World Technology and Engineering Education Conference

China's 13# National Technology and Engineering Educators Conference on Educational Experiments in Senior High Schools
Ordos, China

\- - - - - - - - - - - - - - - - - - - -

Global Status and Trends for Technology and Engineering Education

Steven A. Barbato
Executive Director/CEO

Technology and Engineering bring STEM to Life!

International Technology and Engineering Educators Association
www.iteea.org

国际技术与工程教育协会中国中心

International Technology and Engineering Educators Association Chinese Center

ITEEA

Technology and Engineering bring STEM to Life!

ITEEA INTERNATIONAL CENTERS

PROMOTING TECHNOLGICAL
LITERACY AROUND THE WORLD

INTERNATIONAL ITEEA/PATT CONFERENCE
DALLAS, TX - MARCH 16-18, 2017

Where Are We Now and Where Are We Going in Technology and Engineering Education?

The Study of Technology and Engineering

- Many countries in the world have been and are now implementing the study of technology and engineering to increase their capabilities.

In the United States as well as in other countries, there is confusion about the term and meaning of "technology and engineering education."

Science vs. **Technology**

- Deals with the natural world.
- Is very concerned with **what is (exists)** in the natural world. (i.e.: Biology, Chemistry, Physics, Astronomy, Geology, etc.)

- Deals with how humans modify, change, alter, or control the natural world.
- Is very concerned with **what can or should be** designed, made, or developed from natural and manmade materials and substances to satisfy human needs and wants




Science vs. Technology (Continued)

- Is concerned with processes that seek out the meaning of the natural world by **"inquiring", "discovering what is", "exploring", and using "the Scientific Method".**

- Is concerned with such processes that we use to alter/change the natural world such as **"Invention", Innovation", Practical Problem Solving, and Design.**

While technology and science have a common denominator being the natural world, they are similar yet very different.

Technology is not any more "applied science" than science is "applied technology".

Blending of Technology and Science

- Bio-Technology Engineering
- Nano-Technology Engineering
- Agri-Science Engineering
- Applied Optics Engineering
- Biological Engineering
- And many others

Who is a technologically literate person?

One that understands:

- ✓What technology is
- ✓How technology is created
- ✓How the use of technology and engineering design shapes society and in turn, How society shapes the development of technology
- ✓A person who is comfortable with and objective about the use of technology and engineering design – neither scared of it nor infatuated with it.

Technological and Engineering Literacy Involves:

- Much more than a knowledge about computers and digital electronics.
- Gaining a degree of knowledge about the nature, behavior, power, and consequences of technology from a real world perspective. (Designing Under Constraints)

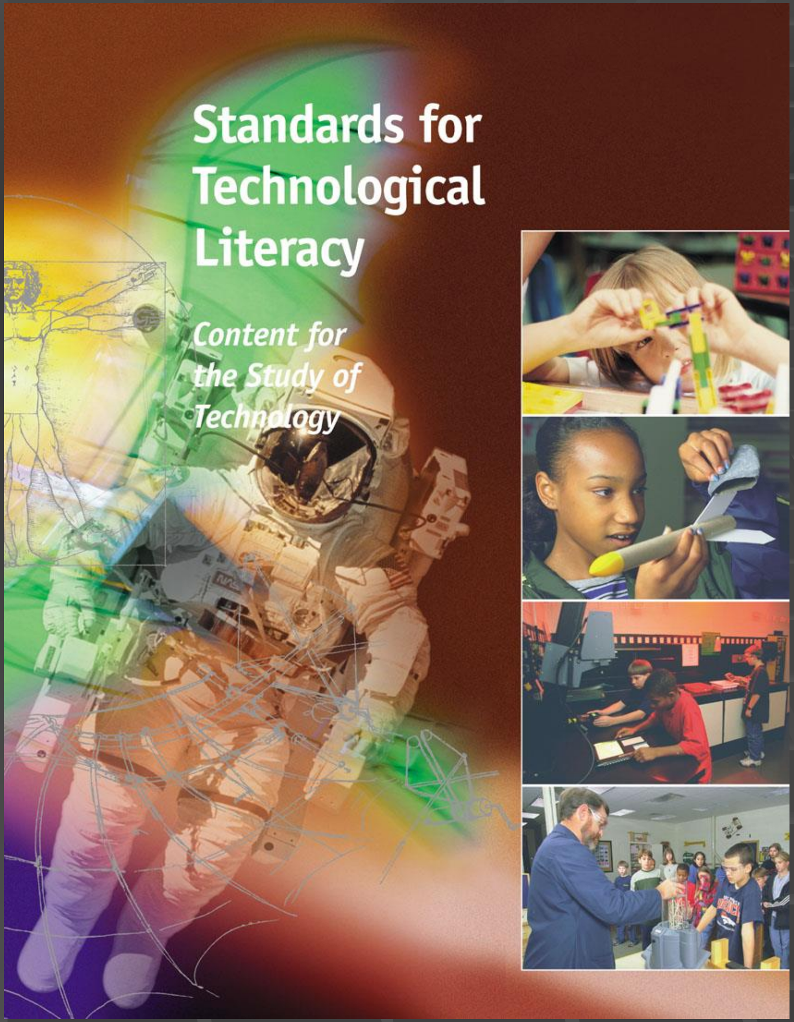
There is a growing movement in some countries to teach the integrative subjects of Science, Technology, Engineering, and Mathematics (STEM).

So how do we educate our people to be technologically and engineering literate?

? ? ? ? ? ? ?

What <u>Content</u> should be taught in the study of technology and engineering that will provide technological and engineering literacy for all students?

Standards for Technological Literacy (STL)(ITEA, 2000,2002/2007) presents the content for what every student should know and be able to do in order to be technologically literate.



www.iteea.org

Technological and Engineering Literacy

Technology and engineering literacy is the capacity to use, understand, and evaluate technology as well as to understand technological and engineering principles and strategies needed to develop solutions and achieve goals!

Technology and engineering literacy involves the mastery of a set of tools needed to participate intelligently and thoughtfully in society!

Integrative STEM Education” (I-STEM Education)

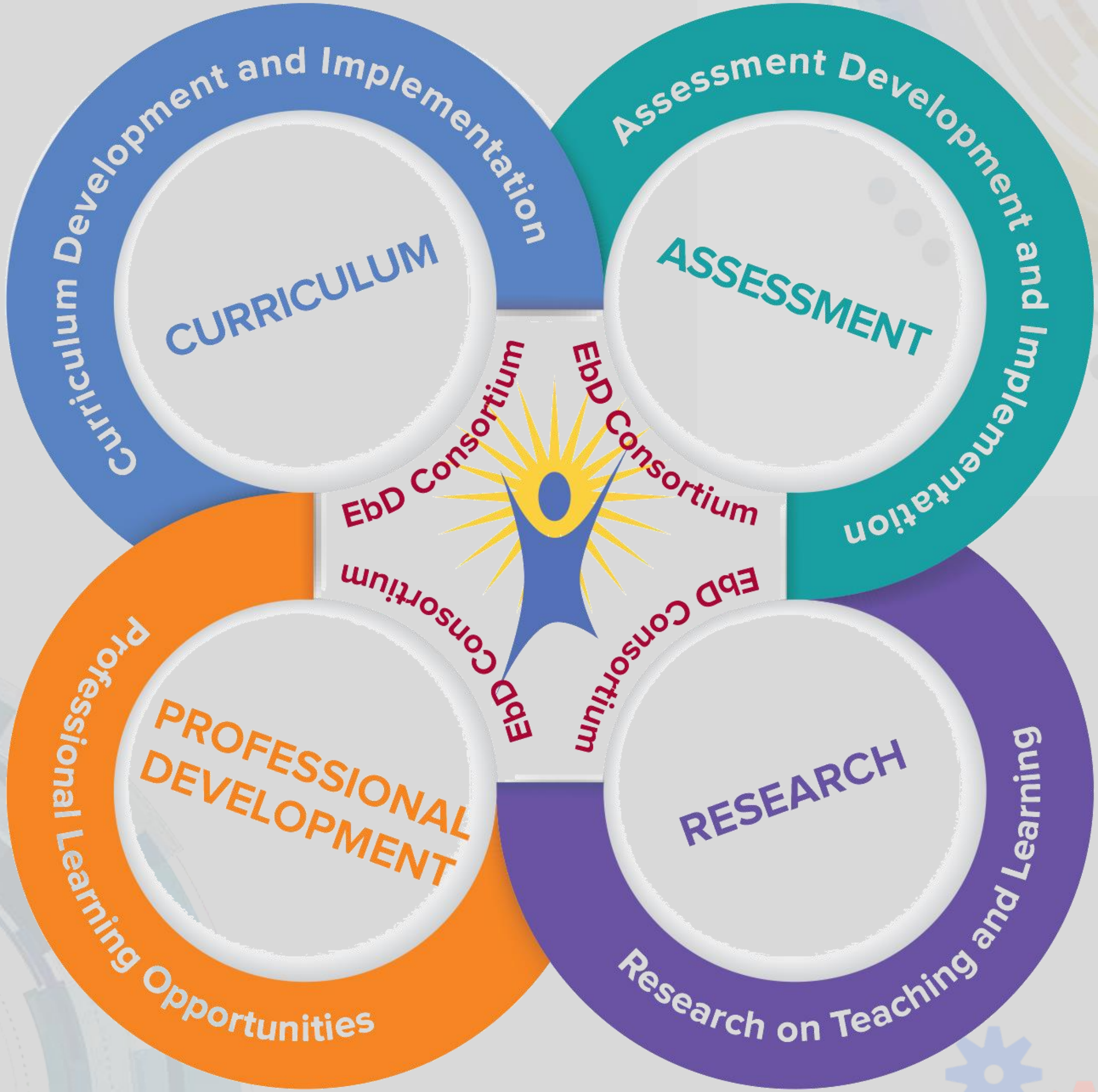
“Integrative STEM Education” (I-STEM Education) is operationally defined as “The application of technological and engineering design based pedagogical approaches to intentionally teach content and practices of science and mathematics education through the content and practices of technology and engineering education.

Integrative STEM Education is equally applicable at the natural intersections of learning within the continuum of content areas, educational environments, and academic levels”.

(Wells & Ernst, 2012-16: As adapted from Sanders/Wells program documents 2006-10)

What “STEM” Looks like

- Space Holder to insert slide 17 Ted Talk Video of Jane Chen’s Project! Click **Here** to view!


Curriculum Development and Implementation
CURRICULUM
Assessment Development and Implementation
ASSESSMENT
Professional Learning Opportunities
PROFESSIONAL DEVELOPMENT
Research on Teaching and Learning
RESEARCH
EbD Consortium
EbD Consortium
EbD Consortium
EbD Consortium

ITEEA
Technology and Engineering bring STEM to Life!

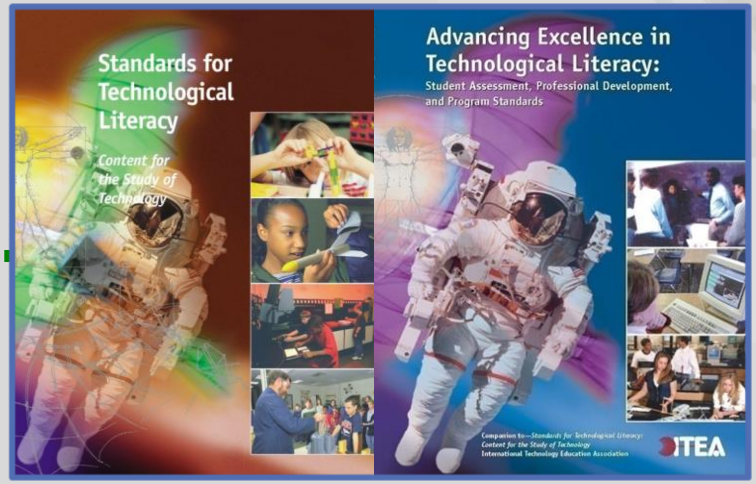
What is Engineering byDesign™ (EbD)?

NEXT GENERATION SCIENCE STANDARDS

COMMON CORE STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

GRAND CHALLENGES FOR ENGINEERING

Engineering Habits of Mind



I-STEM FocalPoints™
ITEEA

Engineering byDesign™

EbD Organizing Principles

1. Engineering through design improves life.
2. Technology has affected & continues to affect everyday life.
3. Technology drives invention & innovation and is a thinking & doing process.
4. Technologies are combined to make technological systems.
5. Technology creates issues and impacts that change the way people live and interact.
6. Technology is the basis for improving on the past and creating the future.
7. Technology and Engineering combined with Integrative STEM Education approaches teaches real-world problem solving.
8. Technology uses inquiry, design, and systems thinking to produce solutions.
9. Technological and Engineering design is a process used to develop solutions for human wants and needs.
10. Technological applications create the designed world.

K-12 Standards-Based Integrative-STEM Model

The CORE:

CORE PROGRAM				
K–2		EbD-TEEMS NXTGEN™	NASA	1-6 weeks
3–6		EbD-TEEMS NXTGEN™ *(6th Grade Capstone)*, I³	NSF NASA	1-6 weeks
6		*Exploring Technology*	NASA	18 weeks
7		*Invention and Innovation*	NASA	18 weeks
8		*Technological Systems*	NASA	18 weeks
9		*Foundations of Technology*	NASA	36 weeks
10–12	HS Choices	*Technology and Society*	NASA	36 weeks
10–12	HS Choices	*Technological Design*	NASA	36 weeks
11–12	HS Choices	*Advanced Design Applications* *	NSF	36 weeks
11–12	HS Choices	*Advanced Technological Applications* *	NSF	36 weeks
11–12		*Engineering Design (Capstone)*	NASA	36 weeks

Endorsed by States' Career Clusters

New Middle School Curricula

Engineering for All – Food: Vertical Farming
Engineering for All – Water: The World in Crisis

- Each 6 week unit is based on NGSS
- Project Drivers:
  - Promoting the potential of engineering as a social good.
  - Revisiting overarching themes (design, modeling, systems, resources, and human values).
  - Using authentic social contexts for teaching and learning STEM ideas and practices.
  - Using *Informed* Design as the core pedagogical methodology.

Digital Initiatives

- Professional Learning Communities (PLCs) around Integrative STEM Education;
- I-STEM FocalPoints;
- EbD-BUZZ: Engineering byDesign PD / Author Development / NTEC Training / ATEC Certification;
- EbD-BUZZ: Network Schools
- Foundations of Technology – Student Online Version
- 6E Learning byDeSIGN

I-STEM Education
Professional Learning Community 2016-2017

Designing a community of practice for practicing teachers, preservice teachers, graduate students, and other stakeholders for successful implementation of Integrative STEM Education

Example:

Housed in ITEEA's LMS, *EbD-BUZZ*, and grounded in 10 monthly interactive online sessions during 2016-2017 academic year comprised of presentations, discussions, networking, and Q&A opportunities.

I-STEM Education
Professional Learning Community 2016-2017

PLC Course/Session Themes

Nature and Definition of I-STEM Education

Whole School Engagement; Funding Your Integrative STEM Education Initiatives

Collaboration Among Disciplines: Integrative Themes, Projects, and Design Challenges

Maximizing Your STEM Lab: Best Practices

Collaborative Development of Formative and Summative Assessments

Iterative Nature of Engineering Design Processes

Teacher Leadership Opportunities; Classroom Management for Problem Identification, Problem Solving, and Creative Outcomes

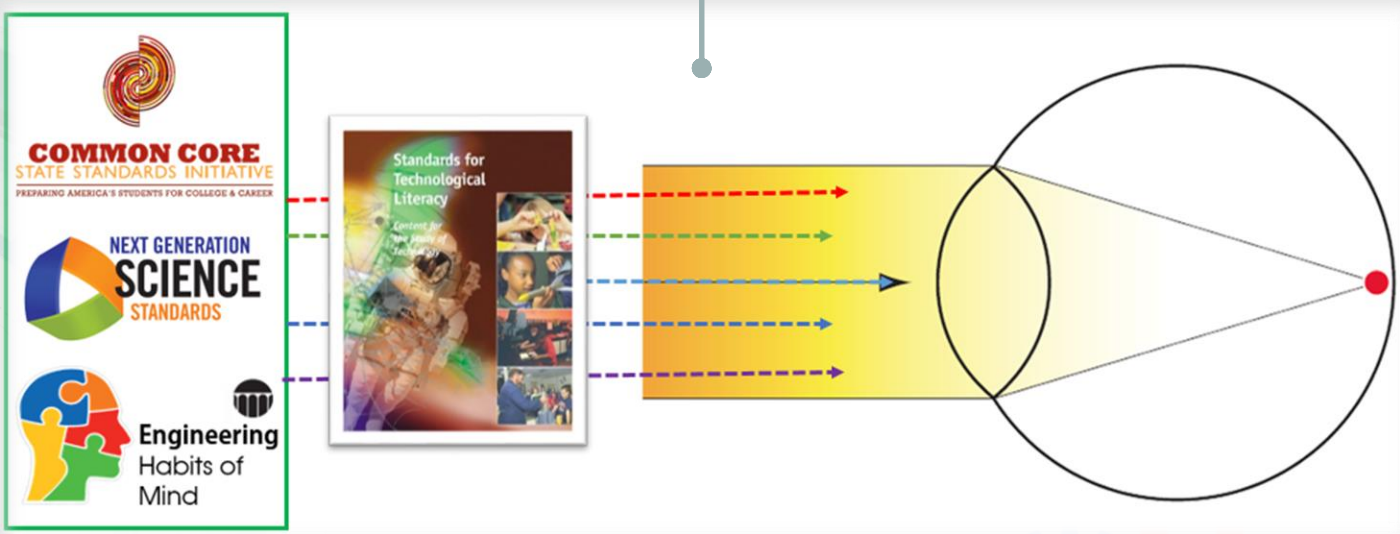
Field Testing and Action Research

Getting the Word Out: Sharing, Advocacy, Conference Presentations, and Publication

Now what? Stretch Goals, Avoiding Complacency, Continuous Improvement

I-STEM FocalPoints™

ITEEA



Sample Scenario

Grade 7

FocalPoint #3

DOMAIN: Knowing

ORGANIZATIONAL THEME: Nature of I-STEM

SCENARIO

Using the 2010 BP oil spill in the Gulf of Mexico as an example, students will work collaboratively in groups to explore and develop criteria and systems for cleaning up an oil spill. Students will explore the environmental impacts of the oil spill, as well as the impacts of possible solutions on biodiversity and ecosystems. This activity should allow student groups to delve deeply in different aspects of this challenge.

Domains & Themes

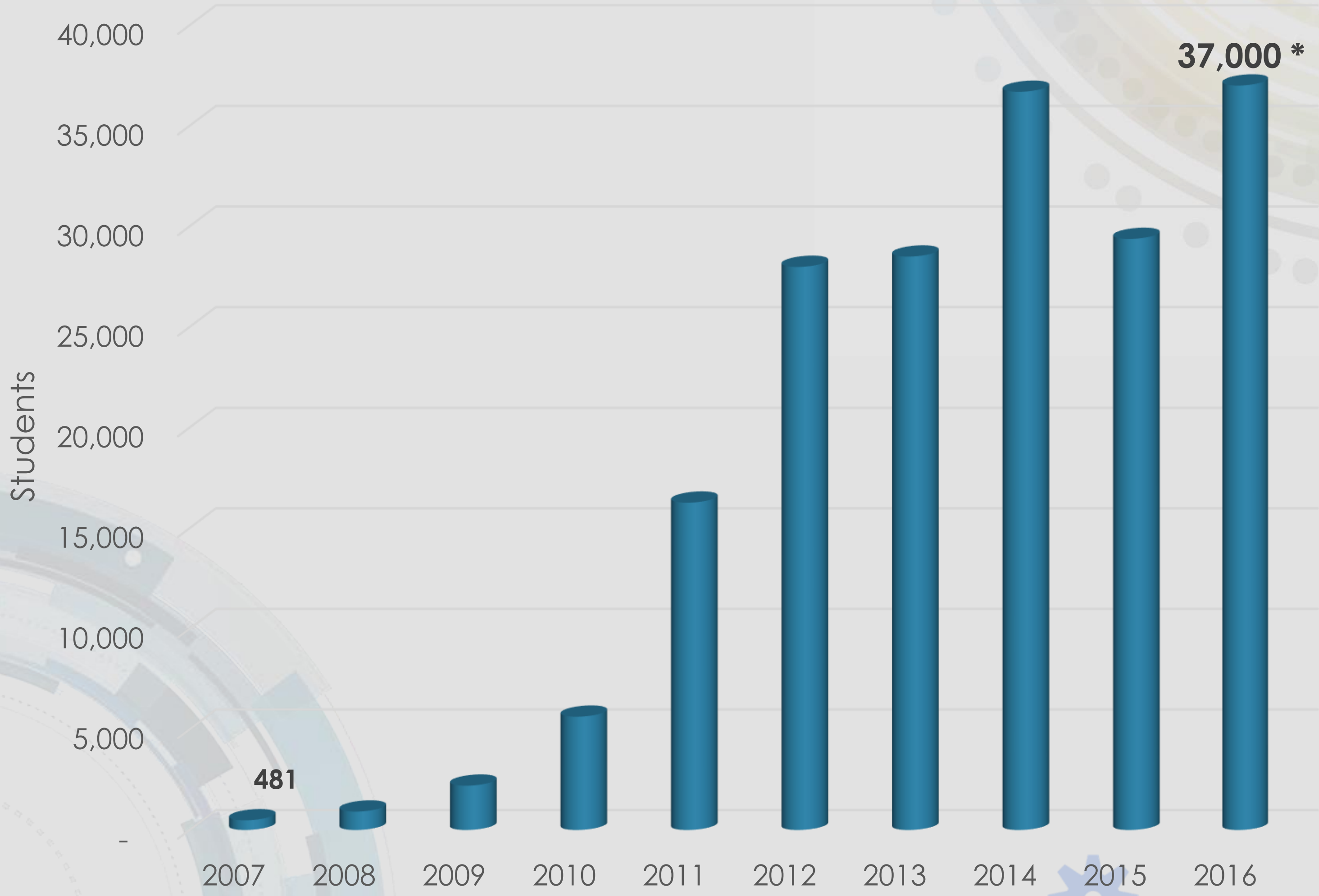
Knowing

Taking in information, organizing it, and understanding relationships.

- **I-STEM Content:** Knowledge and skills identified within standards documents as well as additional content derived from STEM integration.

- **Nature of I-STEM:** The Nature of Integrated Science, Technology, Engineering, and Mathematics is the idea that these academic content areas are naturally connected. In the I-STEM classroom, students should understand that these areas of study have traditionally been considered separate, but that all areas are required to understand content as well as to think about how they use the information learned in class.

EbD Online Assessment



Assessment

Consortium Research 2016 – 2017

- **Purpose**
  - Clear need for documented evidence of student learning and achievement. (FLF 2016)
  - Assessment instrument must measure growth on valued metrics beyond the STL. (FLF 2016)
- **Research Questions**
  - Does Engineering byDesign affect student learning of STEM content?
  - To what extend does Engineering byDesign support math and science learning in the classroom?
- **Method**
  - The NSF Project's "Engineering for All" research model will guide the next generation of STEM-CTL research on student learning.
    - Item analysis and metrics built into the system - Conducted in EbD-BUZZ; n = ~400 students
    - Based on NGSS and STL.
- Data Collection
  - RQ_1 Student data - EfA, Pilot and historical database.
  - RQ_2 Literature Review, Content analysis; Professional development Surveys; and Student data

Leadership In Professional Organizations

Being An Active Participant!

Technology and Engineering bring STEM to Life!

International Technology and Engineering Educators Association

www.iteea.org

Engineering byDesign™

STEM Center for Teaching & Learning™

Activity:

1) Write down one item **YOU** want to share about your "STEM" program and/or current beliefs of how to deliver STEM education for all students.

2) Please take a second and describe your iconic STEM education scenario.

- A few guiding prompts:
- Describe the students.
- Describe the teacher(s).
- What does the classroom look like?
- What does STEM Education look like?

ITEEA's International Center: China Website Resources

Main **ITEEA's International Center: China webpage** Page – http://www.iteea.org/China.aspx

ITEEA **ITEEA's International Center: China** Resource Page – http://www.iteea.org/China_Resources.aspx

ITEEA **ITEEA's International Center: China** Certificate PDF – http://www.iteea.org/ITEEA_China_Center_Certificate.aspx

In conclusion…

The power and promise of technology and engineering education must be further enhanced to assure that **all** people are technologically and engineering literate in the future.

Reflection Questions, & Discussion

Future Conference Dates

Dallas – March 16-18, 2017 • Atlanta – April 12-14, 2018

Kansas City – March 28-30, 2019 • Memphis – March 12-14, 2020

www.iteea.org

April - 2016

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

May - 2016

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

June - 2016

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July - 2016

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August - 2016

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

September - 2016

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

October - 2016

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November - 2016

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

December - 2016

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

January - 2017

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

February - 2017

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

March - 2017

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Thank you!

国际技术与工程教育协会中国中心

International Technology and Engineering Educators Association Chinese Center

Technology and Engineering bring STEM to Life!