Totino-Grace Engineering Institute

Experiential Engineering Education

Future Engineers?

What is Engineering?

- ABET: (Accreditation Board for Engineering and Technology):

"Engineering is the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience & practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind"

“Scientists explore what is; Engineers create what has not been.”

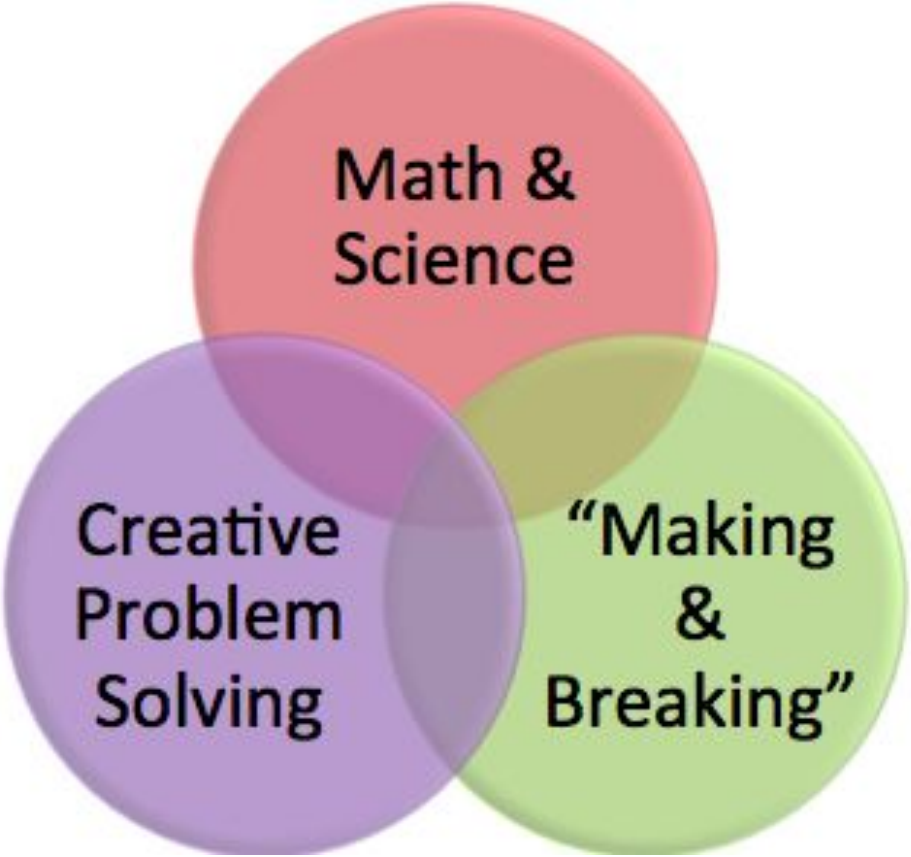
Engineering is:

- “Design under constraints”
- “Solving problems with the resources available”
- “Combination of <u>Analysis</u> and <u>Creativity</u>”

“There is no shortage of ideas . . . . . But a huge shortage of people who can get it done in a challenging environment”

Engineering Requirements

- Math & Science Knowledge
- Creativity & Problem Solving
- Communication and Teamwork Skills
- “Tool Literacy”


Math &
Science
Creative
Problem
Solving
"Making
&
Breaking"

- Engineering is **Iterative** (you learn & revise)
- But not all iteration is created equal . . . .the more you know, the shorter the iteration process
- Math & Science can prove your solution works (with DATA)

- Math & Science makes designs **better**, more **efficient**, **provable** and less "**expensive**"

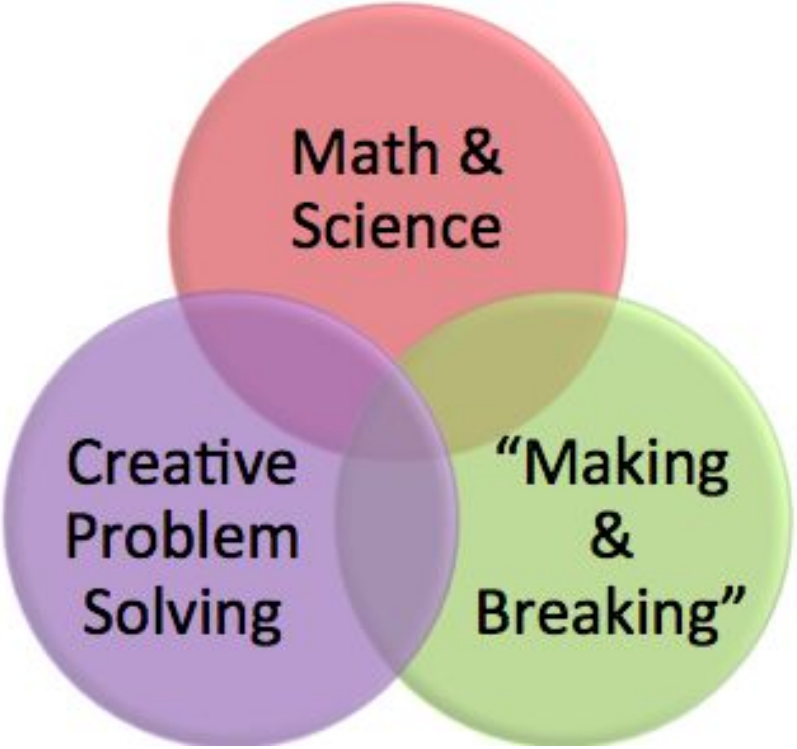
Creative Problem Solving

- “Structured” Creative Problem Solving
- There is a process to Engineering Design
- Real Engineering is the ability to be creative within a list of constraints

"Making & Breaking"

- "Tool Literacy" – digital fabrication (3D printer and laser cutter) as well as tools, machines and equipment, and manufacturing processes
- Having a physical understanding of the world around you is inherent to engineering
- High Engineering correlation with spatial reasoning and mental modeling
- An understanding of manufacturing processes enables engineers to create better designs

Combination of all 3



Engineering Degrees/Specialties:

- Aerospace
- Agricultural
- Biomedical
- Chemical
- Civil
- Computer/Electronics
- Electrical
- Environmental
- Industrial
- Marine/Ocean/Naval
- Materials
- Mechanical
- Mining/Geological
- Nuclear
- Petroleum
- Robotics/Automated Systems
- Software
- Structural
- Others. . . .?

12: TOP 10 MAJORS WITH THE HIGHEST MEDIAN EARNINGS**

	Median	Earnings at 25th Percentile	Earnings at 75th Percentile
Petroleum Engineering	120,000	82,000	189,000
Pharmacy Pharmaceutical Sciences and Administration	105,000	83,000	120,000
Mathematics and Computer Science	98,000	75,000	134,000
Aerospace Engineering	87,000	60,000	115,000
Chemical Engineering	86,000	60,000	120,000
Electrical Engineering	85,000	60,000	110,000
Naval Architecture and Marine Engineering	82,000	44,000	120,000
Mechanical Engineering	80,000	59,000	105,000
Metallurgical Engineering	80,000	50,000	106,000
Mining and Mineral Engineering	80,000	52,000	125,000

* *Full-time, full-year workers with a terminal Bachelor's.*

* *There was a tie for last place, and we are representing some, but not all, of those majors that tied.*

E3 Engineering Institute Goals:

- Expose more of our students to the field of Engineering
  - What is Engineering? What do Engineers do?
    - Give them first-hand experiences
  - Exposure to different types of Engineering and different career options
  - Evaluate Engineering as a potential path
  - Help them decide what school(s) and what field they want to pursue.

E3 Engineering Institute Goals:

- Prepare those that pursue Engineering (and those that don't)
  - Learn to "think" like engineers (Engineering Design Process)
  - Develop the skills required of an Engineer
    - Analysis (math and science application)
    - Creative Problem Solving
    - Communication and Presentation
    - "Tool Literacy" - Fabrication, CAD, Software/Programming

Program Details

Three-year cohort program - students apply during their 9th grade year and move through the program together during their 10th-12th grade years

We currently have:

- 149 program graduates over last 3 years who are now in college.
- 59 seniors in their 3rd year of the program
- 36 juniors in their 2nd year
- 65 sophomores who have just begun the program

35% of our E3 students are females

Program Curriculum Components:

- Curriculum : Engineering I
  Engineering II
  Engineering III (Capstone Course)

- 4 years of rigorous math and science courses required

- Other suggested courses:
  CAD, Woods/Metals, Computer Science, Visual Arts

SENIOR CAPSTONE PROJECTS

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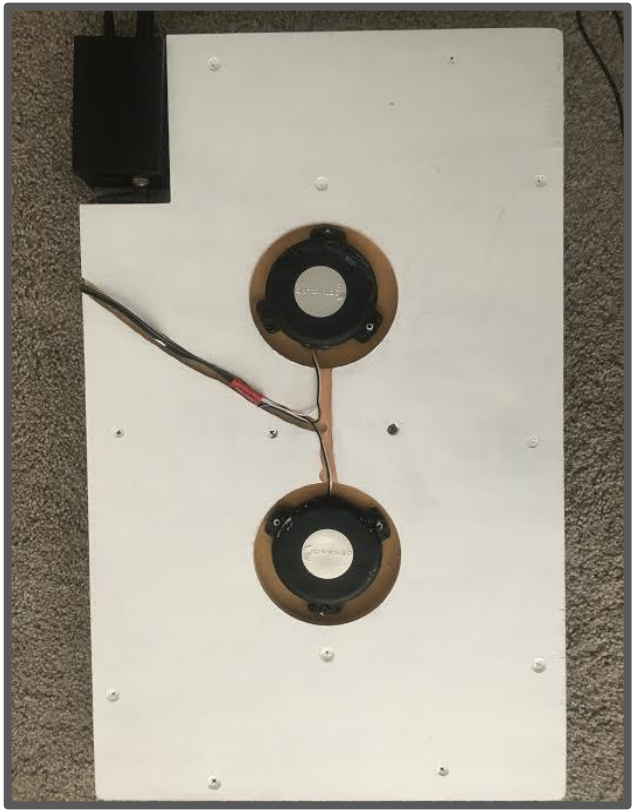

SENIOR CAPSTONE PROJECTS

Additional Program Components:

- Engineering Mentorship
- Field Experience Practicum (Job-Shadow)
- Field Trips/Enrichment Activities/Guest Speakers
- Capstone Project Public Presentation
- FIRST Robotics
- Global Component ($H_2$0 For Life)
- Summer Camp

Field Trips

Medtronic
Boston Scientific
LifeCore Biomedical
Graco
BAE
Cummins
Corval
Pentair
FedTech
Invest Cast
Midwest Rubber and Supply
Ajax

U of M Civil Engineering Dept

U of M St. Anthony Falls Lab

U of M Robotics Show

U of M ME and EE Senior Design

U of St Thomas ME Senior Design

U of St. Thomas Machine Comp

Engineering Mentorship

- Every student has an individual mentor that they talk/meet with over 2+ years
  - 160+ Individual engineers volunteering as mentors

- Every student shadows their mentor for at least one day

- Many E3 graduates continue to communicate with their mentor.

College/Career Preparedness

- ≈ 50% of E3 students have decided to pursue an engineering degree (from first two cohorts)

- Feedback from first three groups has been really positive in terms of being prepared for their engineering program

Common Concerns/Questions

- Conflict with Kathleen Murphy Scholars Program?
- Additional homework and workload?
- Commitment to 3 years?

Application Process

All interested ninth grade students must apply to be part of the E3 Institute.

- **Application:** Students must complete an online application, which can be found on the E3 Institute Webpage – **Due, February 1, 2019**

- **Recommendation Forms:** Students must ask two teachers (one of them being a math or science teacher) to complete a recommendation form, which can be downloaded on the E3 webpage or picked up from the academic office – **Due, February 4, 2019 (so given to teachers this week)**

- **Interview:** Students will participate in an interview to understand the student's interests, skills and past experiences and ensure the student understands the full scope of the program expectations. – Interviews will be scheduled during school days in early February.

- **Notification:** Students will be notified of their acceptance into the E3 Institute via email by **Friday, February 15, 2019.** If accepted, students would then register for the Engineering 1 course for their sophomore year.