Objective
At the end of this tutorial, the student will be able to apply different System Thinking Perspectives to various situations and problems so they can be framed and reframed in different ways, thus allowing for new kinds of solutions to emerge.

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

**SYSTEMS RULE:** Any idea or thing **can be split into parts or lumped into a whole**

**RELATIONSHIP RULE:** Any idea or thing **can relate to other things or ideas**

**PERSPECTIVES RULE:** Any idea or thing **can be the point or the view of a perspective**

Why is “Systems Thinking” important?

Why is Systems Science an *Oxymoron*?
“Systems thinking is not a science; it is a conceptual ability, an orientation, and a framework. However, systems thinking is informed by knowledge-about-systems.”


Define a System

What is a System?

<table>
<thead>
<tr>
<th></th>
<th>Boundary</th>
<th>Environment</th>
<th>Purpose</th>
<th>Function</th>
<th>System</th>
<th>Just Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football Team</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marriage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools in a Toolbox</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Connect the dots by drawing ______ straight lines through the nine dots without retracing and without lifting your pen.
Connect the dots by drawing ______ straight lines through the nine dots **without retracing and without lifting your pen.**
What are *your* thoughts about systems, parts and boundaries?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What challenges have you had with interrelatedness, connections, or interfaces?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

“Everything we hear is an opinion, not a fact.  
*Everything we see is perspective*, not the truth.”

~Marcus Aurelius

What do you see?

☐ Old Lady

☐ Young Women

☐ Both
How have your Perspectives been challenged? ________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

What are your thoughts about Categories? ________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Co-implying elements
- **DISTINCTION**: A thing implies an other
- **SYSTEM**: A part implies a whole
- **RELATIONSHIP**: An action implies a reaction
- **PERSPECTIVE**: A point implies a view.
Exercise: Draw a Picture of How to Make Toast - Using no words, Illustrate the important actions to someone who has never made toast before.
Modeling using simple rules

**DISTINCTIONS RULE**
- Use same size for all distinctions

**SYSTEMS RULE**
- Use shape-size to show part-whole

**RELATIONSHIP RULE**
- Use lines exclusively for relationships

**PERSPECTIVES RULE**
- Eyeball icon for perspectives

Mix and match and combine and recombine these basic visual elements

*Combining Systems Rule and the Relationship Rule*

*Applying relationship rule to parts of a whole*

Whose Perspective?
Lessons Learned from “Draw Toast”

Mental Models

Cognitive Biases
“Surfacing, Testing, Improving our internal pictures of how the world works – promises to be a major breakthrough…. involves identifying, clarifying, and changing one’s mental model and its component assumptions”

- Make your own reasoning explicit
- Encourage others to explore your views
- Encourage others to share their views – “think aloud”
- Investigate views that differ from yours
- State your assumptions clearly, and back them up with data
- Work together to get new information
- Work together to overcome barriers

Conclusion

- Why Systems Thinking?
  - Attacking problems from a Systems Perspective is a reaction to the ineffectiveness of Scientific Reductionism.

- Use both Frameworks
  - Use all the tools from System Science and Traditional Science
  - Systems Science is new and young – give it time!

- Beware of Cognitive Biases

Your Instructor

Paul Martin is a practicing Systems Engineer with over 35 years of experience in manufacturing, defense development, maintenance and Government acquisition. He’s been everything from a Product Engineer for General Electric Products Division to a Software Systems Engineer for a multi-million dollar Navy program. He started SE Scholar, LLC several years ago to help other Systems Engineers navigate the INCOSE SEP Certification process. His unique INCOSE SEP Exam Preparation Course is used by UMBC Training Center as well as his own online business at www.se-scholar.com

On the Certification side of things, Paul has two: (1) INCOSE’s “Expert Systems Engineering Professional” (ESEP) since 2012 and (2) CompTIA’s Certified Technical Trainer (CTT+). He’s also a Senior Member of IEEE. Paul has a side job as an Adjunct Professor at University of Maryland, Baltimore County where he developed and teaches two Systems Engineering courses. He’s also an active member of his local INCOSE Chapter where he serves on the Board of Directors as Communications Officer.
References

Primary References

• Wujec, T. Draw Toast: A Primer in Systems Thinking Website http://www.drawtoast.com/

Other References

• Classic old or young woman illusion - first appeared on an 1888 German postcard and was later adapted by British cartoonist William Ely Hill, who published it in a humor magazine in 1915 with the title "My Wife and My Mother-in-Law."
• Ellison, Harlan and Roy Thomas (w), Herb Trimpe (p) Sam Grainger (i). "The Brute ... That Shouted Love... At the Heart of the Atom." Incredible Hulk Vol 1 #140 (June 1971), Marvel Comics.
• ISO/IEC/IEEE 15288:2015 Systems and software engineering -- System life cycle processes
• O'Shaughnessy, P.T.; Website http://catdrop.com/, the flying cat story Or “operation cat drop” A history of this often-told tale
• Systems Engineering and System Definitions | INCOSE-TP-| 22 July 2019
Science Reference – by dates

Copernicus (1473 -1543)
- Copernicus (1543) De revolutionibus orbium coelestium (On the revolutions of the celestial spheres)
  - Heliocentric model of universe

Bacon (1561-1626)
- Bacon, F. (1620). Novum organum. (New Instrument)
  - Father of empirical experimentation

Descartes (1596-1650)
- Descartes, R. (1637) A Discourse on Method
  - Rational methodology, reductionism

Newton (1643 - 1727)
- Newton, I. (1687) Philosophiae naturalis principia mathematica (Mathematical Principles of Natural Philosophy)
  - First Physicist

Systems Science References

Emergence References
- Early Emergence references: