# Embedding One Health in Science Education:

## A Reflexive and Transdisciplinary Framework for Science Teacher Education

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**Environment and Sustainable Development, Blended Intensive Programmes (BIP) in March & April 2026**

*Organized by the UNESCO Chair on Teacher Education for Sustainable Development at the University of Ljubljana, in collaboration with the University of Klagenfurt, the Private University College Augustinum, and the National and Kapodistrian University of Athens.*

# Theoretical Background

- **Complex Health Problems** (CHPs) like zoonosis, AMR, food security…
- ...affect humans, animals and the environment alike,
- ...cause economic and social consequences
- ...and are therefore of high social relevance (Velavan & Meyer, 2020; Zinsstag et al., 2018; WHO et al., 2022)
- Despite warnings by experts regarding the **growing risk of spillover events**, the global community has not yet implemented sufficient measures to prevent these incidents (Gruetzmacher et al., 2021; Hobusch et al., 2024)


WE CAN EXPECT MORE PANDEMICS TO COME, OWING TO FACTORS LIKE CLIMATE CHANGE, MASS MIGRATION, GLOBALIZATION, AND HUMAN ENCROACHMENT ON WILDLIFE AND INSECT ECOSYSTEMS.

Source: https://hub.jhu.edu/magazine/2025/spring/ready-for-next-pandemic/

# One Health- The beginning 2004…

West Nile Virus

Ebola Hemorrhagic Fever

Mad Cow Disease (BSE)

SARS

Mpox

Avian Influenza

Recent outbreacks 2003/2004


Quelle: http://www.oneworldonehealth.org/sept2004/owoh_sept04.html

# One Health- Manhattan Principles (in 2004)

We urge the world's leaders, civil society, the global health community and institutions of science to:

1. Recognize the essential link between human, domestic animal and wildlife health and the threat disease poses to people, their food supplies and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.

2. Recognize that decisions regarding land and water use have real implications for health. Alterations in the resilience of ecosystems and shifts in patterns of disease emergence and spread manifest themselves when we fail to recognize this relationship.

3. Include wildlife health science as an essential component of global disease prevention, surveillance, monitoring, control and mitigation.

4. Recognize that human health programs can greatly contribute to conservation efforts.

5. Devise adaptive, holistic and forward-looking approaches to the prevention, surveillance, monitoring, control and mitigation of emerging and resurging diseases that take the complex interconnections among species into full account.

6. Seek opportunities to fully integrate biodiversity conservation perspectives and human needs (including those related to domestic animal health) when developing solutions to infectious disease threats.

7. Reduce the demand for and better regulate the international live wildlife and bushmeat trade not only to protect wildlife populations but to lessen the risks of disease movement, cross-species transmission, and the development of novel pathogen-host relaWe urge the world's leaders, civil society, the global health community and institutions of science to:
tionships. The costs of this worldwide trade in terms of impacts on public health, agriculture and conservation are enormous, and the global community must address this trade as the real threat it is to global socioeconomic security.

8. Restrict the mass culling of free-ranging wildlife species for disease control to situations where there is a multidisciplinary, international scientific consensus that a wildlife population poses an urgent, significant threat to human health, food security, or wildlife health more broadly.

9. Increase investment in the global human and animal health infrastructure commensurate with the serious nature of emerging and resurging disease threats to people, domestic animals and wildlife. Enhanced capacity for global human and animal health surveillance and for clear, timely information-sharing (that takes language barriers into account) can only help improve coordination of responses among governmental and nongovernmental agencies, public and animal health institutions, vaccine / pharmaceutical manufacturers, and other stakeholders.

10. Form collaborative relationships among governments, local people, and the private and public (i.e.- non-profit) sectors to meet the challenges of global health and biodiversity conservation.

11. Provide adequate resources and support for global wildlife health surveillance networks that exchange disease information with the public health and agricultural animal health communities as part of early warning systems for the emergence and resurgence of disease threats.

12. Invest in educating and raising awareness among the world's people and in influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to succeed in improving prospects for a healthier planet.

# One Health- Berlin Principles (in 2019)

We urge world leaders, governments, civil society, the global health and conservation communities, academia and scientific institutions, business, finance leaders, and investment holders to:

1) Recognize and take action to: retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature; and ensure the conservation and protection of biodiversity, which interwoven with intact and functional ecosystems provides the critical foundational infrastructure of life, health and well-being on our planet;

2) Take action to develop strong institutions that integrate understanding of human and animal health with the health of the environment and invest in the translation of robust science-based knowledge into policy and practice;

3) Take action to combat the current climate crisis, which is creating new severe threats to human, animal and environmental health, and exacerbating existing challenges;

4) Recognize that decisions regarding land, air, sea, and freshwater use directly impact health and wellbeing of humans, animals and ecosystems and that alterations in ecosystems paired with decreased resilience generate shifts in communicable and non-communicable disease emergence, exacerbation and spread; and take action accordingly to eliminate or mitigate these impacts;

5) Devise adaptive, holistic and forward-looking approaches to the detection, prevention, monitoring, control and mitigation of emerging/resurging diseases and exacerbating communicable and non-communicable diseases, that incorporate the complex interconnections among species, ecosystems, and human society, while accounting fully for harmful economic drivers, and perverse subsidies;

6) Take action to meaningfully integrate biodiversity conservation perspectives and human health and well-being when developing solutions for communicable and non-communicable disease threats;

7) Increase cross-sectoral investment in the global human, livestock, wildlife, plant and ecosystem health infrastructure and international funding mechanisms for the protection of ecosystems, commensurate with the serious nature of emerging/resurging and exacerbating communicable and non-communicable disease threats to life on our planet;

8) Enhance capacity for cross-sectoral and trans-disciplinary health surveillance and clear, timely information sharing to improve coordination of responses among governments and NGOs, health, academia and other institutions, industry and other stakeholders;

9) Form participatory, collaborative relationships among governments, NGOs, and Indigenous Peoples and local communities while strengthening the public sector to meet the challenges of global health and biodiversity conservation; and

10) Invest in educating and raising awareness for global citizenship and holistic planetary health approaches among children and adults in schools, communities, and universities while also influencing policy processes to increase recognition that human health ultimately depends on ecosystem integrity and a healthy planet.

# Comparison 15 years…

Beibehalten / weiterentwickelt · Neu in Berlin 2019 · Deutlich erweitert · Entfallen / integriert

**Manhattan 2004 (12)** | Berlin 2019 (10)

*Verabschiedet von der Wildlife Conservation Society, New York, 2004. Markierungen zeigen, was sich bis 2019 verändert hat.*

1. Recognize the essential link between human, domestic animal and wildlife health and the threat disease poses to people, their food supplies and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.
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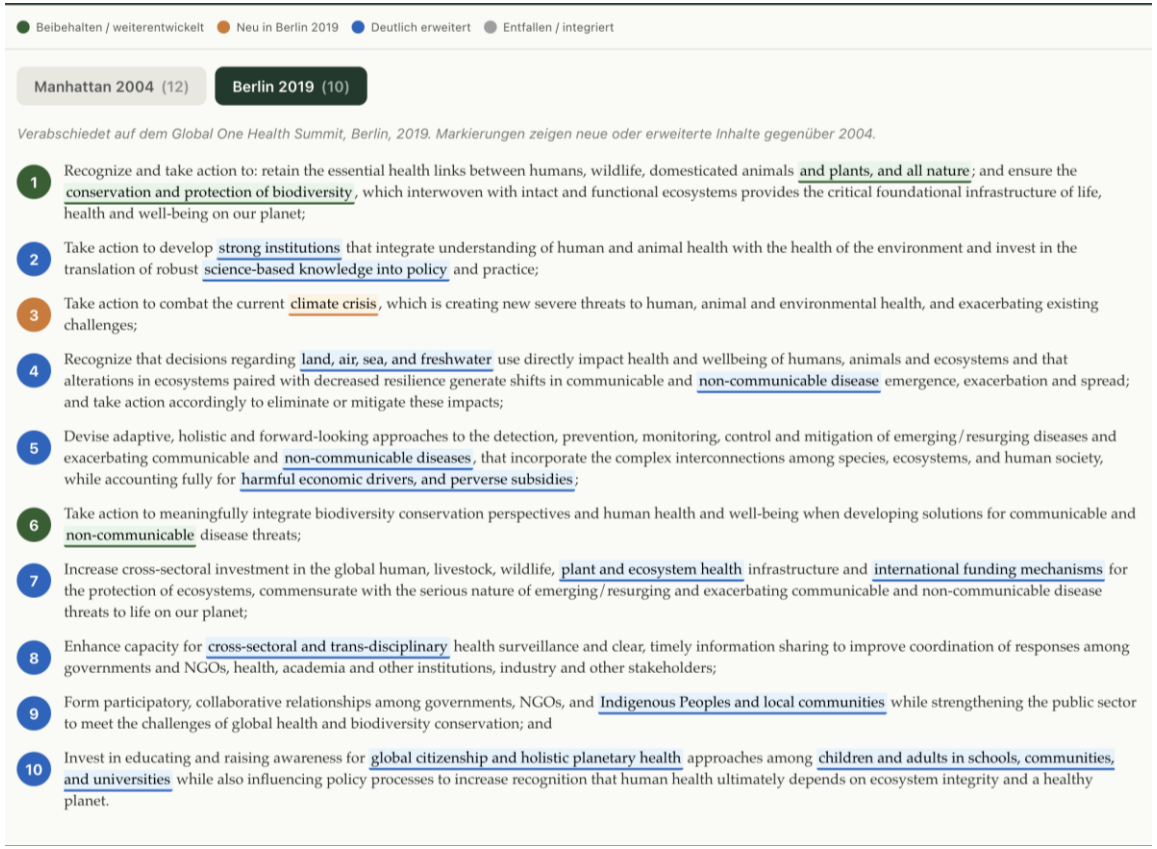


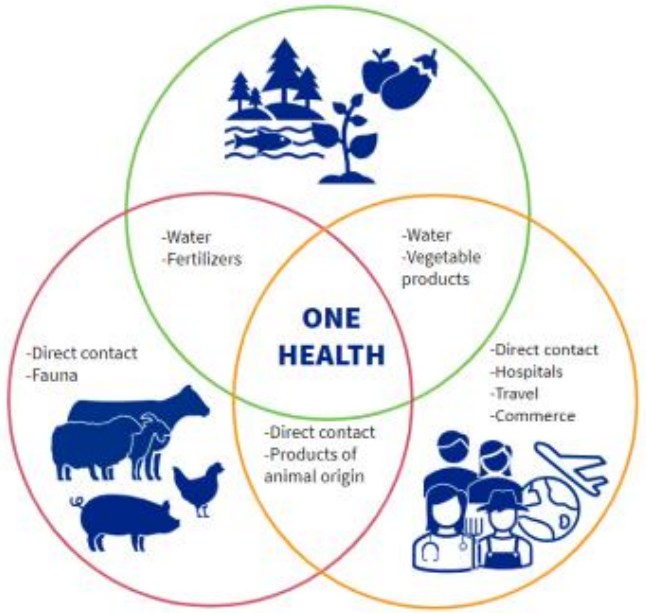
# One Health (OH) Approach

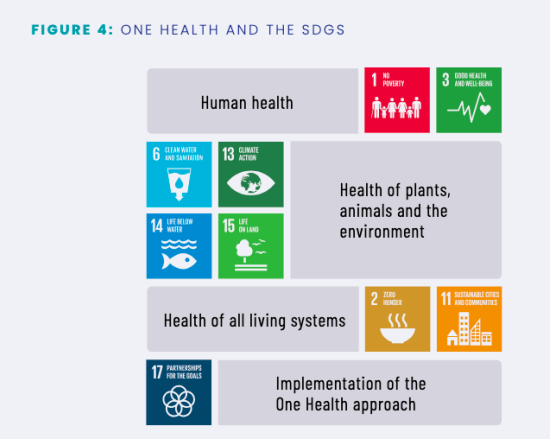
- OH is an **integrated approach** that seeks to **optimize health** outcomes across these domains through **transdisciplinary collaboration** between multiple scientific and non-scientific sectors (Betram et al., 2024; OHHLEP, 2022)

- Significant role of society is highlighted in macro-level EU/UN documents (Queenan et al., 2017; WHO et al., 2022)

- Synergies exist between OH objectives and the 2030 Agenda's contextual SDGs (Rüegg et al., 2017; Sinclair, 2019; Viegas, 2022)

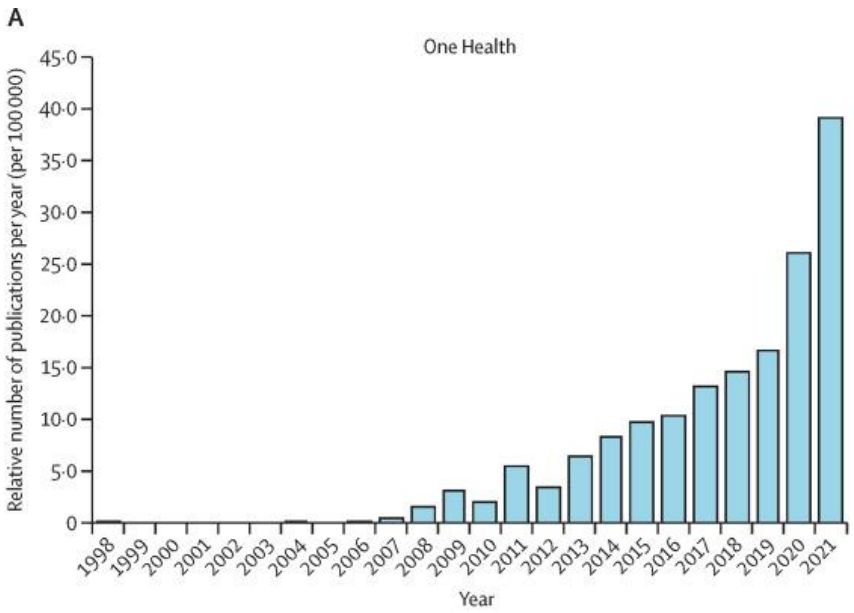
→ unclear how these integrated concepts can be transformed to build OH core competencies (Laing et al., 2023) for formal education purposes…



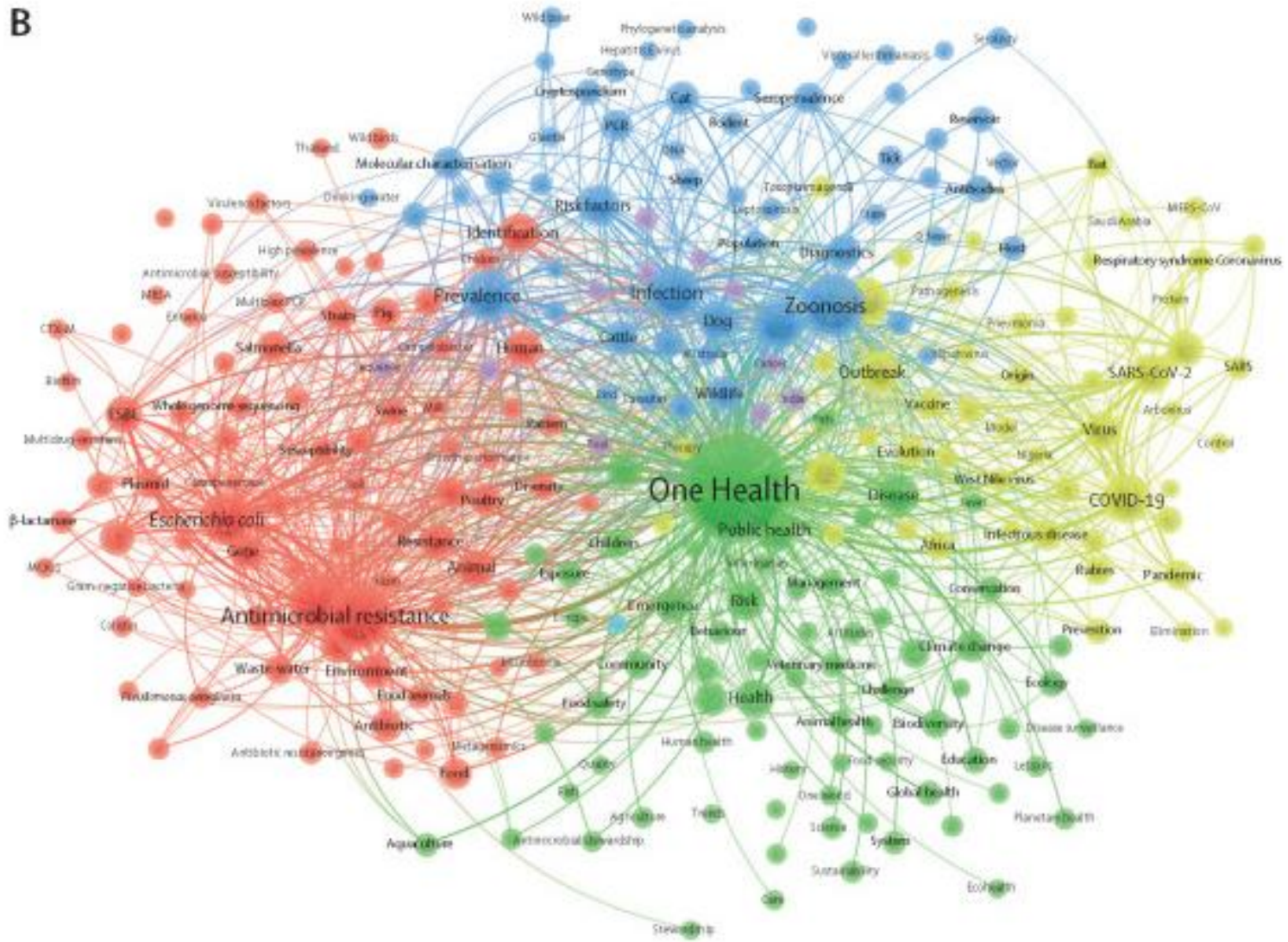




Food and Agriculture Organization of the United Nations
UN environment programme
World Health Organization
World Organisation for Animal Health
Founded as OIE

# One Health - The research field



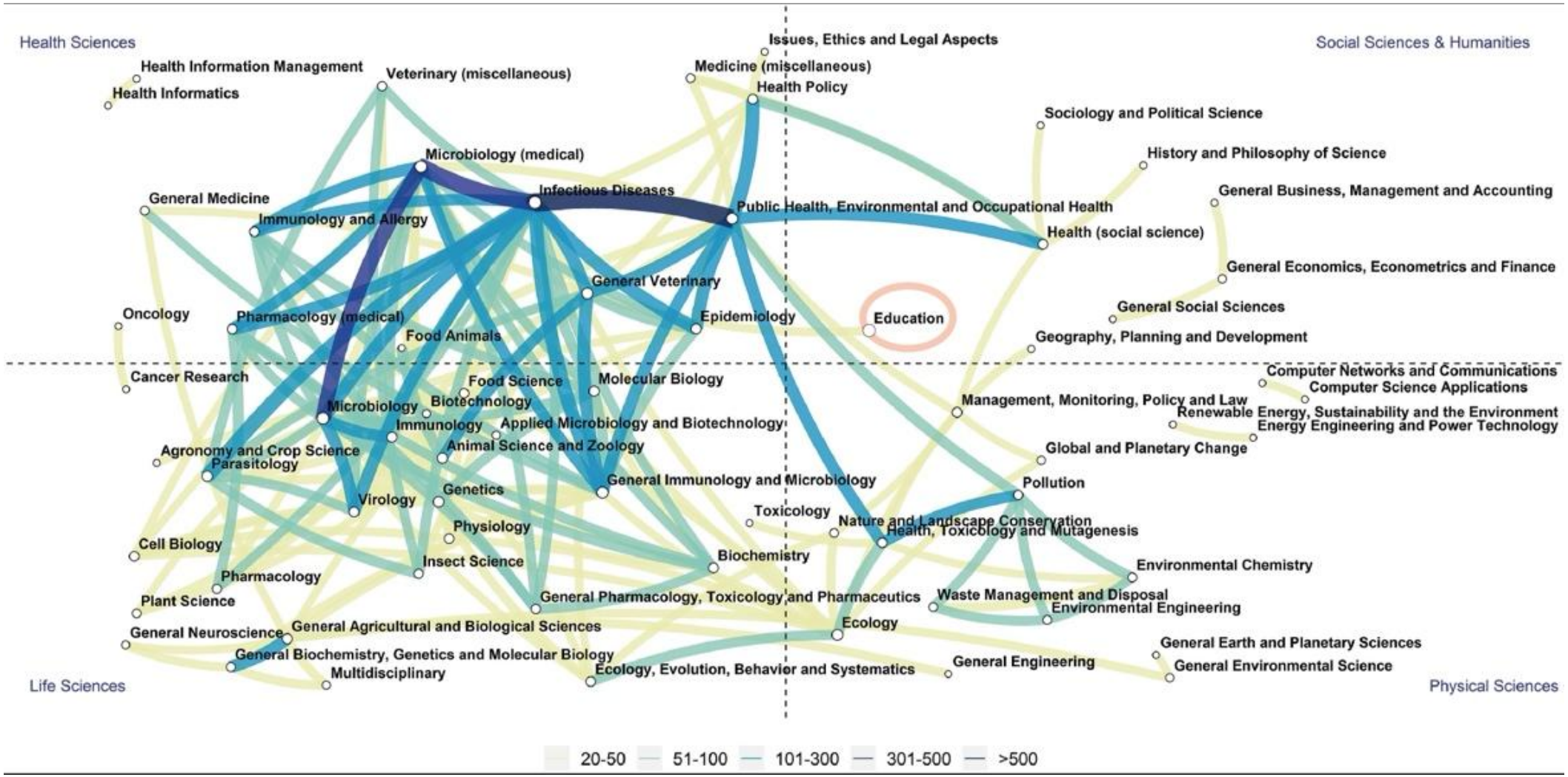

Prevalence of One Health publications




Keyword co-occurrence network graph, highlighting research topics' frequency and interconnections

Castañeda et al., 2023

# One Health - The research field and the education gap




Research field network within One Health publications from 2012 to 2021. The analysis of over 8,000 publications highlighted major research areas like zoonosis, infectious diseases, and microbiology. However, limited engagement was observed from the Social Sciences & Humanities, particularly in the field of education (Qiang et al., 2022)

# One Health - The research field and the education gap

# The One Health Teaching Clinic model

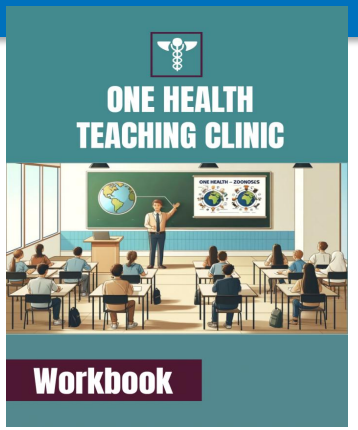
# The One Health Teaching Clinic model

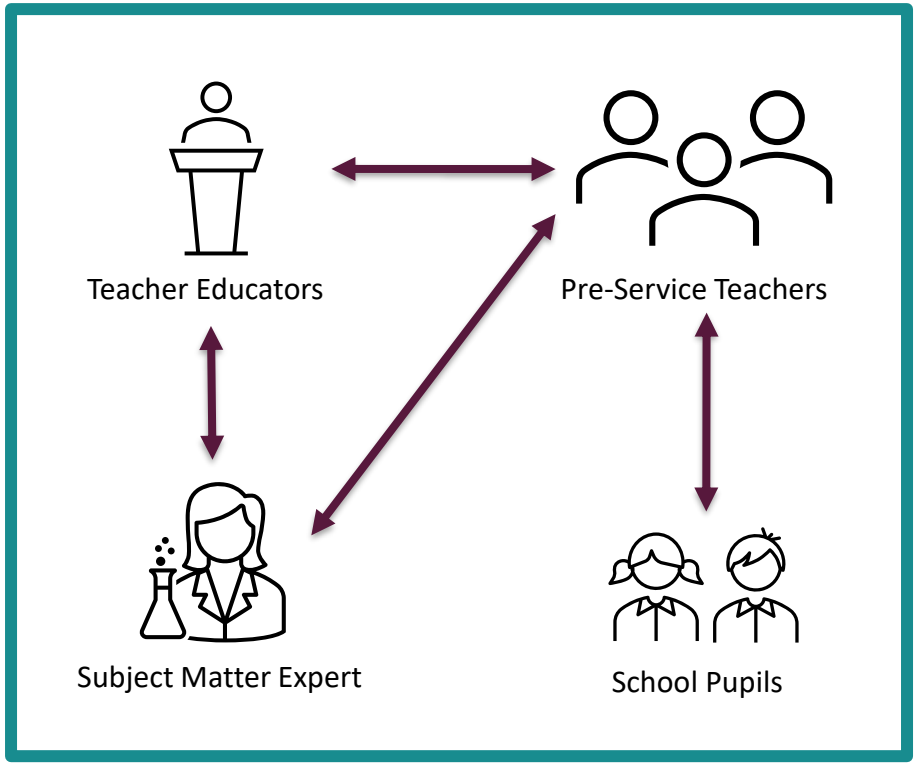
- University teacher education course for
  - Pre-service biology/science teachers (P-SSTs)
  - Pre-service agricultural teachers

- P-SSTs  are working in groups of 3-5

- Co-creation together with one **subject matter expert**

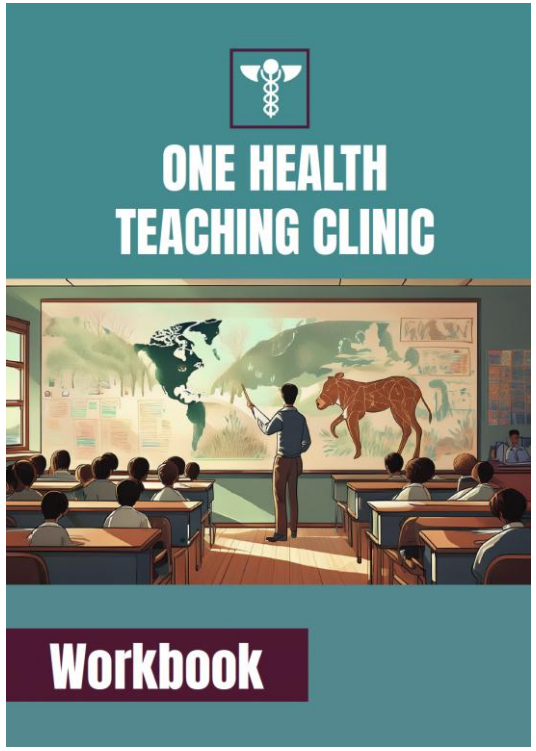
- Guided by the Workbook/
  13 weeks workflow/steps




Hobusch et al., 2025

# One Health Teaching Clinic: Coursework Outline and Essential Steps




**Welcome Aboard**
- Aufgabenformate
- Roadmap
- Begleitforschung
- Einführung One Health

**Arbeitspaket 1: Diving In**
- Einlesen in Ihr One Health Thema
- Input: Concept Maps
- Naturwissenschaftliche Concept Map
- 1. SME - Meeting: fachliche Klärung

**Arbeitspaket 2: New Perspectives**
- Input One Health & Society
- Lebensweltliche Concept Map
- Zusammenführung der Concept Maps

**Arbeitspaket 3: Game Plan**
- Input Socio Scientific Issues
- MOOCs zur Unterrichtsplanung
- Unterrichtsplanung
- Forschungsdesign

**Arbeitspaket 4: Game Plan Finish**
- 2. SME Meeting: Feedback
- Freigabe durch Kursleitung

**Arbeitspaket 5: In Action**
- Durchführung der Unterrichtsintervention

**Arbeitspaket 6: Data Dive**
- Datenanalyse & Interpretation
- 3. SME Meeting: Austausch

**Arbeitspaket 7: Showtime**
- Postererstellung
- Posterpräsentation bei der Mini-Konferen

**Arbeitspaket 8: Wrapping it Up**
- Reflexion des Gelernten
- Transfer in die Praxis

BADGE UP


# Step 1: Engagement with Disciplinary Expertise (Example)

ONE HEALTH TEACHING CLINIC

**Protecting Our Future: A One Health Approach to Pandemics**

**Dr. Ahmed Abd El Wahed**

Ich bin Leiter des Labors am Institut für Tierhygiene und Öffentliches Veterinärwesen an der Universität Leipzig und habe 2011 meinen Doktortitel in Biologie an der Universität Göttingen erworben.

Meine Forschungsschwerpunkte liegen in der Entwicklung mobiler Labore zur schnellen Erkennung von Viren, Bakterien und Parasiten, die in ressourcenarmen Regionen Afrikas und Asiens erfolgreich eingesetzt wurden. Zudem beschäftige ich mich mit der Epitopkartierung nach Immunisierungen und Impfungen, um mithilfe von Mikroarrays die besten Kandidaten für Impfstoffe zu identifizieren.

Derzeit arbeite ich u.a. daran, innovative Verfahren zur Diagnostik des Mpox-Virus (ehemals Affenpocken) zu entwickeln. Ziel ist es, Diagnosemethoden in Regionen mit eingeschränkter Infrastruktur zu optimieren, um schnelle und präzise Ergebnisse zu ermöglichen. Diese Arbeit ist essenziell, um rasch auf Epidemien reagieren zu können und zur globalen Gesundheitsüberwachung beizutragen.

**Kontakt:**
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Paper 1


Paper 2


Paper 3

3-5 pre-service science teachers

**One Health Teaching Clinic course**

**Centre of Biology Education**

Prof. Benedikt Heuckmann

Universität Münster

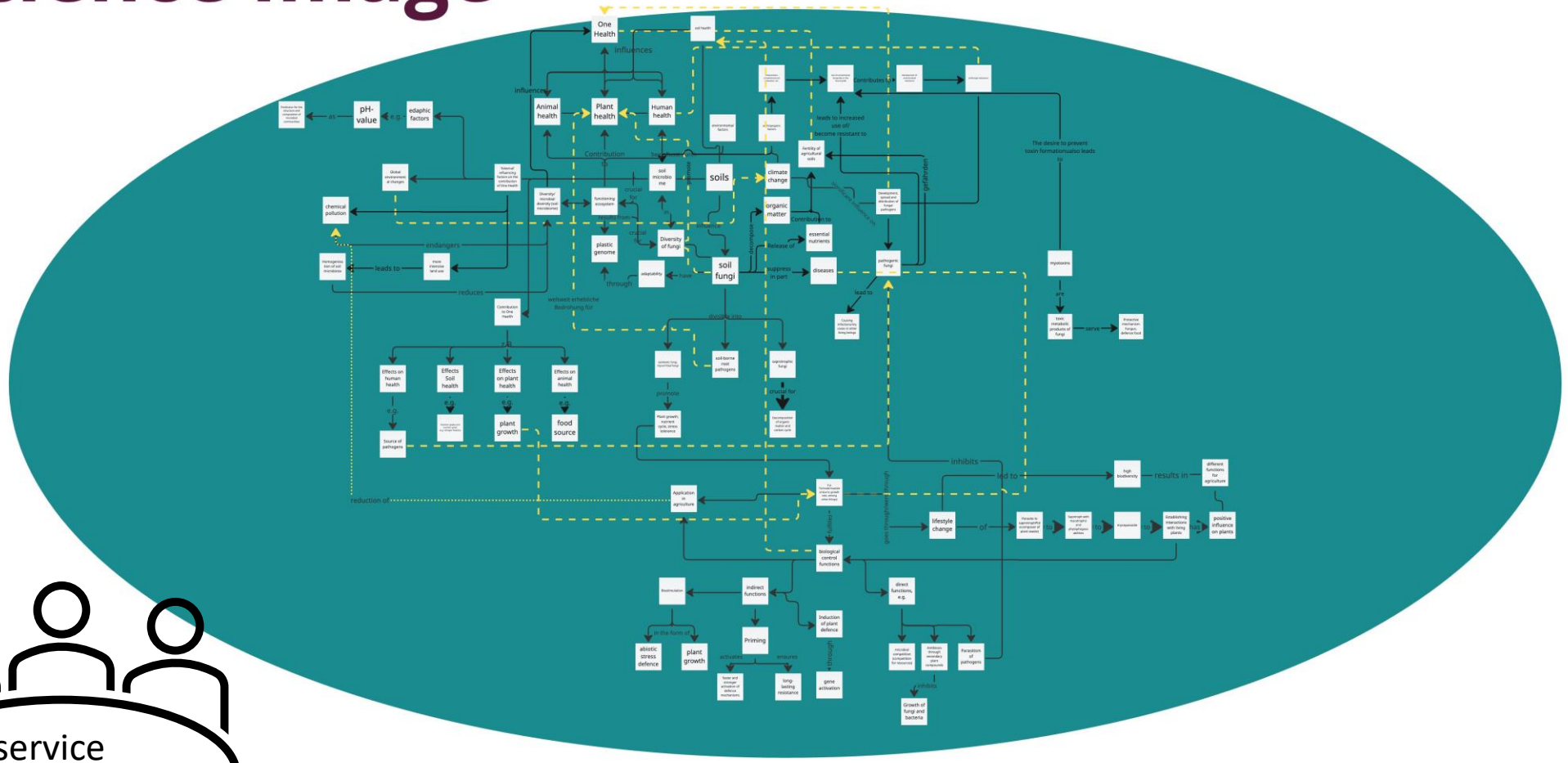
# Step 2: First Concept Map (Science Lens)

Paper 1


Paper 2

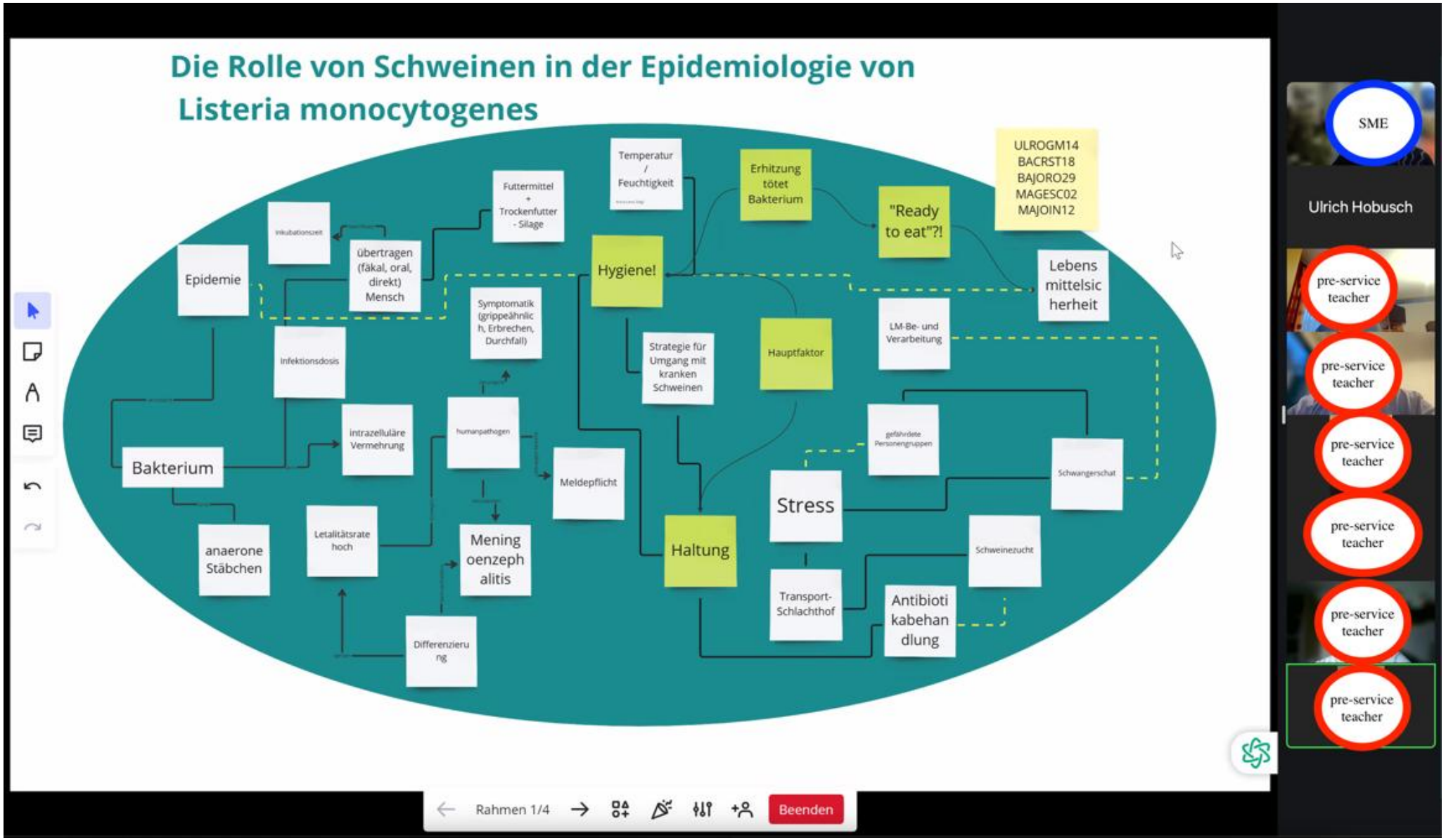

Paper 3


## Science Image




pre-service science teachers

# Step 3: Expert Feedback, Session 1

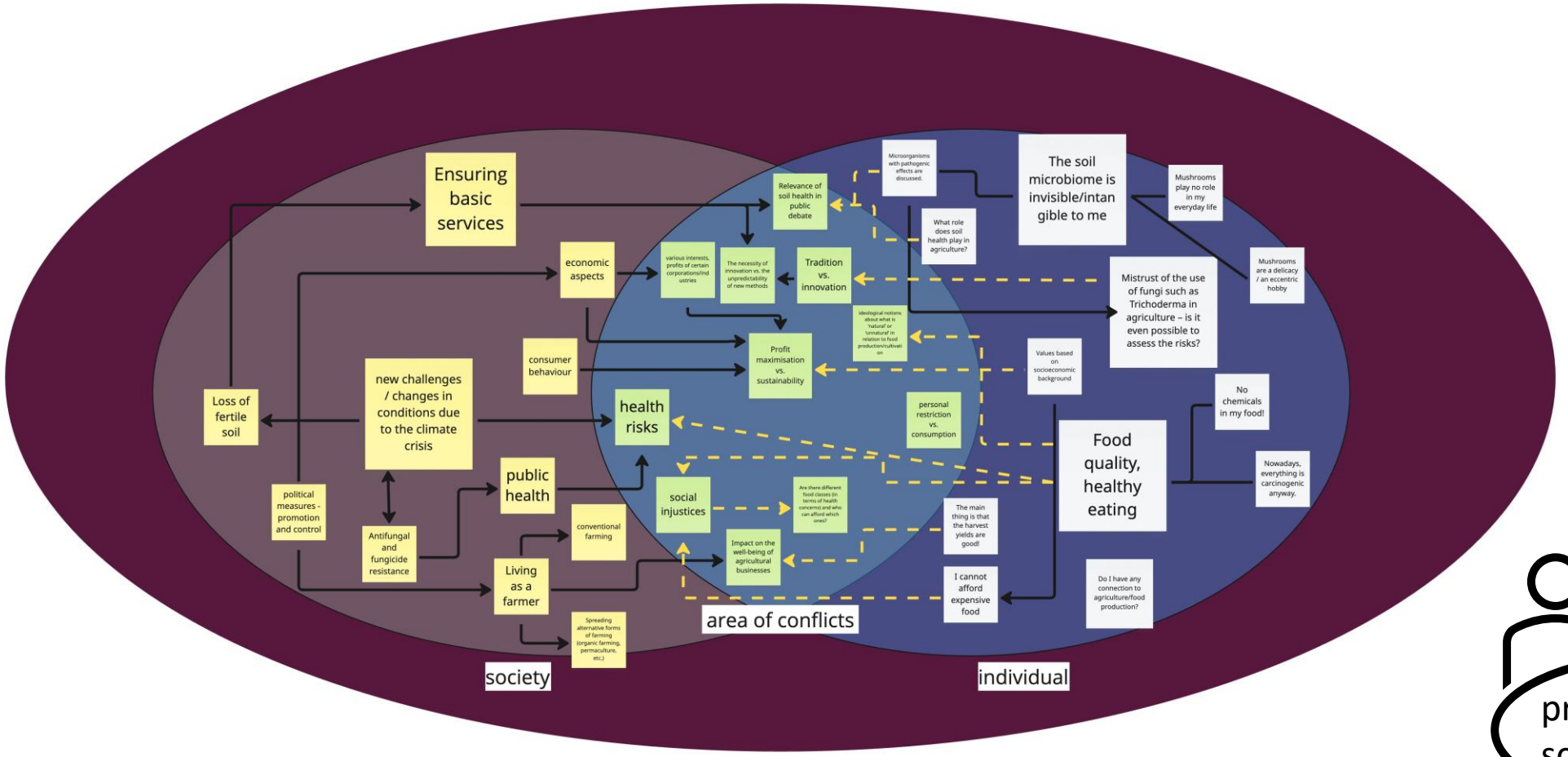



zoom

About 1 hour

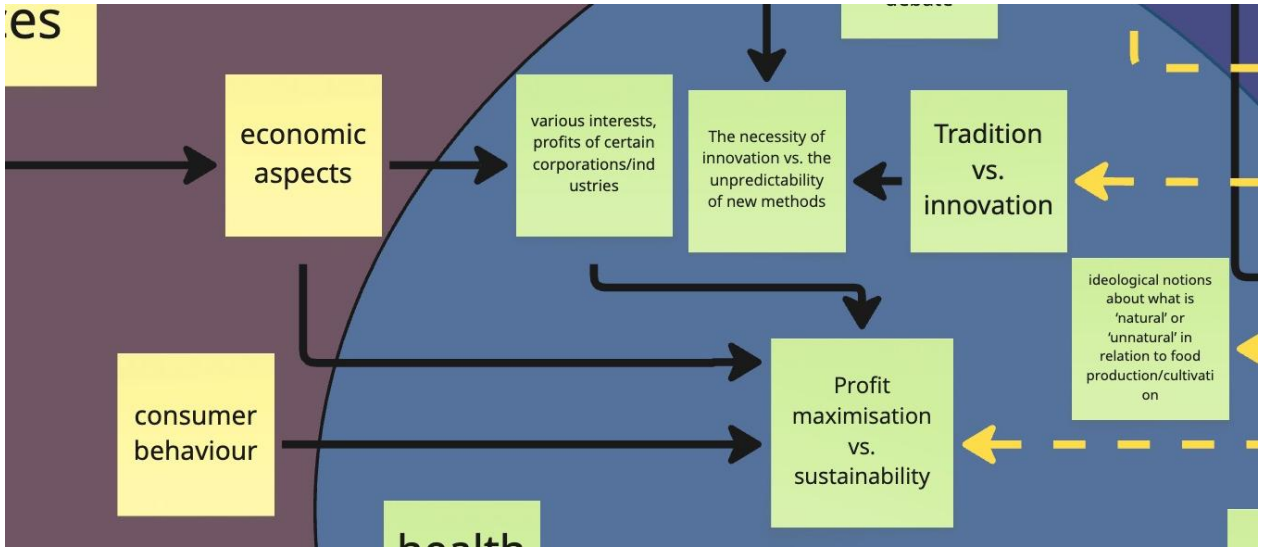
# Step 4: Lifeworld (Lens/Images)

## Lifeworld Image




pre-service science teachers

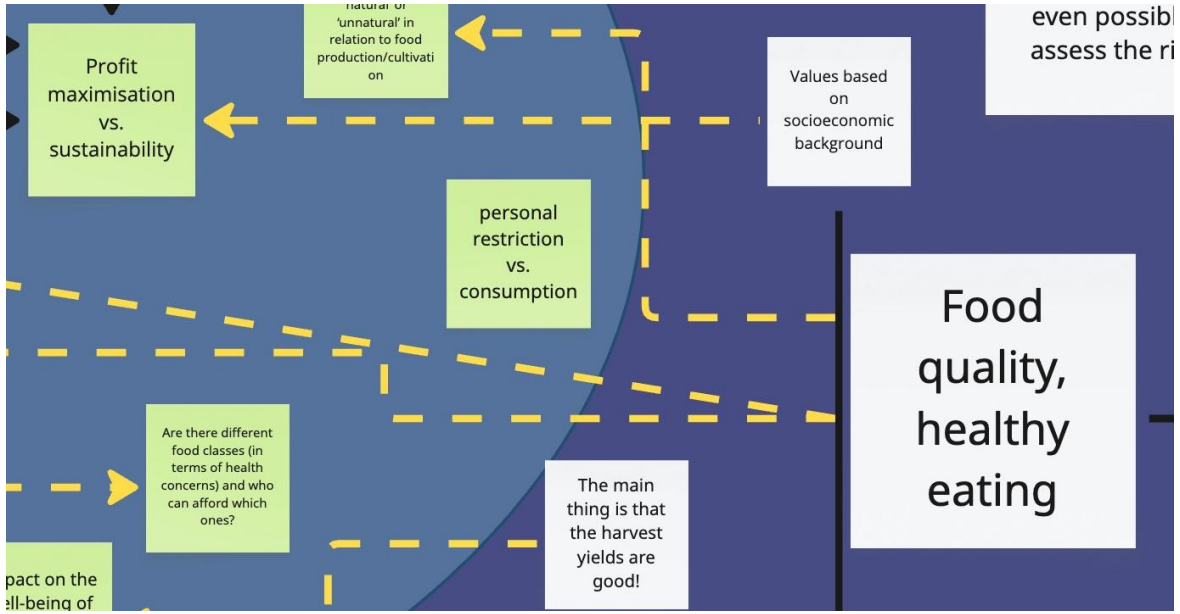
# Context matters …



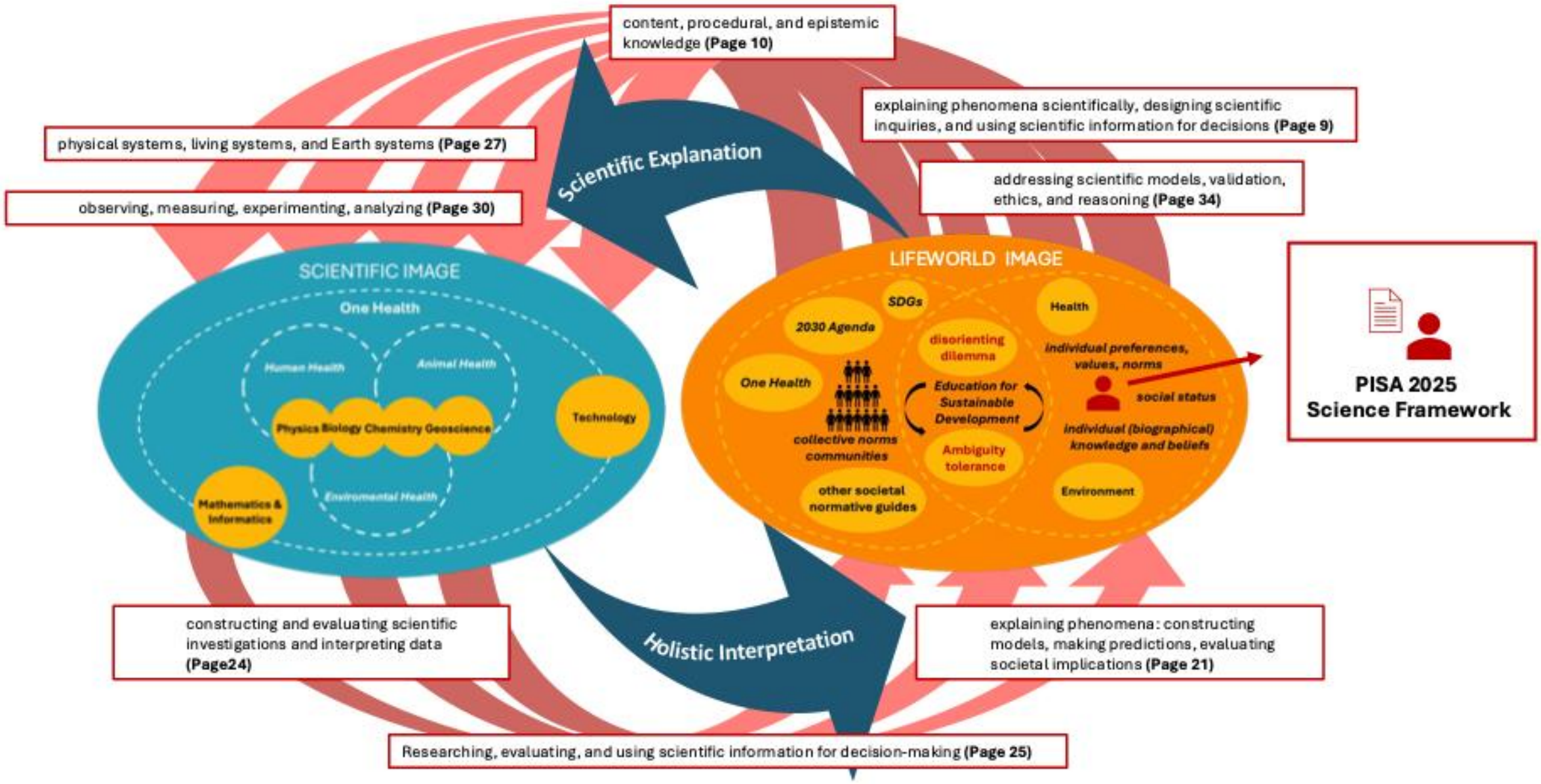

society

area of conflicts

individual

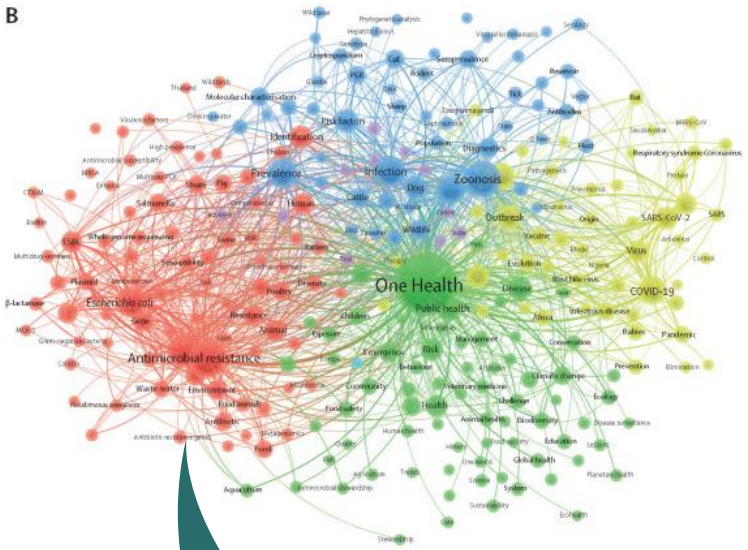


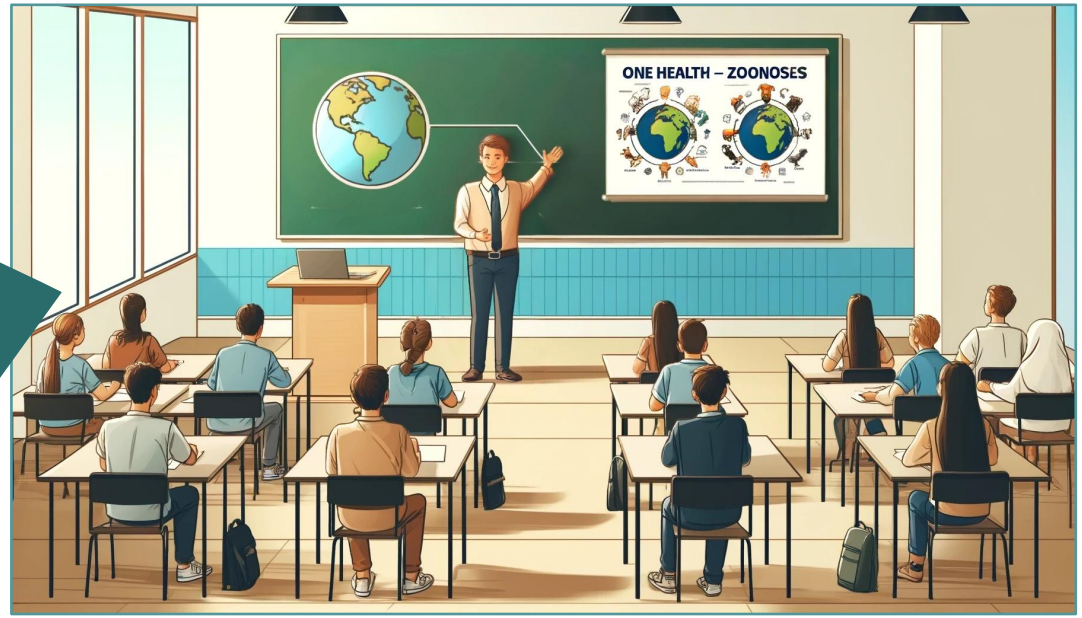
# PISA 2025 Science Framework



# Summary

## One Health into the Classroom





**Research Question(s)**: What are the main challenges pre-service science teachers face when integrating complex One Health-related socio-scientific issues into school teaching and learning environments?

- How can these challenges be addressed to enhance interdisciplinary science teaching strategies?

# The One Health Teaching Clinic network

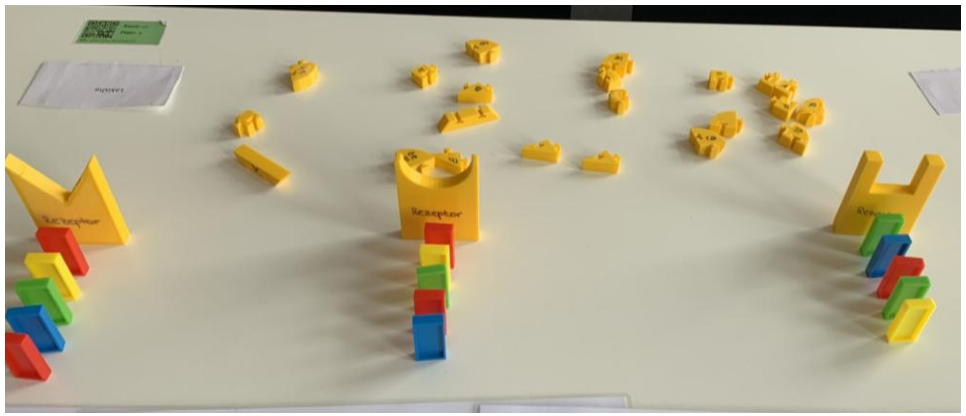

ONE HEALTH

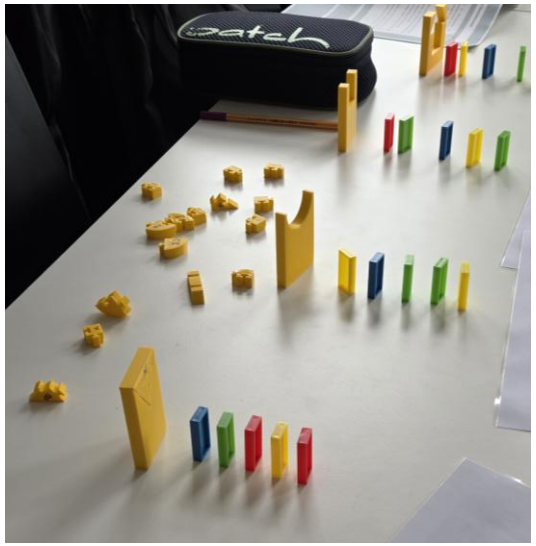
TEACHING CLINIC

NETWORK

# Example Case

A Didactic Analogy of *Signal Transduction* and its *Disruption* by *Environmental Toxicants*





**Colored domino blocks in a row** = an ordered signaling cascade (receptor → second messenger → transcription factors → cellular response).

**Colors** = different signaling pathways or molecular entities (e.g., hormones, enzymes, transcription factors).

**The falling of a domino** = activation or inhibition of a signal.

**Yellow blocks placed in the pathway** = disruptive factors (endocrine disruptors) that block, divert, or aberrantly amplify signal transmission.

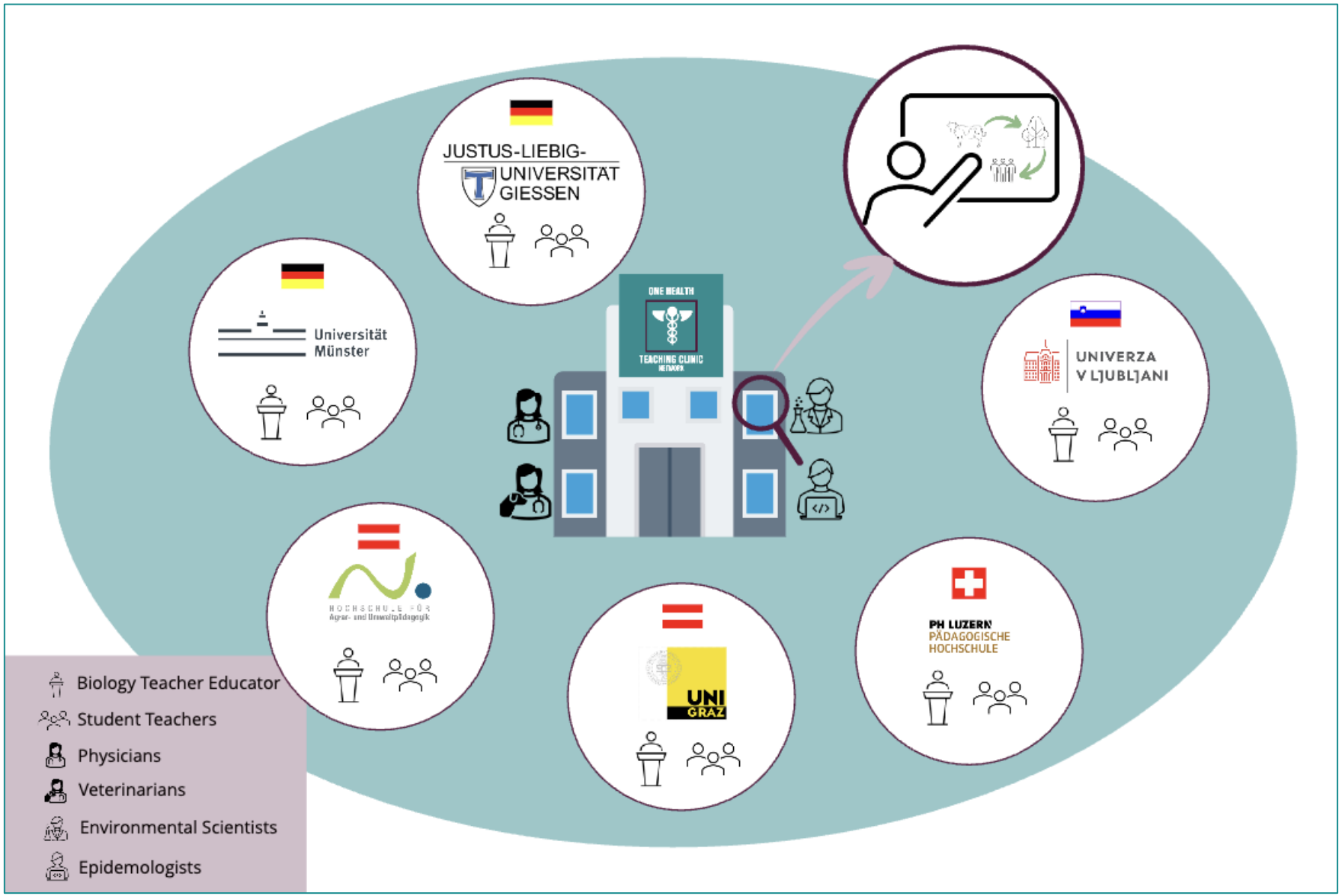
**Small scattered pieces** = nonspecific effects, such as side effects or cross-reactions.

# Further Examples

Hands-on lesson on the use of *Trichoderma* fungi as beneficial organisms for soil health (Münster, Germany).


Ash Dieback in Germany – first prize in the Biotopie competition (Gießen, Germany), awarded for promoting assessment skills.

# One Health Teaching Clinic Network Expansion

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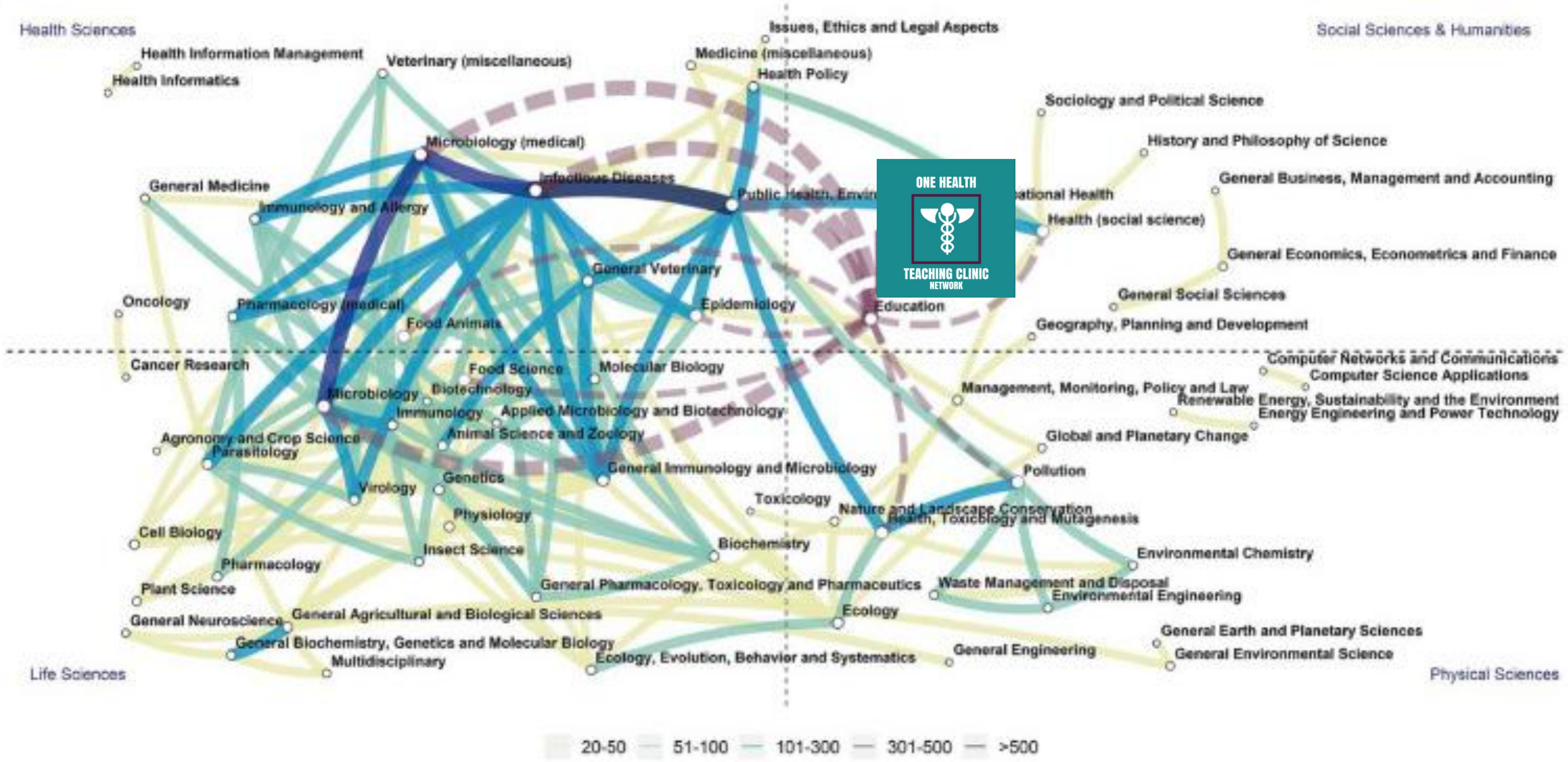
# The Vision: One Health Education Roadmap 2030




Adapted from Qiang et al., 2022, by Hobusch et al., 2024

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# Thank you for your attention. Any questions?

# Workshop

# Synoptic Transfer Framework


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**Environment and Sustainable Development, Blended Intensive Programmes (BIP) in March & April 2026**

*Organized by the UNESCO Chair on Teacher Education for Sustainable Development at the University of Ljubljana, in collaboration with the University of Klagenfurt, the Private University College Augustinum, and the National and Kapodistrian University of Athens.*