Scott Carter

Week 1 Notes

Virtual Meeting 1 (May 20, 2025)

- Methods of STEM Education – Summer 2025
- Elective Course – Fall 2025
- Elective Course – Spring 2026
- Regeneron Internship, Tarrytown, NY – Summer 2026
- Online Learning Space preview provided
- NASA STEM Engagement:
    - 59K educator participants
    - Goal: integrate stem in teaching practices
    - Goal: access NASA data and resources
    - Goal: Employ STEM practices
    - Plan with all students in mind
- NASA Directorates:
    - Aeronautics
    - Mission Support
    - Science Mission (possible connections to anatomy course)
    - Space Operations (possible connections to anatomy course)
    - Endeavor
    - Space Technology
    - Exploration Systems Development
- This program named after Endeavor Shuttle – first educator in space
- NASA Spinoffs Investigation – examples from TN:
    - Cryofuels
    - Carbon dioxide sensors monitoring vehicle emissions
    - High temperature superconductors

Reading 1: Integrated STEM defined (Nadelson and Seifert)

- Information Age >>>> Age of Synthesis
- Future STEM career development requires interdisciplinary instruction that snthesizes new approaches and solutions
- Possible applications: energy, clean water, transportation, climate change
- Instruction should mirror the integration we currently see in STEM careers
- Integrated STEM defined: seamless amolgamation of content and concepts from multiple STEM disciplines

- Context of problem determines approach to integration, and solution
- Characterizing integrated STEM problems:
    - Ill-structured
    - Multiple potential solutions
    - Require knowledge/skills from multiple STEM disciplines
- With greater exposure to integrated STEM, the student experience will be more like those the workplace experience
- Challenges associated with teaching integrated STEM:
    - Shifting focus from discipline-based to problem-based
    - Teacher STEM knowledge and professional mindset
    - Mentoring/facilitating professional development experiences
    - Shifts from facts to application
    - Ambiguity in curricular outcomes

Reading 2: A Conceptual Framework for Integrated STEM Education (Kelly and Knowles)

- Student interest in STEM disciplines declining in Western developed nations
- International cooperation and alignment required t solve global problems
- Few teachers know how to operationalize STEM learning
- Problems with carrying out STEM agenda over the last two decades:
    - Competing agendas
    - Lack of coherent effort
    - Managing STEM integration
- To remain competitive in global economy, we must raise student achievement in STEM subjects
- STEM can be viewed as a meta-discipline
- STEM often taught disconnected from the arts, creativity, design
- Authors' definition of integrated STEM education: approach to teaching the STEM content of two or more STEM domains, bound by STEM practices within an authentic context for the purpose of connecting these subjects to enhance student learning
- A conceptual framework for integrated STEM education is provided to guide STEM educators (Block and Tackle Analogy)
- Research shows STEM learning is enhanced when the teacher has sufficient knowledge and domain pedagogical content knowledge

- Situated Cognition Theory: Understanding how knowledge and skills can be applied is as important as learning the knowledge and skills themselves
- Engineering design is the key to subject integration
- Students need to recognize the interplay between science, engineering, and technology (and policy in environmental science)
- Inherent features of integrated STEM instruction:
    - Analogical reasoning
    - Uncertainty
- Teachers harbor misconceptions about hands-on instruction
- A more appropriate objective would be minds-on instruction
- Two common views of technology:
    - Engineering view: making and using of material objects
    - Humanities perspective: response to a specific human endeavor
- The humanities perspective is value-laden (cultural, political, economic, environmental)
- Mitchum: technology is itself a discipline consisting of objects, knowledge, activities, volition
- Technology may be viewed as a vehicle for change – positive or negative
- Cultivating a community of practice is optimal in integrated STEM instruction
- This community should include experts and novices
- Building a community of practice could be challenging for teachers because it will require networking with experts and scheduling interactions with your students
- A community of practice shares common language, practices, skills
- STEM practices should be taught alongside STEM content in integrated STEM learning
- Several tables are provided to compare STEM sub-disciplines:
    - Science practices vs. engineering practices
    - Science skills and practices vs. technology skills and practices
    - Math standards for math practice
- STEM TRAILS is an exemplary integrated STEM program focusing on high school biology, physics, and technology education
- STEM TRAILS trains teachers to develop high quality integrated STEM instruction