Finding your way in a complex world

Systems thinking as a central skill in sustainability and health education

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SYSDENE Research Team

- Research Cooperation between Swiss and German Universities of Teacher Education
- SYSDENE = systems thinking for sustainable development
- Starting points:
  - Studies by Klieme/Meichle (1994) and by Ossimitz (2000)
  - Discussions about competences for a sustainable future and about curricular standards
  - Action research on ST in USA (watersfoundation.org)
- Team Switzerland:
  PHSG : Ursula Frischknecht-Tobler, Patrick Kunz
  PHZH: Ueli Nagel, Brigitte Bollmann, ZHAW: Sandra Wilhelm

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SYSDENE research group

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Goals

- Investigating the premises, the promises and the possibilities to support the understanding of the nature of complex systems in grades 1-9 within the existing curricula
- Development of a coherent teaching approach for systems thinking
- Development of appropriate teaching materials

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«Walkshop»

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What is Systems Thinking (ST)?

in the German speaking areas often used as a synonym for...

- vernetztes Denken = „linking-thinking“
- ganzheitliches Denken = holistic thinking
- kybernetisches Denken = cybernetic thinking
- komplexes Problemlösen = complex problem solving

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Definition by SYSDENE :

Systems thinking is the capacity to

- ***describe , reconstruct and model complex fields of reality as systems***
- ***explain these systems model-based***
- ***prognosticate/forecast future developments considering the predictive probability and the systems boundary***
- ***conceptualize and assess possible systemic action plans***

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«Circles in the Air»

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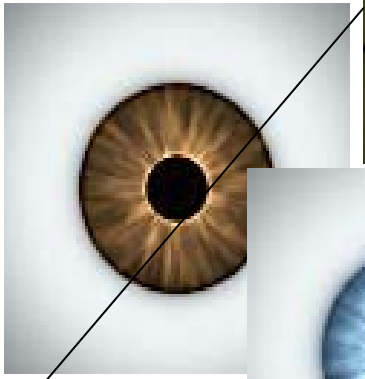
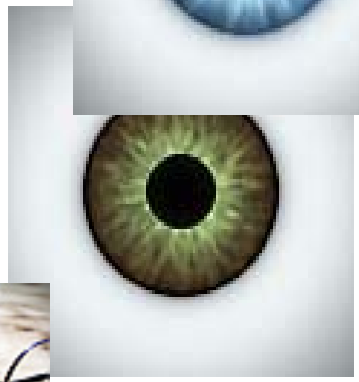
Change of Perspective or seeing the world with different eyes

What, if…..?





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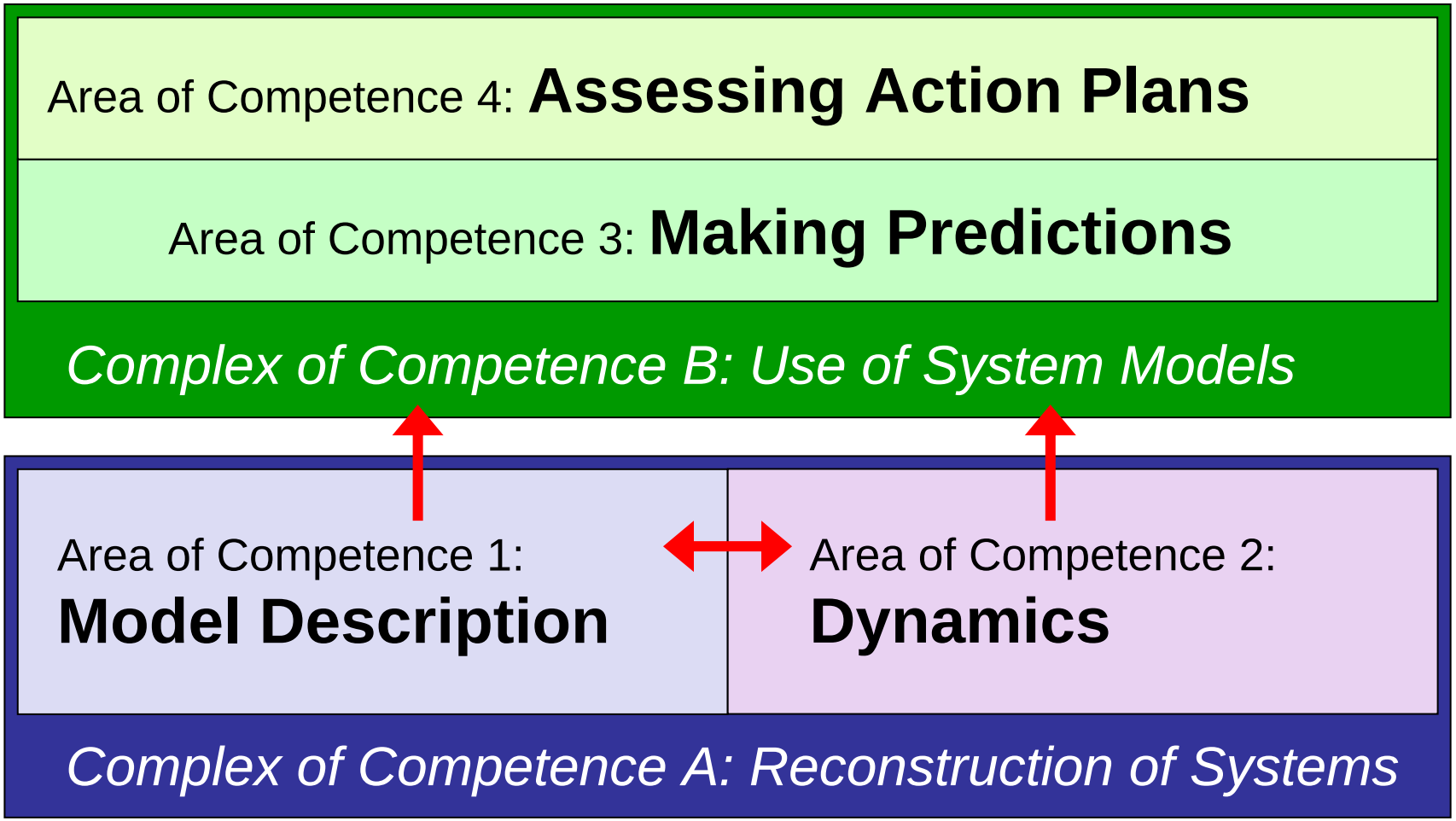
The SYSDENE Model of Competences

(Frischknecht, Nagel & Seybold 2008)



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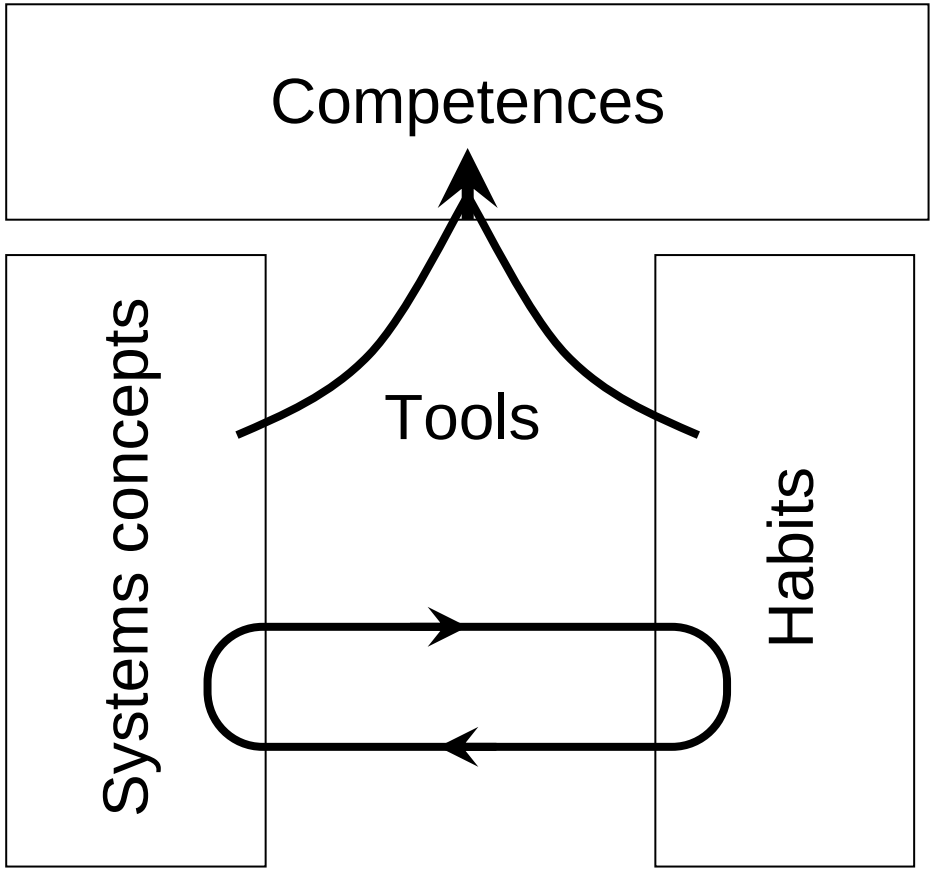
Components of Systems Thinking



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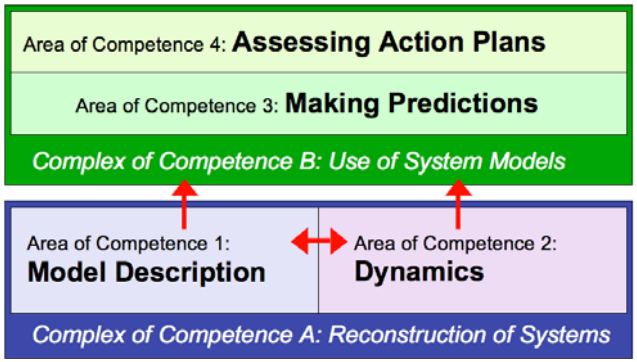
Competences



1. Can systems competences be fostered and taught?
2. What is needed to acquire these competences?

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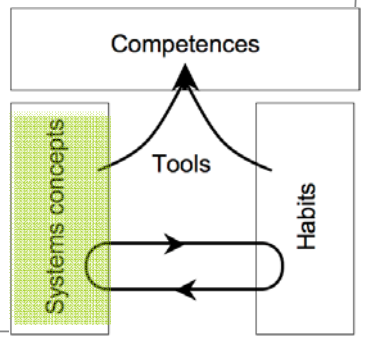
Systems Concepts

- Organisation of the system (parts, boundaries, interdependence)
- Feedback mechanisms
- Non-linear relationships
- Dynamics (change over time, delays..)
- System archetypes



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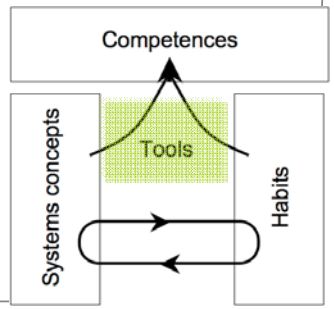
Tools

- Connection Circles (qualitative)
- Functional Diagrams (qualitative)
- Behavior-Over-Time Graphs = BOTGs (semiquantitative)
- Stock-and-Flow-Diagrams (quantitative)
- Systems dynamics (Computer modelling; quantitative)



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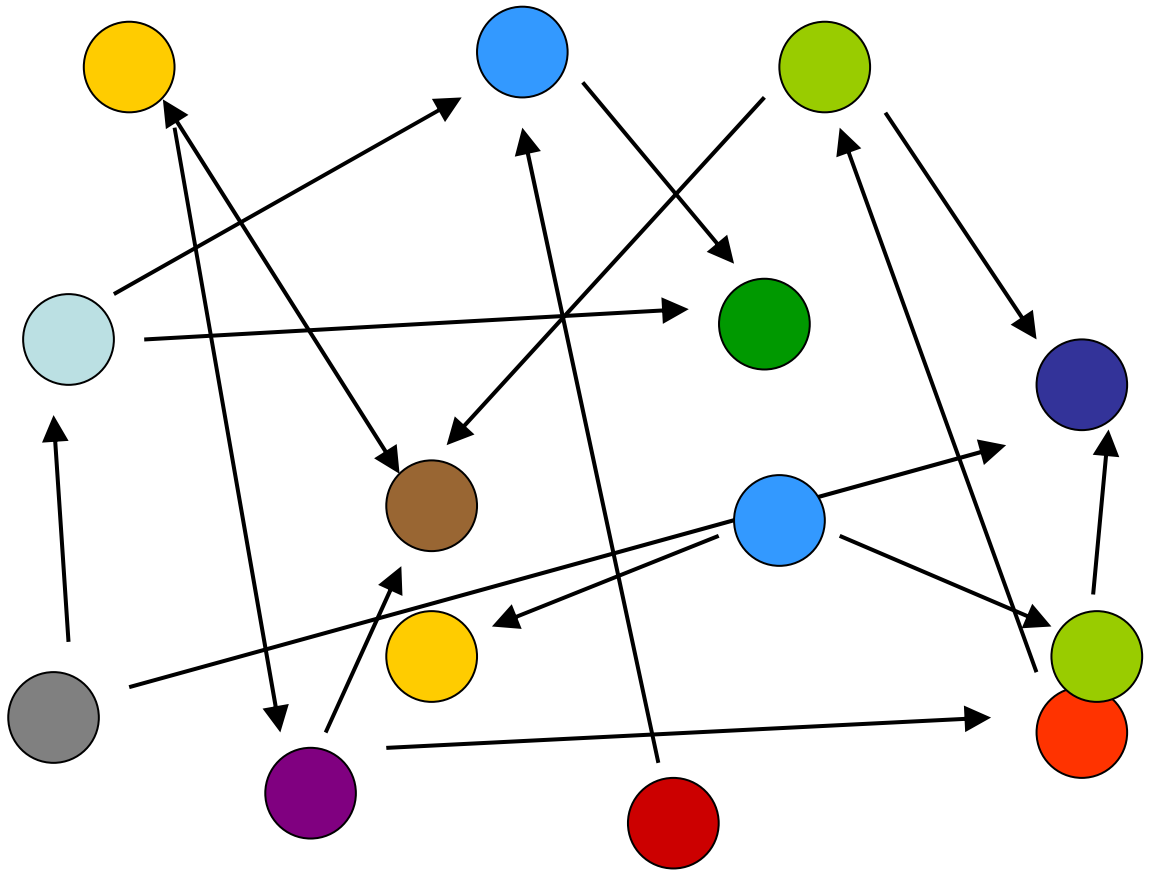
Triangle Game («Mittendrin»)



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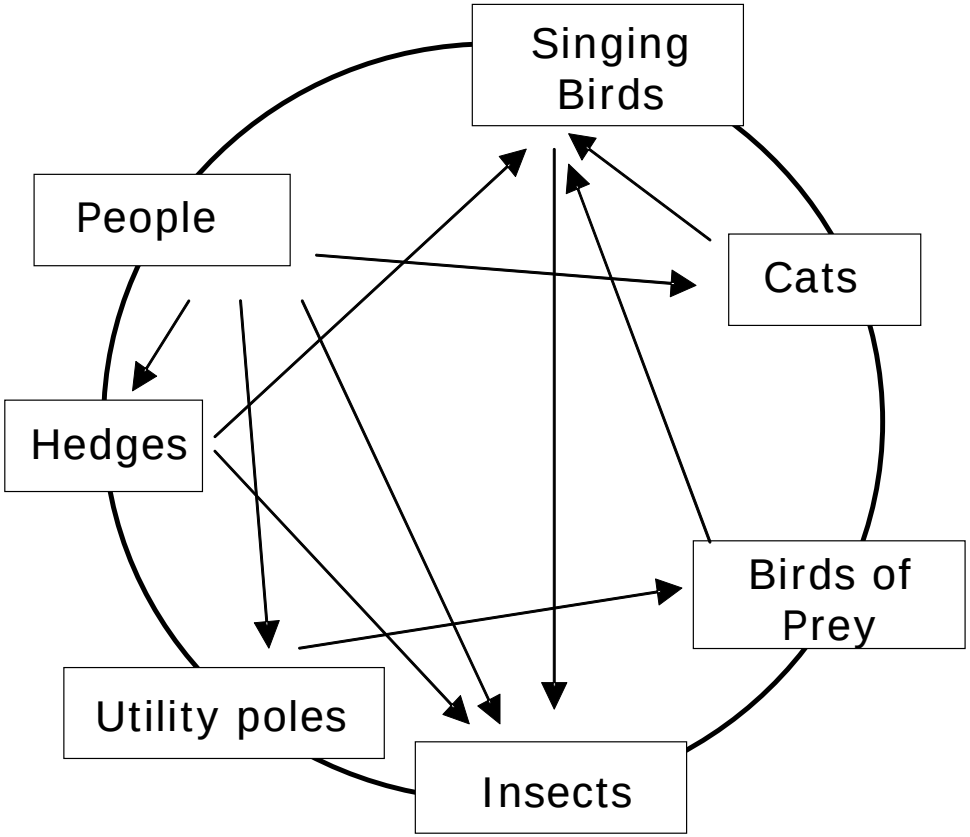
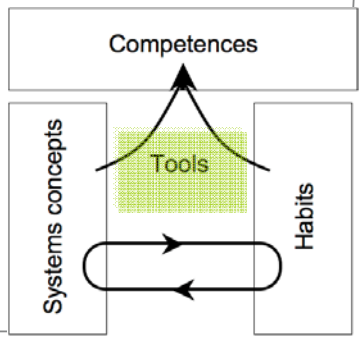
Tools

- Connection circle (qualitative)





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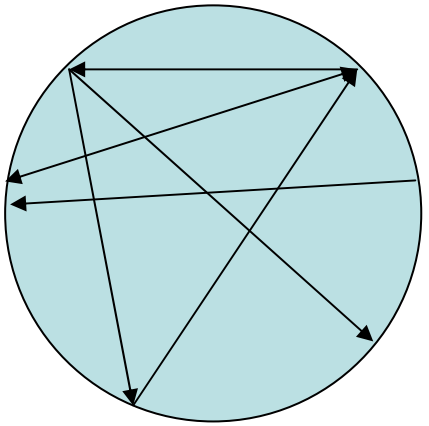
How to work with the Connection Circle

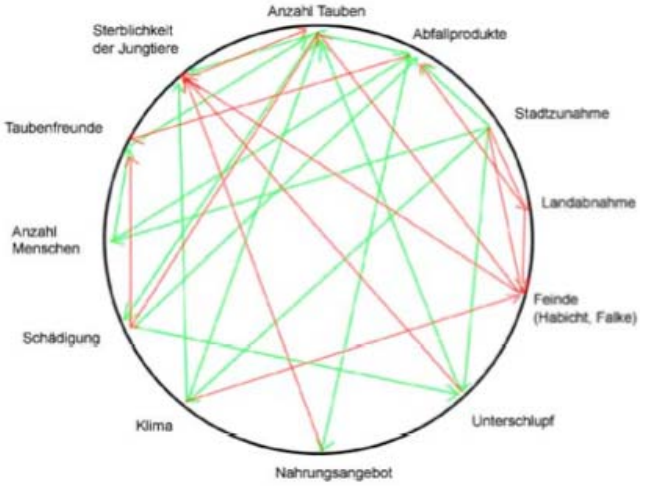
Connection Circles are thinking tools that we draw according to a situation, a story, a problem. With this we can understand the functionning of a system. (after Quaden and Tichotsky, 2004)



Rules:

Regeln zum Vernetzungskreis:

1. Nimm Elemente aus der Geschichte (Systemelemente), die **alle** drei der folgenden Kriterien erfüllen
    - Sie sind wichtig für die Veränderungen in der Geschichte
    - Es sind Nomen oder Nomensätze
    - Sie werden in der Geschichte grösser oder kleiner / mehr oder weniger / nehmen zu oder ab
2. Schreibe diese Elemente um den Kreis herum auf. Nimm nicht mehr als 5-10
3. Finde die Elemente auf dem Kreis, die bewirken, dass ein anderes Element grösser oder kleiner wird / mehr oder weniger wird / zu- oder abnimmt
    - Zeichne einen Pfeil von der Ursache zur Wirkung
    - Die Verbindung zwischen den beiden Elementen muss direkt sein
4. Suche nach Rückkopplungsschleifen, bei denen der Pfeil wieder zum Ausgangselement zurückführt.



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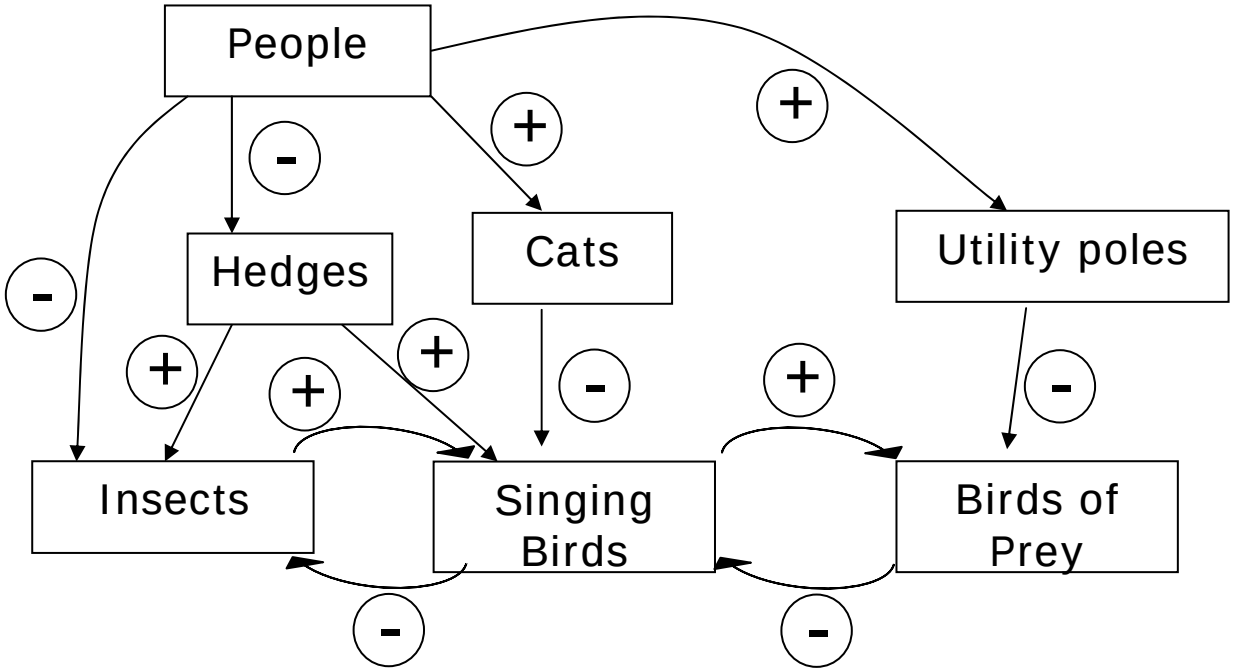
Tools

- Connection circle (qualitative)
- Functional Diagrams and Causal Loops (qualitative)



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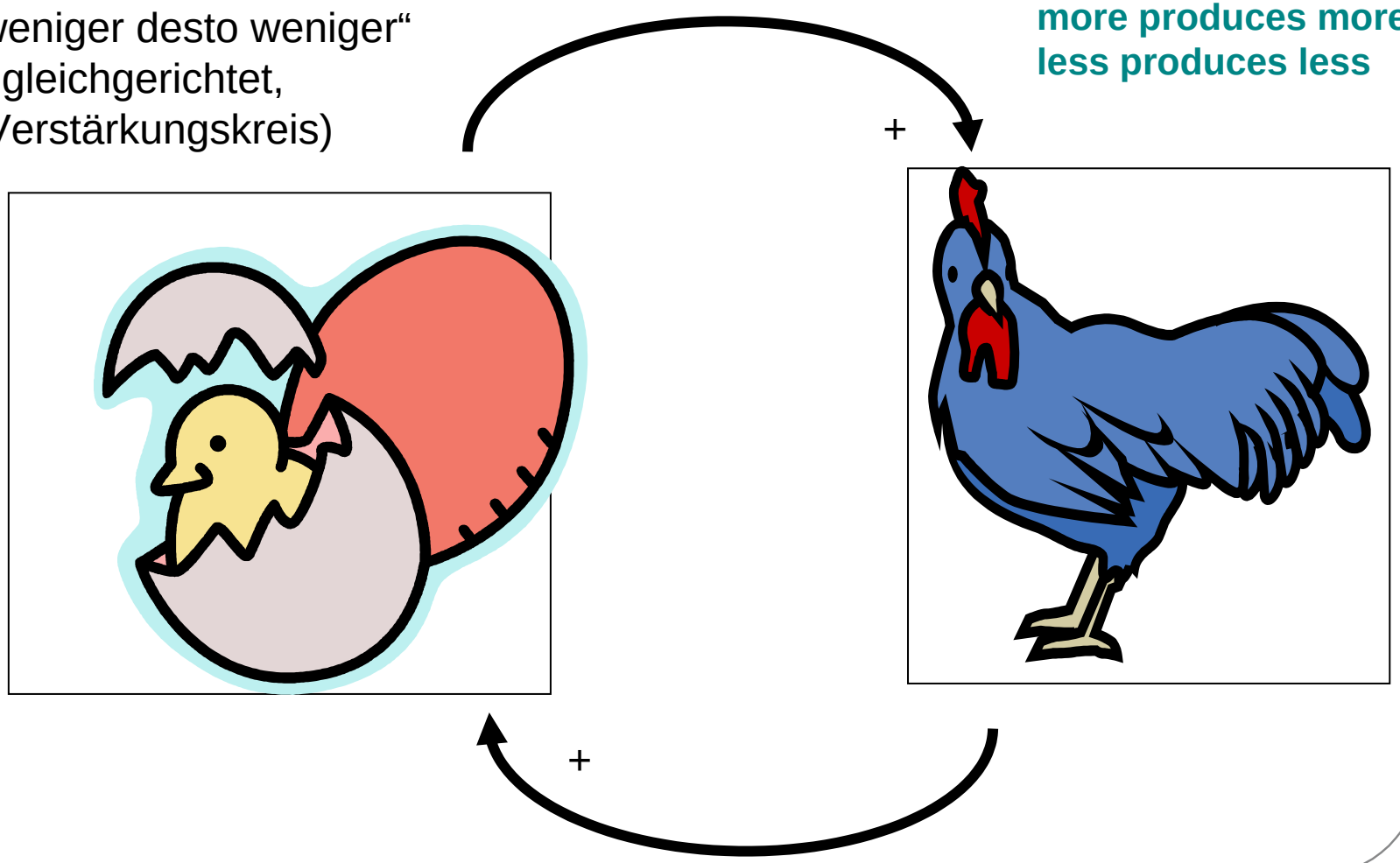
Reinforcing Feedback

„Je mehr desto mehr“ oder
„Je weniger desto weniger“
(G = gleichgerichtet,
V = Verstärkungskreis)

more produces more
less produces less



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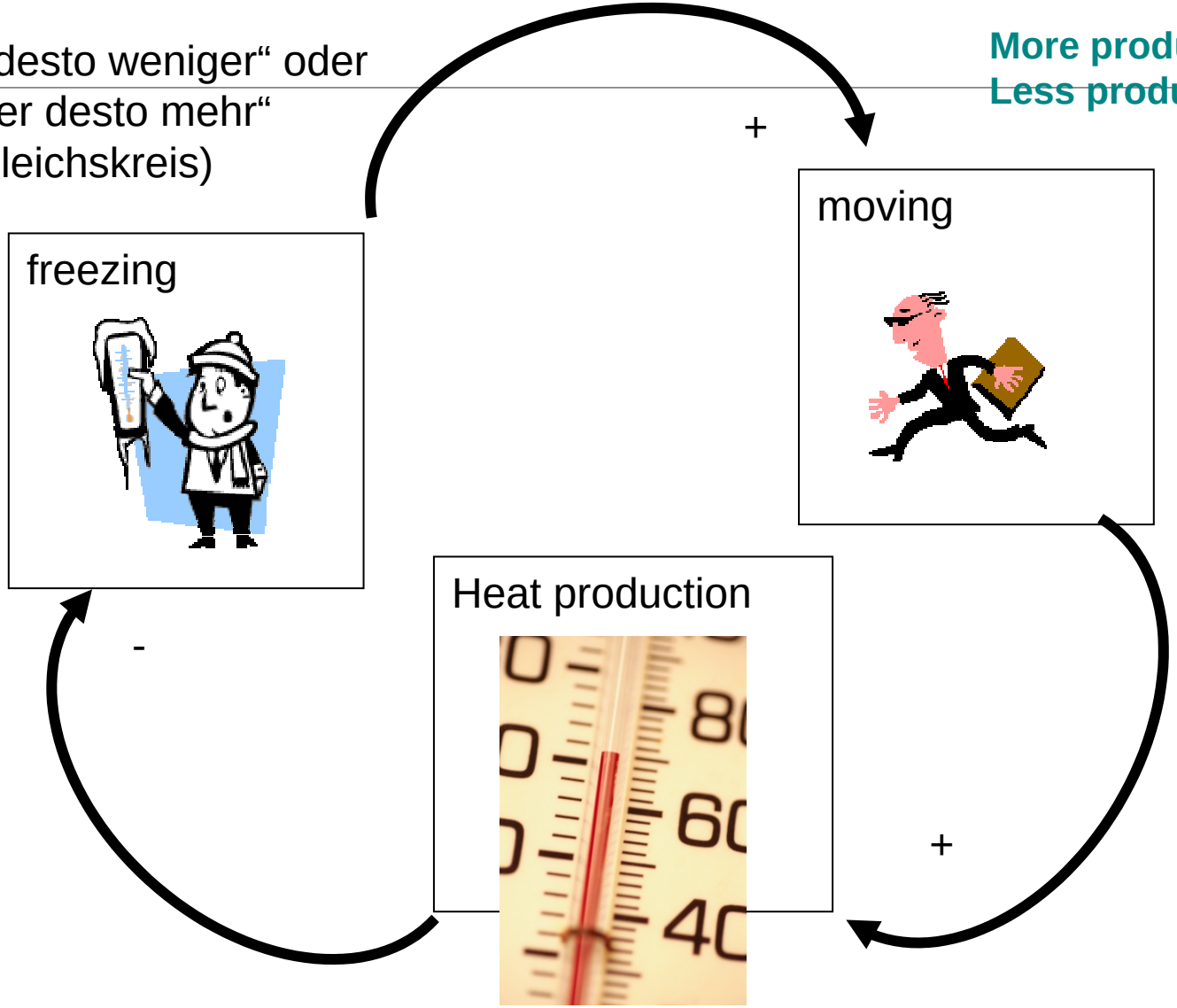
Balancing Feedback

„Je mehr desto weniger“ oder
„Je weniger desto mehr“
(A = Ausgleichskreis)

More produces less
Less produces more



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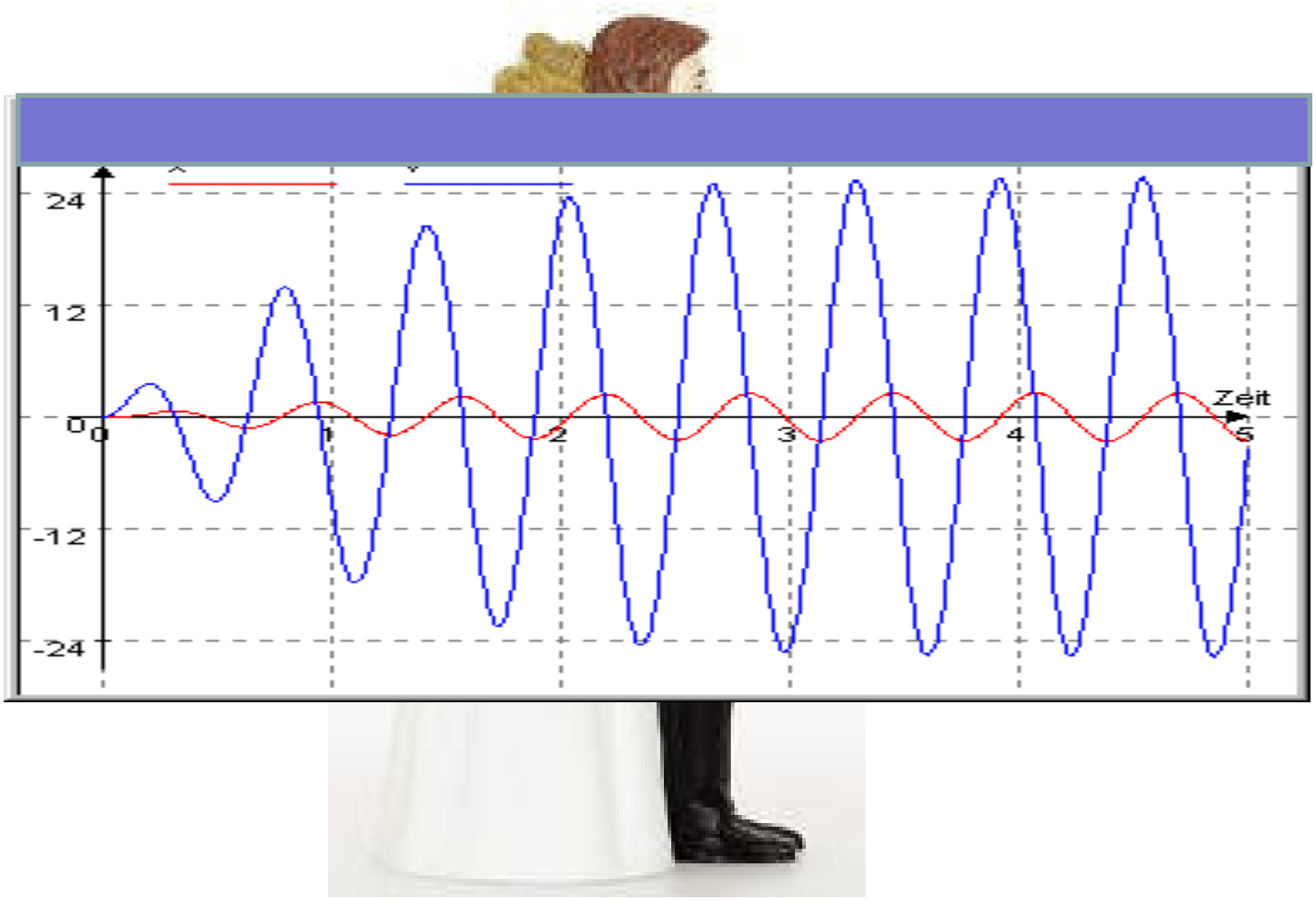
«Back to Back»: feedback live



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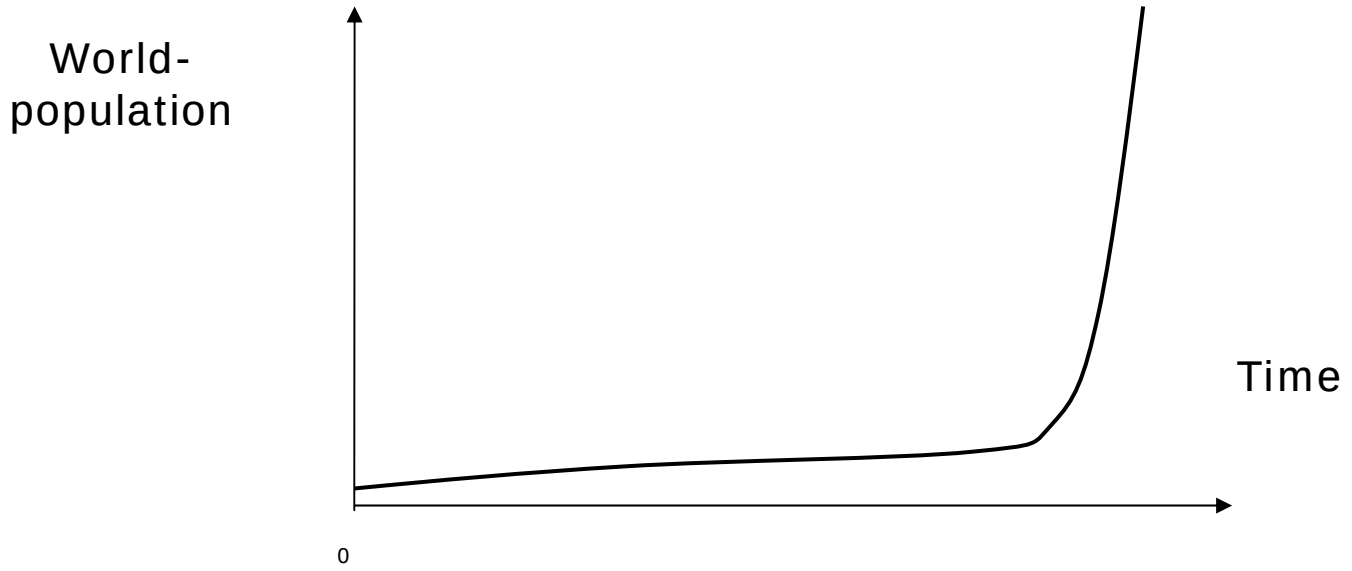
Tools

- Connection Circle (qualitative)
- Functional Diagrams / Causal Loops (qualitative)
- Behavior-Over-Time Graphs = BOTGs ((semi-)quantitative)



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Tools

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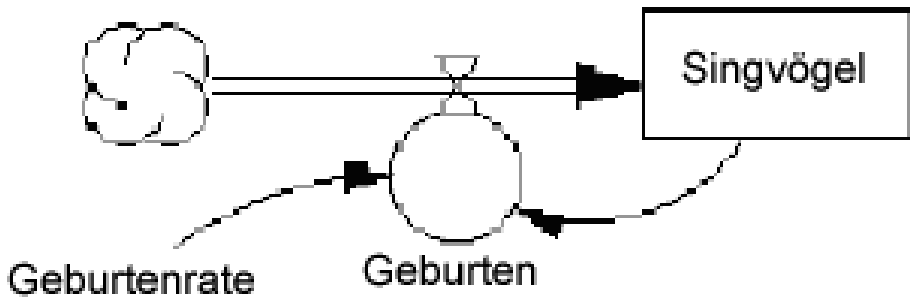
- Functional Diagrams (qualitative)
- Behavior-Over-Time Graphs = BOTGs, seimquantitative)
- Stock-and Flow-Diagrams (quantitative)



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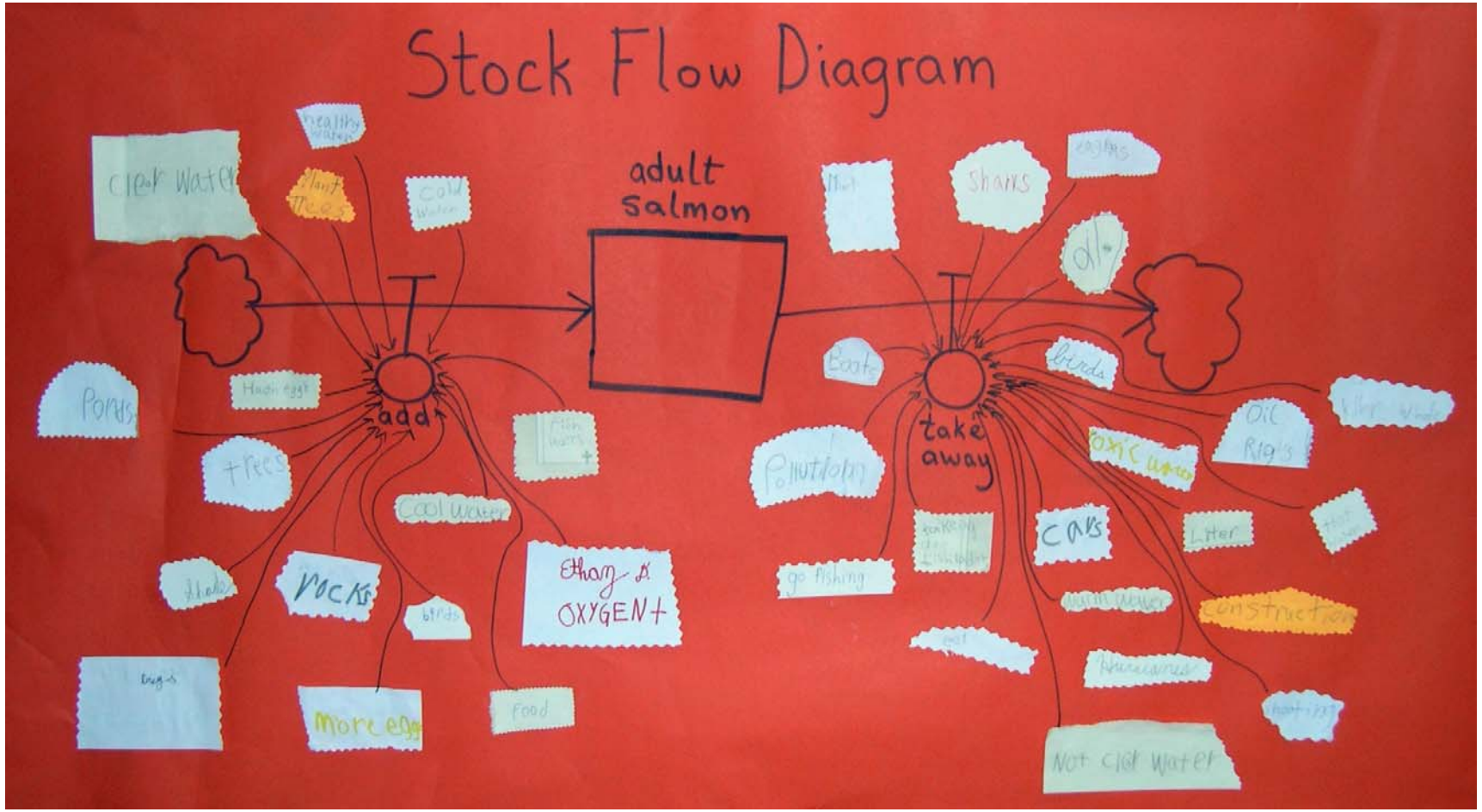
Example from a grade 2 class (Portland)



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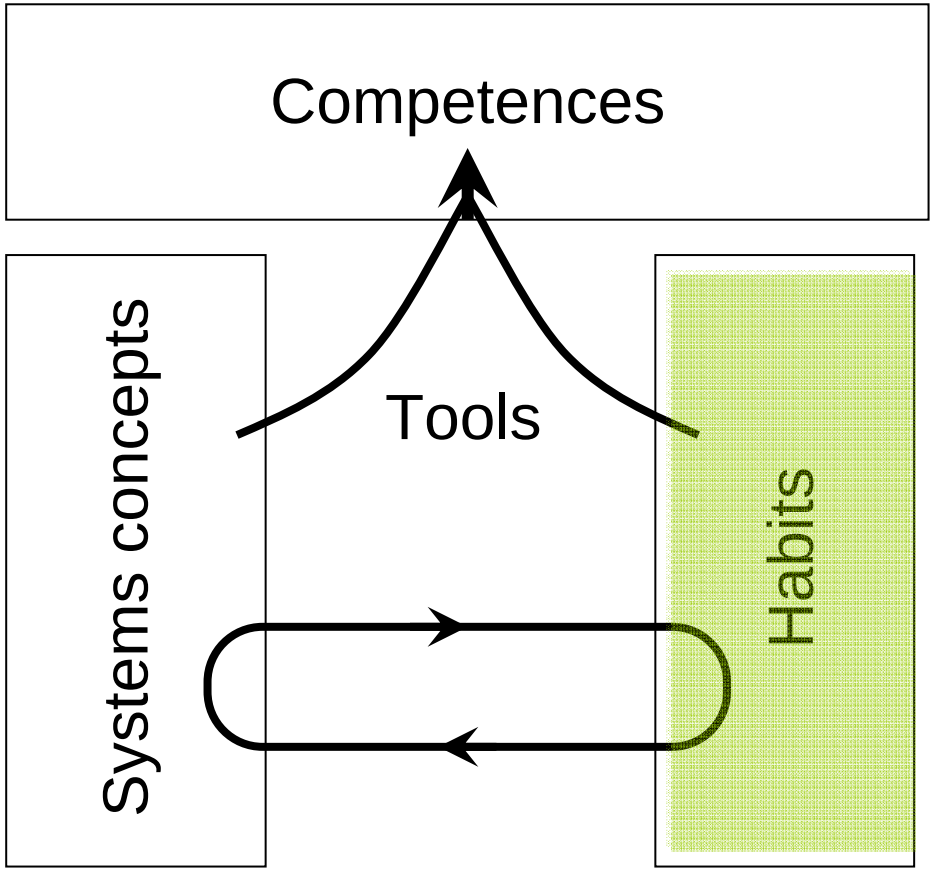
Components of Systems Thinking



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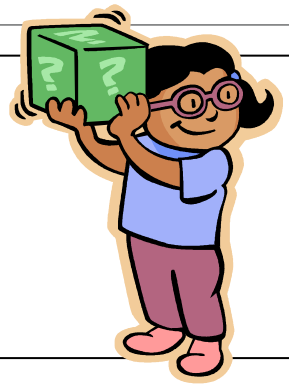
Habits of a Systems Thinker

(adapted from www. watersfoundation.com)

Ich betrachte die Dinge von verschiedenen Seiten.



I look at the system from different angles. Change of perspective

I observe how elements within systems change over time

Ich finde heraus, wie Dinge und Beziehungen sich mit der Zeit ändern.

Ich denke nach über Wirkungen, die kurz und solche, die länger andauern.

I consider both short and long term consequences of actions

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«Habits» in the Classroom

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Publications

Book 1 («Systemdenken» 2008):

- ✓ State of research on ST
- ✓ SYSDENE competence model
- ✓ Research of the SYSDENE group

Book 2 («Systemdenken fördern» planned for fall 2010):

- ✓ Basic knowledge on ST
- ✓ Classroom materials, ST training, examples for lessons, toolbox

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IMPULSE ZUR UNTERRICHTSENTWICKLUNG
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Systemtraining und Unterrichtsreihen
zum vernetzten Denken 1.–9. Schuljahr
schul verlag plus