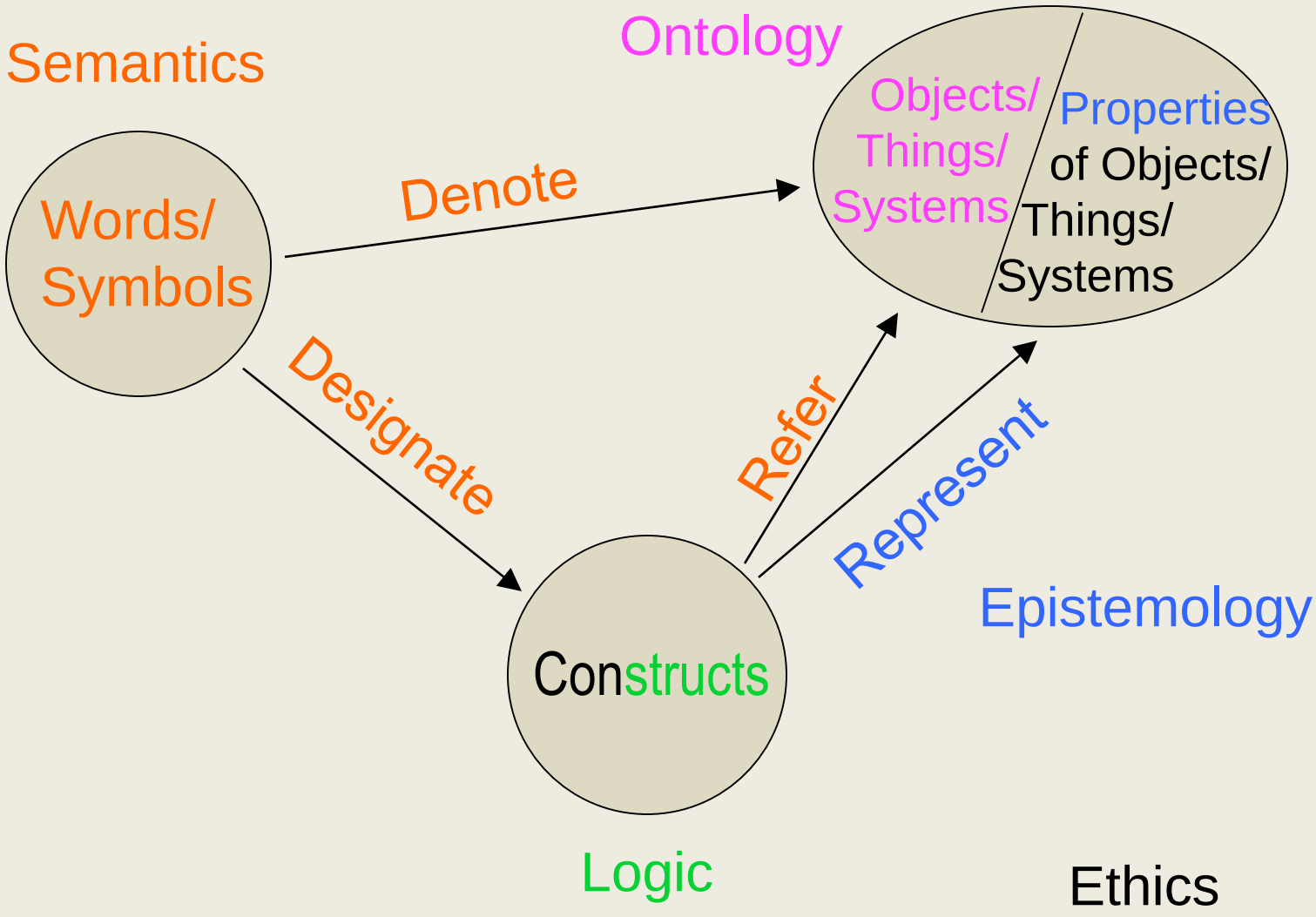
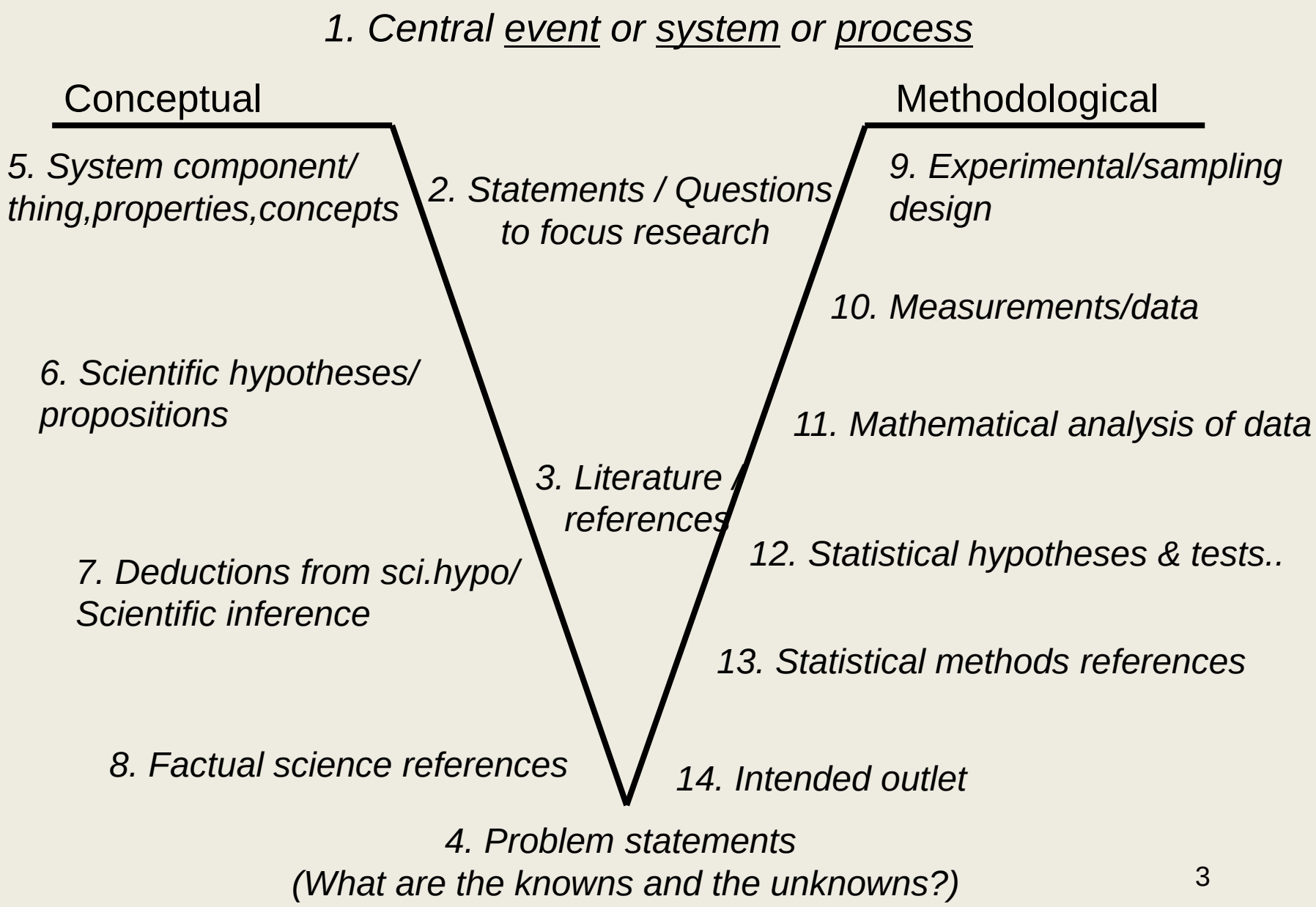
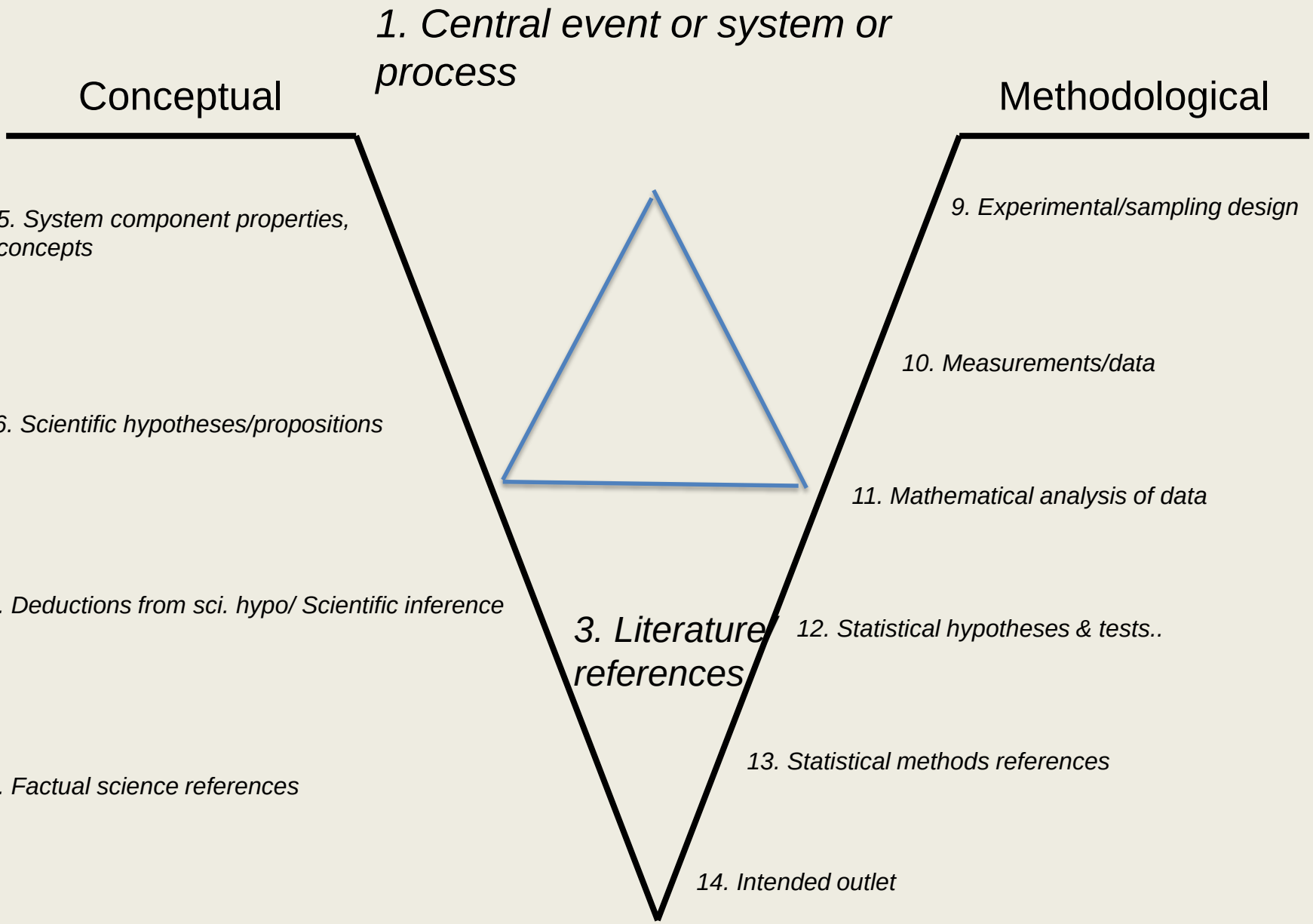
Science and Ontology


Semantics
Ontology
Words/
Symbols
Denote
Objects/
Things/
Systems
Properties
of Objects/
Things/
Systems
Designate
Refer
Represent
Epistemology
Constructs
Logic
Ethics


1. Central event or system or process
Conceptual
Methodological
5. System component/ thing,properties,concepts
2. Statements / Questions to focus research
9. Experimental/sampling design
10. Measurements/data
6. Scientific hypotheses/ propositions
11. Mathematical analysis of data
3. Literature / references
12. Statistical hypotheses & tests..
7. Deductions from sci.hypo/ Scientific inference
13. Statistical methods references
8. Factual science references
14. Intended outlet
4. Problem statements
(What are the knowns and the unknowns?)


1. Central event or system or process
Conceptual
Methodological
5. System component properties, concepts
9. Experimental/sampling design
10. Measurements/data
6. Scientific hypotheses/propositions
11. Mathematical analysis of data
7. Deductions from sci. hypo/ Scientific inference
3. Literature references
12. Statistical hypotheses & tests..
13. Statistical methods references
8. Factual science references
14. Intended outlet
4. Problem statements (knowns & unknowns)

Ontology in scientific research:

- ‘ontos’ ‘…to be…’
- ‘logia’ ‘…the study of…’

- Ontology is the study of being, … of what exists, and how it is organized, or can be organized.

What does ontology have to do with… (anything in) life?

1. Everyone has an ontological perspective

What does ontology have to do with… (anything in) life?

1. Everyone has an ontological perspective

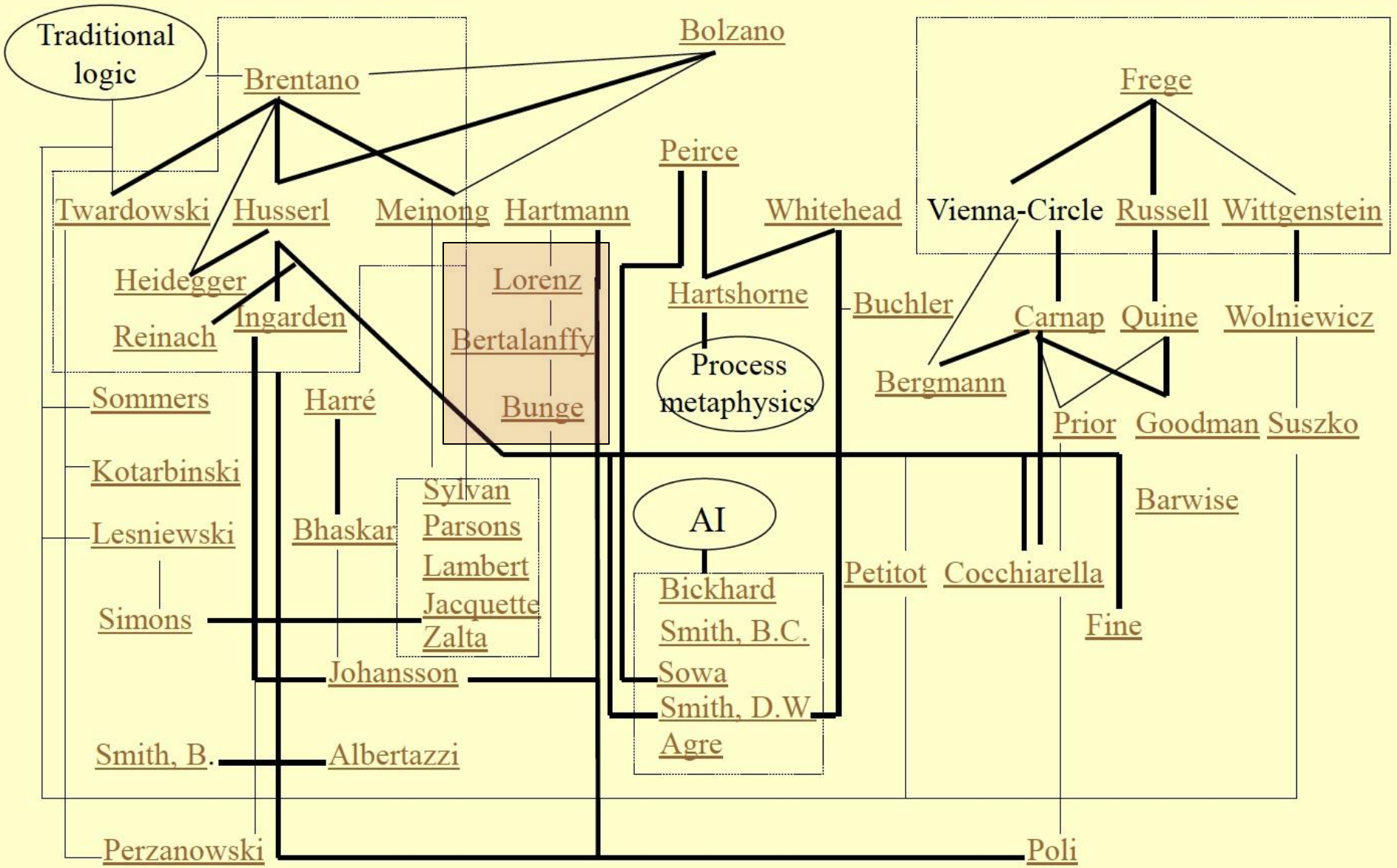
1. Your ontological perspective is the ‘furniture in your world’ [M. Bunge]

What does ontology have to do with … (anything in) life?

1. Everyone has an ontological perspective
2. Your ontological perspective is the ‘furniture in your world’ [M. Bunge]

3. The ‘furniture in your world’ ensures you ‘follow certain paths – between pieces’ – probably over and over again.

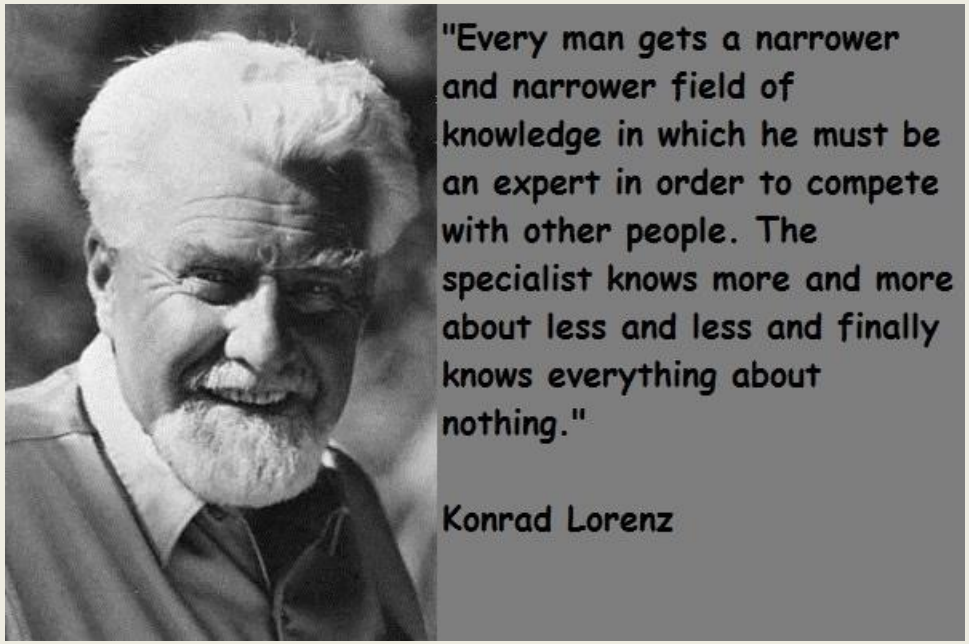
HOME Descriptive and Formal Ontologists.
From an initial proposal by R. Poli. Feedback by N. Cocchiarella, I. Johansson, and Barry Smith



Lines indicate two kinds of dependence: thick lines major dependences and thin lines less relevant dependences. A distinction between individual dependence (from scholar to scholar) and general pendence (from a (boxed) School, Movement or Topical Area to some individual -- or vice-versa) is also considered. Names a re organized in a (roughly) top-down way according to Authors's birth-date.

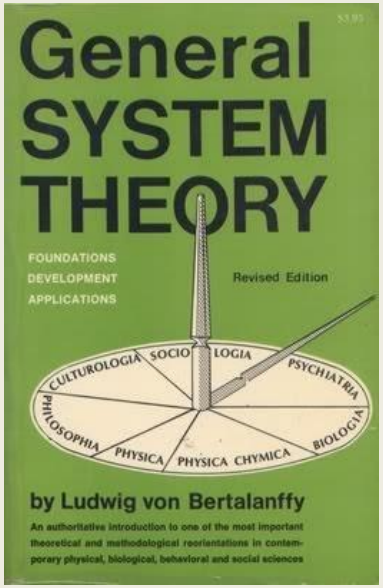
Konrad Lorenz (1903-1989)

Nobel prize 1973 --- Austrian evolutionary ontologist.



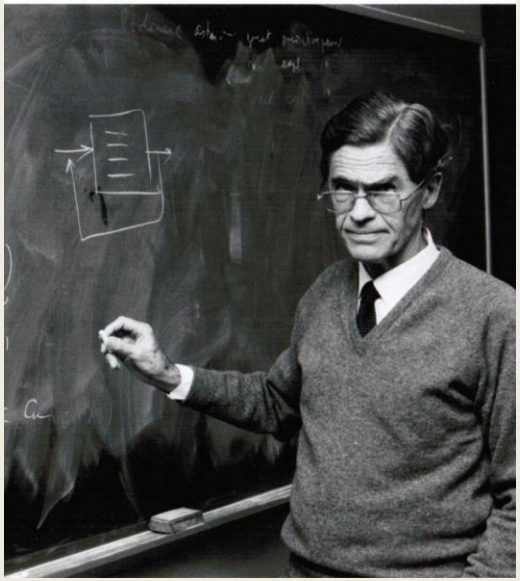
L. von Bertalanffy

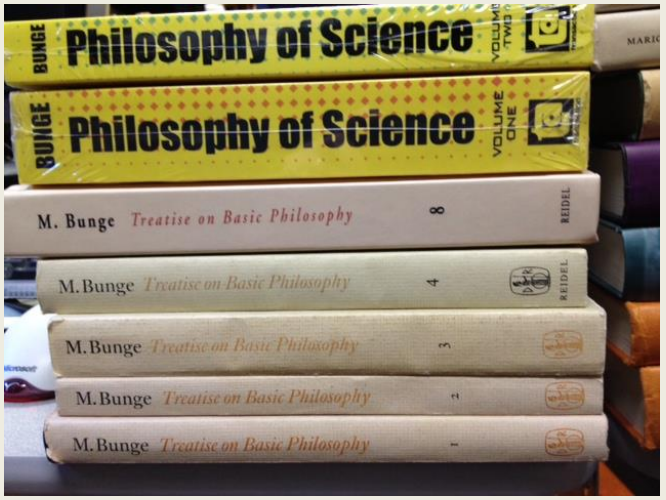
- A dominant ontological view is that of ‘systems’.
- But this is fairly recent – post WWII
- L. von Bertalanffy’s contributions



$$h' = \alpha h^{\theta} - \beta h$$

Mario Bunge contributions to ‘ontology’:





Vol 3: Ontology I: The furniture of the world

1. Substance
2. Form
3. Thing
4. Possibility
5. Change**
6. SpaceTime

Mario Bunge contributions to ‘ontology’:

Vol 3: Ontology I: The furniture of the world

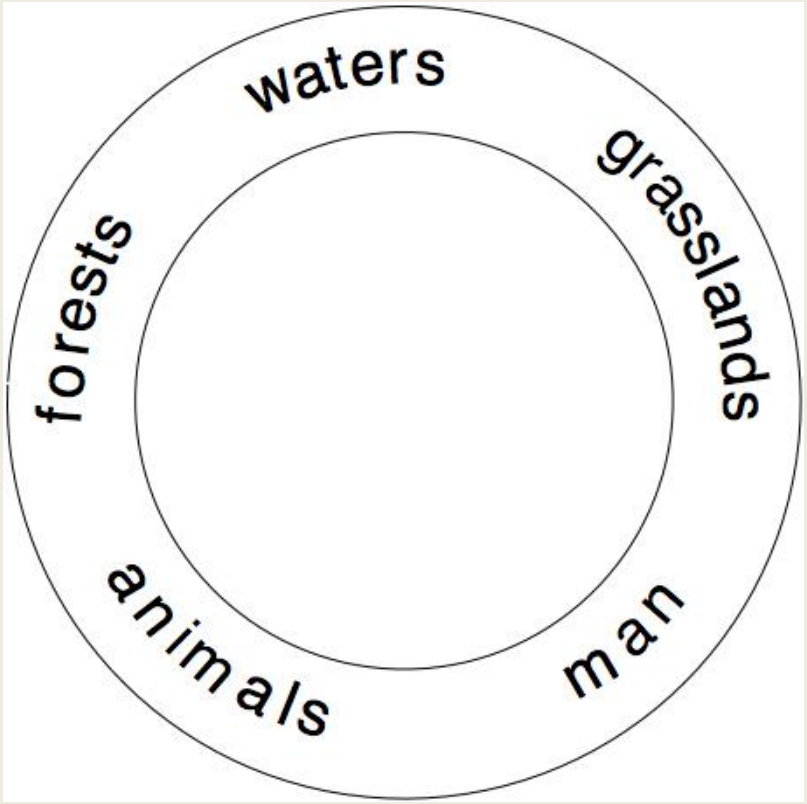
1. Substance
2. Form
3. Thing
4. Possibility
5. Change
6. SpaceTime

Vol 4: Ontology II: A world of systems

1. System
2. Chemism
3. Life
4. Mind
5. Society
6. A Systemic World View

Forest land ontologies compared:

Commodity
(former perspective)



natural systems
(recent perspective)

In a ‘systems ontology’ … any ‘chunk of what is out there’ can be grouped (roughly) into 3 parts:

1. The composition (things ‘strongly’ interacting)

2. The structure (the connections among things in the composition)

3. The environment (the rest of the things out there that are less strongly interacting)

What is needed is some rhyme or reason for selecting the items to place in the system's parts:

1. Composition (nodes)

2. Structure (arcs connecting nodes)

3. Environment (nodes)

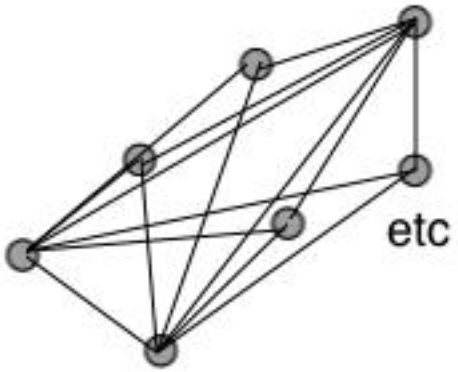
There are at least 2 strategies for specifying the "system":

a) Narrow down from all possible arcs
to identify subsystems to focus on?

b) Build up from blank -- by forming an arc – node representation of system?

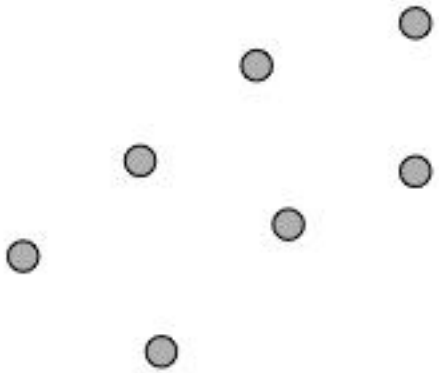
Strategy 1a: Begin with nodes and all possible connections:

- = Candidate things/machines or population of things/ machines.



Strategy 1b: Begin with no connections and build up
-- by forming an arc – node representation of system?
:

= Candidate things/machines or population of things/ machines.



= A thing/machine or populations of things/machines.

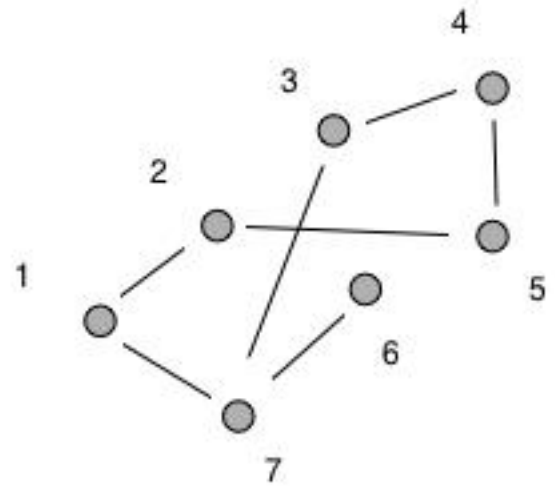
= A relationship

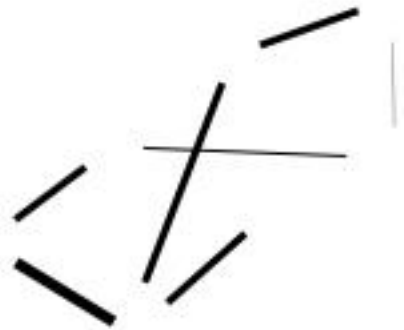
= uni-directional relationship

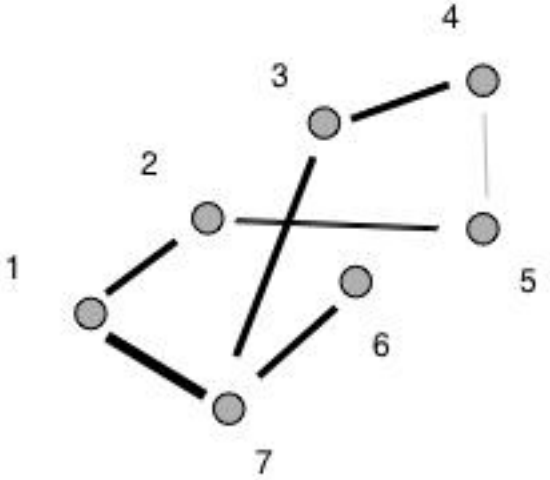
= bi-directional relationship

= strong relationship

= weak relationship







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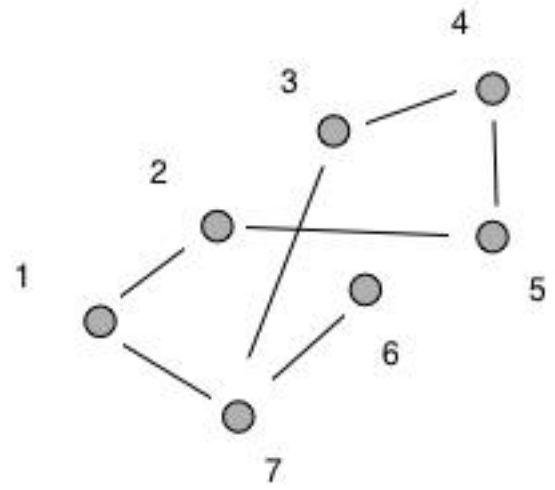
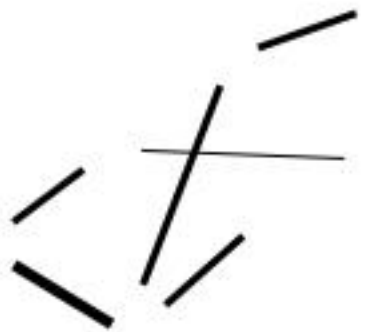
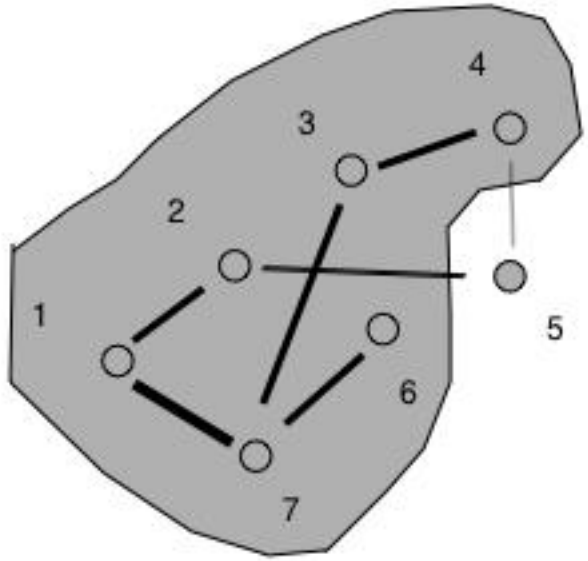






Nodes [1,2,3,4,6,7] $\longrightarrow$ system Composition

Node [5] $\longrightarrow$ system Environment.

You may want to develop a mathematical equation for each element in the Composition that reflects node interdependence (Structure)

But just measure elements in Environment to have a time series on that node.

$$\frac{d1}{dt} = f_1(1,2,3,4,5,6,7)$$

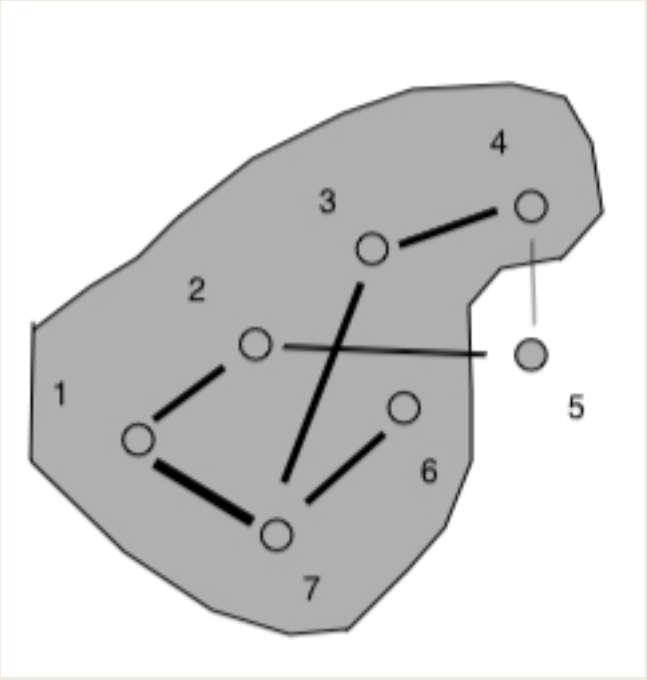
$$\frac{d2}{dt} = f_2(1,2,3,4,5(t),6,7)$$

$$\frac{d3}{dt} = f_3(1,2,3,4,5,6,7)$$

$$\frac{d4}{dt} = f_4(1,2,3,4,5(t),6,7)$$

$$\frac{d6}{dt} = f_6(1,2,3,4,5,6,7)$$

$$\frac{d7}{dt} = f_7(1,2,3,4,5,6,7)$$



HOWEVER:

The world:

- is so complex, and
- can be studied from many perspectives,

I've come to believe the

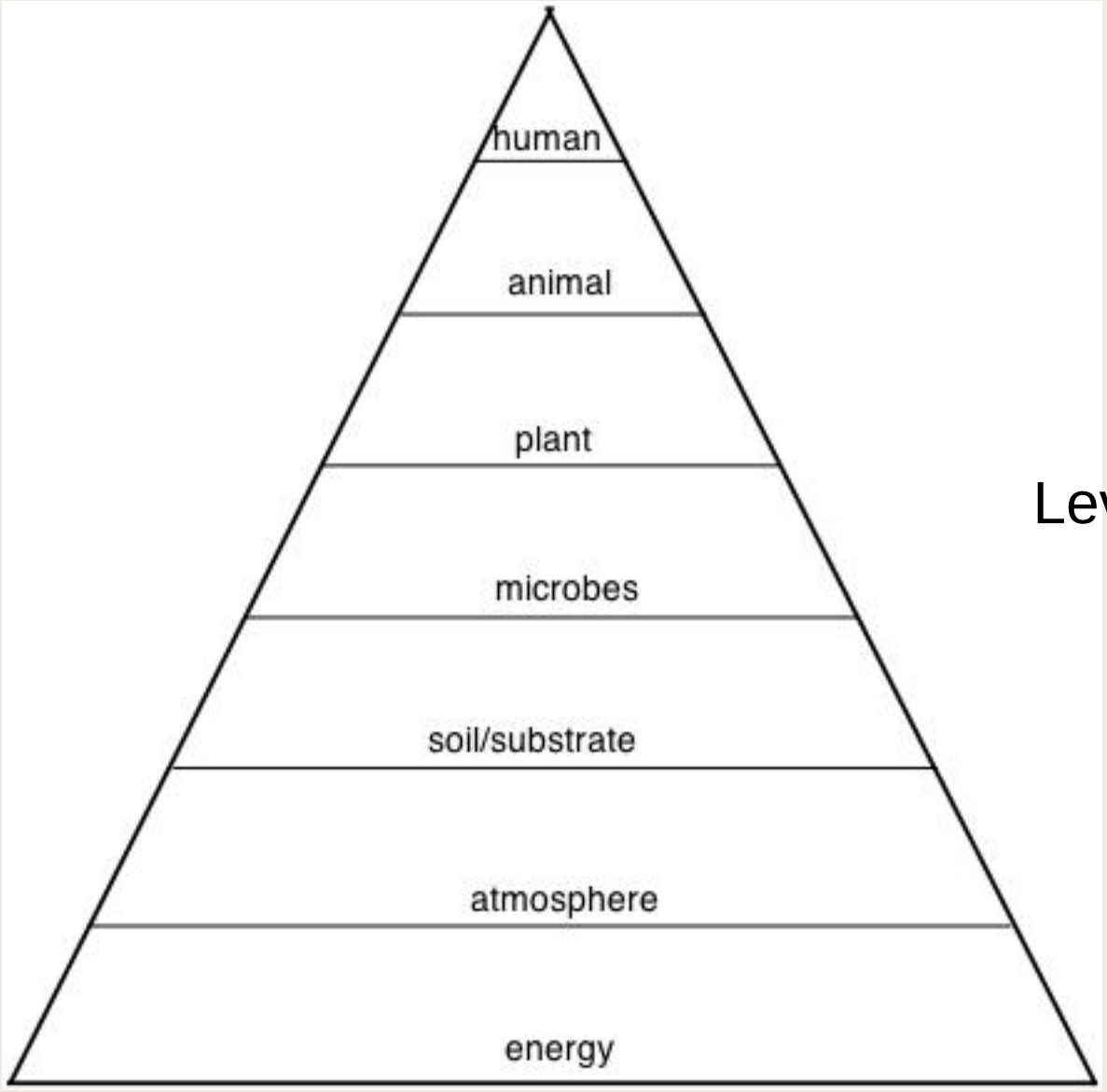
<composition, structure, environment>

schema is often too simple to communicate the ontological perspective one is pursuing.

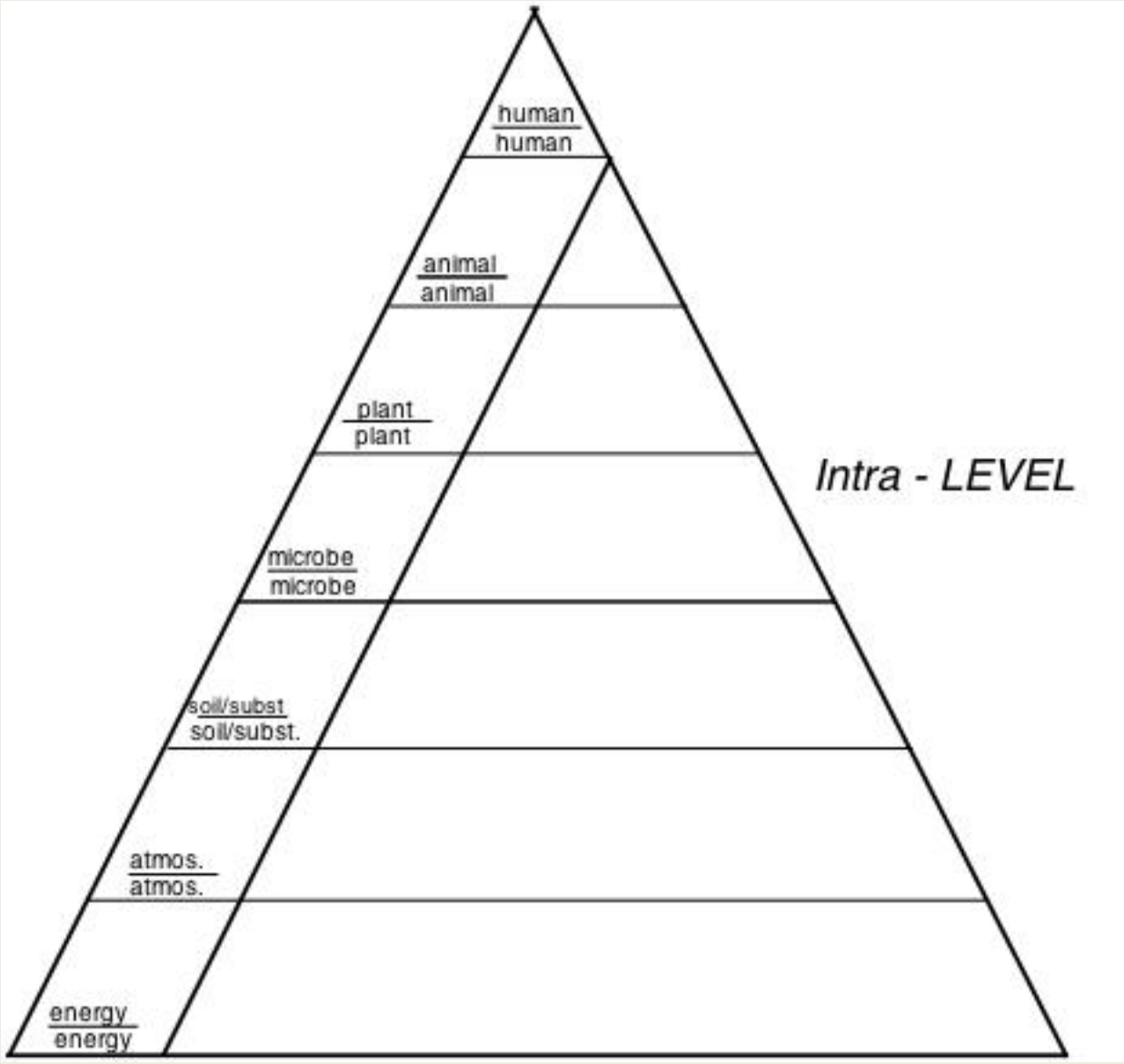
The concepts of

- ‘Level’ and
- ‘Order of Interaction’

are also useful in provide a starting point in implementing an alternative ‘Systems’ ontological framework:


human
animal
plant
microbes
soil/substrate
atmosphere
energy

Levels


human
human
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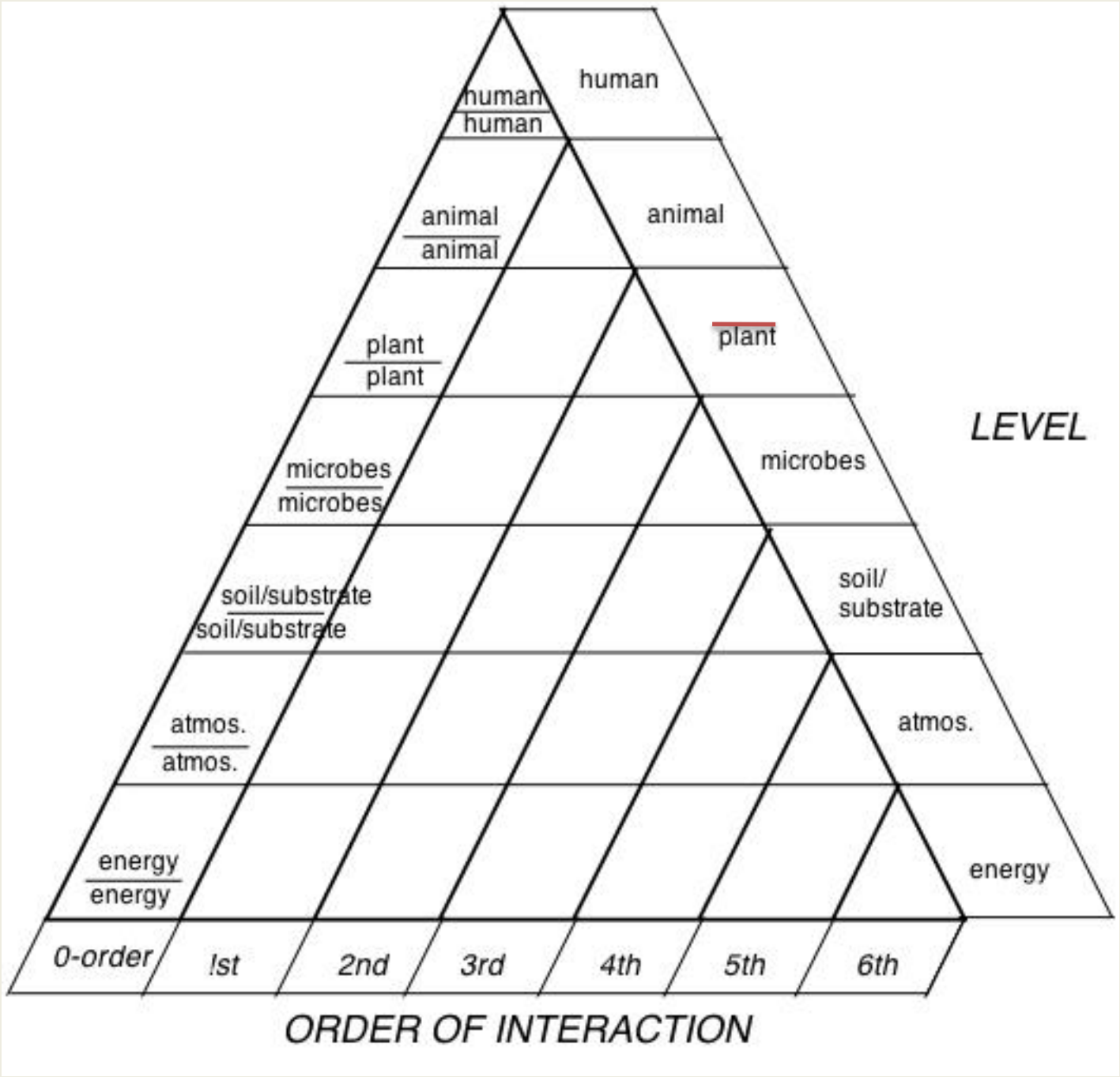
energy
energy
Intra - LEVEL


human
human
human
animal
animal
animal
plant
plant
plant
microbes
microbes
microbes
soil/substrate
soil/substrate
soil/
substrate
atmos.
atmos.
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energy
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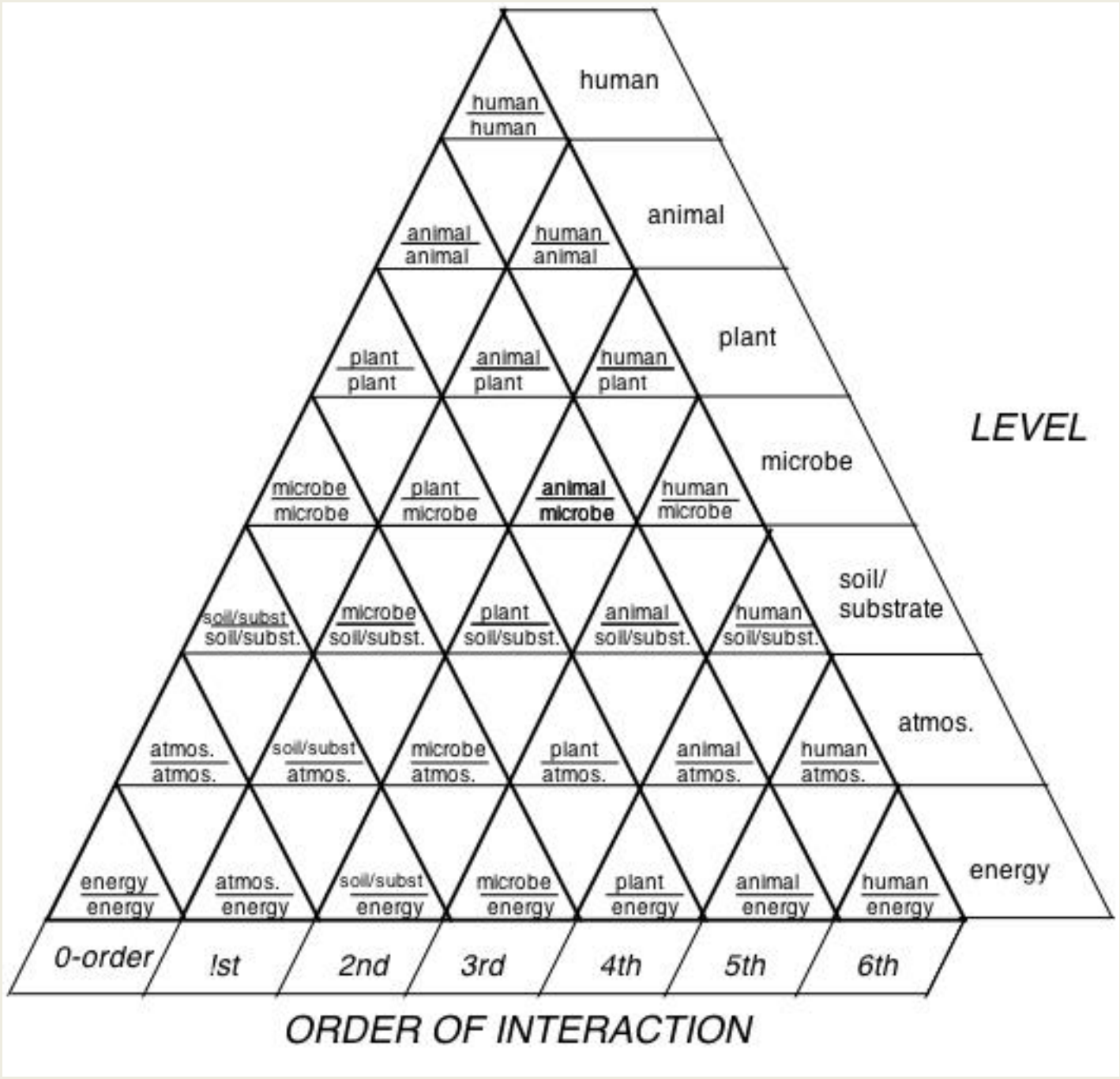
energy
LEVEL
0-order
!st
2nd
3rd
4th
5th
6th
ORDER OF INTERACTION


human
human / human
animal
animal / animal
human / animal
plant
plant / plant
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human / plant
microbe
microbe / microbe
plant / microbe
animal / microbe
human / microbe
soil/ substrate
soil/subst / soil/subst.
microbe / soil/subst.
plant / soil/subst.
animal / soil/subst.
human / soil/subst.
atmos.
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soil/subst / atmos.
microbe / atmos.
plant / atmos.
animal / atmos.
human / atmos.
energy
energy / energy
atmos. / energy
soil/subst / energy
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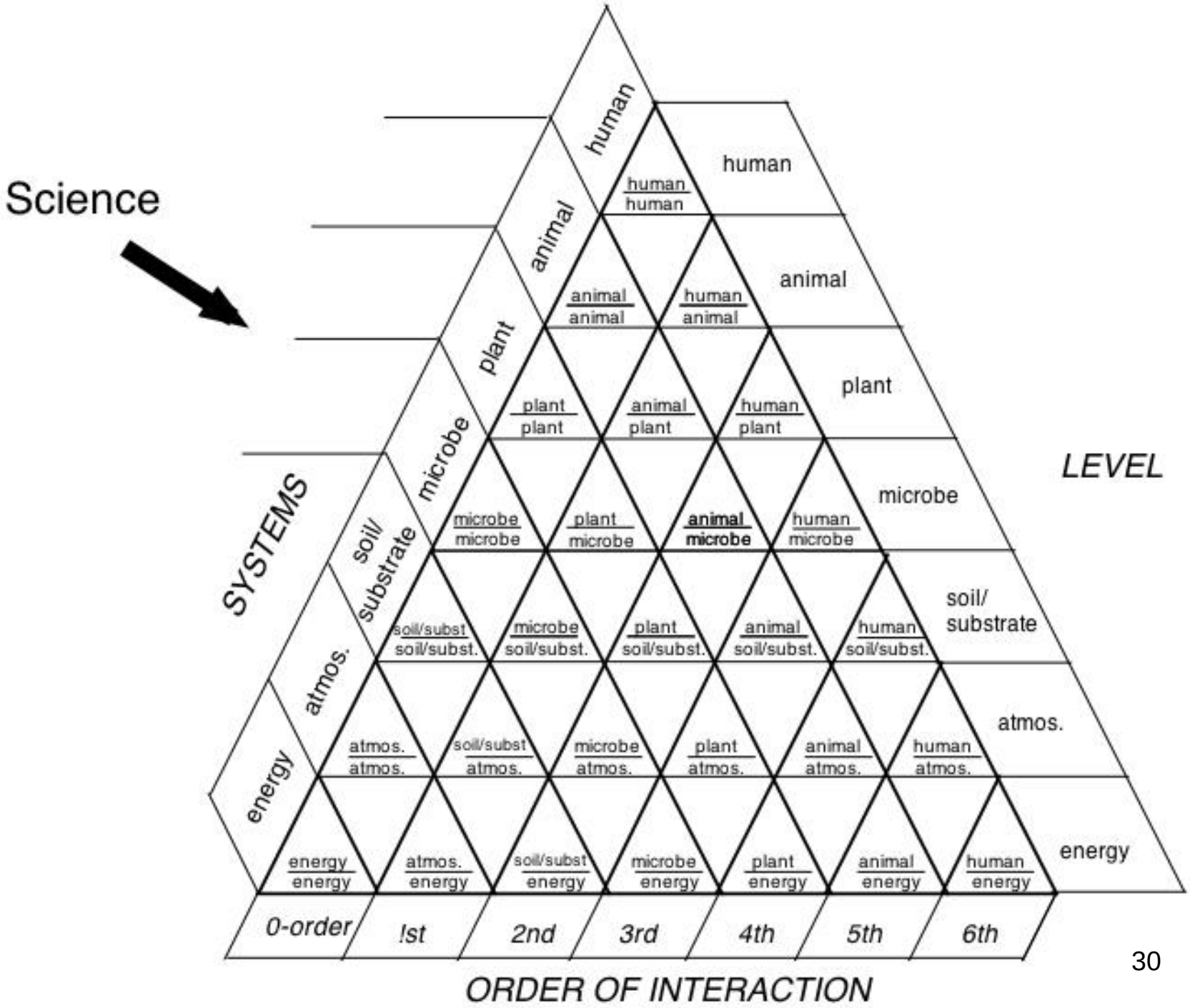
plant / energy
animal / energy
human / energy
LEVEL
0-order
!st
2nd
3rd
4th
5th
6th
ORDER OF INTERACTION


Science
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microbe/soil/subst.
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animal/soil/subst.
human/soil/subst.
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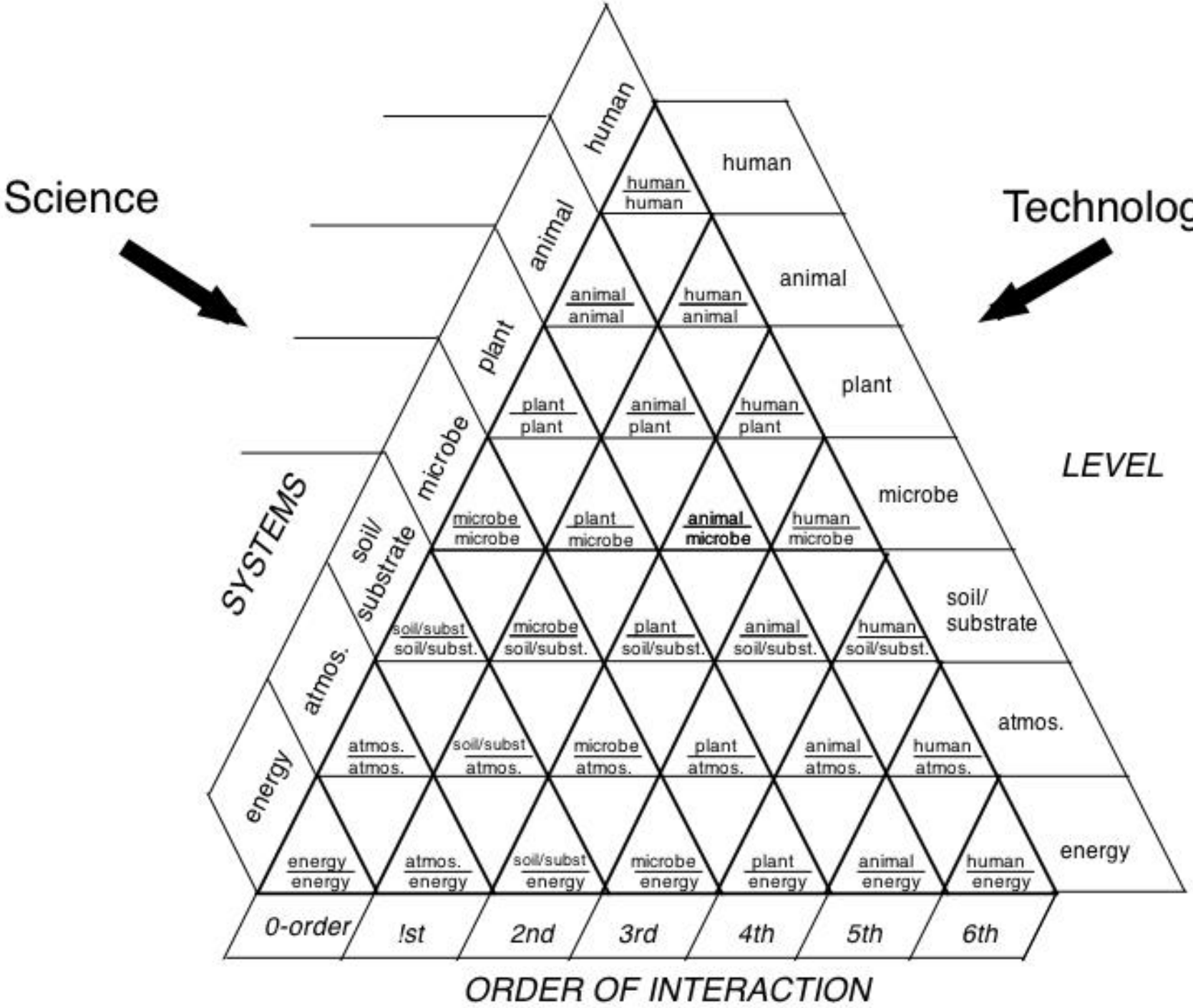
ORDER OF INTERACTION


Science
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LEVEL
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animal/ animal
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microbe/ microbe
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soil/subst/ energy
microbe/ energy
plant/ energy
animal/ energy
human/ energy
0-order
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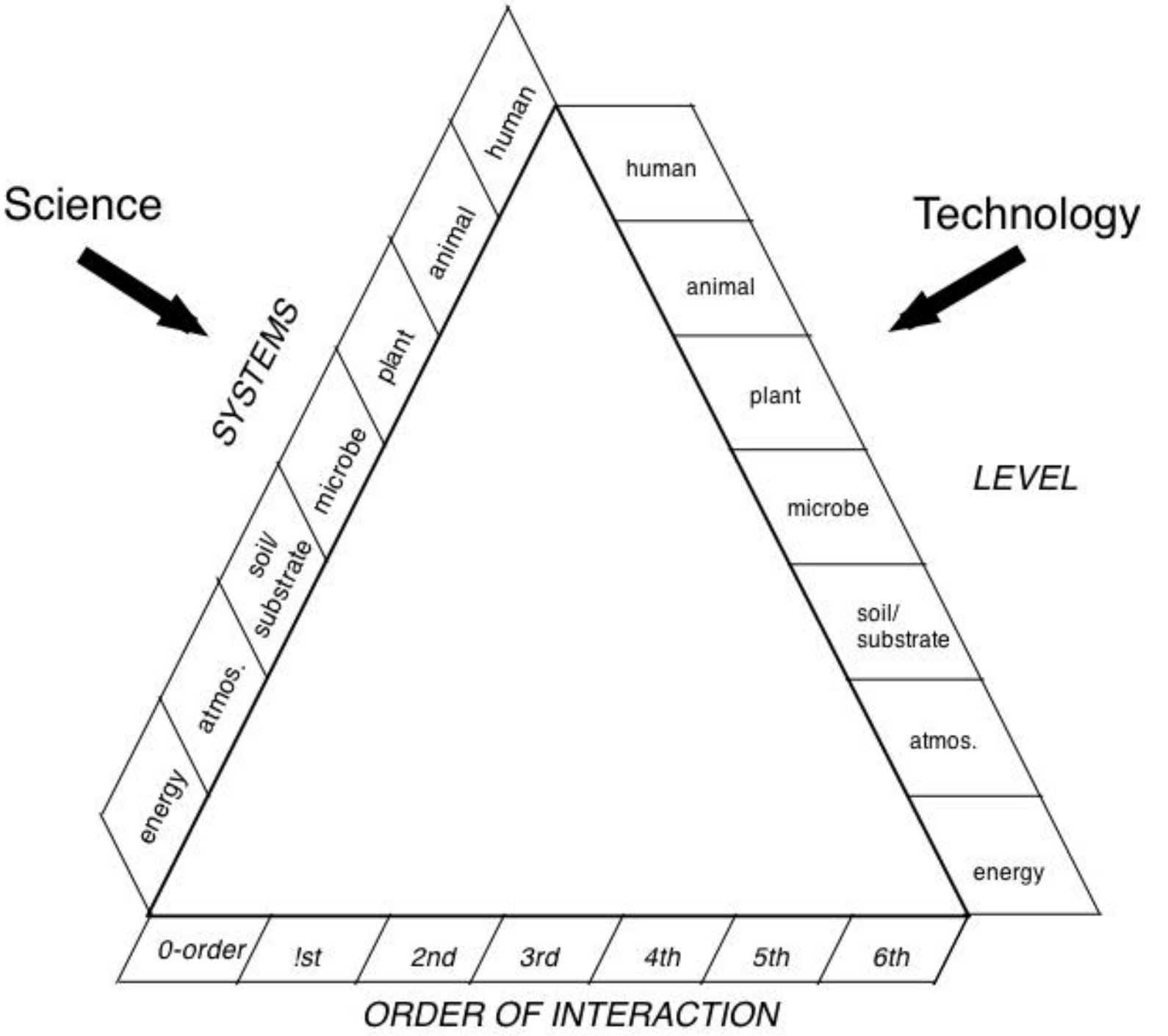
3rd
4th
5th
6th
ORDER OF INTERACTION

The levels – systems ontological perspective poses the same issues as the arc-node perspective:

1) Should I begin with every triangle delineated and omit those not being considered, or

2) Should I begin with a blank larger triangle and delineate only those triangles that form my system.


Science
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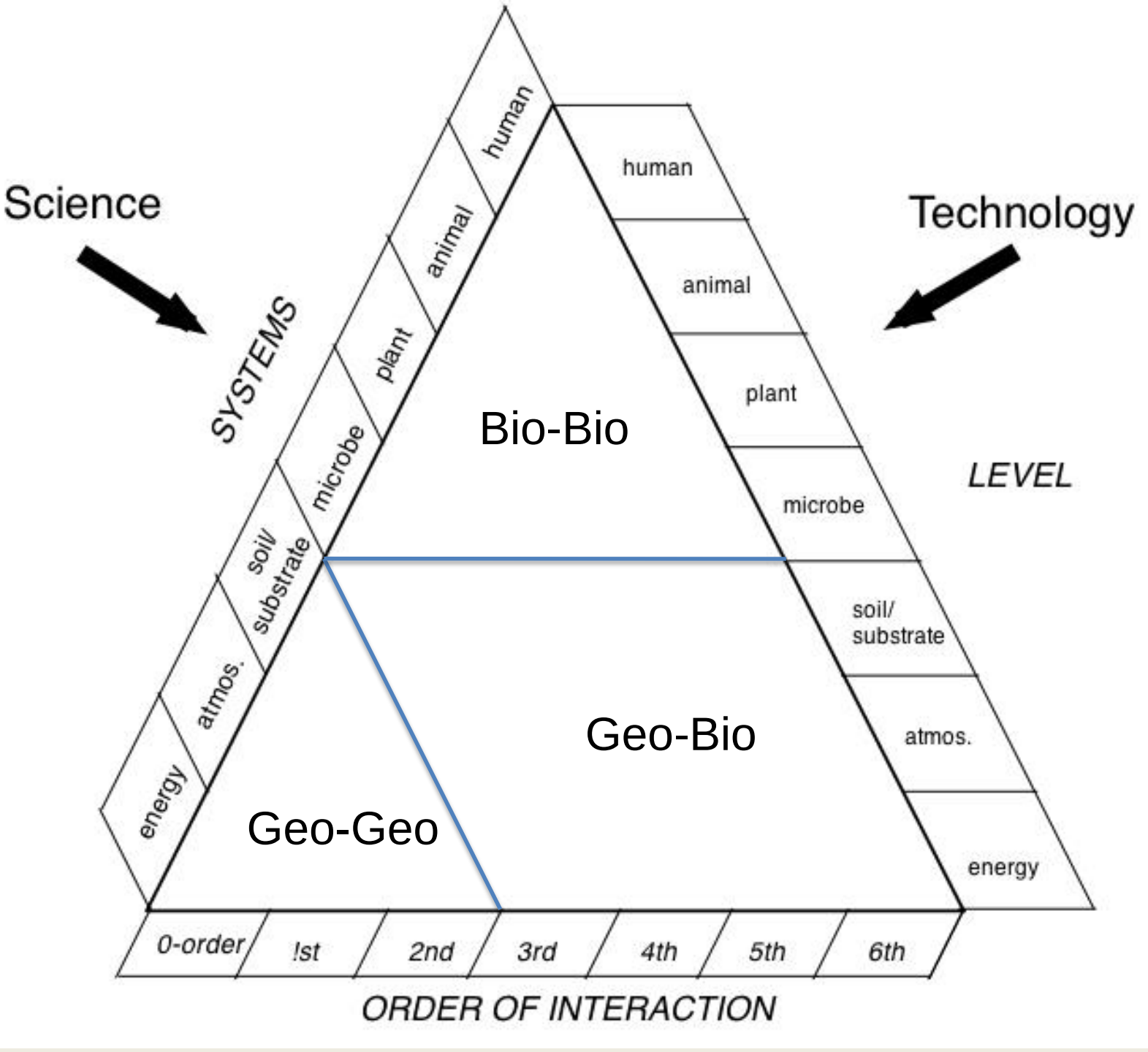
ORDER OF INTERACTION


Science
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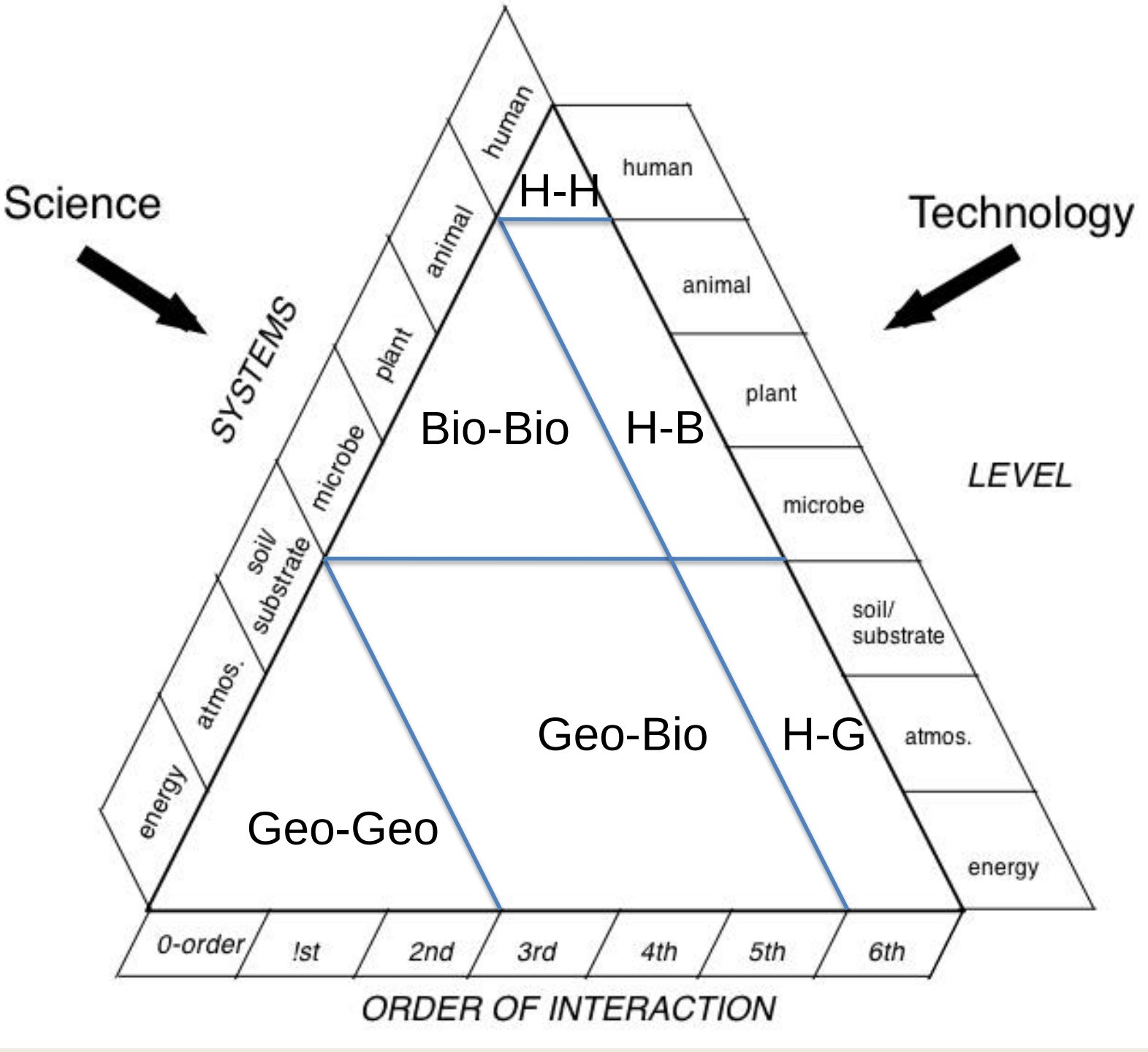
6th
ORDER OF INTERACTION


Science
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Bio-Bio
H-B
Geo-Bio
H-G
Geo-Geo
human
animal
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microbe
soil/ substrate
atmos.
energy
0-order
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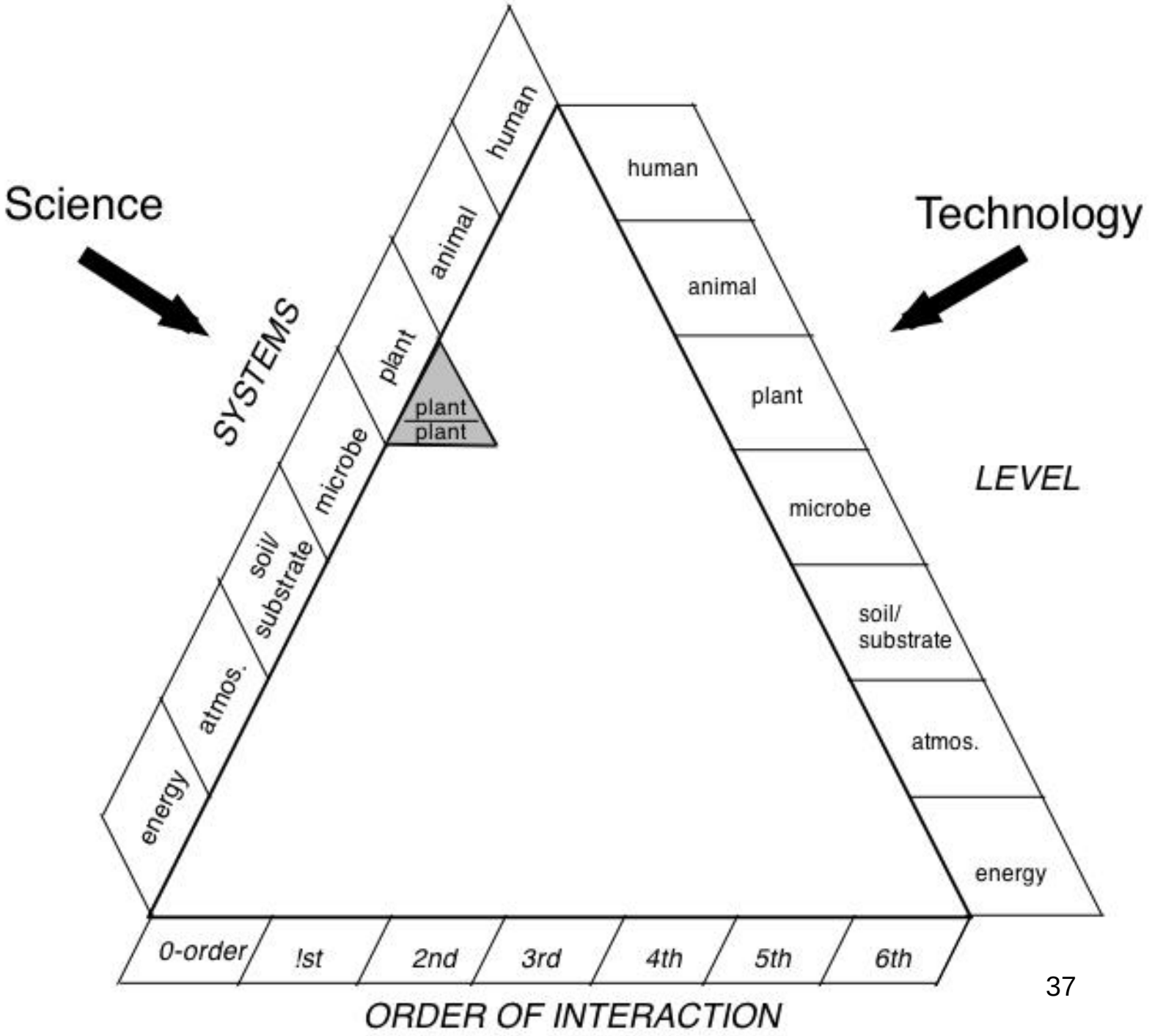
2nd
3rd
4th
5th
6th
ORDER OF INTERACTION

There are some advantages to working with larger blocks:

a) Including ALL triangles (>half of which are empty) seems to confuse rather than clarify.

b) The entire range of possible levels is still there, and omissions of components may be more easily spotted and corrected.

"Study"


Science
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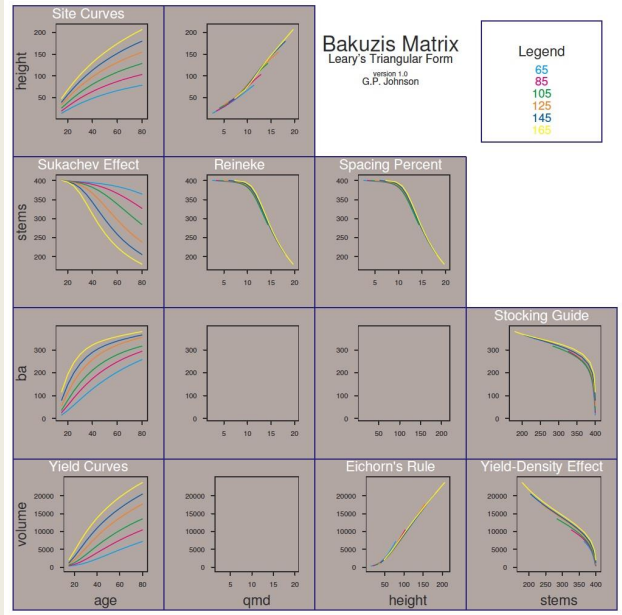
5th
6th
ORDER OF INTERACTION

“Study”


Site Curves
Bakuzis Matrix
Leary's Triangular Form
version 1.0
G.P. Johnson
Legend
65
85
105
125
145
165
Sukachev Effect
Reineke
Spacing Percent
Stocking Guide
Yield Curves
Eichorn's Rule
Yield-Density Effect
height
stems
ba
volume
age
qmd
height
stems

human
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plant
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Technology
LEVEL
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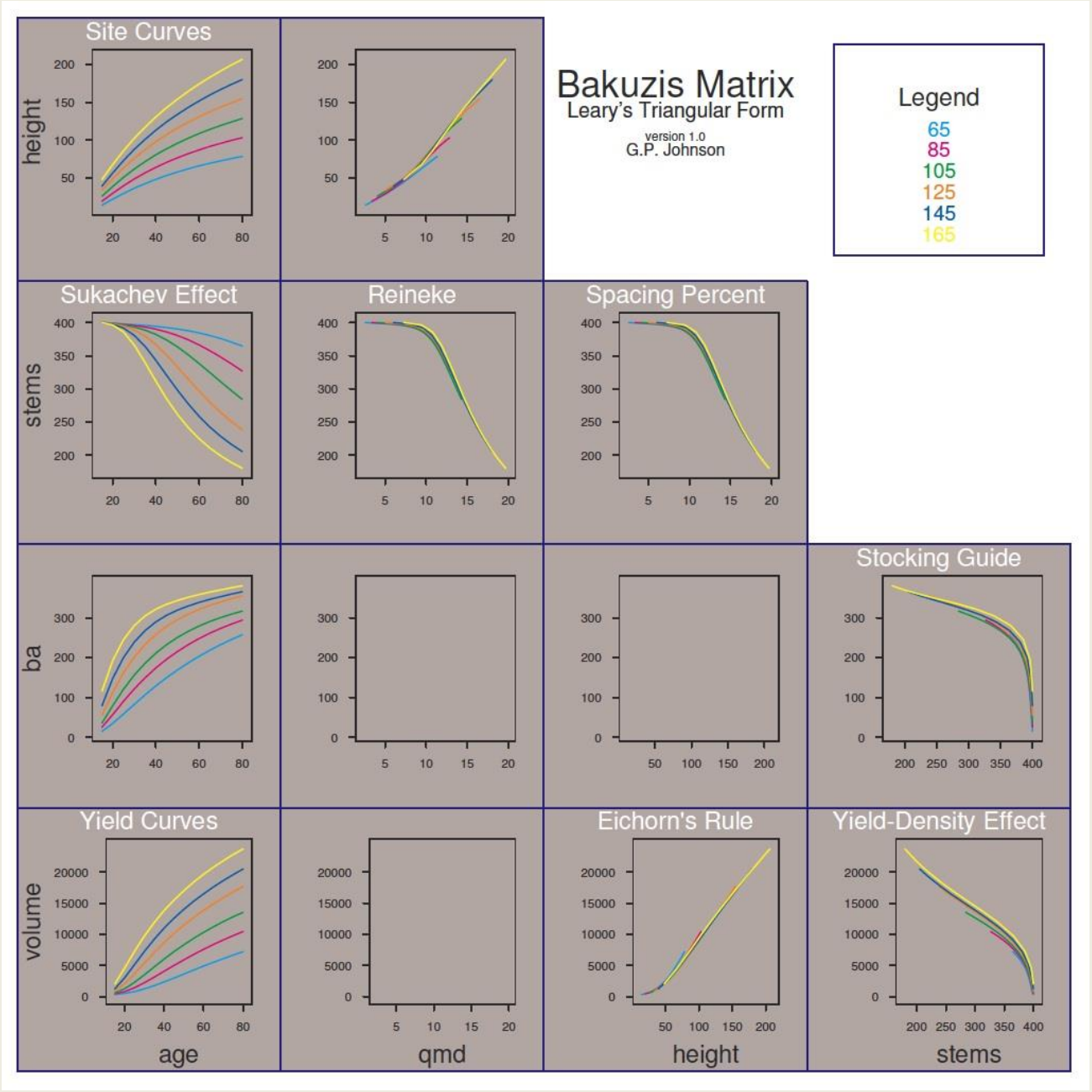
ORDER OF INTERACTION


Site Curves
Bakuzis Matrix
Leary's Triangular Form
version 1.0
G.P. Johnson
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165
Sukachev Effect
Reineke
Spacing Percent
Stocking Guide
Yield Curves
Eichorn's Rule
Yield-Density Effect
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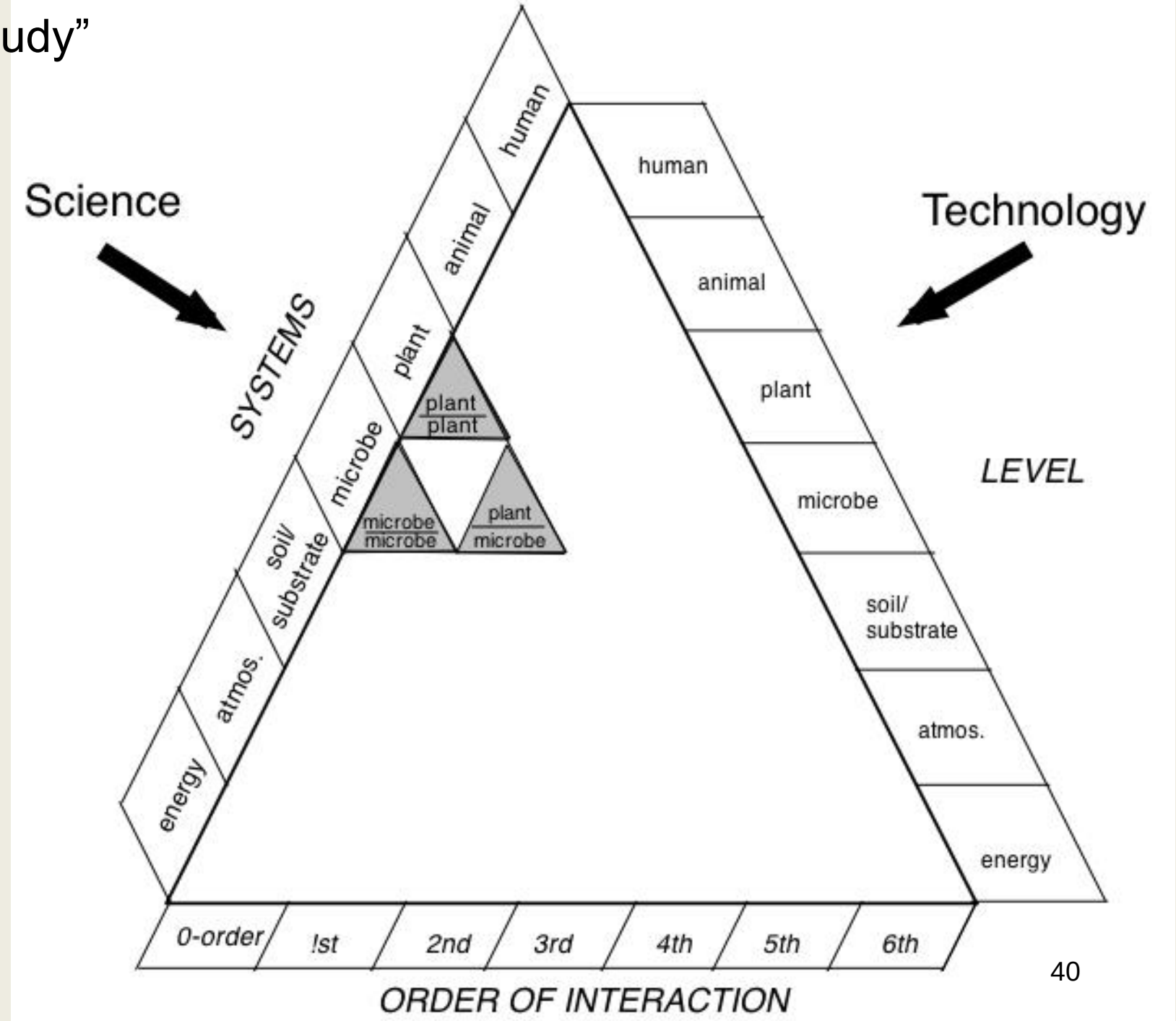
stems

"3-cell study"


Science
Technology
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LEVEL
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microbe
soil/ substrate
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energy
plant / plant
microbe / microbe
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0-order
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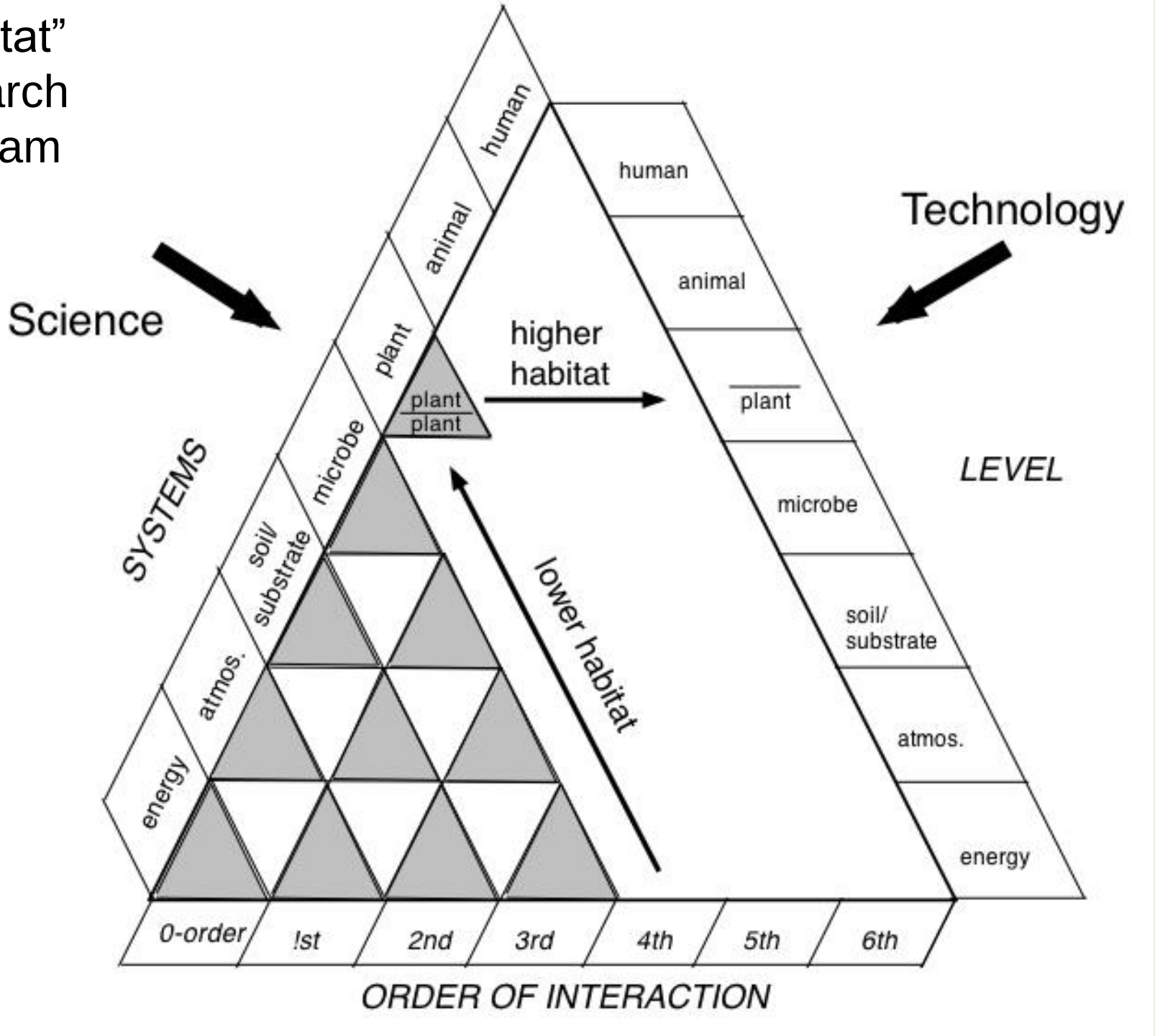
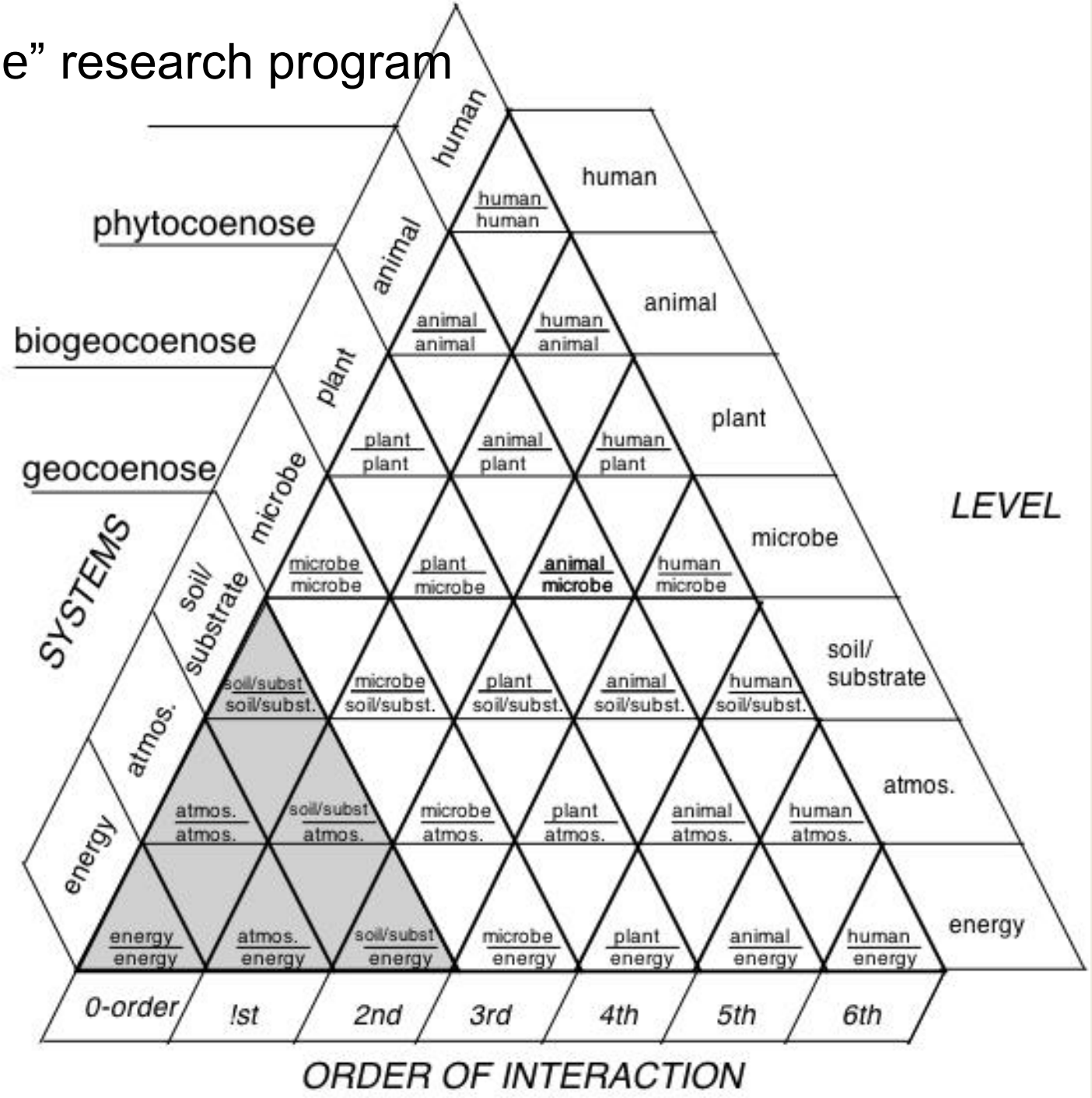
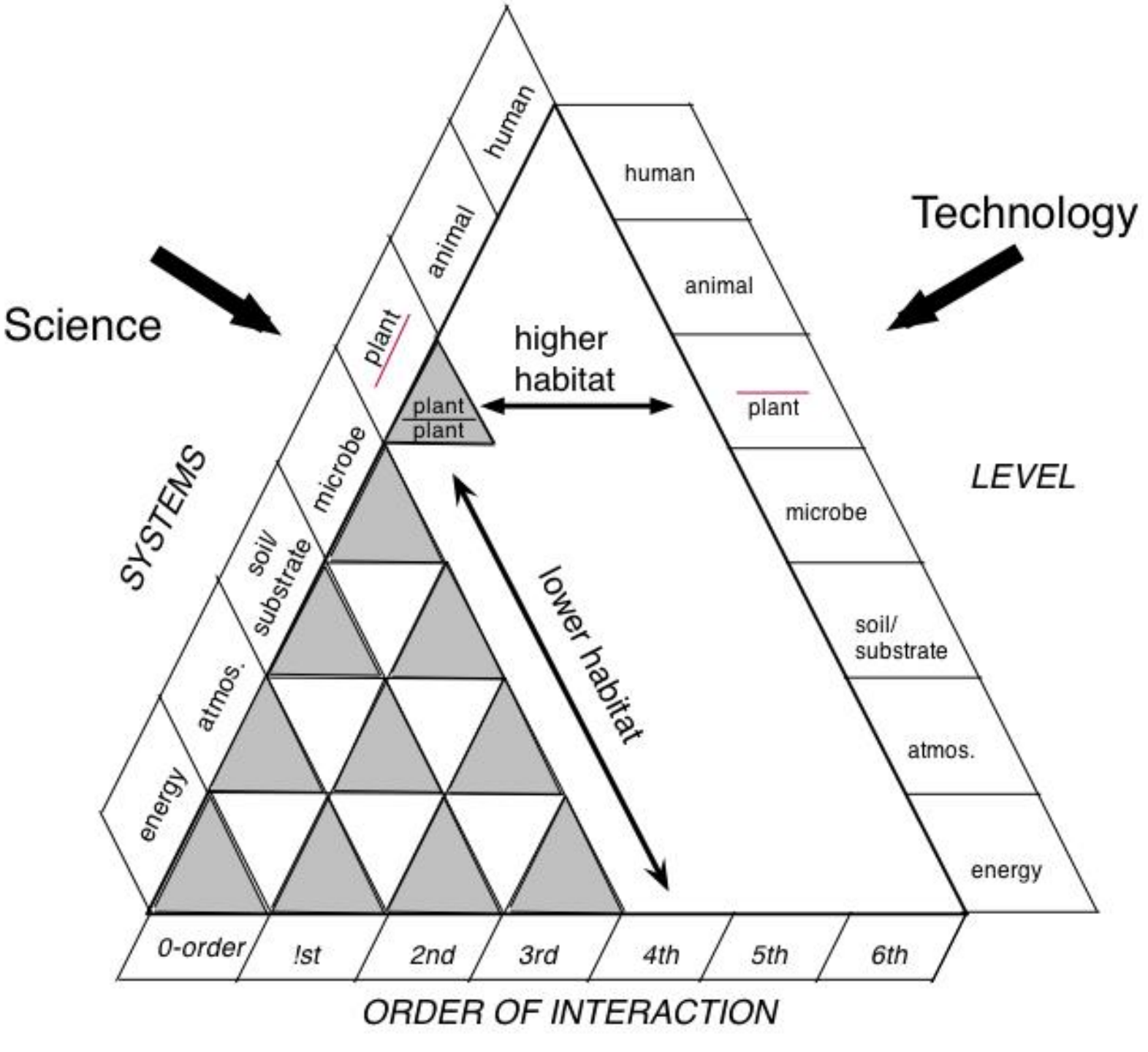
3rd
4th
5th
6th
ORDER OF INTERACTION

“Habitat” research program

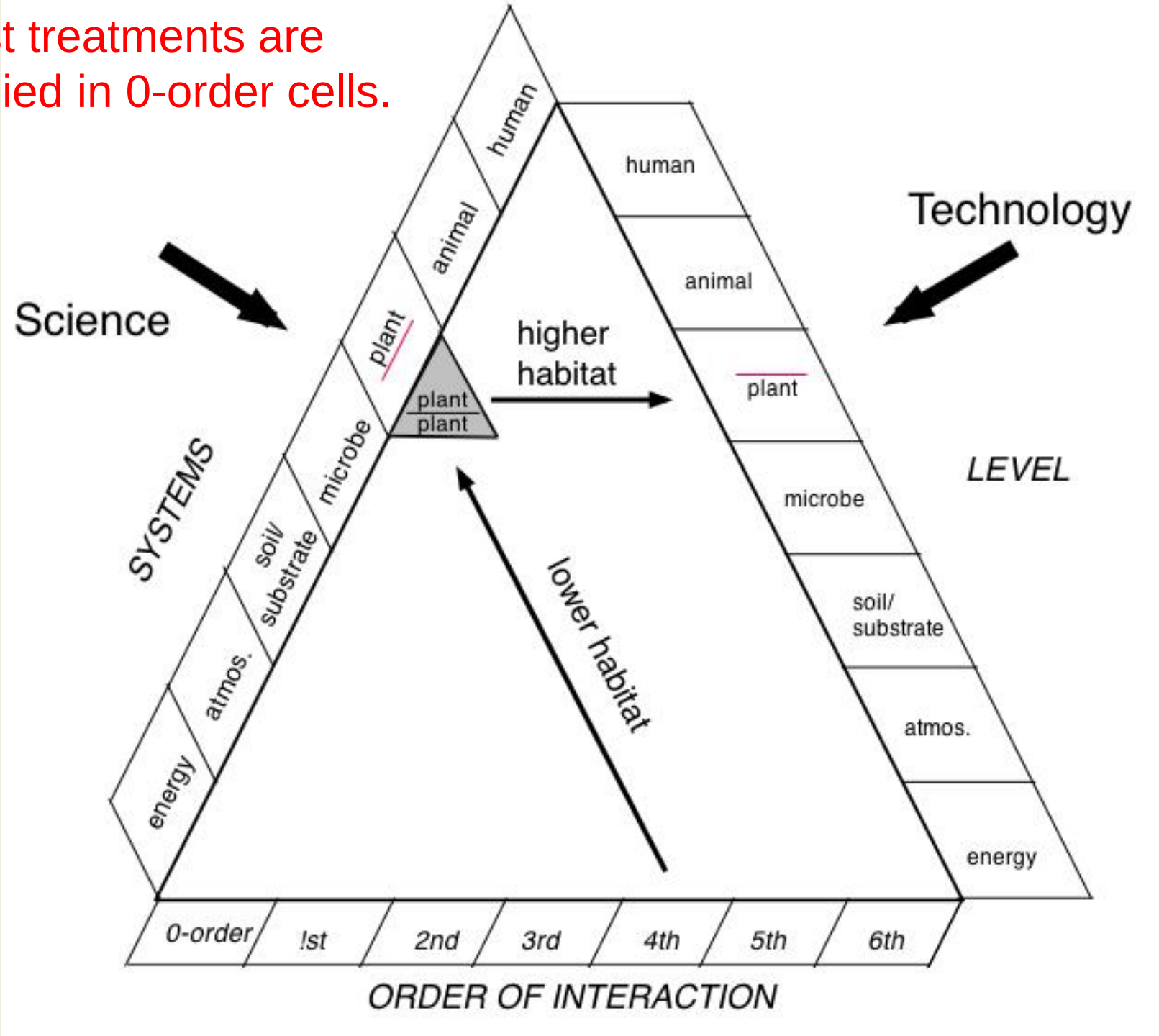


“Coenose” research program




Science
Technology
SYSTEMS
LEVEL
human
animal
plant
microbe
soil/
substrate
atmos.
energy
plant
plant
higher
habitat
lower habitat
human
animal
plant
microbe
soil/
substrate
atmos.
energy
0-order
!st
2nd
3rd
4th
5th
6th
ORDER OF INTERACTION

Most treatments are applied in 0-order cells.



Aspen FACE (Free-Air Carbon Dioxide Enrichment) Experiment

Science

SYSTEMS

human
animal
plant
microbe
soil/ substrate
atmos.

LEVEL

human
a

plant / plant
animal / plant
plant / microbe
plant / soil/subst.
plant / atmosph.
plant / energy
energy

2nd
3rd
4th
5th
6th

ORDER OF INTERACTION

Example of a 3rd order treatment cell.

Science

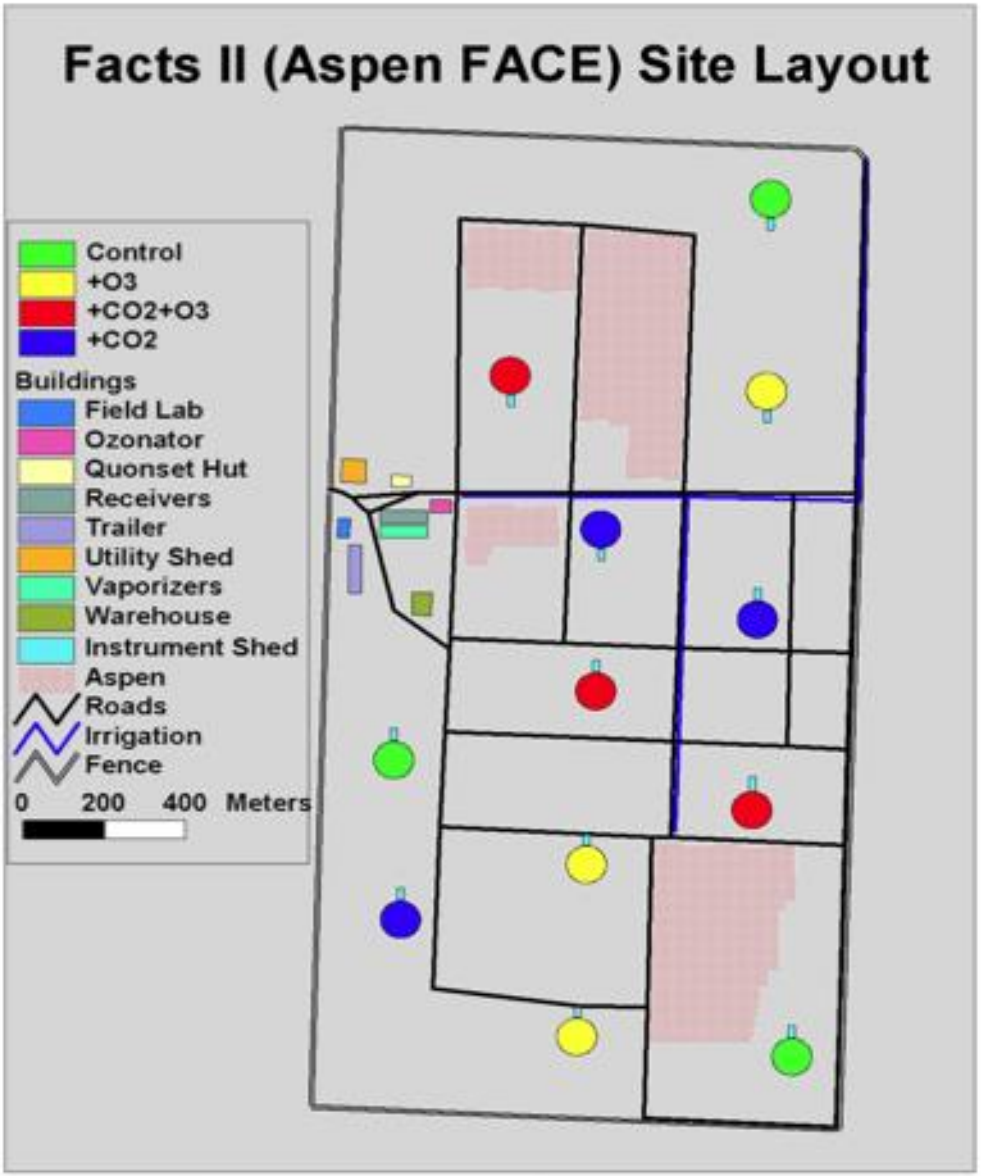
SYSTEMS

human
animal
plant
microbe
soil/ substrate
atmos.
energy

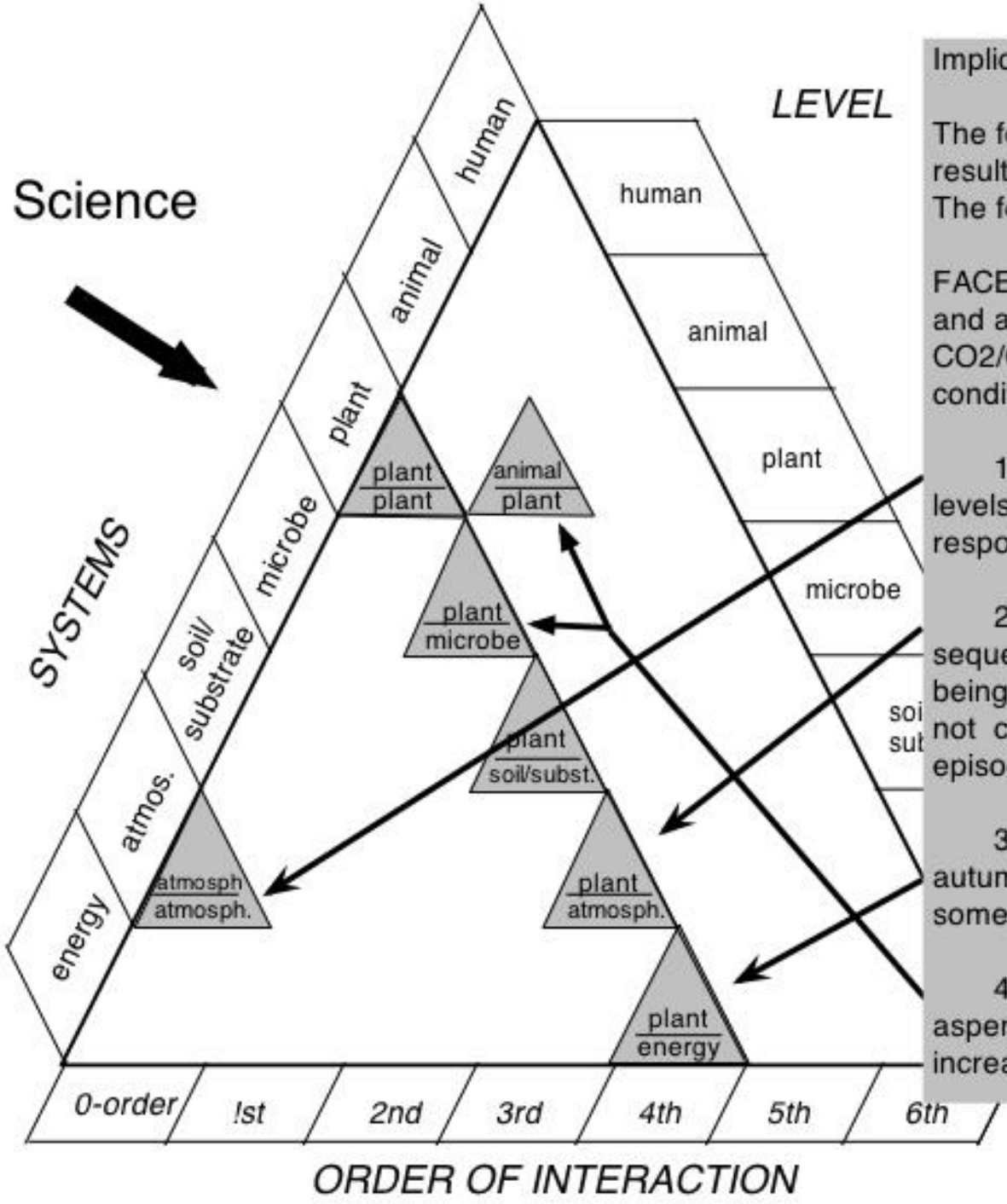
plant / plant
animal / plant
plant / microbe
plant / soil/subst.
plant / atmosph.
plant / energ

0-order
!st
2nd
3rd
4th
5th
6th

ORDER OF INTERACTION



http://aspenface.mtu.edu/Newsletter%20June%202004.pdf



Implications of Our Results

The following pages illustrate some of the results to date from the FACE experiment. The following key points should be noted:

FACE provides a window into the future and allows for experimental testing of CO2/O3 interactions under realistic forest conditions.

1. Our results suggest that moderate levels of O3 will offset elevated CO2 responses projected for the year 2100.

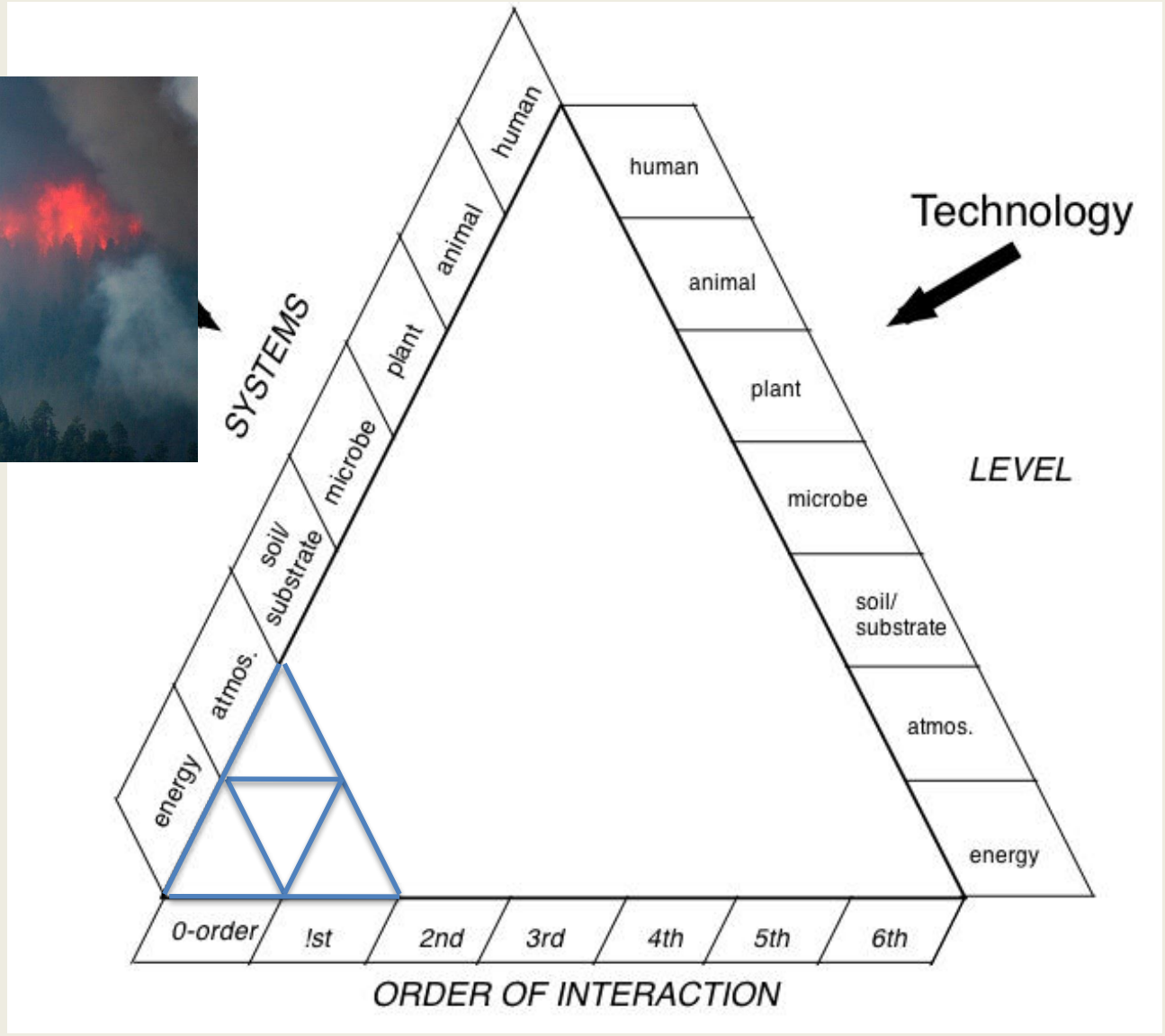
2. Our results suggest carbon sequestration under elevated CO2 is being overestimated by modellers who do not consider O3 in areas with periodic episodic O3.

3. Elevated CO2 delays normal autumn leaf senescence, predisposing some aspen genotypes to winter dieback.

4. Our preliminary results indicate that aspen and birch insects and diseases may increase under elevated CO2 and O3.

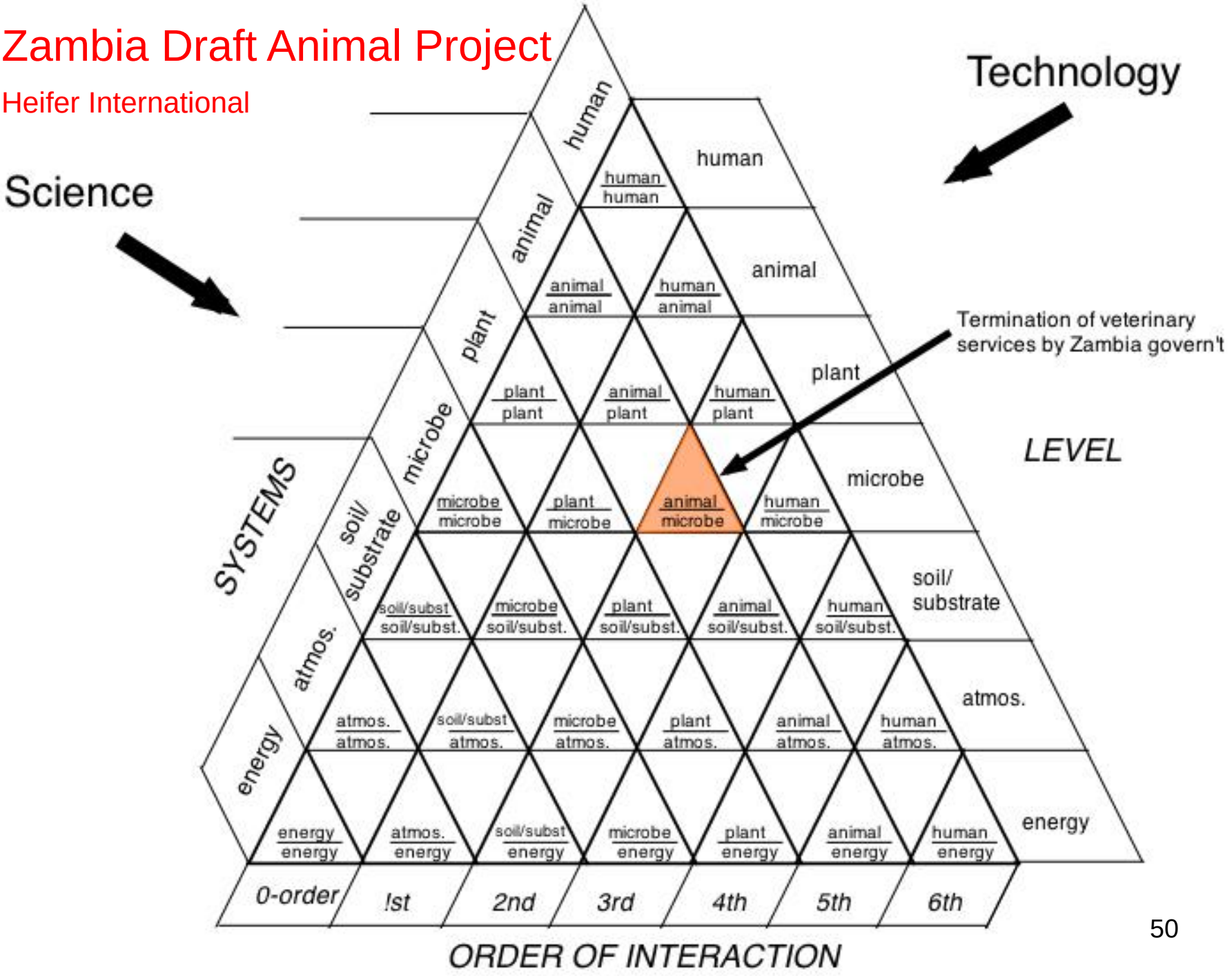
Source: FACE website

Haines fire index



Zambia Draft Animal Project

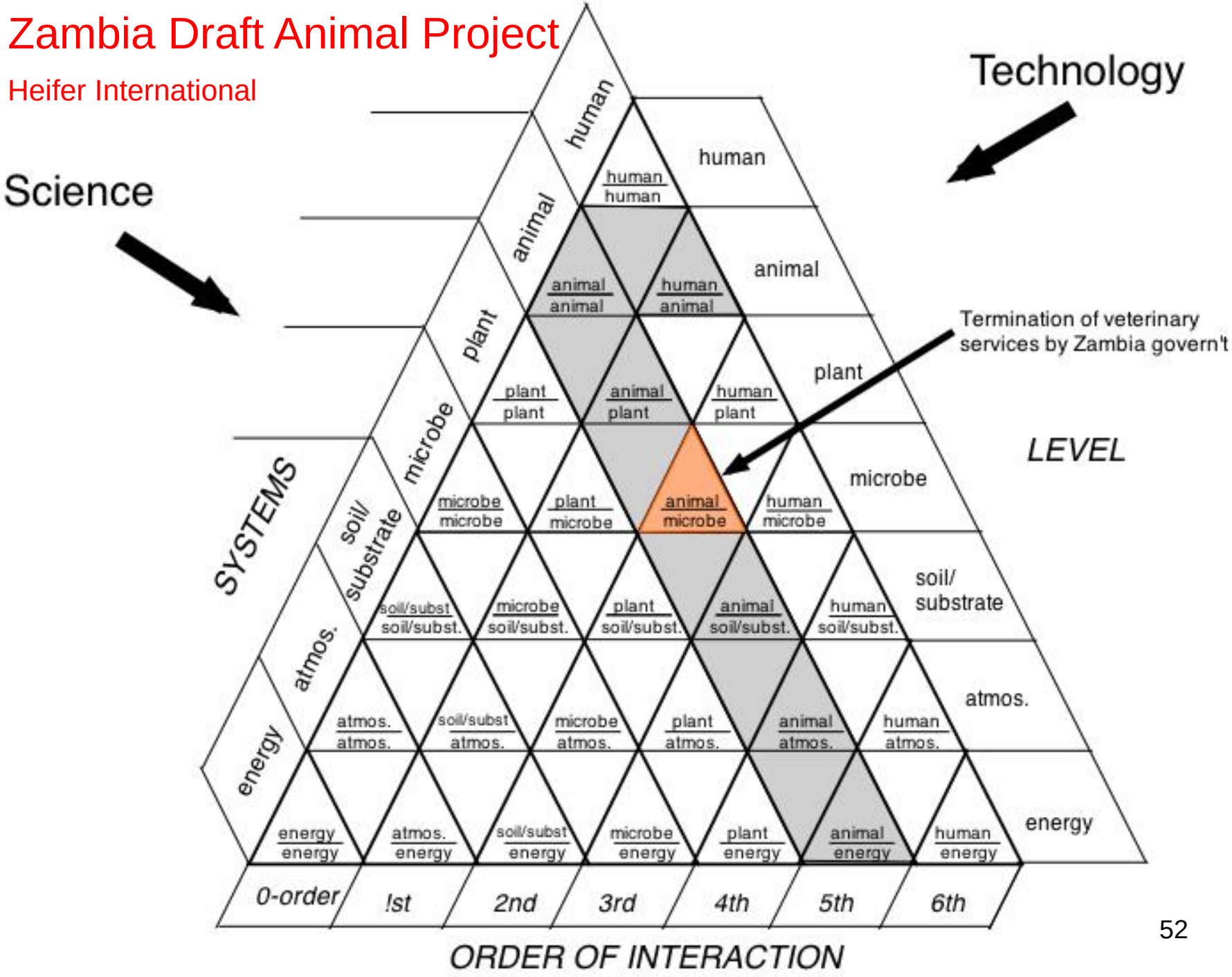
Heifer International



“Worku Tegegne pets his cow in Ghibe Valley, southwest of Addis Ababa, Ethiopia, which is suffering from bovine trypanosomiasis, transmitted by tsetse flies.”
Marthe Van Der Wolf
Voice of America
November 14, 2012

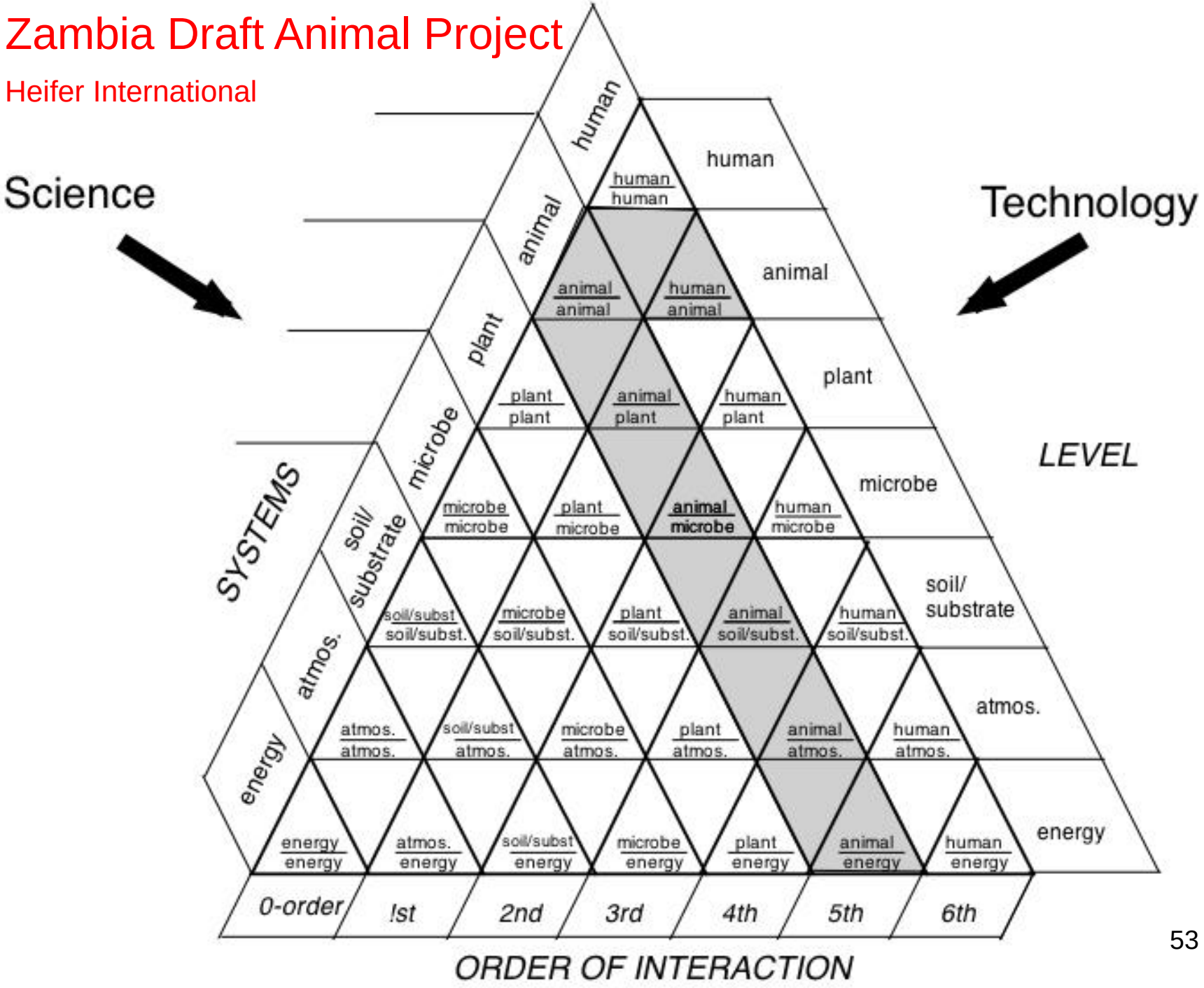
Zambia Draft Animal Project

Heifer International



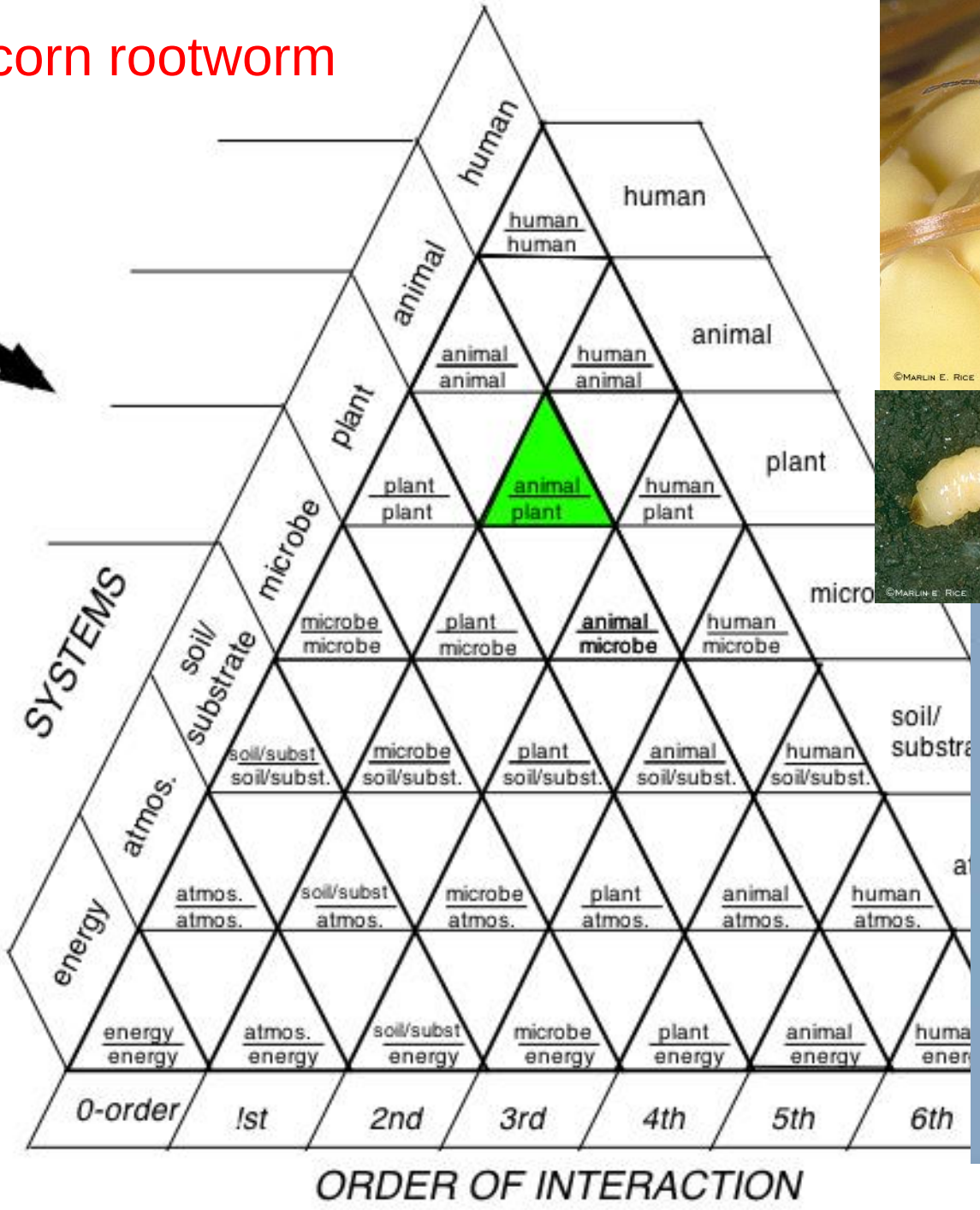
Zambia Draft Animal Project

Heifer International

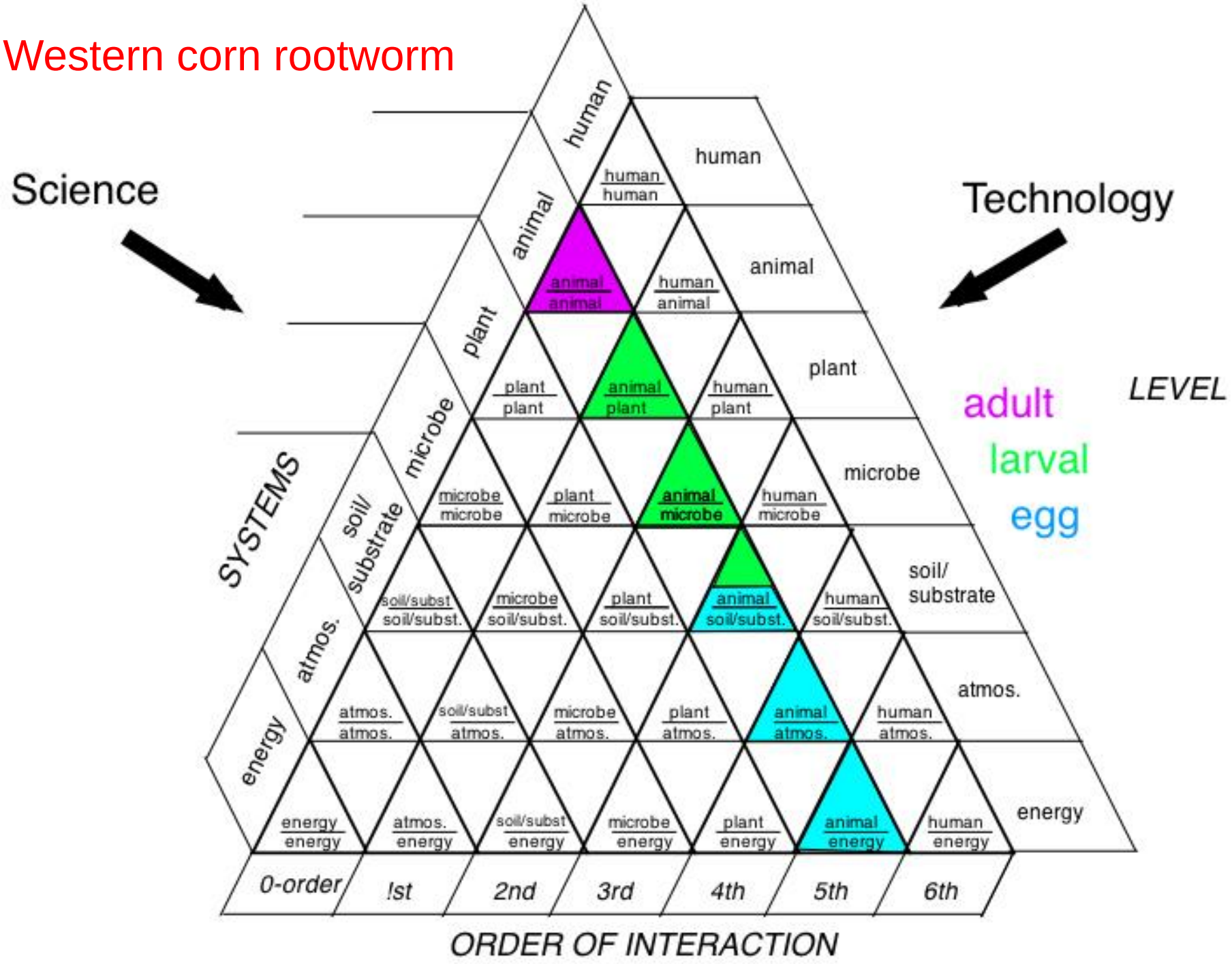


Western corn rootworm

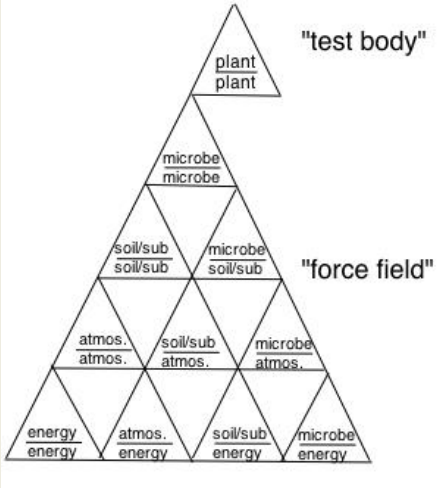
Science

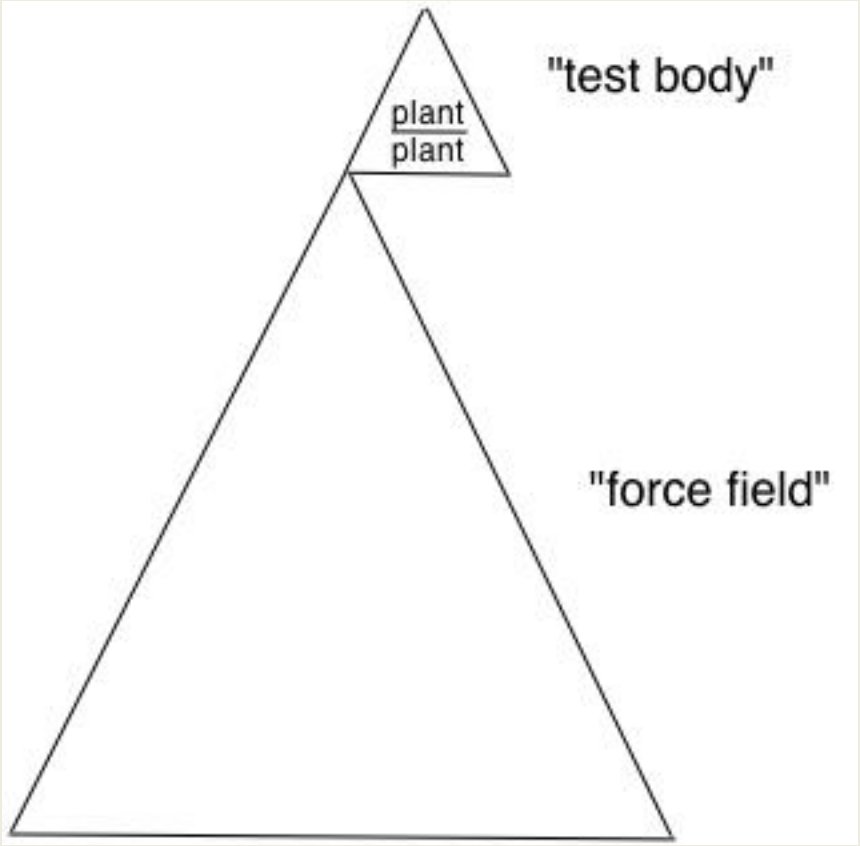


Western corn rootworm



Borrow a concept from physics, and have plant as "test body" in a "force field".





Ecological classification schemes use this strategy – look to the vegetation to understand the physical system.

Examples are:
-- habitat types
-- synecologcal coordinates

Facts:

1. research resources are limited.
2. can't measure / assess every triangle state.
3. must group triangles or perhaps completely ignore some.

Questions:

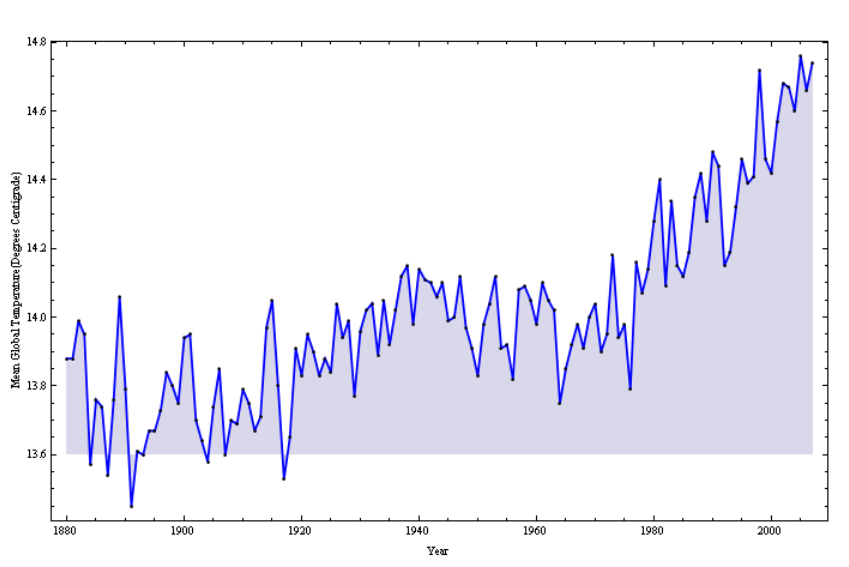
1) Which triangles to ignore?

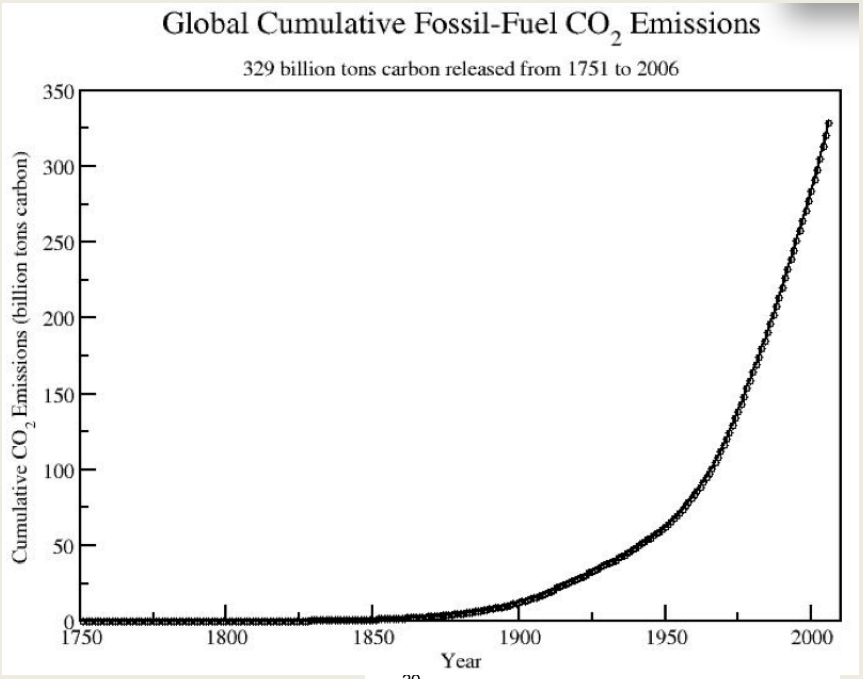
2) Which triangles to group?

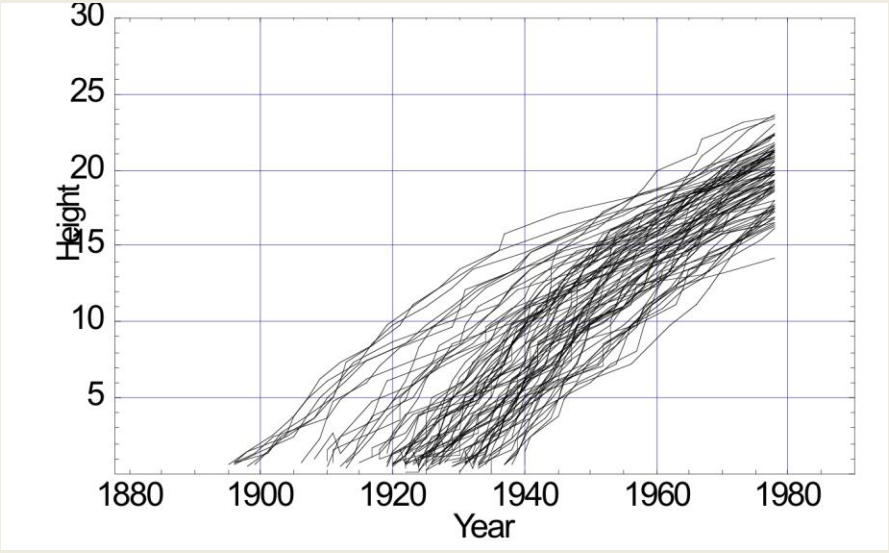
3) How best to group?

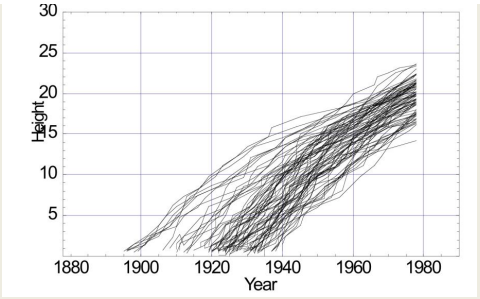
There can be dangers in over-grouping in an era of global environmental change.

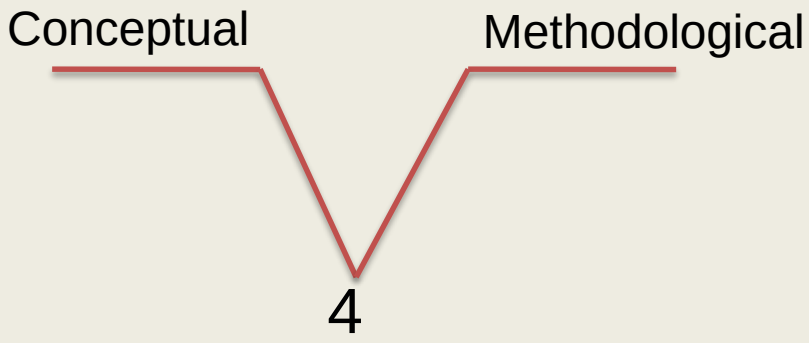
Global temperature trends: 1880-2006











4. "Problem statement (what are the knowns and the unknowns?)" Expressed in words, not equations!!

What might we know?

a) Where …,

b) When …,

What might we **not** know?

a) Where …,

b) When …,

c) What is the character of..,

d) What if …,

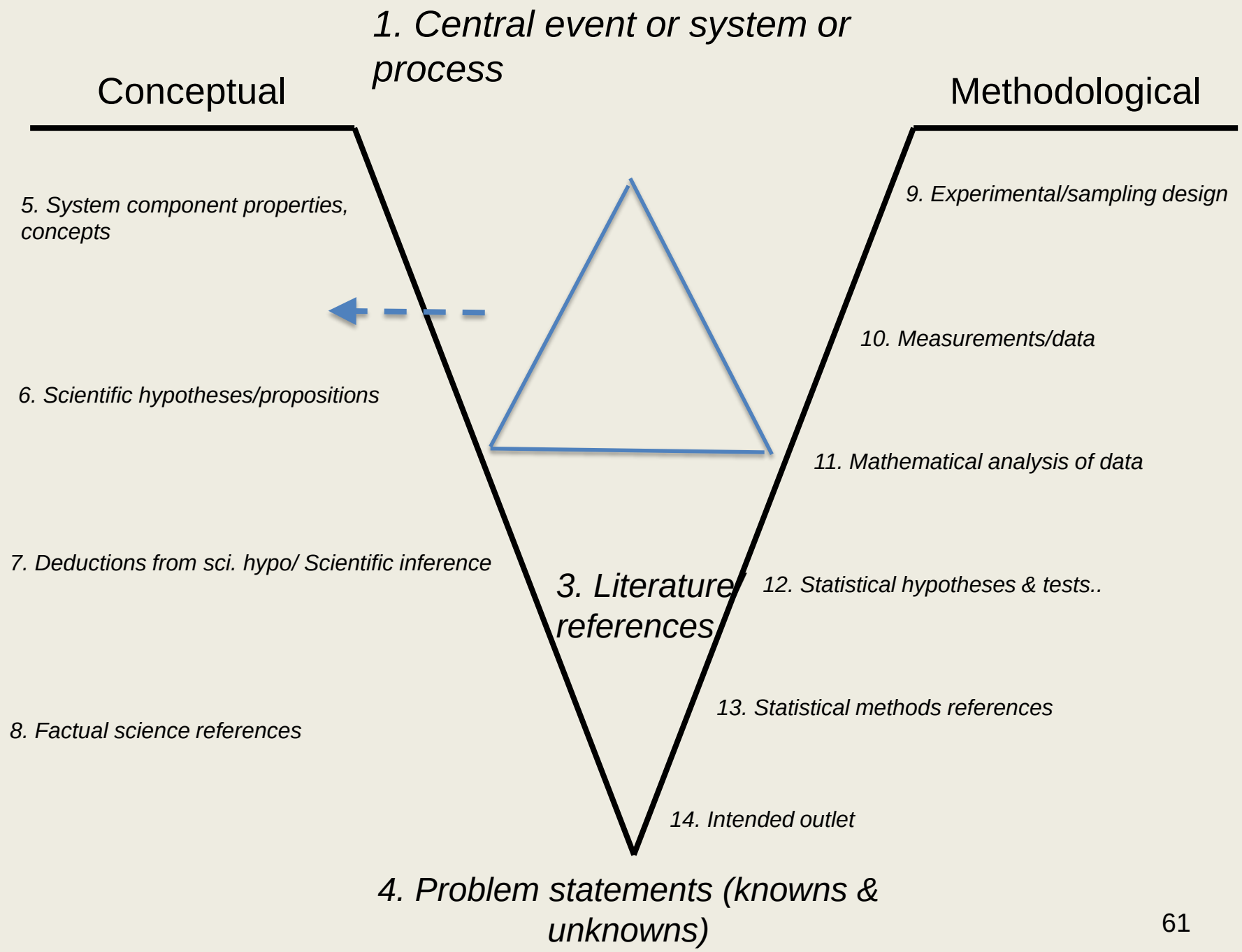
e) Why …,

f) How to …,

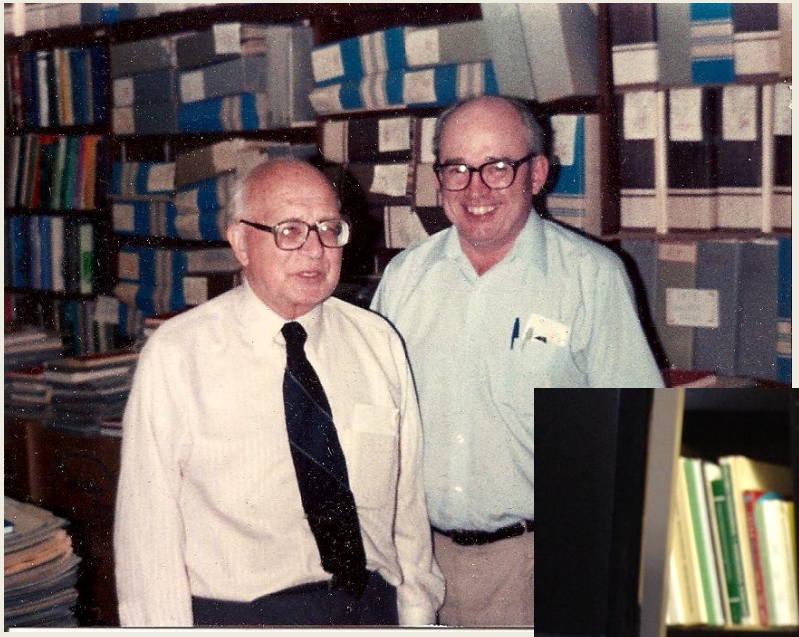
Takeaways (Aware, Understand, Appreciate):

S/he with the 'superior' ontological perspective [o.p.] will 'win' – sooner or later –

1. Aw.. that ontological perspectives exist
2. Un.. some of range available
3. Un.. where yours fits in
4. Ap.. strengths and weaknesses of each
5. Un.. o.p. aren't directly testable like propositions

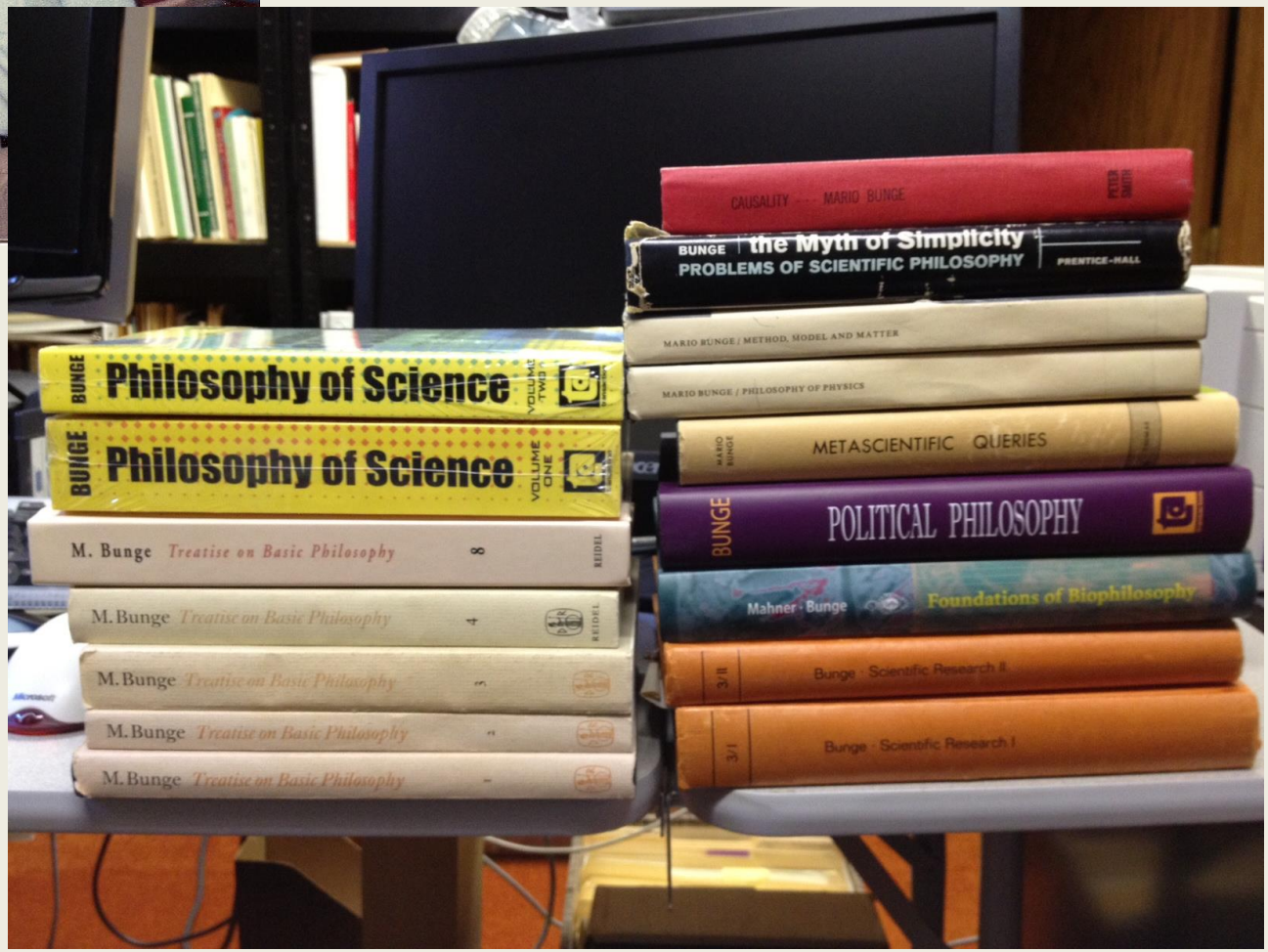

1. Central event or system or process
Conceptual
Methodological
5. System component properties, concepts
9. Experimental/sampling design
10. Measurements/data
6. Scientific hypotheses/propositions
11. Mathematical analysis of data
7. Deductions from sci. hypo/ Scientific inference
3. Literature references
12. Statistical hypotheses & tests..
13. Statistical methods references
8. Factual science references
14. Intended outlet
4. Problem statements (knowns & unknowns)

Thank You



Acknowledgements:

E. V. Bakuzis
U. Minnesota




W.E. Miller
Don Haines
Richard Dickson
Mario Bunge

Fellow employee retirement gift:

I act in accord with what I value. To do otherwise would be irrational.

I value only things I think exist. To do otherwise would be delusional.

What exists I organize using principles from ontology.

Therefore I act out my ontological perspective.