

Perspective-based Inquiry Learning

Developing a practical and an effective
teaching repertoire

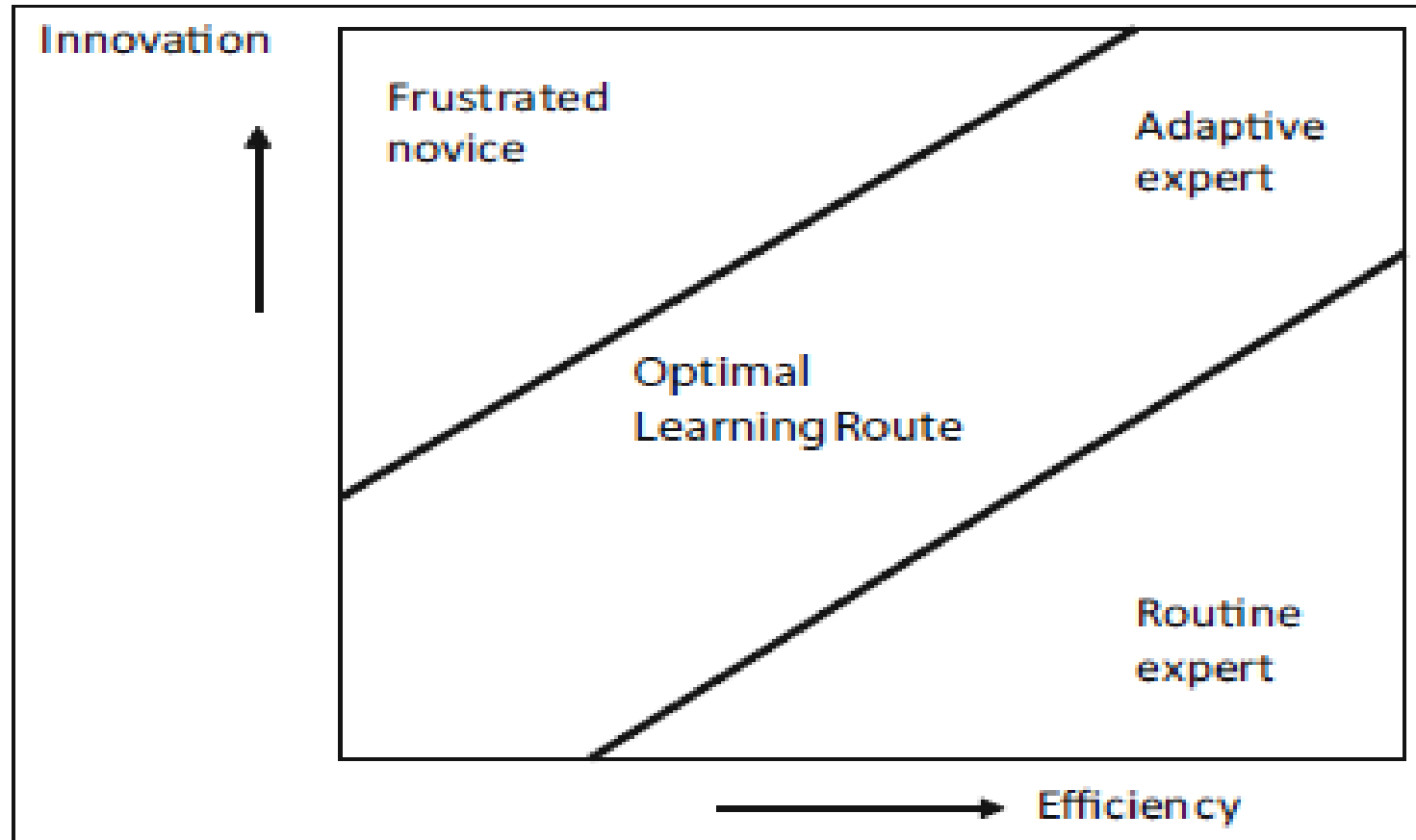


Fred Janssen

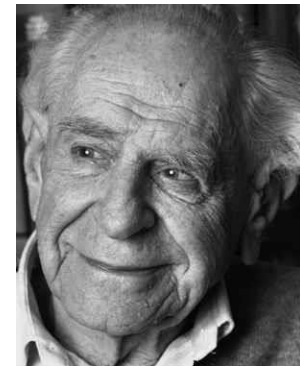


Universiteit
Leiden
ICLON

Teaching repertoire development



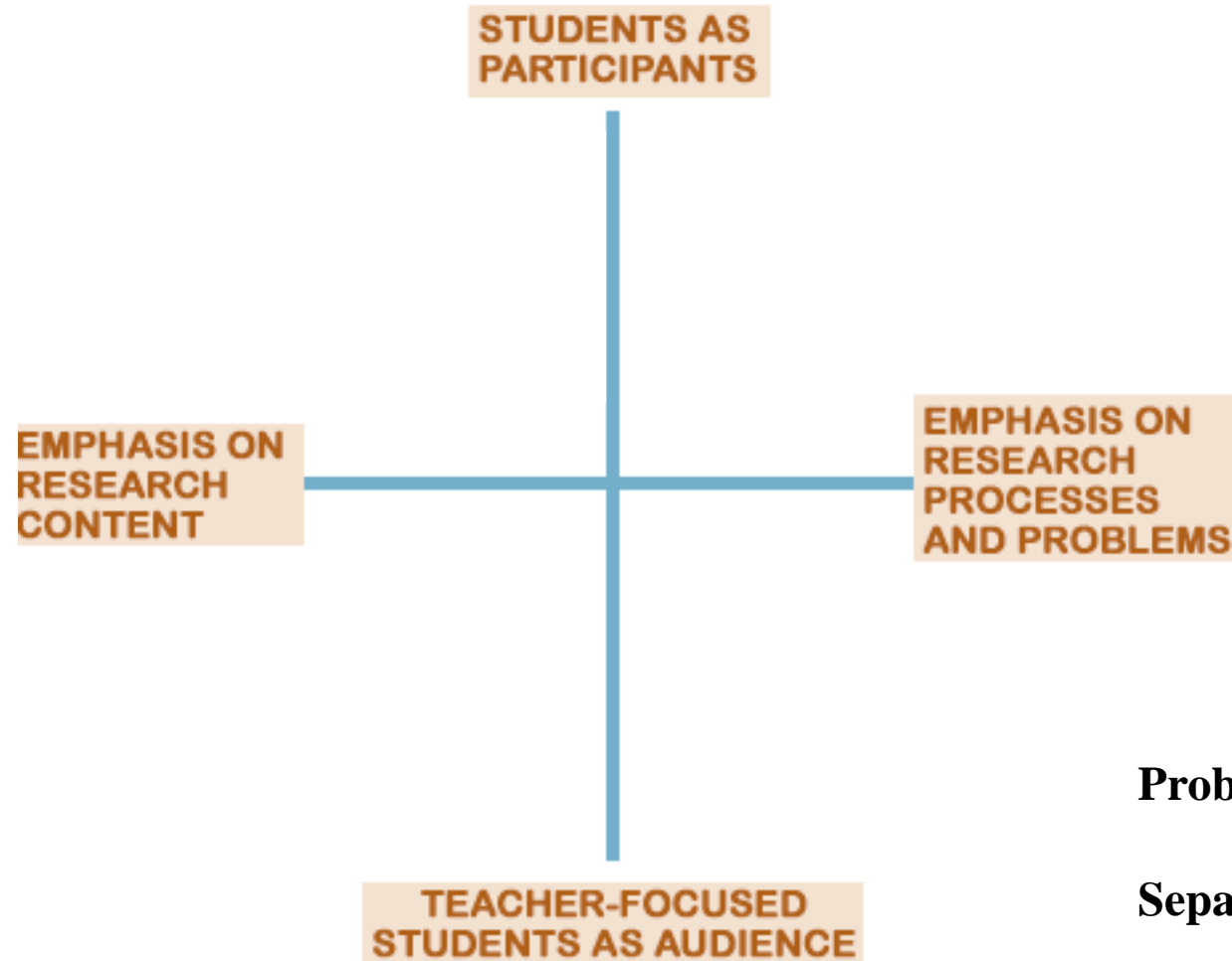
Popper's dream



I dreamt of one day founding a school in which **young people** could learn without boredom, and **would be stimulated to pose problems and discuss them**; a school in **which no unwanted answers to unasked questions would have to be listened to**; in which one did not study for the sake of passing examinations

(Popper, 1973, p. 41)

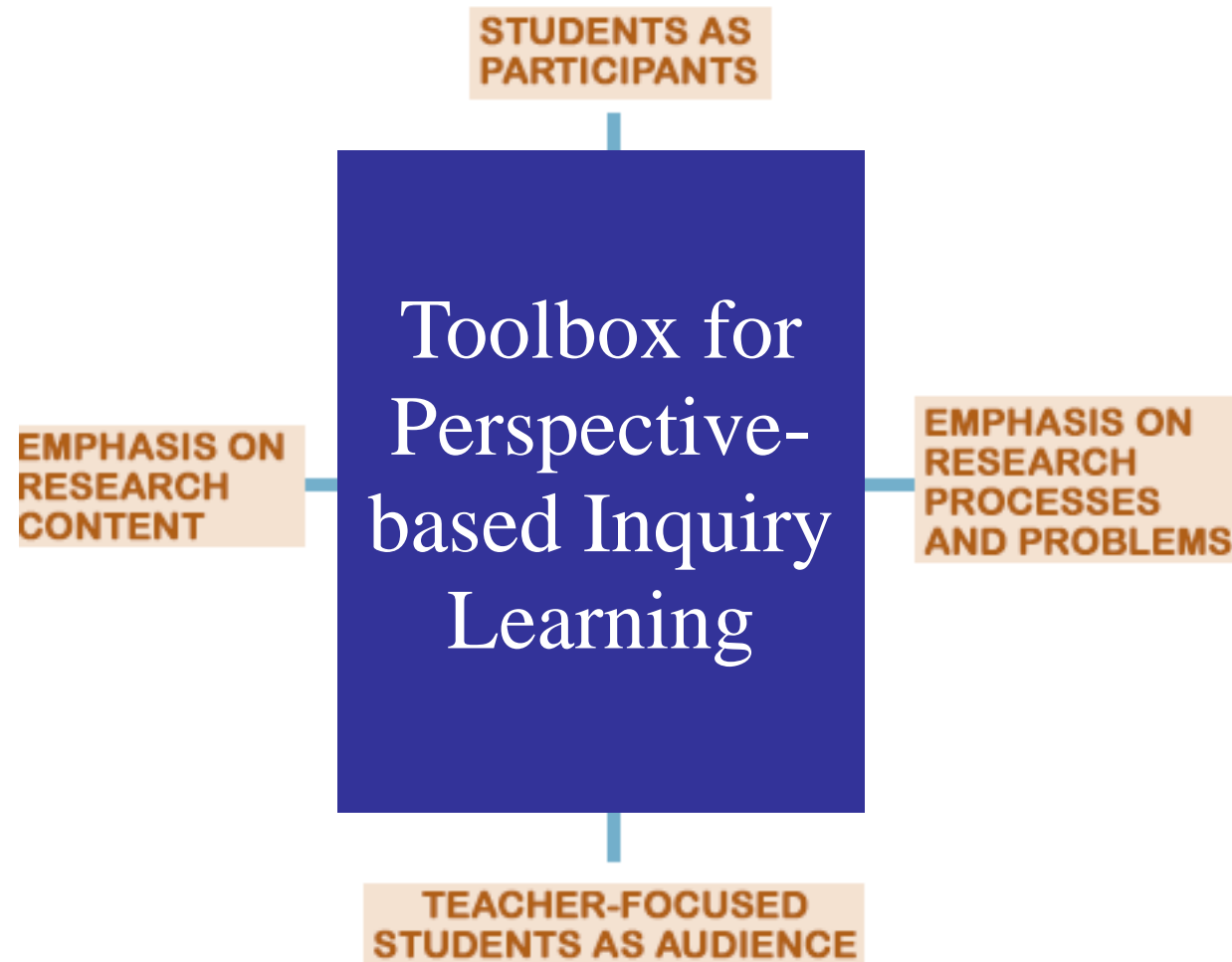
Positioning in relation to Healey's framework



Problem Healey's model

Separation content and process

Toolbox for Perspective-based Inquiry Learning



100-year research tradition

How to bring students' learning processes closer to researchers' practices?

Dewey (1916); Bruner (1962); Schwab (1963); for a recent downloadable review of reviews [70 pages]
→ Janssen et al (2016)

- Over 1.7 million scientific publications
- Over 150 reviews in the last 10 years (for science education alone)
- 5 Handbooks in the last 10 years (for science education alone)
- Recurrent “innovation” in primary, secondary and higher education

Why is inquiry-based teaching important?

It promotes:

- Motivation for learning
- Active learning
- Deep understanding and flexible use of knowledge
- Learning how to think like (learning a perspective: how to create and criticize knowledge in a domain?)
- Developing a multi-perspectival approach to complex problems
- Understanding the nature of inquiry

Important but not practical

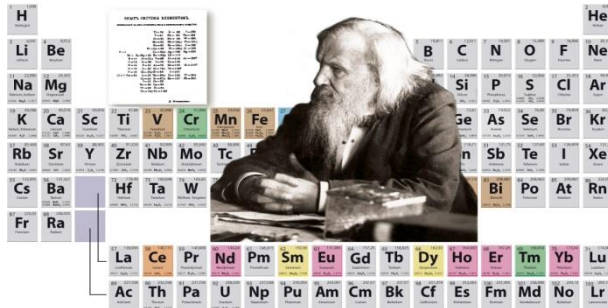
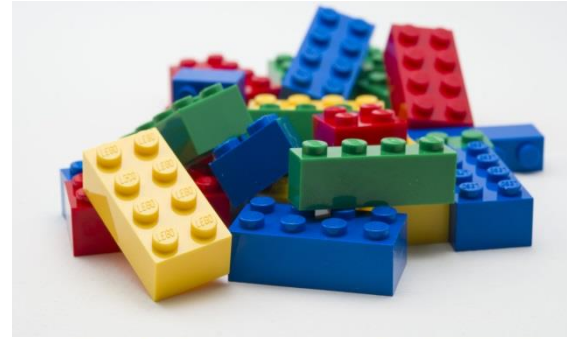
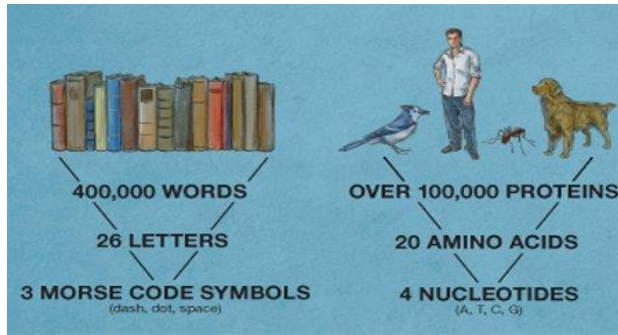
How to implement inquiry-based teaching with:

- Limited time and resources
(for design, enactment and reflection)
- Large groups of diverse students
- An overloaded curriculum (much to teach)

Recurrent findings

- **Effective** approaches of inquiry-based teaching are often considered as **not practical**
 - **Practical** approaches of inquiry-based teaching are **often not effective**, like:
 - Incidental unguided discovery learning
 - Cookbook inquiry
- A need for tools to develop a practical and effective repertoire for inquiry based teaching

Hints for a practical and generative solution

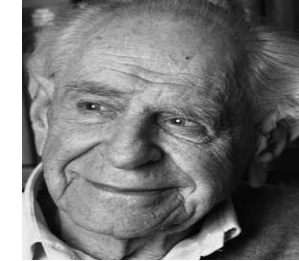
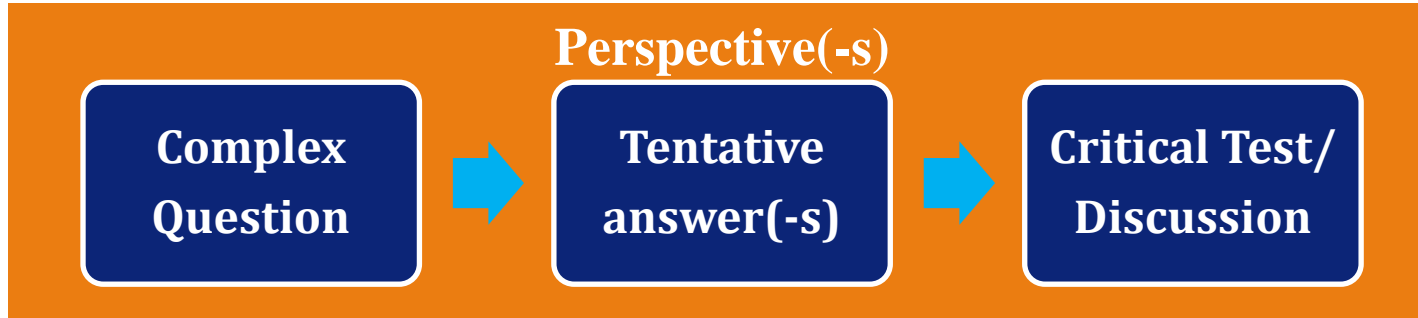


Incremental innovation by recombination and adaption of existing building blocks

(see for the power of modularity in teaching Janssen et al, 2015)

Inquiry + Regular Teaching = Inquiry Based Teaching

Building blocks of inquiry



Building blocks of regular teaching



A practical toolkit for building a repertoire for perspective-based inquiry learning

Three tools

- Laddering tool for explicating your current teaching approach
[part 1]
- Building block tool for converting regular teaching into multiple forms of perspective-based inquiry learning
[part 2]
- Perspective tool explicating and teaching domain-specific ways of thinking (perspectives)
[part 3]

Part 1

Laddering tool for explicating current teaching approach

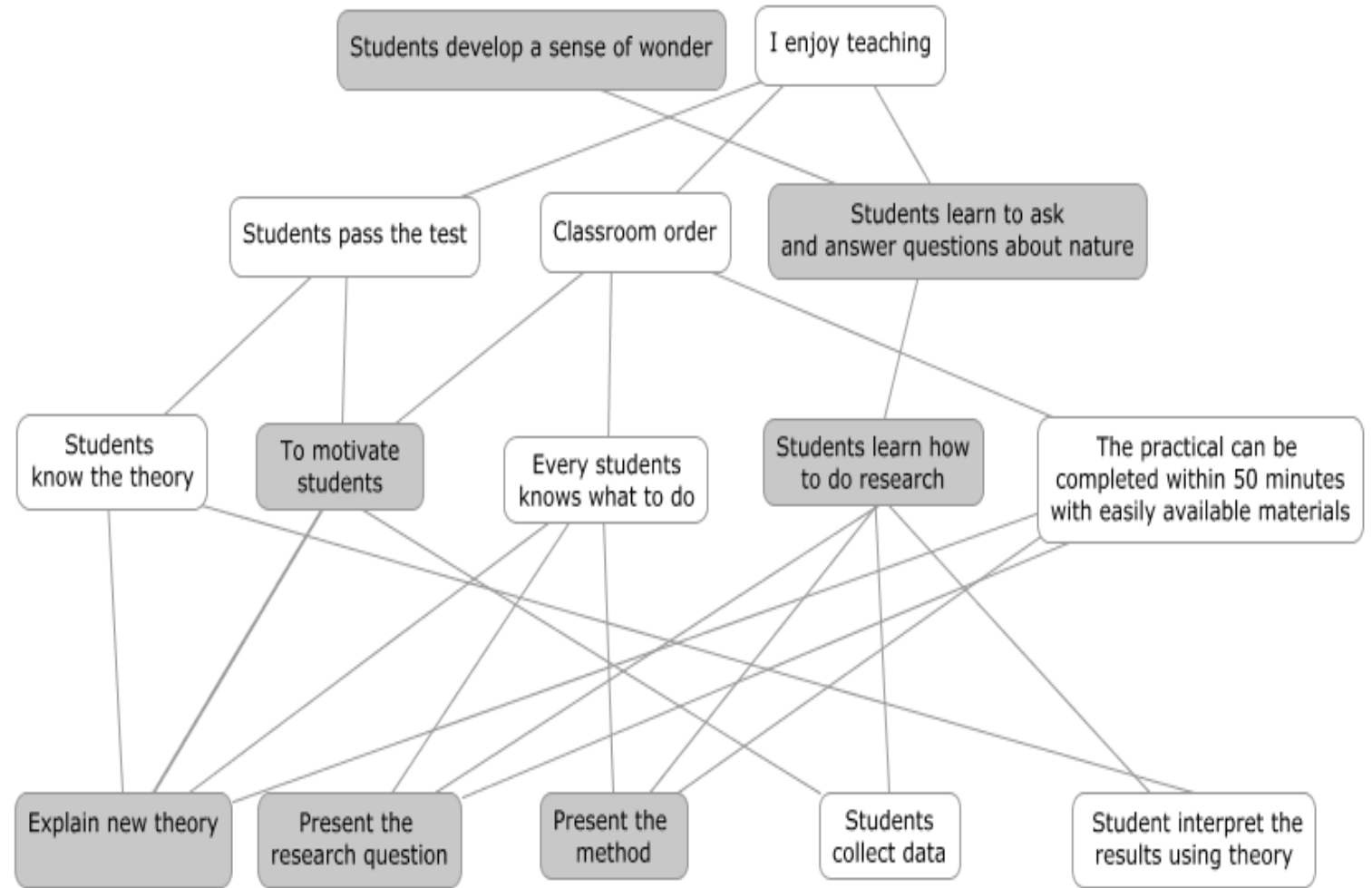
Co-construction of goal system representations

Laddering method (Janssen, Westbroek, Doyle & Driel, 2013; Janssen, Westbroek & Borko, submitted)

1. **Select** a representative lesson
2. **What** do you regularly do (lesson segments)?
3. **Why** do you do it that way, why is that important?
4. **Evaluate** what goes well (white boxes)/where you like to improve (grey boxes)

Goal system Joyce

Why important?



What do you regularly do?

Part 2

Building block tool for converting regular teaching into multiple forms of inquiry-based teaching

Tool for converting regular teaching into inquiry based teaching

Innovation by recombination with only five building blocks



Simple
Questions



Complex
Question

Tentative
Answer(s)

Critical
Test/
Discussion

Complex question first !



Criteria

- Understandable
- Creates a need to know for what you like to teach



Converting regular to inquiry based teaching: some options

Regular	 Explanation	Simple Questions		 Complex Question
IQBT a	 Complex Question	 Explanation	Simple Questions	 Complex Question
IQBT b	 Complex Question	Tentative Answer(s)	 Explanation	Critical Test/ Discussion
IQBT c	 Complex Question	Tentative Answer(s)	Critical Test/ Discussion	 Explanation

Many more options

In class 1
(end)

Before class 2

In class 2



Complex
Question

Book and/or Online




Tentative
Answer(s)

Critical
Test/
Discussion



Simple
Questions



Complex
Question



Complex
Question

Adaptive support by
omission



Tentative
Answer(s)

Adaptive support by omission



Complex
Question



Simple
Questions

Critical
Test/
Discussion

Students can
choose or develop
a complex
question

Adaptive support by omission

Consider everything you normally do as support for students to answer the complex question and provide this support only if needed.

Overview of options with the five building blocks

Nature of the complex questions	One perspectives	Two perspectives	Multiple perspectives
Scope of complex questions	One class	Multiple classes	Whole course
How many complex questions?	One	Multiple	Personalized
Who designs the complex questions	Teacher	Teacher and student	Student
Relation lecture, seminar, practicals	Separate	Lecture and seminar integrated	Lectures, seminar practicals integrated
Adaptive support	None	Few learning routes	Personalized learning routes
Emphasis	Understanding and application of knowledge	+ Analyzing, evaluating and creating knowledge	+ Critical use of perspective(s)

Part 3

Perspective tool for explicating and teaching domain-specific ways of thinking (perspectives)

Knowledge (growth) is perspectival

exemplified by the blind men and the elephant (poem from John Godfrey Saxe)

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind.

The First approached the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
"God bless me! but the Elephant
Is very like a wall!"

The Second, feeling of the tusk,
Cried, "Ho! what have we here
So very round and smooth and sharp?
To me 'tis mighty clear
This wonder of an Elephant
Is very like a spear!"

The Third approached the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:
"I see," quoth he, "the Elephant
Is very like a snake!"

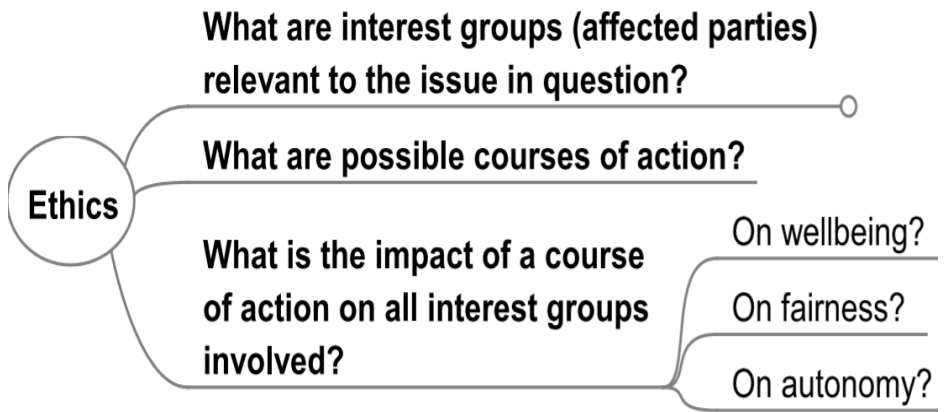
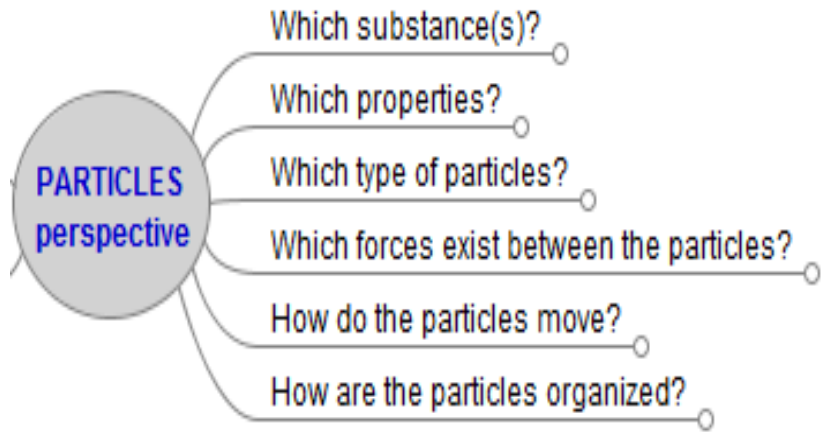


The Fourth reached out an eager hand,
And felt about the knee.
"What most this wondrous beast is like
Is mighty plain," quoth he;
"Tis clear enough the Elephant
Is very like a tree!"

The Fifth, who chanced to touch the ear,
Said: "E'en the blindest man
Can tell what this resembles most;
Deny the fact who can
This marvel of an Elephant
Is very like a fan!"

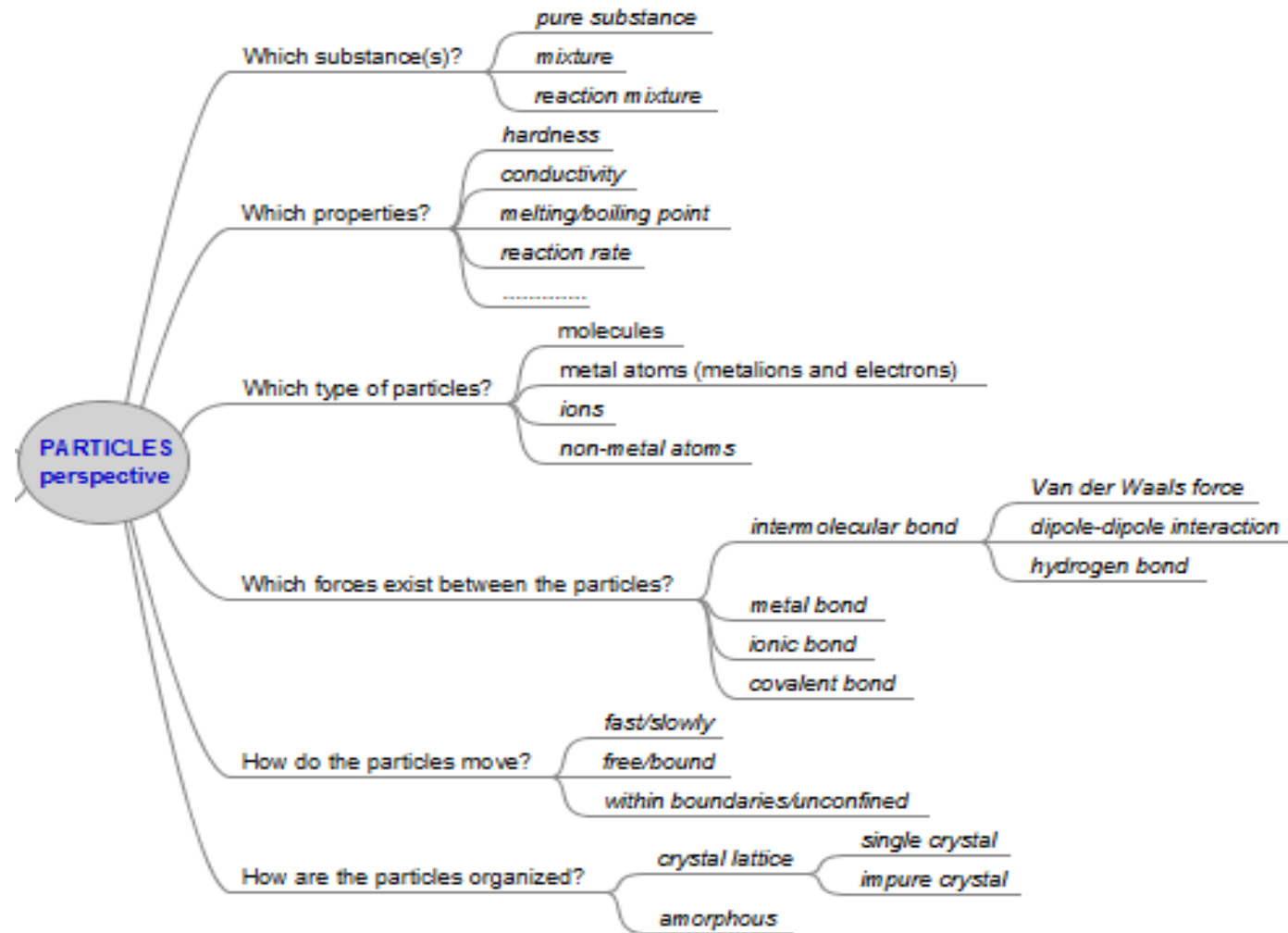
The Sixth no sooner had begun
About the beast to grope,
Than, seizing on the swinging tail
That fell within his scope,
"I see," quoth he, "the Elephant
Is very like a rope!"

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong!



For many many more examples of perspectives for multiple subjects ranging from mathematics, to history, to linguistics see free download Janssen et al, 2018

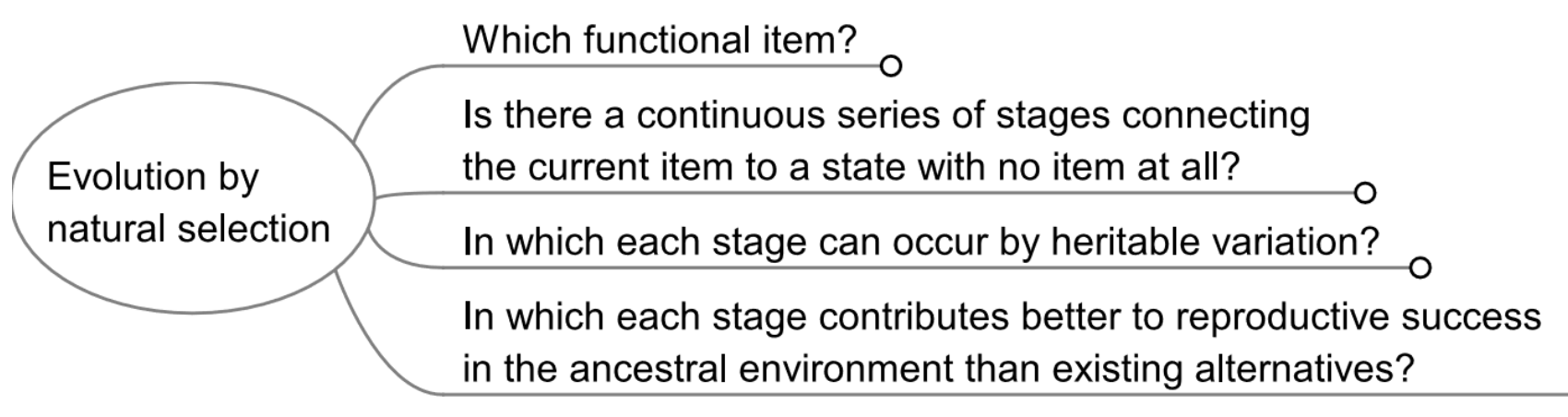
Perspectives scaffold and organize knowledge growth in a domain



Evolutionary perspective as a tool for thinking

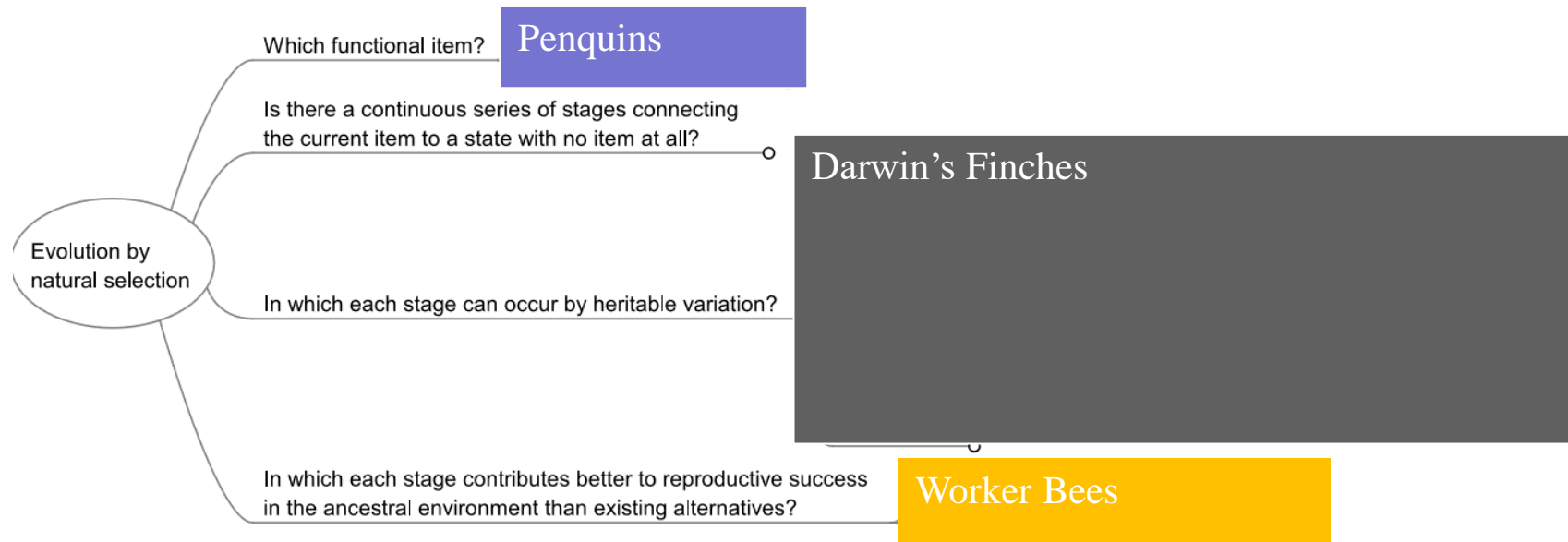
Again: **Why legs not wheels?**

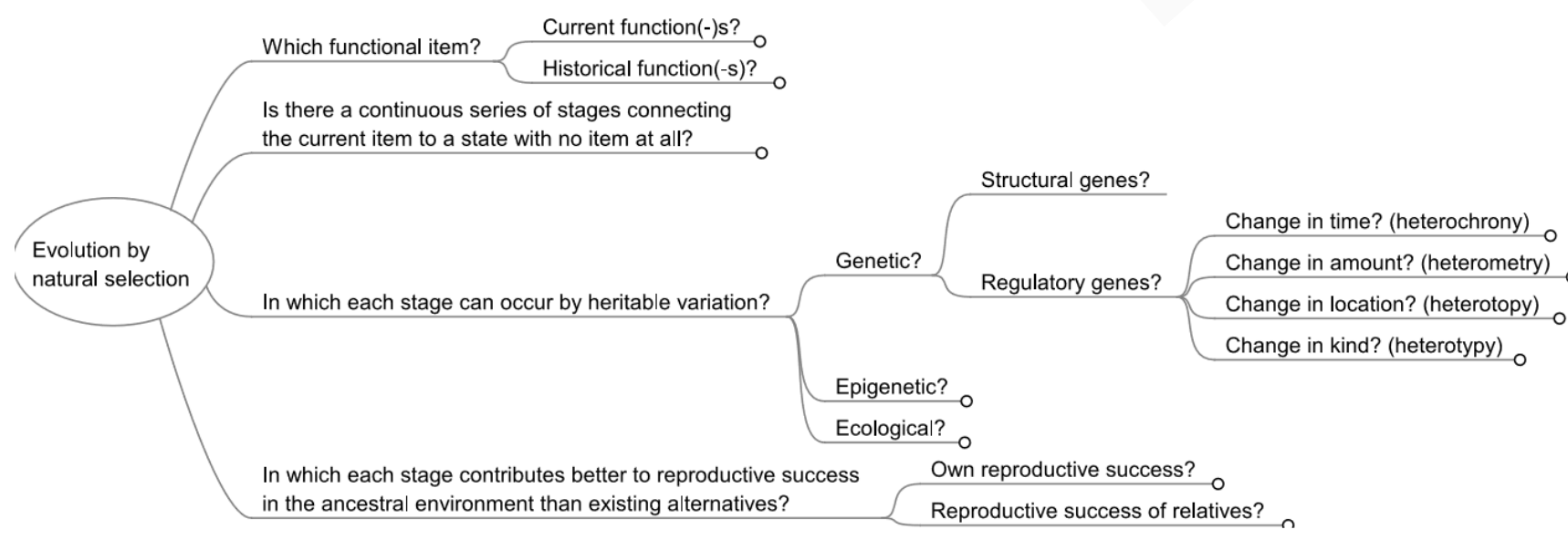
[Use the evolutionary perspective below.
Try to come up with a least three different
arguments]



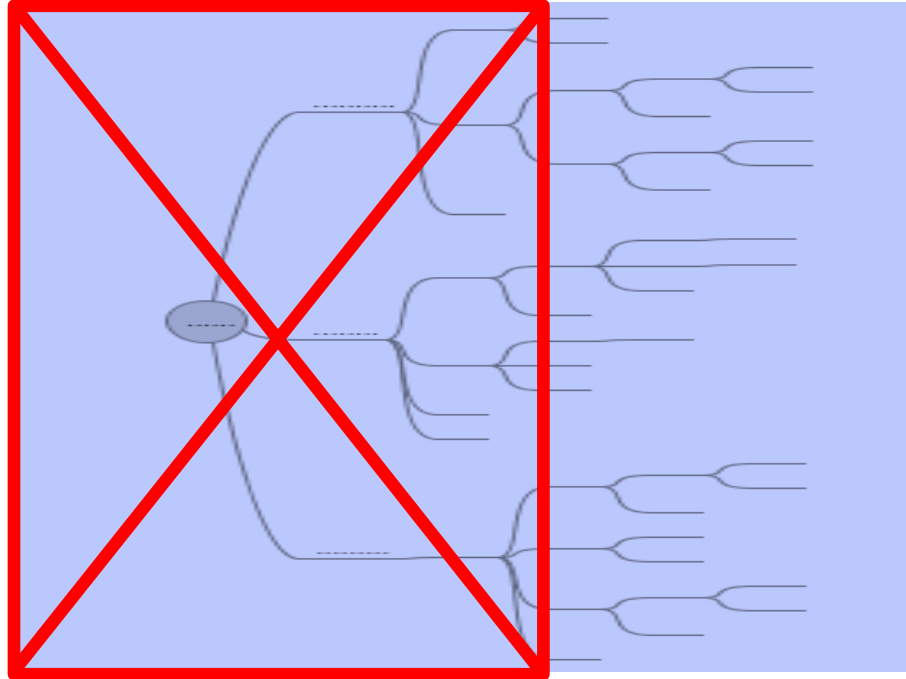


Stepwise expanding the perspective driven by complex questions providing the need or expansion





Perspectives are essential domain specific tools for thinking and provide coherence. What happens if they are skipped?

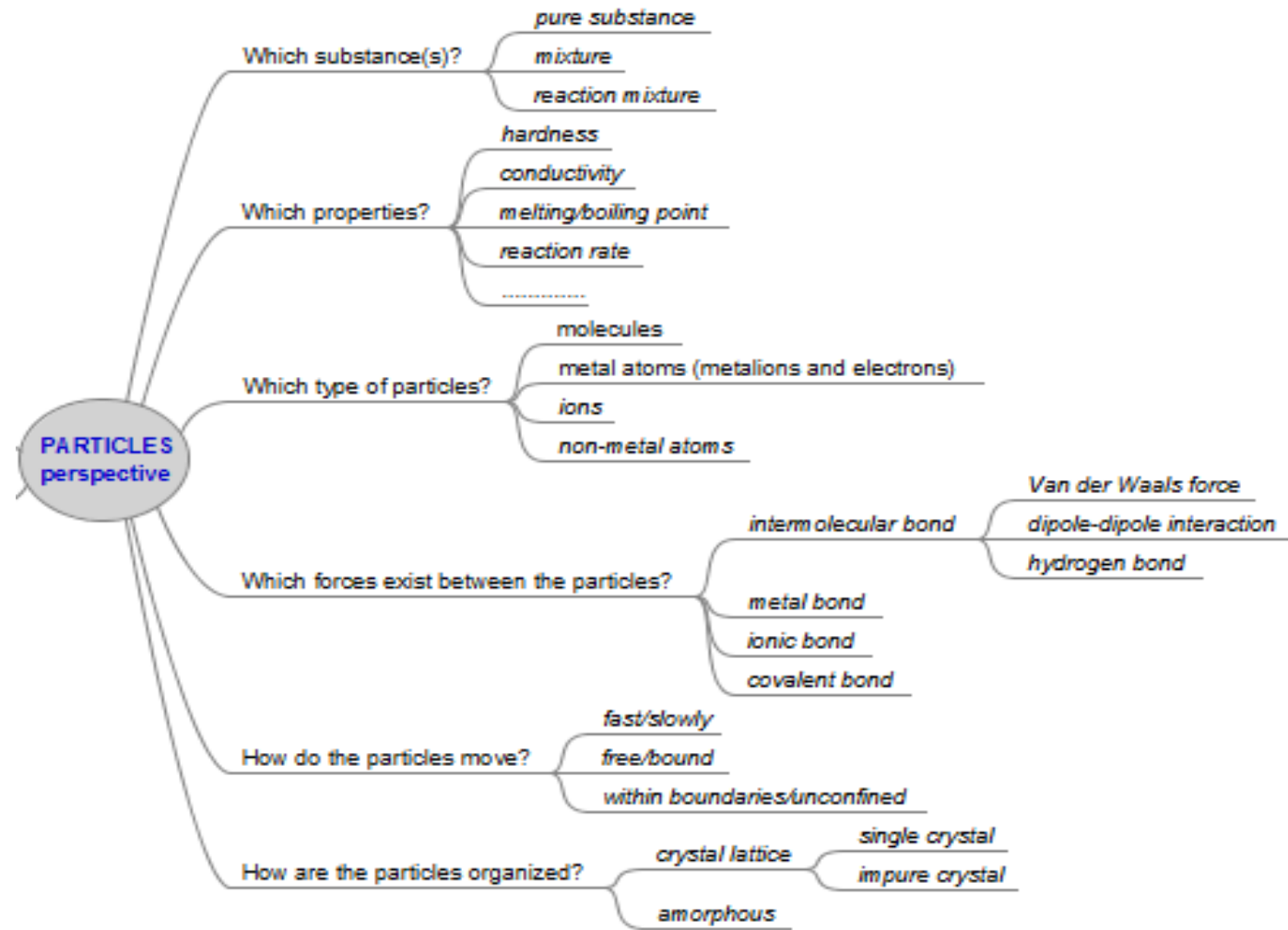


- Fragmentation
- Students lack powerful thinking tools to develop knowledge
- Students do not learn how to think like

Perspectives as branching trees

Abstract schema underlying the particle perspective

The **properties** of **substances** can be explained by the nature of the **particles** of which it consists, the **forces** between them, and the **movement** and **organization** of those particles



Some examples of perspectives from Leiden University

Biomedical perspective

How does a disease originate and how can it be treated?

- What are the complaints/ symptoms?
- How often, where and with whom does it occur?
- How does it normally function?
- What is going wrong?
 - Psychosocially
 - Physical damage
 - Pathogens
 - Auto-immune responses
 - Genetics
 - Nutrient deficiency
- How can it be treated?
- How can it be prevented?

Nelleke Gruis



LUMC

Overview of her course



Some examples of perspectives from Leiden University

Perspective for European Law

How to arrange free selling and buying for businesses and consumers in the EU?

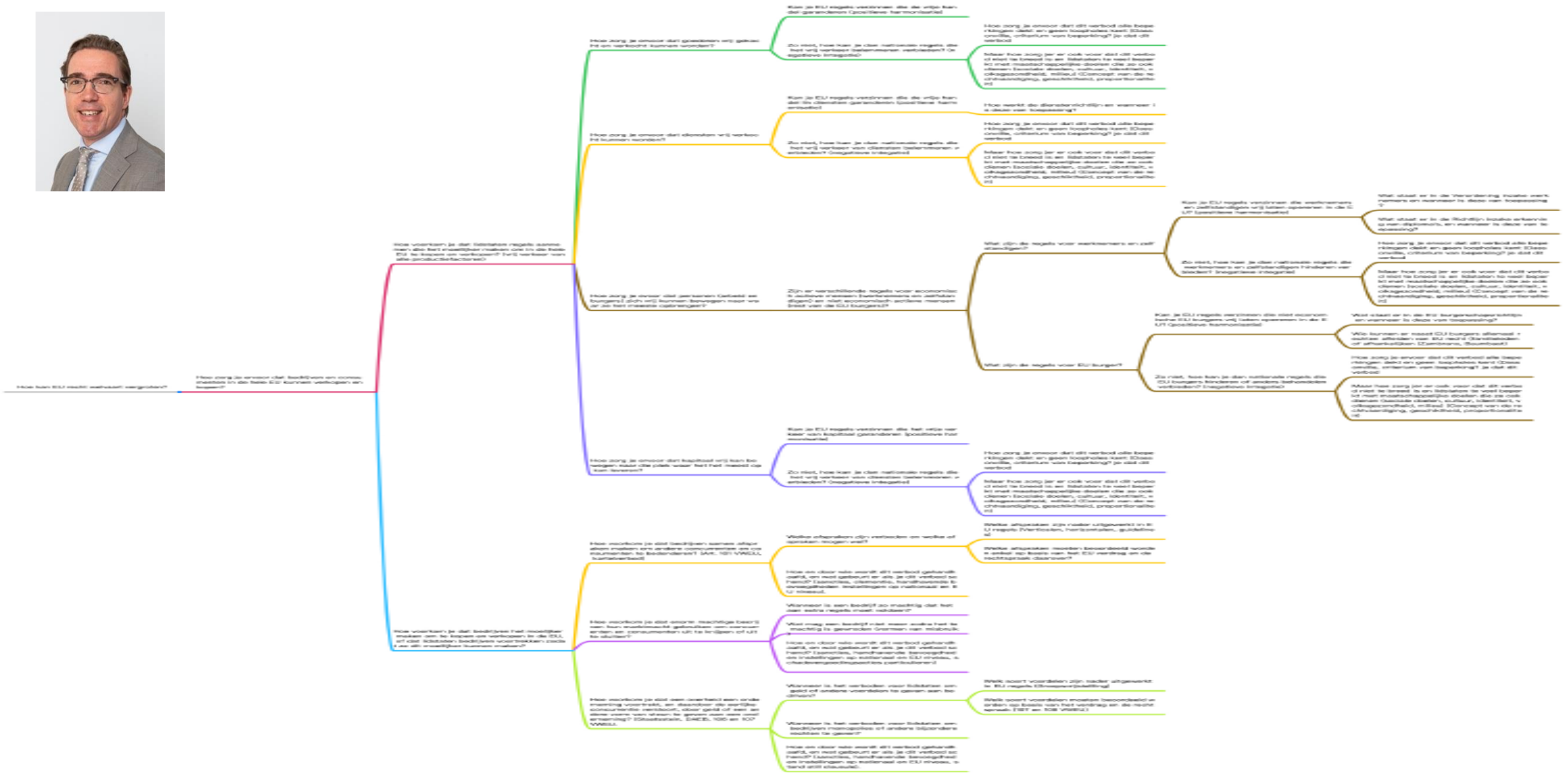
- How to prevent that EU member states obstruct free movement of production factors?
 - Goods?
 - Services?
 - People (citizens and labor)?
 - Capital?
- How to prevent that businesses complicate buying and selling?

Armin Cuyvers



FdR

Perspective for European Law





Taal mentaal 1: van zinsontleder naar taalkundig onderzoeker

Taalkundig perspectief

Bouwstenen (8 niveaus)

zin – zinsdeel – woordgroep – woord – morfeem – syllabe – foneem – foneemkenmerk

Voor elke bouwsteen:

Welke eigenschappen? Wat is de interne structuur? Wat is de externe distributie?

Welke combinatorische regels? Merge? Hiërarchie? Recursie? Lineaire ordening? Gewicht?

Semantische en syntactische selectie? Sonoriteit?

Rol van betekenis? Betekenisdragend? Betekenisonderscheidend?
Compositioneel?

Diagnostiek? Permutatie – Weglating – Vervanging – Integriteit -
Hiërarchietesten (c-commandeerrelaties)

Grote vraag als startpunt voor elk hoofdstuk/college

- Hoofdstuk 1: Het Nederlands als cognitief systeem

Vraag: Welke vragen kun je stellen over taal?

- Hoofdstuk 2: Bouwstenen van het Nederlands

Vraag: Deel de volgende zin [...] op in steeds kleinere onderdelen.

- Hoofdstuk 3: Een Nederlandse zin bouwen

Vraag: Bouw met de bouwstenen uit hoofdstuk 2 een zin. Kan je de bouwstenen ook rijgen i.p.v. Mergen?

- Hoofdstuk 4: De ruggengraat van de Nederlandse zin

Vraag: Waarmee begint het bouwen van een zin? Waarom?

Docenten moleculaire genetica (4 studieonderdelen in de bachelor)

FWN

Jaar BSc1
Vak Moleculaire Genetica 5 EC
Periode Blok 1 – September-Oktober
Coördinator Remko Offringa

Historisch overzicht
celcyclus en stadia van mitose
term: chromosoom, centromeer, telomeer, chromatide
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Koppeling: testkruising, recombinatie, genetische kaart
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imprinting (kort), cytoplasmatische genen (kort)

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Dubbele helix --> chromatine: metafase chromosoom
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leading/lagging, okazaki, DNA polymerases, vork,
topoisomerasen, snelheid: prok vs euk.,
betrouwbaarheid, fouten & repair
telomeren bij eukaryoten
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Chromatine structuur: histon modificatie (kort)
Epigenetic/imprinting (kort met als voorbeeld histon acetylering en DNA methy
Splicing/alternatieve splicing,
eiwitvouwing, eiwitafbraak: proteasoom
eiwitactiviteit: modificatie/localisatie
wildtype/mutant, reversie/revertant
verlies-/winst-van-functie
punimutaties: transitie/transversie, missense, stil, nonsense
insertie, deletie,
Oorzaak mutaties: replicatie: slippen--> eerder tautomerie
deaminatie (gemethyleerde C hotspot), transpositie: retro en DNA transposons
Chromosoommutaties
Mutagens: baseanalogen, EMS, ethidiumbromide
Straling
DNA schadeherstel: BER, NER, mismatch repair, recombinatie
Gevolg DNA schade --> kanker: (protoloncogenen.
(Ontdekking van) restrictie enzymen/modificatie: methylering
Gelelektroforese: ethidiumbromide, restrictiekaart plasmide
knippen/plakken
cloneren: vector: plasmide, lacZ, cloonbank: BAC/YAC
genomisch DNA bank, cDNA, reverse transcriptase, cDNA bank
identificatie clone: hybridisatie/PCR (uitleg techniek)
Termen: Southern/Northern/Western
Detectie van een SNP (voorheen RFLP/Southern), nu met PCR
DNA fingerprinting met PCR: microsatelieten.
RNA expressie: RNA gel --> RT-PCR, in situ hybridisatie.
Eiwitexpressie-detectie: Western blot
DNA sequencing: Sanger: dideoxy, radioactief/fluorescent
Next generation: PAC-BIO & Nanopore (kort genoemd, in het kader van genom
Genoomsequenties: map-based vs shotgun
Verschillen in genoomgrootte en aantal genen.
Voorbeelden van genoomonderzoek:
Fylogenomics, genetische variatie in gewassen, ancient DNA,
personalized medicine
Retrotransposons en genoomgrootte
Genfamilies: eiwitomologie --> genduplicatie en subfunctionalisatie
exon shuffling
Genetische modificatie in planten en dieren: methoden
Klonen van organismen:
Planten: regeneratie/somatische embryogenese
Dieren: embryosplitsing, Gurdon: kerntransplantatie: Dolly, Copy Cat
Therapeutisch klonen: (pluripotente) stamcellen,

Jaar	BSc2
Vak	Moleculaire Biologie 4 EC
Periode	September
Coördinator	Paul van Heusden
Docenten	Paul van Heusden, Sylvia de Pater
College	Practicum
Gen/Open Reading Frame/structuur mRNA	LabBuddy
Restrictie enzymen	Restrictie afbraak
Recombinant DNA	Agarose gelelektroforese
terminal transferase	PCR
DNA bibliotheek	Zuiveren PCR fragment
cDNA synthese	ligeren
phage lambda	plasmide isolatie
cosmiden	E. coli transformatie
oppikken genen uit DNA bibliotheek	Yeast two-hybrid
PCR	Gisttransformatie (LIAC)
Southern blot	Southern blot
hybridisatie	Basic Bioinformatics (Blast, calculate MW/lep)
labelen van probes	labjournaal
Random primed DNA synthesis	Verlag schrijven
Digoxigenin labeling	
Nick translation	
Polynucleotide kinase	
Northern blot	
Western blot	
RFLP	
Cloning vectors (pUC plasmiden)	
Single-stranded DNA synthesis	
Blue white screening	
DNA sequencing (dedeoxy)	
Transcription vectors	
Site-directed mutagenesis	
DNA ligation	
Ratio vector / insert	
supercoiled	
qPCR	
RT-PCR	
Yeast plasmids	
YAC	
Yeast Two-hybrid	
Yeast as a model organism	
Yeast structural genomics	
DNA array technology	

Jaar	BSc2
Vak	Systeembiologie 3 EC
Periode	December
Coördinator	Paul van Heusden
Docenten	Paul van Heusden, Arthur Ram, Vera van Noort, Young Choi

College	Werkcollege
Genomic architecture Yeast	Metabolic pathways in yeast
Genomics	Transcriptomics yeast
Transcriptomics	Cytoscape
Metabolic pathways	Mass spec data analysis
Proteomics/2D gel electrophoresis	Mathematical modeling
Mass Spectrometry (classical, MALDI-TOF, ESI)	
Introduction of Metabolomics : what to expect from metabolomics (Choi)	
Principal component analysis	
Data analysis Mass Spectroscopy	

Jaar	BSc2
Vak	Moleculaire Microbiologie 4 EC
Periode	Blok 1 September-Oktober
Coördinator	Arthur Ram
Docenten	Arthur Ram, Jozsi van den Broek, Eric van den Hoedel, Peter Post, Mark Aertschold

functionele analyse van genen
mutanten en complementatie groepen
knock outs maken
recombinatie en ku70
aspergillus mutanten
aspergillus transformatie
protoplasten en heterokaryons
reinstriken
methodes voor mutagenese
mutant identificatie via genoom sequenzen en complementeren

sec
tat
Type I-IV

ER-GOLGI-vesicles
microtubuli en kinesin
CopII en Rabs

regulatie mbv transcriptie factor
positieve regulatie (mal-regulon)
negatieve regulatie / repressie (arg-regulon)
negatieve regulatie / inductie (lac-regulon)
attenuatie

verschillen pro vs euk.
RNA processing
gene expressie
chromatine structuur HAT/HDAC
transcriptie factoren (gal4)
regulatie van enzyme productie in Aspergillus
enzyme network
transcriptie factor
transcriptie factor bindingsplaats
co-regulatie

primaire en secundaire metabolieten
citroenzuur productie
penicilline productie
werkingsmechanisme penicilline

Quorum sensing
two component systems
Y. fisheri fisheri LuxR
Biofilm formation
antimicrobial peptides

fungaal biotech
enzymes for biomass degradation
protein production
multicopy strains
protease mutants screening
antibody production
itaconic production
metabolic engineering
deletion/overexpressie

Four bachelor courses of molecular genetics

FWN

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 eiwitvouwing, eiwitafbraak: proteasoom
 eiwitactiviteit: modificatie/localisatie
 wildtype/mutant, reversie/revertant
 verlies-/winst-van-functie
 puntmutaties: transitie/transversie, missense, stil, nonsense
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 Mutagens: baseanalogen, EMS, ethidiumbromide
 Straling
 DNA schadeherstel: BER, NER, mismatch repair, recombinatie
 Gevolg DNA schade --> kanker: (protoloncogenen).
 (Ontdekking van) restrictie enzymen/modificatie: methylering
 Gelelektroforese: ethidiumbromide, restrictiekaart plasmide
 knippen/plakken
 cloneren: vector: plasmide, lacZ, cloonbank: BAC/YAC
 genomisch DNA bank, cDNA, reverse transcriptase, cDNA bank
 identificatie clone: hybridisatie/PCR (uitleg techniek)
 Termen: Southern/Northern/Western
 Detectie van een SNP (voorheen RFLP/Southern), nu met PCR
 DNA fingerprinting met PCR: microsatellieten.
 RNA expressie: RNA gel --> RT-PCR, in situ hybridisatie.
 Eiwitexpressie-detectie: Western blot
 DNA sequencing: Sanger: didexoy, radioactief/fluorescent
 Next generation: PAC-BIO & Nanopore (kort genoemd, in het kader van genom
 Genoomsequenties: map-based vs shotgun
 Verschillen in genoomgrootte en aantal genen.
 Voorbeelden van genoomonderzoek:
 Fylogenomics, genetische variatie in gewassen, ancient DNA,
 personalized medicine
 Retrotransposons en genoomgrootte
 Genfamilies: eiwitomologie --> genduplicatie en subfunctionalisatie
 exon shuffling
 Genetische modificatie in planten en dieren: methoden
 Klonen van organismen:
 Planten: regeneratief/somatische embryogenese
 Dieren: embryosplitsing, Gurdon: kerntransplantatie: Dolly, Copy Cat
 Therapeutisch klonen: (pluripotente) stamcellen,

Jaar	BSc2
Vak	Moleculaire Biologie 4 EC
Periode	September
Coördinator	Paul van Heusden
Docenten	Paul van Heusden, Sylvia de Pater
College	Practicum
Gen/Open Reading Frame/structuur mRNA	LabBuddy
Restrictie enzymen	Restrictie afbraak
Recombinant DNA	Agarose gelelektroforese
terminal transferase	PCR
DNA bibliotheek	Zuiveren PCR fragment
cDNA synthese	ligeren
phage lambda	plasmide isolatie
cosmiden	E. coli transformatie
oppikken genen uit DNA bibliotheek	Yeast two-hybrid
PCR	Gisttransformatie (LIAC)
Southern blot	Southern blot
hybridisatie	Basic Bioinformatics (Blast, calculate MW/lep)
labelen van probes	labjournaal
Random primed DNA synthesis	Verlag schrijven
Digoxigenin labeling	
Nick translation	
Polynucleotide kinase	
Northern blot	
Western blot	
RFLP	
Cloning vectors (pUC plasmiden)	
Single-stranded DNA synthesis	
Blue white screening	
DNA sequencing (dedeoxy)	
Transcription vectors	
Site-directed mutagenesis	
DNA ligation	
Ratio vector / insert	
supercoiled	
qPCR	
RT-PCR	
Yeast plasmids	
YAC	
Yeast Two-hybrid	
Yeast as a model organism	
Yeast structural genomics	
DNA array technology	

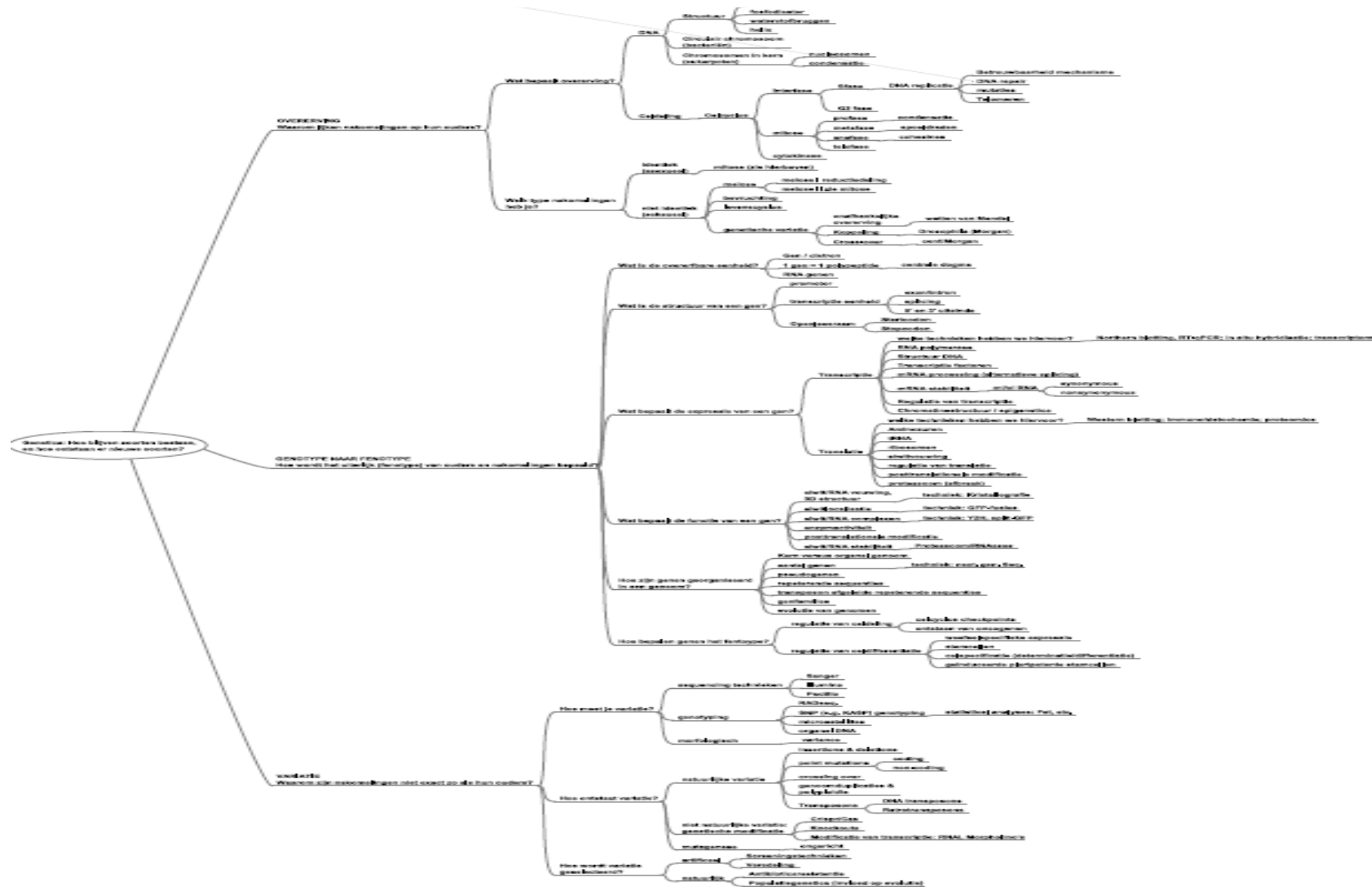
Jaar	BSc2
Vak	Systeembiologie 3 EC
Periode	December
Coördinator	Paul van Heusden
Docenten	Paul van Heusden, Arthur Ram, Vera van Noort, Young Choi

College	Werkcollege
Genomic architecture Yeast	Metabolic pathways in yeast
Genomics	Transcriptomics yeast
Transcriptomics	Cytoscape
Metabolic pathways	Mass spec data analysis
Proteomics/2D gel electrophoresis	Mathematical modeling
Mass Spectrometry (classical, MALDI-TOF, ESI)	
Introduction of Metabolomics : what to expect from metabolomics (Choi)	
Principal component analysis	
Data analysis Mass Spectroscopy	

Jaar	BSc2
Vak	Moleculaire Microbiologie 4 EC
Periode	Blok 1 September-Oktober
Coördinator	Arthur Ram
Docenten	Arthur Ram, Jozsi van den Broek, Eric van den Hoedel, Peter Post, Mark Arentshorst

functionele analyse van genen
 mutanten en complementatie groepen
 knoek outs maken
 recombinatie en ku70
 aspergillus mutanten
 aspergillus transformatie
 protoplasteren en heterokaryons
 restrictoren
 methodes voor mutagenese
 mutant identificatie via genoom sequenzen en complementeren
 sec
 tat
 Type I-IV
 ER-Gol-Gli-vesicles
 microtubuli en kinesin
 CopII en Rabs
 regulatie mbv transcriptie factor
 positieve regulatie (mal-regulon)
 negatieve regulatie / repressie (arg-regulon)
 negatieve regulatie / inductie (lac-regulon)
 attenuatie
 verschillen pro vs euk.
 RNA processing
 gene expressie
 chromatine structuur HAT/HDAC
 transcriptie factoren (gal4)
 regulatie van enzyme productie in Aspergillus
 enzyme network
 transcriptie factor
 transcriptie factor bindingsplaats
 co-regulatie
 primaire en secundaire metabolieten
 citroenzuur productie
 penicilline productie
 werkingsmechanisme penicilline
 Quorum sensing
 two component systems
 Y. fisheri fisheri LuxR
 Biofilm formation
 antimicrobial peptides
 fungal biotech
 enzymes for biomass degradation
 protein production
 multicopy strains
 protease mutants screening
 antibody production
 itaconic production
 metabolic engineering
 deletion/overexpressie

Molecular genetic perspective



Harald van Mill & Frans Rodenburg **FWN**



Perspectives for building portfolios

- Mathematical (basic) perspective
- Statistical perspective
- Ethical perspective

How to explicate a perspective?

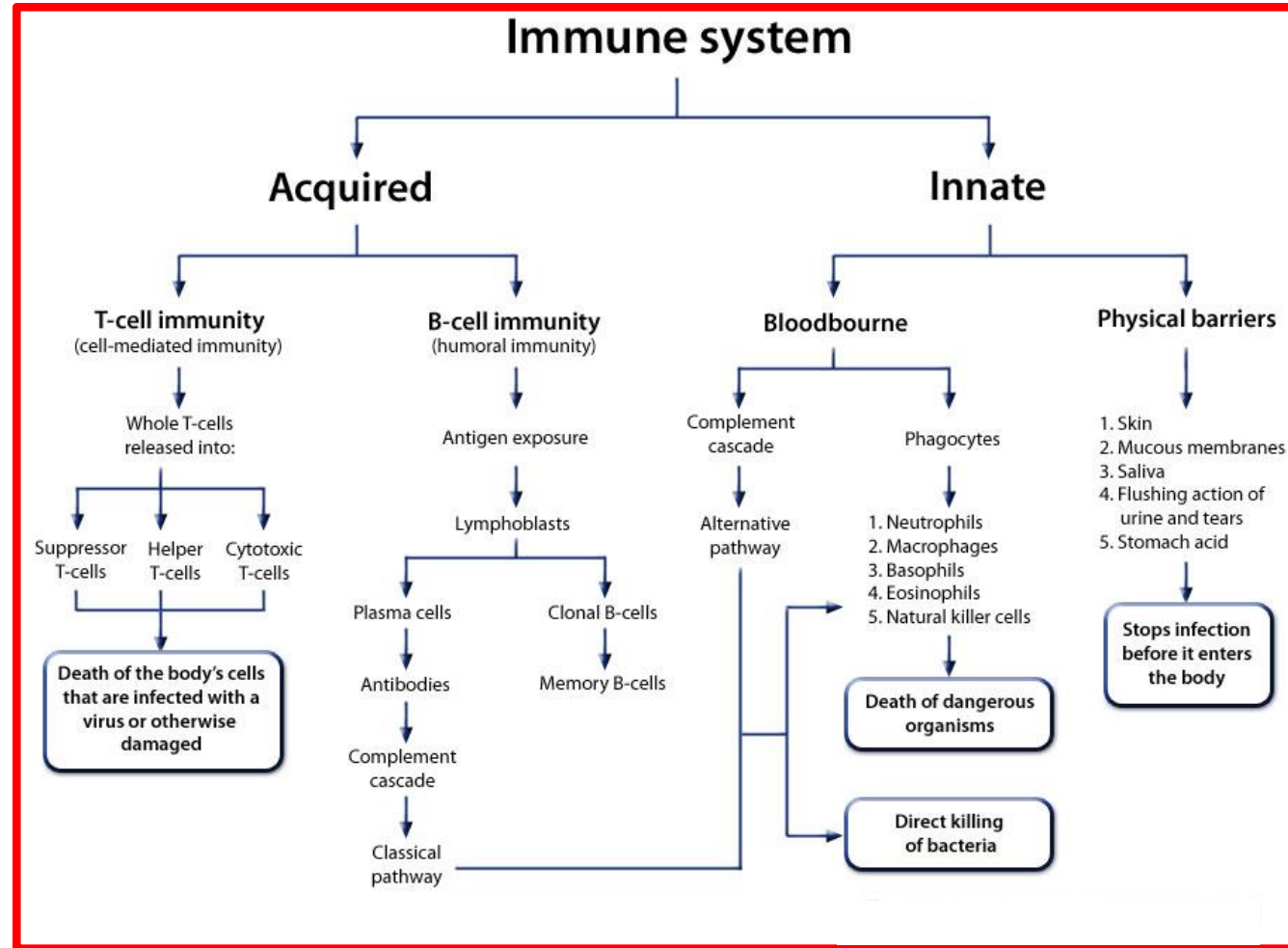
If multiple teachers are assigned to a course the procedure below can be used to develop a coordinated team perspective or set of perspectives

Step 1. List all concepts / insights that you like to teach

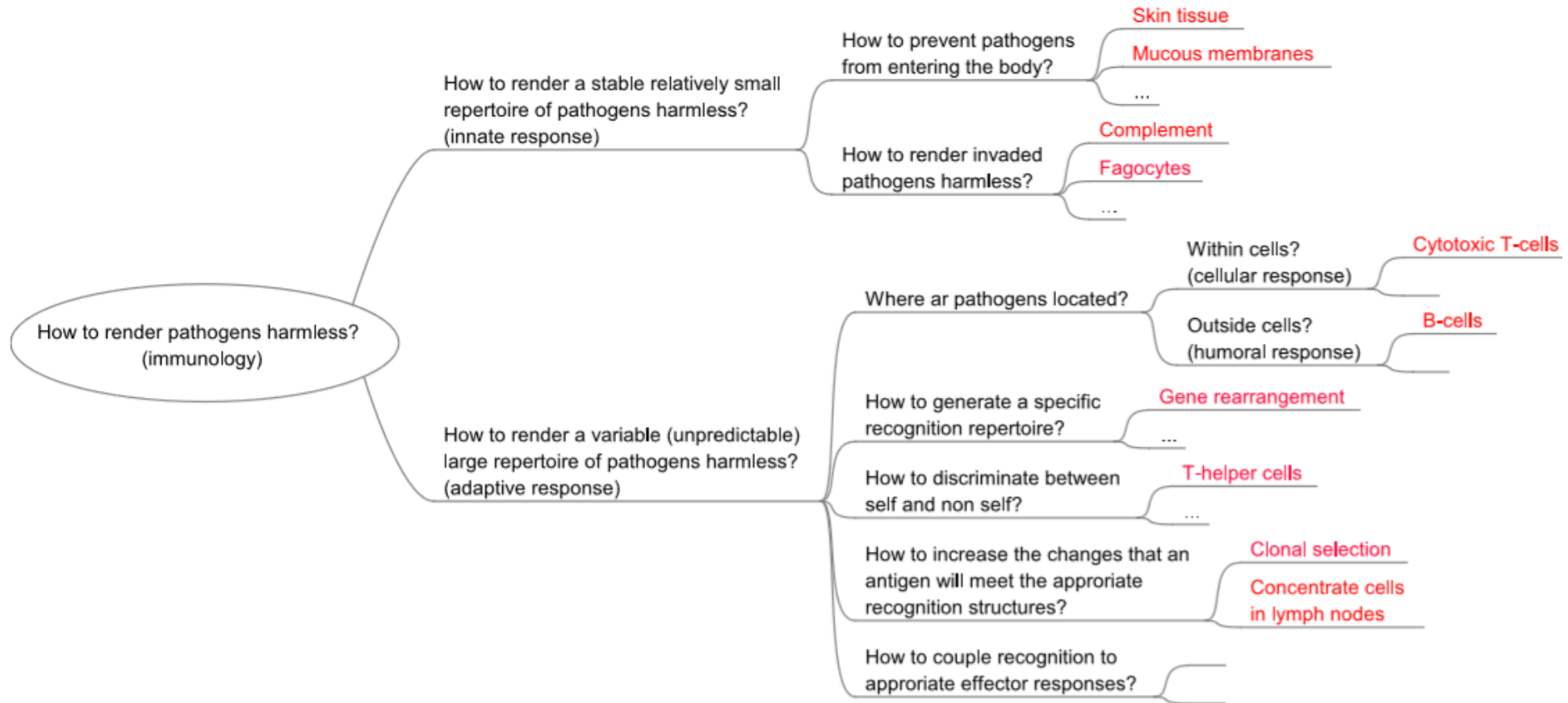
For instance if you teach immunology.

adaptive immune system; B-cells; T-cells; complement; phagocyt; clonal selection, skin et cetera

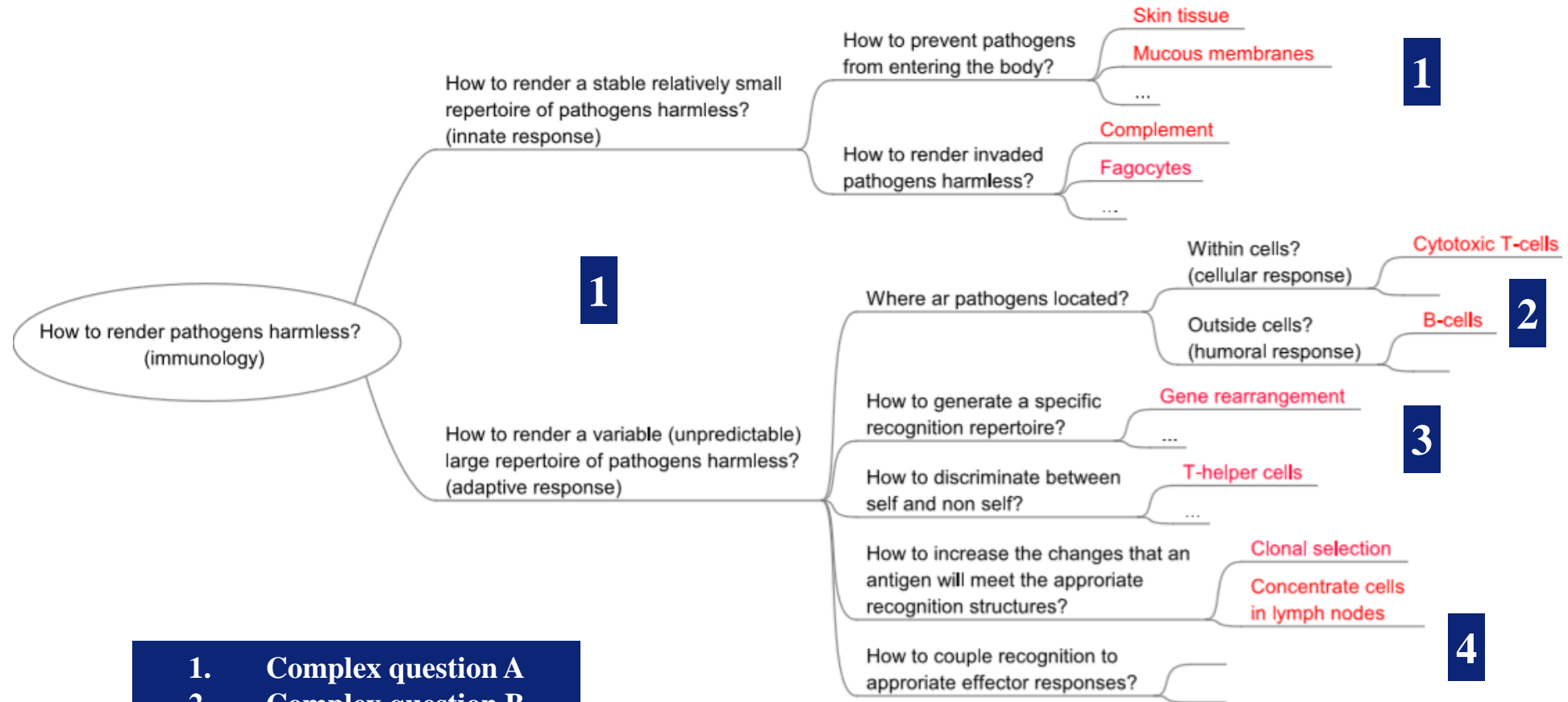
Step 2: Organize concepts in groups (preferably in a hierarchy)



Step 3: Formulate related questions and organize them in a question agenda



Partial course overview (1,2,3 and 4 are numbers of lectures)



1. Complex question A
2. Complex question B
3. Complex question C
4. Complex question D

Fred Janssen

- Master's degree in Biology
- PhD 'Learning biology by designing'
- ICLON, Leiden Graduate School for Teaching (since 1999)
 - Biology teacher educator (until 2016)
 - Full professor of science education (since 2016)
 - Department head secondary education (since 2018)
 - Senior Comenius Fellow / Leiden Teachers' Academy fellow
 - Scientific director ICLON (since 2022)
 - Focus of my own research program (13 PhD's / 2 Post-docs)

**An ecological approach to
student and teacher learning**



Interfacultair Centrum voor Lerarenopleiding, Onderwijsonderzoek en Nascholing (ICLON)

100+ onderwijsexperts

Opleiden van academische docenten	Professionaliseren en wetenschapsoriëntatie	Onderzoek naar onderwijs
<ul style="list-style-type: none"> • 1^e graads & 2^e graads (meerdere trajecten) • 330 studenten • Vakdidactici alfa, bèta, gamma & onderwijskundigen • 18 schoolvakken • Samen opleiden met 9 opleidingsscholen waarbij 90% van alle VO scholen in de regio Zuid Holland zijn aangesloten 	<ul style="list-style-type: none"> • Wetenschapsoriëntatie PO • Wetenschapsoriëntatie VO • VO-HO aansluiting • ONZ netwerk > 60 scholen i.s.m. de faculteiten • Docentprofessionalisering (PO, VO, HO) 	<ul style="list-style-type: none"> • 3 Hoogleraren • 2 UHD's / 5 UD's • 45 lopende PhD projecten / 55 gerealiseerde dissertaties • 240 wetenschappelijke publicaties / 102 professionele publicaties (in de laatste 5 jaar) • Structurele samenwerkingsverbanden en publiceren met met 7 universiteiten uit de top 50 • Nieuwe taak: coördinatie en versterking HO onderzoek

- Goede universitaire, regionale, nationale en internationale verankering
- Opleiden, professionaliseren en onderzoek m.b.t. de gehele keten (po,vo, ho)
- Uitstekende beoordelingen van visitatiecommissies
- Werken vanuit een gemeenschappelijke kennisbasis

ICLON Knowledge base

12 Teaching - Learning principles

For understanding and supporting student and teacher agency development

The 12 teaching-learning principles




Adaptive
Learning is promoted when teaching support is tailored to what a pupil or student needs...



Collaborative learning
Learning is promoted when pupils...



Language awareness
Learning is enhanced when attention is paid to both conceptual and linguistic aspects of the...



Formative
Learning is enhanced when evaluation is used to learn from it...



Goal system-based
Learning is promoted when it builds productively on existing multiple goals...



Inclusive
Learning is promoted when the needs of all learners are met and all learners are included...



Inquiry-based
Learning is enhanced when researchable questions are asked for which data are collected to infer...



Modular
Learning is promoted when teachers rearrange their existing building blocks for educational...



Multiple perspective-based
Learning is promoted when it is...



Safe and participatory
Learning is enhanced when it takes place with (active) participation of all involved, in a safe learning...



Self-regulated
Learning is promoted when pupils and students progressively self-regulate their learning...



Whole task-based
Learning is promoted when subject matter is taught in the context of an authentic task...

Selected publications

- Janssen, F.J.J.M., Westbroek, H.B., Doyle, W. & Driel, van J.H. (2013). How to make innovations practical. *Teachers College Record*, 115 (7), 1-43.
- Janssen, F.J.J.M., Westbroek, H.B. & van Driel, J.H. (2014). How to make guided discovery learning practical for student teachers. *Instructional Science*, 42, 67-90.
- Janssen, F.J.J.M. , Westbroek, H.B. & W. Doyle (2014) The practical turn in teacher education. Designing a preparation sequence for core practice frames. *Journal of Teacher Education*, 65(3), 195-206
- Janssen, F.J.J.M., Westbroek, H.B. & W. Doyle (2015). Practicality studies: How to move from what works in principle to what works in practice. *Journal of the Learning Sciences*, 24(1), 176-186
- Janssen, F.J.J.M. & B. van Berkel (2015). Making philosophies of science education practical for science teachers. *Science & Education*, 24 (3) 229-258.
- Janssen, F.J.J.M., Grossman, P. & H.B. Westbroek (2015). Facilitating decomposition and recomposition in practice based teacher education. The power of modularity. *Teaching and Teacher Education*, 51, 137-146.
- Davis E. A., Janssen, F. J.J.M., & Van Driel, J. H. (2016). Teachers and science curriculum materials: where we are and where we need to go. *Studies in Science Education*, 52(2), 127-160.
- Janssen, F.J.J.M., Hulshof, H. & K. van Veen (2016). *Uitdagend gedifferentieerd vakonderwijs. Praktisch gereedschap om je onderwijsrepertoire te blijven uitbreiden.* Leiden/Groningen: UFB.
- Janssen, F.J.J.M., Vermeulen, M. & J.H. van Driel (2017) *Leerprogressies voor bètadocenten. Ontwikkeling van expertise voor onderzoekend leren. Review studie.* ICLON. Leiden.
- Janssen, F.J.J.M., Könings, K.D. & J.J.G. van Merriënboer (2017). Participatory educational design: How to improve mutual learning and the quality and usability of the design? *European Journal of Education*, 52, 268-279.
- Janssen, F.J.J.M. (2017). *Grip krijgen op complexiteit. Onderwijs voor het 'moeras'.* Oratie. ICLON:Leiden.
- Janssen, F.J.J.M., Hulshof, H. & Van Veen, K. (2018). *Wat is echt de moeite waard om te onderwijzen? Een perspectiefgerichte benadering.* Leiden/Groningen: UFB.
- Janssen, F.J.J.M., Westbroek, H.B., H. Borko (submitted). The indispensable role of the goal construct for understanding and changing teaching practice. *Teaching and Teacher Education*.
- Janssen, F.J.J.M., Westbroek, H.B.. & W. Doyle (submitted). An ecological approach to teaching and teacher learning *Educational Researcher*.