UNIVERSITY
OF SKÖVDE

School of Bioscience

WRITTEN EXAMINATION

Course Evolution G1F

Sub-course

Course code BV314G

Credits for written examination 4.5

Date 2025-08-15

Examination time 08:15 - 13:30

Examination responsible Tomas Jonsson

Teachers concerned Tomas Jonsson

Aid at the exam/appendices No aids (Inga hjälpmedel)

Other Take a new sheet of paper when starting every new part of the exam (4 parts)!
(Börja varje del av tentan (4 delar) på nytt blad!)

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☒ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points If every course objective has been passed (≥50% score on every objective) the final grade is set by the total score according to the following (preliminary) scale: A >= 90%, B >= 80%, C >= 70%, D >= 60%, E >= 50%

Examination results should be made public within 18 working days

Good luck!

Total number of pages 6

Written reexam Evolution BV314G Ht25

Dear student! Welcome to the final exam on the course Evolution (BV314G).

I suggest that you:

- Read through all the questions before you start writing. Note questions if you need to ask me something. I will be visiting you at least once during the exam.
- Take a new sheet of paper when starting every new part of the exam (4 parts)!
- Read every question carefully. If needed, read it more than once.
- Start with the questions you think are easy. This builds confidence and is smart time management.
- Write clear and precise answers that answers the actual question.
- If you draw figures or images to help with your explanation, make sure to explain the drawing with words. **Also, make sure that you include specifications of axes in every diagrams!** Figures or images without explanations will not be rewarded any points.

Grade points: The exam consists of **four parts** corresponding to learning objectives. Each objective is tested by 3-4 questions. The maximum score for each knowledge objective is **10 points**. To pass the exam you must score 50% or more of the total points on each of the four objectives. The final grade on the exam, provided that a pass has been reached, is determined by total score according to the following scale: A $\geq$ 90 %, B $\geq$ 80 %, C $\geq$70 % and D $\geq$ 60 %

I wish you good luck!

Sincerely Tomas Jonsson (Responsible teacher)

1. **Part 1. Learning objective: the student should be able to explain and analyse evolutionary mechanisms (such as adaptation, fitness, mutations, genetic drift, migration) as well as different types of selection, and discuss their relevance for the process of evolution.**

   Questions (10p, E ≥ 5p):

   1.1. **In English:** Describe *The fundamental theorem of natural selection*. Your description should include a definition of *fitness* and explain what the theorem means and how natural selection, via fitness, is linked to *adaptation*. (4p)

   In Swedish: Beskriv *The fundamental theorem of natural selection* ("Det fundamentala teoremet för naturlig selektion"). Din redogörelse ska innehålla en definition av *fitness* och förklara vad det innebär och hur naturlig selektion, via fitness, är kopplat till *adaptation*. (4p)

   1.2. **In English:** In addition to directional, stabilizing and disruptive selection which are part of ordinary (normal) natural selection, there are some other types of selection. Describe:

   a) *intra*sexual selection (2p),
   b) *inter*sexual selection (2p) and
   c) frequency-dependent selection (2p)

   More specifically, explain the meaning of each type of selection and what the results can be (*i*) in terms of types of traits (parts a & b) and (*ii*) change in traits over time (part c). Use examples if you find it useful. (6p in total)

   In Swedish: Utöver riktad, stabiliserande och splittrande selektion, som är varianter på normal naturlig selektion, finns det andra typer av selektion. Beskriv:

   a) *intra*sexuell selektion (2p),
   b) *inter*sexuell selektion (2p) samt
   c) frekvensberoende selektion (2p)

   Mer specifikt, förklara innebörden av varje typ av selektion och vad resultaten kan bli (*i*) i termer av typer av egenskaper (delfrågor a & b) och (*ii*) förändring av egenskaper över tid (delfråga c). Exemplifiera gärna. (6p totalt)

2. **Part 2. Learning objective: the student should be able to describe how the view of species and their (in)variance over time has changed historically, describe main features in the evolutionary history of organisms (including the evolution of humans) and theories about the origin of life and evolution of the cell.**

   Questions (10p, E ≥ 5p):

   2.1. **In English:** Briefly describe two problems/weaknesses in the theory of evolution (= 'Darwin's dilemmas') when it finally was presented in 1859 and how they eventually were 'solved'. (2p)

   In Swedish: Redogör kortfattat för två problem/svagheter med evolutionsteorin (= "Darwins dilemman") då den slutligen presenterades 1859 och hur de till slut fick sin lösning. (2p)

   2.2. **In English:** Briefly describe four different types of observations that support the theory of evolution and explain how they support the theory (i.e. what would we expect if the theory was not correct and thus why/in what way do these observations support the theory?). (4p)

   In Swedish: Redogör översiktligt för fyra olika typer av observationer som stödjer evolutionsteorin och förklara hur de stödjer evolutionsteorin (dvs vad skulle vi förvänta oss om teorin inte stämde och därmed varför/på vilket sätt stödjer dessa observationer teorin?). (4p)

   2.3. **In English:** Summarize the evolutionary history of humans by drawing a simple phylogenetic tree of the following species: *Homo sapiens*, *Australopithecus sp*, *Homo erectus*, *Homo habilis*, *Homo ergaster*, *Homo neanderthalensis*. Include the assumed distribution of the different species (i.e. on what continents did they live?). (3p)

   In Swedish: Sammanfatta översiktligt människans evolutionära historia genom att placera in följande arter i ett enkelt släktträd; *Homo sapiens*, *Australopithecus sp*, *Homo erectus*, *Homo habilis*, *Homo ergaster*, *Homo neanderthalensis*. Ange även de olika arternas sannolika utbredning (dvs på vilka kontinenter fanns de?). (3p)

   2.4. **In English:** Arrange the great apes (gibbon, chimpanzee, orangutan and gorilla) in order of relatedness to humans. (1p)

   In Swedish: Rangordna människoaporna (gibbon, schimpans, orangutang samt gorilla) efter hur nära släkt de är med människan. (1p)

3. **Part 3. Learning objective: the student should be able to explain principles of speciation as well as the cladistic method of creating evolutionary (phylogenetic) trees.**
   Questions (10p, E ≥ 5p):

   3.1. **In English:** Explain why, from a cladistics point of view, it can be correct to say that we are 'fishes' (4 p). More specifically, your answer should in your own words (*i*) describe the meaning of the cladistics terms *monophyli*, *paraphyli* and *polyphyli*, and based on this explain why, from a cladistics point of view, it can be correct to say that we (and all other mammals as well) are 'fishes' (and that birds are dinosaurs).

   In Swedish: Förklara varför det ur ett kladistiskt perspektiv kan vara korrekt att säga att vi är "fiskar" (4 p). Mer specifikt, ditt svar ska med egna ord (*i*) beskriva innebörden av de kladistiska termerna *monofyli*, *parafyli* och *polyfyli*, samt baserat på detta förklara varför det ur ett kladistiskt perspektiv kan vara korrekt att säga att vi (och alla andra däggdjur) är "fiskar" (och att fåglar är dinosaurier).

   3.2. **In English:** Speciation is an important part of evolution, without it, no radiation of life on earth. Describe (*i*) how speciation can occur and what the result can be, (*ii*) what are the mechanisms involved and (*iii*) what conditions are needed for lasting speciation? Your description should include and define the following terms and put them in a context: *Anagenesis*, *cladogenesis*, *anastomosis*, *sympatric* and *allopatric* process, *pre-* and *postzygote barrier*, *directional* and *disruptive selection*. (6p)

   In Swedish: Artbildning är en viktig del av evolutionen, utan den ingen radiation av livet på jorden. Redogör för (*i*) hur artbildning kan gå till och vad resultatet kan bli, (*ii*) vilka mekanismer som är inblandade och (*iii*) vilka förutsättningar krävs för bestående artbildning? Din redogörelse ska innehålla och definiera bl.a. följande termer och sätta in dem i ett sammanhang: *Anagenes*, *kladogenes*, *anastomos*, *sympatrisk* respektive *allopatrisk* process, *pre-* respektive *postzygot barriär*, *riktad* resp. *splittrande selektion.* (6p).

4. **Part 4. Learning objective: the student should be able to give an evolutionary perspective on basic morphology, physiology and life history characteristics of organisms.**
Questions (10p, E ≥ 5p):

4.1. **In English:** Theories of *life history evolution* describes and predicts important aspects of all the 'choices' organisms face during their life time and how these choices should evolve under different environmental conditions. Define life history traits/characteristics (0.5p) and give three examples of life history traits/characters (1.5p). (2p in total)

In Swedish: Teorier om *livshistorieevolution* beskriver och förutsäger viktiga aspekter av alla "val" som organismer står inför under sin livstid och hur dessa val bör evolvera under olika miljöförhållanden. Definiera livshistorieegenskaper (0.5p) och ge tre exempel på livshistorieegenskaper/karaktärer (1.5p). (2p totalt)

4.2. **In English:** A Darwinian demon is a conceptual super organism that excel at everything. However, such organisms do not exist in nature because a range of factors limits evolution. Describe in what ways evolution can be restricted by internal factors (innate characters of the organism) as well as external factors (the environment it lives in). (4p)

In Swedish: En Darwinistisk demon är en konceptuell superorganism som är bäst på allt. Sådana organismer finns dock inte i naturen eftersom en rad faktorer begränsar evolutionen. Beskriv på vilka sätt evolutionen kan begränsas av såväl inre faktorer (organismens medfödda karaktärer) som av externa faktorer (miljön den lever i) (4p)

4.3. **In English:** Aging is a fact of life for all living organisms. However, what causes aging and why evolution 'allows' ageing were unresolved questions for a long time, but we now have a better understanding of this. (4p in total)

a) What are the two main hypotheses that explain physiological ageing and how are they claimed to affect longevity? (3p)
b) How can we explain why evolution 'allows' ageing, i.e. why does evolution not come up with 'solutions' that stop aging? (1p)

In Swedish: Åldrande är ett faktum för alla levande organismer. Men vad som orsakar åldrande och varför evolutionen "tillåter" åldrande var olösta frågor under lång tid, men vi har nu en bättre förståelse för detta. (4p totalt)

a) Vilka är de två huvudhypoteserna som förklarar fysiologiskt åldrande och hur påstås de påverka livslängden? (3p)
b) Hur kan vi förklara varför evolutionen "tillåter" åldrande, d.v.s. varför kommer inte evolutionen med "lösningar" som stoppar åldrandet? (1p)