Think you know it? Well, think again: Reappraising plausibility judgments to facilitate knowledge reconstruction in science

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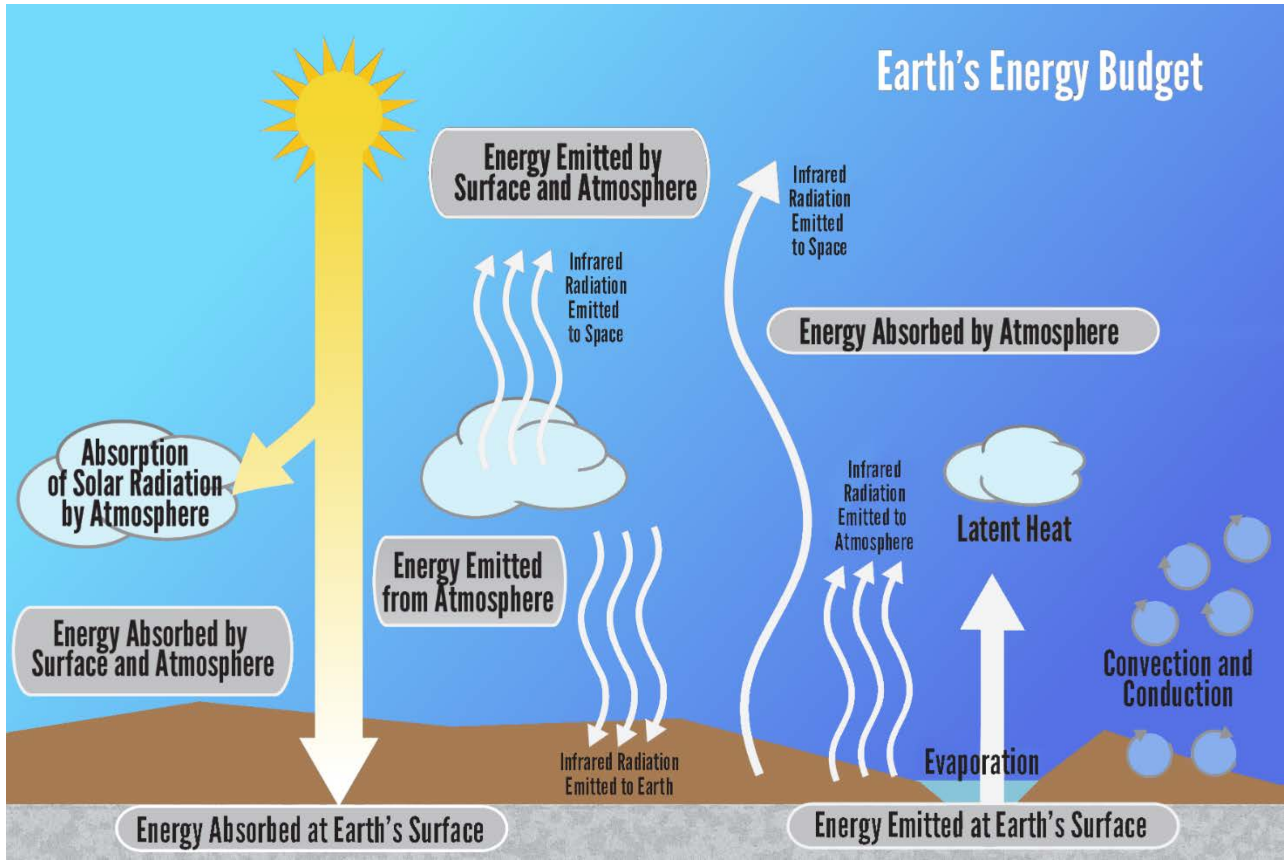

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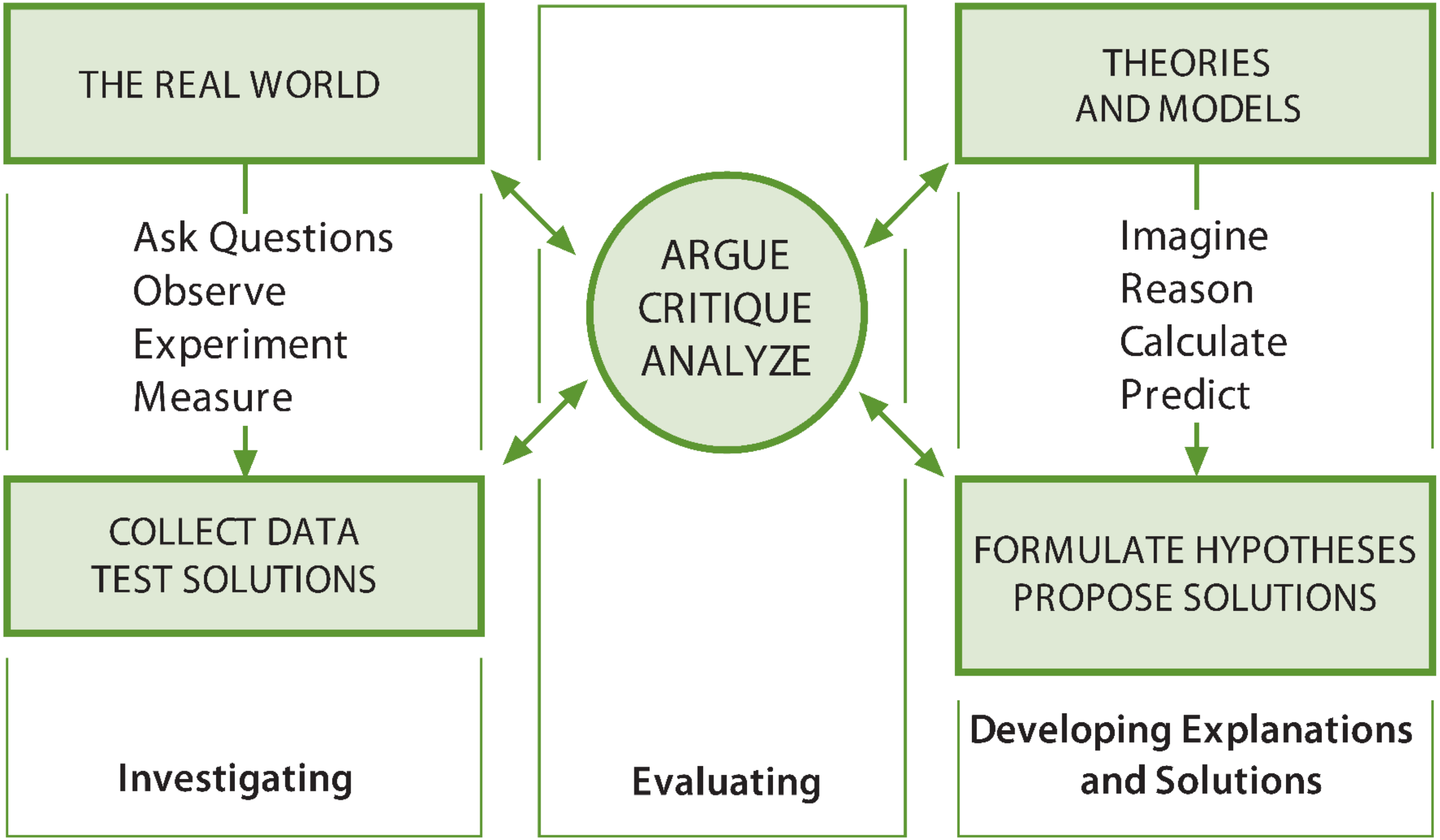
Scientific literacy involves knowing both (1) *what* scientists know & (2) *how* scientists know

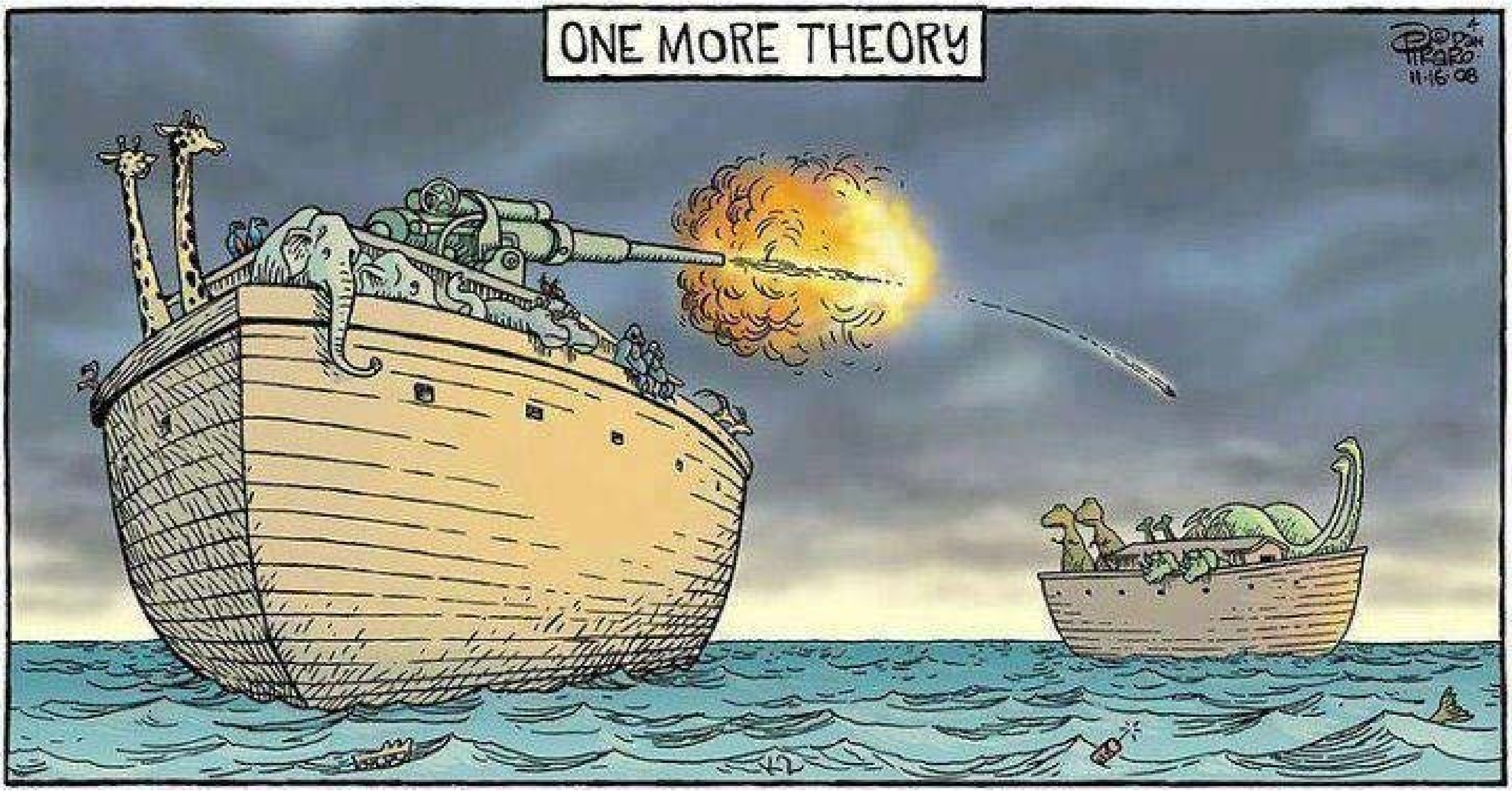


Evaluation as argument, critique, and analysis is central to scientific thinking and knowledge construction (NRC, 2012)

However, students may find scientific explanations to be implausible

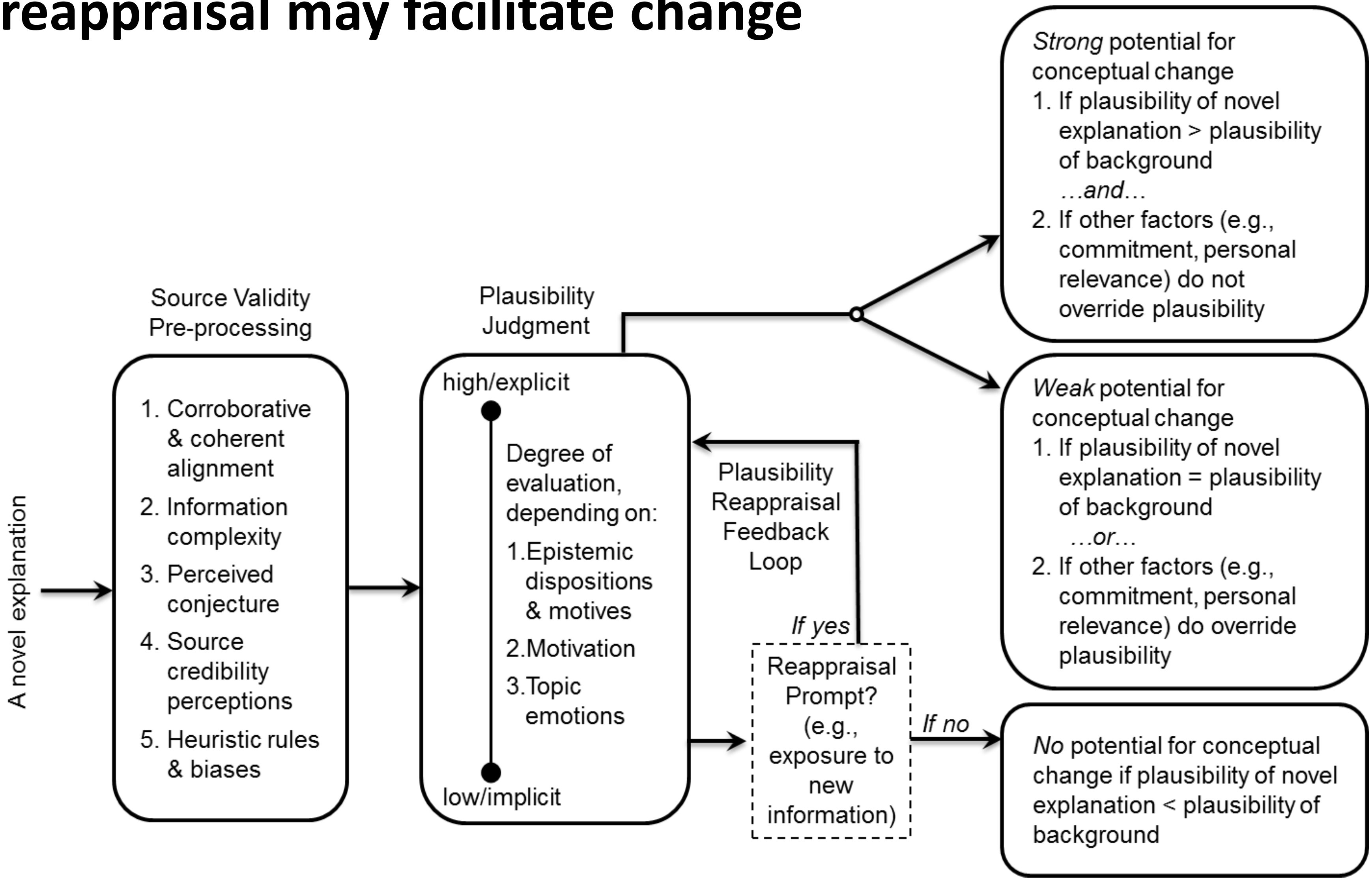
Epistemic judgments (e.g., plausibility) are often formed through automatic cognitive evaluations with little purposeful thinking (Lombardi et al., 2016a)

Plausibility is specifically an epistemic judgment associated with explanations



Other types of epistemic judgments are associated with evidence (e.g., credibility, reliability, & believability; Lombardi et al., 2016a)

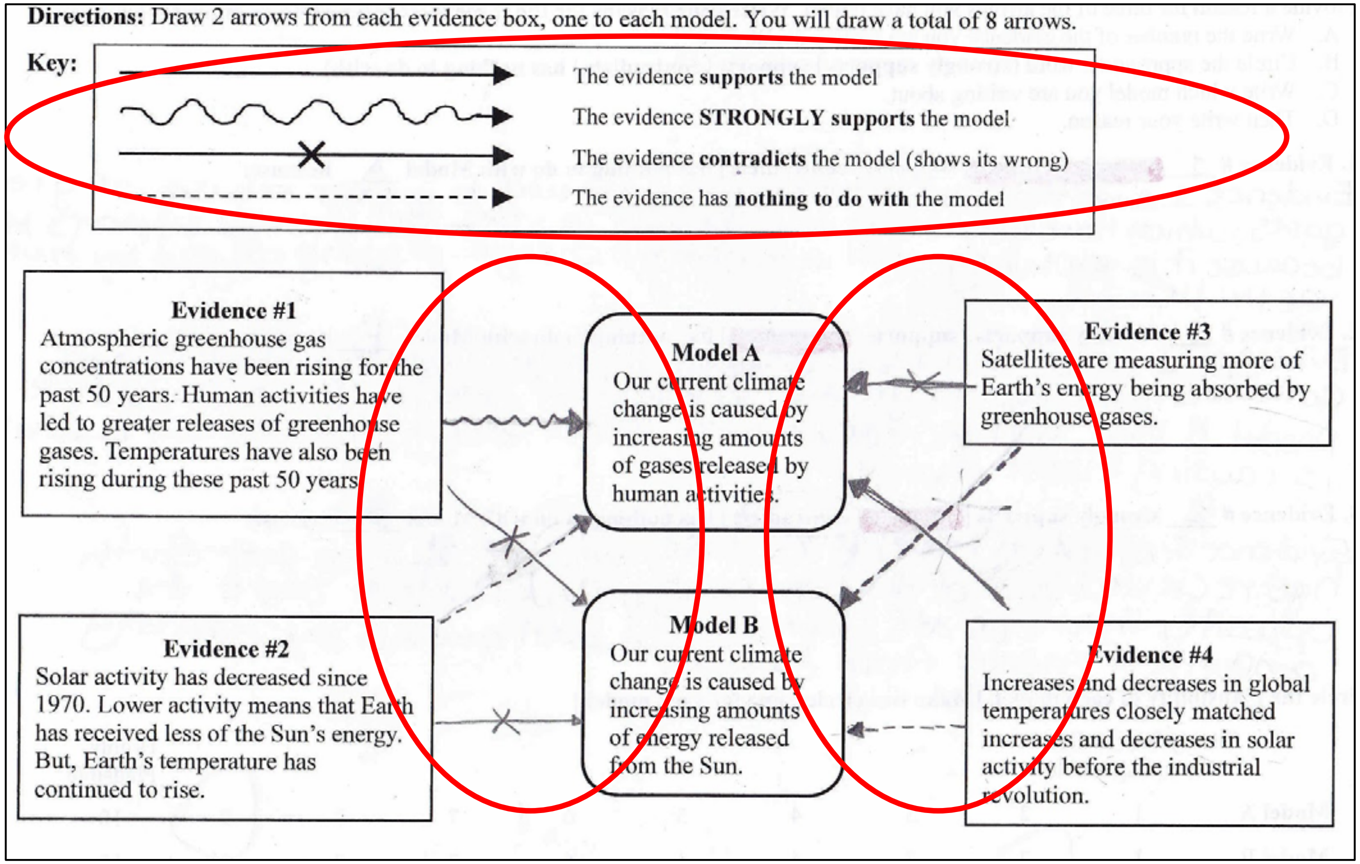
Plausibility is a tentative epistemic judgment, and with reappraisal may facilitate change



Model of plausibility judgments in conceptual change (PJCC; Lombardi et al., 2016a)

Instructional scaffolds can help make students' evaluations more explicit, thoughtful, & scientific…

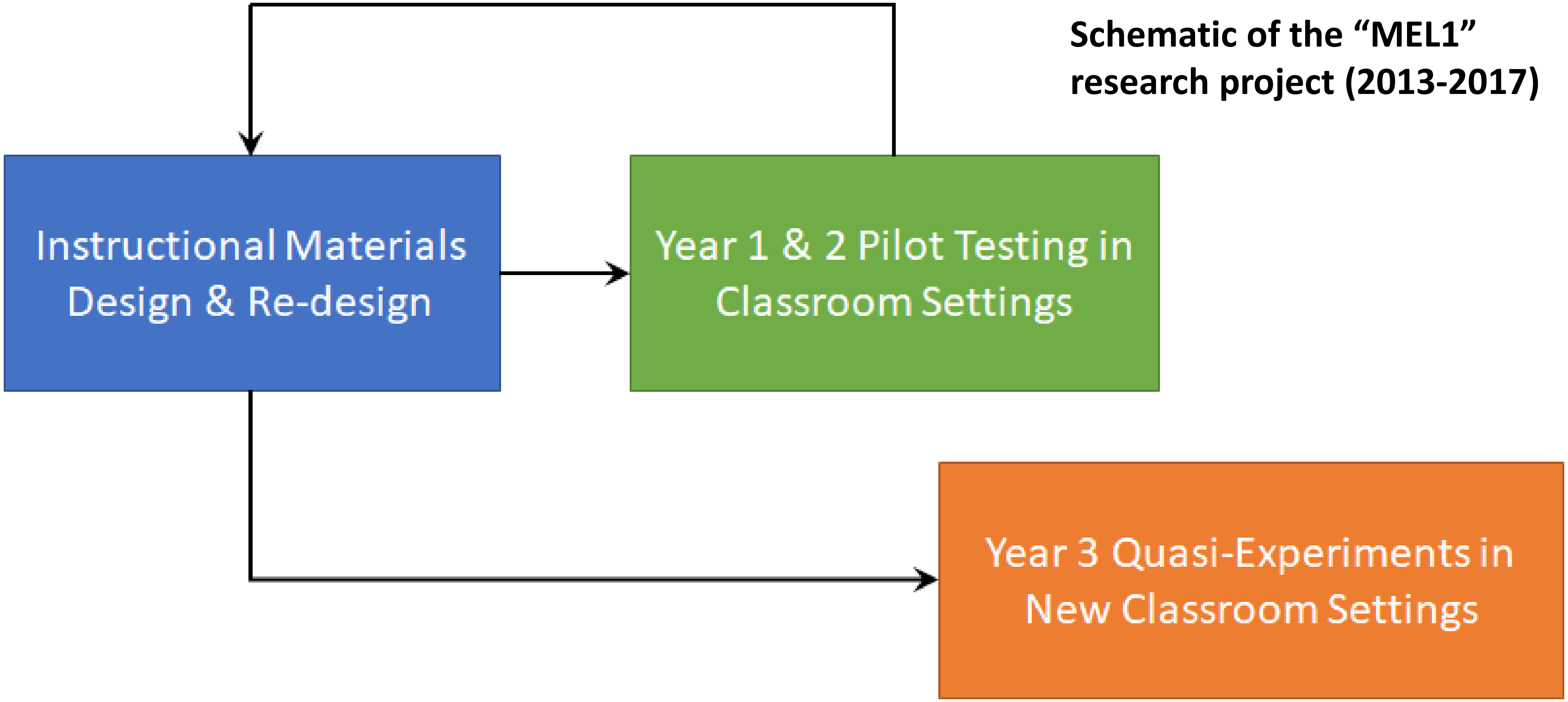
…Chinn & colleagues (2012, 2014)



Scientific evaluations may also promote students' reappraisal of their initial plausibility judgments & knowledge reconstruction (Lombardi et al., 2016a)

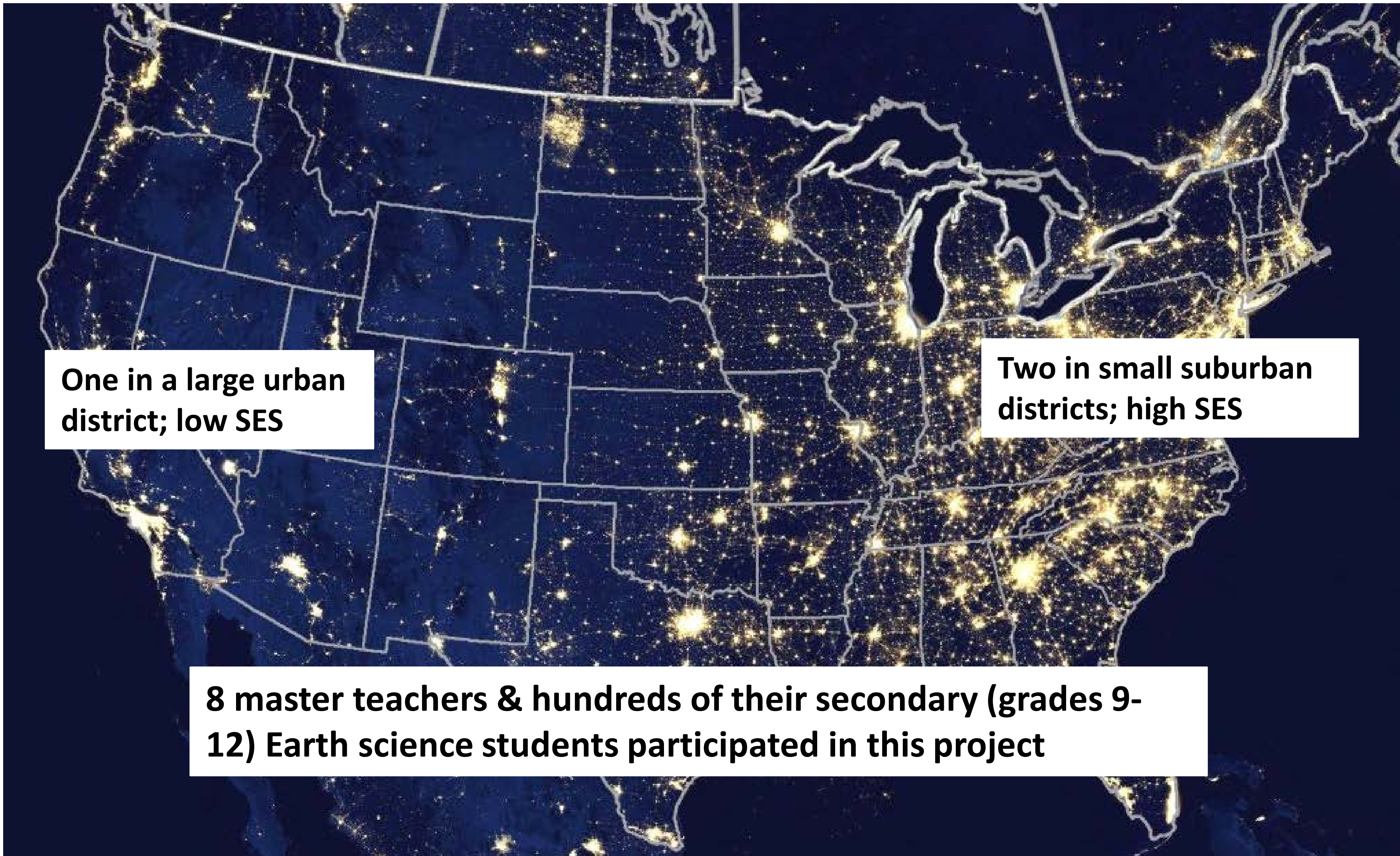
Our projects investigate students' evaluations, plausibility, & knowledge about Earth science topics

Schematic of the "MEL1" research project (2013-2017)



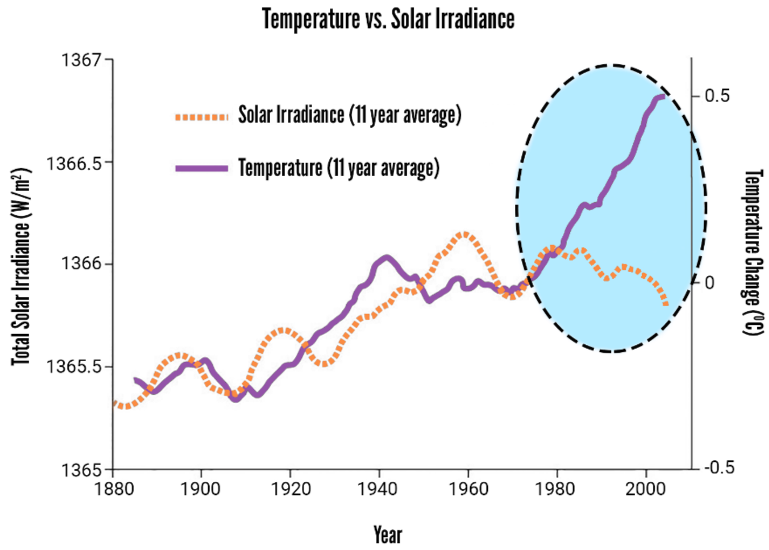
Our research question: How does sustained instruction promoting evaluation result in plausibility reappraisal and knowledge changes about Earth science topics?

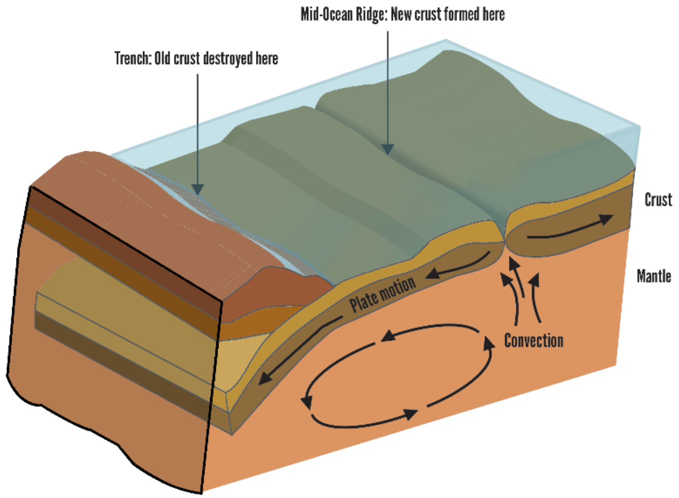
This first project involved three school districts from very different parts of the US



Secondary students experienced instruction about 4 topics during the course of a school year

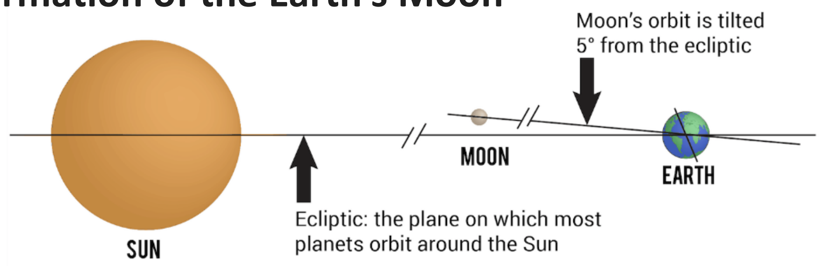
Causes of current climate change

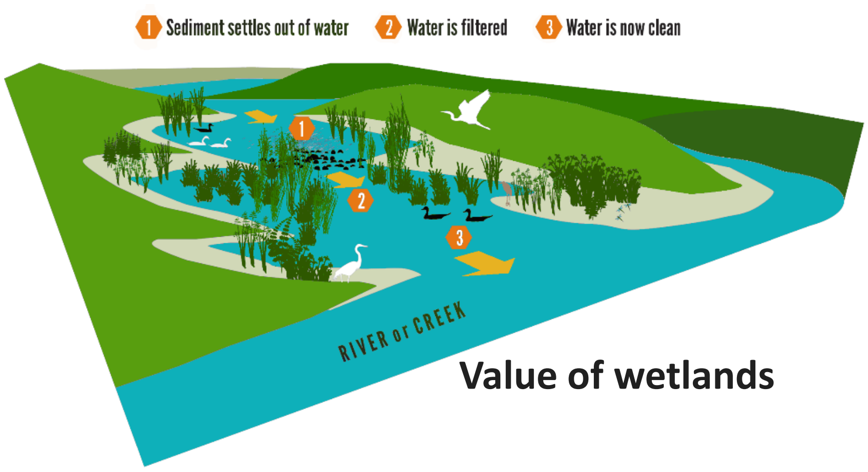




Hydraulic fracturing & earthquakes

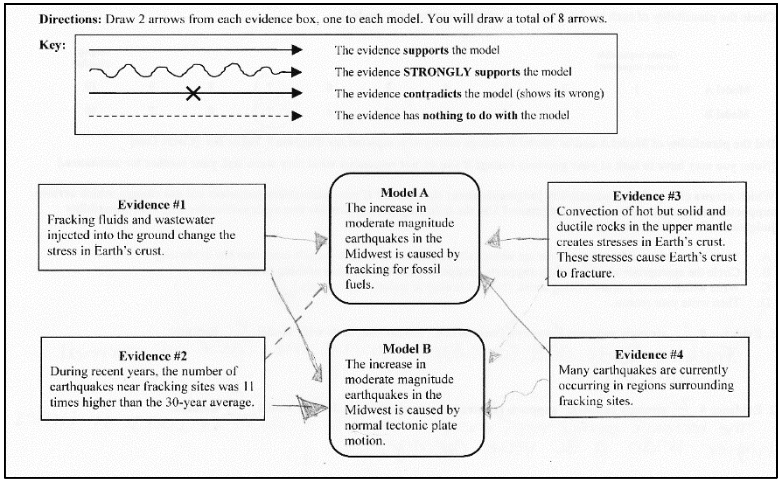
Formation of the Earth's Moon



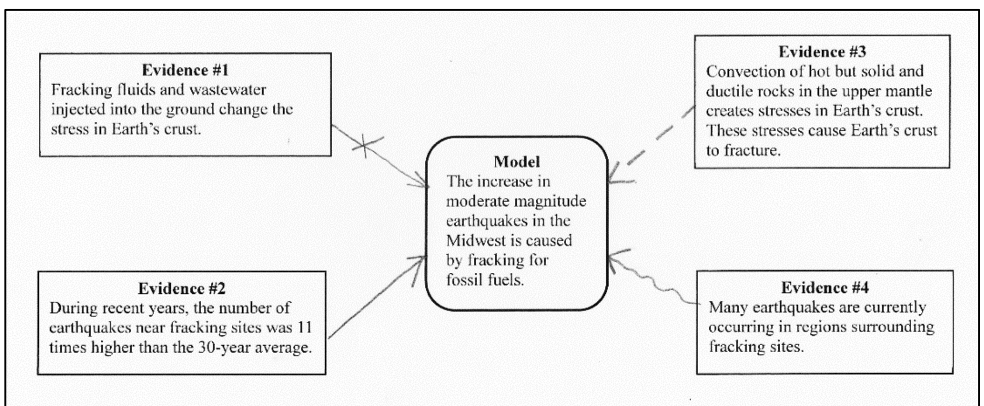


Value of wetlands

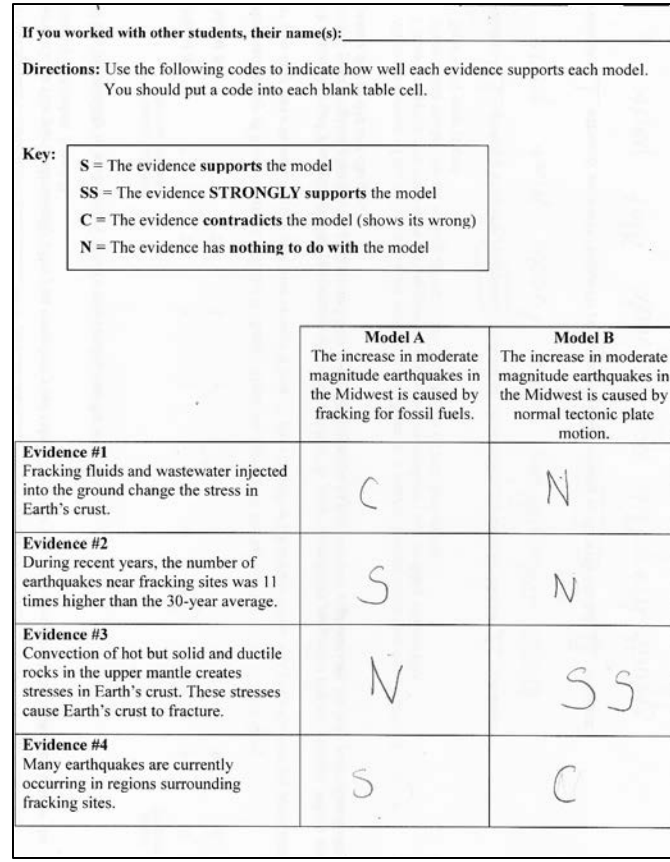
In Year 3, we conducted a quasi-experiment comparing three different tasks



The Model-Evidence Link (MEL) diagram, 4 lines of evidence, 2 alternatives



The Mono-MEL diagram, 4 lines of evidence, only 1 alternative



If you worked with other students, their name(s):____________________

Directions: Use the following codes to indicate how well each evidence supports each model. You should put a code into each blank table cell.

Key:

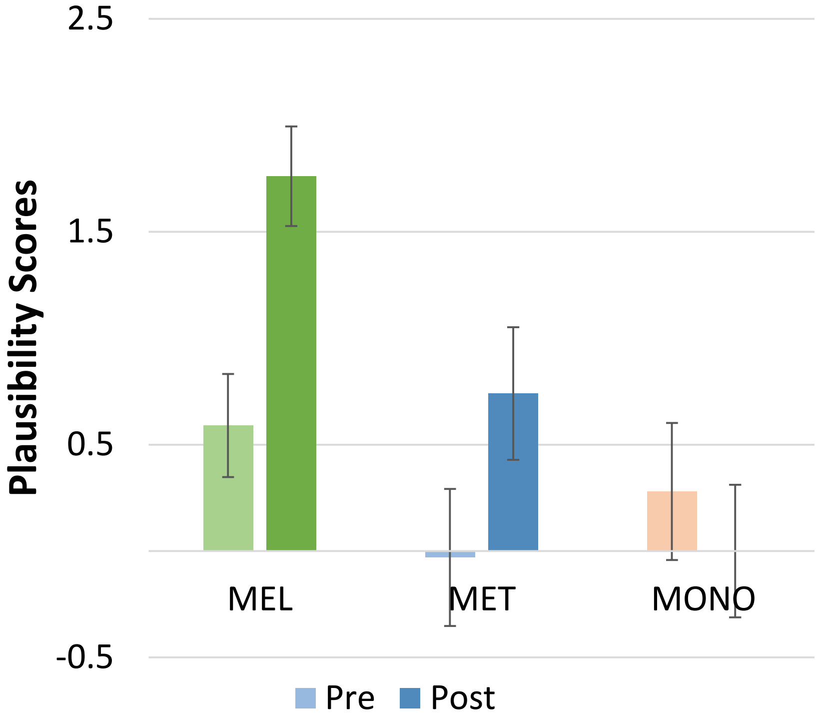
S = The evidence **supports** the model
SS = The evidence **STRONGLY supports** the model
C = The evidence **contradicts** the model (shows its wrong)
N = The evidence has **nothing to do with** the model

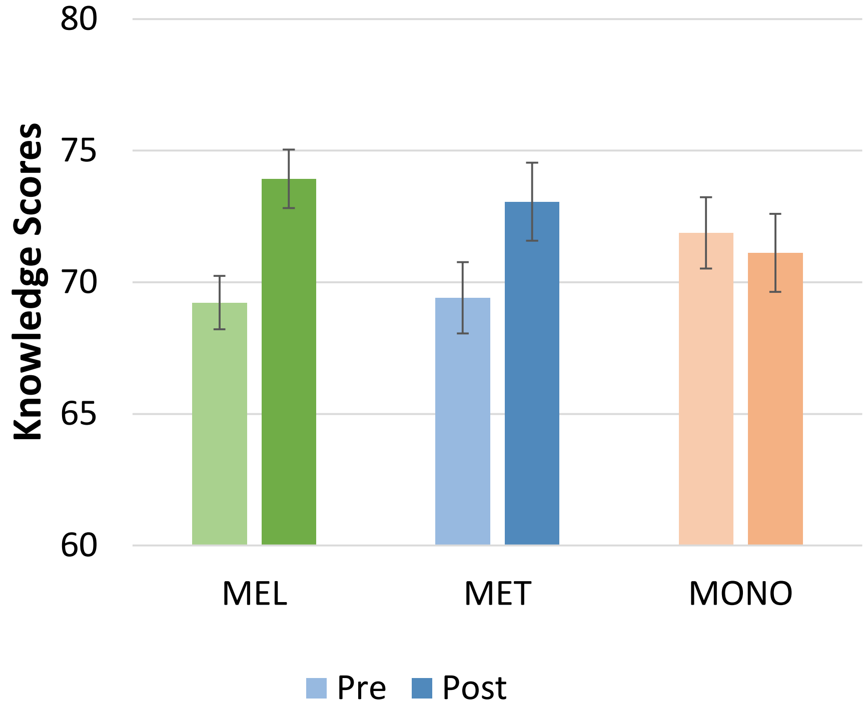
	Model A The increase in moderate magnitude earthquakes in the Midwest is caused by fracking for fossil fuels.	**Model B** The increase in moderate magnitude earthquakes in the Midwest is caused by normal tectonic plate motion.
Evidence #1 Fracking fluids and wastewater injected into the ground change the stress in Earth's crust.	C	N
Evidence #2 During recent years, the number of earthquakes near fracking sites was 11 times higher than the 30-year average.	S	N
Evidence #3 Convection of hot but solid and ductile rocks in the upper mantle creates stresses in Earth's crust. These stresses cause Earth's crust to fracture.	N	SS
Evidence #4 Many earthquakes are currently occurring in regions surrounding fracking sites.	S	C

The Model-Evidence Link Table (MET), 4 lines of evidence, 2 alternatives

Participants scores showed meaningful plausibility shifts and knowledge increases toward the scientific…

…but only when students simultaneously evaluated lines of evidence and two alternative explanations (Lombardi et al., 2018a)

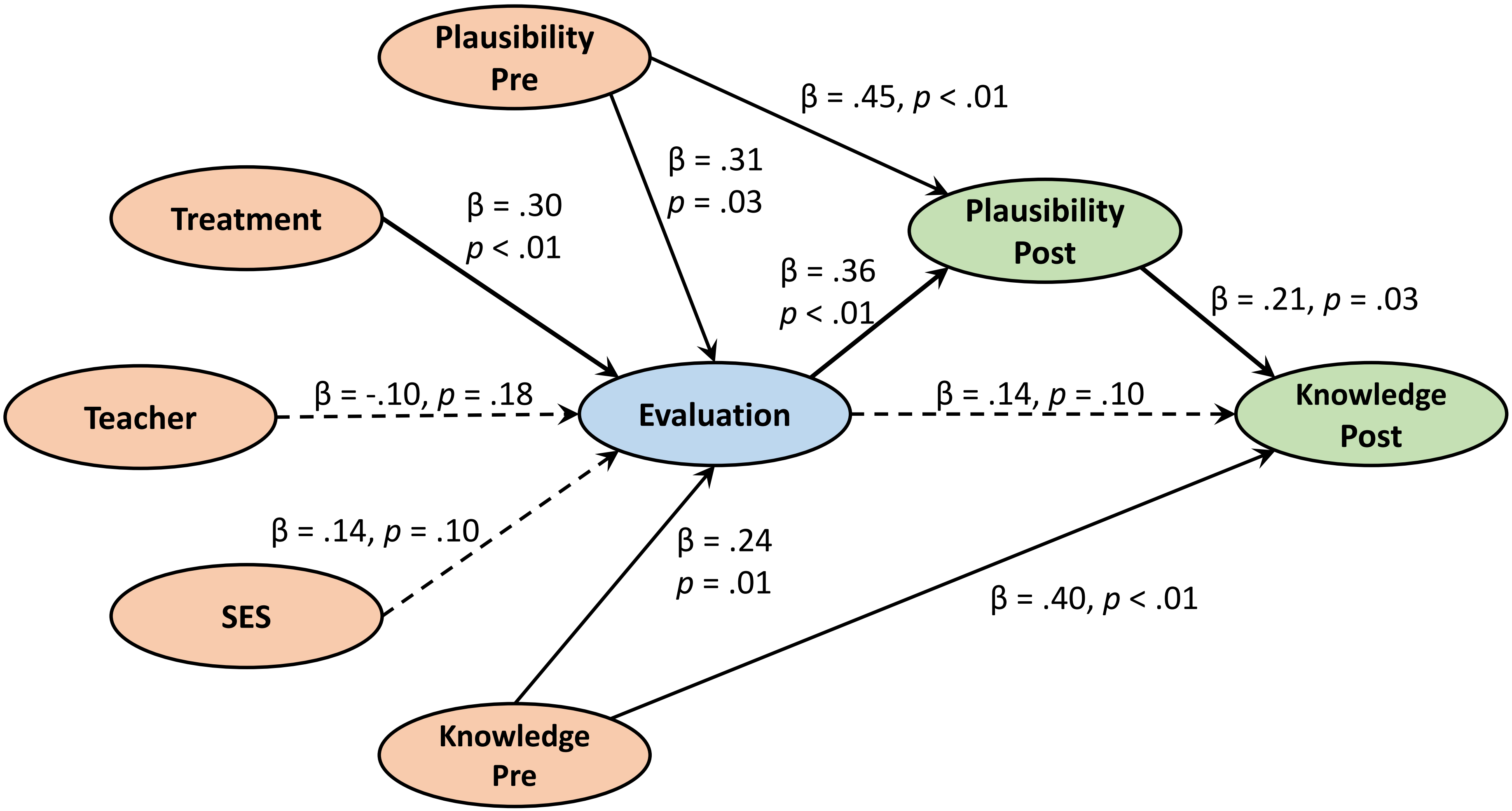




Wilks' λ = .843, $F(2,61) = 5.67$, $p = .006$, medium effect size ($\eta^2 = .157$)

Wilks' λ = .893, $F(2,61) = 3.67$, $p = .03$, medium effect size ($\eta^2 = .107$)

Deeper evaluations facilitated participants' plausibility reappraisals and greater knowledge



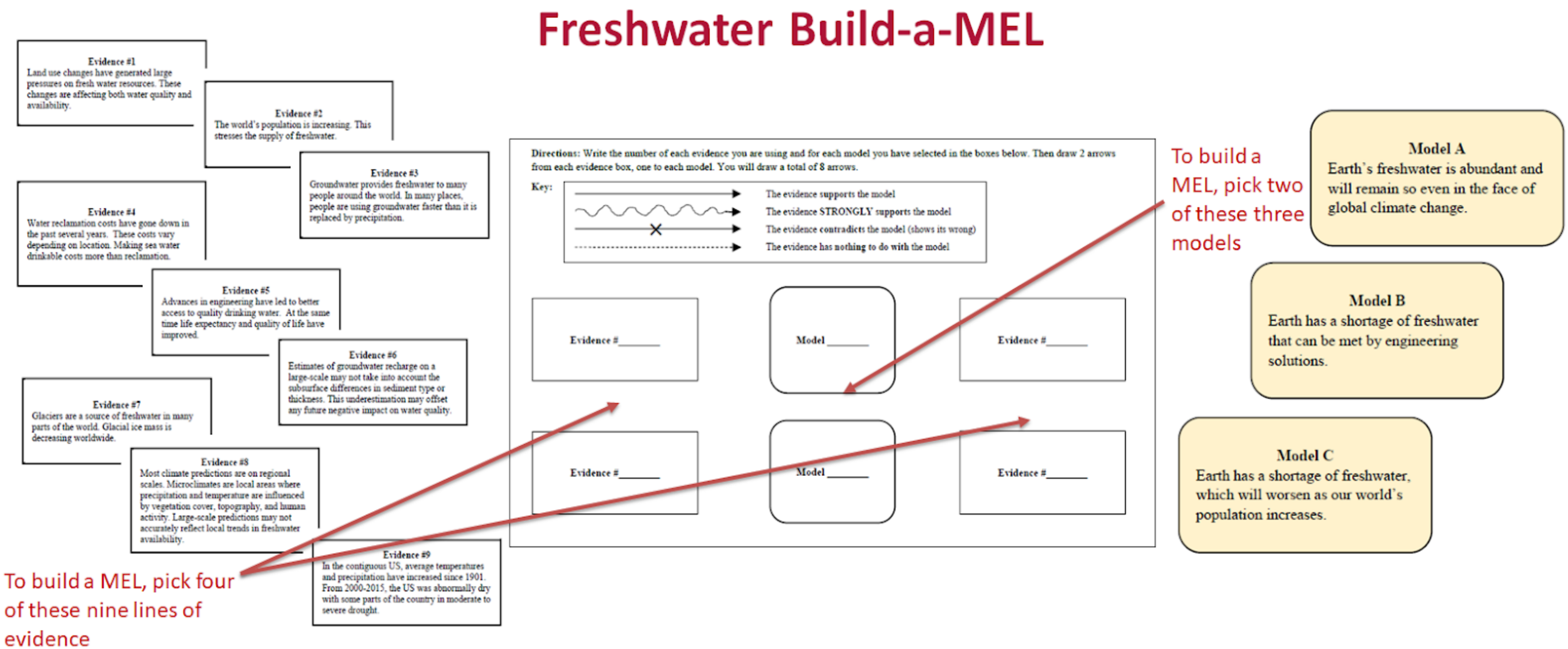
GoF = .437 (large explanatory power); APC = .265, $p < .001$; ARS = .330, $p < .001$; AVIF = 1.12; AFVIF = 1.46; and NLBCDR = 1.0; Lombardi et al. (2018a)

These results are aligned with and complementary to several empirical studies and recent theory…

…(e.g., Lombardi et al., 2013; Lombardi et al., 2016a,b,c; Lombardi et al., 2018b)

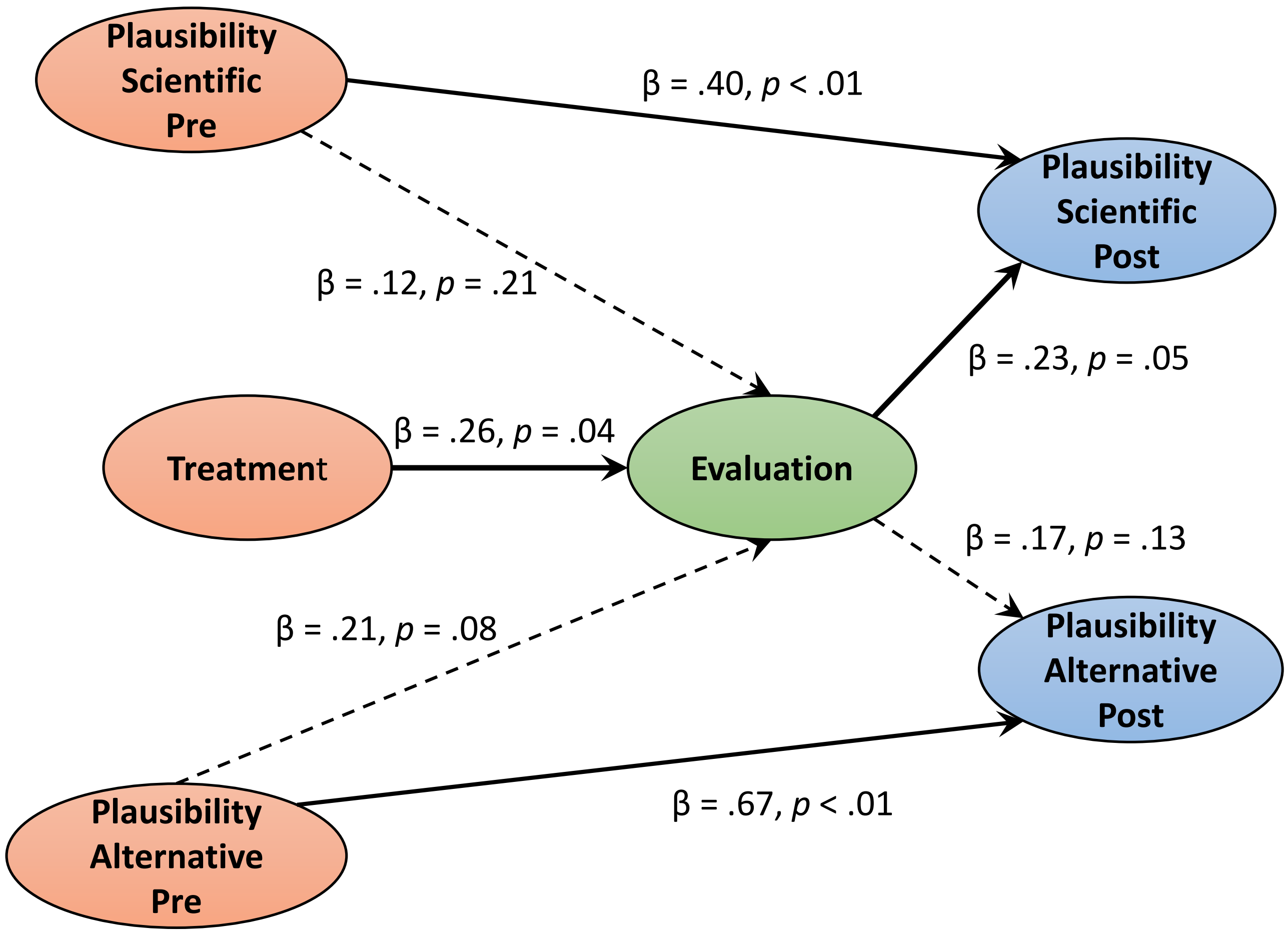
But we are unsatisfied, because unpublished results suggest that students are not transferring their evaluative thinking outside of the classroom context

Our current project examines scaffolds that increase students' "conceptual agency" (Pickering, 1995)



Students who exercise conceptual agency are authors of their own contributions, accountable to the classroom learning community, and have the authority to think about and solve problems (Nussbaum & Asterhan, 2016)

Initial pilot testing reveals that the baMEL may increase evaluations above the pre-constructed MEL



GoF = .434 (large explanatory power), ARS = .248

Researchers & teachers need to help students scientifically evaluate & reappraise their epistemic judgments…

…and development of scientific thinking practices are essential for all so that we can equitably address current and future global challenges

Acknowledgements and thank you!

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