THE STEM CHALLENGE

Michael K. Daugherty
Metro-Goldwyn-Mayer presents the spectacular George Pal production of H. G. Wells' The Time Machine. Whirls you to a world of amazing adventure in the year 800,000! In futuristic MetroColor.

Starring Rod Taylor, Alan Young, Yvette Mimieux, Sebastian Cabot, Tom Helmore.

Screenplay by David Duncan, based on the novel by H. G. Wells. Directed by George Pal.
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 is larger than its constituent parts.
- STEM education removes the traditional barriers erected between the four disciplines, by integrating the four subjects into one cohesive means of teaching and learning.
**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.

The STEM Challenge
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
You get back to that &@#1*?//%* cubicle and start thinking outside the box!
The STEM Challenge

INGENUITY GAP

Unsustainable

Sustainable

Problems
Solutions
BARRIERS TO STEM IMPLEMENTATION

- Belief that science, technology, engineering, and math are not for everyone.
- Kids don’t see relevance of STEM education.
- Lack of qualified teachers.
- Inadequate STEM pre-service training.
- Assuming that improved math and science will solve STEM problems.
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 FRESHMAN

Career Timeline:
- 2014 – Graduation
- 2016 – 2-year degree
- 2019 – 4-year degree
- 2027 – Height of career

Will live in a society dominated by:
- Nanotechnology
- Biotechnology
- Information and network technology
- Neurotechnology

The STEM Challenge
TECHNOLOGIES OUR KIDS 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

The STEM Challenge
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
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
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 will increase creativity, inventiveness, ingenuity, and imagination capabilities

- These characteristics are fostered in STEM centered learning experiences
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.
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 PBK?
+ Different points of view
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

- 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.

Howard Gardner
The number of 8th graders it takes to produce a single Ph.D. in science, engineering, or technology