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| **Title: Philosophy of Science. Objectivity vs Situated Science.** |
| **Learning goals**:   1. Explain how steps in The Scientific Method applies to the daily practice of Science; and how it does not. 2. Define objectivity in Scientific knowledge, and why claims of objectivity privileges Scientific knowledge over other fields of knowledge. 3. Understand Kuhn’s view of scientific progress, and define the terms paradigm, scientific revolution and normal science. 4. Differentiate between The Scientific Method and Kuhn’s description of Science; especially in terms of objectivity vs situated knowledge. Understand the role of limited available resources (including time, money, and technology) in experimental design and scientific work. 5. Appreciate the importance of philosophy of science in providing understanding of the importance of science in our world. |
| **Instructions for the faculty**:  This subunit begins before introduction to Van Halen and Brown M&Ms. The Scientific Method is first introduced and discussed, then the Brown M&Ms experiment is introduced to illustrate The Scientific Method in action. I recommend teaching this subunit with **subunit I: Experimental Design and Hypothesis Testing in the Real World**, as discussions on both The Scientific Method and Nature of Scientific Revolution can be incorporated into that subunit. These discussions add another session (about 2 hr) to this teaching unit, and includes 2 pieces of homework, each about 1 hr each.  ASSUMED PRIOR KNOWLEDGE: Students should have some familiarity with The Scientific Method, learned in previous Science classes.  FACULTY SPECIALIZED KNOWLEDGE. Some familiarity with Kuhn is useful, but not strictly necessary. The reading provided here gives a pretty good description of Kuhn’s philosophy. Examples given of paradigms described here should be understood before class discussion, and can be replaced as long as they illustrate the same key aspects of the nature of paradigms. |
| **Intended outcomes**:  After this activity, students should recognize that an understanding of philosophy of science can actually help them understand and critique Science. Students should also understand that objectivity of science is actively questioned and scrutinized. |
| **Assessment**: There are two handouts associated with the different readings. |
| 1. **Day 0.** Assign handout on The Scientific Method (TSM) the night before the first class (Student\_HandoutTSM) (This homework take ~30 minutes). 2. **Day 1.** **TSM. History.** Start with discussion on history of The Scientific Method. (Faculty\_HandoutTSM\_ANSWERKEY). Go over main-points of the history of TSM, in particular how modern TSM was developed in Vienna Circle. 3. **Structure.** Discuss the steps in the modern TSM (Faculty\_TSMFlowchart). 4. Follow this up with discussion on the characteristics of TSM around objectivity/universality. 5. **Weaknesses.** Now discuss problems with TSM. What can it not do? 6. **Use.** Despite its failings, TSM is still a powerful philosophy and image of science. Though it is a flawed philosophy, it remains an underlying structure in how we understand science. If you had assigned a primary paper prior to this discussion, refer back to the primary paper, and show how structure of papers conforms to steps in TSM (Faculty\_TSMflowchart). 7. Now, with an understanding of TSM, begin the VanHalen teaching unit, focusing on how different parts of the teaching unit/example corresponds to different steps of TSM during different points of the class discussion (Faculty\_TSMflowchart). 8. If you’re using the subunit on Experimental Design in the Real World, you can link new information and revision of hypothesis to latter steps on TSM. 9. After discussion on conclusions. Point out how TSM can be used for pseudo-science by reversing steps (Facuty\_flowchart). By already deciding what your conclusion will be, you can ‘walk backwards’ and select the results that corresponds to the result, then walk backwards again and state your hypothesis that fits the result (Faculty\_TSMflowchart). If teaching subunit on statistics, you can incorporate Wakefield’s discredited paper on vaccination as one example. 10. End of first day. Assign reading on Kuhn (Student\_Kuhnreading) and corresponding worksheet (Student\_Kuhnworksheet). 11. **Day 2.** Discuss Kuhn in class. (Faculty\_Kuhnworksheet\_AnswerKey). Start with a discussion on History of Scientific Revolution as a reaction to TSM; that it tried to show that Science was not objective/universal, but instead was historically situated. 12. In terms of paradigms, focus on Kuhn’s concept of paradigms with examples (Faculty\_Ondinos&paradigms). The three examples are meant to illustrate different important aspects of paradigms. (1.) In the Non-Avian Feathered Dinosaur example, it illustrates that the same evidence can mean completely different things under different paradigms. (2.) The BMI and Myocardial Infarction example shows that paradigms has real world consequences in terms of application of Science and knowledge. (3.) The Van Halen example illustrates that we all have paradigms that informs our work in Science. |