



THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Soil, Water &
Environmental Sciences

How We Develop Lifelong Skills and Systems Thinking

April 9, 2019

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Director of Arizona Project WET



COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

**WATER RESOURCES
RESEARCH CENTER**

Arizona Project WET develops water stewardship and STEM learning through:

- Teacher professional development that evolves instructional practices and deepens content knowledge
- direct student outreach that is embedded in or extends in-classroom instruction
- community engagement

APW has conducted professional development with 11,150 teachers and reached over three-quarter million students in 263 communities.



STEM Definition

STEM education is an interdisciplinary approach to learning that removes the traditional barriers separating the four disciplines of science, technology, engineering and mathematics, and integrates them into real world, rigorous & relevant learning experiences for students.

- We can also say STEAM with A for Arts or Agriculture
- Or STREAM with R for reading

But, we mean the same thing: an integrated approach to learning



THINK WATER

[Home](#)[What we do](#)[About](#)[DSRP](#)[More...](#)

SYSTEMS THINKING + WATER

ThinkWater is a national campaign supported by the U.S. Department of Agriculture to help people of all backgrounds and ages think and care deeply about water. It does so by applying systems thinking to existing water education and research efforts and by actively engaging people in a new way around water issues. Our Mission-Vision is to **Engage, Educate** and **Empower** a world of Systems Thinkers to solve wicked water problems.



Derek Cabrera Cornell University, Ithaca

Sociocybernetics, Teaching Methods, Science Education

PhD

il 11.27



Laura Cabrera Cornell University, Ithaca

Educational Assessment, Educational Policy

PhD

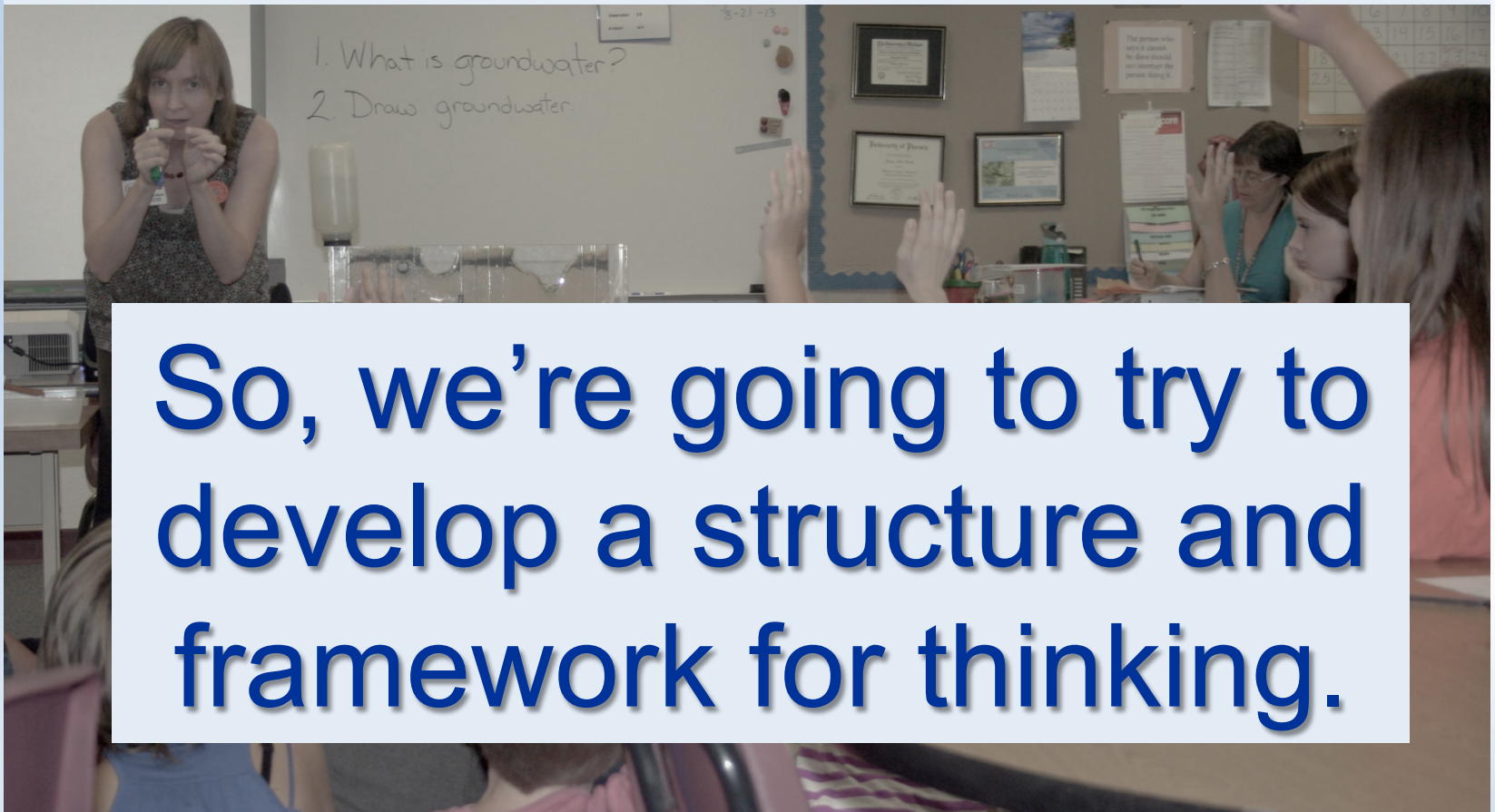
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<https://www.thinkwater.us/>

Video



When we say: *Think about it,*
to students. They say:
What do you mean?



So, we're going to try to
develop a structure and
framework for thinking.

Four Simple Thinking Patterns:

- Make D**ISTINCTIONS**
- Build S**YSTEMS – Parts and Wholes**
- Describe R**ELATIONSHIPS**
- Take P**ERSPECTIVES**

We Call this Systems Thinking method DSRP.

Make DISTINCTIONS

- What is a river?
- What is a river not?



is?

is?

is?



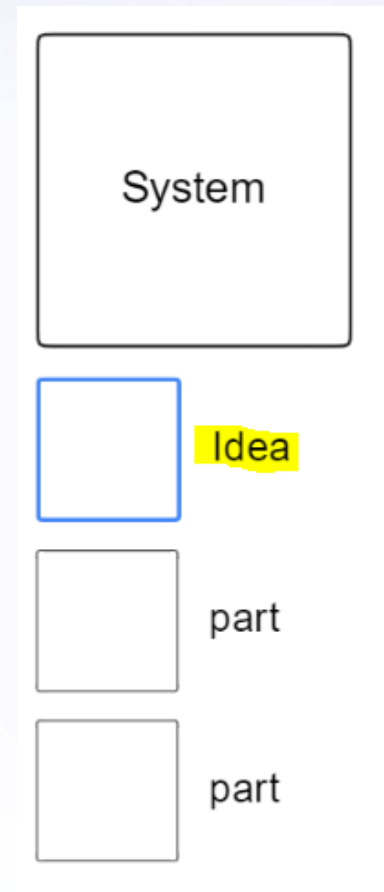
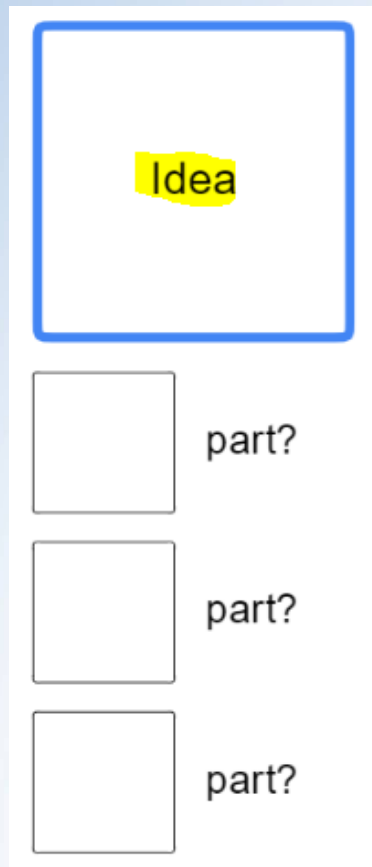
is not?

is not?

is not?

Build SYSTEMS

- What are the parts of a river?
- What is a river a part of?



Watersheds

- Make **DISTINCTIONS**
- Build **SYSTEMS – Parts and Wholes**

Key/Legend:

Ridges (along upfold) = **Green**

Valleys (along downfold) = **Blue**

Farms (colored area) = **Brown**

Old Mines (*) = **Red**

Cities (#) = **Purple**

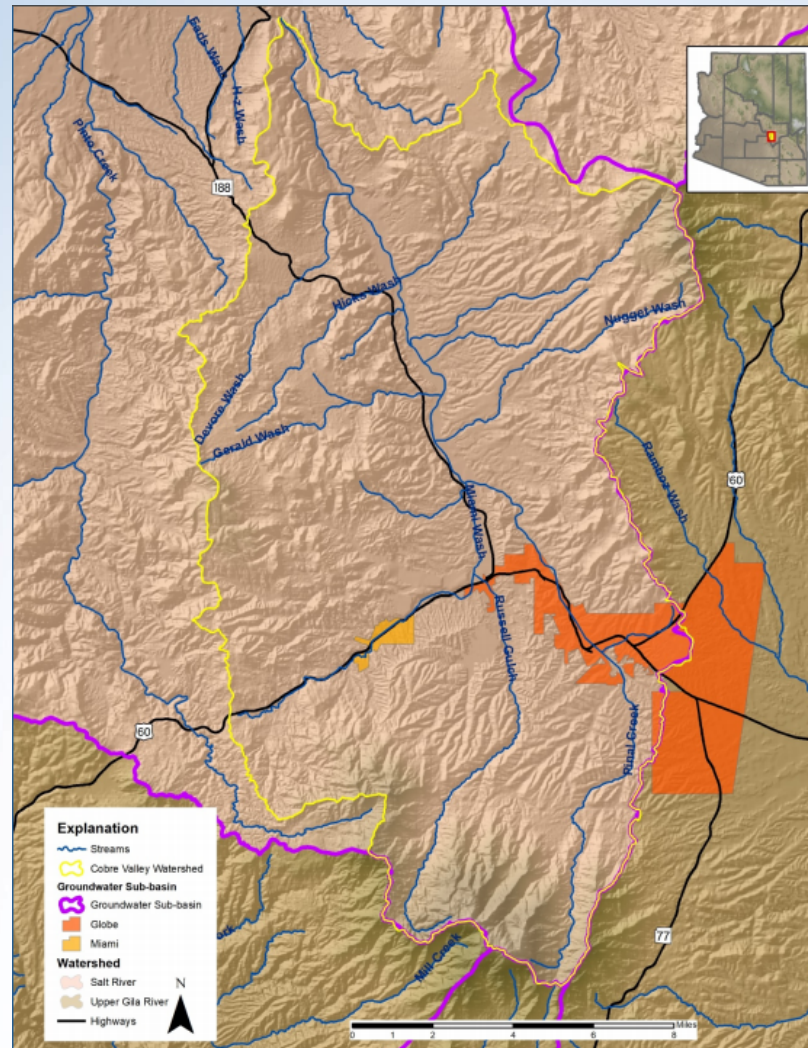
**What do we manage when we
manage a watershed?**

Model of land surface

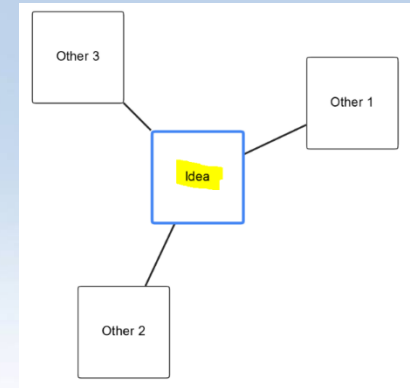


Cobre Valley Watershed Map

- Tributaries and Boundary



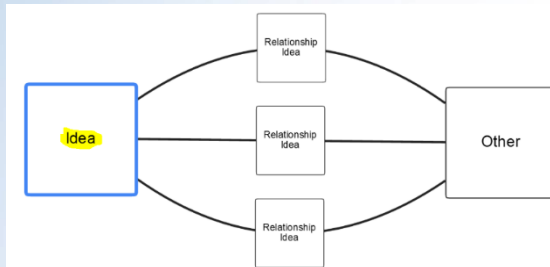
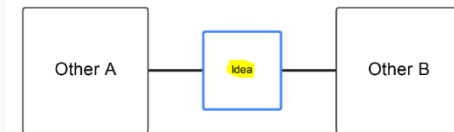
Make RELATIONSHIPS



What are the relationships between a river and the land in a watershed?

What other ideas are related to _____?

What are the relationships among _____ and other ideas?

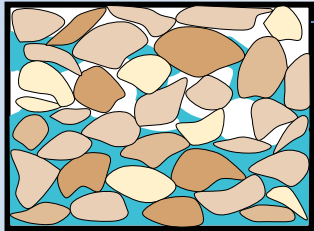
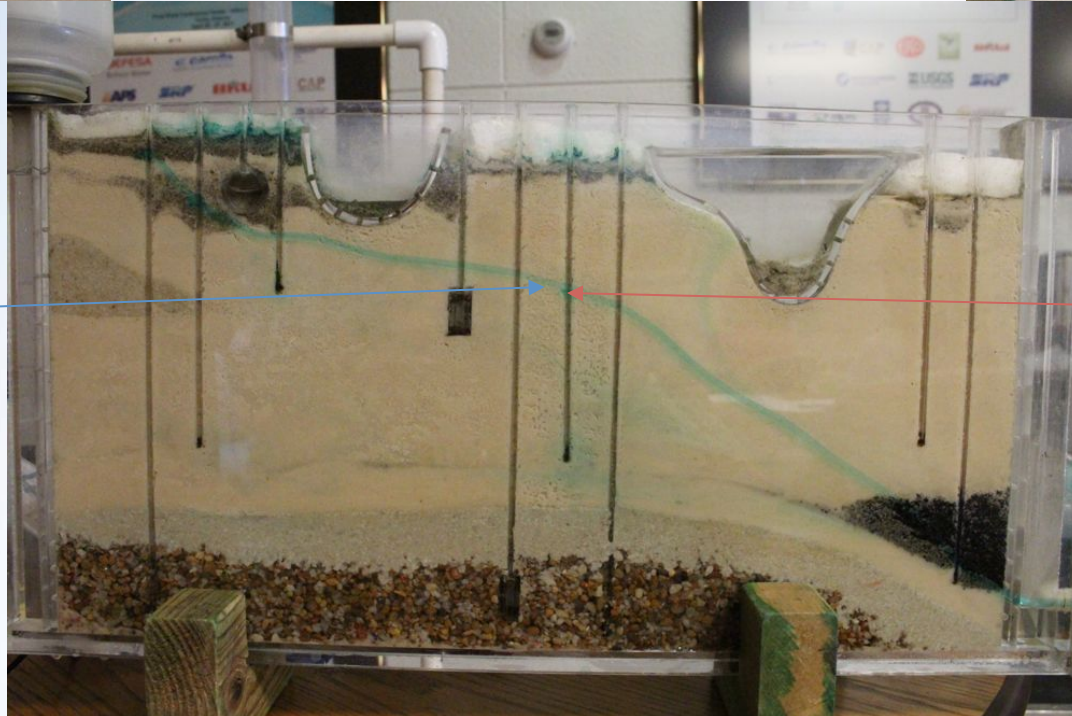


What ideas are related by _____?

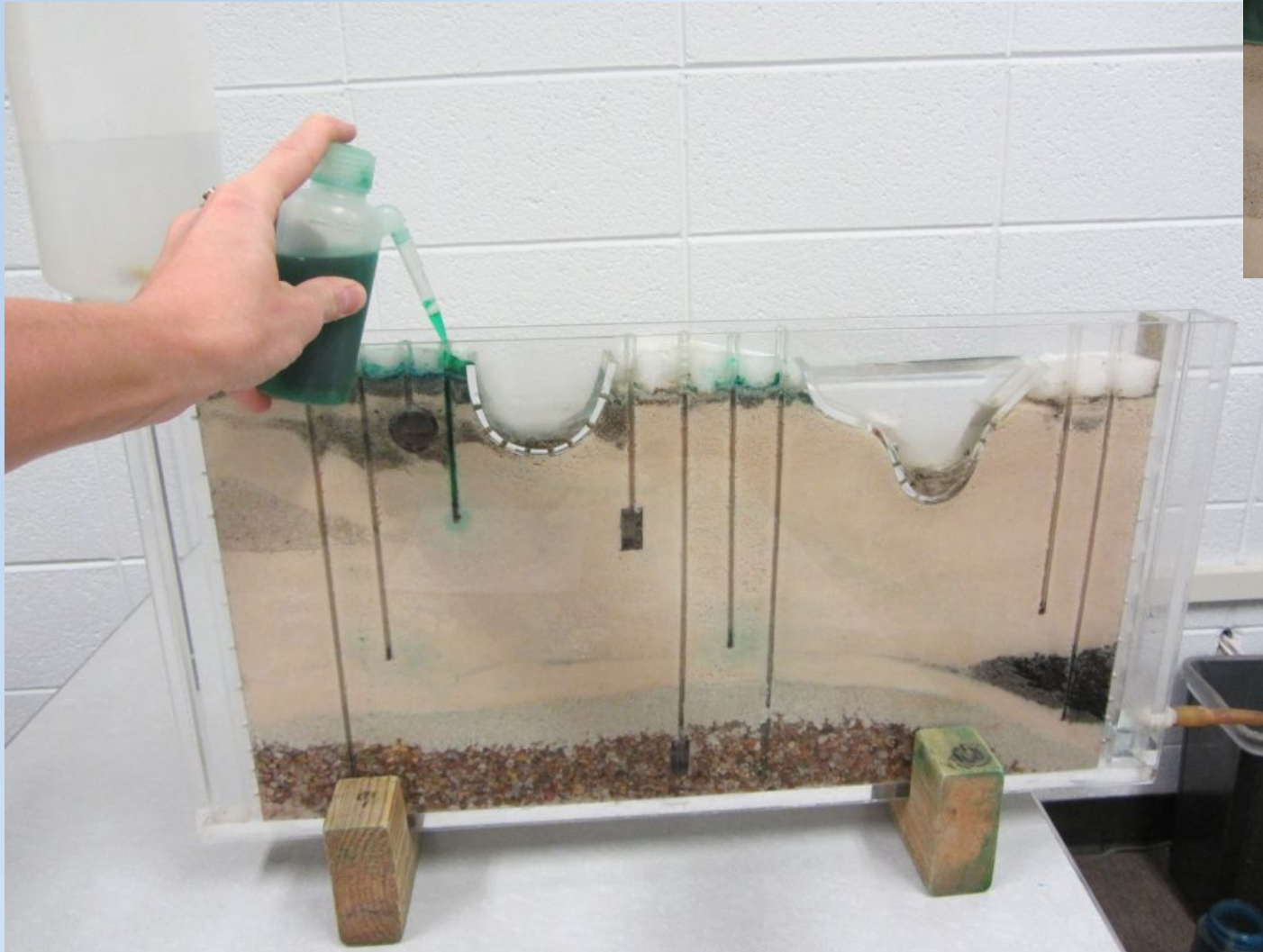
A System

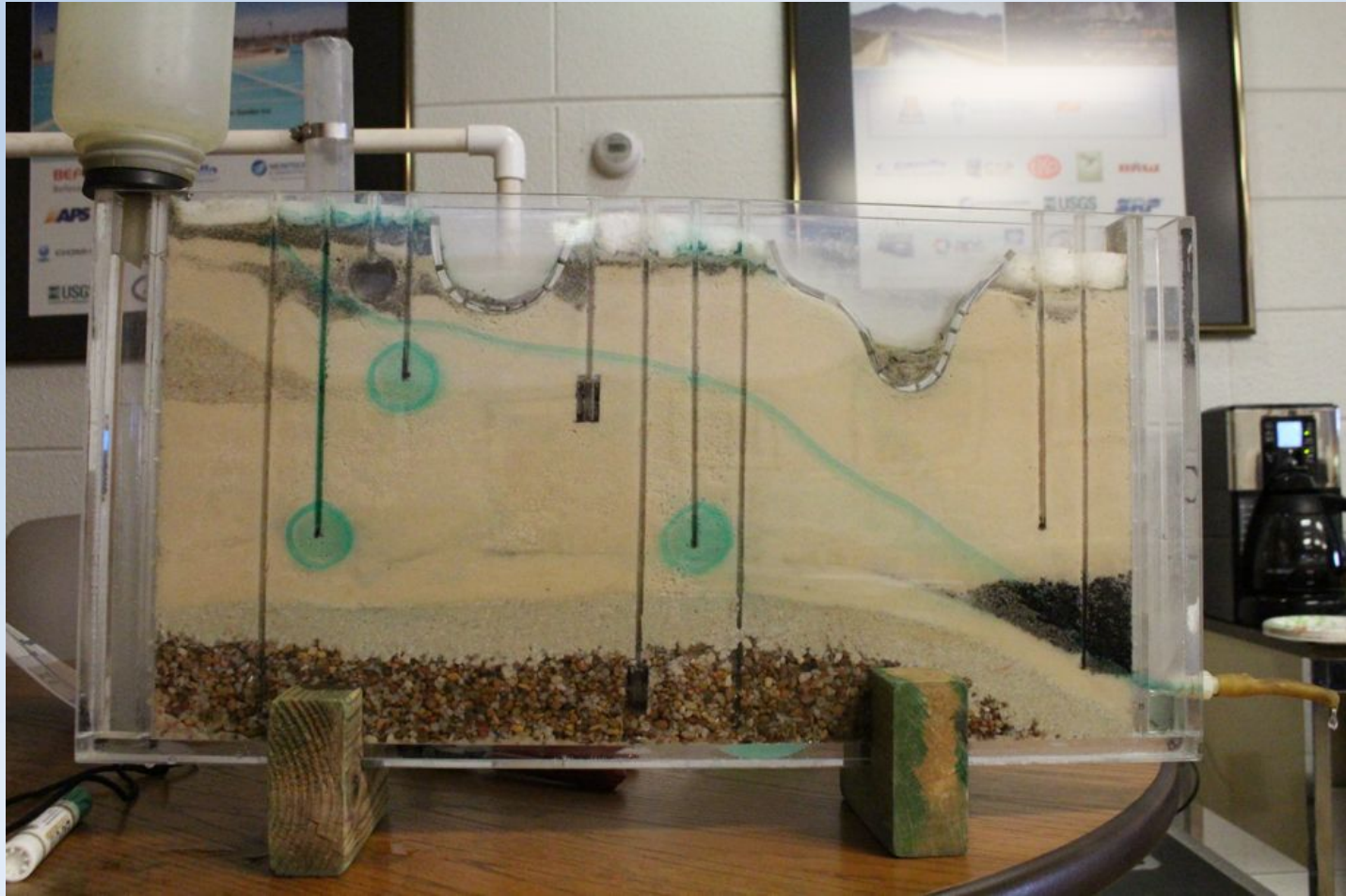
Recharge Area

Discharge Area



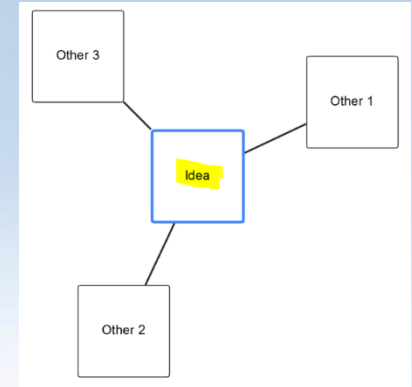
Making Claims Based on Evidence





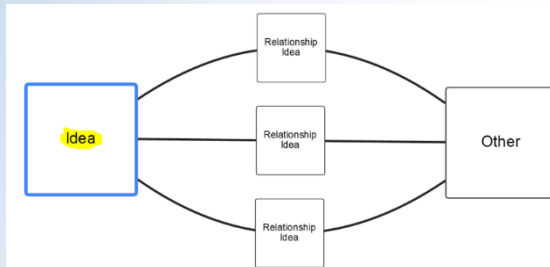
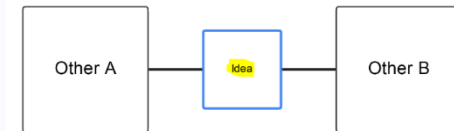


Make RELATIONSHIPS



What other ideas are related to _____?

What are the relationships among _____ and other ideas?

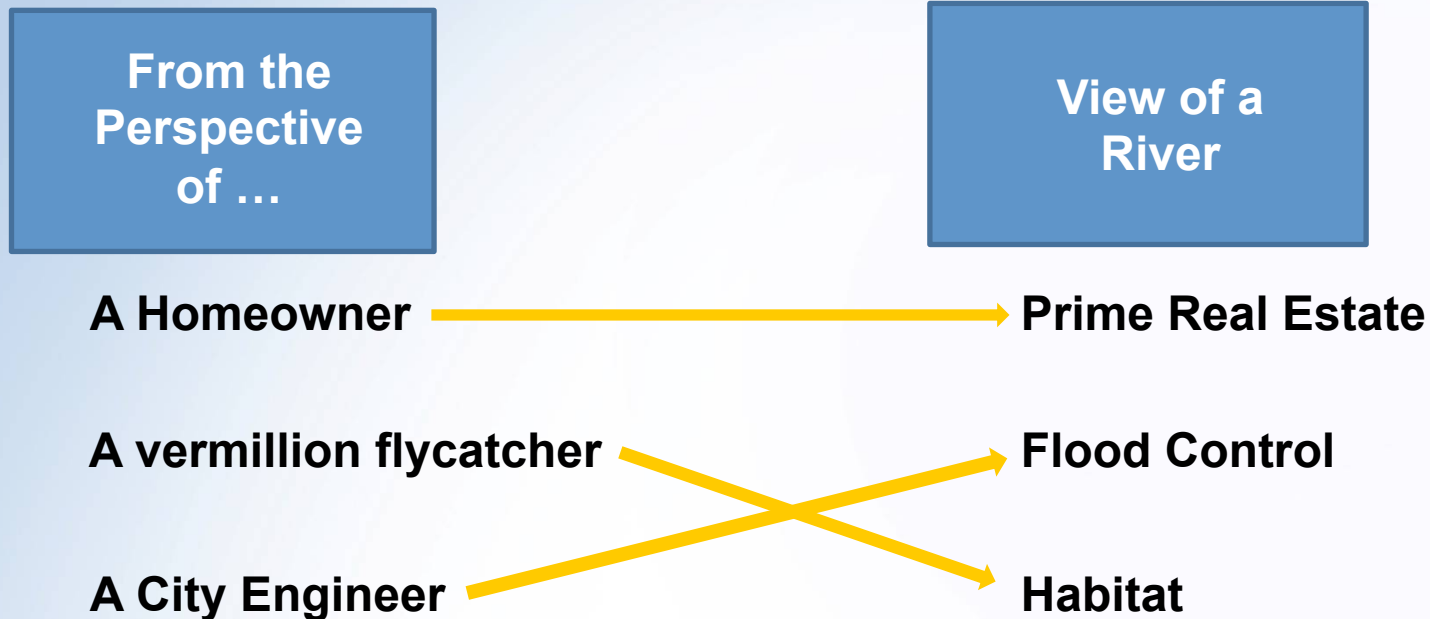


What ideas are related by _____?

What are the relationships between a river and the groundwater system?

Take PERSPECTIVES

Can you think about a river from multiple perspectives?



When you change the way you look at things, the things you look at change!

Make DISTINCTIONS

- What is a compound sentence?
- What is a compound sentence not?



is?

is?

is?



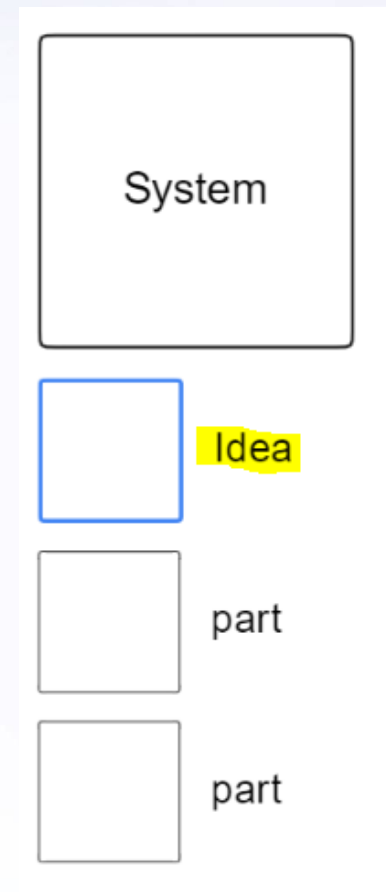
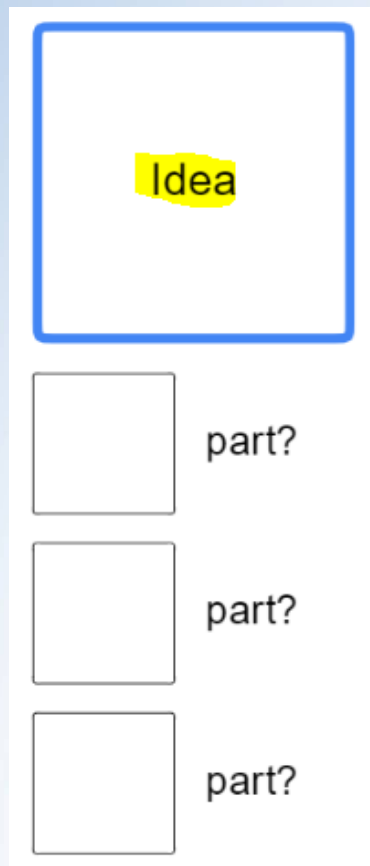
is not?

is not?

is not?

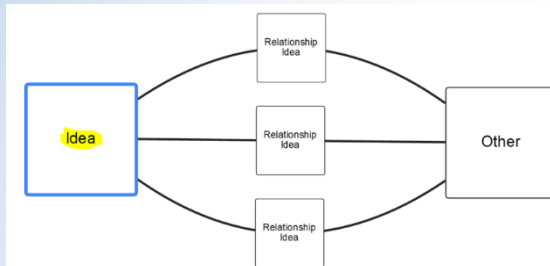
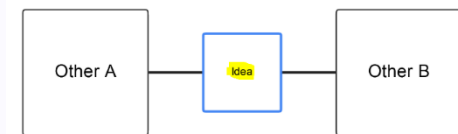
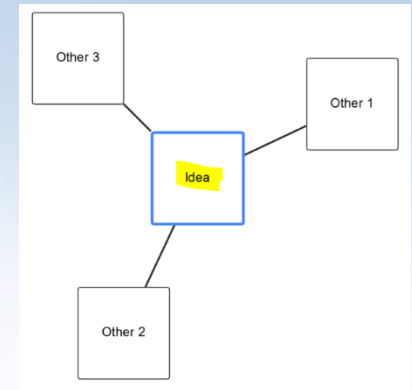
Build SYSTEMS

- What are the parts of a compound sentence?
- What is a compound sentence a part of?



Make RELATIONSHIPS

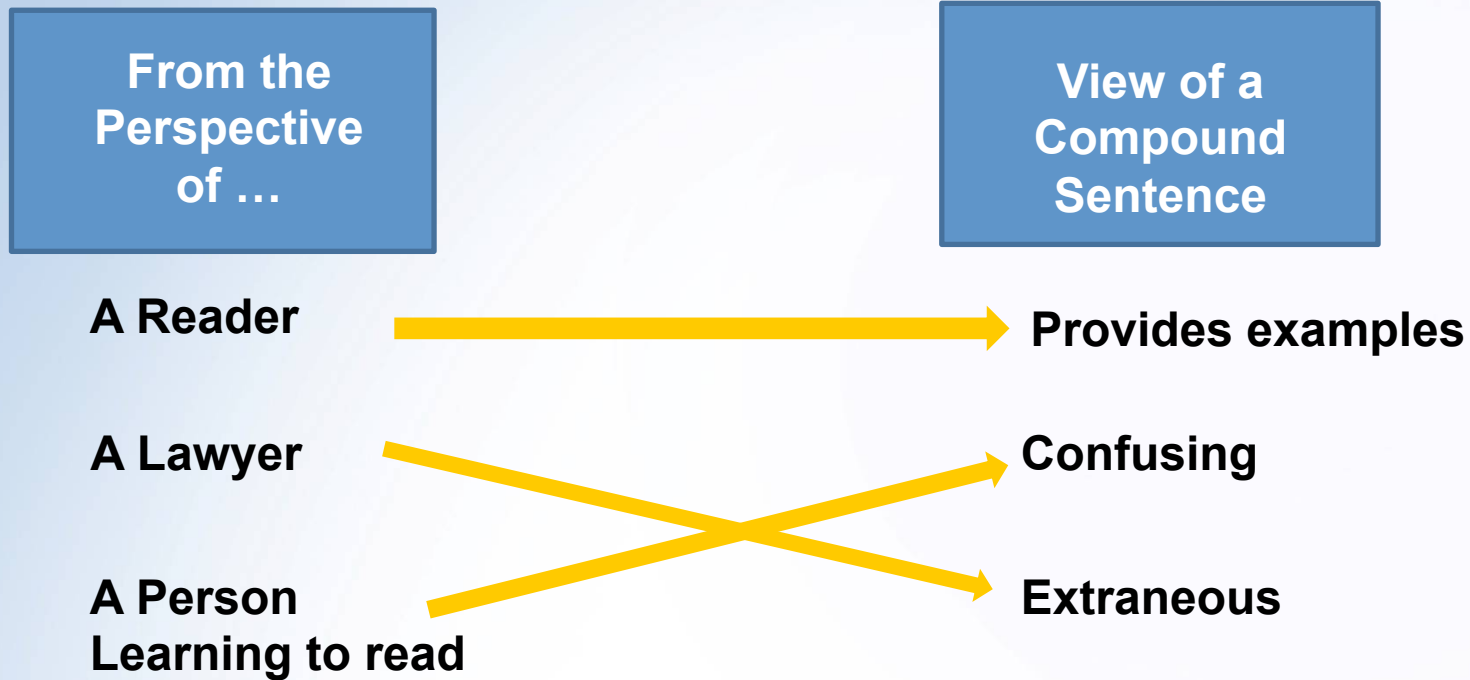
What are the relationships between a compound sentence and the paragraph?



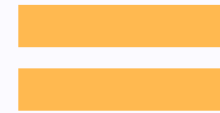
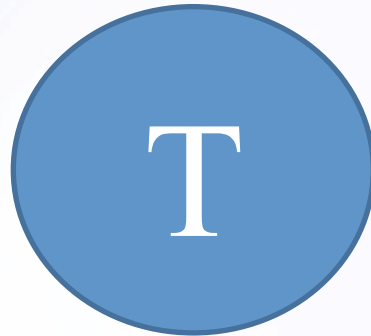
What are the relationships between a compound sentence and an exclamation?

Take PERSPECTIVES

Can you think about a compound sentence from multiple perspectives?

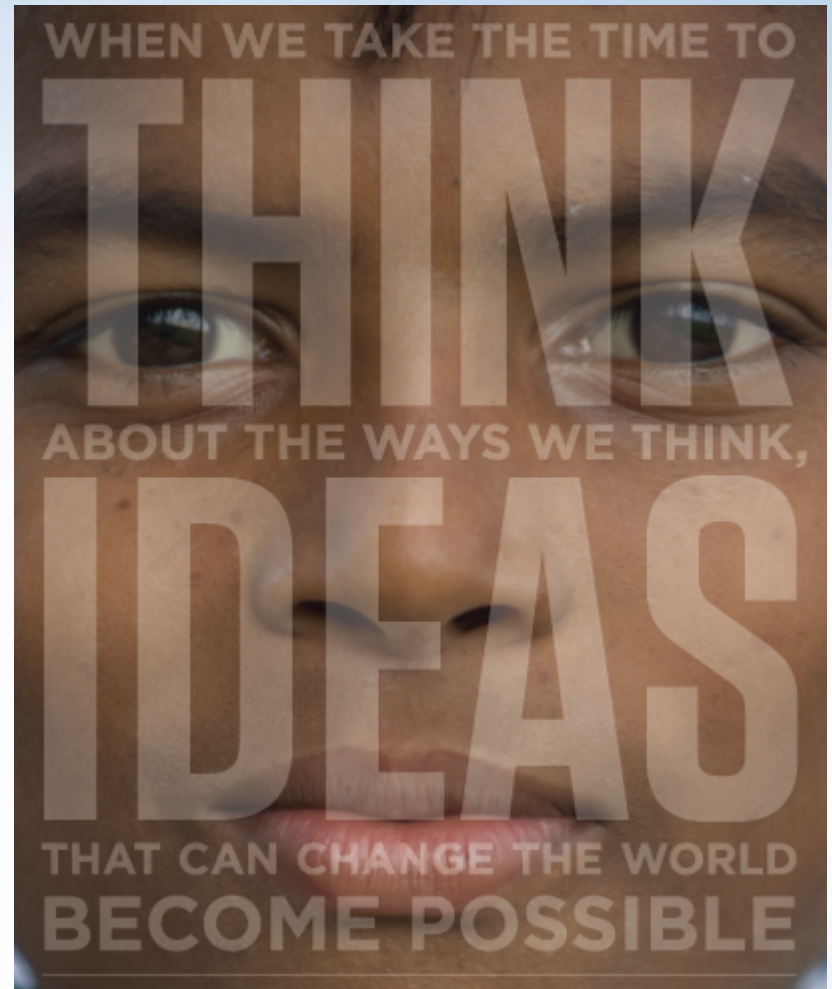


When you change the way you look at things, the things you look at change!

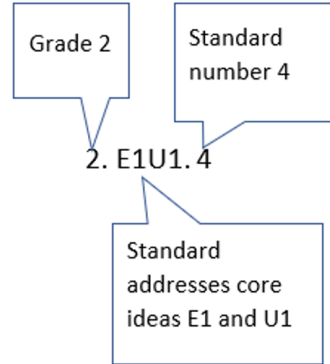


Metacognition

The awareness and understanding of one's own thought processes that result in analytical, social and emotional intelligence, as well as character and perseverance.



Arizona Science Standards



2.E1U1.4. Observe and investigate how wind and water change the shape of the land resulting in a variety of landforms.

Core Ideas for Knowing Science

Physical Science

- P1: All matter in the Universe is made of very small particles.
- P2: Objects can affect other objects at a distance.
- P3: Changing the movement of an object requires a net force to be acting on it.
- P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.

Earth and Space Science

- E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate.
- E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.

Life Science

- L1: Organisms are organized on a cellular basis and have a finite life span.
- L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Core Ideas for Using Science

- U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised.
- U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.
- U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

Arizona Science Standards

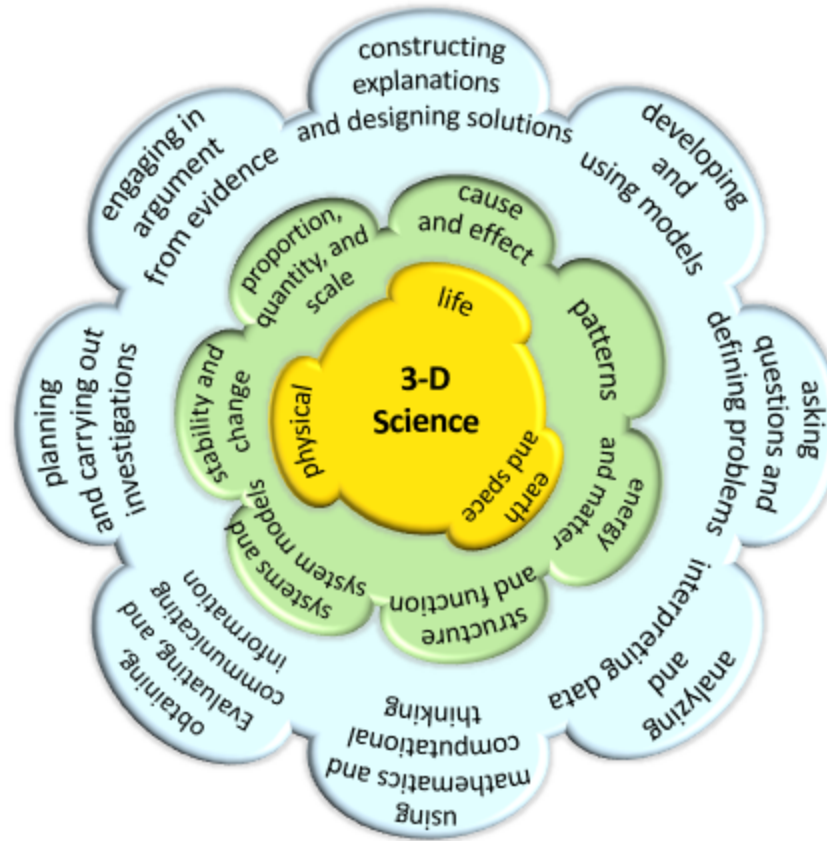


Figure 1: Three Dimensions of Science Instruction

Arizona Water Festival Program

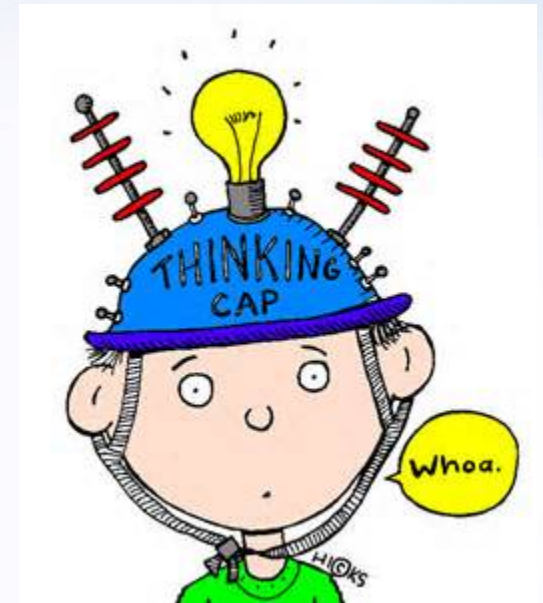
4.E1U1.6 - Plan and carry out an investigation to explore and explain the interactions between Earth's major systems and the impact on Earth's surface materials and processes.

4.E1U3.9 - Construct and support an evidence based argument about the availability of water and its impact on life.

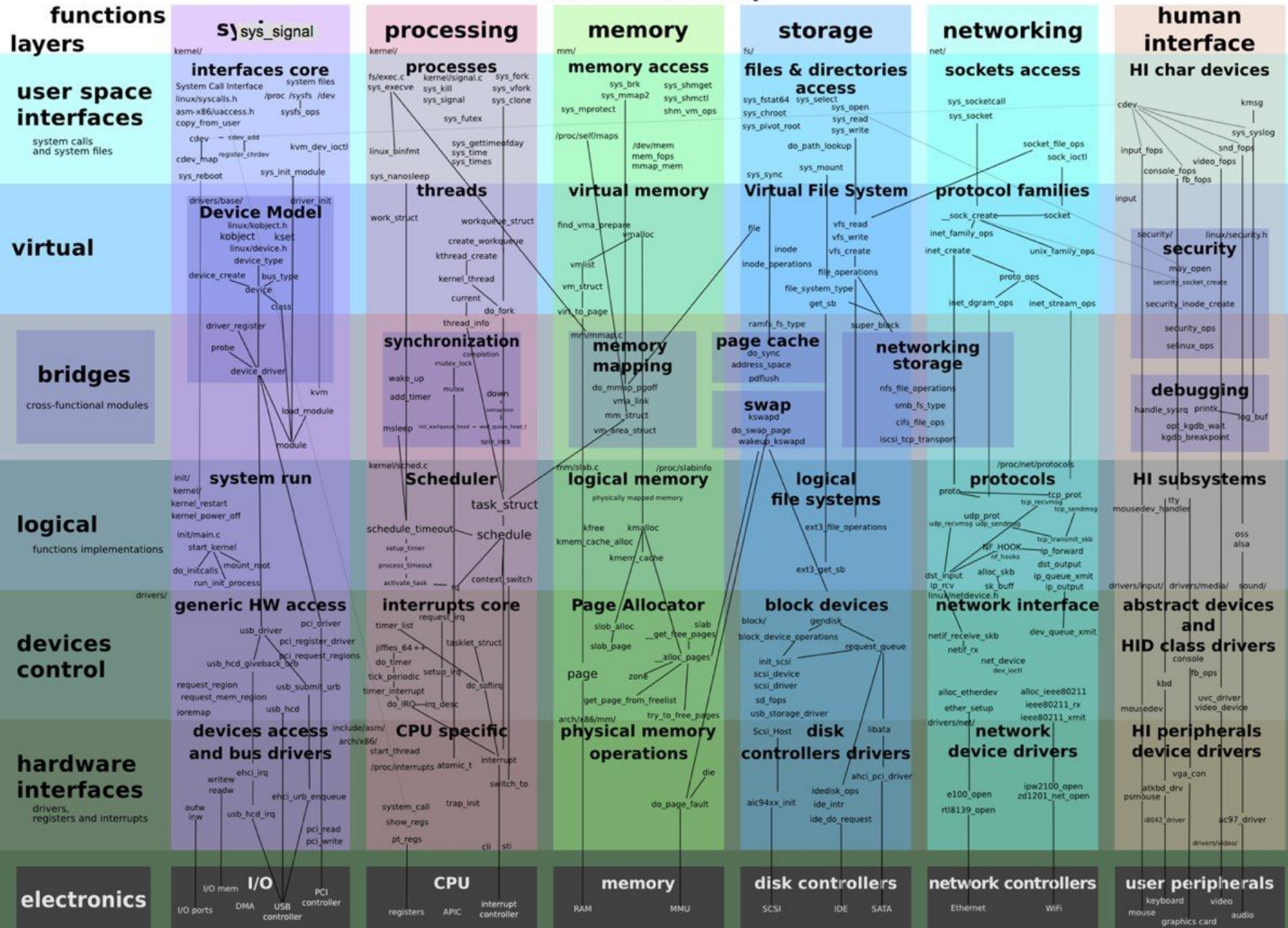
Summary

Giving thinking a language and structure provides a framework and process for thinking about any topic.

Systems thinkers are needed to solve complex, multidisciplinary issues like water security & sustainability.



Linux kernel map





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