Engineering Design and Problem Solving
from
The University of Texas at Austin
Presentation Highlights

- Why and how did a top-10 school of engineering get involved in high school engineering education?
- What is the Engineer Your World curriculum?
- How do we prepare and support our teachers?
- What’s next for our program?
- What are the program costs over time?
Engineering is not just for college anymore.

And yet little is known about effective engineering education (curriculum and instruction) at the secondary level.
Engineer Your World solves two problems.

- The problems:
  - A dearth of available, affordable high school engineering curriculum accessible to all students
  - A scarcity of teachers prepared and supported to teach such a course

- The solution:
  - A nationally vetted, low-cost, human-centered high school engineering course
  - A strong commitment to teacher development and support
Engineer Your World is part of a comprehensive approach.

**Degree Programs for Current and Future Teachers**

Bachelor’s Degrees for STEM Majors Pursing Teaching Certification

Graduate Degrees for Practitioners: Master of Arts in STEM Education – Engineering (MASEE)

**Curriculum for High School Engineering Education**

A model high school engineering course and supporting professional development:

**Research and Evaluation**

Important Research in the Emerging Field of Engineering Education

Independent Evaluation to Determine Project Effectiveness
Engineer Your World succeeds in a growing network of schools.

<table>
<thead>
<tr>
<th>Year</th>
<th>States</th>
<th>Schools</th>
<th>Teachers</th>
<th>Students</th>
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<tbody>
<tr>
<td>2011-12</td>
<td>1</td>
<td>7</td>
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<tr>
<td>2012-13</td>
<td>8</td>
<td>23</td>
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<tr>
<td>2013-14</td>
<td>14</td>
<td>73</td>
<td>74</td>
<td>2600</td>
</tr>
<tr>
<td>2014-15</td>
<td>12</td>
<td>77</td>
<td>79</td>
<td>3300</td>
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<tr>
<td>2015-16</td>
<td>16</td>
<td>115</td>
<td>120</td>
<td>~5000</td>
</tr>
</tbody>
</table>

Growth of the Engineer Your World network, beginning with 2011-12 pilot year.

2012-13 Engineer Your World Partner Schools

2015-16 Engineer Your World Partner Schools
Engineer Your World is standards-based for national deployment.


Approved by University of California System for California A-G credit

Satisfies Texas Essential Knowledge and Skills for Engineering Design & Problem Solving

Aligns with New York State Standard 1: Analysis, Inquiry and Design (Engineering Design)
Engineer Your World is broadening participation.

**Engineer Your World is**
- **Attractive** to diverse populations
- **Accessible** to students across many levels
- **Affordable** for a broad range of rural and urban schools
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Our curriculum is designed to engage students.

- Authentic engineering practices
- Project-based environment
  - 80% hands-on
  - Teacher-guided, student-driven
- Engineering (＆ 21st Century) Skills
  - Creativity and innovation
  - Critical thinking and problem solving
  - Communication and collaboration
- Exploring engineering fields and professions
What do students do in 
*Engineer Your World?* *(Fall Semester)*

**Unit 1**
Overview & Norms

**SKILLS:**
- Engineering documentation
- Effective collaboration
What do students do in Engineer Your World? (Fall Semester)

Unit 1
Overview & Norms

Unit 2
Exploration
Customer Needs
(Multidisciplinary)

SKILLS:
- Interview product users
- Interpret user needs
- Define design requirements
- Explore engineering careers
What do students do in *Engineer Your World?* *(Fall Semester)*

**SKILLS:**
- Analyze and interpret requirements
- Generate concepts
- Build, test and redesign
- Create technical documentation
What do students do in "Engineer Your World?" (Fall Semester)

**SKILLS:**
- Design an experiment
- Collect and analyze data
- Create and interpret graphs
What do students do in \textit{Engineer Your World?} (Fall Semester)

\begin{itemize}
  \item Unit 1: Overview & Norms
  \item Unit 2: Exploration Customer Needs (Multidisciplinary)
  \item Unit 3: Challenge Discovering Design (Multidisciplinary)
  \item Unit 4: Exploration Understanding Data (Chemical)
  \item Unit 5: Challenge Designing with Data (Civil)
\end{itemize}

\textbf{SKILLS:}

\begin{itemize}
  \item Construct physical models
  \item Use a data acquisition system
  \item Analyze data sets
  \item Predict design performance
  \item Consider tradeoffs
  \item Report engineering recommendations
\end{itemize}
What do students do in *Engineer Your World?* (Spring Semester)

Unit 6
*Challenge*
Reverse Engineering
(Mechanical)

**SKILLS:**
- Benchmark consumer products
- Develop design specifications
- Disassemble a product and analyze functionality
- Create redesign solutions
- Document concepts with technical drawings
What do students do in Engineer Your World?  
(Spring Semester)

**Unit 6**  
Challenge  
Reverse Engineering  
(Mechanical)

**Unit 7**  
Exploration  
Programming  
(Electrical, Software)

**SKILLS:**
- Build a circuit with an Arduino microcontroller
- Create flowcharts
- Program in visual and text-based integrated development environments
What do students do in Engineer Your World? (Spring Semester)

Unit 6
Challenge
Reverse Engineering
(Mechanical)

Unit 7
Challenge
Exploration
Programming
(Electrical, Software)

Unit 8
Challenge
Systems Engineering
(Aerospace/Multidisciplinary)

SKILLS:

- Analyze and decompose a system
- Program control algorithms
- Identify and mitigate risks
- Analyze engineering ethics
- Integrate subsystem designs
- Develop and execute a launch plan
- Practice effective project management
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We start with two weeks of professional development at UT Austin.

Engage teams of teachers in authentic engineering practices

Model effective teaching practices for project-based instruction

“I wish every professional development would take some notes from you. Every single thing was relevant. This is one of the best professional developments that I have ever been to.”

- 2013 Participant
We continue with comprehensive induction support.

- Access to an emerging virtual professional learning community of 120+ teachers from 16 states
- Monthly videoconferences with fellow *Engineer Your World* teachers
- Emerging peer mentor program
- On-demand access to staff engineers and instructional coaches

“It's an amazing curriculum…. (T)he support from *UTeachEngineering* is fantastic!”

- 2013 Participant
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Where are we going next?

- **Piloting “dual enrollment”** option (UT Austin credit)
- **Piloting computationally rigorous second-year course**
  - Abstraction (using modeling tools to design and predict performance of water rockets)
  - Algorithmic thinking (managing a system of lakes)
  - Data (body-worn monitoring device)
  - Programming (disaster relief drone)
  - Creativity, global impact, and the internet (underlies every unit)
- **Continuing and expanding research**
  - Effective recruitment strategies for broadening participation
  - Student impacts
Presentation Highlights

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- What’s are the program costs over time?
We are recruiting partner schools for our research.

Matching Support from UTeachEngineering

- Equipment and Materials
- Travel and Housing
- Teacher Stipend
- Professional Development Fee
- Curriculum Licensing Fee

Our Investment (up to $7000)

Your Investment ($5000)

Apply for matching funds at www.EngineerYourWorld.org
The first 100 schools who join in 2016-17 will save $2000.

Matching Support from UTeachEngineering

- Equipment and Materials
- Travel and Housing
- Teacher Stipend
- Professional Development Fee
- Curriculum Licensing Fee

Our Investment (up to $9000)

Your Investment ($3000)

Apply for matching funds at www.EngineerYourWorld.org
What are the program costs over time?

*Costs do not include dual enrollment credit.*
The Cockrell School of Engineering at The University of Texas at Austin is pleased to offer *Engineer Your World*, an innovative, year-long high school engineering design curriculum for students who want to learn about engineering and its role in shaping our world.

**Benefits of the Curriculum**

**Rigor and Relevance**
Developed by a team of University of Texas faculty and NASA engineers, *Engineer Your World* engages students in authentic engineering practices in a project-based environment. Students complete a series of socially relevant design challenges to develop engineering design skills and habits of mind.

**Versatility**
*Engineer Your World* is taught successfully in grades 9 - 12 by educators from diverse backgrounds. Our partner schools include:
- Engineering academies, STEM schools, and comprehensive high schools;
- Single- and mixed-gender schools;
- Public and private schools;
- Urban, suburban and rural schools; and
- Schools serving students across the socio-economic spectrum.

**The Student Experience**

**Students Discover How Engineering Shapes Their World**
*Engineer Your World* highlights engineering’s potential to impact human lives and the world around us. Students discover how engineers
- Create solutions for people;
- Use a creative design process;
- Make data-supported design decisions;
- Improve lives;
- Design the products of our everyday lives;
- Use computational thinking to develop solutions; and
- Collaborate to solve complex challenges.

**Students Develop Engineering Design Skills**
*Engineer Your World* uses a unique, multi-level engineering design process that is both accessible to high school students and authentic to the experience of professional engineers.

**Students Build Engineering Habits of Mind**
Students in *Engineer Your World* develop and practice the engineering skills and habits of mind that are central to the engineering profession and that distinguish it from other scientific and technical fields.

**Students Explore Engineering Fields and Professions**
*Engineer Your World* covers the breadth of engineering fields and professions so that students can make informed decisions about pursuing engineering.

To learn more about this innovative program and how your school can join, visit: [www.engineeryourworld.org](http://www.engineeryourworld.org)
Exceptional Professional Development and Teacher Support

Engineer Your World teachers participate in a vibrant professional learning community and are supported by a dedicated team of engineers and instructional support specialists at The University of Texas at Austin.

Professional Development

Teachers Attend a Two-Week Professional Development Institute
Delivered by a team of engineers and instructional support specialists, this professional development program:
- Engages teams of teachers in authentic engineering practices;
- Enables teachers to experience the curriculum that they will teach;
- Enhances engineering pedagogical content knowledge;
- Models effective teaching practices for project-based instruction;
- Facilitates collaborative strategic planning and reflection on classroom practice; and
- Connects participants with veteran Engineer Your World teachers who share tips for successfully managing the project-based classroom, facilitating effective collaboration, promoting productive failure, differentiating instruction, and assessing student learning.

Instructional Support

Teachers Benefit from Ongoing Instructional Support During the Academic Year
Recognizing the value of ongoing professional development and support, Engineer Your World program:
- Engages novice and veteran teachers in collaborative videoconferences;
- Promotes peer-to-peer interaction and sharing of best practices through online discussion forums; and
- Offers on-demand access to staff engineers and instructional support specialists throughout the year.

“<I wish every professional development would take some notes from you. Every single thing was relevant. This is one of the best professional developments that I have ever been to.”

– Engineer Your World Teacher

To learn more about this innovative program and how your school can join, visit: www.engineeryourworld.org
Engineer Your World is an innovative, high-quality, year-long high school engineering curriculum that engages students in authentic engineering practices in a project-based environment, scaffolds student learning over a series of engaging and socially relevant design challenges, and requires purposeful application of relevant STEM concepts.

**Engineer Your World Offers Financial Support for Schools**

- **Schools invest $5000 in the first year** by paying $2000 for teacher professional development and $3000 for curricular materials and instructional support. The annual cost in subsequent years is just $3000.

- **Engineer Your World provides up to $7000 of support** comprising $4000 in classroom equipment and supplies, and as much as $3000 in professional development support (i.e., $1200 in lodging, up to $800 in transportation costs, and a $1000 teacher stipend).

**Apply now and save $2000!**

We will waive the professional development fee for the first 100 schools to join and execute all required agreements.

**Ready to Join Engineer Your World?**

Simply have a campus administrator complete the online application at [www.engineeryourworld.org](http://www.engineeryourworld.org).

Schools selected for this opportunity will execute a three-year contract, curriculum licensing agreement, and research agreement with The University of Texas at Austin.

Schools agree to respond to annual requests for feedback and to assure full participation by the Engineer Your World teacher as required in the teacher participant agreement.