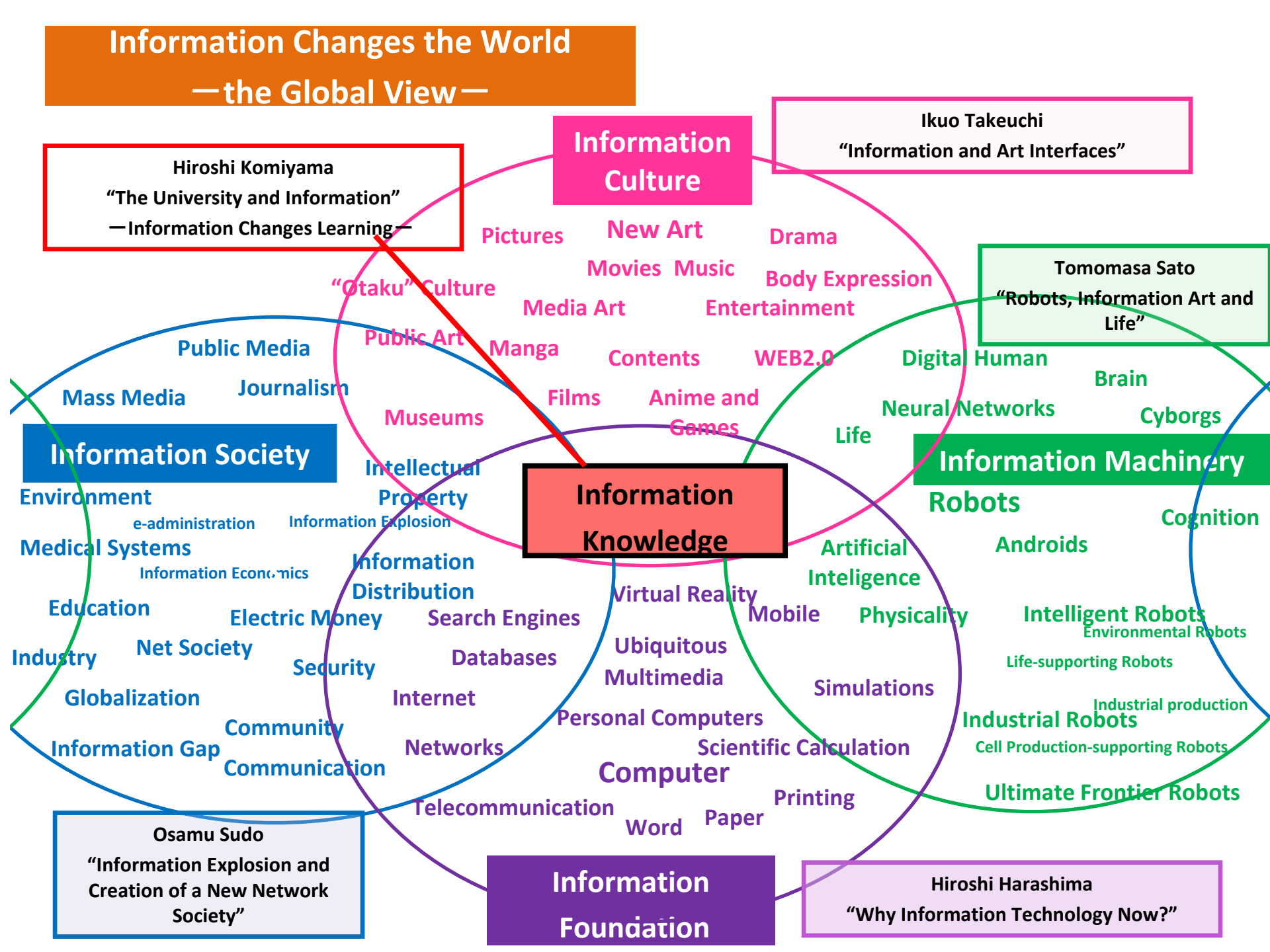
Global Focus on Knowledge Lecture Series
“Information Changes the World” No.1

東京大学
THE UNIVERSITY OF TOKYO

The University and Information
—Information Changes Learning—

President of the University of Tokyo

Hiroshi Komiyama


Information Changes the World
—the Global View—
Hiroshi Komiyama
"The University and Information"
—Information Changes Learning—
Information Culture
Ikuo Takeuchi
"Information and Art Interfaces"
Pictures
New Art
Drama
Movies
Music
Body Expression
"Otaku" Culture
Media Art
Entertainment
Public Art
Manga
Contents
WEB2.0
Tomomasa Sato
"Robots, Information Art and Life"
Digital Human
Brain
Public Media
Mass Media
Journalism
Films
Anime and Games
Museums
Neural Networks
Cyborgs
Life
Information Society
Information Machinery
Intellectual Property
Information Explosion
Environment
e-administration
Medical Systems
Information Economics
Information Knowledge
Robots
Cognition
Androids
Artificial Inteligence
Information Distribution
Virtual Reality
Mobile
Physicality
Intelligent Robots
Environmental Robots
Education
Electric Money
Search Engines
Industry
Net Society
Security
Databases
Ubiquitous Multimedia
Life-supporting Robots
Simulations
Globalization
Internet
Industrial production
Personal Computers
Industrial Robots
Community
Information Gap
Networks
Scientific Calculation
Cell Production-supporting Robots
Communication
Computer
Ultimate Frontier Robots
Printing
Telecommunication
Paper
Word
Osamu Sudo
"Information Explosion and Creation of a New Network Society"
Information Foundation
Hiroshi Harashima
"Why Information Technology Now?"

Information Changes How You See

- **Machines ←Robots→ Life, Intelligence**
- **Functions and Structures of Protein ←Visualization→ Pharmacology**

Information Changes How You Think

- **Knowledge ←Structuralization → Utilization of Knowledge**
- **Knowledge ←Information→ Sustainability**

Information Changes our Senses

- **Games**
- **New Art**

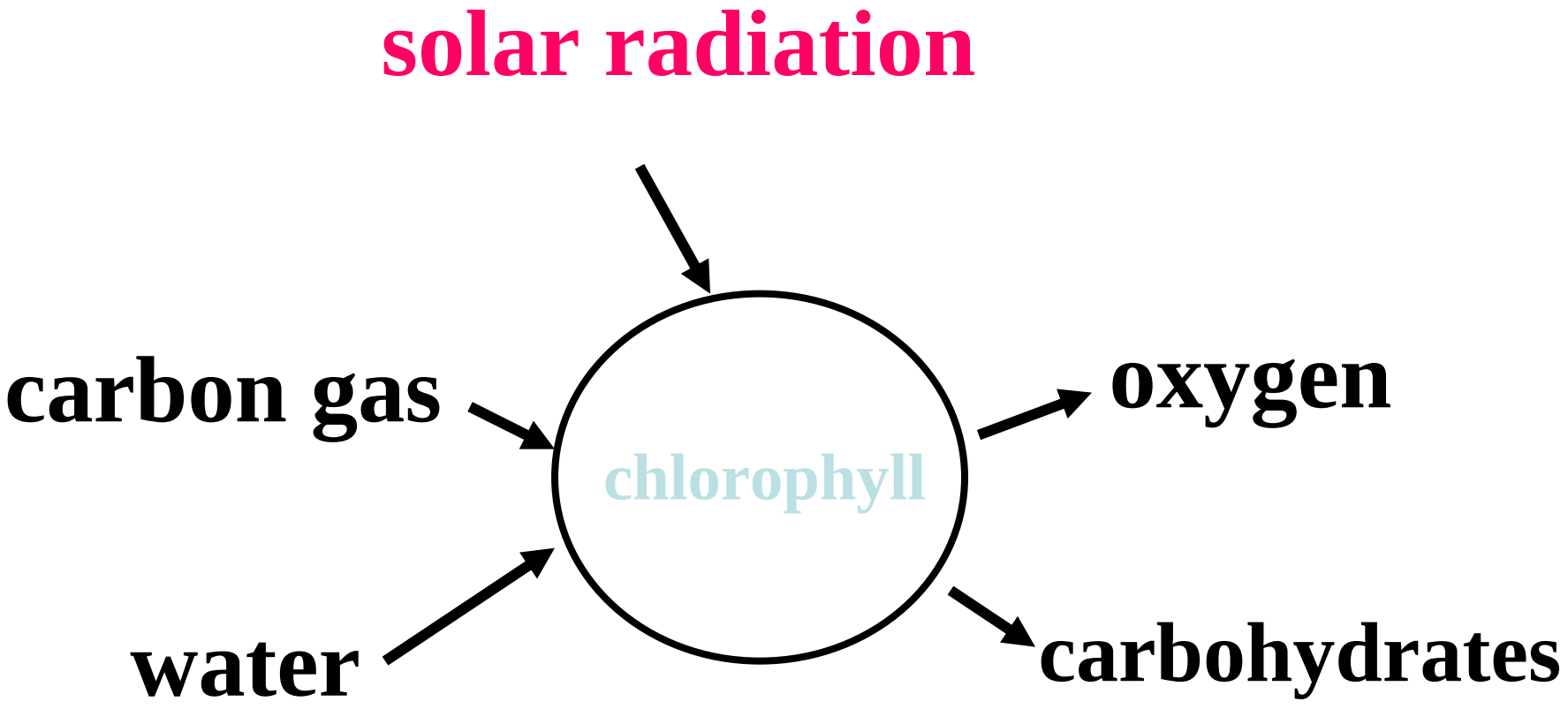
Circumstances in Existing Disciplines

- Various disciplines are in a state of chaos.
- Can anyone grasp the big picture?
  Particle size of a panoramic view
- Information is borderless：it can cross borders in an instant.

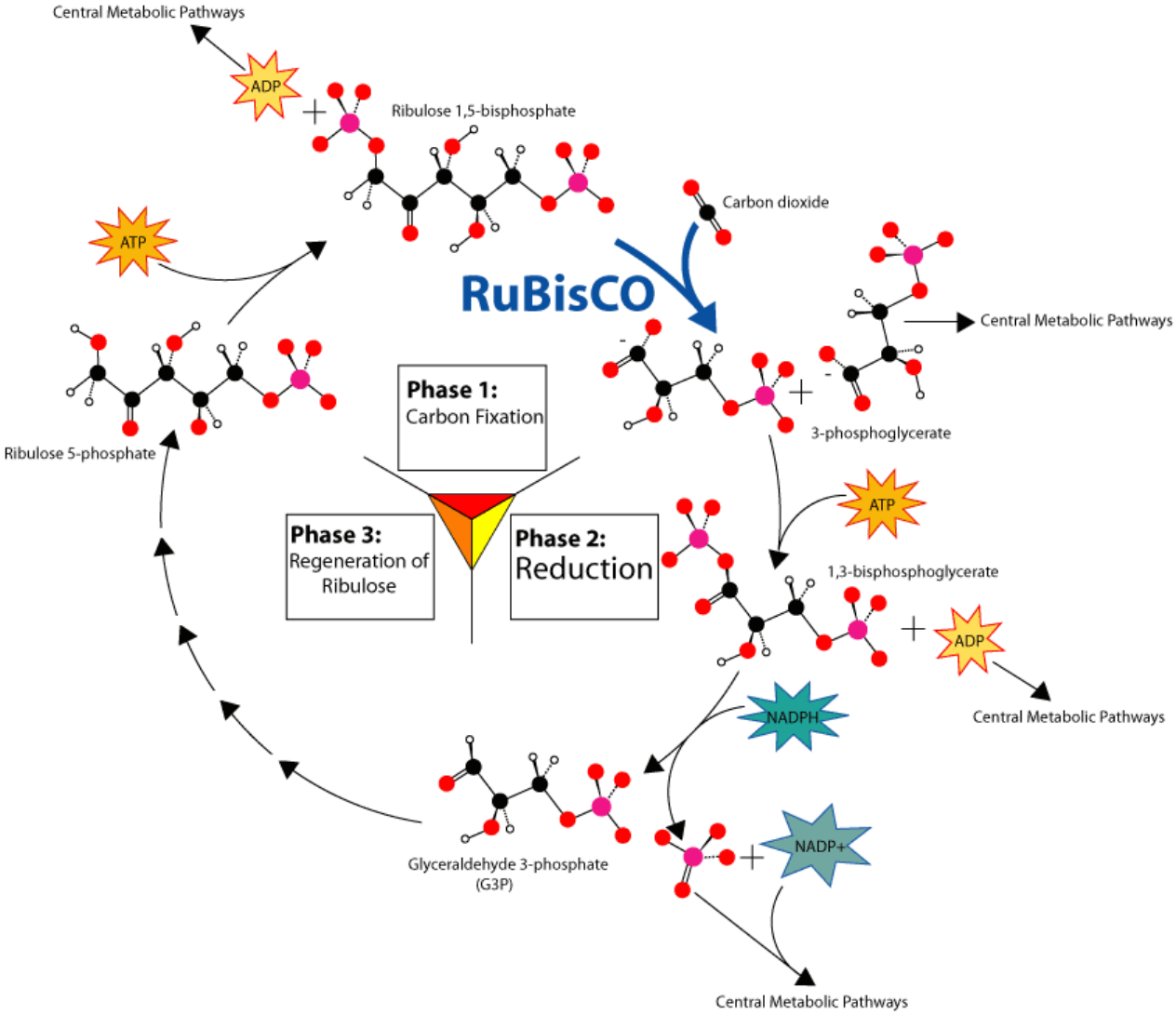
- the Google Empire （Google dominates the field of creating order from knowledge chaos.）
  ⇔ arbitrary ranking
  A speed that exceeds the speed of thought.
  Possibility of “unexpected discovery”(serendipity) is lost.

Light and Shadow of Science

Human Knowledge over 1900 years



Explosion of Knowledge !



‡ http://ja.wikipedia.org/wiki/%E7%94%BB%E5%83%8F:Calvin-cycle3.png

Can Anyone Grasp the Big Picture?

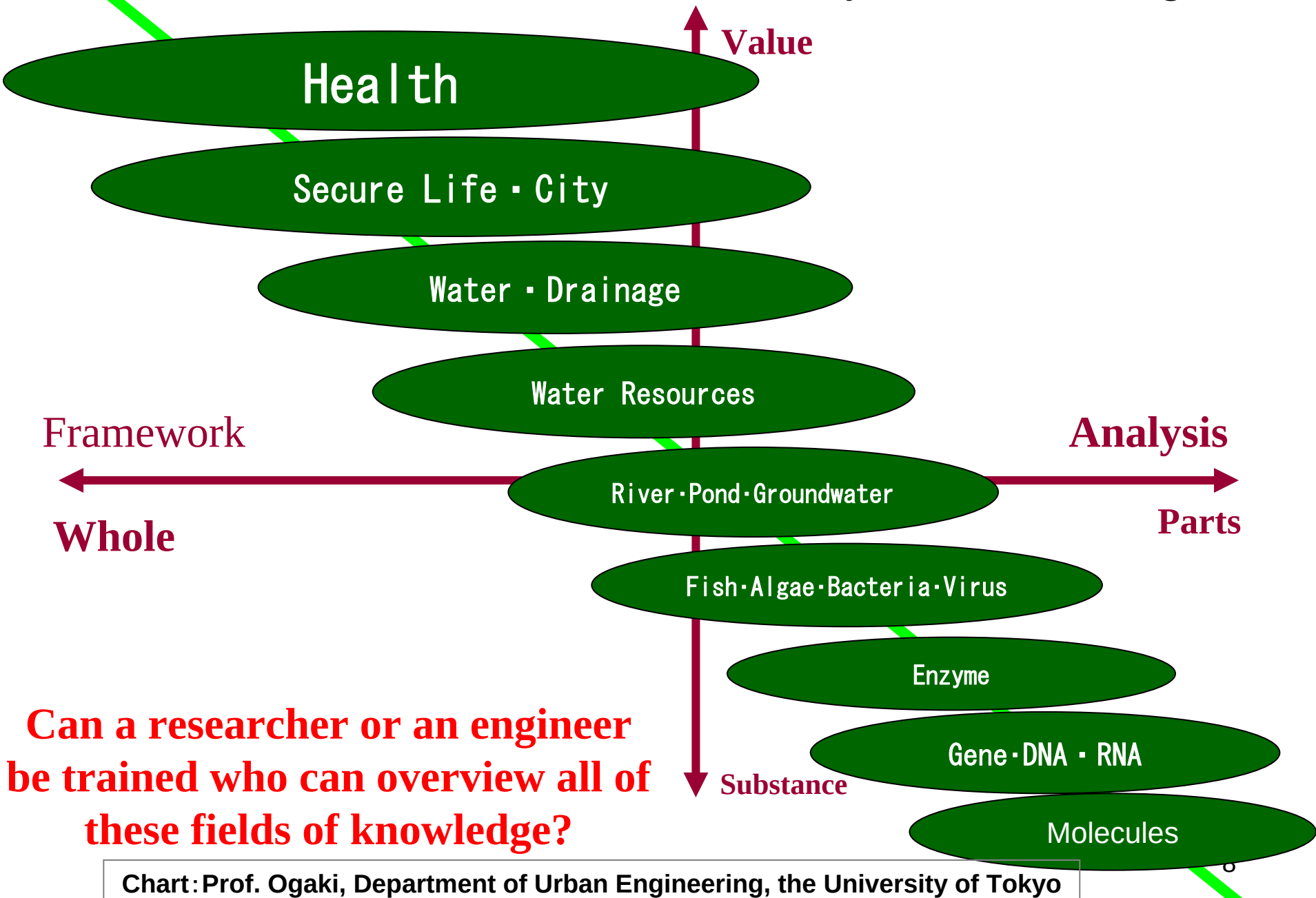
Computer's Y2K Problem

Nobody could.

Repeated Post Experiments

3／38

Issues in the Water Environment （by Prof. Shinichiro Ogaki）



Can a researcher or an engineer be trained who can overview all of these fields of knowledge?

Chart：Prof. Ogaki, Department of Urban Engineering, the University of Tokyo

Knowledge Structure in the Water Environment (by Prof. Shinichiro Ogaki)

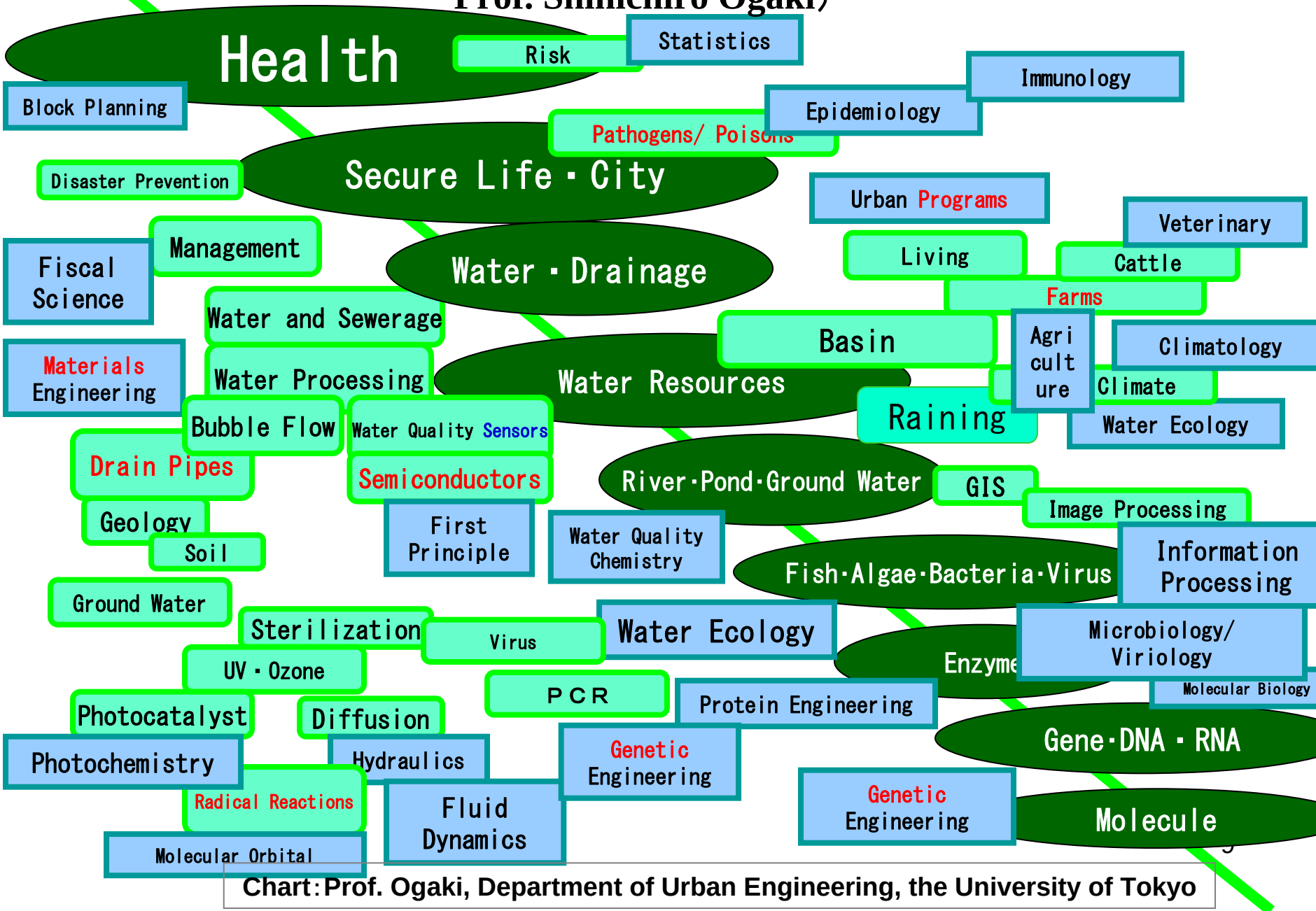
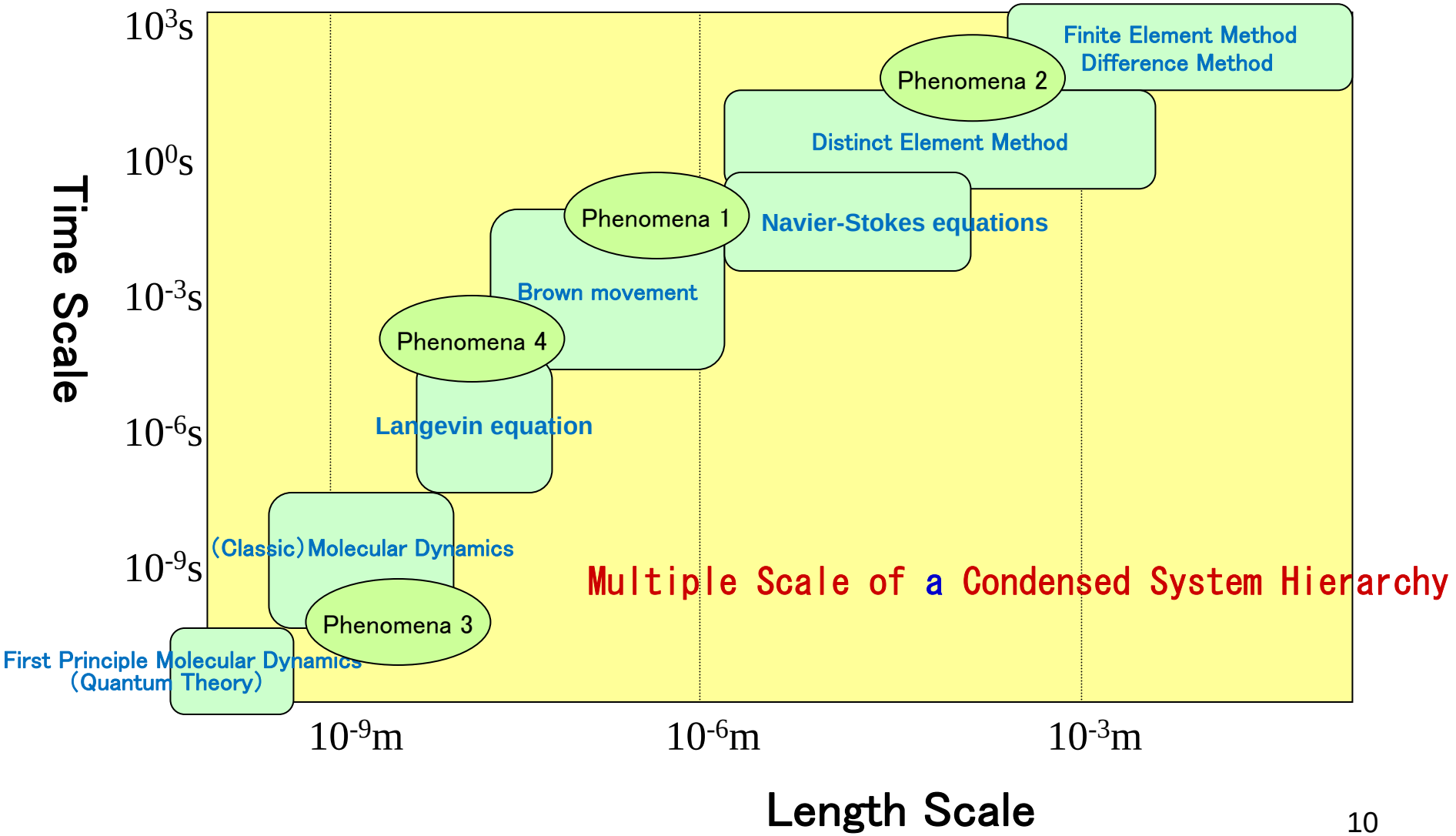
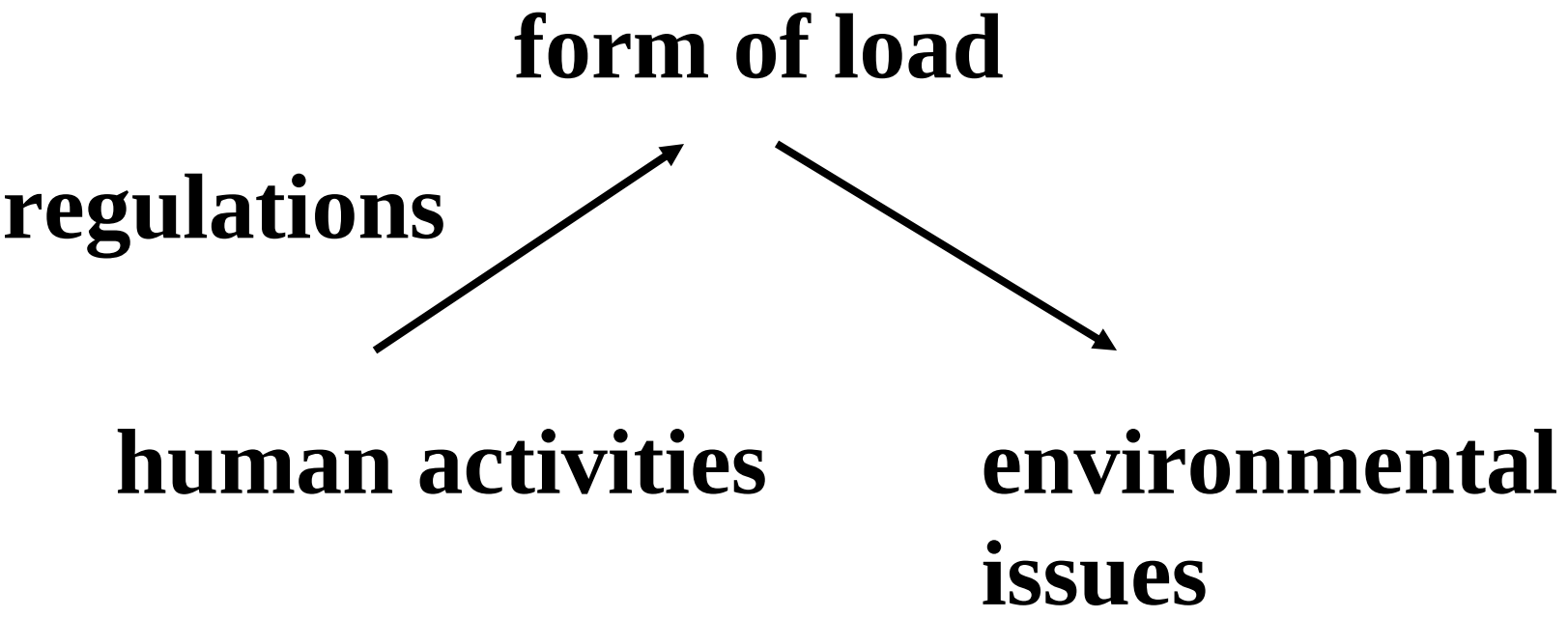


Chart:Prof. Ogaki, Department of Urban Engineering, the University of Tokyo

Knowledge Structure of Material Science



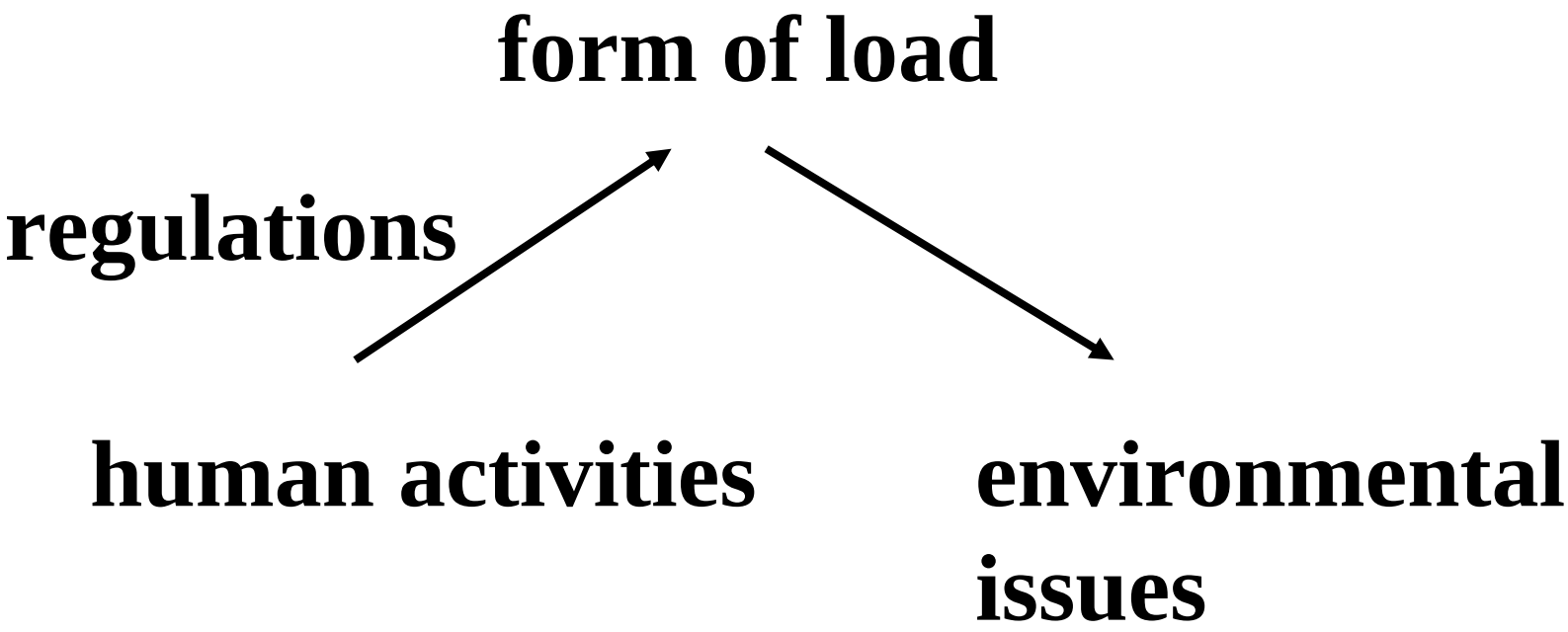
Knowledge Structure of Environmental Issues



“Structuring knowledge” is essential to utilizing knowledge chaos.

To utilize knowledge beyond the borders of disciplines.

Panoramic View of Environmental Problems



Implementation Example: Environmental Mandala（**Itaru Yasui**）

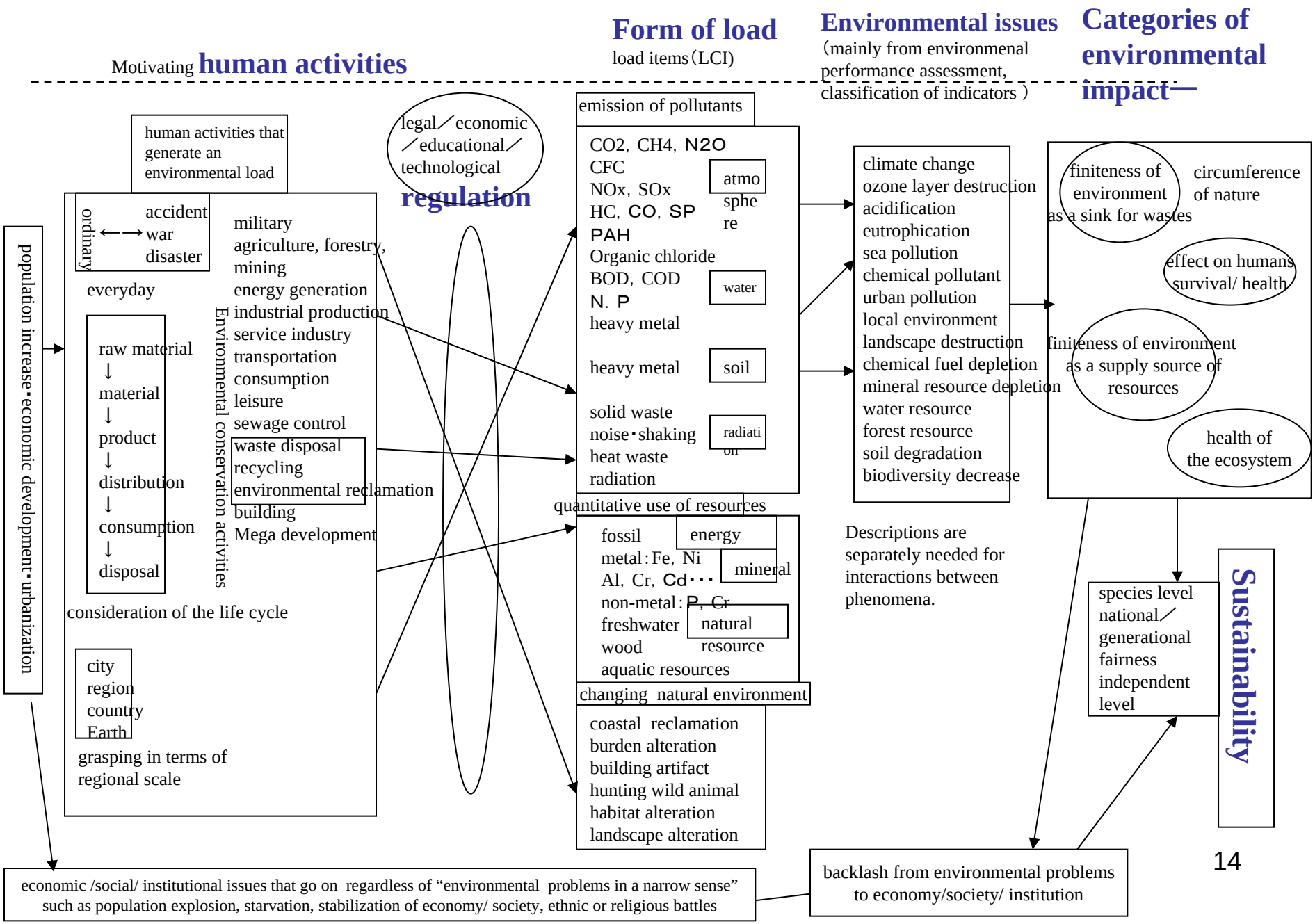


Image of Knowledge Structuring1

Panoramic View, Overview

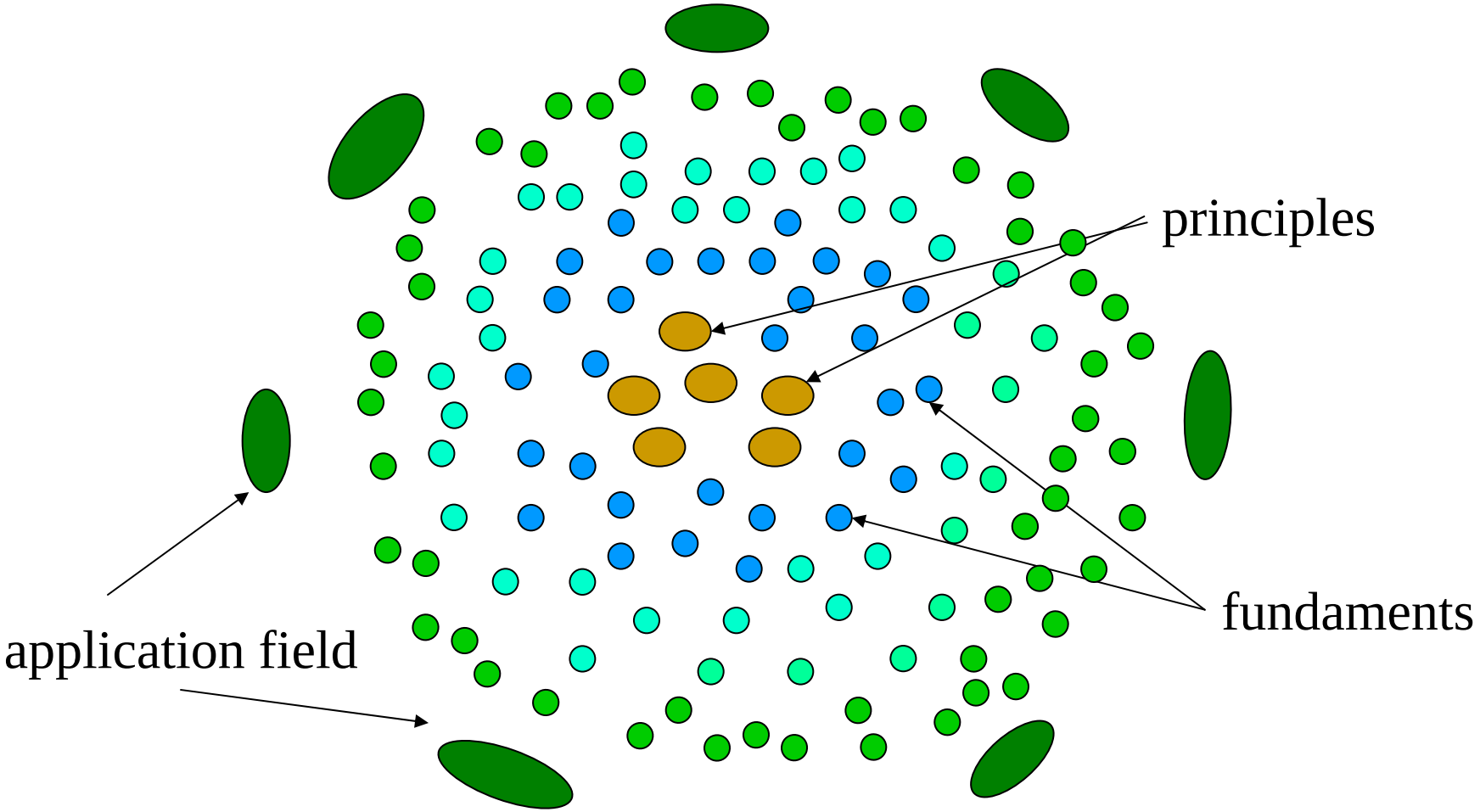
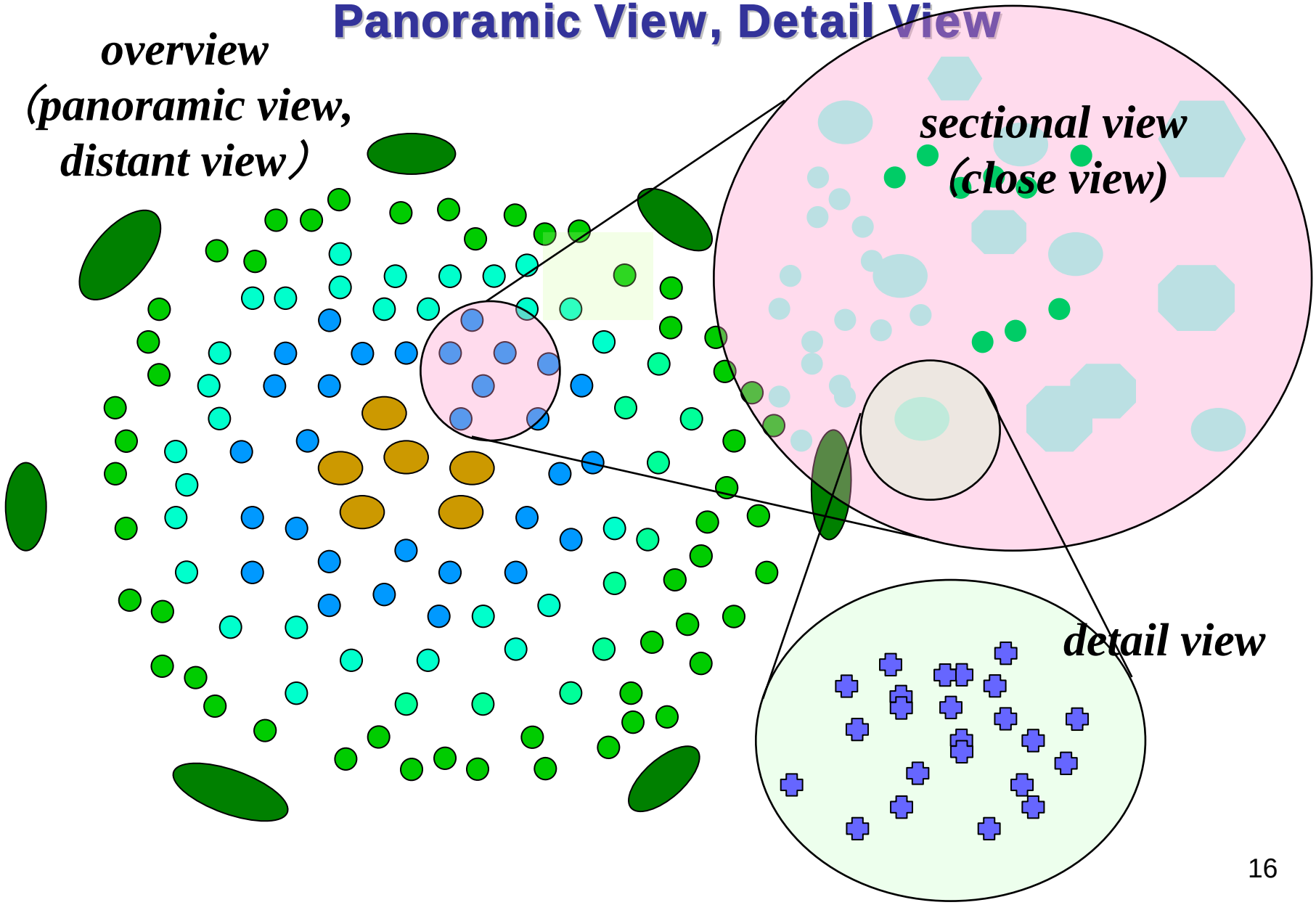
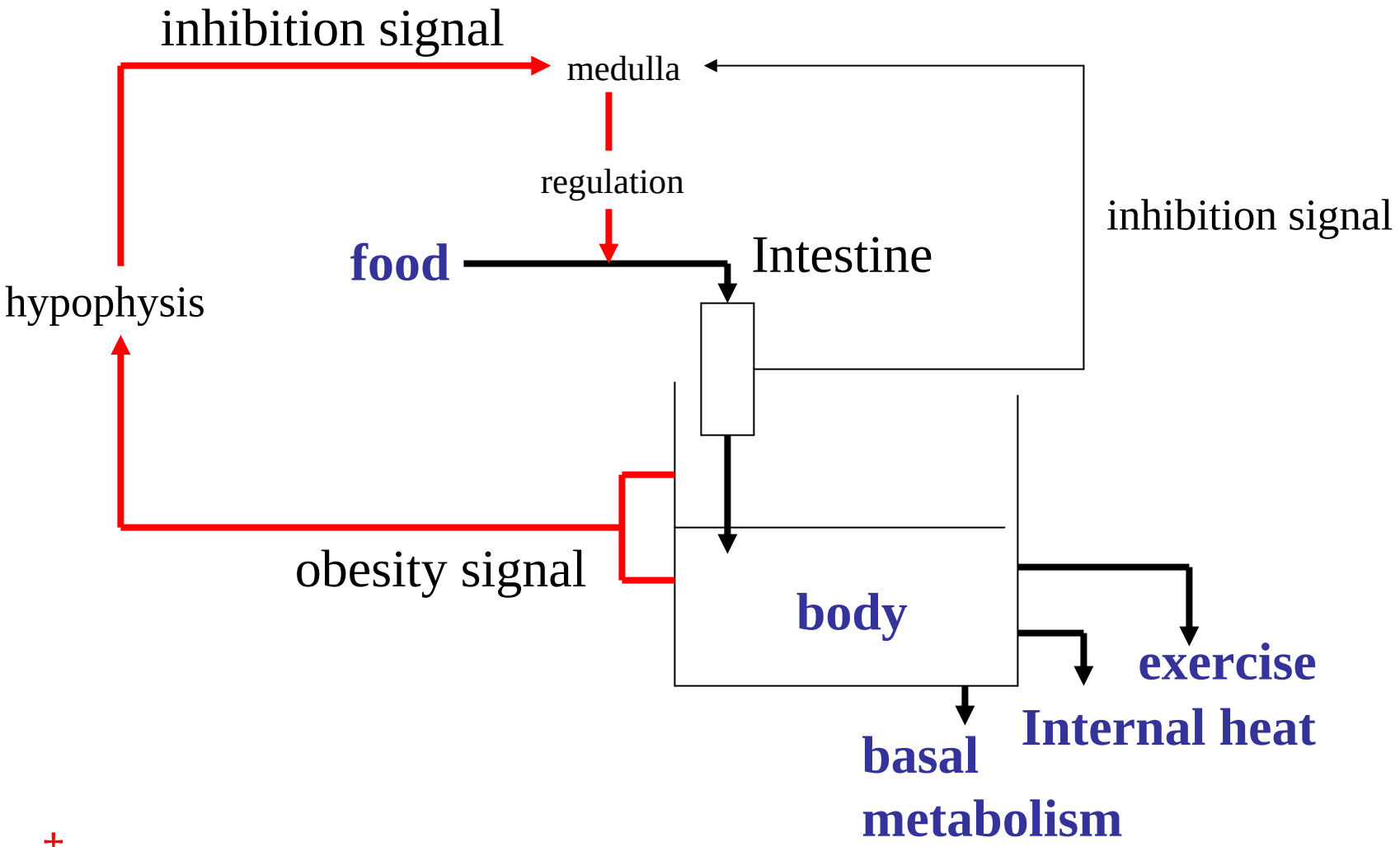


Image of Knowledge Structuring 2
Panoramic View, Detail View

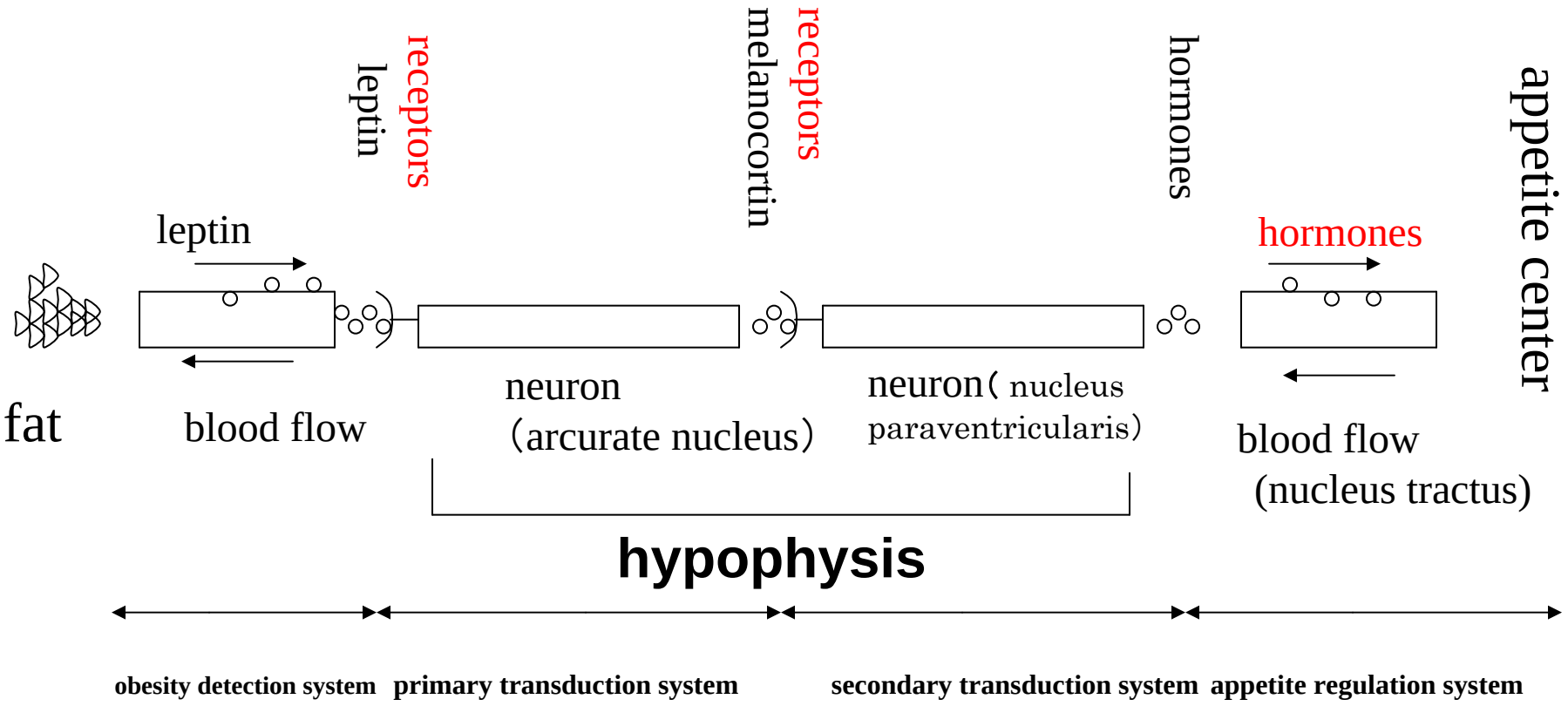


Weight Control Feedback System



‡ (**Hajime Nishimura, "genomu igaku nyumon" 2003, Nippon-Hyoron-sha Co.,Ltd.)**

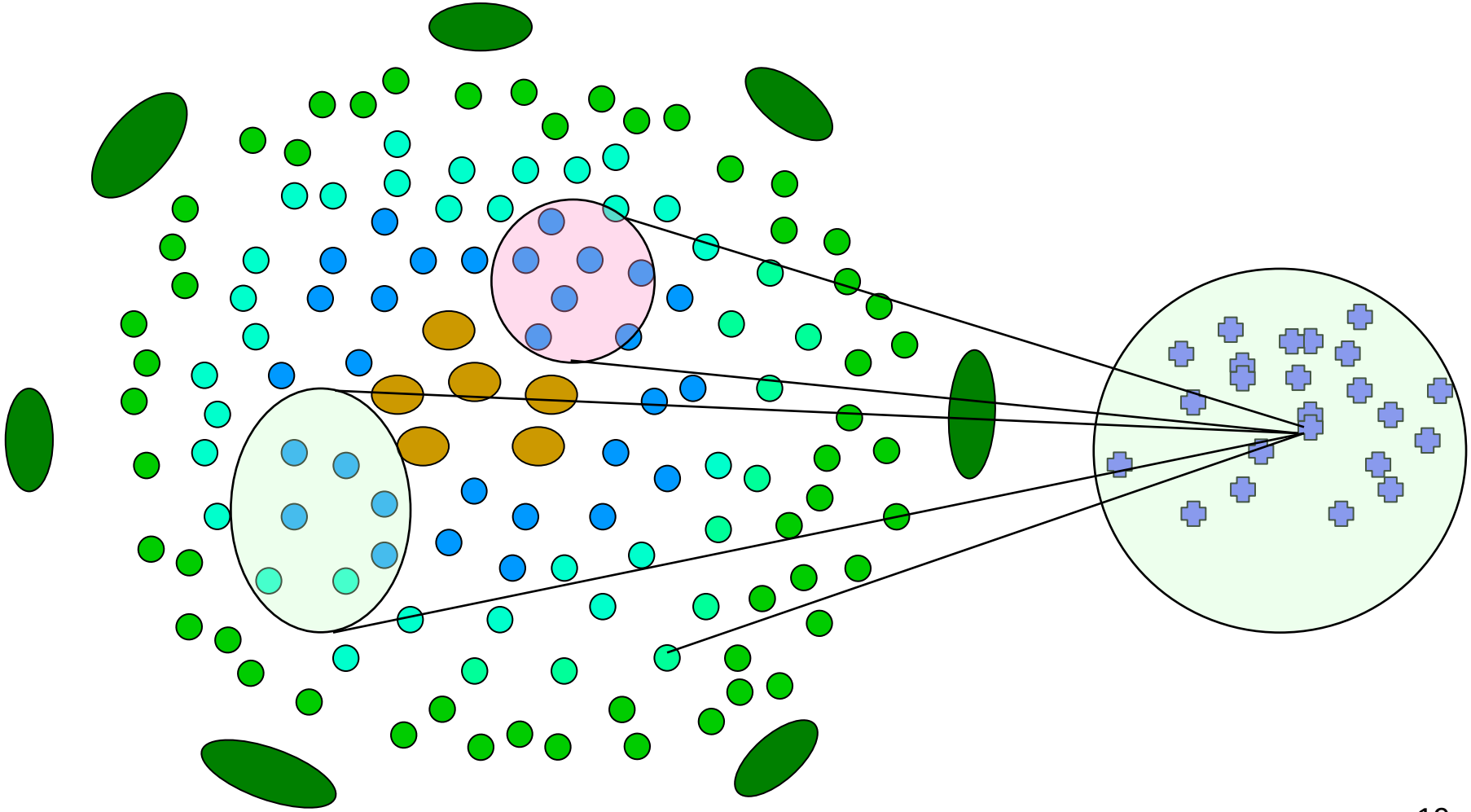
Sectional View：Signal Transduction for Obesity Regulation



‡（Hajime Nishimura, “genomu igaku nyumon” 2003, Nippon-Hyoron-sha Co.,Ltd.)

Image of Knowledge Structuring 3

Panoramic View, Synthesis of Disciplines



Birth of Biodiversity

- agriculture : environment biology
- literature : ecological ethics
- mathematics

⇒One of the sustainability sciences

-Information Gives New Expressions to Academic Disciplines-

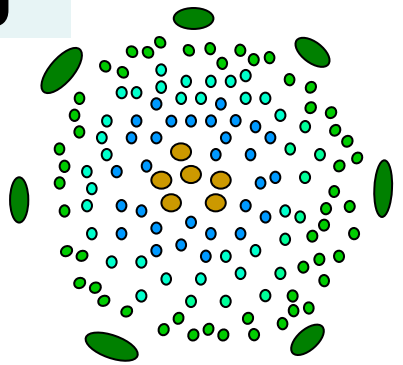
- Expression of academia is no longer words alone.

- New words

  Simulation and visualization

Structure of “Knowledge Structuring”

Knowledge Structuring1: Panoramic View



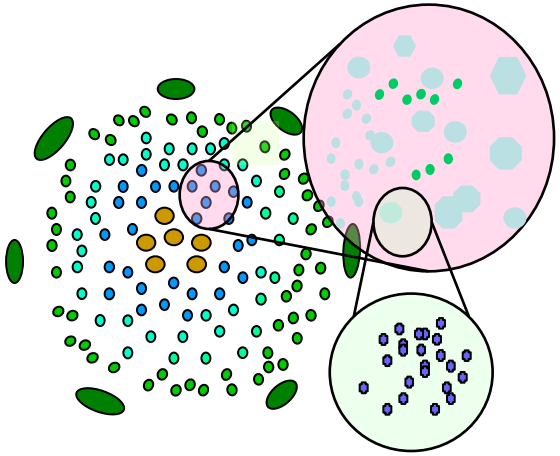
Education principles of the University of Tokyo - text:ontology:research

Substance process - process:structure:function:application

Human - molecular biology:cell:feedback system

Environment - human activities:impact factors:environmental issues:countermeasures

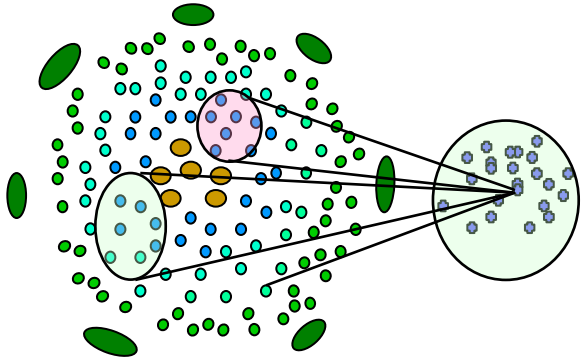
Knowledge Structuring2: Detail View



Feedback system of human obesity

Technologies for sustainability - detail view of a detail view

Knowledge Structurin3: **Synthesis**



ecological science(agriculture)+ educational ethics(liberal arts)+ math

electricity generation: bicycle:wind mill:waterwheel:thermal power:nuclear power

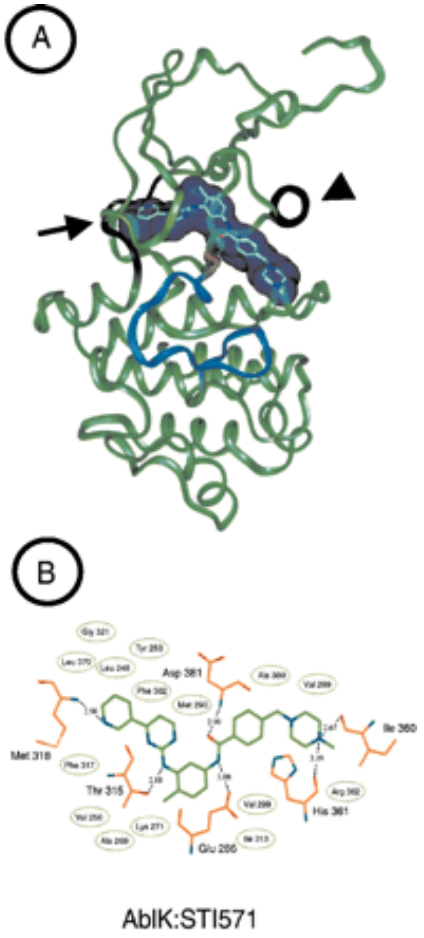
quantum mechanics, Boltzmann equation, Navier-Stokes

Example of Simulation

-The structure of genomes and medicine－

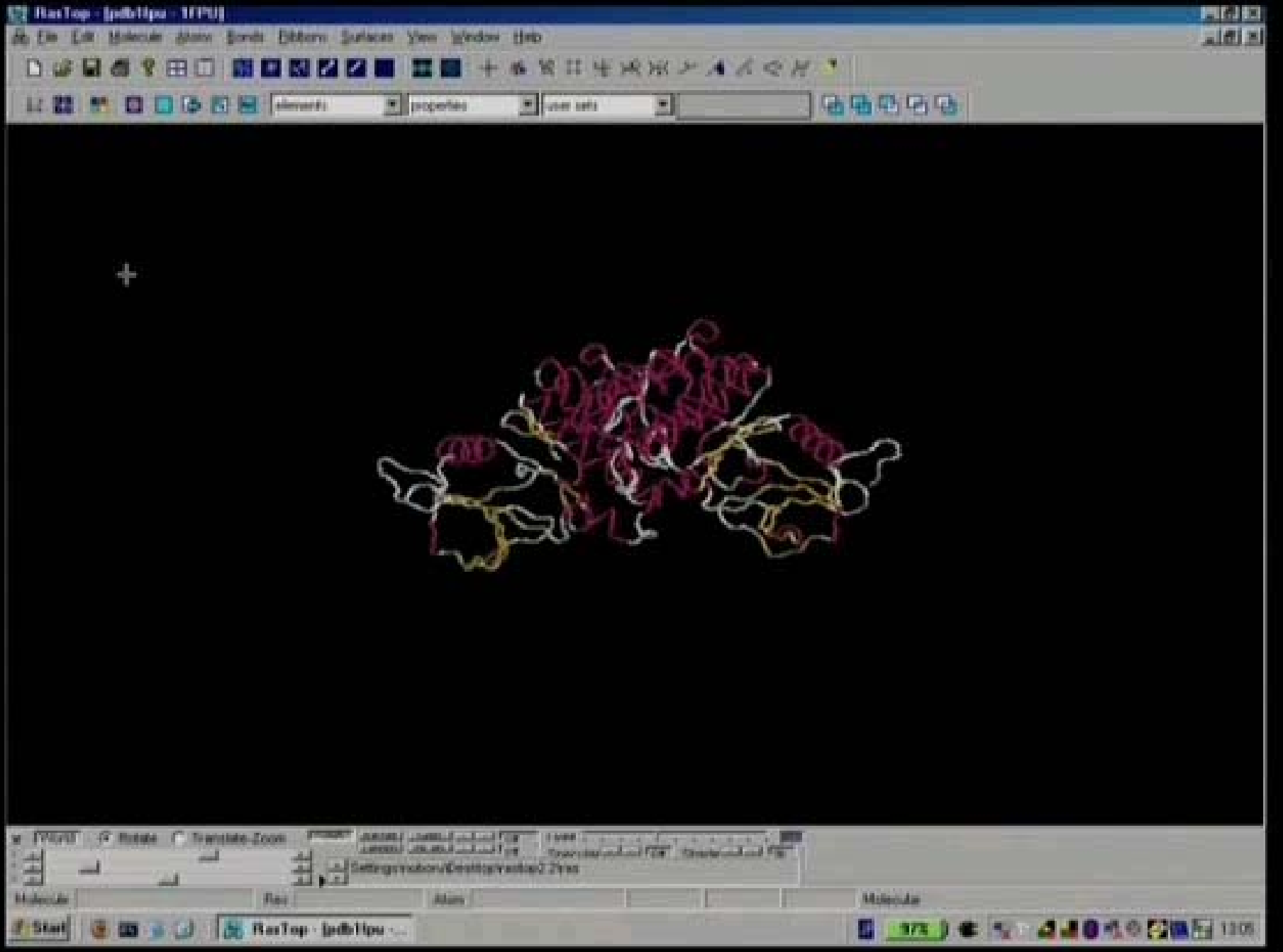
The Steric Structure of Proteins

- Gene sequence determines protein “sequence” and protein sequence determines the steric structure (the function of protein).
- Their virtual structure can be seen on a PC.



AblK:STI571

- Bcr-Abl kinase inhibits binding with substrates.
  → Abnormal proliferation is inhibited.
- Bcr-Abl kinase specifically reacts.
  → No side-effects.


File Edit Molecule Atoms Bonds Ribbons Surfaces View Window Help
elements
properties
user sets
Rotate
Translate-Zoom
Molecule
Res
Atom
Molecule
Start

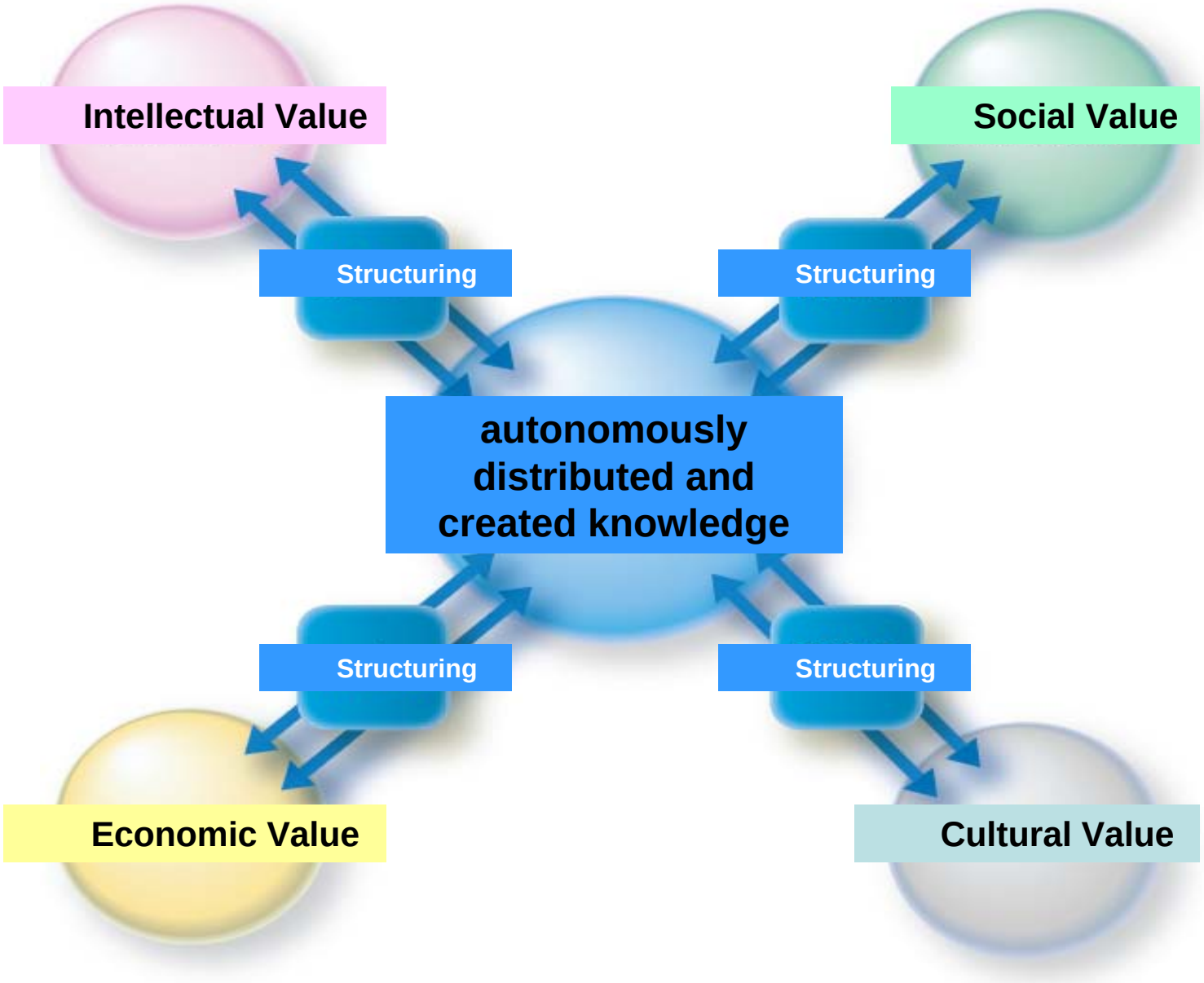
The New Form of Academic Disciplines
-Knowledge structuring changes learning.-

- Simulation, visualization
  New methods of knowledge transmission.
  Information independent of words
- Academic discipline to deal with the needs of the 21st century.
- Considering how to use knowledge is one academic discipline.
  A new method is born from matching knowledge with intelligent values, economic values, social values, and cultural values.

The 21st Century University Model

- Creation of knowledge
- Creation of value
- Transmission of structured knowledge

Concept of “Knowledge Structuring”



Concept of a “Knowledge Structuring Center”

Intelligent Value-Related Research

- Evolving textbooks
- Digitization of an all-campus syllabus and “UT all-campus knowledge structuring “ using MIMA search techniques
- Science and technology literacy forJapanese people
- Visualization of university education and research

Social Value Related Research

- Idea-supporting systems for problem solving
- Structuring and visualization of medical knowledge
- Structuring of compliance issues

Structuring Method Development

- Development of knowledge-structuring methods
- Liquefaction and crystallization of knowledge expression
- Semantic computing
- Structuring Knowledge from the Web

Economic Value-Related Research

- Material nano-technology knowledge basis
- Workshop for business knowledge structuring

Cultural Value-Related Research

- “New Encyclopedia” Project
- “Wisdom and Tree of Media Analysis”Project
- Structuring of NHK archives and educational navigation

Komiyama's Conviction

Educational resources should be concentrated in Komaba.

The results of knowledge segmentation remain at the forefront for all people

the answer : textbook ⇔ ontology ⇔ research

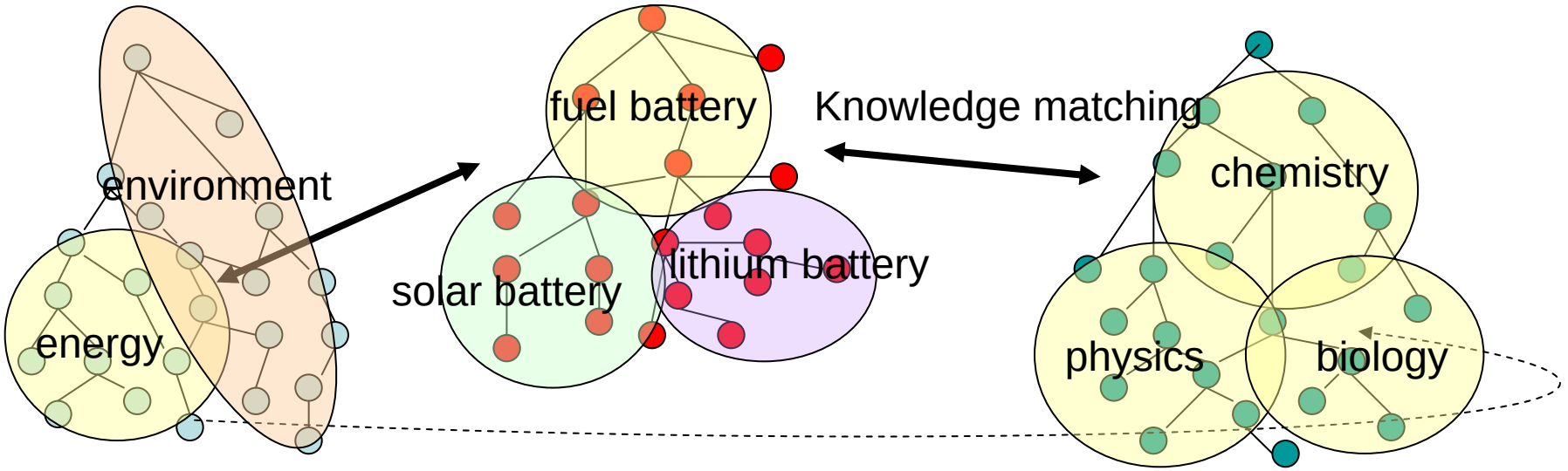
Research and education should be linked in real time.

environment : energy : sustainability : science of aging : ocean
brain science : nuclear power plants : giant earthquakes, etc.

the answer : knowledge structuring + education institution

Knowledge Structuring

- Knowledge has a network structure.



Reintegration by knowledge fragmentation and analogy

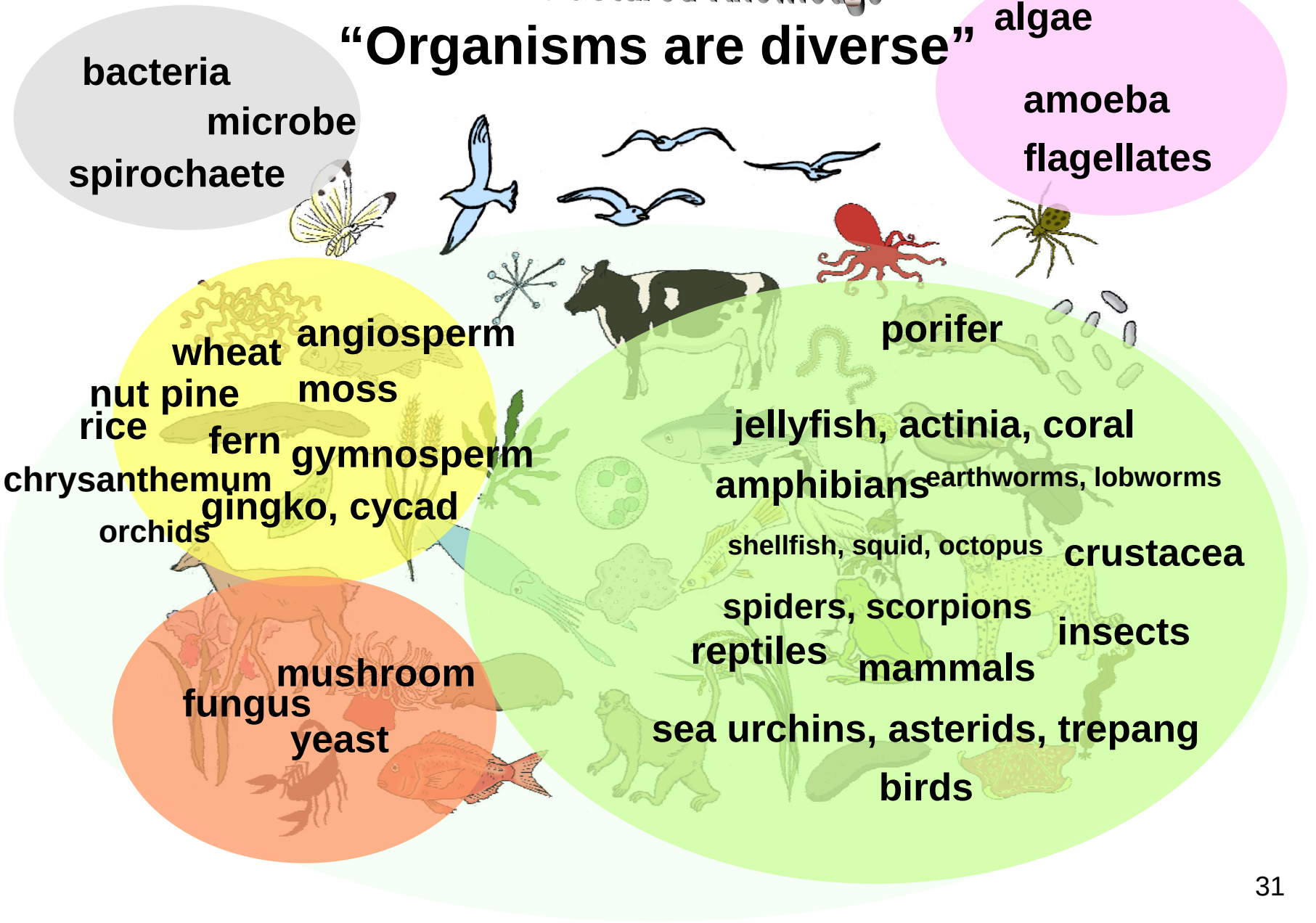
understanding of a broad knowledge base

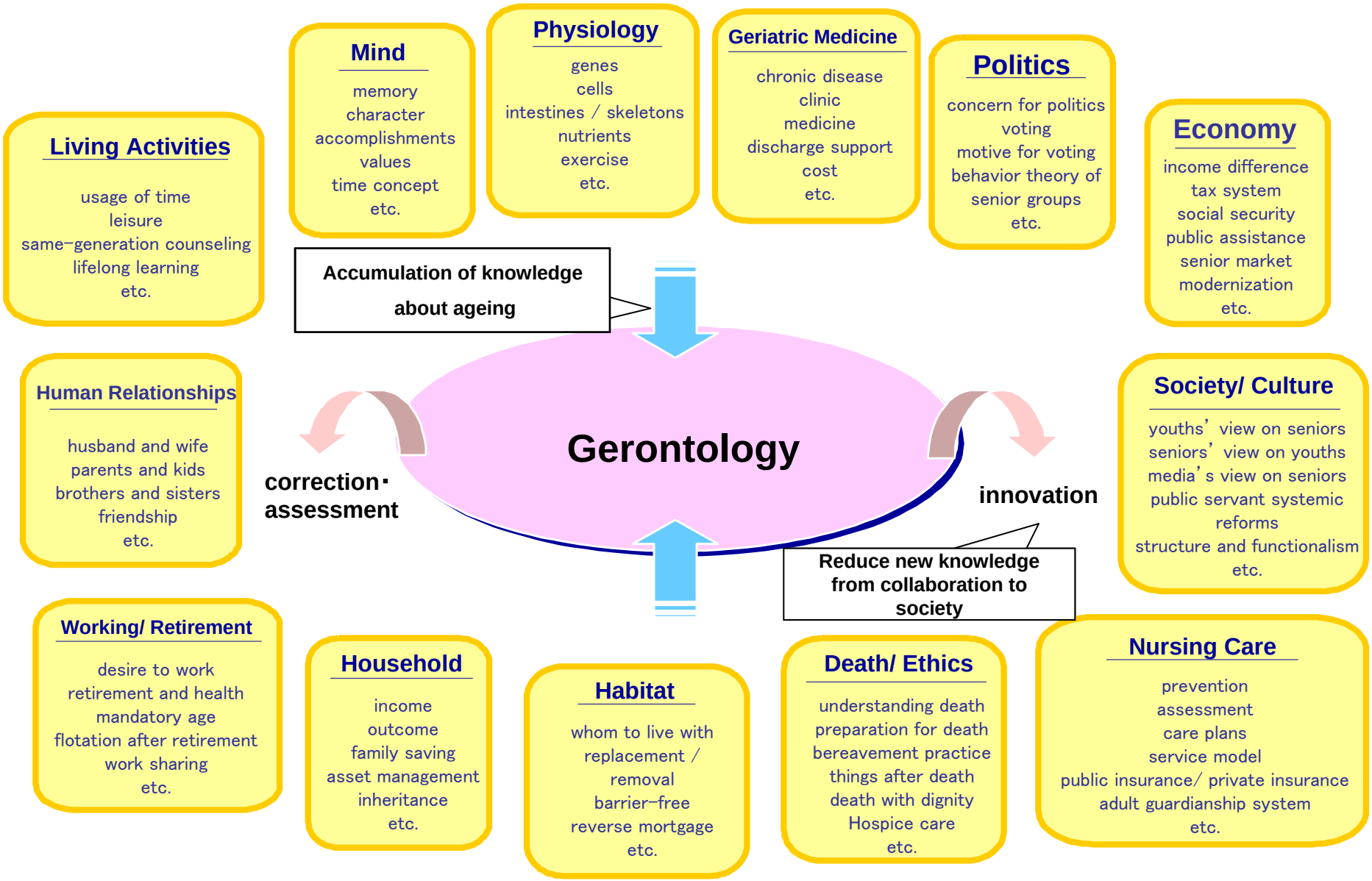
reuse of knowledge

adding value to knowledge

Unstructured Knowledge

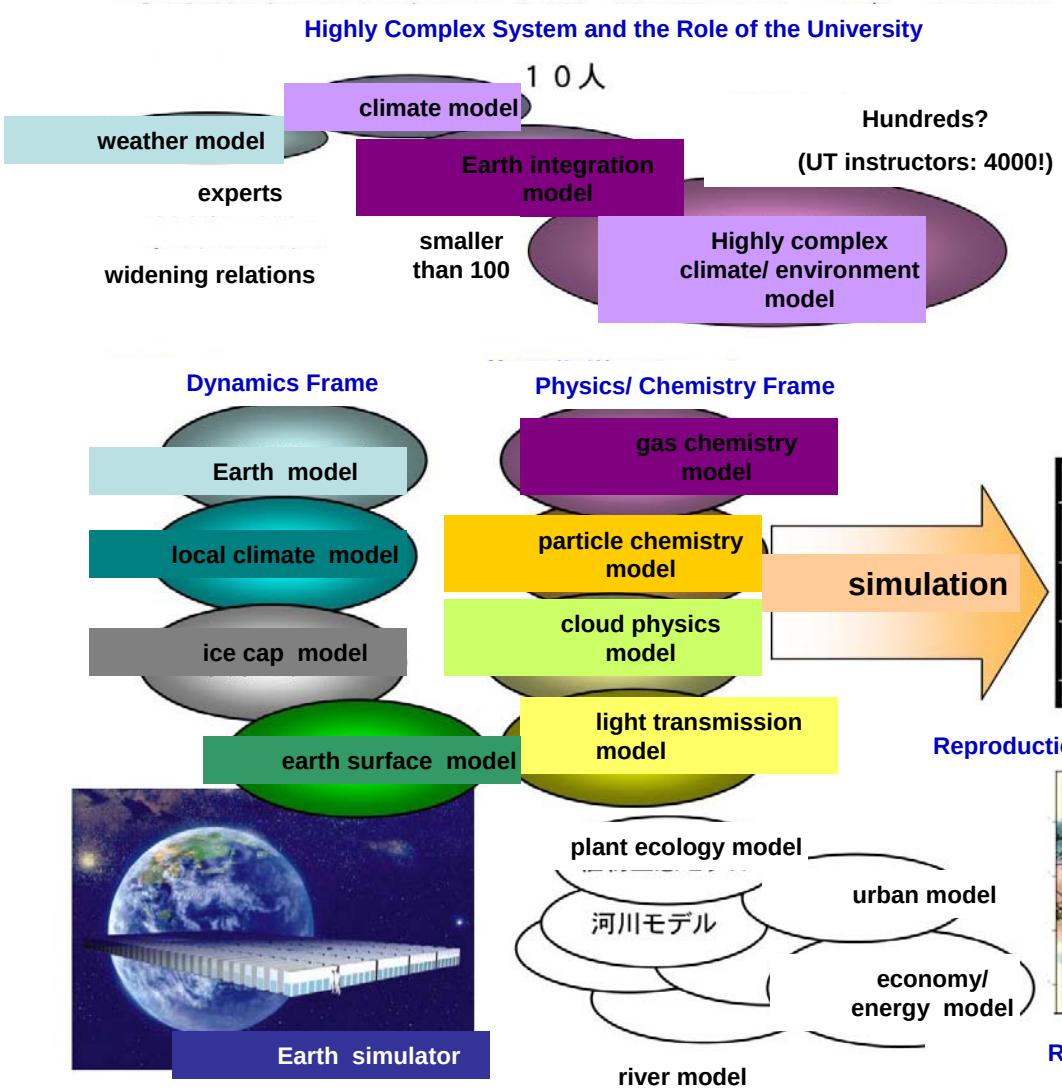
“Organisms are diverse”



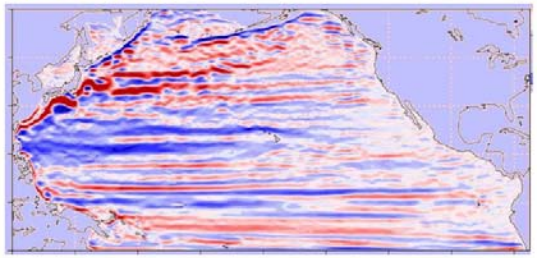

Living Activities
usage of time
leisure
same-generation counseling
lifelong learning
etc.
Mind
memory
character
accomplishments
values
time concept
etc.
Physiology
genes
cells
intestines / skeletons
nutrients
exercise
etc.
Geriatric Medicine
chronic disease
clinic
medicine
discharge support
cost
etc.
Politics
concern for politics
voting
motive for voting
behavior theory of
senior groups
etc.
Economy
income difference
tax system
social security
public assistance
senior market
modernization
etc.
Accumulation of knowledge about ageing
Human Relationships
husband and wife
parents and kids
brothers and sisters
friendship
etc.
correction・assessment
Gerontology
innovation
Society/ Culture
youths' view on seniors
seniors' view on youths
media's view on seniors
public servant systemic reforms
structure and functionalism
etc.
Reduce new knowledge from collaboration to society
Working/ Retirement
desire to work
retirement and health
mandatory age
flotation after retirement
work sharing
etc.
Household
income
outcome
family saving
asset management
inheritance
etc.
Habitat
whom to live with
replacement / removal
barrier-free
reverse mortgage
etc.
Death/ Ethics
understanding death
preparation for death
bereavement practice
things after death
death with dignity
Hospice care
etc.
Nursing Care
prevention
assessment
care plans
service model
public insurance/ private insurance
adult guardianship system
etc.

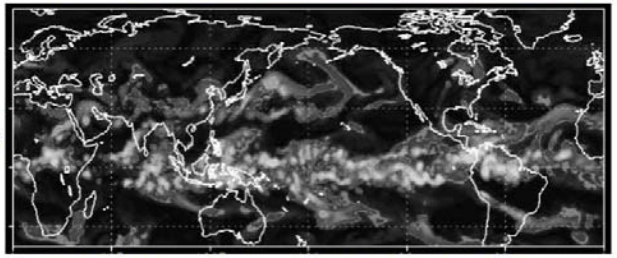
Purpose of Scientific Integration - Project “Earth”

Show the relationship between various academic disciplines concerned with the Earth. Make them easy to understand for freshmen and the general public, stratify them so that the top level would be in laboratories. Show them on the Web so that anyone can see them in libraries.
→Make possible various simulations and models.

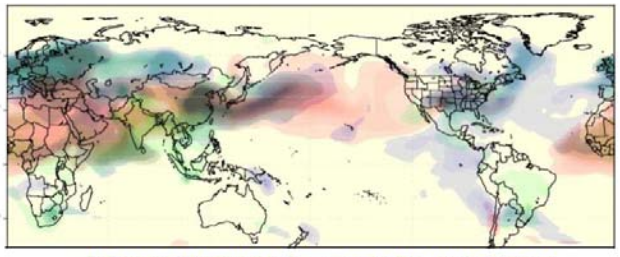


Reproduction of an Intermediate WaterJet by a High-Resolution Model Using an Earth Simulator





Reproduction of Vapor Distribution by a High-Resolution Atmosphere Model



Reproduction of Air Pollutants and Sand Aerosol Distribution

Role of Information in Education

- Relationship between a trend of knowledge and higher education
- Relationship between a trend of knowledge and elementary and secondary education

  The next generation will solve today's issues.
- Relationship between a trend of knowledge and continuing education

⇔ Humans share "structured knowledge"

in real time

Komiyama's Conviction

Educational resources should be concentrated in Komaba.

The results of knowledge segmentation remain at the forefront for all people

the answer : textbook ⇔ ontology ⇔ research

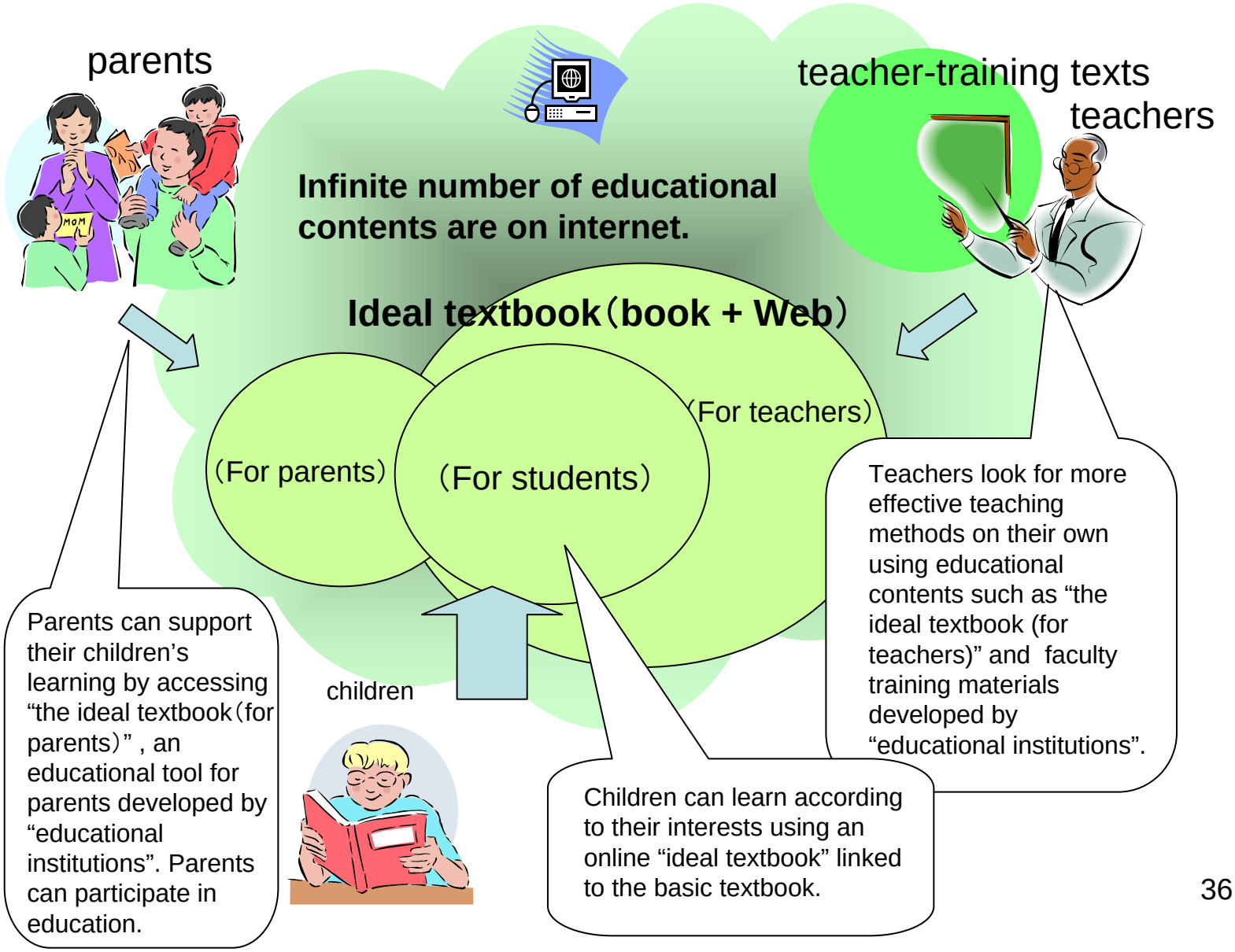
Research and education should be linked in real time.

environment : energy : sustainability : science of aging : ocean
brain science : nuclear power plants : giant earthquakes, etc.

the answer : a knowledge-structuring + education institution

This gives birth to and fosters genuine learning.

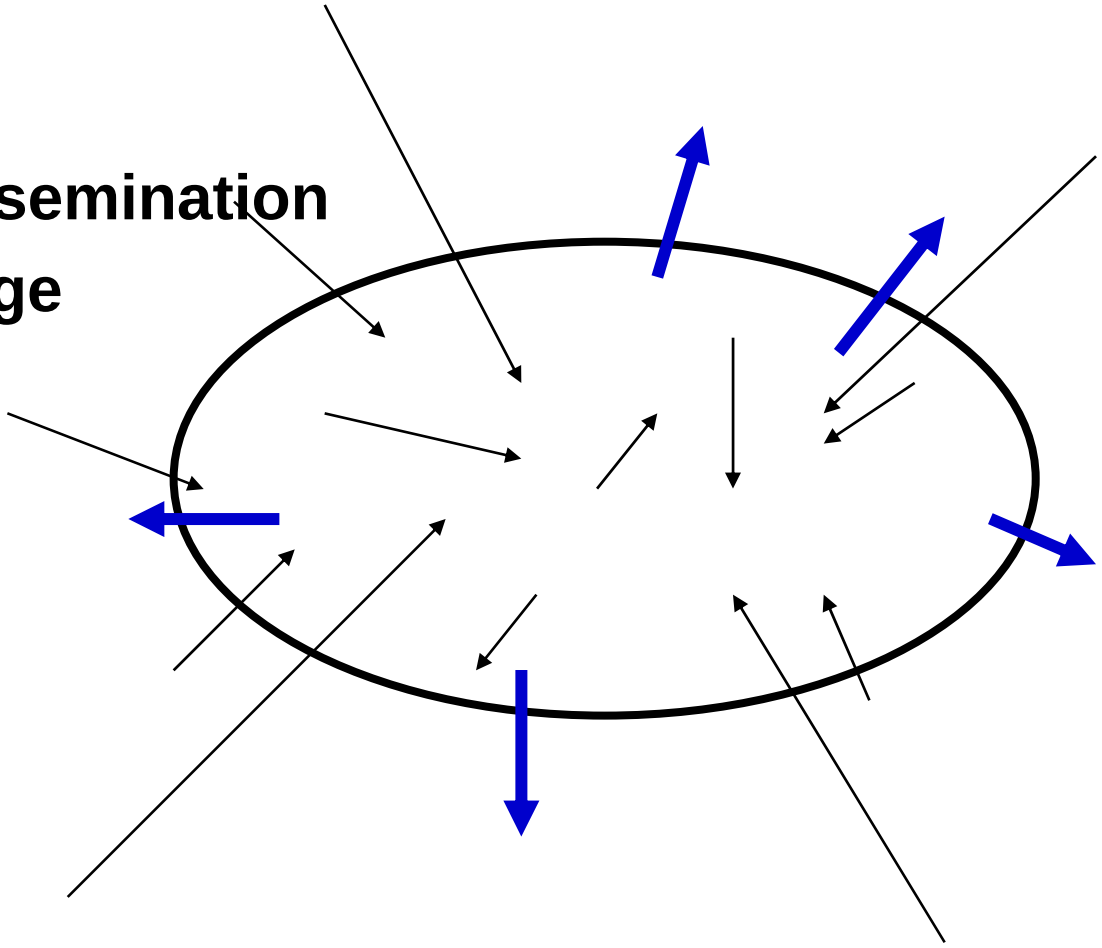
Research in Elementary Education in Real-time

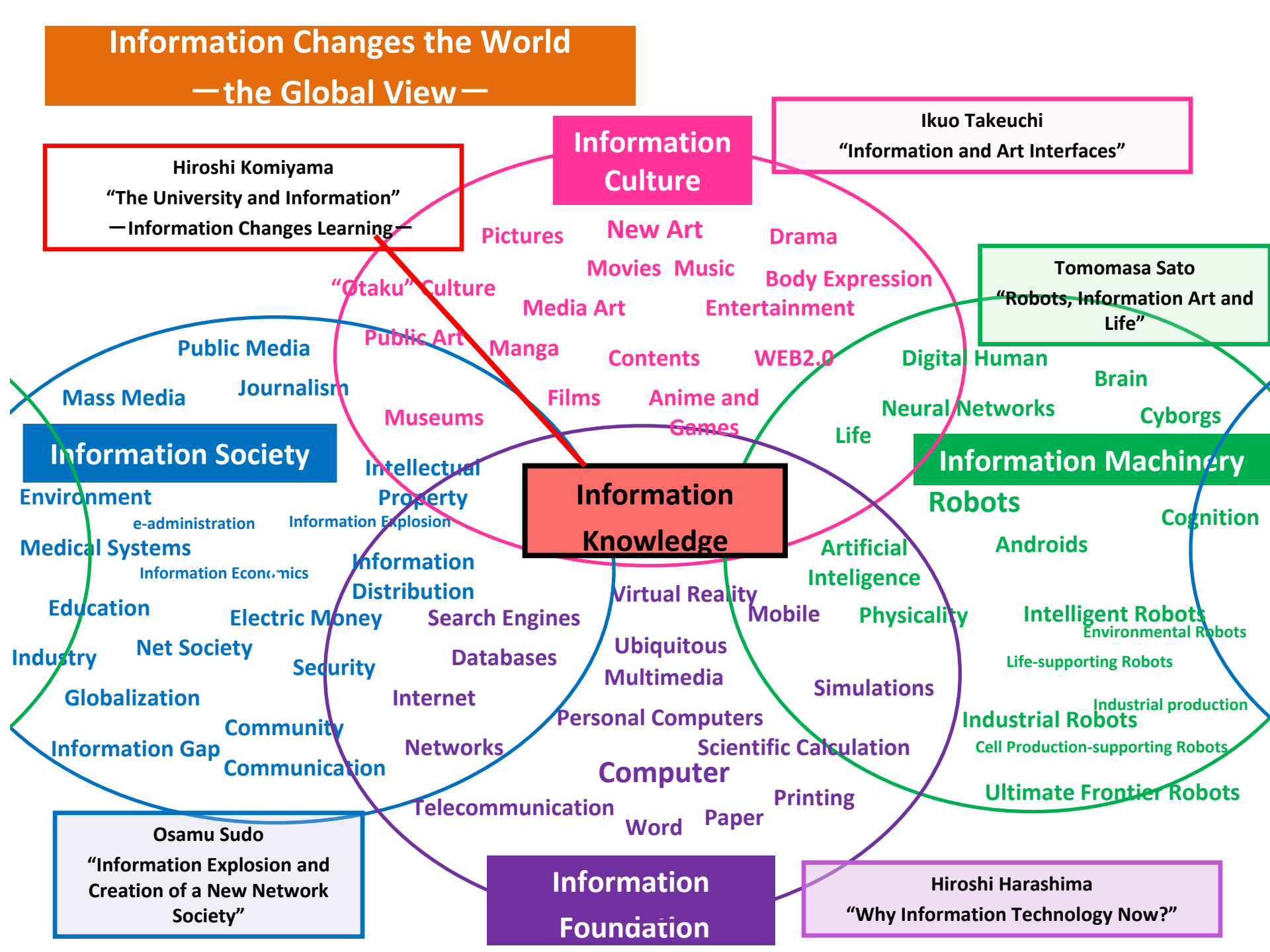


Real-time Dissemination of Structured Knowledge

Generation and dissemination of knowledge

Structured knowledge

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Industry
Net Society
Security
Databases
Ubiquitous Multimedia
Life-supporting Robots
Simulations
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