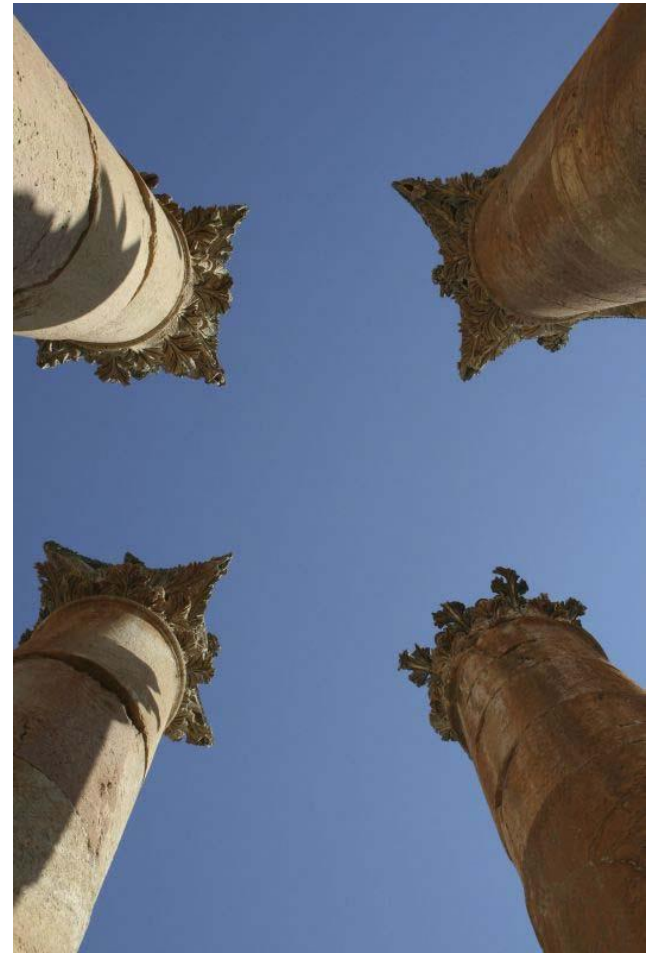


The Problem

- **Just as the nation's economic engines and national security measures have come to rest squarely on the shoulders of science, technology, engineering, and mathematics (STEM), American students are recoiling from these disciplines in record numbers.**

4 Pillars of STEM

- STEM is an approach to teaching that's larger than its constituent parts
- STEM removes the traditional barriers erected between the four disciplines, by integrating the four subjects into one cohesive curriculum



STEM: science, technology, engineering, mathematics

✘ **Science** : Discover and describe

+A better understanding of life (What is)

✘ **Technology**: Invent and innovate

+Improving the natural world

✘ **Engineering** : Control, modify, or design materials, processes, and systems

+What could be

✘ **Mathematics**: Symbolic language for representing reality



THE NEED

- Improve the quality of STEM education and experiences;
- Promote engaged learning in STEM fields;
- Prepare teachers to deliver comprehensive STEM education;
- Change the status quo concerning learning and teaching STEM;
- Move individuals from underrepresented groups into the STEM disciplines; and,
- Increase the number of students in STEM programs and fields.

Current State OF STEM

- ✘ Many students not receiving an adequate STEM education
- ✘ Focus often on specialty or magnet high schools
- ✘ STEM subjects not taught everyday in many schools
 - + 29% of K-5 teachers report teaching science two or fewer days per week



CREATIVITY CORPORATION

You get back to
that &@#!*?*//%* cubicle
and start thinking
outside the box!



Barriers to integrated STEM implementation

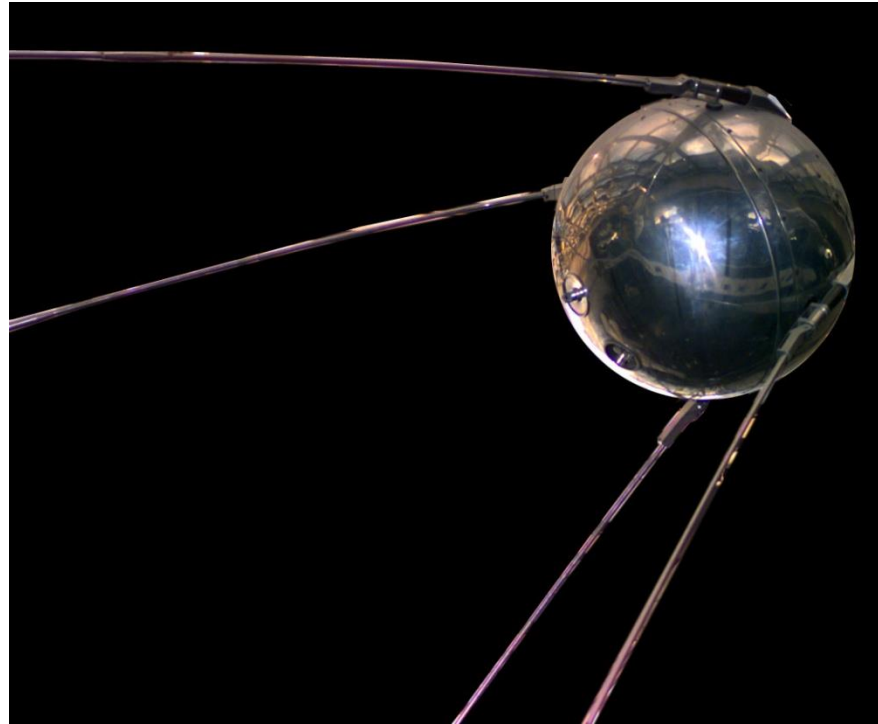
- Belief that STEM is not for everyone.
- Kids not seeing relevance of STEM
- Lack of qualified teachers.
- Inadequate STEM pre-service training.
- Assuming more math and science will solve STEM problems



Key Issues

- **The U.S. needs 400,000 new graduates in STEM fields by 2015.**
- **Careers in traditionally American-led industries outside of science & technology such as farming, health care, and finance also require a strong knowledge of STEM.**
- **We need to cultivate the next generation of innovators and big thinkers**

1957: Challenge to America



What is the challenge today?

“You cannot see what you cannot imagine!”

Today's High School Freshman



Career Timeline:

- 2017 – Graduation
- 2019 – 2-year degree
- 2022 – 4-year degree
- 2030 – Height of career

Will live in a society dominated by:

- Nanotechnology
- Biotechnology
- Information and network technology
- Neurotechnology

Technologies that our students will develop

- Free energy
- Cognitive implants
- Longevity medicines
- Bio technology applications
- Non-lethal weapons
- Universal inoculation
- Individual warning systems
- Personal health monitoring systems
- Replicators
- Transporters



Top 10 STEM Challenges

- China and India are challenging American dominance
- Brand promiscuity: People aren't loyal consumers
- Global battle for smart talent
- Globalization of manufacturing and production
- Engineering and technology talent is often imported
- Technological problems exceed capabilities of national workforce
- Educational infrastructure not sufficient to produce creative people/solutions
- Attractive and lucrative offers in other countries draw away best and brightest

Top 10 Threats in 2015

- **Surveillance technology that watches you 24/7.**
- **Wireless RFID “bots” in clothing to monitor your behavior, travel, and purchases.**
- **Consumer databases to predict your behavior.**
- **Gene vaccines that remove unwanted behavior.**
- **Neuro-advertising – retina or brain direct.**
- **Personal DNA theft.**
- **Pharmaceuticals to adjust behavior.**
- **Braining scanning for thought control.**
- **Brain implants to modify behavior.**

In their current form, schools:



- ✘ Emphasize solving problems correctly—not creatively!
 - ✘ 20 year process of minimizing creativity
 - + Tests, grades, college admission, degrees, etc. are emphasized
- ✘ Target and reward
 - + Logical thinkers
 - + Factual competence
 - + Math and science skill

STEM: Core Concepts

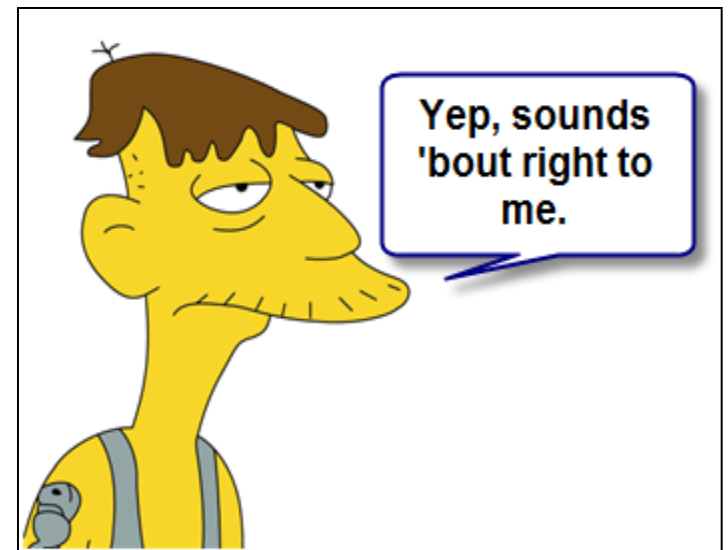
21st Century knowledge and skills

- ✘ Communications
- ✘ Problem solving
- ✘ Critical thinking
- ✘ Information technology applications
- ✘ Systems thinking
- ✘ Safety, health, and environment
- ✘ Leadership and teamwork
- ✘ Ethics and legal responsibilities
- ✘ Creativity, invention, and ingenuity



The Critical Part of STEM

- Improved STEM programs can create individuals capable of new solutions and better decisions
 - Increased science and math capability is not enough
 - Experiences centered on design, innovation, engineering, and technology increase creativity, inventiveness, ingenuity, and imagination capabilities
- These characteristics are fostered in STEM centered learning experiences

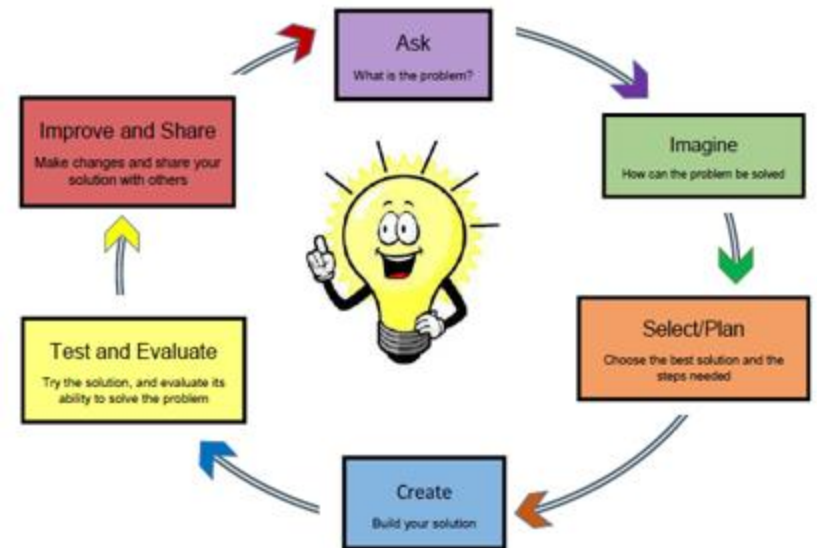


Goals OF STEM

- ✘ Every student is technologically literate
- ✘ Every student challenged to greater creativity
- ✘ Cultivate quantity and quality of STEM teachers and teaching
- ✘ Remove stigma that makes it unattractive to students.
- ✘ Decrease percentage of students needing remedial help with STEM concepts and courses
- ✘ Increase undergraduate students pursuing STEM careers.

The inclusion of ENGINEERING design

- Why is this important?
 - Invention and innovation
 - Generate & research ideas
- Source of Ideas?
 - Interrogating our Personal Bank of Knowledge
 - Existing Common Body of Knowledge
- Quality of the Design?
 - Different points of view



Beyond the Herd Mentality

Howard Gardner

- Instead of beginning (and, all too often, ending) with test scores, we should begin by considering the kinds of minds that we want to cultivate in our education system.
- My own reflections suggest that in the future, we need to cultivate five kinds of minds if we want to be successful as a nation and, more important, as a world. Those minds include:



Beyond the Herd Mentality

Howard Gardner

- ✘ **A disciplined mind** that can think well and appropriately in the major disciplines;
- ✘ **A synthesizing mind** that can sift through a large amount of information, decide what is important, and put it together in creative ways;
- ✘ **A creative mind** that can raise new questions, come up with novel solutions, think outside the box;
- ✘ **A respectful mind** that honors the differences among individuals and groups, and tries to understand them; and,
- ✘ **An ethical mind** that thinks, beyond selfish interests, about the kind of citizen that one should be.

- STEM education is influential in driving national economic growth & innovation
- Every person depends on elements of STEM daily
- Those who pursue careers in STEM are shaped as early as elementary school

Quick challenge - The Color Trader

Cooperative Learning

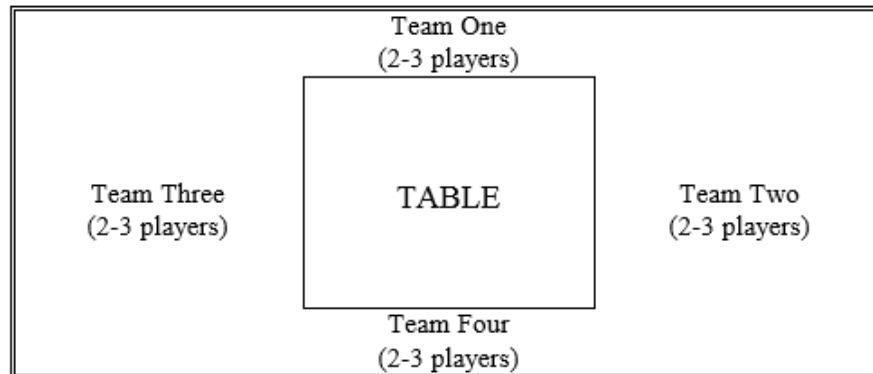
The Color Trader **Rules Sheet**

Michael K. Daugherty

Objective

This activity was designed for the purpose of creating an atmosphere where students are required to think about the ethical ramifications of the decisions they make. During the implementation of this activity, students will need to be placed into teams of two or three and grouped around the perimeter of a table (see *Color Trader Table Diagram*). Take a few moments to cover the directions and the procedures for this activity prior to implementing the activity.

Color Trader Table Diagram



History of STEM Education

- Vocational Education Act of 1917- The government financially supported technical education
- After Sputnik launched physics, chemistry, biology, and mathematics curriculum were more properly funded
- Before the 1960s – Elementary schools had little, if any, science taught

- 1950s and 1960s - High school science courses were developed by leading scientists
- These courses created hands on experiments and ways to ask questions
- 1990s – NSF funded course materials to integrate science, mathematics, and technology and the middle and elementary school levels
- Early 2000s – Assistant Director for Education and Human Resources created the acronym STEM to replace SMET

Personal Benefits for Students

- STEM-related careers among the highest paying and the fastest growing positions
- From 2008 to 2018 STEM jobs are projected to grow twice as fast as non-STEM jobs

Student Benefits

- STEM employees get an 11 percent higher pay wage than those with the same degree in a different occupation
- STEM educated employees also receive a higher wage even if they do not have a STEM occupation

U.S. Benefits

- More than half of economic growth has come from technological innovation since World War II
- STEM employees greatly impact the culture of innovation in business models and strategies
- The groundwork for economic development will start with STEM education

Future

- If the U.S. can “out innovate” other countries competing in STEM education we will continue to grow our economy as well as the global economy

Message from STEM Kids

