

# CASE STUDY

## **STEAM + EE**

Science, Technology,  
Engineering, Arts, and Math  
(STEAM) meet  
Economics and Equity (EE):  
Strange Bedfellows,  
but Oh How STEAM-EE

# Don't Get Left Behind

With each passing day, 21st century learning gets a little more obsolete. Don't get left behind. Empower students and revolutionize learning with the hottest content around.

The 21st century is defined by unprecedented, inter-connected challenges: climate change, water scarcity, food deserts, economic inequality—and on. Left unsolved, these problems will plague students of the 22nd century, the descendants of today's students. **Equity is truly intergenerational.**



The Next Generation Science Standards support “scientific and technological literacy for an educated society,” and recognize that “economic innovation depends on a broad foundation of math and science learning.”

But behind this “looms the larger question of what it takes to thrive in today's society. Citizens now face problems from pandemics to energy shortages whose solutions require all the... genius we can muster.”

## Ready to muster *your* genius?

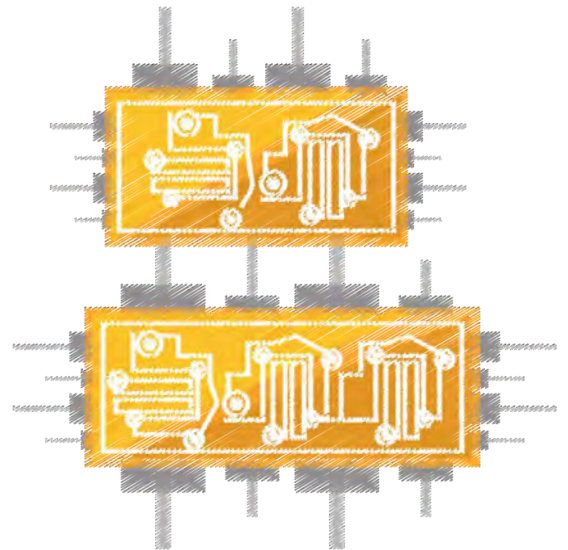
# Building Up STEAM

Changing the story requires wise applications of STEAM (science, technology, engineering, arts, and math). But tomorrow's careers demand something more: economic literacy and a commitment to equity. Ask yourself the following questions:

- Students attending schools in low-income communities are more likely to be exposed to toxins in the air and soil. *Do your students know how to clean up pollutants and advocate for economic policies that support environmental justice?*
- The way we design, manufacture and dispose of our “stuff” has profound impacts on workers, consumers, and our health. *Do your students understand the new “industrial revolution” that’s shaping the future of engineering?*
- Efforts to mitigate climate change are driving a boom in renewable energy. *Do your students know how it can make their own communities more resilient?*

**If you answered “no” to any of those questions, you’re short-changing your students.**

**It's an equity issue because all students deserve access to an education that will connect them with the world today *and* help them imagine the world of tomorrow.**



**Educators can talk about “critical thinking” all they want, but the fact is: *kids can’t think deeply about shallow content.***

## Interconnected Challenges + Integrated Approaches



When we begin working with teachers and instructional leaders and ask about their biggest challenges, this is what we hear again and again:

- **Students aren't engaged because the curriculum doesn't engage with them.**
- **Obsolete thinking puts content in silos, where real problems don't exist.**
- **Kids deserve better, and they're capable of much more than is expected.**

Integrated content is the best way to approach the interconnected problems we face. Applying knowledge about the economy to environmental and social issues can improve equity and make our communities stronger. And, it's simply more authentic—it's the way the world really works.

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**You probably already have the pieces, but without the right support, trying new approaches can be risky. We will help you make it happen.**

**Read on to see how others have invigorated their curriculum and boosted achievement.**

# The Difference a STEAM-EE Curriculum Can Make

## BEFORE: STEAM



In a traditional high school structure, students take separate chemistry and biology classes. While they're rigorous, the classes isolate disciplines and keep learning “in the test tube,” leaving students to wonder why it all matters.

Relevant community connections are not defined in the district's curriculum maps, meaning teachers don't have the support to broaden learning, even though they'd like to.

## AFTER: STEAM-EE

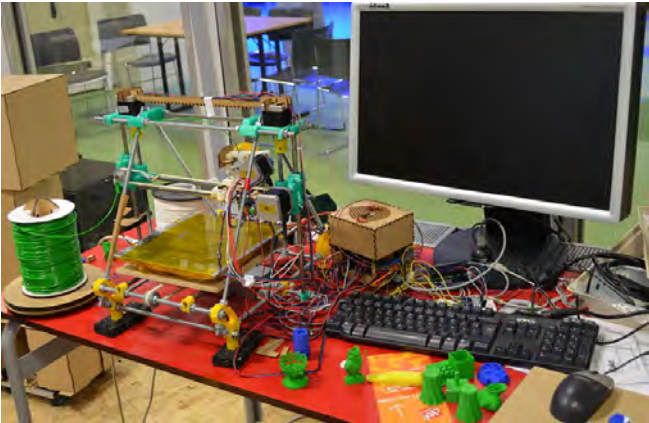


In an interdisciplinary, project-based high school course, *STEAM in the Community*, students in a high-poverty school investigated why their community has been disproportionately exposed to environmental hazards.

Guided by a teacher prepared for this approach, students uncovered the economic backstory, applied knowledge of chemistry and biology to clean up pollutants, and collaborated with community leaders to identify policies that support both environmental health and economic development—all while learning about new careers linking STEAM, economics, and public policy.

# The Difference a STEAM-EE Curriculum Can Make

## BEFORE: STEAM



High school students in a STEAM program learn coding, robotics, and design with 3-D printers. They gain important skills and learn about careers, but don't grasp the larger economic and social context of these fields.

The teachers would like to introduce this, but don't have the necessary guidance or resources.



## AFTER: STEAM-EE

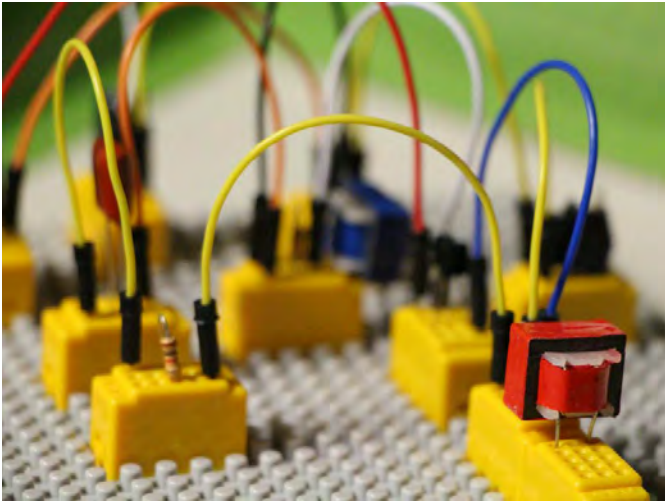


In their “Engineering, Design, and Society” course, middle school students explored the life cycles of everyday items (such as their phones) to learn the science and economics behind design, manufacturing, consumption, and disposal.

Tapping cutting-edge innovations from the manufacturing industry, students designed products that support a “triple bottom line” of social, economic, and environmental benefits.

# The Difference a STEAM-EE Curriculum Can Make

## BEFORE: STEAM



Following their prescribed curriculum, elementary teachers focus their electricity lessons on understanding and building circuits. While the lessons are hands-on and meet standards, students don't learn meaningful applications relevant to their communities.

Teachers want to change this, but without support to reframe their curriculum, they feel trapped into doing things the old way.



## AFTER: STEAM-EE



In an extended project-based unit, elementary students explored how energy consumption impacts their community.

Hands-on activities about electricity were blended seamlessly with literacy and social studies instruction, preparing students to talk with community leaders about local renewable energy projects and the new businesses behind them.

# HOW TO MAKE YOUR CURRICULUM STEAM-EE: THE SOLUTION

**How can Creative Change help?**

**Take a peek inside our STEAM-EE Professional Development Program**



# Curriculum Resources

Our online Curriculum Resource Center offers a complete digital library to support STEAM-EE learning.

## EXAMPLES

### Life-Cycle Analysis: The Life Story of a Potato Chip

Through an ordinary item (potato chips), learners explore the concept of life cycle analysis through:

- Computational thinking
- Exponents and scientific notation
- Geological time scales

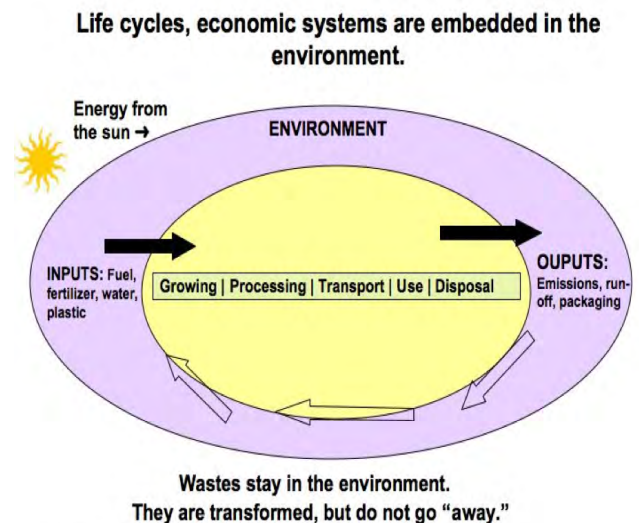
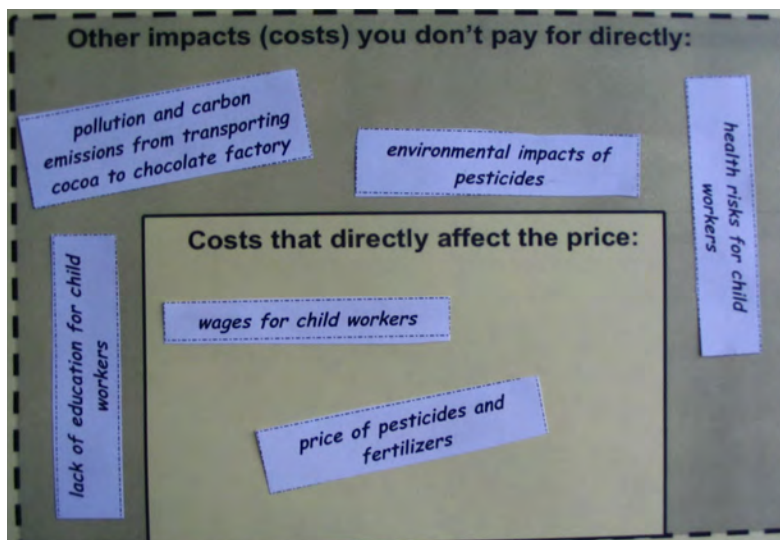


Diagram: Creative Change Educational Solutions. Adapted from works of Herman Daly.

### Social and Environmental Impacts: Price vs. Cost



Learners examine the social and environmental impacts of producing goods (such as shirts and chocolate), and then compare and contrast the an item's price (what a consumer pays) with the full costs (the price + external impacts). They apply these concepts to reflect on factors that influence their consumer choices.

Lesson includes:

- Poetry
- Reading selections
- Formative assessments
- Critical thinking activities

## Aluminum Recycling and Energy Use

Students compare the inputs and outputs of matter involved in manufacturing cans from virgin vs. recycled aluminum. The lessons build scientific and economic literacy through:

- Modeling phenomenon about transformations of energy
- Computational thinking
- Interdisciplinary texts and assessments aligned to Common Core



## Sustainable Design

After researching and comparing the environmental impacts of furniture components (e.g., wood vs. bamboo; polyester vs. cotton), 6th grade students created this prototype of a couch, coupled with a report detailing the rationale for each material selected.



# Overview: The CCES Process

Over a period of one year, we worked with 35 middle school teachers to design the highlighted project-based STEAM-EE curriculum makeovers.

The program involved science and economics teachers in 10 districts, from rural to urban, across two states. It combined on-site professional development and ongoing coaching for instructional design and evaluation. Teachers also received our portfolio of model units that merge science, economics, design, and engineering. The project's goals were to increase:

- a. Teachers' knowledge of product life cycles and links between economy and environment.
- b. Teachers' confidence in delivering instruction on these topics.
- c. Students' knowledge of these topics.



# 3 Steps to Change

## Step 1: On-site Professional Development

Workshops begin by immersing teachers in content knowledge and research-based pedagogical strategies. To model effective approaches, the sessions engage staff in hands-on activities they can replicate with their students, followed by thoughtful analysis.

Approaches have included:

- Concept mapping and life cycle analysis
- Labs to explore the properties of polymers, metals, fabrics, and other materials
- Hands-on simulations of entropy and what it means for the economy
- Explorations of design principles used by plants and animals (“biomimicry”)
- Critical analysis of ads and “greenwashing” techniques
- Analysis of supply chains and leverage points for change



## Step 2. Curriculum (Re)Framing

Using our signature method, teachers (re)design project-based units that:

- Connect to students' cultures and experiences
- Center inquiry around real-world issues
- Support literacy through content instruction
- Place standards in a meaningful context
- Culminate with solution-oriented projects with a real audience and purpose

## Step 3. Implementation and Support

As teachers take the new approaches into the classroom, we provide one-on-one support with lesson planning, assessment, and instructional strategies. Support is provided in-person, via email, and phone meetings. To build internal leadership, we connect educators and provide a platform for learning communities where educators to collaborate and reflect upon their practice.

# Does it Work? You Betcha.

Creative Change administered pre- and post-tests to assess the impacts of STEAM-EE curriculum makeovers on 35 middle school teachers and more than 500 students.

Number of students who...	Increased
Could describe the materials needed to make something:	54 to 76%
Could describe the wastes created when making something:	52 to 76%
Would consider the working conditions in which a product was made before buying it:	35 to 57%
Would consider who made a product before buying it:	19 to 28%
Would consider what a product is made of before buying it:	12 to 25%

## Impact on Educators

A stronger curriculum changes more than just the students. Teachers learn new things and gain confidence in their teaching abilities as well. For example, the Sustainable by Design lesson aimed to increase teachers' knowledge and comfort teaching about product life cycles and the links between the economy and the environment. Highlights included:

- The number of teachers who understood the First Law of Thermodynamics and its economic implications grew from 28% to 67%.
- The percentage of teachers who could describe the difference between the conventional and ecological economic model, and who could identify that the environment is the biophysical basis for the economy, doubled.
- The percentage of science teachers comfortable with teaching economic concepts almost tripled, increasing from 28% to over 80%
- The number of teachers who reported being familiar with and having taught the Ecological Footprint increased by 60%.

## What Students Said:

**“Why do we do things the easy way and not the right way?”**

**“Price is what you pay now. Cost is what everyone and the environment will pay in the future.”**



## What Teachers Said:



**“This curriculum is a perfect springboard for doing things that the kids could really relate to. We had a lot of fun but they did a lot of deep thinking, and they loved it... I think the ideas and concepts really permeate into just about everything that they do, from how they look at the world and how they look at their learning, to how they recycle their scrap paper.”**

**“The kids were into this unit with every cell of their bodies.”**

**To read more about educator and student experiences, visit:**

**[CreativeChange.net](http://CreativeChange.net)**

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# ABOUT CREATIVE CHANGE



**We are an education consulting firm. School districts turn to us when their curriculum isn't working – when achievement is lagging, kids aren't challenged, or it's time to modernize content.**

Our mission is to help educators with curriculum transformation for better schools, more impassioned teachers, and fully engaged students. Our clients say that after working with us, their curriculum is more effective and meaningful to students because the learning experience is now about the things kids really want to know.

We are making a great impact in under-served communities across the country, our process is helping students learn to their highest potential.



**To learn more, call  
(734) 482-0924  
or visit us at:  
[creativechange.net](http://creativechange.net)**

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*Coordination for New York professional development provided by the Children's Environmental Literacy Foundation.*



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Thinking about making a change? Take the first step with our curriculum assessment tool, accessible by clicking [here](#) or access the form on our website: [CreativeChange.net](http://CreativeChange.net) We'll review your results and will follow up with you.



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