1p)

b) A blastomere is transplanted to the outside of a mouse embryo at the four-cell stage. Which tissue is this blastomere most likely to contribute to at the blastocyst stage and what will that tissue develop into? (1p)

c) Which morphological structure plays a central role for the invagination of anteriorly and posteriorly located cells during gastrulation in amniotes. In which region does this structure originate? (1p)

d) Give an example of a secreted protein that is expressed in a left-right asymmetric fashion during vertebrate embryogenesis and mention its function. (1p)

5. a) Folate (folic acid, vitamin B9) appears to have a particular importance during the early stages of the nervous system formation. What process is it necessary for? (1p)

b) Describe briefly the difference between primary and secondary neurulation! (1p)

c) Growth cones are during the development of the nervous system important for outgrowth and navigation of nerve fibers. Name an **intracellular** protein that is involved in these growth cone activities. Motivate your answer! (1p)

d) Name two genes that are of major importance for the development of the eye! (1p)

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6. a) Hox genes have several functions during pattern formation of the limbs. Name two of them. (1 p)

b) Briefly describe an experiment that leads to polydactyly? (1p)

c) List two specific functions of Bone morphogenetic proteins in the developing limb? (1p)

d) Name two stem cells that can be found in the human skin! (1p)

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7. a) Which signaling molecules (secreted by the notochord) are required for dorsal pancreatic bud induction? (1p)

b) Name two signals and their respective locations along the left/right body axis that ensure that the heart tube loops to the left side. (1p)

c) Name the structures of the mammalian heart, which develop from (i) the primary and (ii) the secondary heart field! (1p)

d) Name at least 4 teratogens! (1p: of which 2 or 3 will give 0.5 points, 4 or more will give 1 point).

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In the essay section, describe more in detail. But: stay focused such that we understand what you mean!

E1. Describe all mechanisms that prevent polyspermy in the sea urchin **and** the mouse system. Preferentially use drawings. Name the layers that are involved in the different mechanisms. Also: indicate the components of the layers! (5p).

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E2. Describe establishment of the dorsal-ventral axis in the Drosophila oocyte prior to fertilization and subdivision of the dorsal ventral axis into regions of specific gene activity in the embryo following fertilization. (5p)

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E3. Describe the sequence of events that leads from sperm entry to formation of the Spemann organizer in the amphibian embryo. Mention the gene products involved and their function. (5p)

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E4. Describe the role of extraembryonic tissues in the establishment of anterior-posterior polarity during early development of the mouse embryo. Include structure of the embryo, tissue movements and molecular components involved (5p).

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E5. When the neural tube has formed, it undergoes a ventral-to-dorsal patterning. Give the main signals that regulate this, and describe where these signals come from. Use figures! (5p).

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E6. Newts can replace a perfectly functional leg upon partial amputation. How is this type of regeneration (mechanism) called? Describe the cellular changes. Compare the molecular processes to those of normal limb development. (5p).

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E7. Describe the mechanisms controlling kidney development. Which morphological events are characteristic, which signaling molecules are involved and where are they secreted from? (5p)

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