Transforming the Role of Engineering in Science Education: A Demonstration, Conversation and Action Plan

TeachEngineering
STEM curriculum for k-12

National Science Teaching Association

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Showcase the increasingly sophisticated integration of science and math content in the engineering design process as the grade level of the NGSS-aligned activity increases.

- Experience the integration of engineering and the sciences
- Demonstrate how science education and engineering education can converge around common science themes
- Generate action steps for projects to implement similar strategies

Next Generation Science Standards

Disciplinary core ideas, science & engineering practices & cross-cutting concepts:

- **Incorporate** *engineering design* into K-12 learning, the Next Generation Science Standards
- **Pair** engineering practices with science concepts to bridge connections
- **Promote** problem solving and project-based learning
- **Strengthen** critical thinking skills

Success in K-12 settings and informal settings

- Effective teachers are key to success
- To be successful, STEM education practitioners *experience* the integration of engineering and the sciences
- Refer to handouts on the NGSS

Science and Engineering Practices

- Asking Questions and Defining problems
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Using Mathematics and Computational Thinking
- Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas

Science Subject matter areas:

- Physical Sciences
- Life Sciences
- Earth & Space Sciences

Engineering, Technology and the Application of Science:

ET 51 Engineering design

[defining, delimiting, developing, optimizing]

ET 52 Links among engineering, technology, science & society

[interdependence of S/E/T; influence of S/E/T on society & natural world

Crosscutting Concepts

- Patterns
- Cause & Effect: Mechanism and explanation
- Scale, Proportion and Quantity
- Systems and System Models
- Energy and Matter: Flows, cycles, and conservation
- Structure and Function
- Stability and Change

Sorting Hat!

Wind-Powered Sail Cars (3-5)

Amusement Park Ride: Ups and Downs in Design (6-8)

Engineering Ethics: Evaluating Popular Inventions (9-12)

Engineering Ethics: Evaluating Popular Inventions

Your task as an individual:

1) Review the sheets showing the top inventions from 2018. As an individual, select your top design choice for the Invention of the Year and a runner up choice. Refer to the Activity Worksheet Part 1.

Engineering Ethics: Evaluating Popular Inventions

2) Place a sticky note (yellow) on the poster board for your first choice and a sticky note (blue) on the poster board indicating your second choice.

Engineering Ethics: Evaluating Popular Inventions

- As a small group, share your results and rationale for your choices of Top Invention of the Year and the runner up.
- Discuss what important criteria the top invention and the runner up meet.
- Is there a group consensus on the top invention of the year?

Engineering Ethics: Evaluating Popular Inventions

- As a whole group, we will review and discuss the top choices. Refer to Part 2 on Critical Evaluation.

A) Who does the design benefit? In what ways?

B) Who or what might be harmed by this design? In what ways?

C) Who might be discouraged or excluded from using this design?

D) Who funded the development of this design?

E) After looking more critically at this design, is there anything you noticed about it?

Summary

The Next Generation Science Standards offer a unique opportunity for educators to connect science and engineering education, while promoting diversity and inclusion across disciplines.

We are all faced with a series of great opportunities

brilliantly disguised as impossible situations.

Charles Swindoll.

Small group discussion by grade band:

Now that you have experienced an element of what these activities are like, how could engineering design transform science education in your grade band?

Report Out *the* (one!) Top Priority Action Step from your group

Conclusion:

The power of design thinking and development of engineering habits of mind. A different way of seeing the world.