STEAM – Unit 1 (STEAM TANK BIOMEDICAL ENGINEERING)

Content Area: **ENGINEERING (Gifted and Talented Grade 4)**
Course(s):
Time Period: **Ongoing**
Length: **Ongoing**
Status: **Published**

Big Idea

Gifted and talented students should be exposed to the career possibilities in intellectually challenging, high demand areas such as biomedical engineering. "Biomedical engineers use engineering to solve problems in medicine, such as creating replacement body parts, drug-delivery systems, medical instruments, and test equipment. Their work helps restore health and function, and improves the quality of life for people who are sick or injured." (Science Buddies.org, 2018) Over the next decade, biomedical engineers might build mini robots that destroy cancer cells, design an instrument that helps diabetics monitor their health, and improve the design of neural controlled robotic prosthetic devices.

Steam tank projects will be an empathy based activity. Students will be challenged to brainstorm and identify a problem in the biomedical field. Students will research the problem and interview stakeholders. Students will then follow the engineering design process to build a prototype for their invention. Students will identify a need or problem, interview stakeholders, design a solution, build a prototype, test it, identify problems, and fix them. This way of designing is called iteration.

Once the prototype build phase is completed and informally presented, students will create a video of their concept for a STEM competition. If student projects are accepted into the 1st round, students will create a presentation, flyers, brochures and possibly a web site (or applicable social media) to sell their product.

Enduring Understanding

SWBAT understand the career possibilities in biomedical engineering. SWBAT identify the scientific method. SWBAT understand the engineering design process. SWBAT identify the importance of using empathy, models and iteration in design. SWBAT empathize with stakeholders to improve design outcomes. SWBAT make connections between scientific concepts (such as chemistry, physics, and circuitry) and effective biomedical engineering practices. SWBAT make connections between experiments conducted in the laboratory and real world experiences. SWBAT understand the basics of graphic design and advertising.

Skills

- Research engineering.
- Use presentation technology to write a presentation about findings.
- Practice the scientific method.
- Use spreadsheet technology to graph data and findings.
- Practice the engineering design process. Use tools to build a prototype.
- Use technology to present information about historical figures in the industry.

Standards

NATIONAL ASSOCIATION FOR GIFTED CHILDREN. www.nagc.org.

Standard 3: Curriculum Planning and Instruction Description: Educators apply the theory and research-based models of curriculum and instruction related to students with gifts and talents and respond to their needs by planning, selecting, adapting, and creating culturally relevant curriculum and by using a repertoire of evidence-based instructional strategies to ensure specific student outcomes. Student Outcomes Evidence-Based Practices

3.1. Curriculum Planning. Students with gifts and talents demonstrate growth commensurate with aptitude during the school year.

3.1.1. Educators use local, state, and national standards to align and expand curriculum and instructional plans.

3.1.2. Educators design and use a comprehensive and continuous scope and sequence to develop differentiated plans for PK-12 students with gifts and talents.

3.1.3. Educators adapt, modify, or replace the core or standard curriculum to meet the needs of students with gifts and talents and those with special needs such as twice-exceptional, highly gifted, and English language learners.

3.1.4. Educators design differentiated curricula that incorporate advanced, conceptually challenging, in-depth, distinctive, and complex content for students with gifts and talents.

3.1.5. Educators use a balanced assessment system, including preassessment and formative assessment, to identify students' needs, develop differentiated education plans, and adjust plans based on continual progress monitoring.

3.1.6. Educators use pre-assessments and pace instruction based on the learning rates of students with gifts and talents and accelerate and compact learning as appropriate.

3.1.7. Educators use information and technologies, including assistive technologies, to individualize for students with gifts and talents, including those who are twice-exceptional.

3.2. Talent Development. Students with gifts and talents become more competent in multiple talent areas and across dimensions of learning.

3.2.1. Educators design curricula in cognitive, affective, aesthetic, social, and leadership domains that are challenging and effective for students with gifts and talents.

3.2.2. Educators use metacognitive models to meet the needs of students with gifts and talents.

3.3. Talent Development. Students with gifts and talents develop their abilities in their domain of talent and/or area of interest.

3.3.1. Educators select, adapt, and use a repertoire of instructional strategies and materials that differentiate for students with gifts and talents and that respond to diversity.

3.3.2. Educators use school and community resources that support differentiation.

3.3.3. Educators provide opportunities for students with gifts and talents to explore, develop, or research their areas of interest and/or talent.

3.4. Instructional Strategies. Students with gifts and talents become independent investigators.

3.4.1. Educators use critical-thinking strategies to meet the needs of students with gifts and talents.

3.4.2. Educators use creative-thinking strategies to meet the needs of students with gifts and talents.

3.4.3. Educators use problem-solving model strategies to meet the needs of students with gifts and talents. 5 National Association for Gifted Children 1331 H Street, NW, Suite 1001 Washington, DC 20005 202.785.4268 www.nagc.org 9-21-10 3.4.4. Educators use inquiry models to meet the needs of students with gifts and talents.

3.5. Culturally Relevant Curriculum. Students with gifts and talents develop knowledge and skills for living and being productive in a multicultural, diverse, and global society.

3.5.1. Educators develop and use challenging, culturally responsive curriculum to engage all students with gifts and talents.

3.5.2. Educators integrate career exploration experiences into learning opportunities for students with gifts and talents, e.g. biography study or speakers.

3.5.3. Educators use curriculum for deep explorations of cultures, languages, and social issues related to diversity.

3.6. Resources. Students with gifts and talents benefit from gifted education programming that provides a variety of high quality resources and materials.

3.6.1. Teachers and administrators demonstrate familiarity with sources for high quality resources and materials that are appropriate for learners with gifts and talents.

Assessments

- Teacher observation
- Successful completion of project
- Successful completion of portfolio
- Successful presentation of project to the class

Resources/Instructional Materials

VIDEOS/BOOKS

- EGFI: Powerhouse on Wheels.
- PBS KIDS KID ENGINEER: Uplift Wheelchair
- PBS KIDS KID ENGINEER: Walker/Wheeler

WEB SITES

- Teachengineering.org (space series)
- NASA
- CIVIL AIR PATROL - ACE and AEX PROGRAM (AEROSPACE STEM CURRICULUM)
- Buehler Challenger & Science Center's programs, Paramus, NJ
- Library Series Space Discovery Guides Book Set
- EGFI
- Future Engineers
- Engineering is Elementary
- Science buddies
- Foss
- Smithsonian
- Design Squad PBS
- Discovery Education - Energy
- Mystery Science Curriculum
- South Carolina Science Curriculum
- Steve Spangler
- Science Bob
- Exploratorium Science Snacks
- Imagination Station Toledo.org
- http://globaldayofdesign.com/
- http://worlds-of-learning.com/
- Pbs learning media nj
- Siemens Lesson Plans
- Lesson Planet

TENTATIVE LESSONS

- Explore field of biomedical engineering. Read books about biomedical engineering such as *Biomedical engineers!* by Diane Bailey. Watch videos about biomedical engineering projects by Science Buddies.org, PBS Design Squad.org, etc.
    - TEACHENGINEERING.ORG BIOMEDICAL ENGINEERING AND THE HUMAN BODY UNIT. Human beings are fascinating and complex living organisms—a symphony of different functional systems working in concert. Through a 10-lesson series with hands-on activities students are introduced to seven systems of the human body—skeletal, muscular, circulatory, respiratory, digestive, sensory, and reproductive—as well as genetics. At every stage, they are also introduced to engineers' creative, real-world involvement in caring for the human body.
    - TEACHENGINEERING.ORG Prosthetic Party: Build and Test Replacement Legs activity. Student teams investigate biomedical engineering and the technology of prosthetics. Students create lower-leg prosthetic prototypes using various ordinary materials. Each team demonstrate its device's strength and consider its pros and cons, giving insight into the characteristics and materials biomedical engineers consider in designing artificial limbs.
    - TEACHENGINEERING.ORG HANDS ON ACTIVITY PROTECT THOSE EYES. Students design and build prototypes for protective eyewear. They choose different activities or sports that require protective

eyewear and design a device for that particular use. Students learn about the many ways in which the eyes can be damaged and how engineers incorporate different features and materials into eyewear designs to best protect the eyes.

- PBS DESIGN SQUAD SAFE LANDING CHALLENGE SHEET. In some situations, the only way for people to get essential supplies like food and medicine is when they are airdropped (dropped to the ground from a plane). Can you think of situations when an airdrop might be necessary? The job of an engineer is to make sure that containers of important supplies aren't damaged when dropped from great heights.
- Connell Lesson: Design a Specialized Wheelchair. Students gain an understanding of assistive devices. Students design and build prototypes of specialized wheelchairs. Before beginning the engineering design process students review current specialized wheelchairs on the market. They also interview associates in school that use wheelchairs. Students identify a "need" and design a specialized wheelchair for an active sport, hobby, weather condition, or everyday activity.
- EGFI: Seeing the World Through a Different Lense. Students gain an understanding of physical limitations and the biomedical engineering design process by performing a variety of tasks without using their thumbs, eyes, or legs, then working in teams to create or improve and adaptive device. Bioengineering technologies explore the production of mechanical devices, products, biological substances, and organisms to improve health and our daily lives. Biomedical and mechanical engineers design and test various types of prosthetics to assist people with disabilities.
- TRY ENGINEERING: SMOOTH OPERATOR. http://tryengineering.org/lesson-plans/smooth-operator. This lesson focuses on surgical instrument design. Teams of students construct surgical instruments from everyday materials. They then test their surgical instruments to determine how well they can perform a simulated "surgical procedure".
- EGFI: DESIGN A SNEAKER. http://teachers.egfi-k12.org/design-a-sneaker/. Biomedical engineers are involved in the design of sneakers. While it is important for sneakers to look stylish to appeal to consumers, they also must function properly. Many factors must be considered when designing sneakers, such as who will wear them (male, female, child) and the types of activities for which they'll be used. Those indicate what shoe characteristics are most important for the design, such as traction, cushioning, and height.
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- Brainstorm about tools people use today that are created by a biomedical engineer.
- Come up with a problem.
- Design a survey for stakeholders.
- Submit survey to stakeholders or conduct interview with stakeholders.
- Identify key goals in the design.
- Draw a prototype and identify building materials needed.
- Build prototype.
- Informally present prototypes to teacher, classmates, and stakeholders.
- Fix any issues with prototype.
- Create a submission video for a STEM competition using the green screen. Edit video on IPAD and upload to Google Classroom. Share with teacher.
- Create a presentation for the prototype using Google Slides, Powerpoint, or Buncee.
- Create a sales brochure for the prototype using Google Docs, Powerpoint, Google Slides, or Buncee.
- Create a web site for the prototype using Google sites.

Modifications

Individual accommodations

• Additional support

• Adapting lessons to meet various learning styles

Integration of 21st Century Skills

Focus on the development of 21st Century Content Skills:

- Global awareness
- Civic literacy
- Health and wellness awareness
- Environmental literacy

Focus on the Development of Learning and Thinking Skills:

- Critical Thinking and Problem Solving Skills
- Communication Skills
- Creativity and Innovation Skills
- Collaboration Skills
- Information and Media Literacy Skills
- Contextual Learning Skills

Focus on the Development of Life Skills:

- Leadership
- Ethics
- Accountability
- Adaptability
- Personal Productivity
- Personal Responsibility
- People Skills
- Self Direction
- Social Responsibility

Interdisciplinary Connections

- Academic and Technical Rigor - Projects are designed to address key learning standards identified by the school or district.
- Authenticity - Projects use a real world context (e.g., community problems) and address issues that matter to the students.
- Applied Learning - Projects engage students in solving problems calling for competencies expected in high-performance work organizations (e.g.,teamwork, problem-solving, communication, etc.).
- Active Exploration - Projects extend beyond the classroom by connecting to community explorations.
- Adult Connections - Projects connect students with the wider community.
- Assessment Practices - Projects involve students in regular, performance-based exhibitions and assessments of their work; evaluation criteria reflect personal, school, and real-world standards of performance.

WORKS CITED

"Science Fair Project Ideas, Answers, & Tools." *Science Buddies*, www.sciencebuddies.org/.