

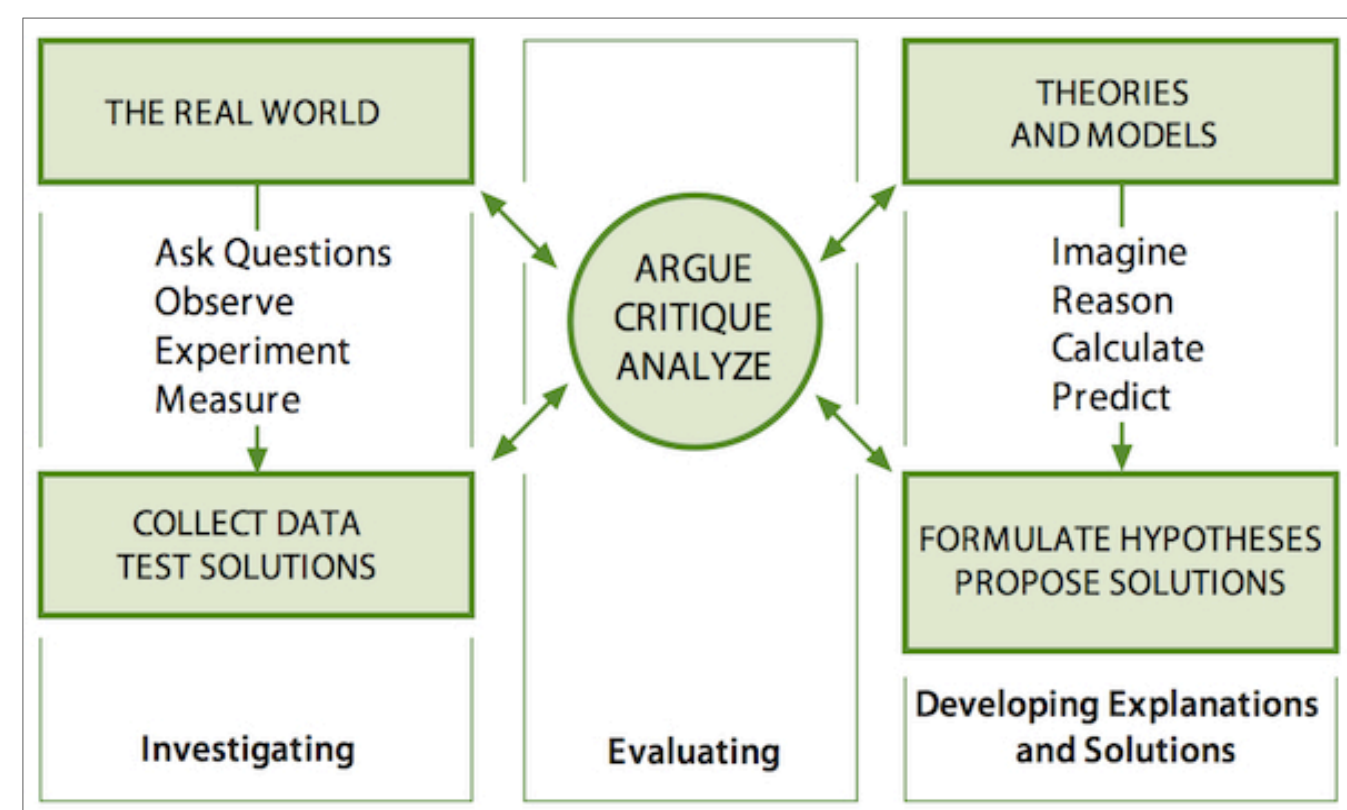
Deepening High School Students' Knowledge about Earth Science Topics Through Scientific Evaluation & Plausibility Reappraisal

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Critical evaluation is an important aspect of science and is receiving increasing attention in science education. The present study investigated (1) changes to plausibility judgments and knowledge as a result of a series of instructional activities that facilitated evaluation of scientific and alternative models in four different Earth science topics (climate change, fracking and earthquakes, wetlands and land use, and the formation of Earth's Moon) and (2) whether evaluations promoted by the activities mediate the relation between post instructional plausibility and knowledge. Repeated measure MANOVAs showed that participants shifted toward scientifically accepted explanations and increased their knowledge about relevant Earth science topics after participating in the activities. Greater levels of plausibility reappraisal mediated the relation between evaluation and knowledge, as shown by structural equation modeling. Effect sizes were small to large, depending upon topic and instructional context. The activities used in this study can help students develop their critical thinking skills by facilitating evaluation of the validity of explanations based on evidence, a scientific practice that is key to understanding both scientific content and science as a process.

Background

- ❖ “Scientific knowledge is a particular kind of knowledge...justified and critiqued on the basis of evidence and...validated by the larger scientific community.
- ❖ ...alternative interpretations of scientific evidence can occur...such interpretations must be carefully scrutinized, and...the plausibility of the supporting evidence must be considered.” (NRC, 2012, p. 251)
- ❖ Critical evaluation may be especially important for understanding scientific topics with a large *plausibility gap* (Lombardi et al., 2013).



The three spheres of activity for scientists and engineers (NRC, 2012, p. 45)

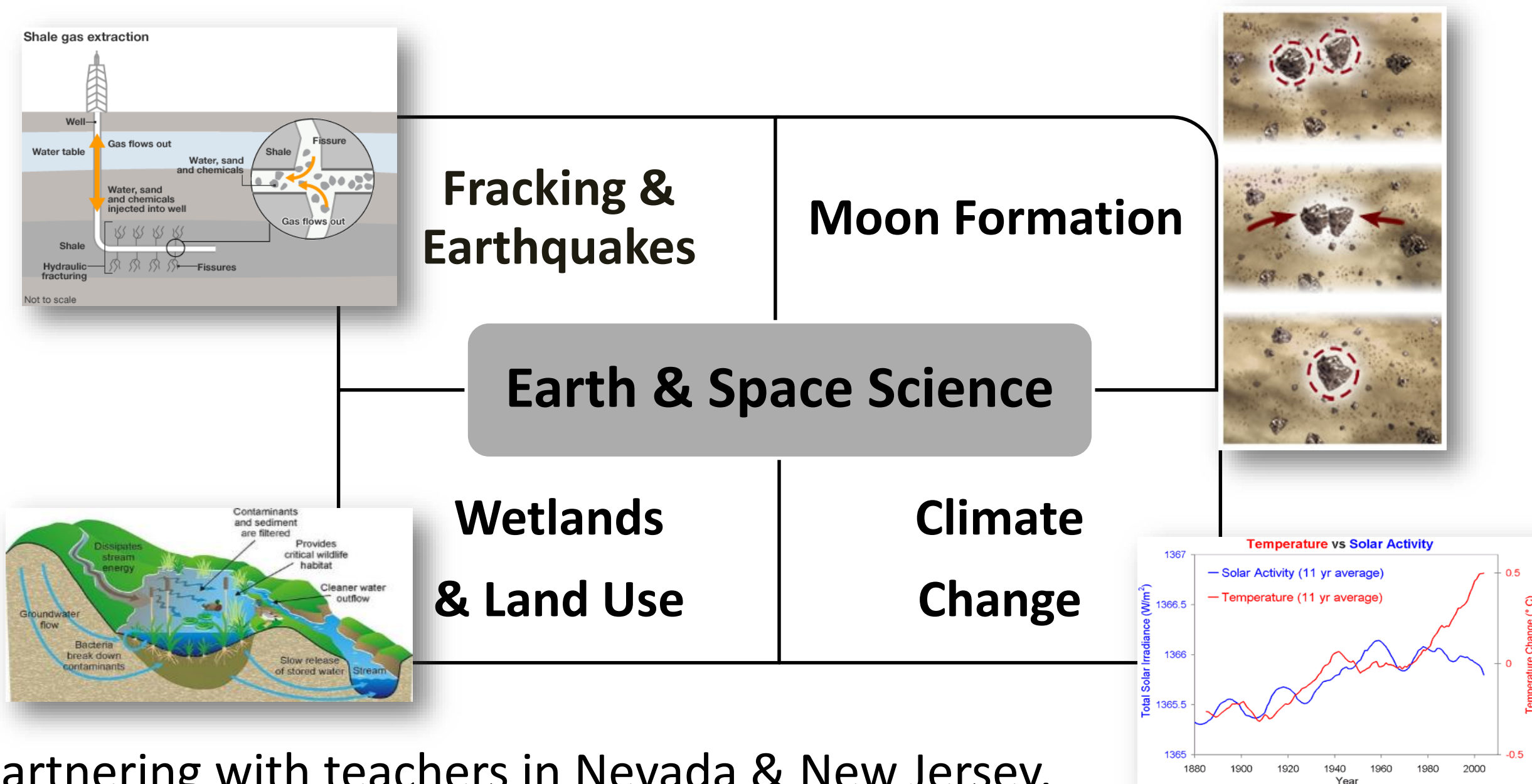
- ❖ **Plausibility Gap:** Where individuals find competing—but non-scientific—ideas more plausible than explanations offered by scientists.

Model-Evidence Link (MEL) Diagrams

- ❖ MELs potentially promote critical evaluation and plausibility reappraisal of explanations and deeper knowledge of scientific phenomena (Lombardi et al., 2016).
- ❖ MELs are easily integrated into the curriculum because they are modular and can be used as a substitute for more traditional, but less effective, instruction.

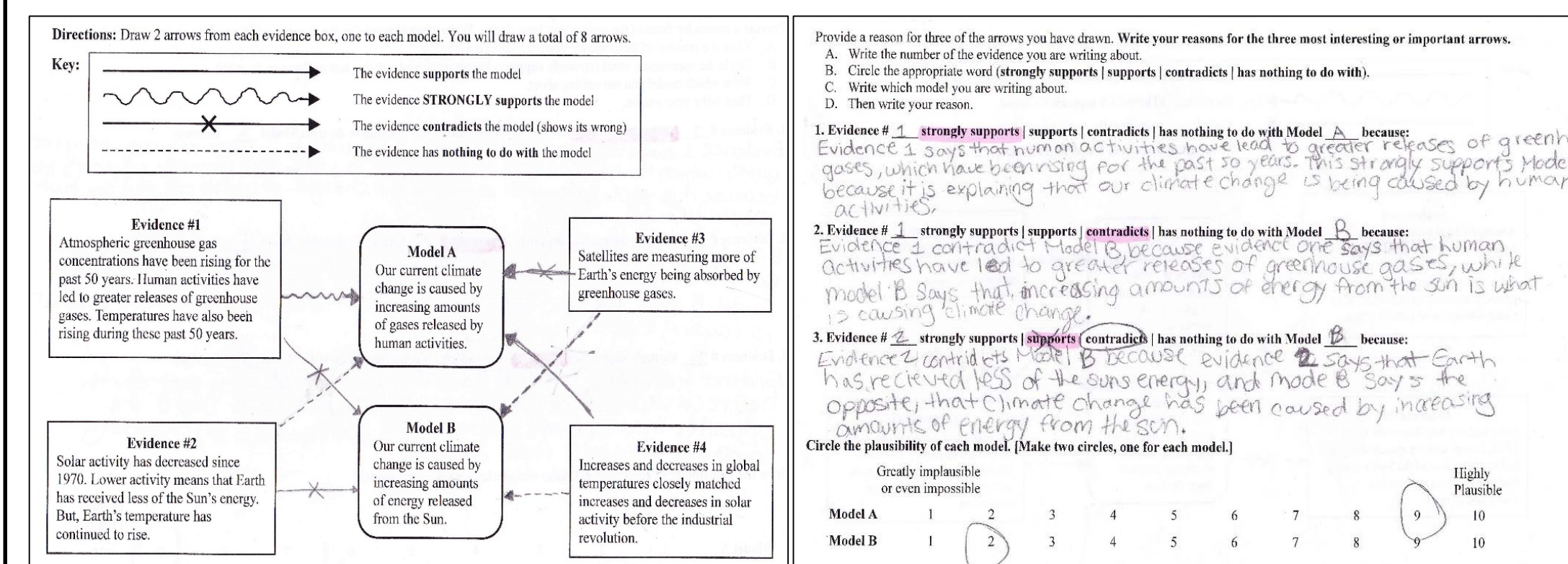
The Project

- ❖ Researchers at Rutgers University developed the structure and mode of the MEL (Chinn & Buckland, 2012) for life science.
- ❖ We are developing MELs for Earth and space science topics:



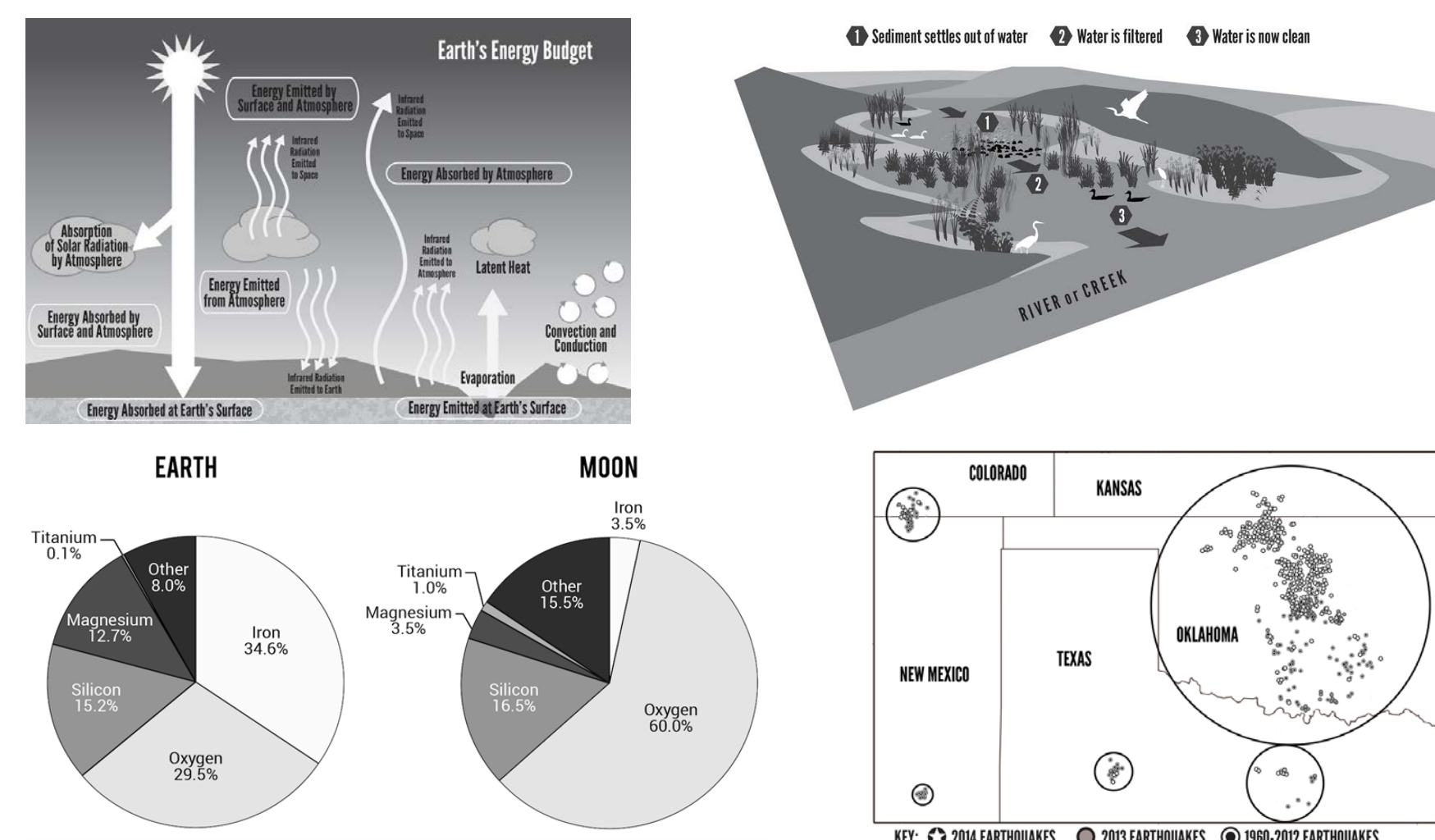
- ❖ Partnering with teachers in Nevada & New Jersey.
- ❖ High school Earth science students are participants.

Example: Climate Change MEL



A student example of a completed model-evidence link (MEL) diagram about explanations of current climate change.

Evidence

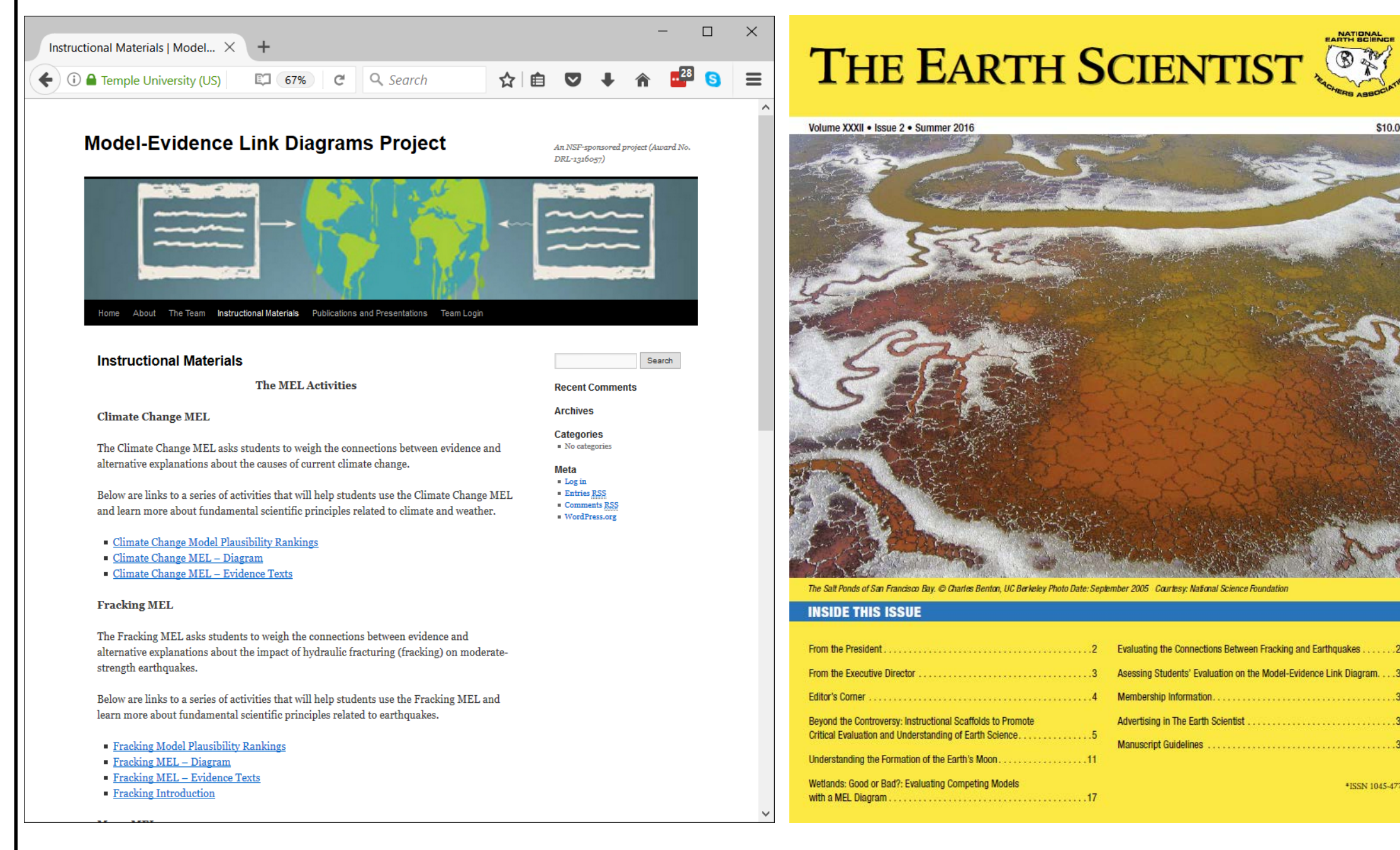


These are examples of figures associated with each evidence text. There is one set of evidence texts for each MEL.

For More Information

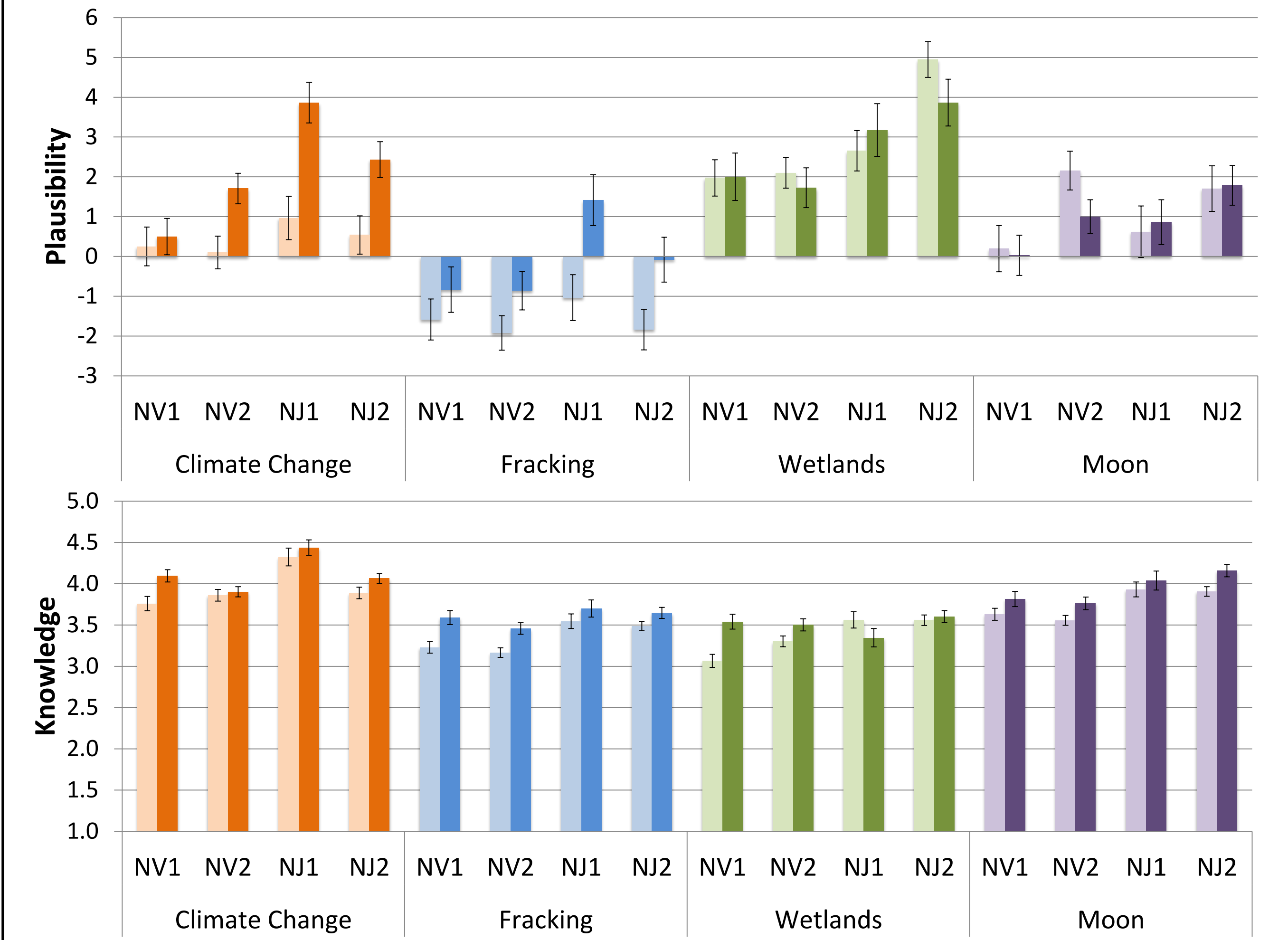
<http://sites.temple.edu/melidiagrams/>

- ❖ The website contains all the MELs and associated materials for free download.
- ❖ Our recent open-access issue in *The Earth Scientist* facilitates access to our project's instructional materials.

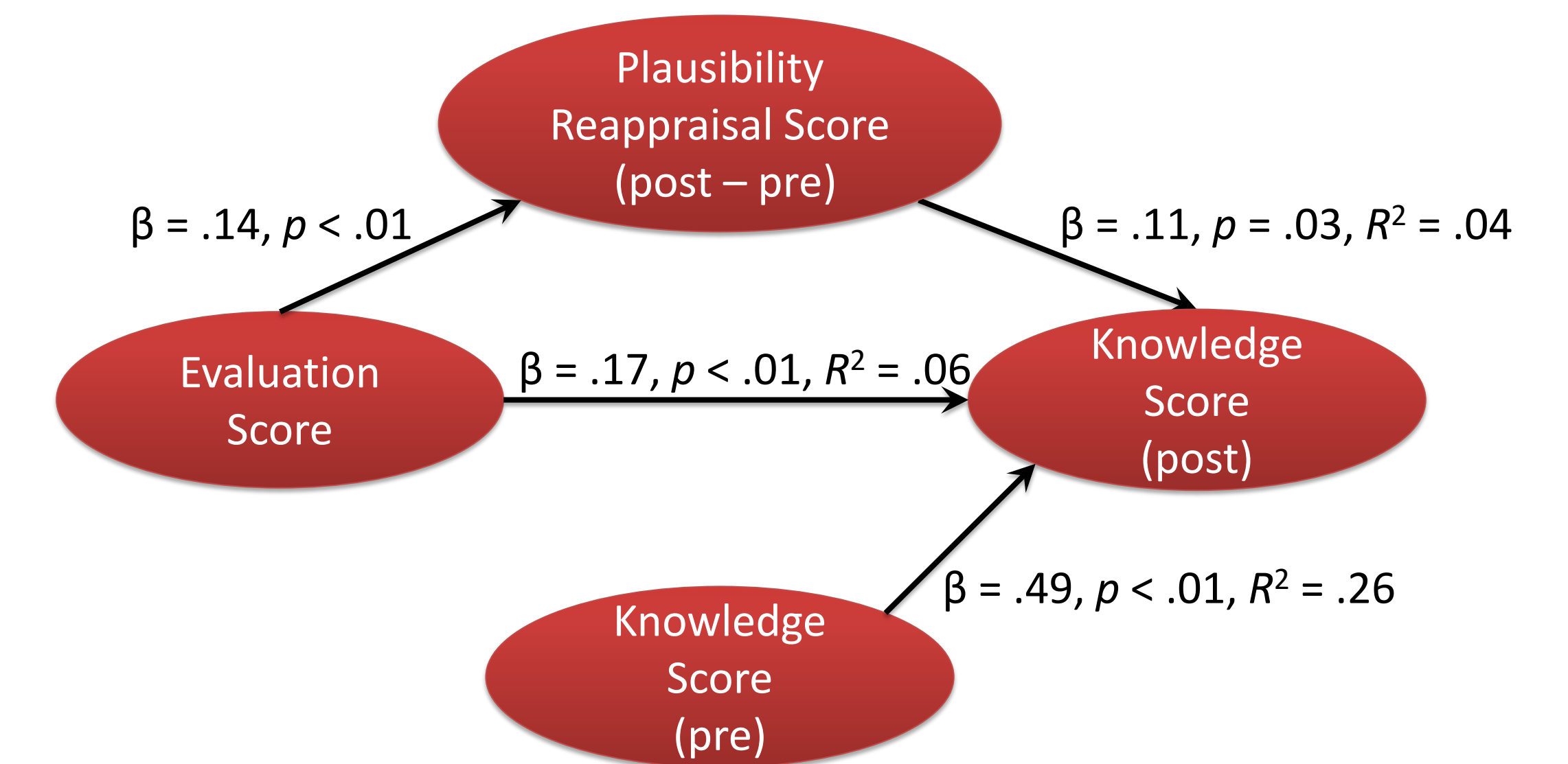


Research Results

- ❖ Year 1 of the project included initial material development and preliminary testing of materials.
- ❖ Year 2 included a full-scale, year-long pilot test of revised materials with 4 teachers and their students (2 in New Jersey & 2 in Nevada).



Pre (lighter shade) to post (darker) instructional changes in plausibility and knowledge for the four MELs by teacher, with standard error bars.



The MELs mediated the relation between evaluation and knowledge through promotion of students' plausibility reappraisal.

References

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