

**CoRe: Content Representation Tool
(Loughran, Mulhall, & Berry, 2004)**

Laura Guerdan

Big Idea:	Scientific Knowledge is tentative.
1. What you intend students to learn about this idea	I think it is critical that students understand that scientific knowledge can be revised or changed and even completely reversed. “Students should recognize that scientific knowledge is provisional. Current scientific knowledge is the best we have but may be subject to further change given new evidence” (Osborne, 2002).
2. Why is it important for students to know this	Driver states that it is important for students to understand the nature of science “to improve scientific literacy; that is, increase the numbers of ‘scientifically literate’ adults in society and hence to improve public understanding of science” (Driver et al, 1996). In addition to the broad aim of increasing society’s understanding of NOS, Driver also argues that learning about the tentativeness of science helps students to be more successful in the classroom. She states, “students who view science knowledge as revisable (dynamic) rather than fixed (static) were less likely to believe that learning science depended on memorization and achieved a more integrated understanding of the topic of study” (Driver et al, 1996).
3. What else you know about this idea (that you do not intend students to know yet).	<p>In addition to realizing that scientific knowledge is tentative, I have some knowledge and understanding concerning how scientific knowledge can change.</p> <ul style="list-style-type: none"> - McComas discusses the myth that “Science and its Methods Provide Absolute Proof.” He states that “whether scientists routinely try to falsify their notions and how much contrary evidence it takes for a scientist’s mind to change are issues worth exploring,” (1996). Chalmers explores this very notion by examining the beliefs of both Kuhn and Popper. -A key feature of [Thomas Kuhn’s] theory is the emphasis placed on the revolutionary character of scientific progress, where a revolution involves the abandonment of one theoretical structure and its replacement by another , incompatible one” (Chalmers, 1999). Kuhn’s theory states that scientists work within one paradigm until enough anomalies are presented that a paradigm shift occurs (Chalmers, 1999). - Popper’s theory of Falsification states that “science progresses only by trial and error, by conjectures and refutations” (Chalmers, 1999). Further, Popper believed that “speculative theories are to be rigorously and ruthlessly tested by observation and experiment. Theories that fail to stand up to observational and

	experimental tests must be eliminated and replaced by further speculative conjectures” (Chalmers, 1999).
4. Difficulties/limitations connected with teaching this idea	<p>-I have learned that a teacher can understand the nature of science and even believe that teaching NOS is important, but not have the skills or resources necessary to successfully teach NOS to students in the science classroom.</p> <p>-Since the Chemistry department has a common curriculum and common assessments, I need to convince my colleagues that teaching the Nature of Science is important.</p> <p>- Teaching and assessing NOS in the classroom requires a significant amount of time.</p>
5. Knowledge about students’ thinking which influences your teaching of this idea	Driver states that “most [students] show no sign that they appreciate the conjectural nature of theories” (1996). In my own experience, students think of scientific knowledge as absolute and invariable. When first presented with the idea that science is tentative, students often ask why we bother to study the information if it can change. As a result, it is especially important that my students understand the overarching goal of science, in addition to other big ideas about NOS.
6. Other factors that influence your teaching of this idea	Most well-known scientific theories, laws, or discoveries are associated with men. Additionally, there are very few famous scientists who are women. I have noticed that the girls in my class (in comparison to the boys) are less confident in their answers, and hesitate to respond to questions. By teaching the Nature of Science, in addition to historical aspects of science, the females in my classes may gain confidence in their scientific abilities and may begin to realize that science is not ‘just for the boys’.
7. Teaching procedures (and particular reasons for using these to engage with this idea)	<p>-Using bridging analogies to help students better understand the nature of science, such as relating tentativeness to a weather forecast. I would question students as to why a meteorologist can change the forecast daily, and then relate that tentativeness to other ‘textbook’ science concepts.</p> <p>-The story about magnet therapy is one that I would share with my students. I would ask students to formulate a moral to the story. This would help my students understand that conflicting thoughts or ideas can lead to new scientific knowledge, and that sometimes that new knowledge replaces an existing theory or speculation.</p> <p>- In class, I would use lab activities or other curriculum materials to imbed NOS teaching. However, I know that in order for NOS teaching to be effective, I must be explicit in making a connection that explains how the classes’ actions or thinking is similar to how scientists act or think. I cannot assume that my students will make the connection themselves and must take time to specifically address the Nature of Science within my</p>

	<p>daily science lessons. Additionally, my NOS teaching must not be a separate unit, but must be present in each unit throughout the school year.</p> <p>-To demonstrate the tentativeness of science, I would find an older earth science book that discusses Pluto as a planet, and then a more recent book that does not include Pluto as a planet. I would let students examine each source and then ask students which book they would recommend the district use. Students would need to defend their thinking, and the class would partake in a group discussion of how scientific thinking can change.</p> <p>- I would also use my cartoon as a way to spark discussion in class concerning the tentativeness of science. I would have students write their ideas about which character they agree with most, and would then have my students pair with a partner to discuss their ideas. We would then have a whole-class discussion about the cartoon that would allow us to more closely examine the idea of science being tentative.</p>
<p>8. Specific ways of ascertaining students' understanding or confusion around this idea.</p>	<p>- In my science classroom, I would likely use the V-NOS tool or a similar questionnaire to understand students' initial understanding of NOS at the start of the year. I would use the same tool at the end of the school year to examine if student's ideas of NOS have changed.</p> <p>- The card sort activity would allow me to make students thinking 'visible'. While students work on the activity, I will be able to walk around the classroom and see how students sort the terms. This would allow me to understand how students think about NOS. Additionally, I could use the card sort activity at several points throughout the year so that I can gauge if student's ideas about NOS are changing.</p> <p>- The cartoon activity would also provide me with information about students ideas, understanding, and confusion around the idea of science being tentative.</p> <p>- A formal assessment, such as a test question concerning the tentativeness of science, would also allow me to understand student's thinking.</p>

References

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