

Examenvragen 2^e Master Biochemie & Biotechnologie

Beste student, dit document bevat alle examenvragen die bijgehouden zijn doorheen de voorbije jaren. Hou er rekening mee dat sommige onvolledig zijn en dat er een hele hoop ontbreken. We hebben ervoor gekozen ze te ordenen van recent naar oud zodat de meest relevante vragen vanboven komen te staan. Sommige examenvragen dateren van lang geleden (2005-2006 of ouder) en zijn vaak niet erg relevant meer. De reden dat we deze alsnog behouden is omdat ze meestal nog steeds de essentie, belangrijke onderwerpen van de vakken weergeven.

Wil je bijdragen aan ons archief? Via de onderstaande Google Forms link kan je je examenvragen snel en eenvoudig deponeren!

<https://forms.gle/b1gWieHGFAAEhTp36>

Voor de masters is het belangrijk om Ufora in het oog te houden. De meeste professoren geven daar duidelijke voorbeeldvragen en documenten die benadrukken welke leerstof belangrijk is en welke niet.

Inhoudstafel

Pagina 2

Jaargang 2019-2020

Jaargang 2019-2020

Neurobiology

6/01

Part Van Loo:

- 1) Inhibition of BMP signalling initiates neural induction. Explain
- 2) Why are axons in CNS are less able to regenerate after injury (compared to axons of PNS)?
- 3) What is the role of microglia in Alzheimer Disease. What are disease-associated microglia? How can single cell technologies help in finding a solution for AD?
- 4) Explain following shortly:
 - Golgi stain
 - Substantia nigra
 - Neurotrophic factor
 - ...

Part Vandenbroucke:

- 1) How is the resting potential generated and maintained in glia cells and nerve cells?
- 2) Explain MRI and its applications.
- 3) Why is the brain immune-privileged (or not)?
- 4) Explain the neuromuscular junction and name an associated abnormality.

13/01

Part Van Loo:

- 1) What is the function of astrocytes? Are they involved in memory formation? (5)
- 2) Explain the role of environmental cues during axon guidance (5)
- 3) What is the cause of ALS? Are microglia involved in ALS? How can iPS help in finding a solution for ALS? (6)
- 4) Explain following shortly: (1 point each)
 - Wallerian degeneration slow (wds mutant)
 - nodes of Ranvier
 - Tau
 - Spemann Organizer

Part Vandenbroucke:

- 1) Structure, function and mechanisms of voltage-gated ion channels. (4)
- 2) Explain MRI and its applications. (3)
- 3) Why is the brain immune-privileged (or not) (3)
- 4) What is the role of gap junctions during signaling? (explain shortly) (1)
- 5) What are metabotropic synapses? (Explain shortly) (1)

17/01

Part Van Loo:

- 1) What is the mechanism of agrins in ACh receptor clustering? (5)

- 2) Which are the signals that define the patterning in the ventral part of the dorsoventral axes (5)
- 3) Explain parkinson, symptoms, causes, actual treatment and possibility to use iPS cells to treat the condition and improve research on it (5)
- 5) Explain following shortly: (1 point each)
 - EAE
 - Glial scar
 - DAM
 - Synaptic pruning
 - Suprachiasmatic nuclei

Part Vandenbroucke:

- 1) Describe structure and mechanism of ACh receptors (4)
- 2) How is the resting potential generated and maintained in glia and nerve cells? (4)
- 3) Explain to image techniques with good spatial resolution (3)
- 4) What are metabotropic synapses? (Explain shortly) (1)

Molecular cancer biology (Geert Berx)

07/01

- 1) explain: xELLigance invasion assay, adenoma+leiomyosarcoma, shelterin complex, paclitaxel, monoclonality of tumor, asymmetric division, tax, xenoderma pigmentosum, aflatoxin B1, staging cancer
- 2) identify and functional assay for adult stem cells
- 3) oxygen use rate, role in carcinogenesis
- 4) wnt in etiology of colon cancer and cancer stem cells
- 5) malaria and burkitts lymphoma, link?
- 6) synthetic lethality, role in targeting BRCA1/2?
- 7) lof of p53 en lkb, gof of kras, how to make relevant mouse model

22/01

- 1) explain: E6 & E7, grade cancer, T-loop, CBC cells, stochastic cancer, alliontis membrane assay, physical carcinogen, NER, gleevec, adenoma & lipoma.
- 2) why do telomeres shorten over time and how does this help cancer progression
- 3) what is the role of just right signaling in the initiation of colon cancer
- 4) how do cancer stem cells exist and how can you proof their existence
- 5) circulating tumor cells and how they help in the dissemination of cancer (there role and how do they protect themselves to promote cancer progression)
- 6) explain immunotherapy and their role in cancer
- 7) make a pre-clinical mouse model to test the role of a tumor suppressor gene in the initiation and maintenance of cancer

Lab Animal Science

- 1) Leg met vb uit hoe je bepaalde leertechnieken kan gebruiken om stress te verminderen bij een proefdier. Leg stap voor stap uit hoe je zit gaat doen & Leg uit wat hier dier ervaart
- 2) 6 verschillende experimentele setups waarbij je telkens de experimental unit en replication/repeated measures moet geven. Welke setup zou jij kiezen en waarom.
- 3) Waarop moet je letten bij transport van proefdieren
- 4) chemische technieken van euthanasie met voor en nadelen

Meerkeuze:

- Voorwat staan de 3 Rs
- Wat moet je doen met een muis na operatie? (eten geven, wakker maken, warm houden)
- Stelling over node tension
- Stelling over moral status
- Tabel interpreteren van housing
- Stelling over bacterial zoonoses

Bionanotechnology

Oral Part:

Article 1: mRNA delivery in retina

- Summary of the article
- Main contribution?
- Role of Muller cells. Why we prefer to target them? Role of pigments cells.
- What drug delivery is better? Intra vitrus or SR? which are the advantages and risks of each one?
- Which animal model is better to study drug delivery in retina? why?
- Do you prefer a small/big negative/positive charged molecule?
- What is the size of the nanocarrier that the authors tried?
- Propose an improvement for the research. Next step? What do you change in the design of the nanocarrier?

Article 2:

Article 3:

Article 4: Photoporation article from Kevin Braeckmans
 Just go through all the results. He stopped at all pictures and lets you explain them. Sometimes he asks a more in depth question.. The picture with the QD and the FITC-dextran MFI comparison was given extra attention because you can see that the MFI of QD was 10th lower compared to that of the FITC-dextran. If you understand the results, you'll be fine. After finishing the article, he also randomly asked about potential pitfalls of the technology and pitfalls when the application is used to incorporate photoporated mammalian cells in the human body. I kindly told him that mammalian cells are not my area of expertise 😊.

Article 5:

Written Part:

1. a) Principal barrier in cellular uptake. How to avoid it?
b) Two cells are communicated by nanotubes. Design an experiment to determine the max. size/weight of the molecules that can be transported using these nanotubes.
2. You have two configuration:
 - a) Cells + AuNP
 - b) Cells + AuNP + antibody that recognize a receptor of cell membrane
 - 2.1) Which is a biosensor? why? which is the optical transducer? Explain plasmon fenome. Which is better to test using SER?.
 - 2.2) A case to apply micromotor concept. You have a cells in culture, in the bottom of the plate and you want to deliver a NP...
3. Drug delivery in breast cancer, using nanobubbles and ultrasound. Which image system can you use to follow the drug delivery?
4. Retina drug delivery. She gave a list of molecules with different: mRNA/pDNA, positive/negative charged, big/small.
 - mRNA: good uptake, low protein expression. Explain why.
 - pDNA: good uptake, good protein expression but at day 3, it goes down. Explain why.
 - Which is better for Intra vitrus injection?
 - Which is better for SR injection?

Biosafety, GMP & IP (Vanhalst & Rüdelsheim)

Case 1: They want to make soy plants that are resistant against pest, like Colorado potato beetle. Therefore, they introduce the haa55 gene in soy plants (AAF567). Haa55 gene comes from fungus that was first discovered on the beach in Malaysia. Haa55 gene encodes for Bt toxin. Introduction was performed through standard *Agrobacterium tumefaciens* transformation, with antibiotic resistance positive selection marker.

Assuming that the use of Bt toxin is new

1. What and how could you safeguard the intellectual property rights of the different aspects of the above outlined case? Think broadly and work out in detail. (Vanhalst)
2. Assume that plants are only partly resistant to pest, you still have to use standard pesticides (only 10% of recommended dose). Additional protection? How to regulate this in EU and USA? (Vanhalst)
3. Is the soy plant (AAF567) a GMO according to the EU? (Rüdelsheim)
4. Can you identify 2 environmental concerns that you should consider when you want to conduct a field test to demonstrate the performance of the modified safflower? What kind of information can you collect in order to determine that the risk is acceptable? (Rüdelsheim)
5. Do you see any issue related to access of genetic resources (within the context of the Convention of Biological Diversity)? (Rüdelsheim)

6. Are there any timing aspects to consider regarding when to submit a biosafety authorization and filing a patent application? (Vanhalst)

Case 2: Banana plants are sensitive for an infection caused by a certain bacteria strain which causes 500 million dollar loss yearly. they isolated 2 genes from sweet pepper and introduced them in the genome of the banana plant via genetic engineering. This resulted in resistance against this bacteria strain. the genes were under control of a constitutive promoter and they used a selection gene to select for the transformed cells.

Assuming that the 2 genes and their function are new:

1. what and how could you safeguard the intellectual property rights of the different aspects of the above outlined case? Think broadly and work out in detail (Vanhalst)
What if the resistant banana plants were created via crossing en breeding the sweet pepper and banana plants (assume this is technical feasible) Would you still use the same IPs? (Vanhalst)
2. Is this a GMO according to the EU?
3. Can you identify 2 environmental concerns that you should consider when you want to conduct a field test to demonstrate the performance of the resistant banana plant? What kind of information can you collect in order to determine that the risk is acceptable?
4. Do you see any issue related to access of genetic resources (within the context of the convention of biological diversity)?
5. Are there any timing aspects to consider regarding when to submit a biosafety authorization and filing a patent application?

Case 3: a) In search of a non- or slow- rotting tomato, you find out through crossing and selection that the crossing of a purple tomato (Cherokee Purple) plant with the Burpless cucumber plant originally obtained from Papua New Guinea results in a new variant that can be left on the stock to dry out, without substantial rotting. This is interesting for making e.g. ketchup or other dry tomato based food products. You intend to market the new tomato plants and tomato's (type a) but want to avoid copying by competitors.

b) A few years later you find out that in fact a single enzyme, encoding the "spoiler" gene, is responsible for the rotting process and that by modifying the tomato variants by deleting said gene, the tomato plants can get the same characteristics as in part (a) above. You intend to market the tomat's and plants (type b), wherein said gene is deleted.

1. assuming that the above discoveries are new:
How could you protect the IP rights of the different aspects of the above outlined case (for a and b)? Think broadly and apply to the case, arguing why the chosen IP rights could be seen as acceptable by the responsible authorities.
Question 2-5 same as above.

Case 4: Plasmodium complex life cycle in mosquito, found gene (FREP1) in gut of mosquito that inhibits plasmodium from maturing there, so effective strategy to prevent spread of malaria.

1. what and how could you safeguard the intellectual property rights of the different aspects of the above outlined case? Think broadly and work out in detail
2. Found a more broad claim from 1999, problem to export your product (produced in europe) to mexico/congo for putting on market?
- 3-5 same as before

Molecular plant breeding (Isabel Roldan-Ruiz)

1. steps in plant breeding, chose one step and say why dna markers can be used for one crop you choose.
2. define linkage, how measured, 2 mapping populations that can be used, how used in breeding, difference between linkage and LD
3. Association mapping: candidate gene and whole genome approaches, describe and compare. How do you proceed to find polymorphisms in one candidate gene, giving a reference genome.
4. Define linkage drag. How is it minimized in Marker assisted backcross breeding? How can DNA-markers help here?
5. Illumina bead micro-array, plot with red(AA)/green(BB)/yellow(AB) dots: explain colors, what axes mean and what AA/AB/BB means

Plant factory (Frank Van Breusegem)

Group 1:

1. Job interview at AgroSavfe
2. Give AgBiotech R&D pipeline + example
3. RoundUp ready technique
4. LY038

Group 2:

1. Explain 3 different MoA of herbicide tolerance traits, including RoundUp and LibertyLink
2. Depict the global AgBiotech Landscape
3. Amflora potato: technique and trait
4. What do you know about the Arctic apple

Epigenetics (Wim Vanden Berghe)

6/01

- 1) compare gene dosage with genetic imprinting
- 2) which epigenetic regulation mechanisms are involved in differentiation of Drosophila or C elegans that lack DNA methylation
- 3) are mitochondria involved in transgenerational/intergenerational epigenetic heritable effects?
- 4) how can some anti cancer therapies induce an antiviral response?

5) you want to silence one specific gene, how? Method? (+explain method) how validate that it works?

20/01

1. why does neanderthal has more GC then recent homo sapiens?
2. Why does c-section results in a higher chance of obesity?
3. Why does an obese women has a reduced fertility and problems with successful cancer?
4. Can early life stressful situations results in depression in later life or next generations?
5. Can lifestyle of father influence offspring? How would you discriminate between adverse epigenetic change herited from mother or father? Give method

Modelling of Biological Systems (Steven Maere)

Given: 4 equations of Brusselator. Each question 2 points.

1. What is the Brusselator + for what dynamics was it designed?
2. Create the rate equations (dx/dt and dy/dt) for these four reactions, all constants $k=1$ and $A, B, C, D = 1$, b, c, d are all positive and constant.
3. define the equilibrium point(s).
4. Analyze the stability at the equilibrium point(s).
5. Does a bifurcation occur? which one?
6. Give the Master Equation, now you have to take all k 's and A, B, C, D into account.
7. What is the different output if you would model this stochastic or determined? Which influences this the most? What techniques would you use in both cases?
8. What is the difference between intrinsic and extrinsic noise? How would you add extrinsic noise to the model?
9. What are Turing patterns? With what mechanism do they mostly occur?
10. How can the Brusselator create Turing patterns? If it's creating Turing patterns, how would you manipulate it so that the dynamics of question a are modelled again?

Genetic diseases (Bruce poppe)

- Types of mutations causing monogenic disorders
- Describe and compare familial and hereditary colorectal cancer
- Relevance of Philadelphia chromosome in CML
- Explain pre-implantation diagnostics of monogenic diseases
- Woman diagnosed with breast cancer, NGS of blood sample shows 18% VAF of Tp53 mutation. What is explanation? What additional analysis?
- Pedigree -> Which possible inheritance pattern(s)?
- Calculate risk for Anne and James te have an affected child. Recessive disease. Mother of Anne is affected. Grandfather of James is affected.
- Found missense variant in woman diagnosed with breast cancer. What additional analyses to prove pathogenicity?

Biotechnology of fungi (Nico Callewaert)

1. which growth phase to produce antibiotics, citric acid and recombinant proteins? Why?
2. Pichia auxotrophic for 3 things (arg, his, ura). You want to transform 4 plasmids. How?
3. Produce recombinant pancreatic digestive enzymes for human consumption. Which media would you consider?
4. S. cerevisiae with one gene KO does not grows well, how would you check for interacting genes? Give screening method.

Bio-ethics (Heide Mertes)

1. Explain hybrid approach. From where does this come from and why?
2. embryonic gene editing for clinical applications. Give 3 (1 pro, 2 contra) arguments for disease-related and non-disease-related applications. Give your personal opinion.
3. Quote: which parts are deontological/consequentialist and why? + what are the strengths and weaknesses in the quotes?
4. Non-discussed topic questions