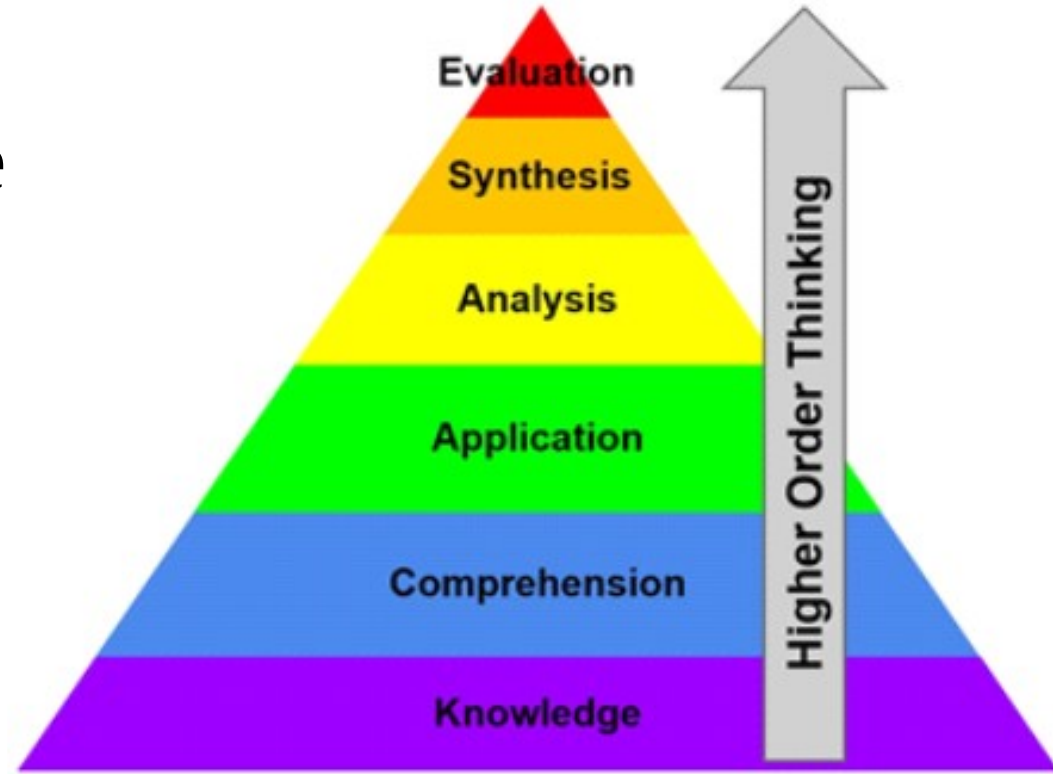


Critical Thinking

“The careful, deliberate determination of whether one should accept, reject, or suspend judgment about a claim and the degree of confidence with which one accepts or rejects it.”

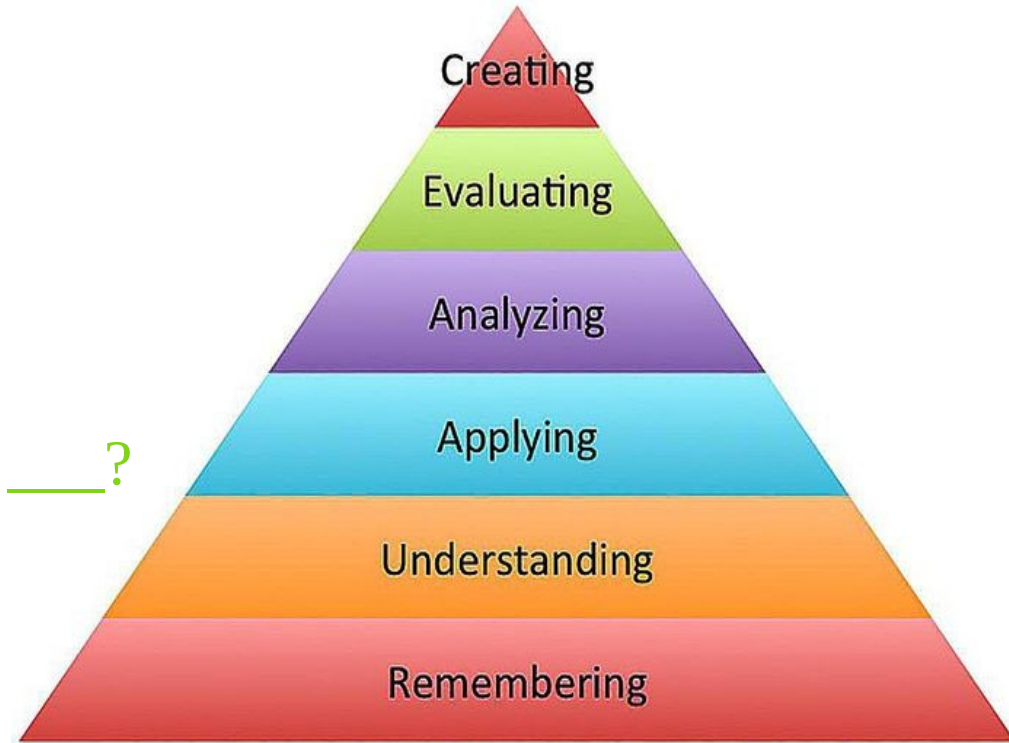
(*Critical Thinking*. B. Moore and R. Parker, 2007)

What are examples of different levels of higher order thinking?



Bloom's Taxonomy
Cognitive Domain

New Version of Bloom's Taxonomy



- Analyzing:

- How can you sort the parts ____?
- What can you infer ____?
- What ideas validate ____?

- Evaluating:

- What criteria would you use to assess ____?
- What data were used to evaluate ____?
- How could you verify ____?

- Creating:

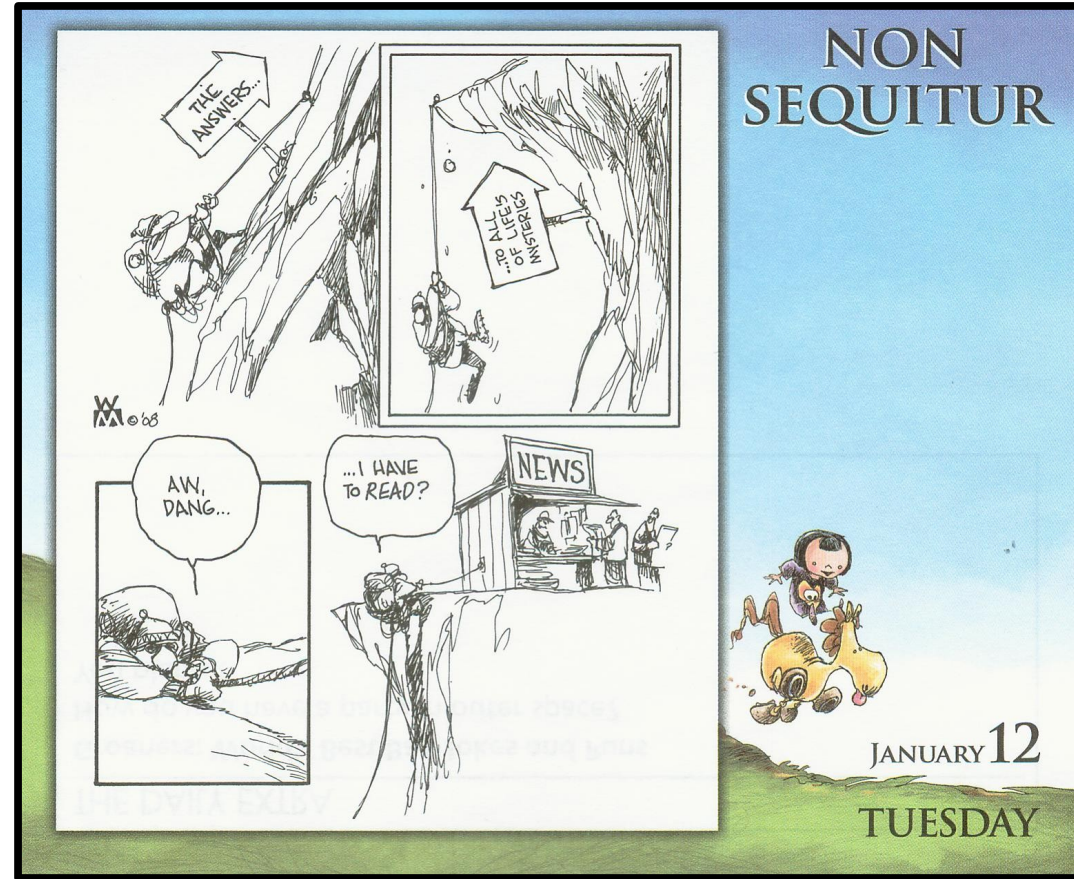
- What alternative would you suggest for ____?
- What changes would you make to revise ____?
- How would you generate a plan to ____?

What can you create
working at a University?

Examples of using Critical Thinking

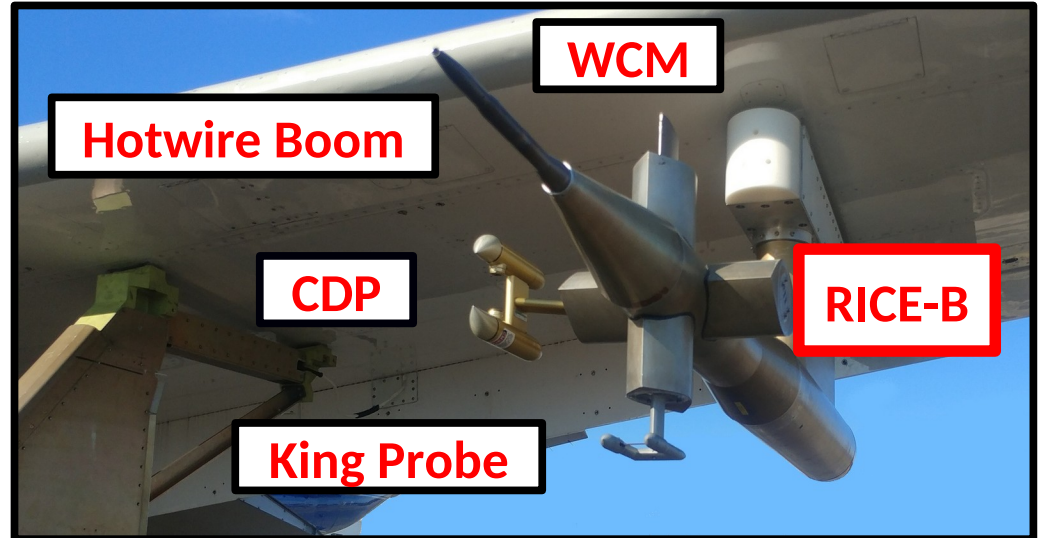
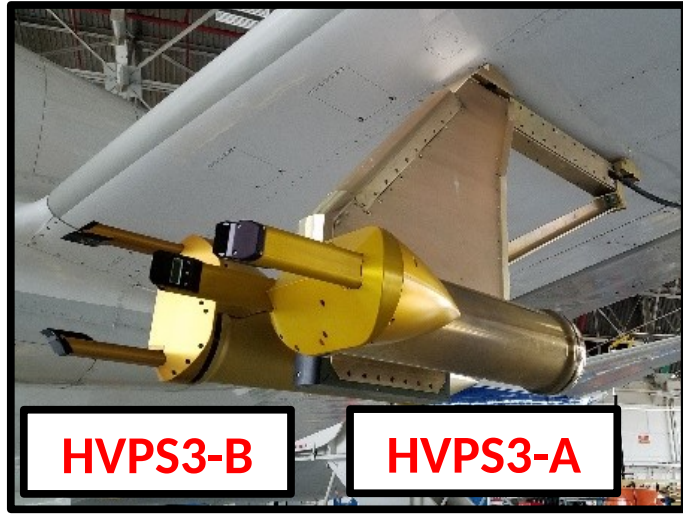
- To Approach Questions to Find an Answer
- To Solving Problems
- To Taking Action

Requires active thinking, the use of reason, and an open mind.



What is an example of how you used critical thinking?

How Does Critical Thinking Apply to Research?



Application of Critical Thinking

Critical thinking should be applied to:

- Expressing your own thoughts, beliefs, and opinions.
- Reading or listening to the thoughts, beliefs, opinions of others.



How can you apply critical thinking to class lectures?

Elements of Reasoning (Thinking)

- Reasoning has a purpose.
- Reasoning is figure something out.
- Reasoning is based on assumptions.
- Reasoning is from a point of view.
- Reasoning is based on information.
- Reasoning is expressed through concepts and theories.
- Reasoning contains interpretation of data and observations.
- Reasoning has implications and consequences.

Periodic Table of the Elements

1 IA H Hydrogen 1.008																	18 VIIIA He Helium 4.003																		
3 Li Lithium 6.941	4 Be Beryllium 9.012																	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.865	48 Cd Cadmium 112.415	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29	55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanides La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.225	78 Pt Platinum 195.084	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89-103 Actinides Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 266	107 Bh Bohrium 264	108 Hs Hassium 277	109 Mt Meitnerium 268	110 Ds Darmstadtium 271	111 Rg Roentgenium 272	112 Cn Copernicium 285	113 Nh Nihonium 284	114 Fl Flerovium 289	115 Mc Moscovium 288	116 Lv Livermorium 293	117 Ts Tennessine 294	118 Og Oganesson 294																		

Questions Using Elements of Reasoning

- Purpose
 - What am I trying to accomplish?
- Questions
 - What question am I raising or addressing?
 - Am I considering all the complexities?
- Information
 - What information or experience am I using?
 - What information do I need?
- Inferences/Conclusions
 - How did I reach this conclusion?
 - Is there another interpretation?



Questions Using Elements of Reasoning

- Concepts
 - What is the main idea?
 - Can I explain it?
- Assumptions
 - What am I taking for granted?
 - What have I assumed?
- Implications/Consequences
 - What am I implying?
- Points of View
 - What point of view am I using?
 - Is there another point of view to consider?



Intellectual Standards

- Clarity – Further elaboration, examples
- Accuracy – Verify, check out
- Precision – More specific, further details
- Relevance – Relate to question
- Depth – Complexities and difficulties
- Breadth – Another perspective, other point of view
- Logic – Makes sense, conclusions follow evidence
- Significance – Central idea, most important facts
- Fairness – Vested interest in the issue



Applying Standards to Elements of Reason

- Intellectual Standards should be applied to Elements of Reason.
- This approach can be used to:
 - Analyze contents of an article.
 - Analyze and assess research.
 - Help you formulate your own conclusions.
 - Help you take a reasoned stand on an issue.
- This leads to developing Intellectual Traits.



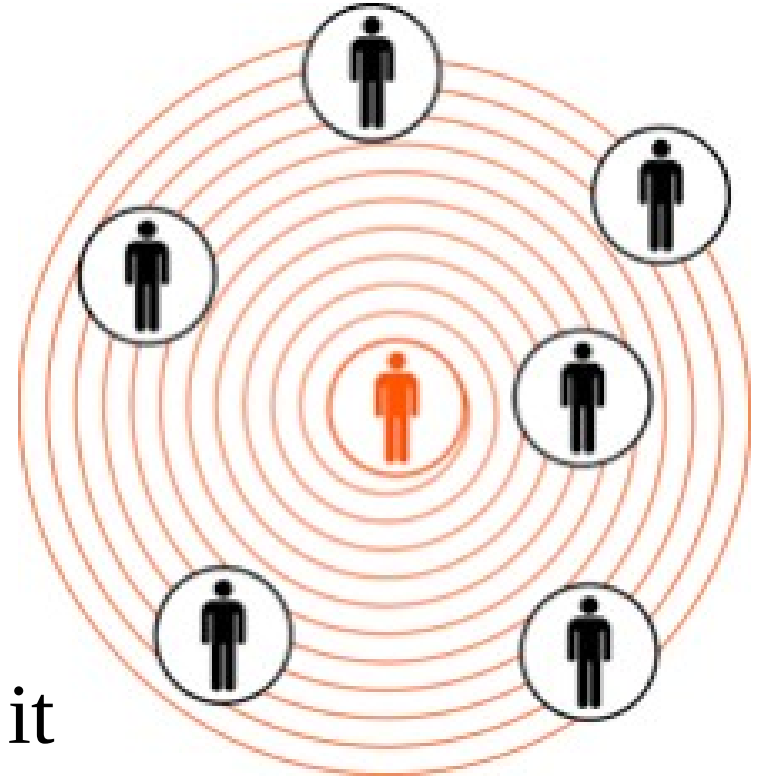
Intellectual Traits

- Intellectual Humility - Realize limits of own knowledge
- Intellectual Courage - Ideas/beliefs/views that counter our own
- Intellectual Empathy - See the other side
- Intellectual Autonomy - Think for yourself
- Intellectual Integrity - Hold yourself to consistent, high standards
- Intellectual Perseverance - Work through confusion
- Confidence in Reason - Believe that high standards will win out
- Fair-mindedness - Treat all viewpoints alike

Egocentric Thinking

It's true because:

- I believe it
- We believe it
- I want to believe it
- I have always believed it
- It is in my own interest to believe it



Apply Critical Thinking to Weather Modification

- Elements of Reasoning
- Intellectual Standards
- Applying Standards to Elements of Reason
- Intellectual Traits
- Taking Action without Egocentric Thinking



Image from cloud seeding in North Dakota on July 2, 2012. Credit: David Delene