

## **Clarification in response to CAPC questions about application to establish graduate concentration MS Natural Science (Middle School Science, Technology, Engineering and Mathematics)**

This MNS degree program is intended to serve Arizona K-8 educators. They need not be certified (private and charter school teachers are not always certified and we plan to make the program available to them) and they need not work in a traditional classroom (i.e. district math or science coordinator or science museum education coordinator) but they must be directly involved with K-8 STEM education and express a desire to become highly qualified to teach middle school STEM subjects. In screening applicants, preference will be given to current K-8 classroom teachers who express an interest in preparing themselves to teach mathematics and/or science in the middle grades.

The goal of this program is to provide STEM content preparation along with appropriate pedagogical approaches and technology tools and affordances to teachers who need deeper knowledge of science and mathematics concepts. The courses described below build upon one another to create a strong foundation in mathematics along with life, earth and physical sciences, using conceptual models as organizing principles, and the practice of modeling to identify patterns and manipulate models to make predictions. All courses utilize overarching sustainability concepts—systems dynamics, trade-offs, cascading effects, unintended consequences and scaling—to scaffold instructional activities.

In addition to deepening their content preparation, the K-8 educators enrolled in this program will study student thinking and learning in the STEM disciplines, both in coursework and in practice during the action research components of their field work.

These courses are carefully designed and sequenced so that upon completion of the MNS program, a K-8 educator will be well prepared to teach and to develop curriculum materials for fundamental science and mathematics topics identified in the Arizona State Standards for grades 6, 7 and 8, and will also be a competent practitioner of modeling instruction—the building, testing and application of conceptual models.

### **Middle School STEM Course descriptions:**

#### **STM 501 - Introduction to Modeling in the STEM Disciplines**

This course utilizes an inquiry approach to learning and teaching middle level mathematics and science in a sustainability context utilizing the conceptual framework of models and modeling. Students will receive a thorough grounding in modeling pedagogy and will be introduced to technological tools that support the practice of modeling.

#### **STM 502 - Cognition and Instruction in STEM**

This course will focus on the study of human learning in the STEM disciplines as it relates to teaching content in both formal and informal contexts. Fundamental theories of learning will be reviewed, and the latest theoretical trends will be examined.

#### **STM 503 – Modeling Integrated Science**

This course extends the building, testing and application of conceptual models to the challenge of integrating mathematics into science content and instruction in the middle school. Students will develop

and field test interdisciplinary STEM instructional units in life, earth and physical science using mathematics to model relationships among variables and will learn about instructional design in a technology mediated learning environment—the Situated Multimedia Arts Learning Laboratory (SMALLab).

STM 504 – Mathematical Modeling in STEM GOOD COURSE! THANKS

This course will explore, in depth, fundamental concepts and procedures in algebra, graph theory, counting and combinatorics, and probability and statistics. Attention is paid to developing a coherent and consistent set of working skills that students will be able to apply to a variety of real-world problems in the STEM disciplines.

STM 505 – Engineering Design

Participants will become familiar with the engineering design process and will design engineering solutions to problems associated with environmental sustainability, engaging in optimization of the outcomes of designed solutions. The engineering design process will be used as an underlying model for designing integrated STEM middle school curricula.

STM 506 – Action Research in the Mathematics and Science Classroom

Students will study qualitative and quantitative research methods appropriate for conducting classroom research in middle school science and mathematics. They will survey the literature, practice data collection strategies and work in teams to design a study and prepare a research proposal for human subjects' approval.

STM 507 – Applications in STEM

Students will study current sustainability research and the underlying mathematical and scientific models that are used to predict outcomes from initial conditions. Special attention will be paid to dynamic systems in the environment and the challenge of scalability.

STM 508 – Quantitative Modeling

Students will engage in modeling change including deterministic and dynamical systems. Discourse will be heavily technology dependent utilizing common data collection, analysis and display software.

STM 509 – Sustainability Science

This course will introduce students to the field of sustainability and explore the fundamental questions of how human and natural systems interact. Through studying real-world environmental issues and problems, they will learn how we shape the environment and how it shapes us. Students will be challenged to design a project for your students involving a local sustainability issue using a transdisciplinary approach.

STM 510 – Final Project

Students will undertake a collaborative classroom research project involving the design, testing, modification and deployment of instructional materials based on content in one of the Modeling Institute courses. Findings will be publically presented and defended at a research colloquium.