Sustainable STE@M: STEM + Arts TEKS Standards Substantiation

Engaging and hands-on ways to gain acceptance for incorporating sustainability into curricula by linking social arts to the science and mathematics behind technology and engineering.

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Aggie STEM 2010
Dallas, TX
Sustainability x 2

UNIVERSAL
• fostering student’s awareness of the limits & consequences of resources use & disposal methods in past, present & future

PROGRAMS
• fostering administrator’s & the public’s view of how your program directly supports the US economy & universal educational efforts
Universal Sustainability

• Promote understanding the cycle of production that relates to all the courses you teach

5 primary areas in the cycle of production:
  • Extraction, production, distribution, consumption, disposal

Relate these to methods used in past, present & trends for the future

• Analyze these trends for their short and long term impacts – benefits and drawbacks for companies, local economy, world culture and universal impacts

Excellent Resource: www.storyofstuff.com
Program Sustainability

Prove you’re saving money & the environment
- Ultimate Recycling
- Business Donations/Involvement
- Make sellable items
- Fill community needs
- Purchase from responsible companies
- Cost cutting – link projects together to min. resources used

Prove you courses reinforce core-curricula
- Align with S-M-LA-SS + benchmarks
- Promote cross-curricular projects
- Work directly with other teachers
- Put up displays in common areas like school entrance, library, cafeteria, etc.
- Use energy saving ideas
A way to teach about all things as they relate to something - Ex: Music
STEM

Science & Technology interpreted through Engineering & the Arts, all understood with elements of Mathematics.
Linking the Silos
S-T-E-M vs. STEM vs. STE@M

What method will work best for your setting?

• Coordination (teaching similar topics at the same time)
• Collaboration (theme teaching – discipline-based)
• Integration (submersion in topic with all topics recognized equally)

All methods can be used at various times
Linking to SCIENCE:
what exists naturally & how it is effected.

STAT
Science Teachers Association of Texas

Part of STAT mission: be a resource for science education; so that all students are scientifically & technologically literate, responsible, & productive citizens.

ISET is a group of teachers who promote the love and understanding of all Sciences - woven together in the real world – want to promote science as a life time learning tool.
Linking to TECHNOLOGY what is human-made.

Part of ATTE mission: To cooperate with other educational groups in the improvement of general education

ITEEA is the professional organization for technology, innovation, design & engineering educators promoting technological literacy for all

Linking to ENGINEERING R&D (research & development) Design & Invention

Within the STEM relationship, the act of using science and math to design new technology is the definition of engineering.

ASEE is a multidisciplinary society for individuals & organizations committed to advancing excellence in all aspects of engineering & engineering technology education.

Linking to MATH

The study of numbers, symbolic relationships, ...

patterns, shapes, uncertainty & reasoning.

Overall concept of mathematical theory, history and application is taught in addition to applied mathematics. Currently there are reality-based projects and activities incorporated into math learning so that students can understand its relation to other things, not just endless abstract problems.

#’s & Operations, Algebra, Geometry, Measurement, Data Analysis, Probability, Reasoning & Proof, Communication, – Includes – Trigonometry, Calculus, Theory
Arts Divisions
Fine, Manual, Language, Liberal, Physical
Including: sociology, psychology, history, politics, philosophy, education, etc
Language Arts

Students:
Read
• Understand
• Communicate effectively through multiple ways

Educators:
Present & Publish
• Leave Legacy
• put things out there in your words - show you can write as much as you can ’do’
• Publish in M-E-S arenas

http://www.blackwell-compass.com/render_image/fragments_linco_compass_intro_image
Social Studies / Civics is…

The study of how society develops with it’s attitudes & customs in the past, present & future. Cornerstone of understanding development, societal constructs, ethics

STS – Science Technology Society

ANT – Actor Network Theory

Liberal Arts Education

INCLUDES EDUCATION!
Fine Arts

oldest sustainable cultural pieces

Aesthetics

• Engineers notoriously overlook this component – functional and aesthetic future

• program signs

• attractive projects and displays
Physical Arts

Connects to athletes

• hands-ons field & classroom
• memorize mental ‘plays’
• turf & equipment development
• Back-up plans vs. pro-athletic goals
Publicity

Get noticed as much as possible in + ways

Compete & win! – pick things your students are good at

• Pick 1-2 things that are impressive to your community and that you can do

• Community support - socialize with PTO's and community groups - present to local politicians and business groups - get direct support for your classroom - political pressure and financial
Sociology

Connect to administration, community, politics, business - community development
GERTA'S
LIVE MUSIC
BLUEGRASS JAM
DANCE
FRIDAY 7:30 PM
ADMISSION: $6.00
Psychology

Give guidance officers and students personal reasons to want to take your course if it’s not mandated

- ‘psych them out’

Develop student ethics no matter what you teach
<table>
<thead>
<tr>
<th>Technology Education Classes</th>
<th>Technology Education Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>you can take next year...</td>
<td>you can take in the future...</td>
</tr>
<tr>
<td><strong>Foundations of Technology</strong></td>
<td><strong>Materials &amp; Processes</strong></td>
</tr>
<tr>
<td>This course covers MANY categories of technology with LOTS of hands-on projects - most of which are student choice based on your dream job!</td>
<td>Learn how to break things &amp; make new things! INCREDIbLY FUN CLASS!</td>
</tr>
<tr>
<td><strong>Construction Technology</strong></td>
<td><strong>Intro to Engineering</strong></td>
</tr>
<tr>
<td>Hands-on learning how to build all kinds of things! Student choice of projects!</td>
<td>INVENT &amp; REINVENT NEW THINGS &amp; Explore Current and Past Inventions! Student choice of projects!</td>
</tr>
<tr>
<td><strong>Grades 9-12</strong></td>
<td><strong>Grades 10-12</strong></td>
</tr>
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</tbody>
</table>
Education

Show all groups how & why what you teach is long supported by all types of educators and biz – use research

Public education needs to progress with a rapidly changing technological society while supporting more students with less resources and money to do it with
Adapt & Grow Program

Keep abreast of business in area coming and going - adjust curriculum

Know data to back up why program concentrations should shift

Be willing to professionally develop yourself in areas you never thought you’d teach
I have developed a much stronger TE department for this school system. The freshman introductory course has been changed to reflect a broad view of technological career choices that will assist all students in developing a better understanding of what other courses and activities they need to plan in order to achieve their personal career goals. This course also helps develop a basic understanding of many modern and common technological competencies needed in order to be functionally literate and adaptable to modern life regardless of what career path is chosen.

The materials and processes course has been updated to give students not taking chemistry & physics a base knowledge in these topics as well as include enough academic integrity to be a good companion hands-on course for those students taking those courses. The addition of this school system's first engineering program offers an exciting outlet for those interested in advanced engineering topics as well as for those interested in inventing as a hobby. As a neighbor to one of the nation's top engineering research communities, we now offer our students a much more competitive edge to get accepted into VT's engineering programs.

The addition of the competitive engineering team has allowed students of all learning styles and interests to excel at creating award-winning projects.

I have been selected to be internationally published for my teaching theories, have been elected President of my department's state teaching association, and have been awarded a regional STEM teacher-of-the-year award.

I have plans to continue to strengthen my department for both traditional and alternative learners as well as for the community. An immediate goal of mine is to promote offering a course on power and energy that would help support the current and mechanical courses at PCHS.
Example Course

WHAT’S YOUR POINT!

- AKA: Introduction to Technology

Expose students to a large range of skill sets & career choices through projects that include research & development

Students perpetually evaluate their points of interest, experiences & talents – develop portfolios

Evaluate local, regional, national & international career path opportunities & developments in historical, current & potential contexts

Investigate a spectrum of careers & the related discipline skills needed to pursue them
Logo & Business Card

- Students create their dream job logo and biz card + slogan
- They need to investigate their academic path & projected salary
- They have to figure out a living budget
Notepads

They bind their notes in notepads that are designed as business promotional items.

Learn about bookmaking, metals, paper, they make their own machine to wind the metal – very simple to do – can be done in ANY classroom.

Nice way to make portfolios of all types
Sustainable Activities

- Look for topics to connect to other subjects
- Ecologically minded
- Economically minded
- Fill a need - social or tangible
- Create thinkers & problem solvers
- Functionally literate students
- Use Design Loop Process
- Have impressive results for students, community & administrators
Lip Balm

- buy local
- organic
- ecological minded
- fill a need - unisex
- develop specific product based on research & design loop
- marketing packaging
Batik

• They design and make their own t-shirts
• Helps them realize they can control their own fashion styles for much less than designer prices and hype
Transportation Game

• Show grand breadth of topic
• Unlimited variables
• Talk list categories
• Play the ‘wilson’ game
Ex. Project: Around the World in Many Ways

Ideally a thematic unit taught by multiple teachers

- discipline based instruction: each teacher revolves some of their lessons around the theme and makes connections to their discipline's benchmarks/standards
  
  - Overview lesson teachers about transportations systems well beyond planes, trains and automobiles to wireless technology ++
  
  - Science – most closely linked to inputs, outputs and byproducts
  
  - Technology – most closely linked to what has been developed – strong industrial and military ties
  
  - Engineering – most closely linked to inventions and goals of industry
  
  - Arts – most closely linked to research and reports on any element – also linked to societal expectations of systems – aesthetic and personal functions
  
  - Math – most closely linked to understanding the equations that make things work – algebra and geometry key
Bridge Supports

a lot with a little

Civil Engineering

- Also WPBD

• One sheet of 8 ½ x 11 cardstock (or 3 index cards) & 12” of tape can hold up 250 lbs.
Pallets

- current waste incredible
- redesigning and reuse
- *Miniature experiments – massive results*

Popsicle stick pallets
Test by running over w/ car
6:12 held F150 pick-up
Cartoonist

- economical reuse
- ultimate recycling
- Cheap furniture that works!
CAD

- green designs now incorporated into most CAD programs
- TurboCAD 3D home builder - $85 – anyone can use – assign 3bed/2bath house
Domes/Yurts

- Inexpensive
- Storm resistant structures
- Can build scale models out of balsa wood or straws
- Test with wind and weather
Systems Engineering

- PB&J experiment, messy but fun!
- Waste less resources & energy
- Understand flow processes, minute instructions, robotics and computing ‘thoughts’
Dyed Carnations – Bio-chemical

• Permanent even after flower dies
• Easy experiment for all ages
• Good for documenting times
• Can use commercial or plant dyes – can extract plant dyes as part of experiment
Plant Splicing - Biotechnology

- Offers way to understand cloning but much simpler
- Good to use for long term experiment – semester long – patience, tracking, variable conditions (hydroponics)
- Use plants that easily propagate from fractions of roots

**MINT & PEONIES ARE EASIEST**
# Biorestoration

- Cleaning the dirt and water with soil
- Good for exploring effects of local factories on environment

<table>
<thead>
<tr>
<th>Lycopersicon esculentum</th>
<th>Can absorb metals from soil</th>
<th>plant every year &amp; tomatoes disposed of</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tomato</strong></td>
<td></td>
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</tr>
<tr>
<td><img src="http://www.wikihow.com/Grow-a-Tomato-Plant" alt="Tomato Plant" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bambusa vulgaris</th>
<th>Removing formaldehyde</th>
<th>Bamboo can last as long as 120 years and is the fastest growing plant in the world</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bamboo</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="http://plants.usda.gov/java/largeImage?imageID=bavu2_001_avp.jpg" alt="Bamboo" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Materials and Processes

Metals – metal melting – make mini-screwdrivers & bending chainmaille
Polymers – squeeze balls and rubber bouncy balls
Ceramics – concrete and broken plate pavers
Composites – hybrids of materials

Kits inexpensive, can be done in any classroom
Geometrics

They are generally amazed at how 2D paper becomes 3D objects, especially the center one that flips inside out.

Students must copy from templates, can be photocopied for younger or LD students

Can be strength tested to learn about sizes, shapes, stability, etc.
Breadmaking - Biotechnology

Lots of math and science here
Living yeast – measuring – following directions - Keeping track of time
Not many classrooms can accommodate this project, but it’s a REALLY great one for learning about chemically treated wood, Geometry, algebra, measuring, teamwork, following directions, multi-functionality, etc.
A game that is easy enough for a toddler to learn, but can be complex enough to stump a genius.

Resource: American Go Association – offers starter kits
Also – free games on-line + www.dallasiugocclub.org
One at Texas A&M -  www.freewebs.com/tamugocclub
Ex: Mathematics Relationships

Pattern recognition
Binary mathematics
Movie - Pi

360 intersections plus one.
• occupies the ultimate position and governs the four quarters.
• number of days in the [lunar] year.
• four quarters symbolizes the four seasons.
• 72 circumference points represent the [five-day] weeks of the [Chinese lunar] calendar.
And more...

- gyak@vt.edu

Feel free to ask for;

- lesson plans on any of these topics
- Links to resources for other topics
- Tell me what you’re trying and how it’s working
- Tips for working with other teachers & administrators