Systems Thinking in Climate Education
Jeremy Solin, ThinkWater
March 14, 2017 - CLEAN Network

THINK WATER

4 ways to apply systems thinking

1. Improve our own thinking - DSRP in metacognition
2. Improve education and outreach - structure information using DSRP, MAC for design
3. Develop adaptive organizations - VMCL
4. Improve understanding of complex issues - mapping using DSRP

KEEP
CALM
JUST
LOOK HARDER
DAMMIT

Systems Thinking

Recognizing and applying our thinking and organizations as a complex adaptive systems...

complex

simple

3 things systems thinkers (you) can do

#1 Be Metacognitive

approximation of

mental
model

real
world

provides feedback on
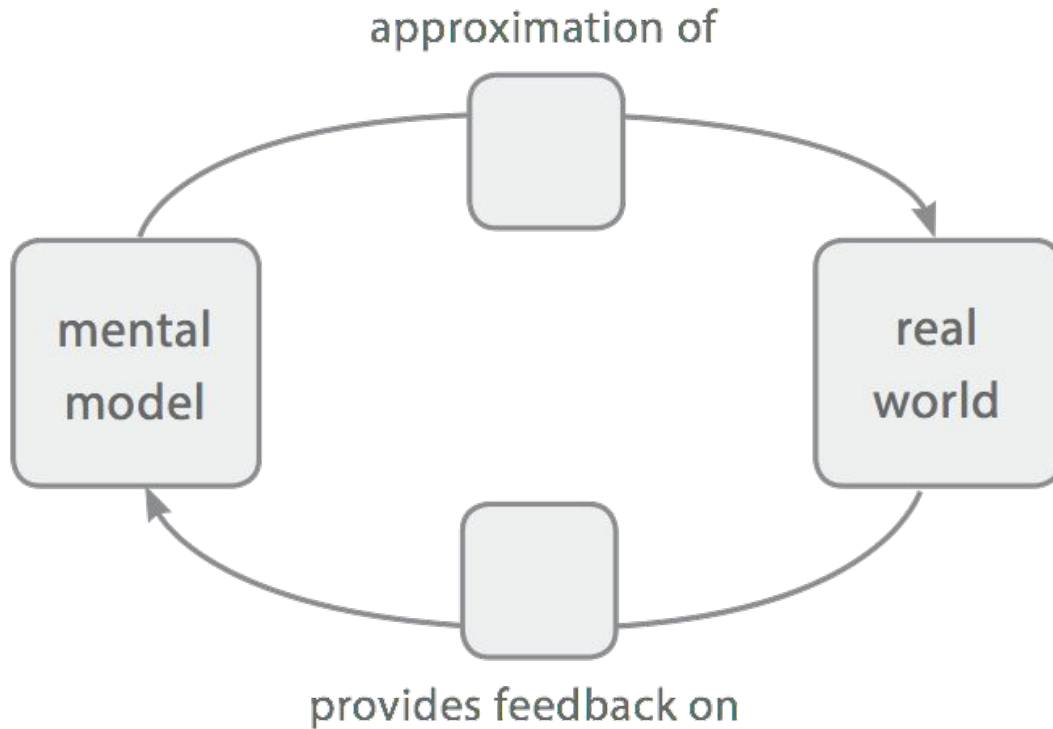
Mental model describes, predicts, and leads to behavior in the real world. Real-world consequences inform adaptation, viability, and competition among models.

WICKED PROBLEMS RESULT FROM THE MISMATCH BETWEEN HOW REAL-WORLD **SYSTEMS** WORK AND HOW WE **THINK** THEY WORK

$$K \neq I$$

$$K = I \cdot T$$

#2 Use the 4 Building Blocks/Rules of Systems Thinking - DSRP

DSRP

simple rules of metacognition/systems thinking

DSRP are the ways information can be STRUCTURED to make meaningful knowledge.

DISTINCTIONS RULE (D): Any idea or thing can be distinguished from the other ideas or things it is with

SYSTEMS RULE (S): Any idea or thing can be split into parts or lumped into a whole

RELATIONSHIP RULE (R): Any idea or thing can relate to other things or ideas

PERSPECTIVES RULE (P): Any thing or idea can be the point or the view of a perspective

Making Distinctions
(identity-other)
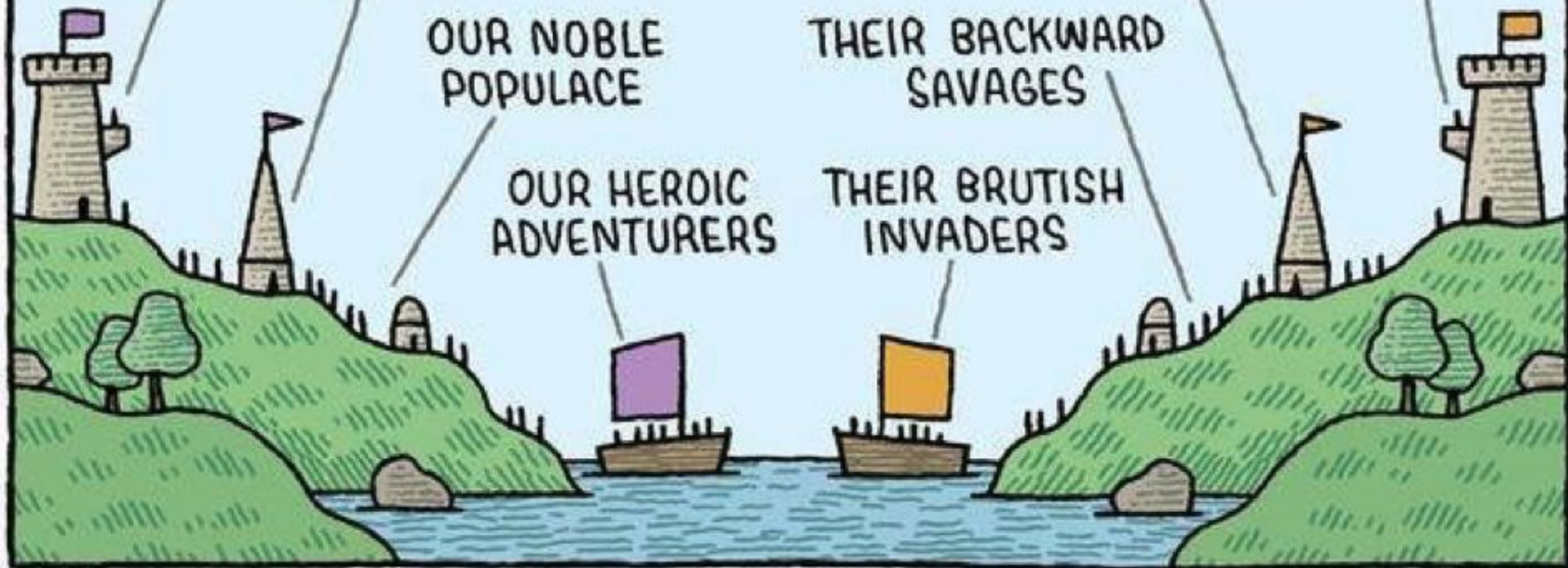
Organizing Systems
(part-whole)
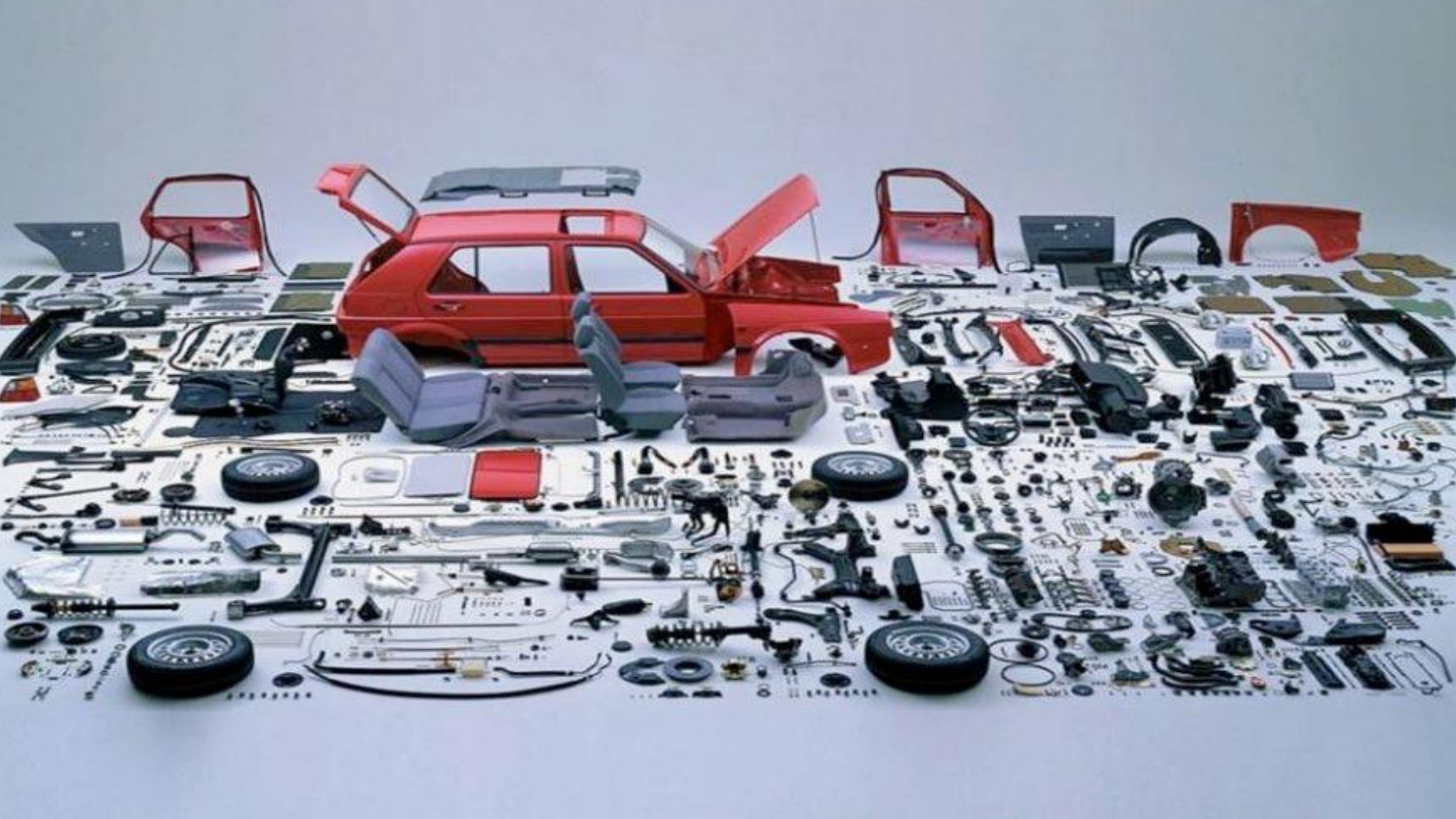
Recognizing Relationships
(action-reaction)
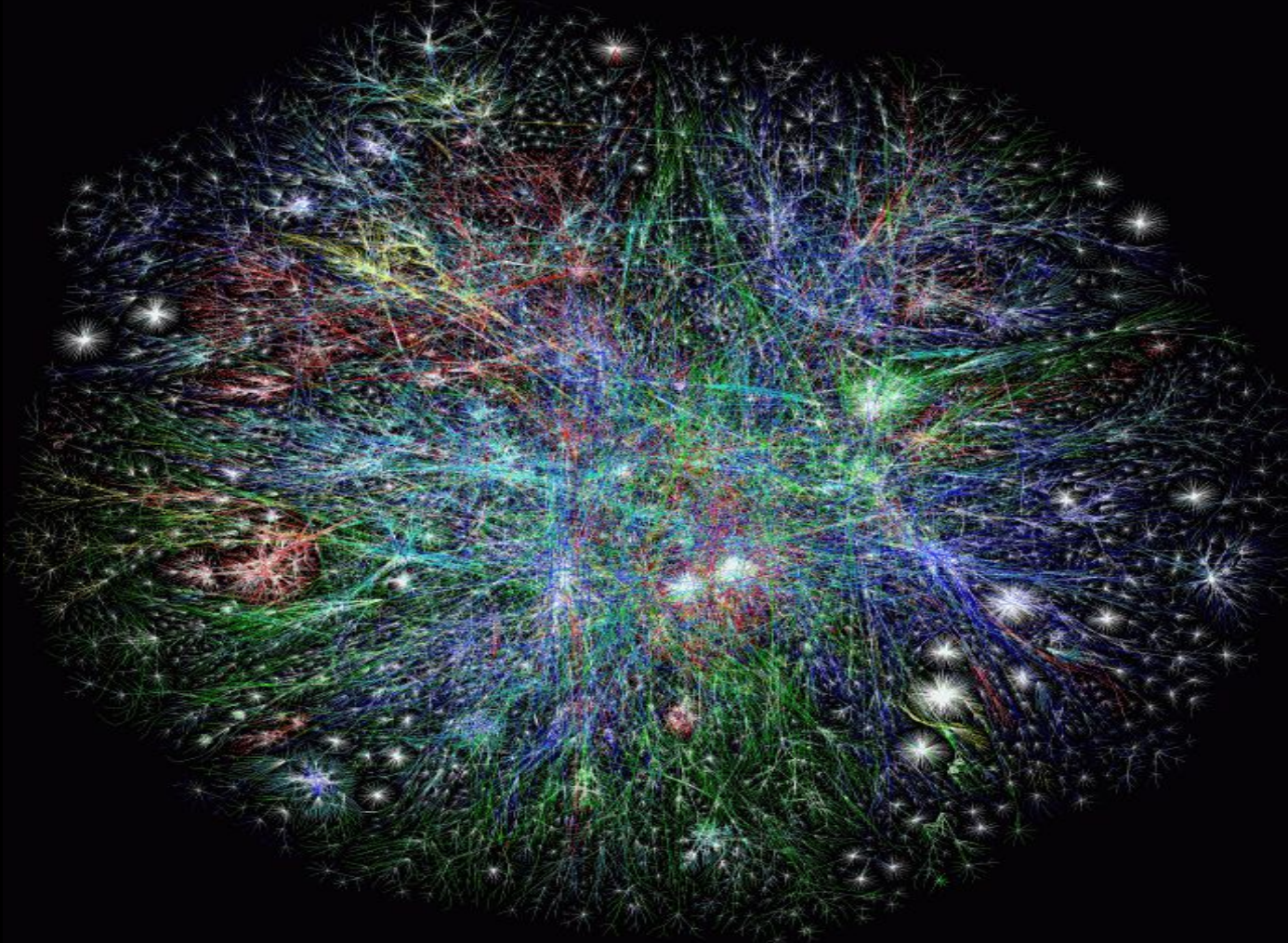
Areology Assyriology Astacology Asteroseismology Astrobiology Astrogeology Astrology Astrometeorology Atmology Audiology
Autecology Auxology Axiology Bacteriology Balneology Barology Batology Bibliology Bioecology Biology Bromatology Brontology
Campanology Cardiology Cariology Cereology Cetology Characterology Chorology Christology Chronology Climatology Codicology
Coleopterology Conchology Coniology Contrology Cosmetology Cosmology Craniology Criminology Cryology Cryptology
Cryptozoology Cynology Cytology Cytomorphology Cytopathology Deltiology Demonology Dendrochronology Dendrology Deontology
Dermatology Dermatopathology Desmology Diabetology Dialectology Dipterology Ecchinology Ecclesiology Eccrinology echinology
Ecogeomorphology Ecohydrology Ecology Economic geology Ecophysiology Edaphology Egyptology Electrophysiology Embryology
Emetology Endocrinology Enigmatology Enology (or Oenology) Entomology Enzymology Epidemiology Epistemology Escapology
Eschatology Ethnology Ethnomusicology Ethology Etiology Etymology Evolutionary biology Evolutionary psychology Exobiology
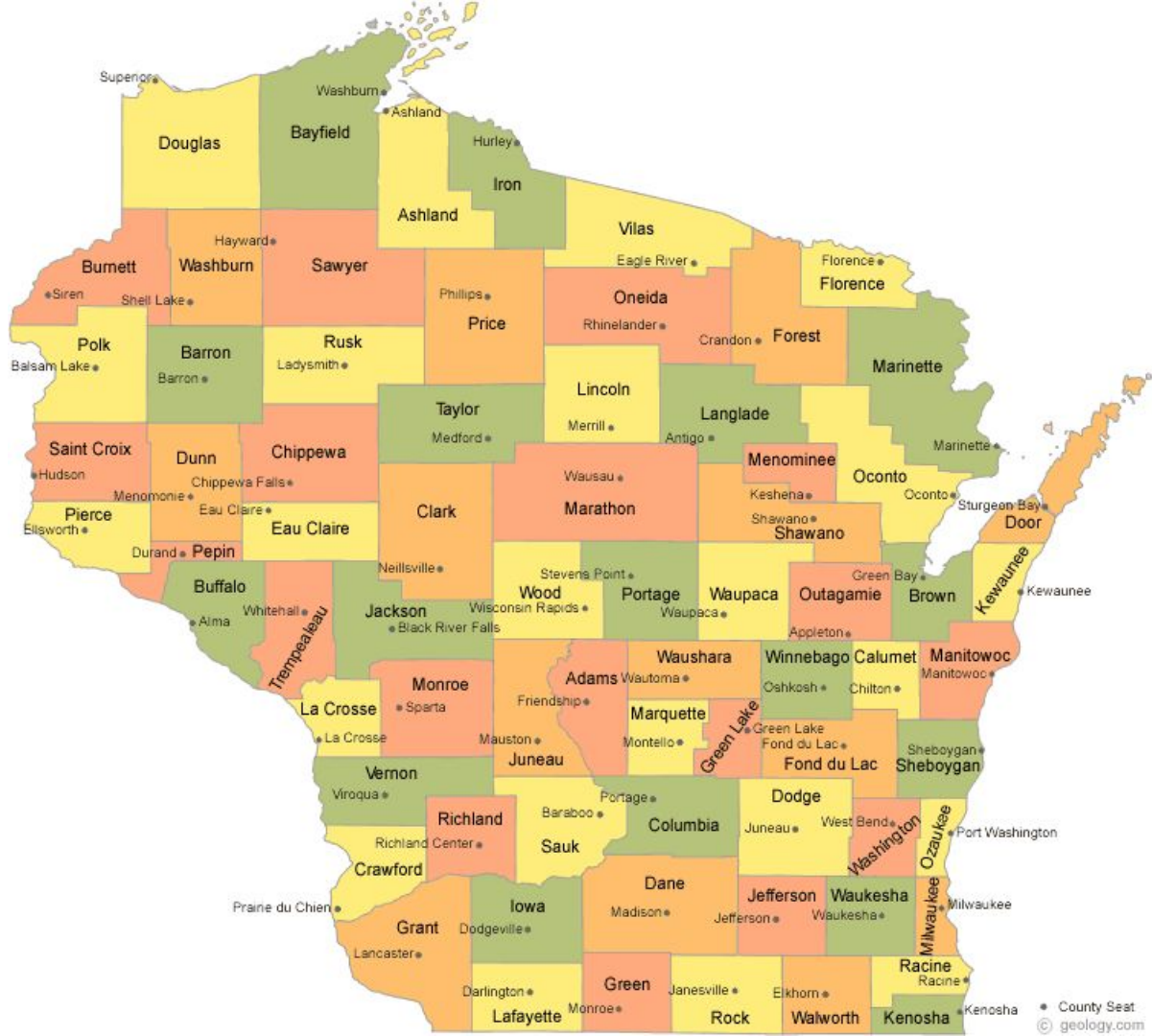Exogeology Felinology Ferroequinology Fetology Formicology Fungology Futurology Garbology Gastrology or Gastroenterology
Gemmology or Gemology Geology Gynecology Geobiology Geochronology Geology Geomorphology Gerontology Glaciology
Grammatology Graphology Grossology (fictional Gyn(a)ecology H(a)ematology Heliology Helioseismology Helminthology Hepatology
Herbology Herpetology Heteroptology Hieroglyphology Hierographology Hierology Hippology Histology Histopathology Historiology
Horology Hydrogeology Hydrology Hypnology Ichnology Ichthyology Ideology Immunology Indology Iranology Islamology
Japanology Karyology Killology Kinesiology Kremlinology Kymatology Laryngology Lepidopterology Lexicology Limnology Litholgy
Ludology Lymphology Malacology Mammalogy Mereology dology Metrology Microbiology Micrology Mineralogy
Missiology Mixology Molinology Morphology Museology Musicology Mycology Myology the scientific study of muscles Myrmecology
Mythology Nanotechnology Nanotribology Nematology Neonatology Nephology Nephrology Neurology Neuropathology
Neurophysiology Nosology Numerology Nutriology Oceanology Odonatology Odontology Oenology Omnology Oncology Oneirology
Onomatology Ontology Oology Ophthalmology Organology Ornithology Orology Orthopterology Osteology Otolaryngology Otology
Otorhinolaryngology Paleoanthropology Paleobiology Paleoclimatology Paleoecology Paleontology Paleophytology Paleozoology
Palynology Parapsychology Parasitology Pathology Pedology Pedology Penology Petrology Pharmacology Phenology
Phenomenology Philology Phlebology Phonology Phrenology Phycology Physiology Phytology Phytopathology Phytosociology
Piphilology Planetology Planktology Pneumology Pomology Posology Primatology Proctology Psephology Psychobiology
Psychology Psychopathology Psychopharmacology Psychophysiology Pulmonology Radiology Redology Reflexology Rheology
Rheumatology Rhinology Ripperology Sarcology Scatology Scientology Sedimentology Seismology Selenology Semiology
Semitology Serology Serpentology Sexology Sindonology Sinology Sitiology Sociobiology Sociology Somatology Somnology
Soteriology Sovietology Speleology Splanchnology Sporalogy Stemmatology Stomatology Sumerology Symbology Symptomatology
Synecology Syphilology Taxology Technology Teleology Teratology Terminology Thanatology Theology Thermology Tibetology
Tocology Tonology Topology Toxicology Traumatology Tribology Trichology Typology Ufology Universology Unology Uranology
Urbanology Urology Uroradiology Vaccinology Velology Venereology Vexillology Victimology Virology Volcanology Xenobiology

BIOLOGY

BIOCHEMISTRY

CHEMISTRY
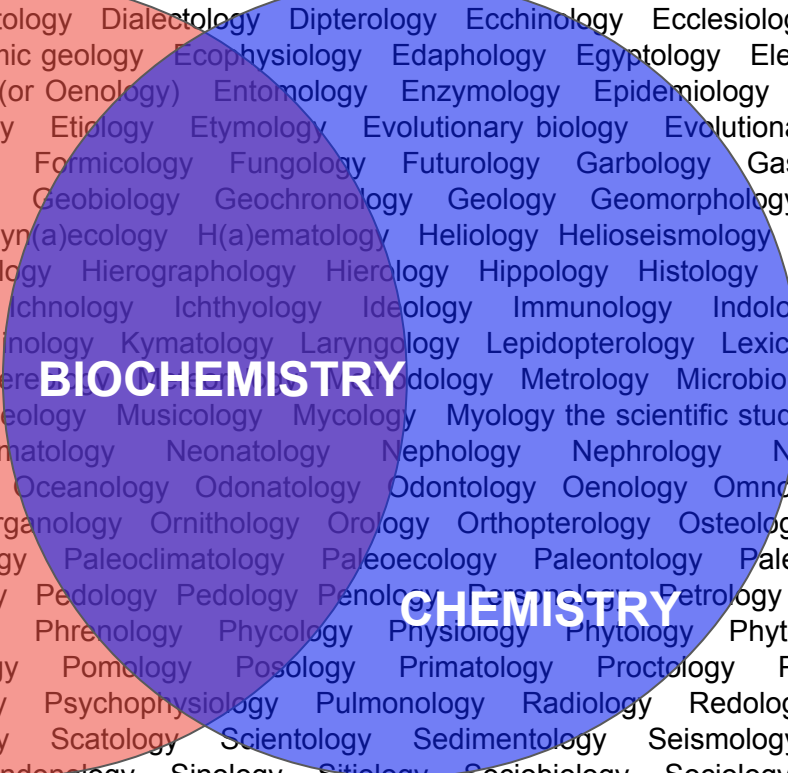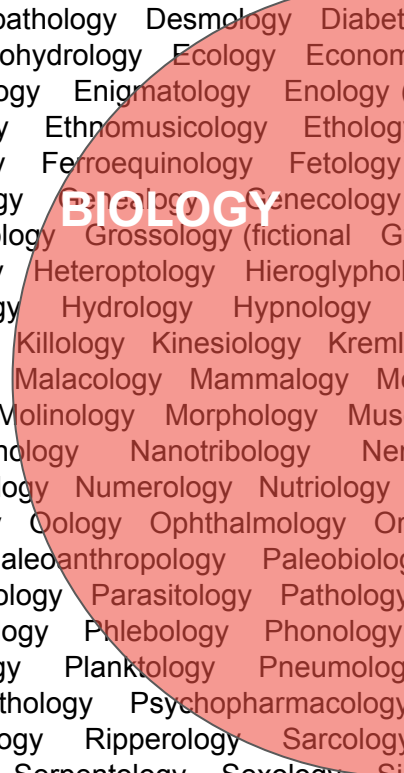
Taking Perspectives (point-view)
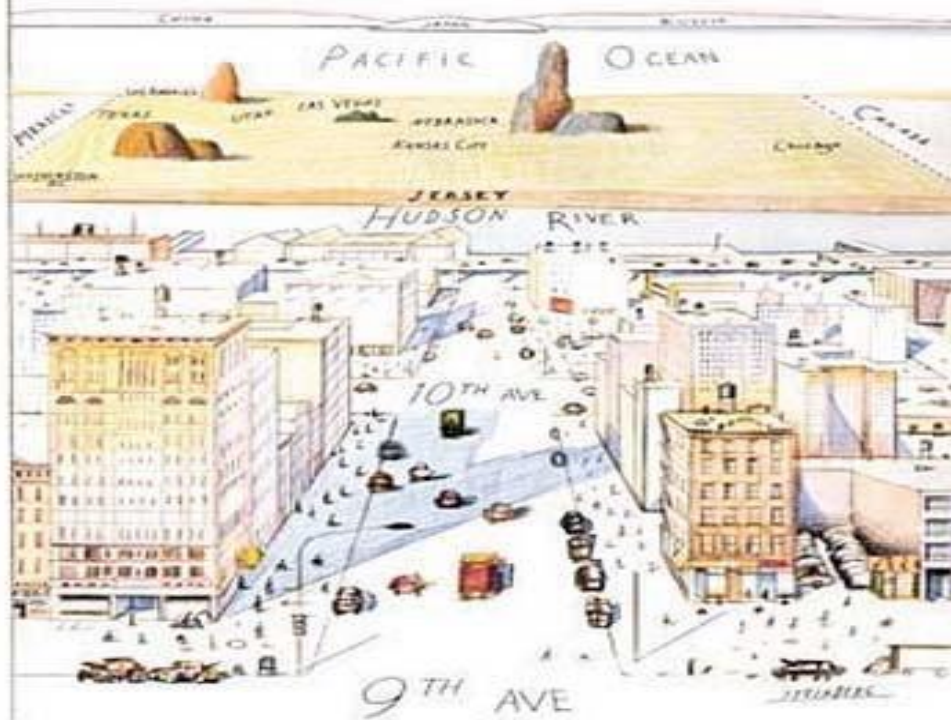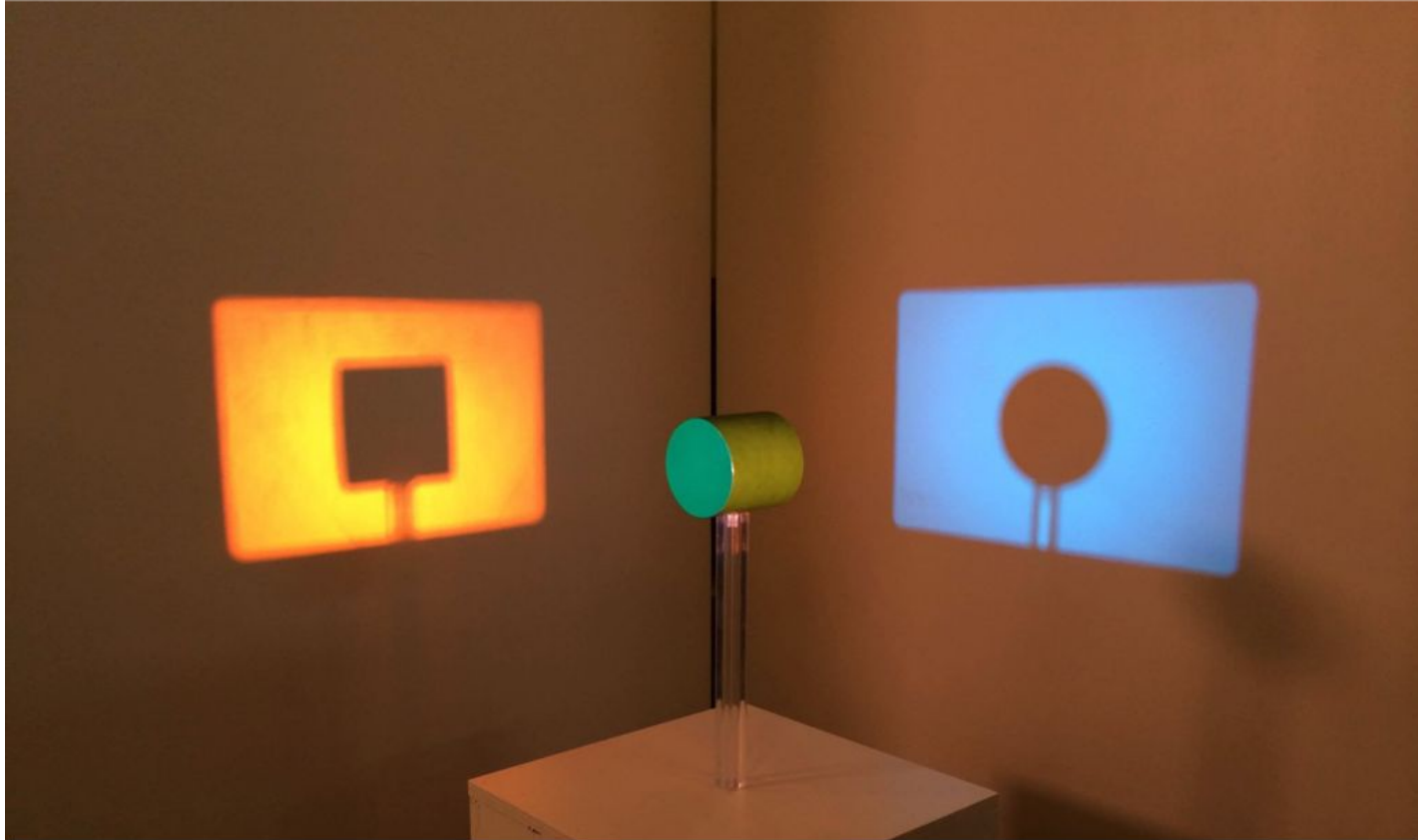
"When you change the way you look at things, the things you look at change."

#3 Repeatedly Apply Systems Thinking (DSRP) to Your Work

Oxford Dictionary of English
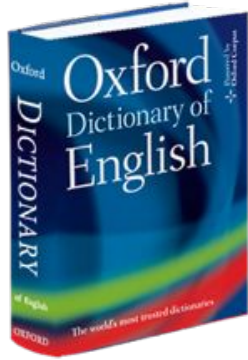
Distinction
System
Relationship
Perspective

DON'T

DO

complex
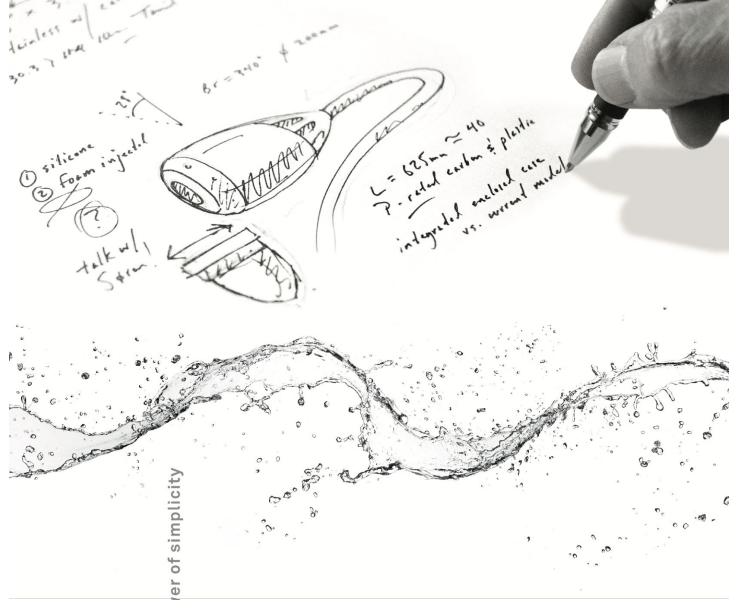
simple

the power of simplicity

dsrp

distinctions • systems • relationships • perspectives

THINK WATER

www.thinkwater.us | www.facebook.com/waterthinkers

Engage, Educate and Empower 400 million Systems Thinkers to solve wicked water problems.

MAC: THREE STEPS TO DESIGNING BETTER LEARNING EXPERIENCES

MAC: Map, Activate, Check

We perceive and understand the real world through mental models. Mental models include beliefs, biases, categories, preferences, theories, etc.

Our mental models describe reality with varying degrees of accuracy. Learning is the process of incorporating feedback from the real world and using it to adjust our mental model as needed.

① **Map the Mental Model (M):**
Map any content and thinking students need to learn (i.e., build a mental model).

Being clear on what you want students to learn is the first step in effective teaching. Lack of clarity at this point will only multiply throughout the lesson and confuse learners as to the goal.

DSRP

Idea

Idea   Idea

Construct a map (e.g., using MetaMap software) of the mental model that you want students to build, then share that mental model with your students, ideally having them help you complete it. This indicates to students they need to construct knowledge through thinking, rather than just the teacher covering information.

② **Activate the Mental Model (A):**
Use an activity (see Activate a Concept) that best activates thinking by grounding to students' prior information and experience.

The function of an activity is to activate learning of the lesson/mental model you are teaching.

See the "Activate a Concept" infographic

Use a rubric (e.g., a metamap) that assesses student understanding of information and thinking. Are they building the mental model you mapped?

③ **Check the Mental Model (C):**
Use checks for understanding to ensure student has built the knowledge mapped and activated by the teacher.

Embed multiple checks for understanding: pre-lesson (foreshadowing), within activities, and traditional post-lesson checks. Students should constantly check their own understanding through self-assessment and reflection.

Fractal—can be used at different scales—in a program, course, unit, lesson, teachable moment, or answering a question.

Utilizes brain science and systems thinking to foster optimal learning and promote metacognition and transfer across subjects

Based on the idea that our mental models (knowledge and skills) are made up of Information X Thinking
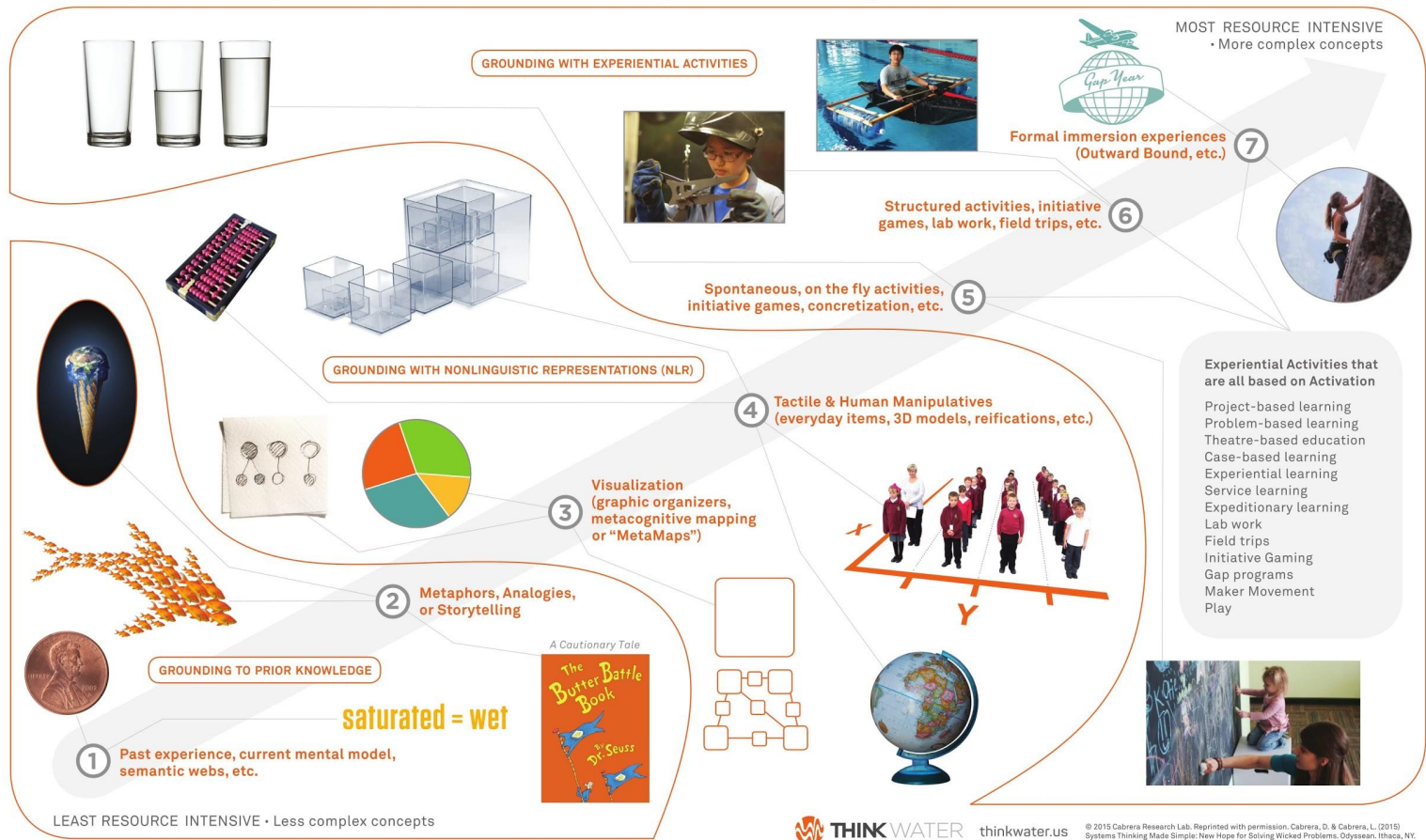
IxT

Requires correspondence between the lesson you map, the activity chosen to activate the lesson, and the method of checking it

M : A : C

The purpose of an activity is to **ACTIVATE A CONCEPT**

The sole purpose of activities is to activate intentional learning of concepts on the part of students.
Use activities as part of MAC: M=map the lesson/mental model   A=activate student learning   C=check for understanding

MOST RESOURCE INTENSIVE
• More complex concepts

GROUNDING WITH EXPERIENTIAL ACTIVITIES

Formal immersion experiences
(Outward Bound, etc.) ⑦

Structured activities, initiative
games, lab work, field trips, etc. ⑥

Spontaneous, on the fly activities,
initiative games, concretization, etc. ⑤

GROUNDING WITH NONLINGUISTIC REPRESENTATIONS (NLR)

Tactile & Human Manipulatives
(everyday items, 3D models, reifications, etc.) ④

Visualization
(graphic organizers,
metacognitive mapping
or "MetaMaps") ③

Metaphors, Analogies,
or Storytelling ②

GROUNDING TO PRIOR KNOWLEDGE

A Cautionary Tale

The Butter Battle Book
By Dr. Seuss

saturated = wet

Past experience, current mental model,
semantic webs, etc. ①

LEAST RESOURCE INTENSIVE • Less complex concepts

**Experiential Activities that
are all based on Activation**

Project-based learning
Problem-based learning
Theatre-based education
Case-based learning
Experiential learning
Service learning
Expeditionary learning
Lab work
Field trips
Initiative Gaming
Gap programs
Maker Movement
Play

www.thinkwater.us I www.facebook.com/waterthinkers

Jeremy Solin
jeremy.solin@ces.uwex.edu