Science & Technology/Engineering Education: A Paradigm Shift at CPS/CCHS

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A Brief Presentation

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Our Foundation

Curricular, Extra Curricular, & Co-curricular

**CCHS**
Engineering Certificate Program
Electrical and Mechanical Engineering
Competitive Robotics
Rivers & Revolutions
Fab Lab
5 Computer Courses
12 Math Courses
17 Science Courses

**CMS**
Earth Science
Life Science
Physical Science
Engineering & Applied Technology
Project Engineering
Lego Robotics
Science Olympiad
Engineers Club

**Alcott**
Thoreau
Willard
Apple Engineering
Marshmallow Challenge
Musical Instrument Design
Wind turbine Design
Bridge Design
Water Filter Design
Electric Circuit Building
Every CPS and CCHS student participates in STEAM experiences or design challenges each school year. These experiences reach all learners so that, after years of these experiences, every student feels confident and creative in analyzing and tackling real world problems through a STEAM lens.” – CPS/CCHS STEAM Vision Statement 2016
From STEM to STEAM

CPS/CCHS STEAM Programs and Activities teach the
**Sciences** (Biology, Chemistry, Earth & Space, and Physics and their sub specialties),
**Technology and Engineering** (as described in the Revised STE Standards, 2016),
**The Arts** (Visual, Acoustic--music and chorus, and Kinesthetic--drama and dance), and all levels of
**Mathematics** (including logic and symbolic reasoning such as Code)
--CPC/CCHS Student Steam Activities Catalog
Engineering Design Process (K - 5)

1. **What’s the problem?**

2. **Brainstorm**

3. **Pick best option**

4. **Make & test a model**

5. **Communicate**

6. **Improve design**

7. **Share Final Design**

8. **Problem-Solving with STEAM**
   Model adopted from Museum of Science; Engineering is Elementary
Engineering Design Process (9-12)

Define the Problem
- needs assessment
- problem statement
- design criteria & goals
- background research

Generate Possible Solutions
- brainstorming - idea trigger method
- thumbnail sketching
- creative thinking

Evaluate Possible Solutions
- do ideas meet design criteria?
- list advantages / disadvantages
- select best design alternatives
- use decision matrix to evaluate

Make and Test a Model
- detailed technical drawings
- prototype or scale model
- mathematical and computer models
- performance and user tests

Modify and Improve Design
- fix problems
- improve design
- do more testing if needed
- worst case - scrap design

Communicate Final Design
- final technical drawings
- technical manuals for assembly, operation, and maintenance
Our pedagogy focuses on the Engineering Design Process which is a systematic, hands-on approach to learning whereby students work with teachers to define, describe, or identify problems and challenges.

Then they follow an iterative series of steps to develop and test alternatives that lead to a final solution or product.

Within the area of STEAM, special emphasis is placed on expressing quantitative relationships, assessment, and presentation.

That is, using math to express information accurately and precisely.

CPC/CCHS Student Steam Activities Catalog
Year IV cohort includes teams from Cambridge Public Schools, Concord Public Schools, Springfield Renaissance School, and The Learning Center for the Deaf in Framingham.
1: **Graduates** leave with the **critical thinking skills and STEAM habits of mind** needed to analyze situations and solve problems that they will face in life. These skills and habits of mind give all students opportunities to pursue STEAM paths in life.

2: K-12 students build **proficiency in the STEAM approach**. Students see the value in STEAM education.

3: **Teachers are supported** and therefore effective STEAM educators. Teachers see the value in STEAM education.
Goal 1 STEAM Thinking - Some Action Steps

- Identify K-12 design challenges;
- Develop common vocabulary;
- Develop/adapt design challenge rubrics to assess students’ work;
- Poster of EDP in every STEAM classroom;
- Gather data on students that are admitted to STEAM programs;
- Develop vehicles to expose students to STEAM careers;
- Provide mentors to increase success in STEAM courses.
Goal 2 STEAM Proficiency- Some Action Steps

- Align K - 12 science curriculum with new MA standards;
- Teach STEAM using common vocabulary;
- Continue summer bridge math programs;
- Create school day schedules that allow for more STEAM experiences.
Goal 3 Teacher Support- Some Action Steps

- Create STEAM professional development opportunities for teachers;
- Create STEAM introduction and opportunities for teachers new to Concord;
- Each teacher mines their current curricula to identify activities that incorporate STEAM activities;
- Find ways to help all teachers (even those in non-STEAM areas) understand the importance of STEAM opportunities;
- Opening day STEAM speaker to create excitement with teachers.
Signposts to Measure Progress

• Students begin applying the STEAM approach across the curriculum (assessed on rubrics)
• Increased number of students choosing STEAM focused and Engineering classes and clubs in HS and Middle School. (2014-2015 baseline data)
• Increased admission to engineering/STEAM colleges and universities. (2014-2015 baseline data)
• Increased percentage of students graduating from college with STEAM majors (tracked by CCHS guidance)
Things to Come

Maker Space at Ripley

Hands-on Workshops for Teachers

District-wide STEAM Field Day
Opening Day Speaker for Faculty: Dr. Arthur Eisenkraft

Learn Physics lessons through cartoons

Bangalore: The Commerce student who hated Physics in her high school, and the aeronautical engineer who couldn't make any sense of quantum would have surely loved the subject in this lecture. On the screen were amusing cartoons that explained Physics theories, poems that made Science look beautiful, and quotes that unravelled their intricacies.

The session was a lecture by Arthur Eisenkraft, professor of Physics and director, Center of Science and Math in Context (COSMIC).

A PROF'S PERSPECTIVE

University of Massachusetts, Boston. Organized by Asim Premji University in the TISS centre in Mumbai, the professor talked about engaging students in Science with Art and Literature on Tuesday.

"When we started with a magazine called Quantum, I didn't like the pictures the publisher used with the stories. I approached a cartoonist..."

"The characters of Physics looked simpler with the cartoons, with the early hired Newton and mustached Einstein. There were quotes from Dante and the Bhagavad Gita, analogies of petri chips, and rules in Disneyland to explain Science. Ordinary things were juxtaposed with dense Science theories."

"Have we ever given students an opportunity to write a poem or draw a picture about Science? Maybe..."

"We need stories, we need art, we need literature. They provide meanings to our lives and help structure the solutions Science finds. It's a combination that is required. Not an either or approach."
Questions? Comments?