SAE INTERNATIONAL

High-Quality STEM Education In Michigan

Chris Ciuca
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SAE International
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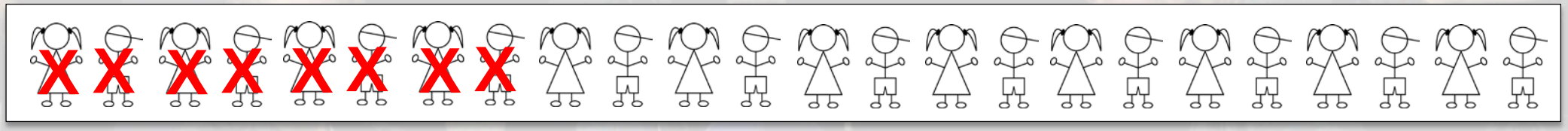
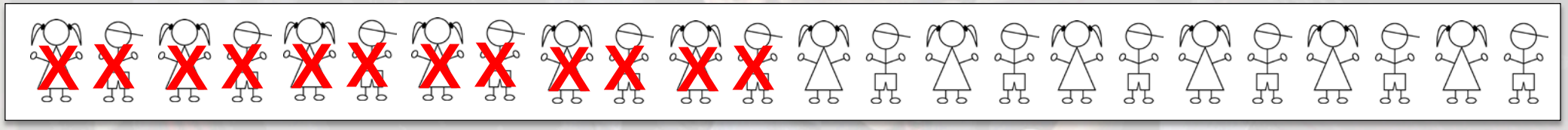
The Roots: Engagement through Integrated STEM Education

WHY STEM EDUCATION?

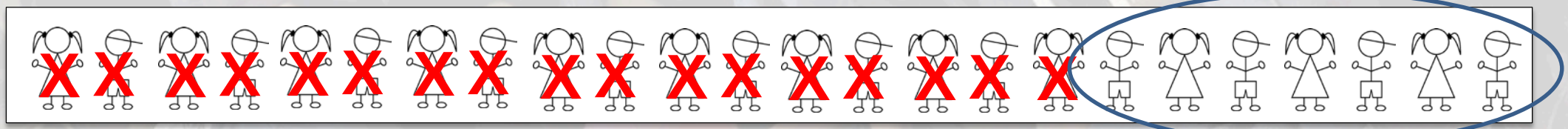


By the time these students are in 4th grade, 1/3 have "*lost an interest in science*"

Let's start the conversation considering a Kindergarten class of 24 students…



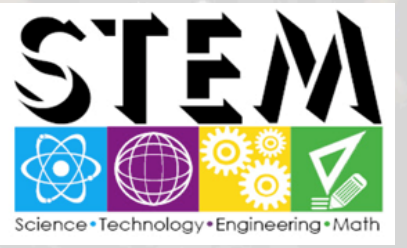
By the 8th grade, "50% of students have deemed science <u>irrelevant</u> to their education or future plans"



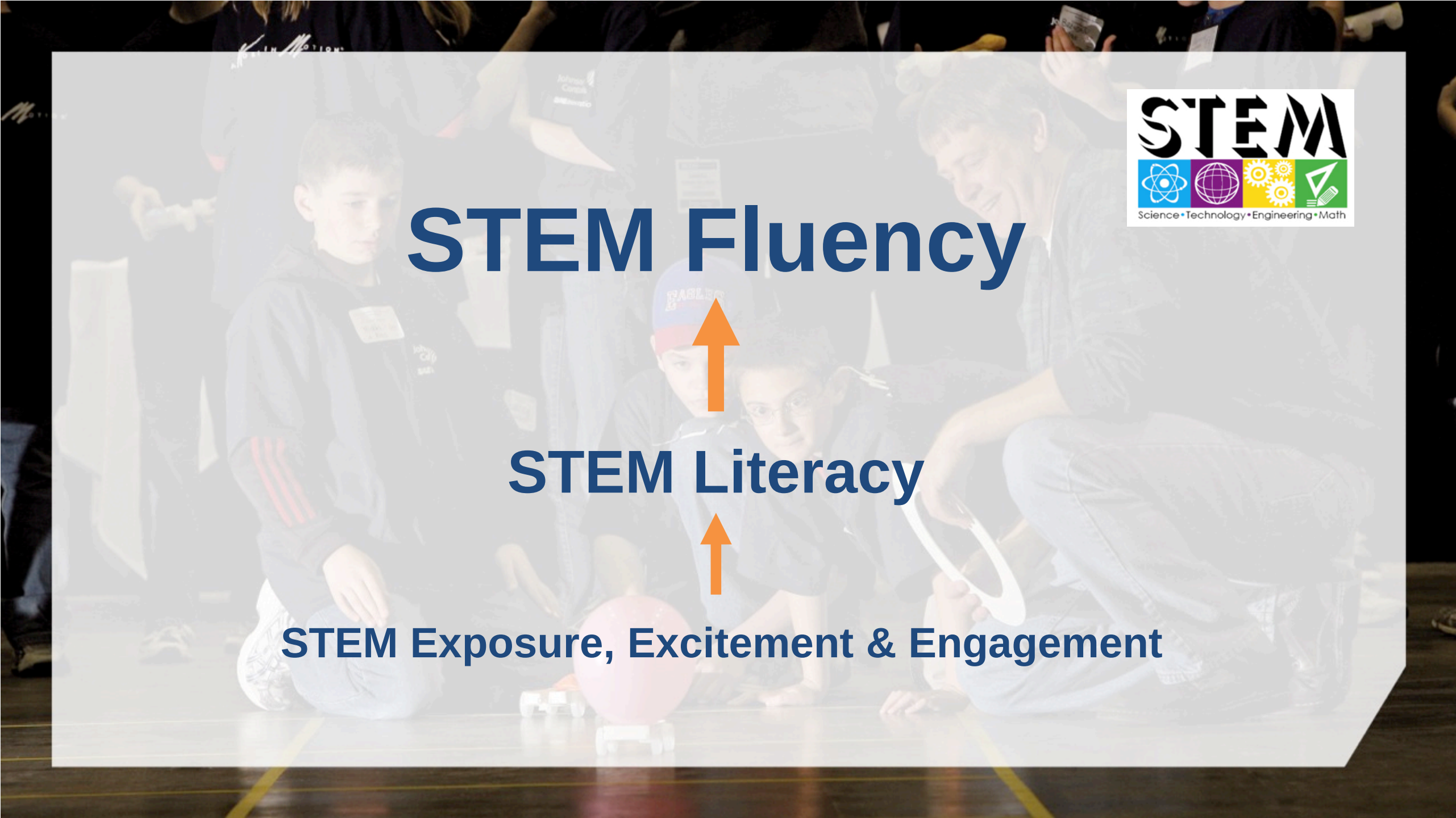
By the time they graduate high school, "only 32% are <u>qualified</u> to attend 4-year colleges"

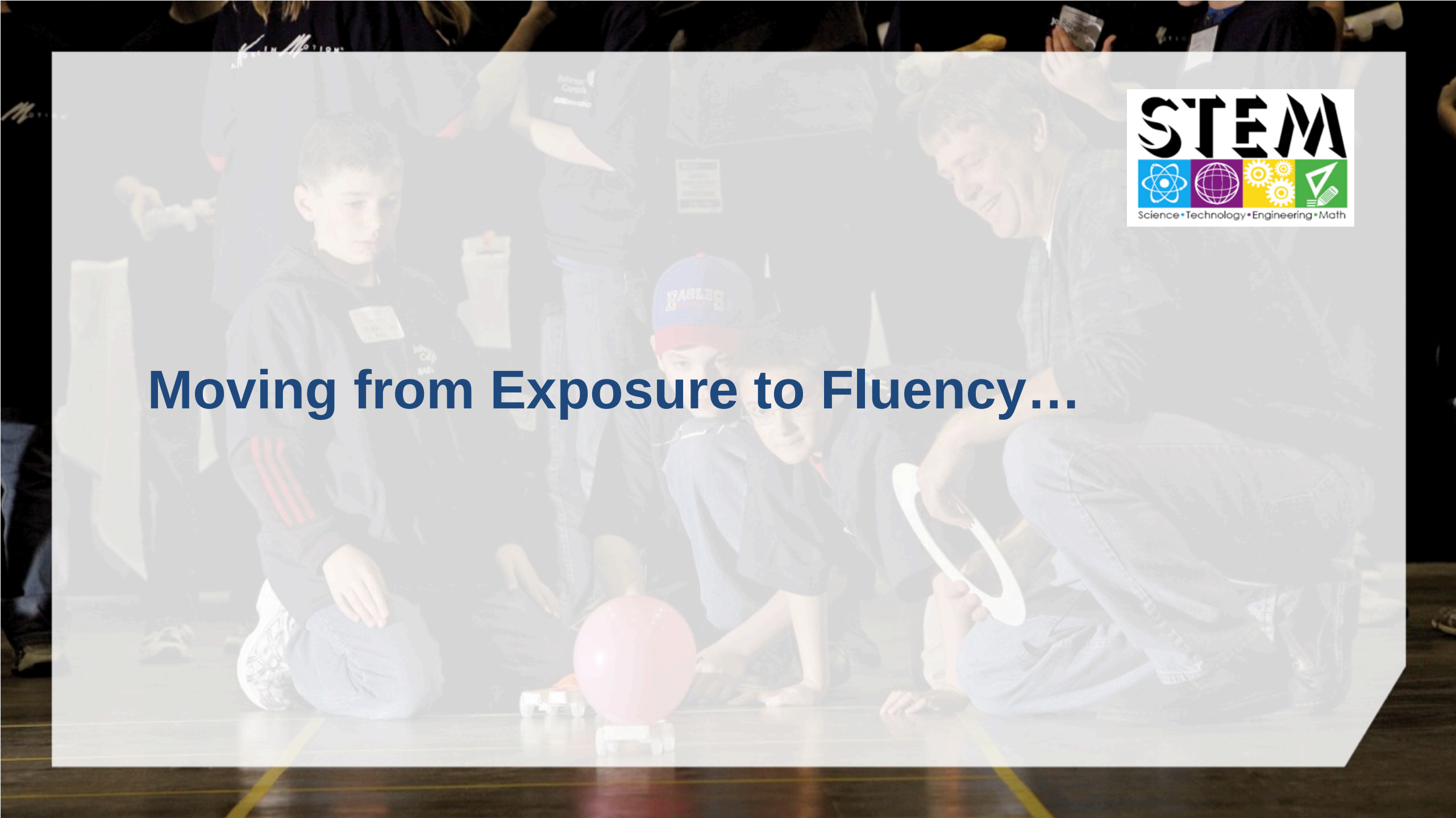
Is STEM Exposure & Excitement the Answer?

WHAT IS HIGH-QUALITY STEM?



- Much more than an acronym for “hands-on” or “doing science”
- Culminating, inclusive approach that provides students with practical applications of conceptual material and information
- Enables students to use conceptual knowledge to develop solutions to real world problems in a practical manner


STEM
Science • Technology • Engineering • Math
STEM Fluency
STEM Literacy
STEM Exposure, Excitement & Engagement



Moving from Exposure to Fluency…

We MUST Look at Classroom-Based Instruction in Multiple Dimensions….


ALERT

STEM EDUCATION & “STANDARDS-BASED”

STEM EDUCATION & “STANDARDS-BASED”

NEXT GENERATION SCIENCE STANDARDS
For States, By States

STEM EDUCATION & “STANDARDS-BASED”

Practices

- Behaviors that scientists engage in as they investigate and build models and theories about the natural world;
- Key set of engineering practices that engineers use as they design and build models and systems.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

STEM EDUCATION & “STANDARDS-BASED”

Content

- ***Broad Importance*** across multiple sciences and engineering disciplines or a ***key organizing concept*** of a single discipline;
- Provide a ***key tool*** for understanding or investigating more complex ideas and solving problems;
- Relate to the ***interests and life experiences of students*** or be connected to societal or personal concerns that require scientific or technological knowledge;
- Be ***teachable*** and ***learnable*** over multiple grades at increasing levels of depth and sophistication.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

STEM EDUCATION & “STANDARDS-BASED”

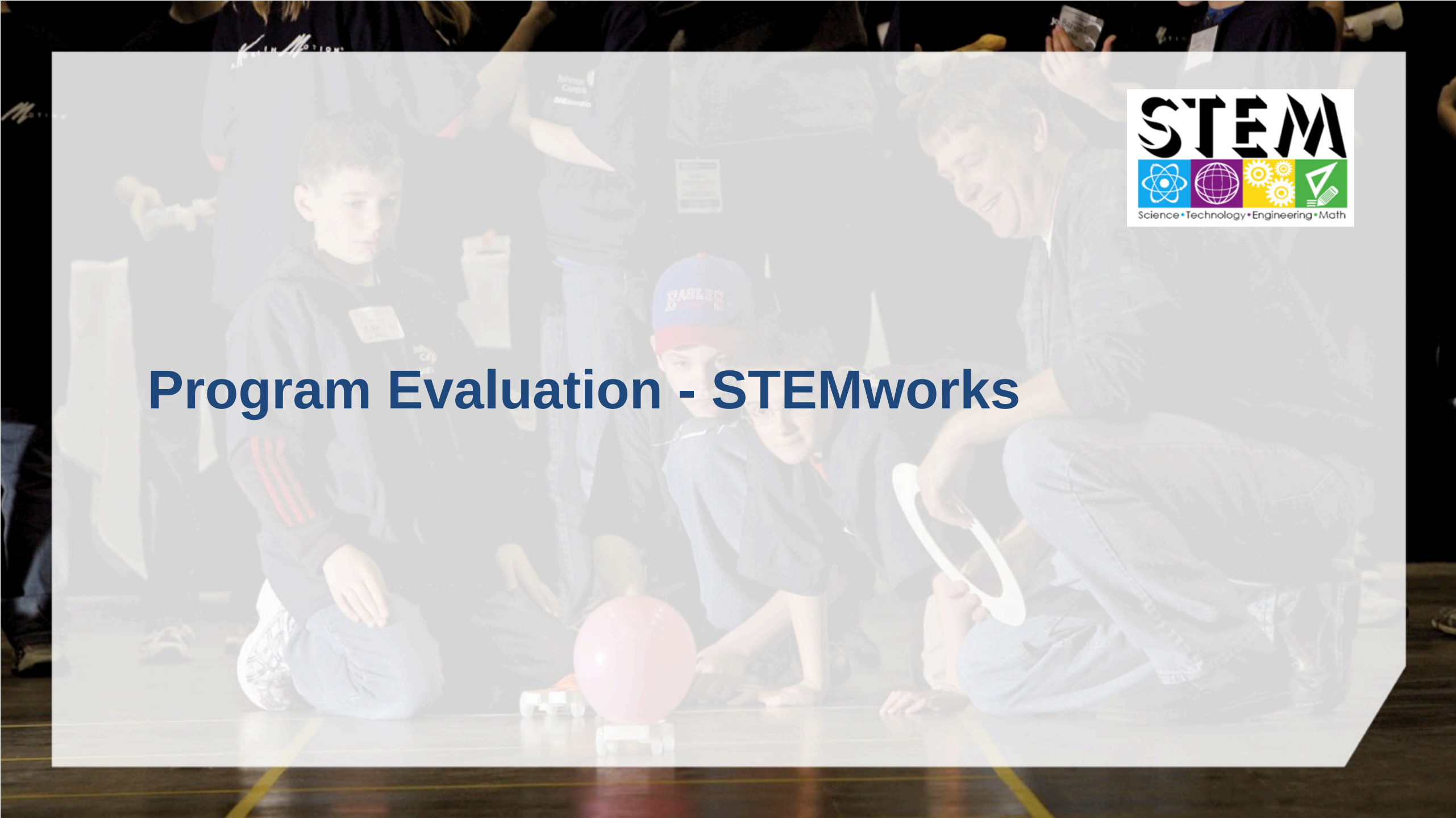
Cross Cutting Concepts

Crosscutting concepts have application across all domains of science.

Linking the different domains of science:

- Patterns, Similarity & Diversity
- Cause & Effect
- Scale, Proportion & Quantity
- Systems & System Models
- Energy & Matter
- Structure & Function
- Stability & Change

NEXT GENERATION SCIENCE STANDARDS
For States, By States



Program Evaluation - STEMworks

Program Evaluation through STEMworks

Michigan House of Representatives
Education Reform Committee

Claus von Zastrow • March 7, 2017

CHANGE THE EQUATION™

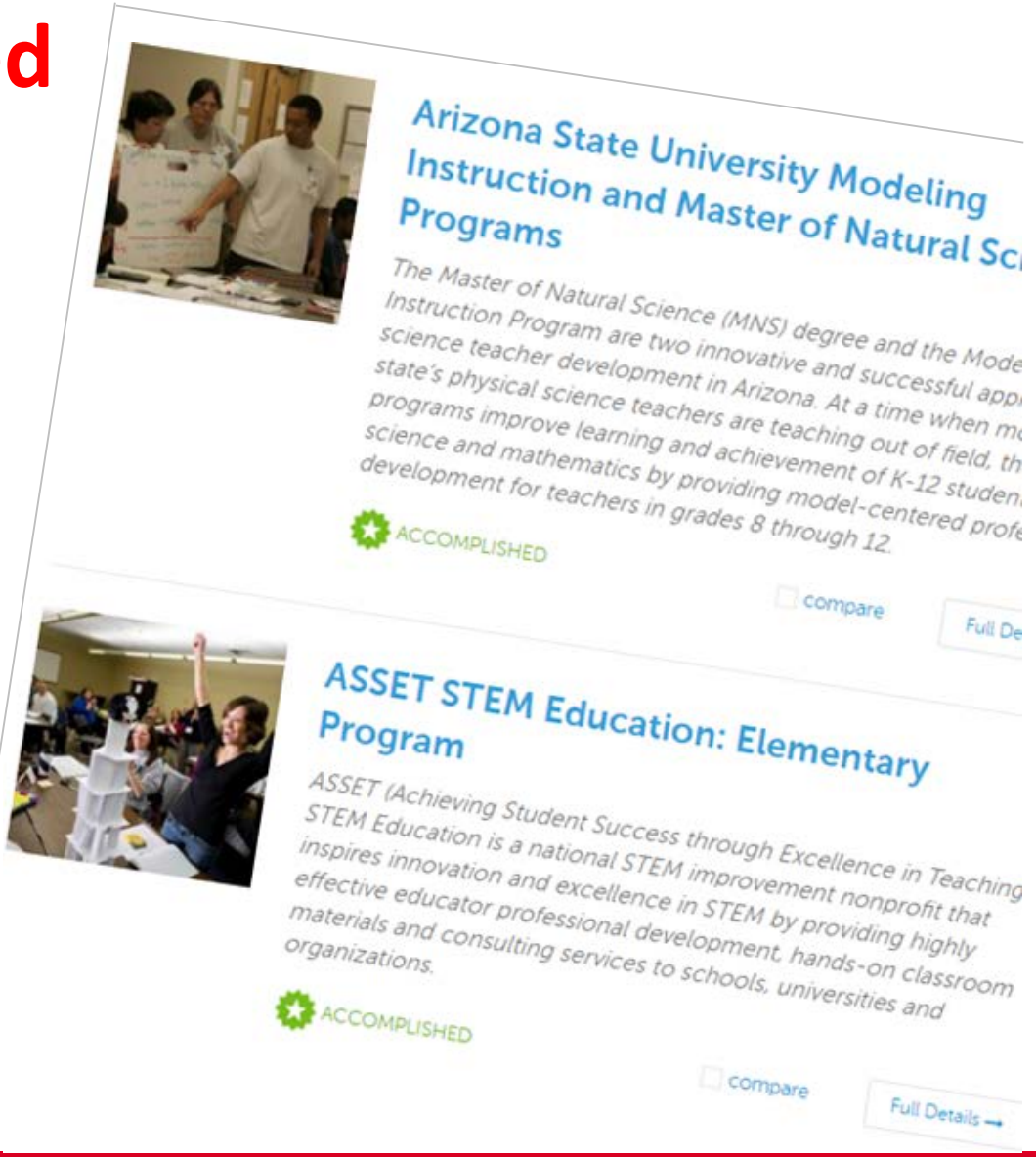
What is Change the Equation?

- 501 (c) (3) Nonprofit to ensure **all students are STEM literate**
- **Non-partisan** and independent
- Supported by **CEOs of major companies** operating in the U.S.
- Focus on scaling the **best programs and strategies**

CHANGE THE EQUATION™

What is STEMworks?

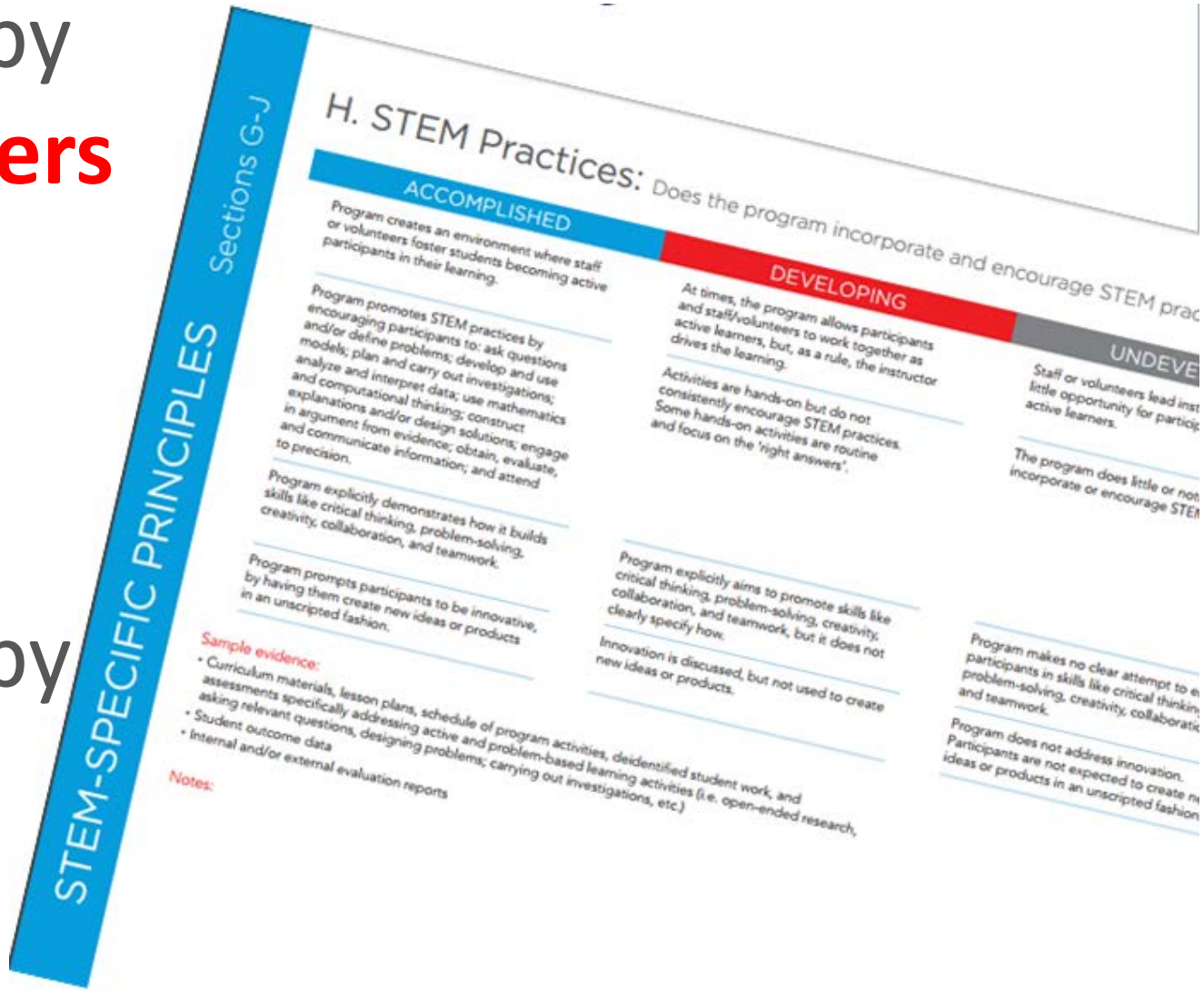
- **Rigorously-vetted** programs
- **Careful third-party** reviews
- Tool to **raise return on public investments**



CHANGE THE EQUATION

Principles for quality

- Created by **CSR leaders**
- Based in **research**
- **Refined** by Experts



CHANGE THE EQUATION™

Principles for quality

OVERARCHING

- Well-defined **Need**
- Rigorous **Evaluation**
- **Sustainability**
- **Replication/ Scalability**
- High-impact **Partnerships**
- **Capacity** to meet goals

STEM-SPECIFIC

- Challenging, relevant **Content**
- STEM **Practices**
- **Inspiration** of STEM interest, engagement
- Focus on **Underrepresented Groups**

CHANGE THE EQUATION™

Example: STEM Practices

STEM-SPECIFIC PRINCIPLES Sections G-J

H. STEM Practices: Does the program incorporate and encourage STEM practices?

ACCOMPLISHED	DEVELOPING	UNDEVELOPED
Program creates an environment where staff or volunteers foster students becoming active participants in their learning.	At times, the program allows participants and staff/volunteers to work together as active learners, but, as a rule, the instructor drives the learning.	Staff or volunteers lead instruction with little opportunity for participants to become active learners.
Program promotes STEM practices by encouraging participants to: ask questions and/or define problems; develop and use models; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; construct explanations and/or design solutions; engage in argument from evidence; obtain, evaluate, and communicate information; and attend to precision.	Activities are hands-on but do not consistently encourage STEM practices. Some hands-on activities are routine and focus on the 'right answers'.	The program does little or nothing to incorporate or encourage STEM practices.
Program explicitly demonstrates how it builds skills like critical thinking, problem-solving, creativity, collaboration, and teamwork.	Program explicitly aims to promote skills like critical thinking, problem-solving, creativity, collaboration, and teamwork, but it does not clearly specify how.	Program makes no clear attempt to engage participants in skills like critical thinking, problem-solving, creativity, collaboration, and teamwork.
Program prompts participants to be innovative, by having them create new ideas or products in an unscripted fashion.	Innovation is discussed, but not used to create new ideas or products.	Program does not address innovation. Participants are not expected to create new ideas or products in an unscripted fashion.

Sample evidence:

- Curriculum materials, lesson plans, schedule of program activities, deidentified student work, and assessments specifically addressing active and problem-based learning activities (i.e. open-ended research, asking relevant questions, designing problems; carrying out investigations, etc.)
- Student outcome data
- Internal and/or external evaluation reports

Notes:

Realizes the vision

Good intentions, but…

Doesn't even address the issue

CHANGE THE EQUATION

Example: STEM Practices

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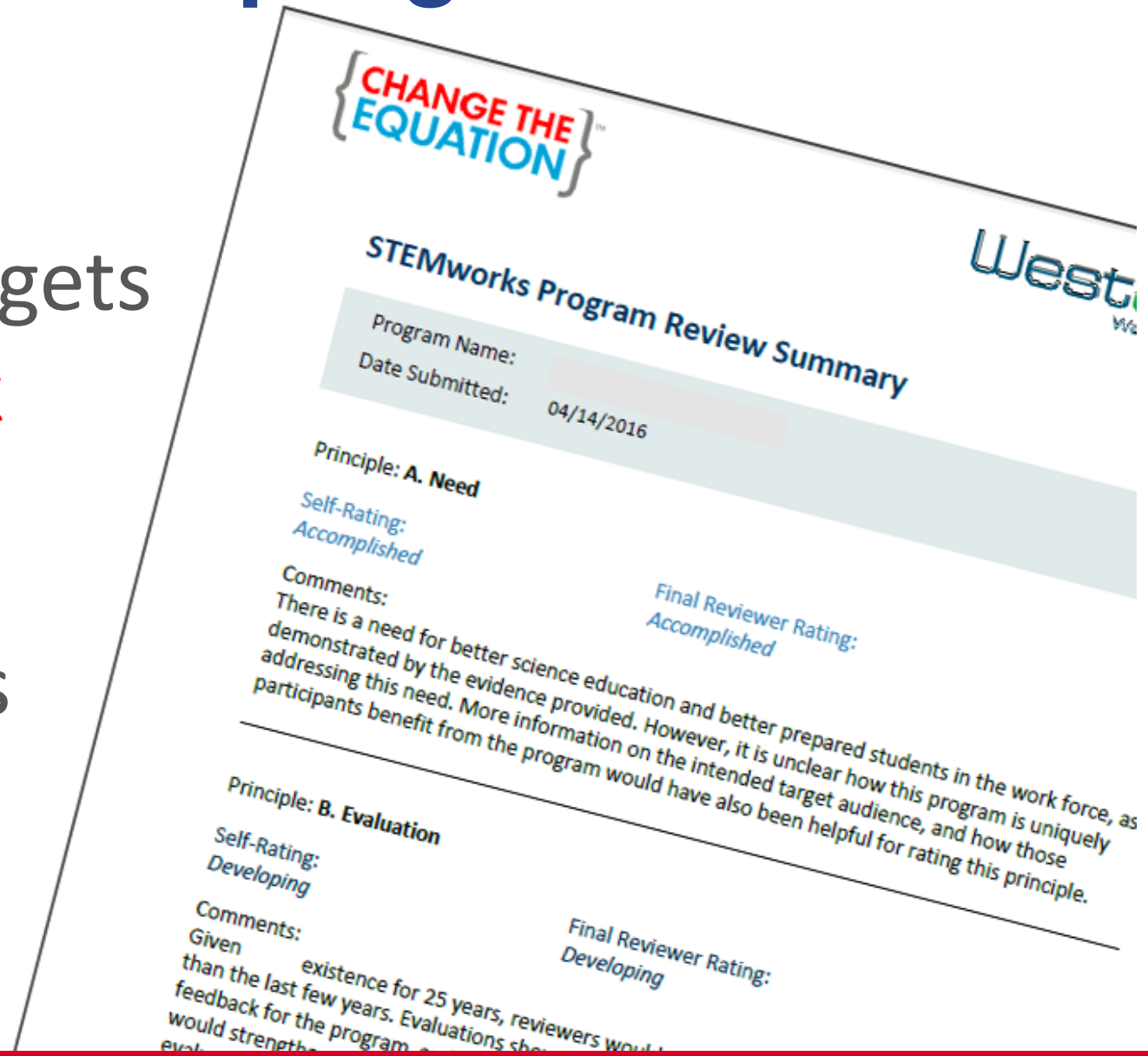
Notes:

Evidence to prove assertions

CHANGE T
EQUATIO

Feedback for programs

- Every program gets **feedback**
- Some programs **reapply**



CHANGE THE EQUATION

STEMworks Program Review Summary

Program Name:

Date Submitted: 04/14/2016

Principle: **A. Need**

Self-Rating:
Accomplished

Final Reviewer Rating:
Accomplished

Comments:
There is a need for better science education and better prepared students in the work force, as demonstrated by the evidence provided. However, it is unclear how this program is uniquely addressing this need. More information on the intended target audience, and how those participants benefit from the program would have also been helpful for rating this principle.

Principle: **B. Evaluation**

Self-Rating:
Developing

Final Reviewer Rating:
Developing

Comments:
Given existence for 25 years, reviewers would than the last few years. Evaluations sh feedback for the program would strength

Very selective process

- Rougly **30%** of applicants have been admitted
- Some are admitted as **“promising”**; some as **“accomplished”**
- All have to **“re-certify”** after 3-4 years.

CHANGE THE EQUATION™

How state leaders partner with us

- Simply **select programs from the existing** STEMworks list
- Use STEMworks to **identify additional programs** for scaling in the state

What states provide

- Reviewers who dedicate **review time** (Ca . 2-3 hours/program)
- **Administrator** to coordinate reviewers
- **Outreach** to STEM program providers in the state
- Pledge **not to alter** the STEMworks principles; states **can add** principles

CHANGE THE EQUATION™

What CTEq provides

- Online **application and review portal**
- **Training** of state reviewers
- **Technical assistance and support** to state partner and program applicants
- **Quality control** to ensure consistent high standards

CHANGE THE EQUATION™

Thank you

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Change the Equation
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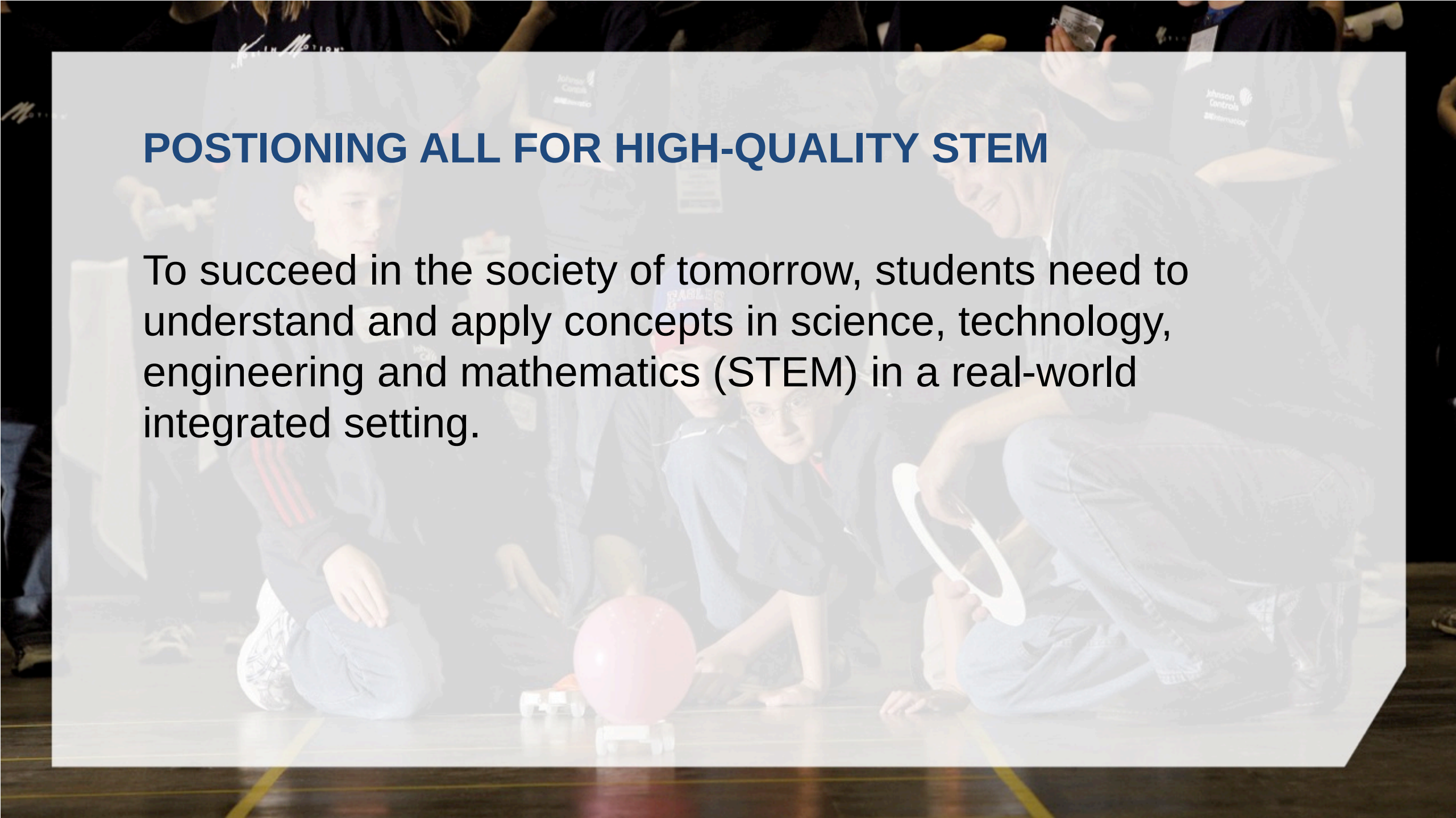
Building the Future of Engagement



POSTIONING ALL FOR HIGH-QUALITY STEM

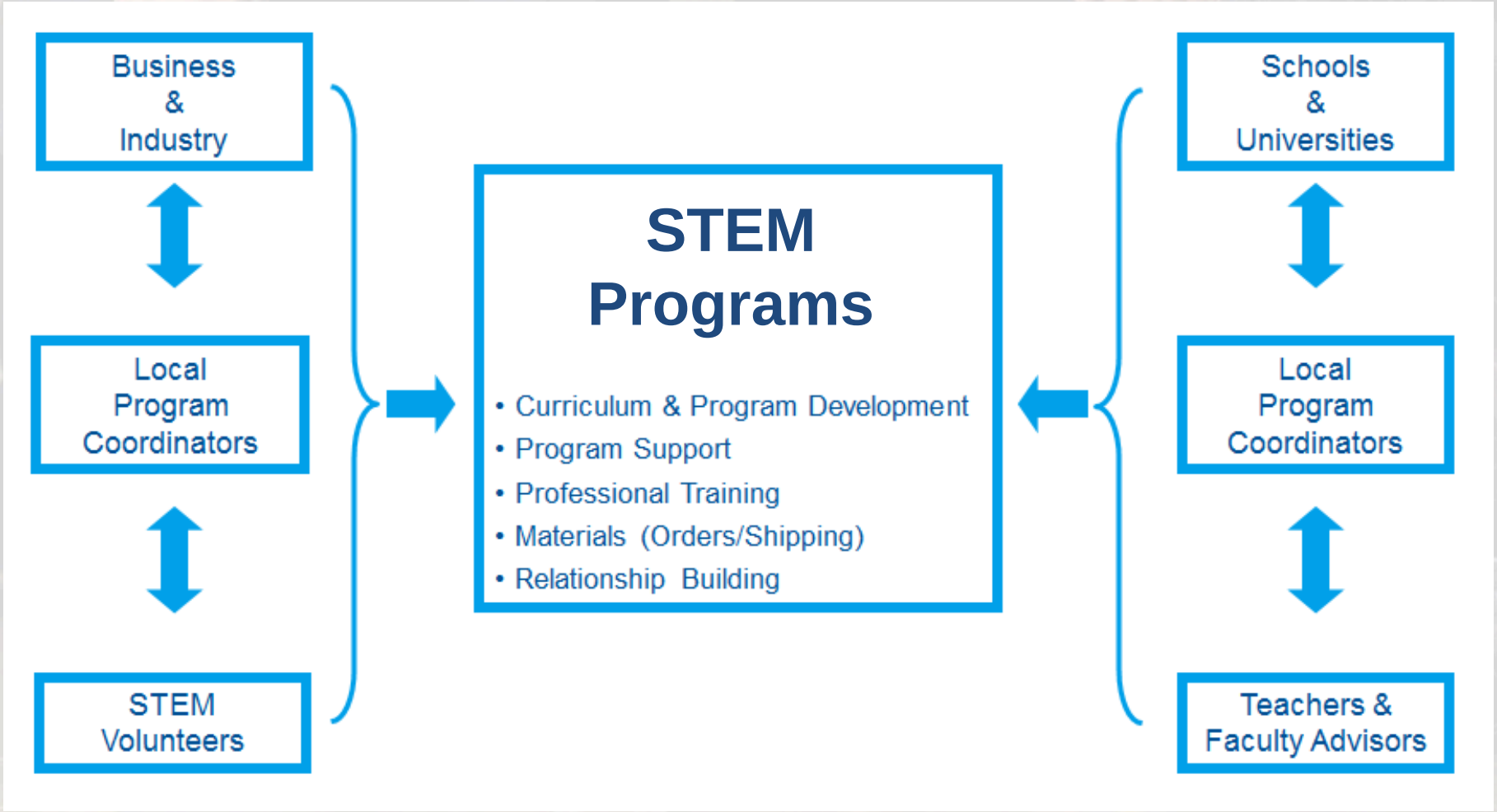
To succeed in the society of tomorrow, students need to understand and apply concepts in science, technology, engineering and mathematics (STEM) in a real-world integrated setting.

POSTIONING ALL FOR HIGH-QUALITY STEM

In addition to becoming literate in these disciplines, students must also:

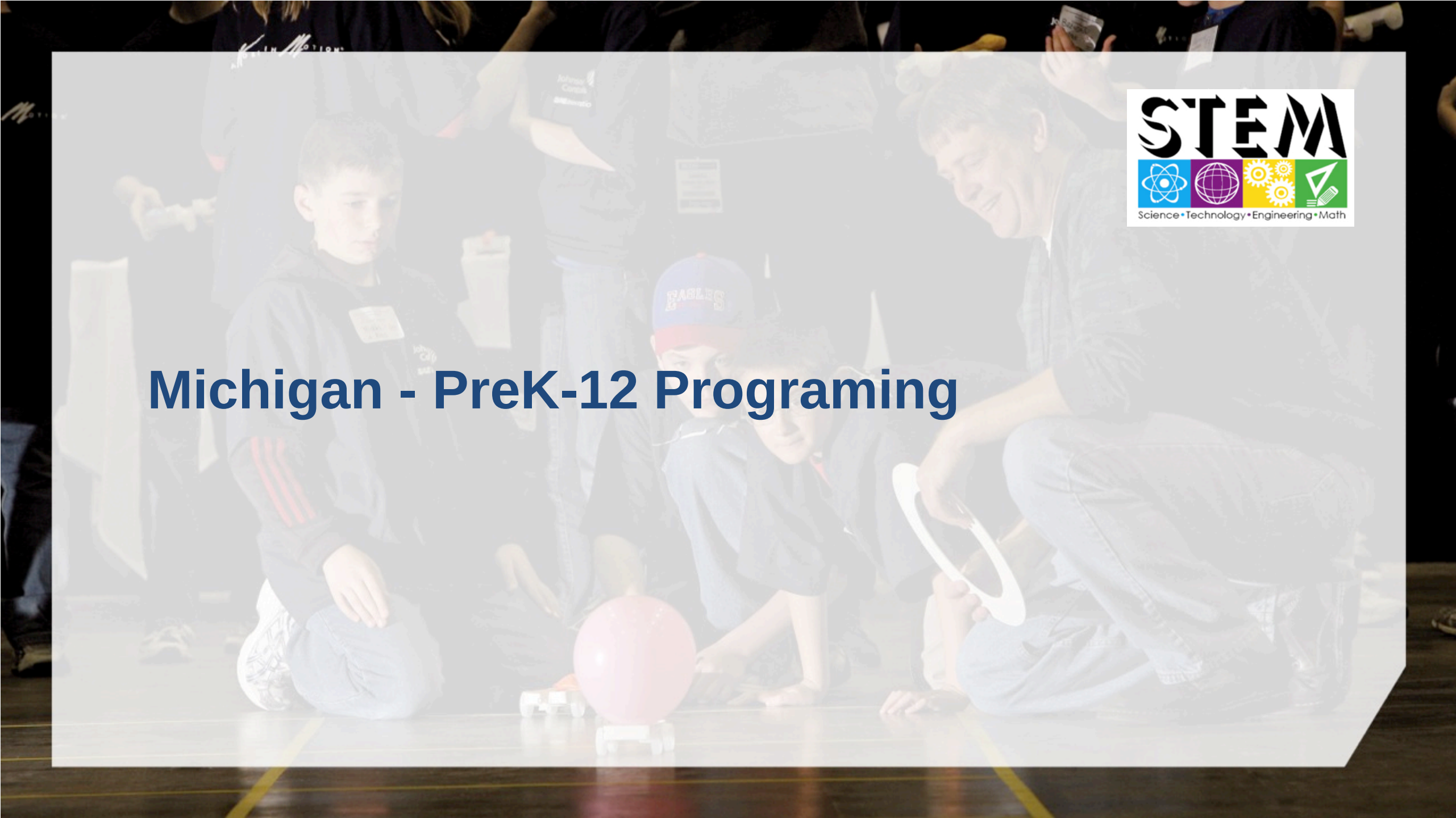
- Learn to solve complex problems
- Communicate clearly
- Raise & resolve questions/problems
- Assimilate information
- Work cooperatively toward common goals

ROLES IN THE STEM COMMUNITY



Some Possible Solutions

BUT…Evaluation MUST Build this List!!!



Michigan - PreK-12 Programing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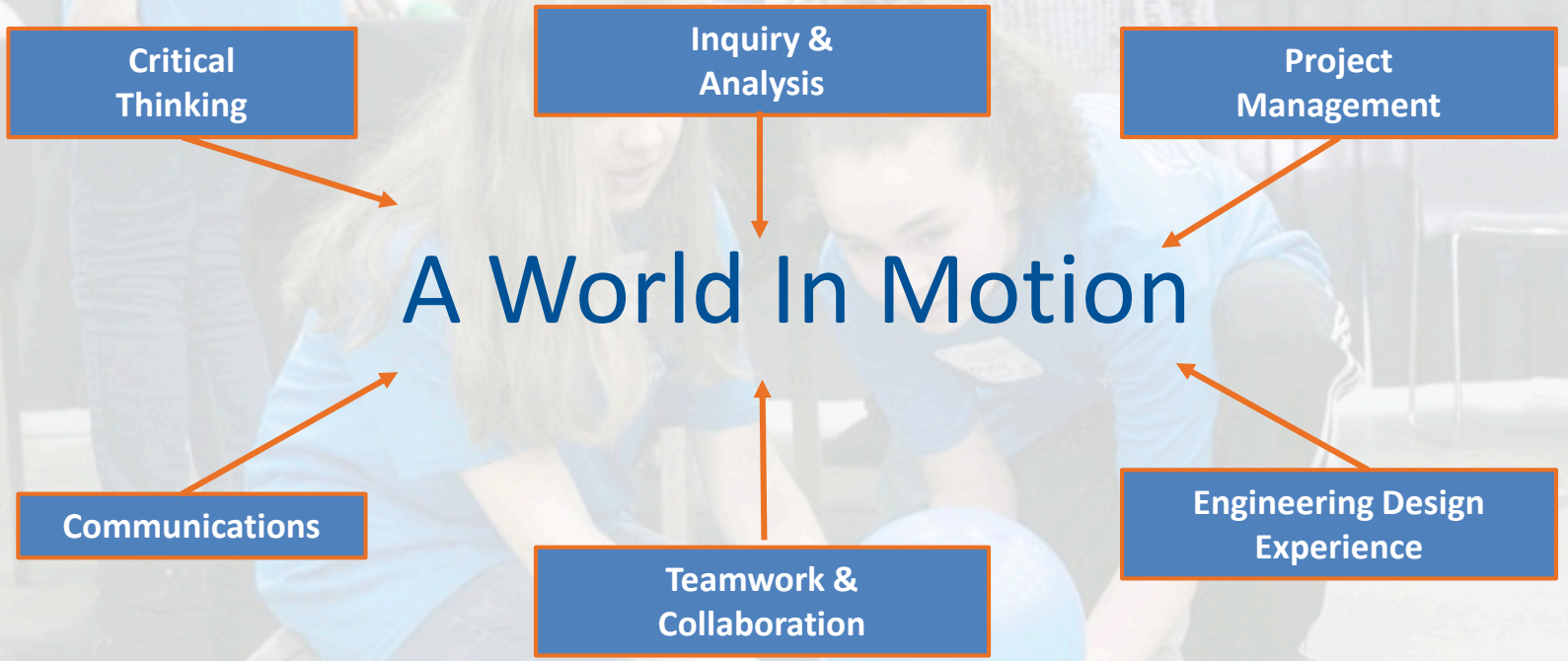
A WORLD IN MOTION (AWIM)

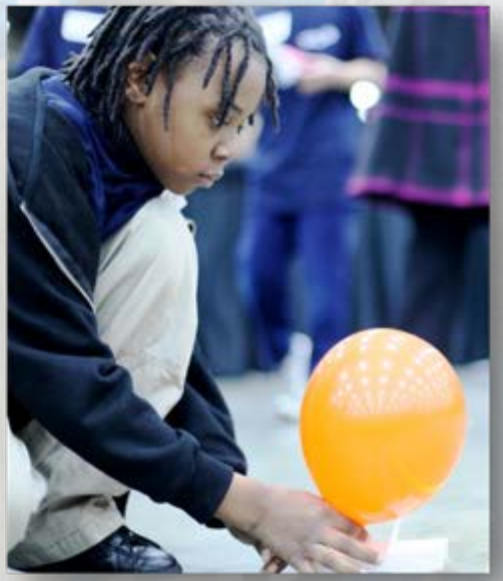
AWIM PROGRAM PHILOSOPHY



AWIM CHALLENGE CLUSTERS

Primary

- Rolling Things
- Inspired by Nature
- Straw Rockets
- Making Music
- Pinball Designers



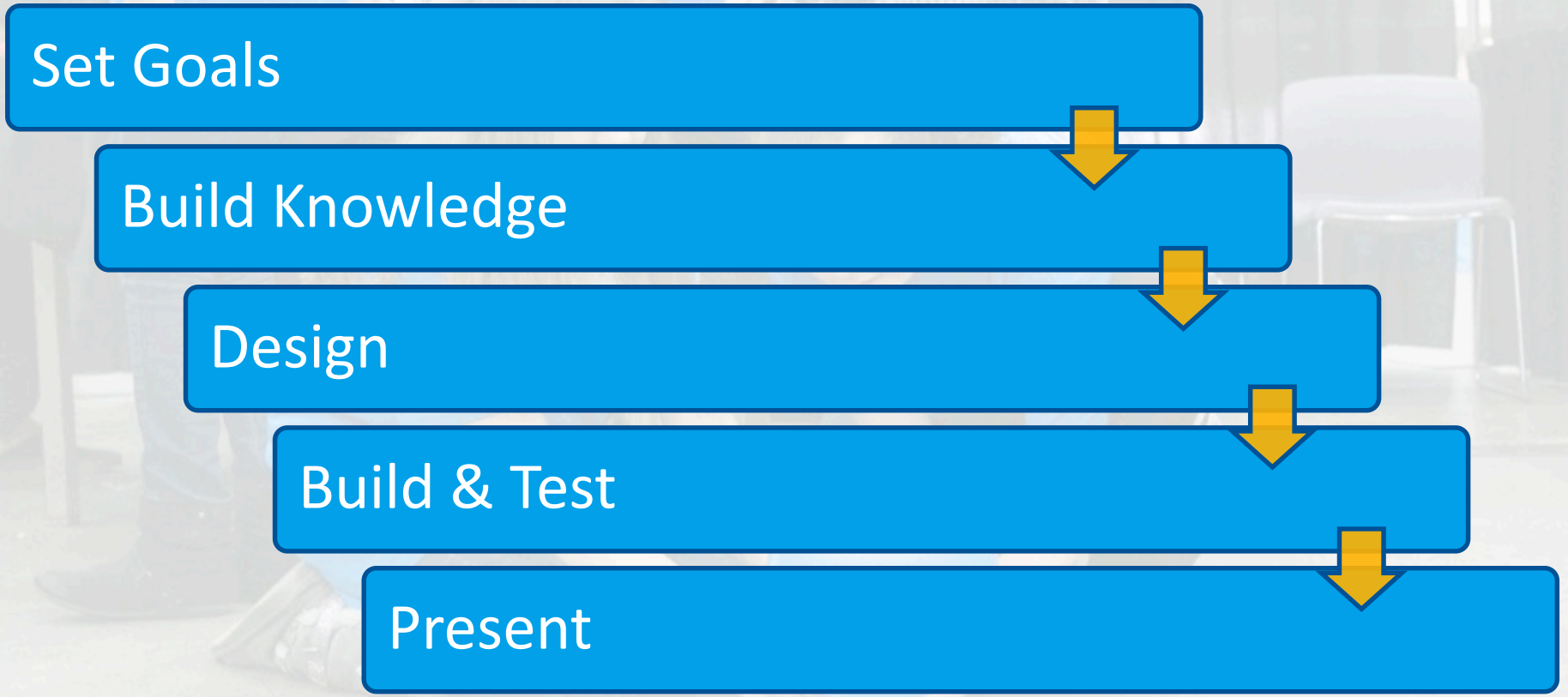
Elementary

- JetToy
- Skimmer
- Gravity Cruiser

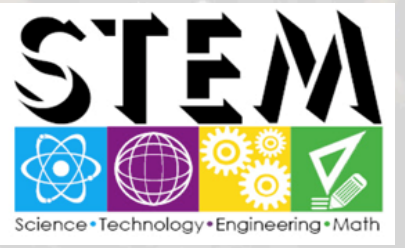
Primary

- Fuel Cell
- Motorized Toy Car
- Glider
- Keeping Our Networks Secure

AWIM ENGINEERING DESIGN EXPERIENCE



AWIM – By the Numbers…



- Over 5,000,000 students served
- More that 36,000 classroom volunteers engaged
- Standards-based (local & national standards)
- Over 112,000 student reached in 2016

- 72% of students displayed a significant increase in the math and science scores
- 81% of students displayed a change of attitude toward math and science
- 84% of students demonstrate decreased intimidation toward learning science
- 91% of students demonstrated increased awareness of the engineering profession

Michigan - High School Programing

SQUARE ONE™

EDUCATION NETWORK

the future starts with us

Leaders in Innovative K-12 STEM Education

Est. 1994

Barb Land
Barb@squareonenetwork.org
248-736-7537

The Square One Education Network is a 501(c)(3) charitable foundation

Industry leaders are seeking talent with…

SQUARE ONE
EDUCATION NETWORK
the future starts with us

Problem Solving Skills

Technical Skills

Good Communication Skills

Industry leaders are seeking talent with…

SQUARE ONE
EDUCATION NETWORK
the future starts with us

Problem Solving Skills

Technical Skills

Good Communication Skills

This is what we do!

What is our unique reason for being?

Talent Readiness!

Empower teachers with a complete set of resources for students to engage, using hands-on learning tools and modern learning fundamentals, with the intent of developing skills needed for the next generation technical workforce.

Offerings…

SQUARE ONE

INNOVATIVE VEHICLE DESIGN℠

- Teacher Professional Development
- Full Scale
- Mini-Racing
- Autonomous
- Underwater
- Additive Manufacturing/3D Printing
- *NEW! V2X Technology Lab Schools*


High School Students Surveyed…
Because of S1 projects…
Has your interest in STEM increased?
Yes = 82%
Awareness of STEM careers increased?
Yes = 88%

SQUARE ONE™

EDUCATION NETWORK

the future starts with us

Annually reaching 12,000 students and 400 teachers across Michigan, Square One seeks to prepare students with the essential skillset for higher learning institutions and the rapidly evolving needs of STEM related jobs.

www.squareonenetwork.org

Michigan - University Programing

SAE INTERNATIONAL

COLLEGE DESIGN SERIES (CDS)

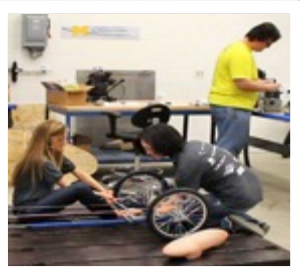
CDS PROGRAM PHILOSOPHY

Students participating in CDS Competitions experience *Xtreme Engineering.* The student experience includes:

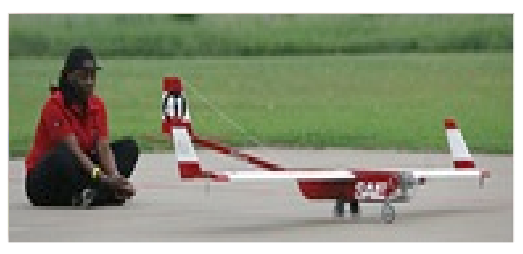
- Student led, hands-on team experience
- Project-based learning beyond textbook theory
- Budgeting, communication, time, production and resource management
- Designing, building and testing a vehicle
- Global student teams
- Direct access to mobility industry employers

SAE Collegiate Design Series

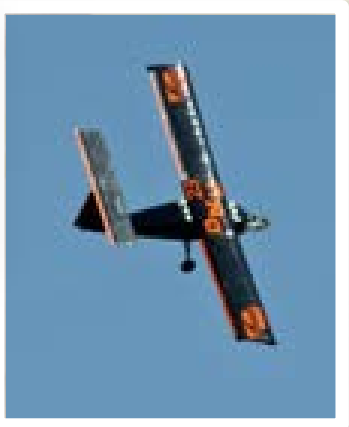
Clean Snowmobile Challenge



Supermileage

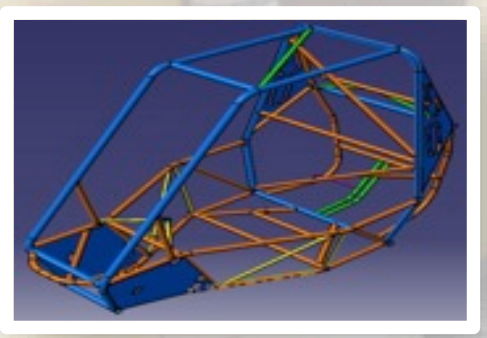


Aero Design



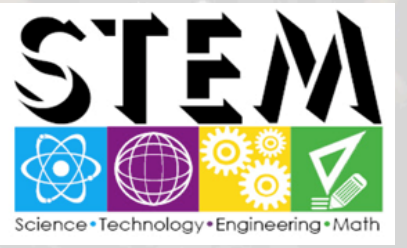
SAE Collegiate Design Series

Formula SAE



Baja SAE

CDS – By the Numbers…



- Served over 10,000 collegiate students through CDS in 2016
- 100% of the *Top 100 Engineer Degree Granting Universities (as rated by ASEE)* participate in CDS – many in multiple programs

- 91% of students demonstrated an improvement in *Leadership Skills*
- 96% of student demonstrated an improvement in *Teaming Skills*
- 93% of students demonstrated an improvement in *Project Management Skills*
- 92% of students demonstrated improvement in *Communication Skills*
- 71% of students demonstrated an improvement in *Finance & Budgeting Skills*

Michigan STEM
Q & A / Open Discussion