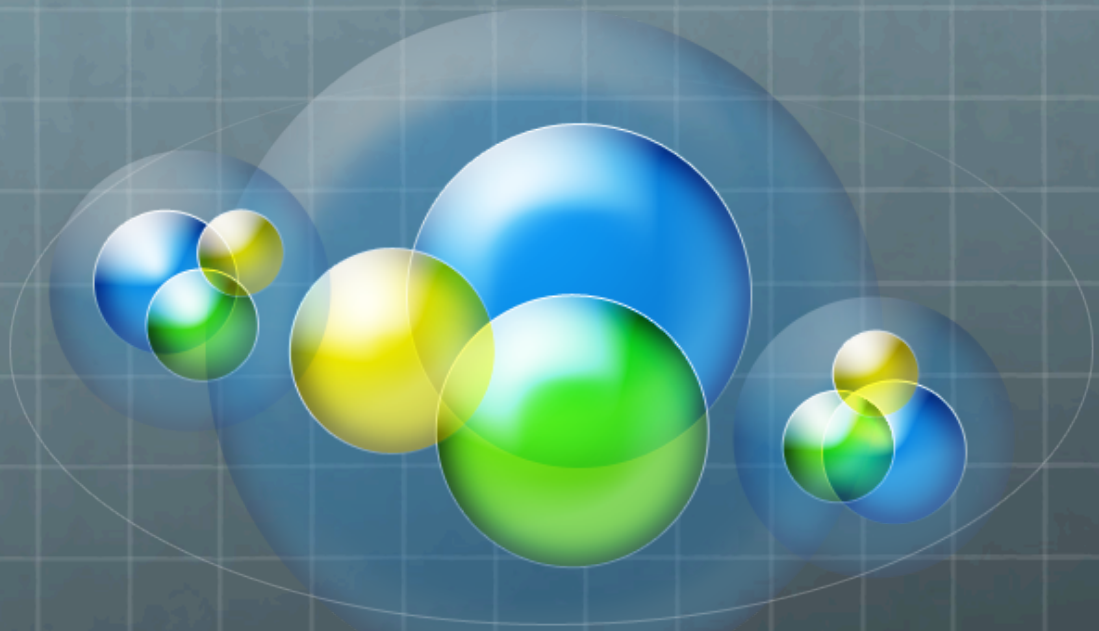


STEM Integration in K12 Education

Claudia Gran | PhD Student Curriculum & Instruction

iDigBio
Integrated Digitized Biocollections

FLORIDA MUSEUM OF NATURAL HISTORY

Where?

- Formal
- After School
- Informal Settings

Why?

- Connected → Relevant
- Enhances motivation
- Increases interest in STEM Careers
- Promotes 21st Century skills
- STEM Literacy
- How it is

STEM in the Curriculum

MATHEMATICS

- Arithmetic
- Geometry
- Algebra
- Trigonometry
- Calculus

SCIENCE

- Biology
- Chemistry
- Physics
- Earth/Space

TECHNOLOGY

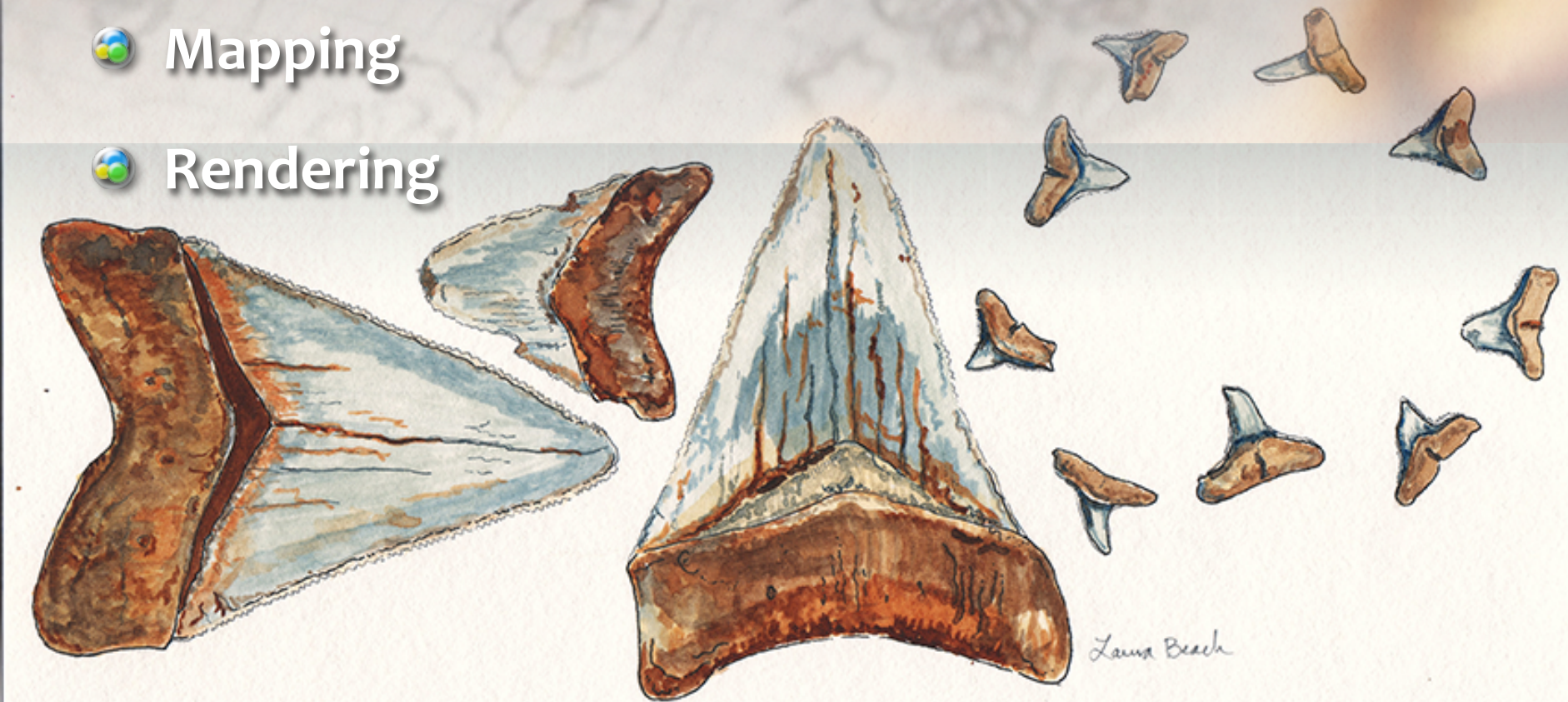
- Industrial Arts
- Instructional Tech
- Construction/ Manufacturing
- Project Lead the Way

ENGINEERING

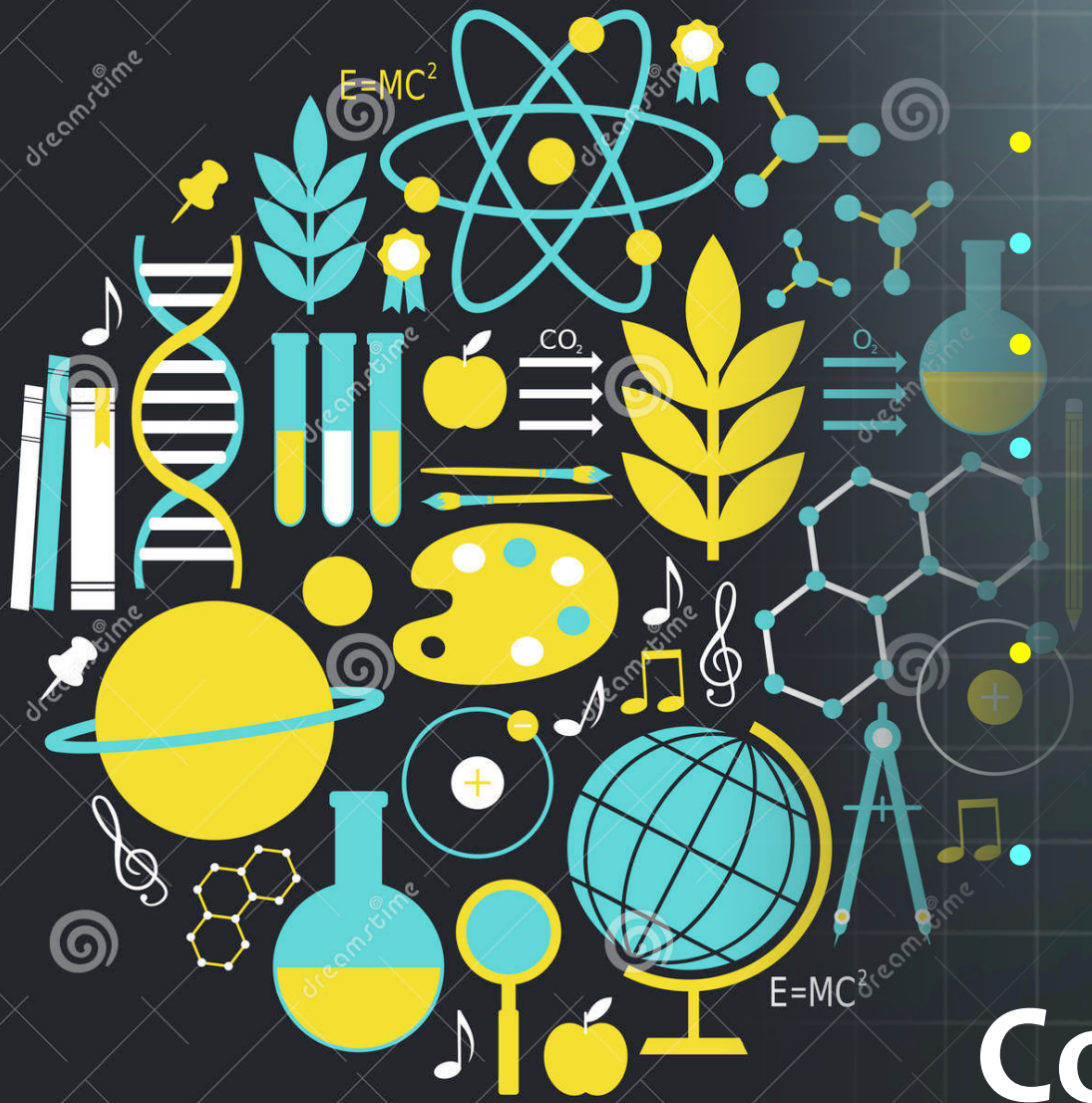
- Science and Engineering Practices – NGSS
- Project Lead the Way: www.pltw.org

Art

- Scientific Illustrations
- Scientific Observation
- Journal Sketching
- Measurements
- Mapping
- Rendering



How can we do it?



- Scientists
- Museum Staff
- Educators
- Curriculum & Instruction
- Educational Technology
- Graduate Students

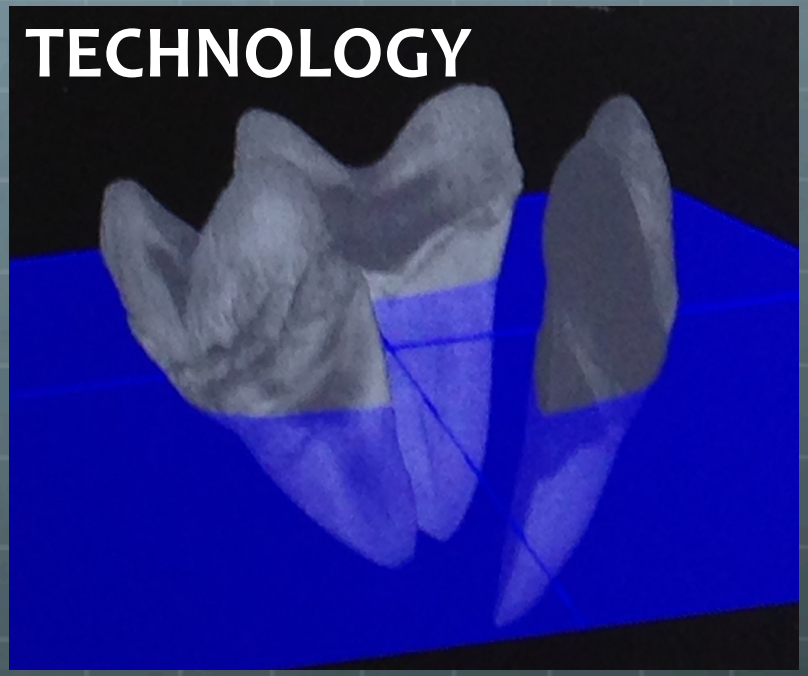
Collaboration

SCIENCE

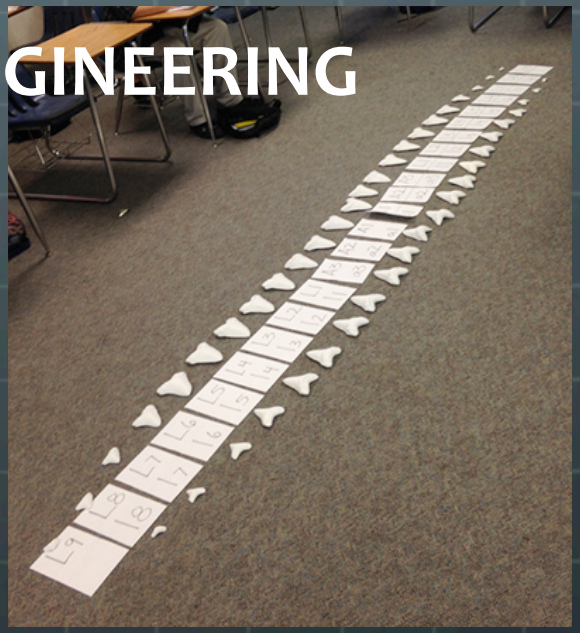
Megalodon Extinction

Megalodon Evolution

TECHNOLOGY



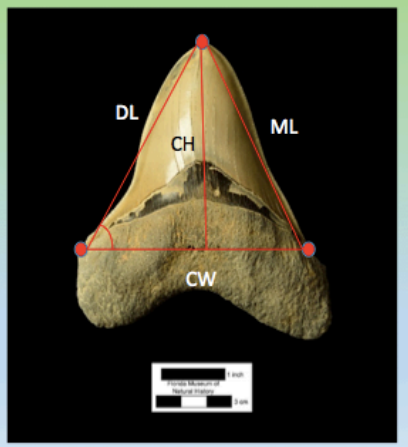
ENGINEERING



MATHEMATICS

Geometry of Megalodon

1. Mark three points and make triangle
2. Measure dimensions (CH, CW, DL, ML)
3. Calculate remaining angles using geometry theorems

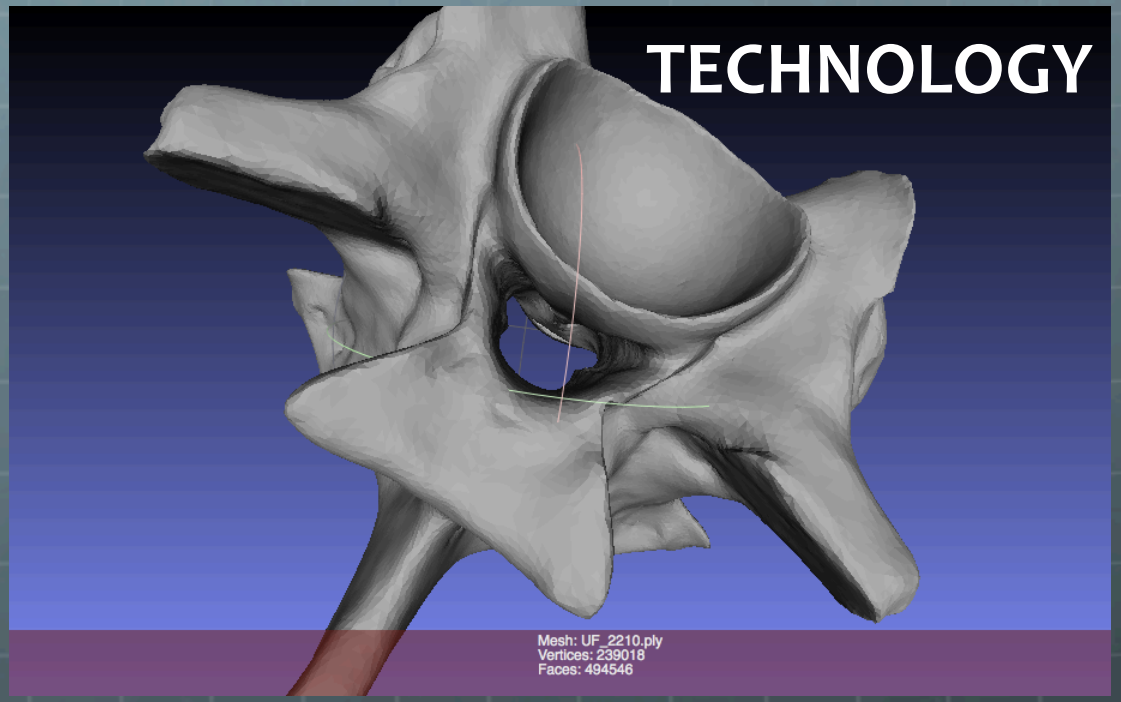


Lower left 3rd tooth (I3)

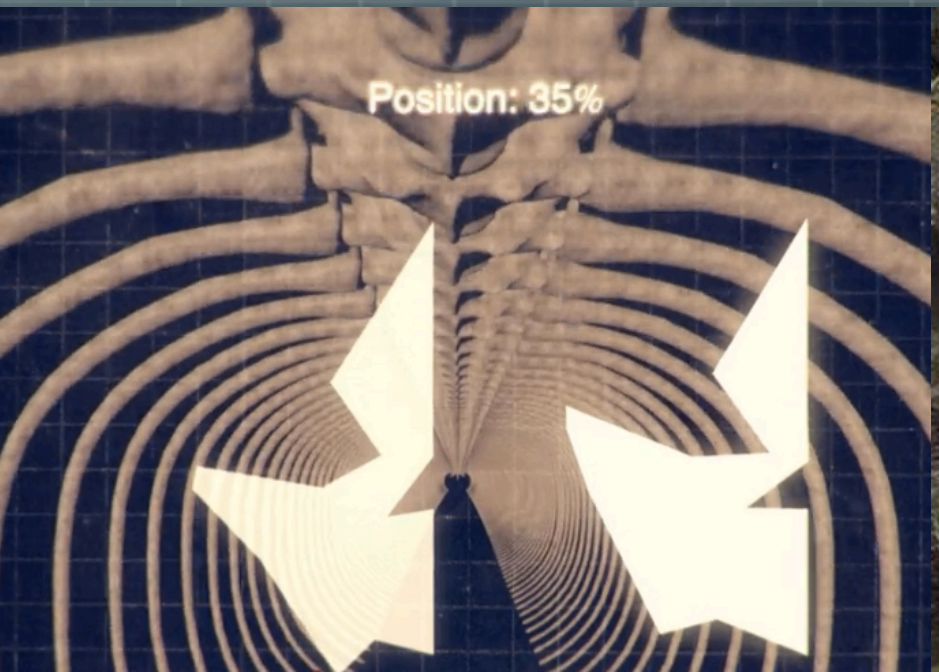
Slide by Victor Perez

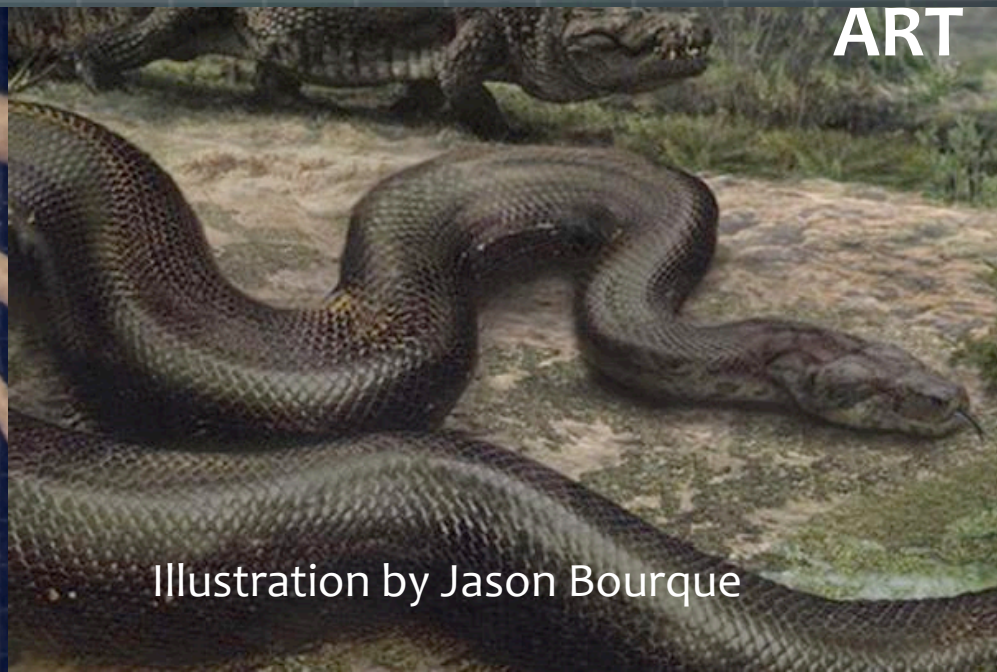
SCIENCE

Paleo climate
Climate Change



MATH & ENGINEERING





The Scope

- Different combinations of the STEM disciplines
- Emphasis on one discipline more than others
- Presented in formal or informal settings
- Involve a range of pedagogical strategies

DEFINITIONS

Integrated, connected, unified, interdisciplinary, multidisciplinary, cross-disciplinary, trans disciplinary…

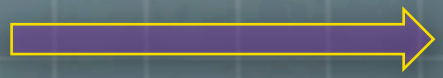
STEM Integration Descriptive Framework

Goals for Students

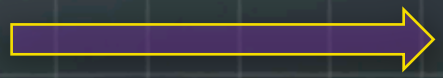
- STEM Literacy
- 21 Century Skills
- STEM workforce readiness
- Interest & Engagement
- Making Connections

Goals for Educators

- Increased STEM content knowledge
- Increased pedagogical content knowledge



Integrated STEM Education



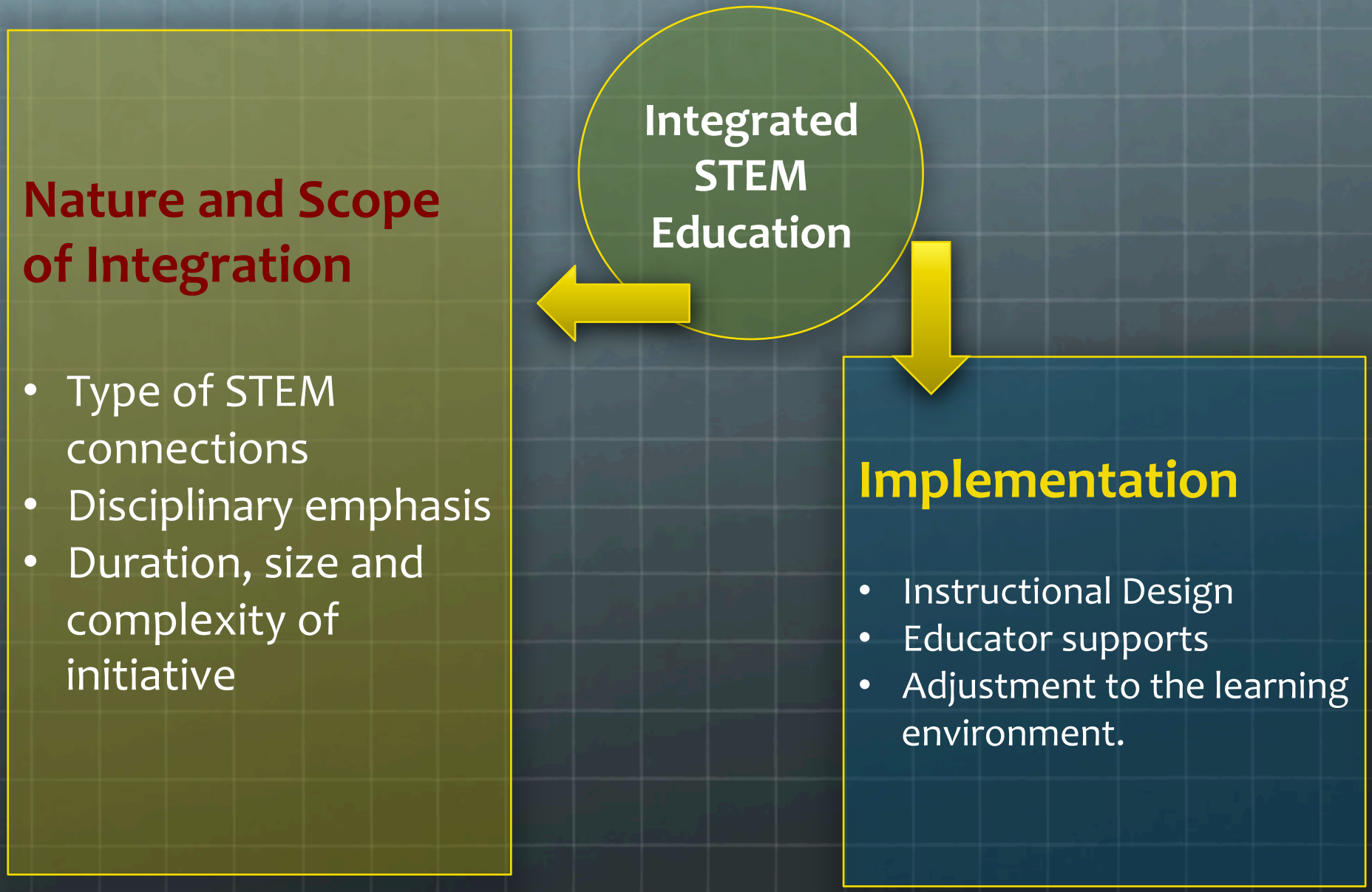
Outcomes for Students

- Learning & Achievement
- 21st Century Competencies
- STEM Course taking, educational persistence, and graduation rates
- STEM Interest
- Development of STEM identity
- Ability to make connections among STEM disciplines

Outcomes for Educators

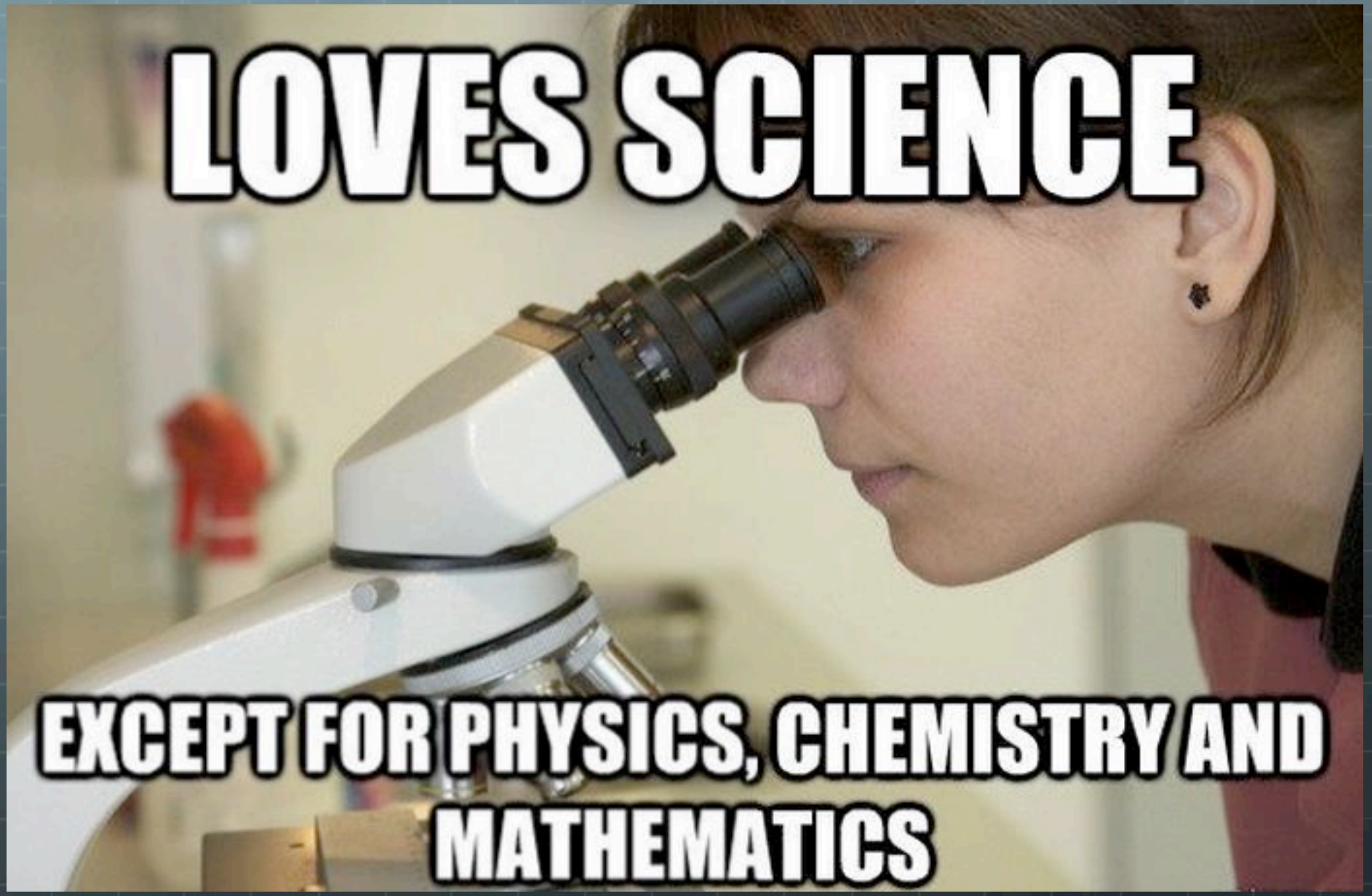
- Changes in practice
- Increased STEM content and pedagogical content knowledge

STEM Integration Descriptive Framework



How is the framework useful?

- To better understand what is confusing and/or under-researched.
- Productive and meaningful discussion about efforts in the name of integrated STEM education.
- Can be used to examine and compare other integrated STEM programs
- Enable researchers in education and cognitive sciences to learn about critical elements.
- Help set goals


LOVES SCIENCE
EXCEPT FOR PHYSICS, CHEMISTRY AND MATHEMATICS

Interest, Identity and Persistence

- Integration vs. No integration and the impact on student motivation.
- Preliminary research finds that STEM Integration is beneficial especially to:
  - Struggled with STEM classes
  - Underrepresented in STEM fields
  - Underrepresented in STEM professions

Integrated STEM

Connections

Improvement in student performance

Learning and Transfer

Favors cognition

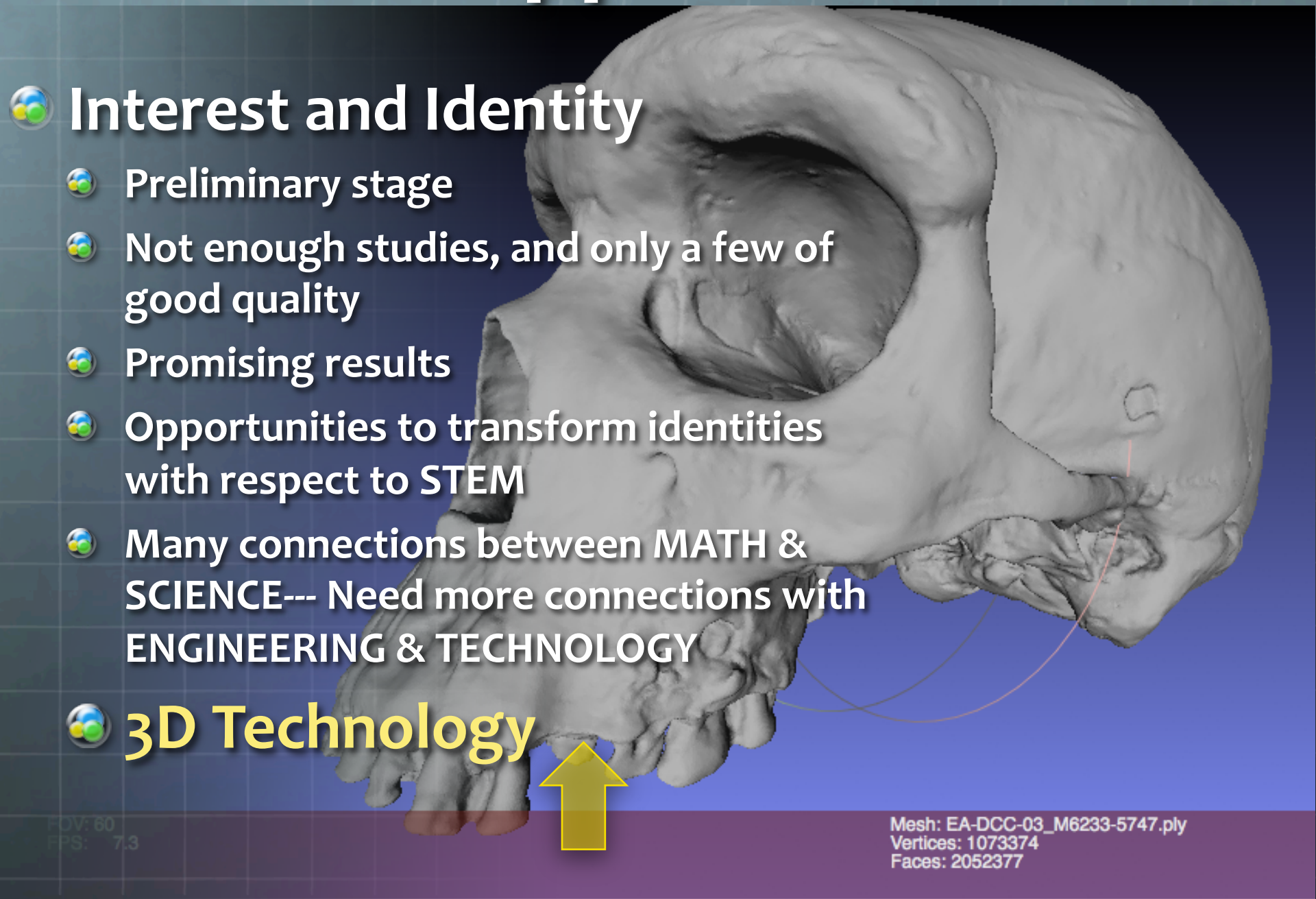
Prior Knowledge

Research Opportunities

- Learning and Achievement
  - Integration leads to improved conceptual learning of EACH discipline.
  - Need research on learning about the connections.
  - Most research has been done about integrated Math and Science with positive results in test scores (Hurley 2001).
    - Sequenced (preceding)
    - Parallel (simultaneously)
    - Partial (together/separated)
    - Enhanced
    - Total (equal)
  - Need consensus on definition of "integrated" so pedagogy can be consistent.

Research Opportunities

- Interest and Identity
  - Preliminary stage
  - Not enough studies, and only a few of good quality
  - Promising results
  - Opportunities to transform identities with respect to STEM
  - Many connections between MATH & SCIENCE--- Need more connections with ENGINEERING & TECHNOLOGY
- 3D Technology

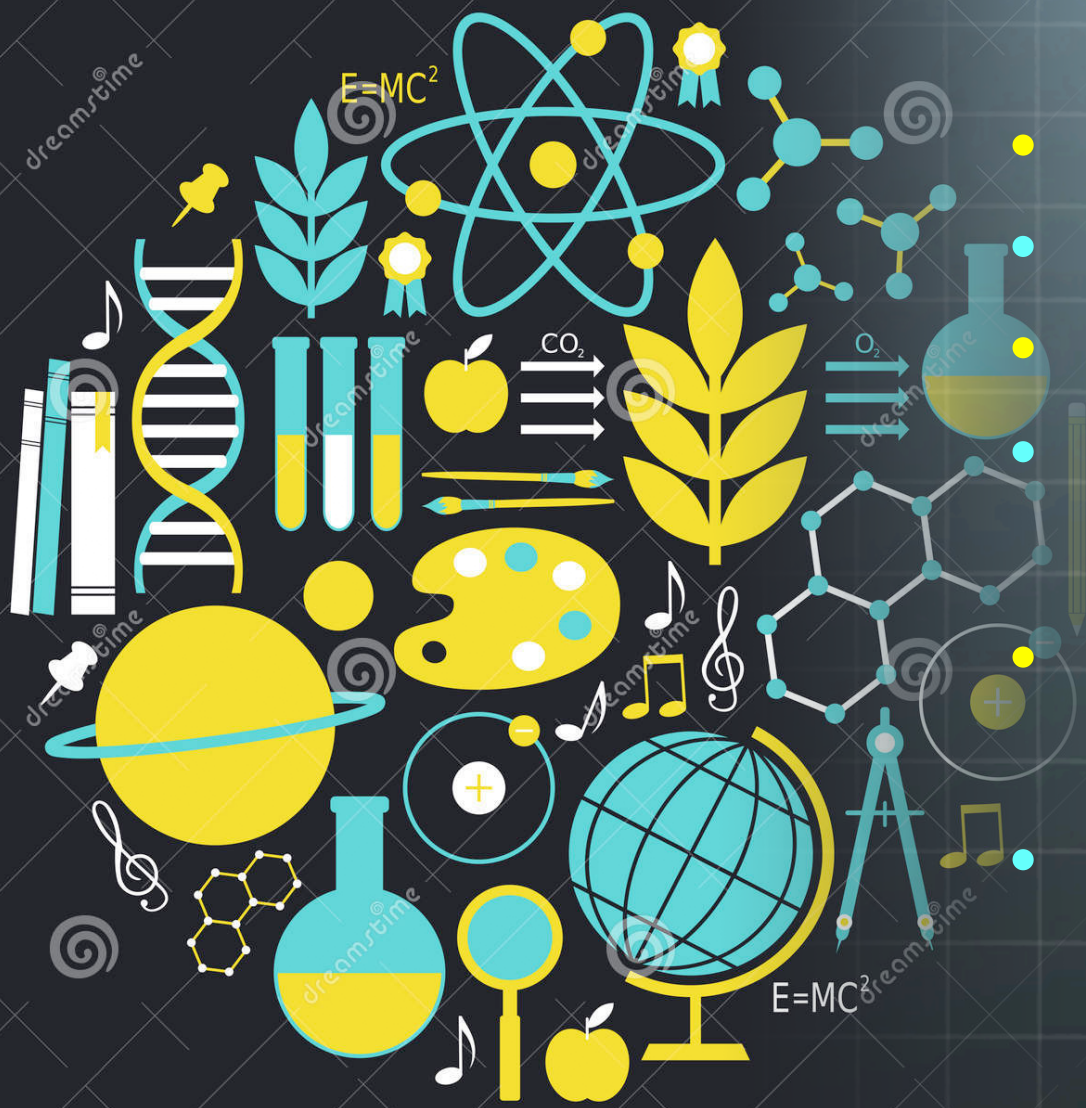


Recommendations I

- Document, document and document
- Common language
- Outcomes should be measured based on clear hypotheses about how Integrated STEM education supports learning.
- More longitudinal studies, multiple methods, diversity and equity.
- Be explicit about the goals. Design integrated STEM experience to fulfill those goals. Know WHY and HOW the STEM Integrated experience will lead to a particular OUTCOME and HOW the outcome will be MEASURED.

Recommendations II

- Designers need to provide opportunities that make STEM connections explicit to students and educators.
- Designers need to attend to learning goals and learning progressions in the individual STEM subjects.
- Hands-on Professional Development for educators.
- Assessments to measure learning and affective outcomes (NSF)
- Collaboration as a model



- Scientists
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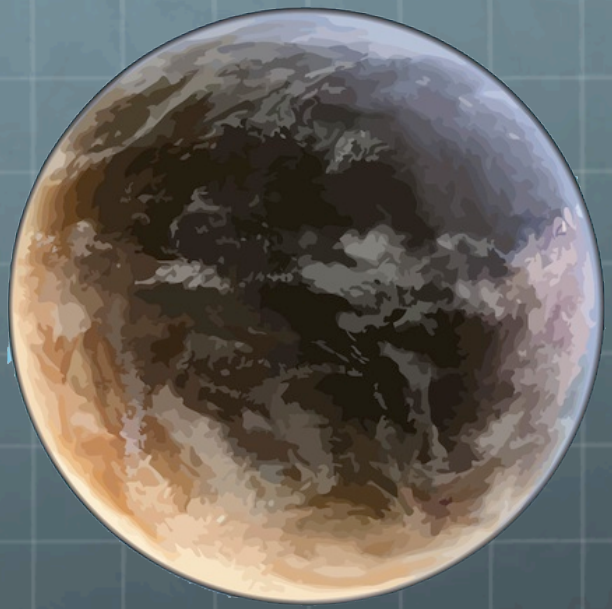
- Graduate Students

Collaboration

Planet Science



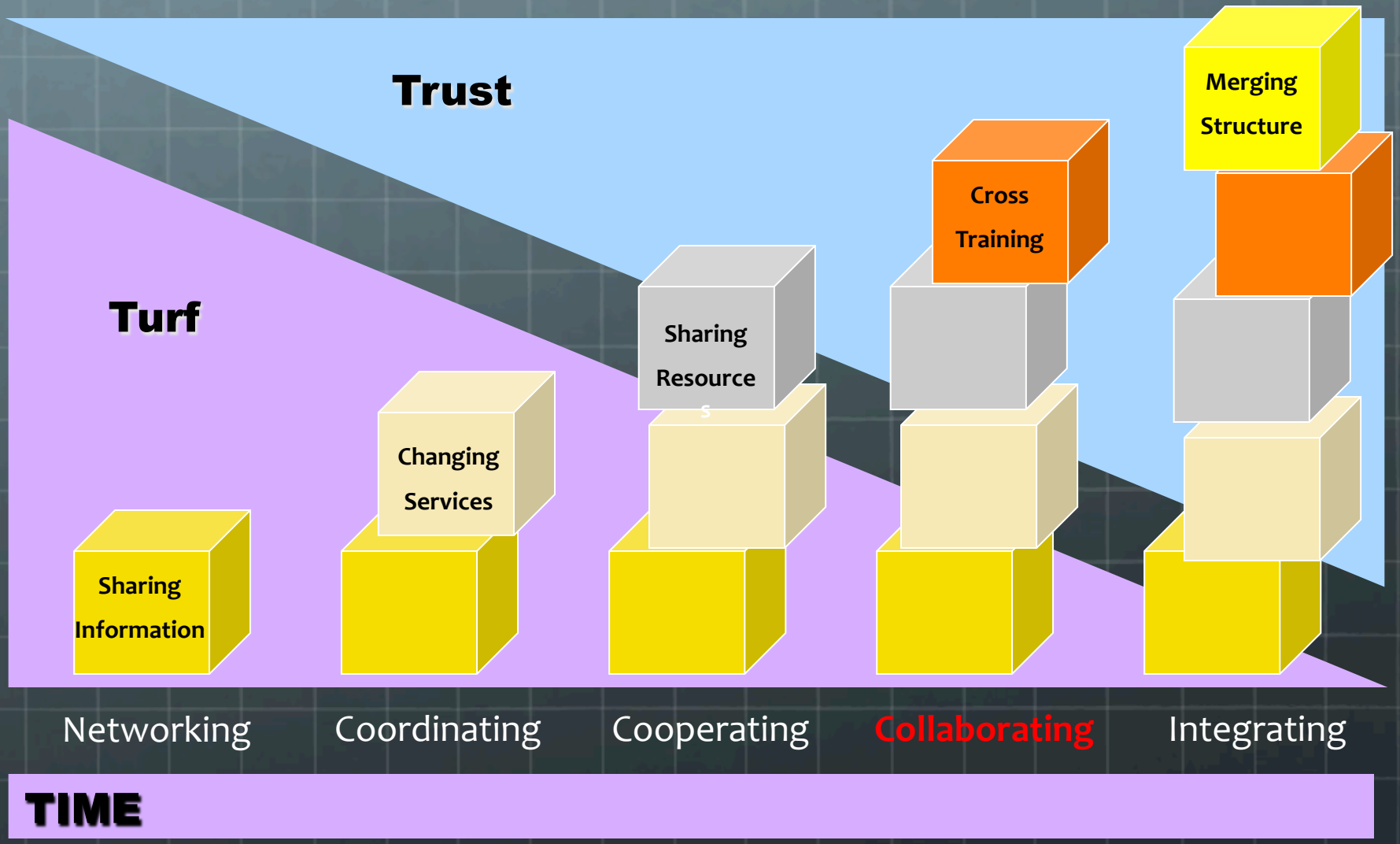
Scientists
Professors
Graduate Students

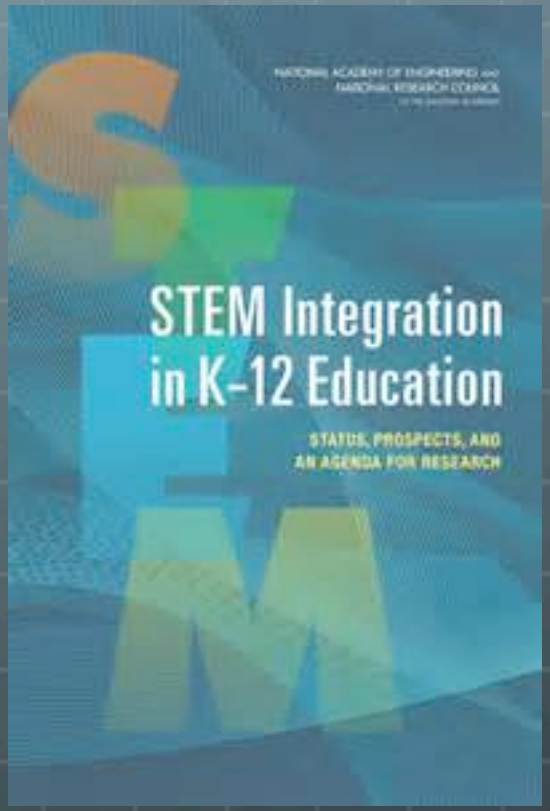
Planet K12

Educators
Curriculum & Instruction
Educational Technology

Collaboration Continuum

http://www.actforyouth.net/youth_development/communities/collaboration.cfm





www.nap.edu/catalog/18612/stem-integration-in-k-12-education-status-prospects-and-an

National Academy of Engineering and National Research Council. *STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research*. Washington, DC: The National Academies Press, 2014.