

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



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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.

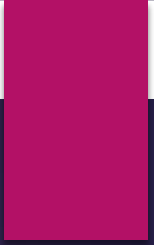
*We are all faced with a series of great opportunities
brilliantly disguised as impossible situations.*

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.