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 equivalent of the zona pellucida in the sea urchin egg? (1p)

b) Which two **secreted** factors "push" the undifferentiated gonad into female ovary development? (1p)

c) Which chromosome composition does a Klinefelter individuum have? (1p)

d) a) Which structures will develop from the Müllerian duct? (1p)

2. a) Signaling through the TGFα family member *gurken* is employed twice during establishment of the axes in the *Drosophila* oocyte. Which cells receive the second signal and how do they react in response to it? (1p)

b) Explain the role of *nanos* during patterning of the *Drosophila* embryo? Mention molecular function and its effect on embryonic pattern. (1p)

c) How is the Spemann organizer induced in the *Xenopus* embryo? (1p)

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

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

b) Which morphological structure that occurs during gastrulation in birds and mammals corresponds to the lateral blastopore lip. (1p)

c) Explain two important characteristics of an organizer? (1p)

d) Which extraembryonic tissue plays an important role in mouse axis formation and which axis does it induce? (1p)

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4. a) Name two components of the signaling pathway that controls development of the terminal regions in the early *Drosophila* embryo and indicate their function (*Drosophila* gene names are not required). (1p)

b) Briefly explain the role of proteoglycans during the establishment of morphogen gradients and mention a family of proteoglycan core proteins. (1p)

c) Give examples of a ligand and a receptor involved in juxtacrine signaling. (1p)

d) In which embryonic structure can Left-Right asymmetry first be detected and what is it that can be observed. (1p)

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5. a) N-cadherin is a type of cell adhesion molecule that can be present on certain cell types. When two cells connect, what would an N-cadherin molecule on the one cell bind to on the other cell? (1p)

b) How can a neuron's "birth-date" in a developing organism be established? (1p)

c) Name a protein from the so called neurotrophin family. (1p)

d) The formation of eyes starts with a single eye-field. Name a molecule that is important for splitting up the single eye-field into two developing eyes! (1p)

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6. a) Which signaling center is responsible for determining the anteroposterior polarity of the limb bud? Name the signal that is secreted? (1p)

b) How is the tissue of dedifferentiated, proliferating cells called that forms after amputation of a leg in salamanders? What signal drives the regrowth of the missing part of the leg? (1p)

c) Define the term “stem cell” and give an example in the adult skin. (1p)

d) Explain the term morphallaxis! In what organism can it be found? (1p)

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7. a) Which signal(s) from the notochord control somite differentiation? Which cell type are they acting on? (1p)

b) Name one signal and its site of origin that specifies the cardiac mesoderm from splanchnic mesoderm. (1p)

c) The four-chambered heart in birds and mammals develops only in part from the linear heart tube. Name at least one additional cell source that contributes to the mature heart and clarify what heart structure it forms. (1p)

d) Which is the enzyme that is involved in the temperature-dependent sex determination of turtles or alligators?(1p)

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

E1. Outline the development of the sperm and the egg and name the different stages. Use dwawings! Also indicate time scales. Indicate the major differences between sperm and egg development. (5p)

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E2. Asymmetric distribution of proteins plays a key role during the establishment of embryonic axes and can be achieved in various ways.
Briefly describe two different mechanisms and give an example for each. (5p)

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E3. Describe the emergence of cell lineages and early asymmetries in the mouse embryo before gastrulation. Mention molecular factors involved, their function and tissue specific expression. (5p)

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E4. Describe the mechanism establishing segment polarity in the *Drosophila* ventral epidermis. Mention the molecular pathways involved as well as their mechanism of function. (This does not include the mechanism of axis specification). (5p)

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E5. The induction of the neurectoderm is a defining event during development. Name at least two secreted molecules that help in this induction, and define their type of action as well as their origin. State also what would happen if they were in some way stopped from exerting their effect. (5p)

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E6. During the development of fingers, bone morphogenetic proteins (BMPs) play distinct roles. What are these? Where are the BMPs expressed? Describe the experiments that showed an involvement of BMPs. How can one and the same signal trigger different responses? (5p)

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E7. Lung development illustrates how epithelial mesenchymal interactions regulate branching morphogenesis. Describe how lung bud formation and branching is initiated and progresses during development. Which genes are required, where are they expressed, and how do they regulate lung formation? (5p)

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