BIMA52 HT 2014 **Exam in Developmental Biology**	**2014-11-03**
Number	**passed** ☐ **not passed** ☐
Time when exam was left back:	**Points:** ***(Erasmus grading:)***

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

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

1. a) Describe at least 2 biochemical changes at the sperm membrane during sperm capacitation! (2p)

b) What happens to sperms when they approach an egg where the ZP2 is not cleaved? (2p)

c) How many cells are present when compaction in mice occurs? (2p)

d) Describe at least 2 cellular environments of model systems where the PAR3/6 proteins play a role! (2p)

2. a) Briefly explain the term "positional information" in the context of embryonic development. (2p)

2b) Briefly outline formation of the Drosophila cellular blastoderm embryo from the fertilized oocyte (no molecular components required). (2p)

2c) Which type of gene (category) would you suspect to be homozygous mutant (loss of function) in a Drosophila larva in which several adjacent body segments have identical appearances? (2p)

2d) Briefly explain the role of the small GTPase Rho1 during gastrulation in the Drosophila embryo. (2p)

3a) Briefly explain the term “embryonic induction”. (2p)

3b) Describe briefly the molecular asymmetry that results from “cortical rotation” in amphibians. (2p)

3c) Mention two functions of the “embryonic shield” in fish. (2p)

3d) Briefly explain the term “epiboly”. (2p)

4a) What are blastomeres that are transplanted to the outside of a mammalian embryo at the four-cell stage most likely to contribute to? (2p)

4b) Briefly outline the factors that establish anterior-posterior polarity in the mammalian gastrula. (2p)

4c) Briefly outline the derivation of embryonic and extraembryonic tissues in the mammalian blastocyst. (2p)

4d) Briefly outline the establishment of left-right asymmetry in the chicken embryo. (2p)

5a) Prosencephalon, mesencephalon and rhombencephalon are structures that can be seen when the nervous system develops. What are these structures, and at which point in the development do they appear? (2p)

5b) From what structure in the developing nervous system are the peripheral nerves originating, and where is this structure located? (2p)

5c) What is Nerve Growth Factor (NGF) and what can it do? (2p)

5d) Eye formation involves reciprocal interactions between the neural tube and the ectoderm. What is the relevant structure (or site) in the ectoderm for this interaction called? (2p)

6a) Briefly describe an experiment that leads to mirror-duplication of the limb! (2p)

6b) Give an example of limb tissue that undergoes apoptosis during development and name a secreted signal that mediates cell death! (2p)

6c) Name and briefly explain two roles of BMP signals in limb development! (2p)

6d) Flatworms can replace head and tail structures when sectioned. What mechanism of regeneration is this phenomenon based on? Name the key cell type that is involved in flatworm regeneration! (2p)

7a) Describe the role of GDNF in kidney development. (2p)

7b) Which structures are derived from the somite? (2p)

7c) Name the signaling molecules secreted from the heart that are critical for endodermal organ induction? Which organs are induced? (2p)

7d) Describe at least 2 effects of Bisphenol A on experimental model systems. (2p)

number

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

E1. Outline how sex determination occurs at the time point of the bipotential genital ridge. Name important genes that are important for specification of the sex of the gonad. Name also the structures that are built up later, but that eventually disappear again during subsequent stages. Preferentially use figures. (10p)

E2. Describe formation of a mature Drosophila egg chamber from germline and somatic stem cells. Include molecular events and tissue interactions that establish polarity in the egg. Outline how a signal that is received by somatic follicle cells is transduced from the cell surface to the nucleus. (10p)

number

E3. Describe in detail the establishment of anterior-posterior polarity in the amphibian embryo. Include morphological events and molecular mechanisms. (10p)

number

E4. Starting at the blastocyst stage, describe the morphological and molecular events that lead to positioning of the primitive streak in the mammalian pre-gastrula embryo. (10p)

number

E5. Describe, using also figures, how the spinal cord of vertebrates gets its characteristic appearance (central canal, gray matter, white matter)! (10p)

number

E6. In the chick mutant *limbless*, limb bud outgrowth is initiated, but formation of leg and wing structures does not occur. Further analysis reveals that the limb buds in the mutant embryo are dorsalized and lack a ventral polarity.

a. Explain why the failure to establish a ventral polarity prevent the limb bud from growing out!

b. Discuss, what effect the failure of limb outgrowth could have on anteroposterior limb pattering?

c. Give two examples of possible gene mutations and explain how they could cause limb bud dorsalization? (10p)

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E7. The heart is the first functional organ that forms in the vertebrate embryo. Describe the principal stages of heart development and comment on the molecular signals that are involved! Compare the fates of the primary and secondary (= anterior) heart fields! What evolutionary advantage could you envision for the invention of the secondary heart field in higher vertebrates? (10p)

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