

UNIVERSITY OF VIRGINIA

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Definition of Scientific Reasoning Competency:

The University of Virginia's School of Engineering and Applied Science (SEAS) expects each of its graduates to have mastered essential fundamental knowledge in the chemical sciences and in calculus-based physics. These two areas provide the science base upon which engineering science and applications are built.

I. In the chemical sciences, the SEAS expects each of its graduates to have mastered the following seven chemical concepts and to be able to demonstrate competency in appropriate problem solving skills related to these seven concepts:

1. Atoms, Elements and Compounds: Chemical formulae. Avogadro's Number. Calculations of atomic, mole, and mass percent.
2. Chemical Reactions: Stoichiometry & balancing of chemical reactions, Calculation of reaction yield and identification of limiting reactants.
3. Solution Chemistry Concepts: Ions, electrolytic solutions hydration. Acids, bases, and pH. Neutralization and equivalency. Balance oxidation/reduction reactions.
4. Energy Considerations: Concepts of enthalpy, entropy, Gibbs free energy and equilibrium. Use LeChatelier's Principle to determine direction of reaction.
5. Electronic Structure of Atoms. Definition of Bohr Atom Model and its limitations. Quantum theory and spectroscopy. Identification of trends in properties of elements in the Periodic Table.
6. Electronic Structure of Molecules: Construct Lewis structures of atoms and molecules. Electronegativity. Identify geometries of simple molecules. Hybridization and molecular orbital concepts. Relationship between reaction enthalpy and chemical bond energies.
7. Intermolecular Interactions: Liquids, solids and the basis of molecular recognition.

II. In calculus based physics, the SEAS expects each of its graduates to have mastered the following nine concepts and to be able to set up problems from first principles, arrange the proper force or circuit diagrams as needed, and obtain a solution:

1. Forces: Newton's laws of motion, gravitation.
2. Work, energy, momentum and their conservation laws.
3. Rotational motion including torque and angular momentum.
4. Simple harmonic motion and waves.
5. Thermodynamics and microscopic properties of gases.
6. Electrostatics and electric currents.
7. Magnetic fields and their applications.
8. Capacitors, inductors, AC circuit equations and oscillations.
9. Optics

Description of Methodology Used to Gather Evidence of Scientific Reasoning Competency

In spring 2004, the University administered the "Collegiate Assessment of Academic Proficiency" (CAAP) test in Scientific Reasoning to a random sample of not less than 5 percent of fourth-year undergraduates enrolled in the School of Engineering and Applied Science. We believe the American College Testing Service's (ACT) CAAP test provides an acceptable reading on the extent to which UVa undergraduates are achieving the goals listed. Moreover, results of this test provide information on the competency levels of UVa students in comparison with students at other institutions using the same test. The results below show the mean test score and the percentile ranking of UVa fourth-year undergraduates in the School of Engineering and Applied Science compared to all other students in the United States who took the same test. The test is scored on a scale of 40 to 80.

Results for spring 2004 assessment of Scientific Reasoning Competency	School of Engineering and Applied Science All Majors and Concentrations
Mean Test Score	67
Percentile Ranking	91

Summary:

School of Engineering and Applied Science undergraduates scored well on the test, in the 91st percentile.