SCIENTIFIC REASONING AND THE PRINCIPLES OF SCIENCE

Science, at its essence, is a process of discovery relying on testable ideas to produce explanations of the natural world. This process, grounded in the Nature of Science and Scientific Reasoning, has resulted in fundamental Scientific Principles allowing us to explain natural phenomena and make informed decisions. Scientific explanations, in turn, often rely on mathematics as the language that describes the natural world.

The Air Force needs science-proficient officers who can make decisions in a world increasingly influenced by scientific and quantitative data. Therefore, the goal of this outcome is to develop science-proficient officers, officers who exercise *scientific habits of mind*[1] including proficiency in the Nature of Science, Scientific Reasoning, and the Principles of Science. These proficiencies are not discipline specific, but are instead integral themes that apply across the natural sciences. To become science-proficient and quantitatively literate officers, cadets must encounter these proficiencies in multiple disciplines.

These proficiencies group into the following three categories:

- ***Nature of Science***.[2] "Science is both a body of knowledge and a process"[3] for building that knowledge. Underpinning this process are perspectives scientists share, forming the *Nature of Science*.
- ***Scientific Reasoning***.[4] Scientific reasoning is the structured, self-correcting system of inquiry that enables individuals to test ideas in order to build reliable explanations of the natural world.[5]
- ***Principles of Science***. Scientific reasoning has resulted in the discovery of fundamental principles explaining the natural world.

USAFA GRADUATES WILL BE ABLE TO:

Nature of Science. [2]

Proficiency 1: Determine if explanations or claims are consistent with the Nature of Science.

Proficiency 2: Explain how a scientific explanation can simultaneously be broadly accepted as reliable yet provisional.

Scientific Reasoning.

Proficiency 3: Generate scientifically testable predictions using if-then reasoning.

Proficiency 4: Evaluate the validity of study design and data collection methods in scientific investigations.

Proficiency 5: Represent and interpret data using mathematics and graphics.

Proficiency 6: Propose rational conclusions through systematic evaluation of results.

Principles of Science.

Proficiency 7: Explain phenomena using fundamental scientific principles that apply across the natural sciences.

Proficiency 8: Make informed decisions by solving problems through the application of scientific and mathematical theories, laws and models.

[1] http://undsci.berkeley.edu/article/think_science

[2] This section is based on the *Understanding Science* website produced by the UC Museum of Paleontology of the University of California at Berkeley. http://undsci.berkeley.edu/

[3] http://undsci.berkeley.edu/article/whatisscience_01

[4] This section is based on the "Process of Science" Module on the *Visionlearning* website funded by the National Science Foundation. http://www.visionlearning.com/en/library/Process-of-Science/49

[5] https://www.aacu.org/sites/default/files/files/VALUE/VALUE_ScientificReasoningRubric.pdf