Understanding, Skills, and Problem Solving

Emphasize conceptual understanding.

- Focus on understanding broad concepts and ideas in all mathematics courses during the first two years.
- Emphasize development of precise, logical thinking. Require students to reason deductively from a set of assumptions to a valid conclusion.
- Present proofs when they enhance understanding. The fundamental connection between proof and understanding must be highlighted.

Emphasize problem solving skills.

- Develop the fundamental computational skills the partner disciplines require, but emphasize integrative skills: the ability to apply a variety of approaches to single problems, to apply familiar techniques in novel settings, and to devise multi-stage approaches in complex situations.

Emphasize mathematical modeling.

- Expect students to create, solve, and interpret mathematical models.
- Provide opportunities for students to describe their results in several ways: analytically, graphically, numerically, and verbally.
- Use models from the partner disciplines: students need to see mathematics in context.

Emphasize communication skills.

- Incorporate development of reading, writing, speaking, and listening skills into courses.
- Require students to explain mathematical concepts and logical arguments in words. Require them to explain the meaning — the hows and whys — of their results.
Emphasize balance between perspectives.

- Continuous and discrete
- Linear and non-linear
- Deterministic and stochastic
- Deductive and inductive
- Exact and approximate
- Pure and applied
- Local and global
- Quantitative and qualitative

Specific Topics and Priorities

Strive for depth over breadth. Explore locally what topics can be omitted and teach the remaining topics in more depth.

Offer non-calculus-based descriptive statistics and data analysis in the first two years (either as a separate course or integrated into other courses).

Offer non-calculus-based discrete mathematics and mathematical reasoning in the first two years, perhaps including discrete dynamical systems.

Continue to offer calculus and linear algebra in the first two years, but make the curriculum more appropriate for the needs of the partner disciplines.

Emphasize two- and three-dimensional topics.

Pay attention to units, scaling, and dimensional analysis.

Replace traditional college algebra courses with courses stressing problem solving, mathematical modeling, descriptive statistics, and applications in the appropriate technical areas. De-emphasize intricate algebraic manipulation.
Instructional Techniques and Technology

Use a variety of teaching methods since different students have different learning styles. In particular, encourage the use of active learning, including

- in-class problem solving opportunities
- class and group discussions
- collaborative group work, and
- out-of-class projects.

Improve interdisciplinary cooperation.

Emphasize the use of appropriate technology.

General Recommendations

Promote professional development.

Establish mechanisms for the development, review, and dissemination of effective instructional materials and techniques, including collaborative efforts between mathematicians and partner disciplines that result in innovative instructional materials.

Emphasize the use of appropriate assessment.

Encourage institutional assessment of programmatic changes.