

SIGNIFICANCE

The **STEM Exploration Day** plays a critical role in advancing science education by immersing K-12 students in **biomedical engineering**, enhancing **STEM readiness**, and fostering **equal educational opportunities**.

OUTREACH

The program engaged a diverse group of students in the application of biomedical engineering principles through hands-on activities such as **building a prosthetic hand** and **extracting strawberry DNA**, *translating theoretical knowledge into practical, applied science*.

IMPACT

Feedback and analysis post-event indicated a **significant boost in STEM engagement**, especially among middle and high school students, who demonstrated increased proficiency in BME concepts and a heightened awareness of the field's societal applications.

Enhancing K-12 STEM Preparedness through Biomedical Engineering Outreach

Tessa DeCicco, Kerrin O'Grady, Jade Carter, Carly Ward, Natalie Petryk, Bridget Sides, Mia Paynton & Doug Yung

Department of Biomedical and Chemical Engineering, Syracuse University

BMCE STEM Exploration Day

The **Biomedical Engineering Student Society (BMES)** at Syracuse University hosted a STEM Exploration Day for students interested in science, technology, engineering, and mathematics disciplines.

Date & Time: March 2, 2024, from 8:30 AM to 4:00 PM

Location: Link Hall

Participants:

Morning: Ages 6-13 from 8:30 AM to 12:30 PM

Afternoon: Ages 14-18 from 12:30 PM to 4:00 PM

Volunteers: Over 30 undergraduate and graduate students

Attendees: Approximately 70 K-12 students



Survey

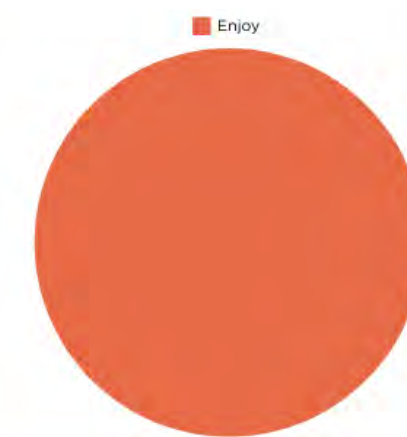
To measure the impact of STEM Exploration Day, we employed a structured methodology centered around data collection through **pre- and post-event surveys** across different age groups to evaluate the event's impact. These surveys are tailored and designed to capture varying levels of understanding and excitement about STEM subjects from our young attendees, ranging from kindergarteners to high school seniors.

The surveys assess initial interest and post-event **shifts in students' attitudes toward STEM careers, problem-solving, and their grasp of biomedical engineering concepts**. The collected data offers valuable insights into the effectiveness of the activities in enhancing student engagement and interest in biomedical engineering and related disciplines.

K-4 RESULTS

High engagement and enjoyment

All 19 participants reported enjoying the STEM Exploration Day activities, reflecting the event's success in creating an engaging and enjoyable learning environment.



Preference towards hands-on activities

The majority of students (18 out of 19) indicated they like solving puzzles or problems, demonstrating a natural engagement with hands-on, problem-solving activities.

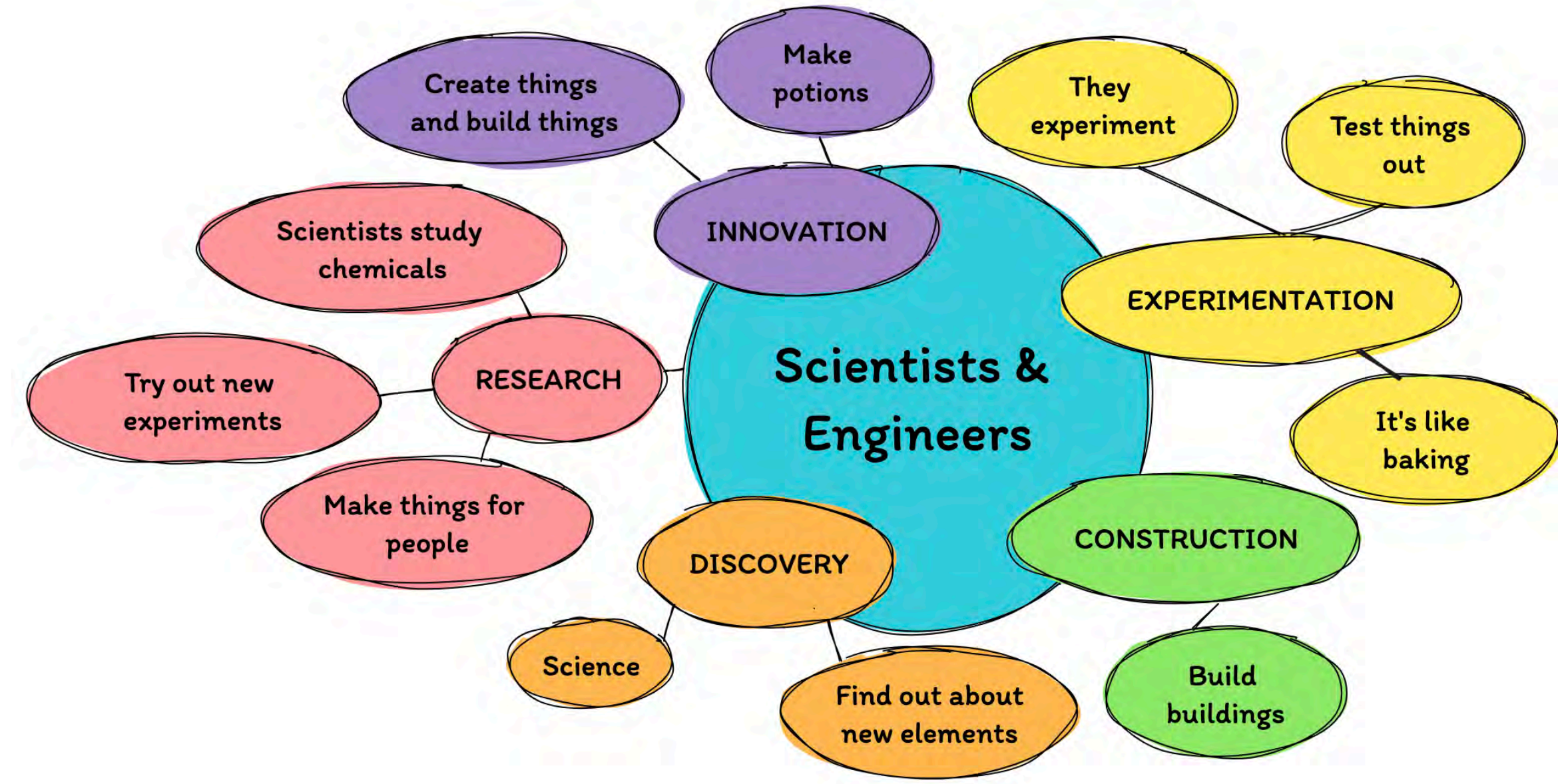
Lessons learned about perseverance and collaboration

Key themes like "learning from mistakes" and "never giving up" were emphasized in discussions about building and creating, highlighting the event's focus on **perseverance and collaborative learning**.

Increased Knowledge and Understanding

The K-4 students showed improved understanding of scientific concepts, emphasizing the importance of **learning from mistakes and persistence** in science, fostering a **resilient learning approach**.

Participant perceptions of scientists and engineers, Based on Survey question 'Draw a picture of a scientist or engineer. What do they do?'



IMPORTANT SKILLS

K-12 students should develop to prepare for a career in engineering

Critical Thinking & Problem Solving

Through engaging with puzzles and strategy games, individuals develop **critical thinking**, enhancing their ability to tackle complex problems in STEM careers.

Teamwork & Collaboration

Learning to work effectively with others through group activities or team sports is **crucial for success in collaborative STEM fields**.

Creativity & Innovation

Creativity, fostered through activities like arts and DIY projects, is **essential for innovation**, allowing individuals to find unique solutions to engineering problems.

Math & Scientific Proficiency

Acquiring math and scientific knowledge through academic study and practical experiments prepares students for the rigorous analytical demands of STEM careers.

Technology & Communication Skills

Mastering technology through interactive digital tools and developing communication skills by exchanging ideas are **pivotal for navigating and succeeding in any STEM field**.

Persistence & Resilience

Building resilience through overcoming challenges in academic competitions or difficult projects is **key to enduring and succeeding in the demanding nature of STEM professions**.

Activities and Learning Outcomes

Understanding physics and engineering through catapult construction

Learning Outcome
Demonstrates foundational physics principles and engineering design

STEM Preparedness
Fosters problem-solving and mechanical reasoning skills

Build a Catapult

DNA Model

Crafting a model to understand the DNA double helix structure

Learning Outcome
Grasps the basics of genetic engineering and molecular biology

STEM Preparedness
Encourages precision & introduces biological design concepts

Building a balloon-powered car to understand energy conversion

Learning Outcome
Conveys the conversion of potential to kinetic energy

STEM Preparedness
Introduces concepts of energy efficiency and propulsion

Race a Balloon-Powered Car

Marshmallow Tower

Creating a tallest structure to sustain earthquake using marshmallows and toothpicks

Learning Outcome
Engages with basic civil engineering and stability principles

STEM Preparedness
Encourages creativity and structural experimentation

Exploring aerodynamics by creating functional paper airplanes

Learning Outcome
Teaches principles of lift, drag, and aerodynamic design

STEM Preparedness
Promotes experimental learning and iterative testing

Paper Airplanes that Work!

Build a Robotic Hand

Applying engineering skills to mimic human hand mechanics

Learning Outcome
Integrates knowledge of mechanics, physics, and material properties

STEM Preparedness
Enhances understanding of biomechanics and innovation

Isolating DNA from strawberries to understand genetic material

Learning Outcome
Illustrates the physical properties of DNA and the concept of extraction

STEM Preparedness
Introduces laboratory techniques and scientific inquiry

Strawberry DNA

EMG/EKG Workshop

Learning about muscle responses and heart rhythms through biometric tests

Learning Outcome
Provides insight into biomedical instrumentation and physiology

STEM Preparedness
Cultivates an understanding of human-machine interfaces and diagnostics

5-8 RESULTS

IMPACT OVERVIEW

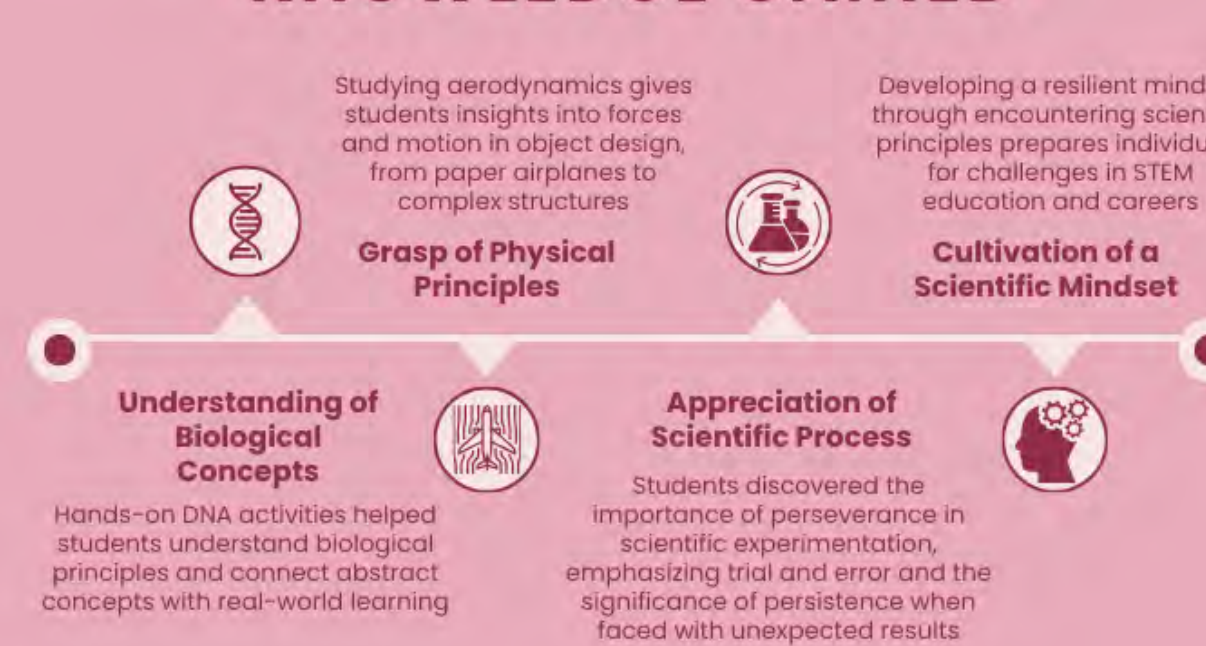


Student Perception of STEM Careers

The bar chart depicts students' views on STEM careers from grades 5-8 survey. It shows that most students link STEM with "experiments and discoveries," noted by 8 of 9 respondents, underscoring the perceived innovative nature of these fields.

Additionally, students recognize the significance of "math and problem-solving" and varied job roles, with each category cited by 5 students. The impact on life was another key aspect, with 6 students acknowledging STEM's role in advancing technology and enhancing life. These insights reveal students' recognition of STEM's technical demands, societal benefits, and career diversity.

KNOWLEDGE GAINED



9-12 RESULTS

Varied Initial Interest in STEM

Interest in STEM fields varies across grade levels, with percentages as follows: K-4 (88%), 5-8 (82%), and 9-12 (70%).



STEM Experience Breakdown

50%

This chart illustrates the balanced mix of attendees: half of the students arrived with prior exposure to biomedical engineering or related fields, while the other half were newcomers to the discipline. This diversity offered a dynamic exchange of perspectives and a unique opportunity for peer-to-peer learning and inspiration.

Real-World Connections

A before-and-after comparison of students' likelihood to consider a STEM career, showing the growth in higher interest levels post-event.



Highlights of New Insights

Students commented on the array of new insights gained in biomedical engineering during the event, including the prevalence of BME applications in daily life, techniques such as DNA extraction, and advancements in EMG technology.

Engineering Facilities Tour

During STEM Exploration Day, high school students from grades 9 to 12 were treated to a special tour of Syracuse University's engineering facilities. This experience provided them with firsthand exposure to the university's cutting-edge research labs and collaborative areas, enhancing their comprehension of practical engineering uses and academic prospects.

Successful Outreach

The STEM Exploration Day effectively reached a diverse group of students, enhancing interest and understanding in STEM, as indicated by the high engagement scores

Tailored Experience

The event offered age-appropriate activities, with a clear stratification in content depth and complexity, catering to the varying developmental stages of K-12 students

Positive Shift in Attitudes

Surveys showed an increase in students' confidence and interest in STEM post-event, suggesting that hands-on, interactive learning is impactful

Balanced Participation

The attendee profile displayed a 50/50 split between those with prior experience in STEM and those without, demonstrating the event's broad appeal

Skill Development

Activities were designed to develop key skills such as critical thinking and collaboration, which are crucial for future STEM professionals

Insightful Learning Outcomes

Students gained valuable insights into real-world STEM applications and potential careers, reinforcing the importance of experiential learning

Varied Interest in STEM Careers

There was a notable range in students' interest in pursuing STEM careers, highlighting the need for continued inspiration and guidance

Future Focus

Considering the strong outcomes, ongoing support and development of similar outreach events could be instrumental in building a robust STEM pipeline for the future



Acknowledgements

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