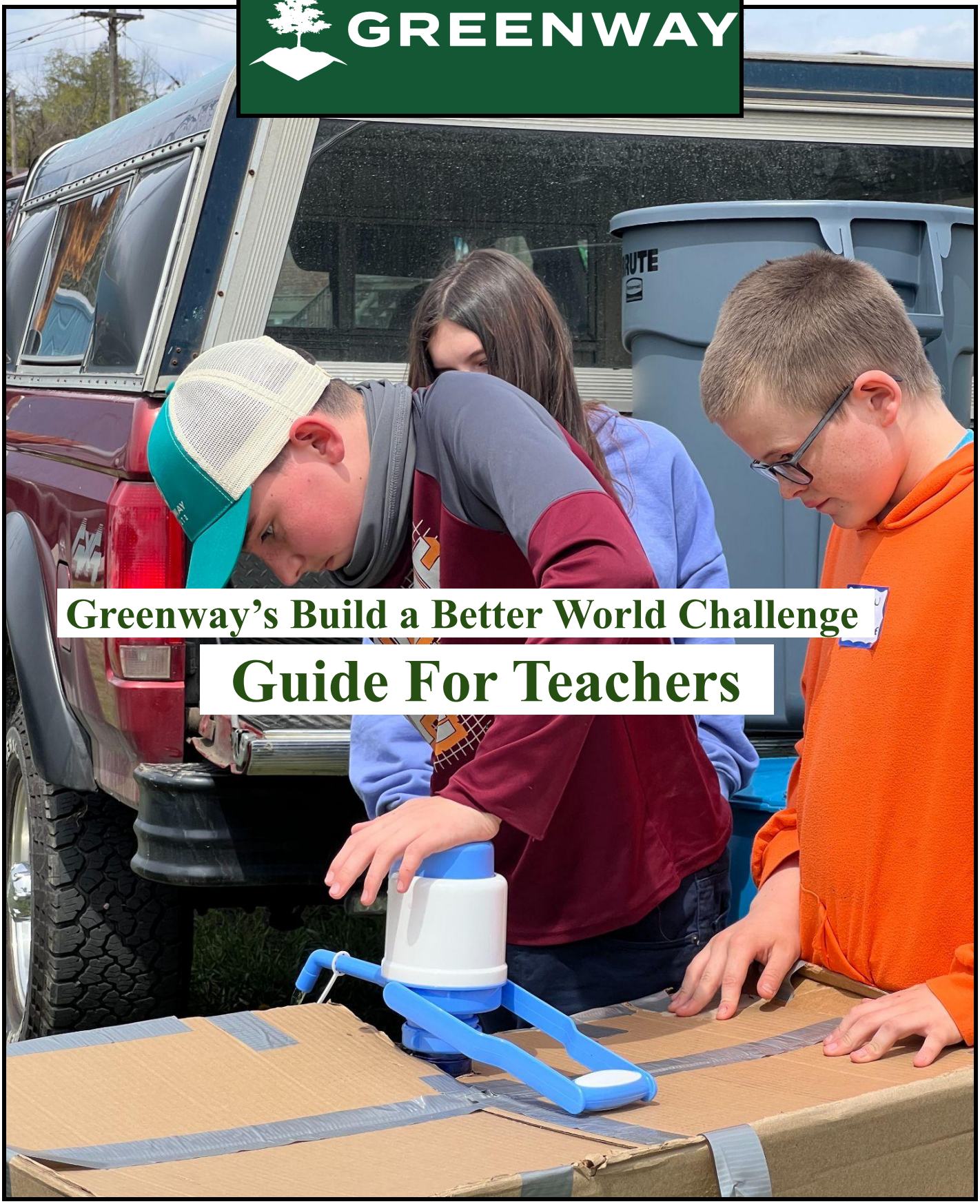
GREENWAY



Greenway's Build a Better World Challenge

Guide For Teachers

GREENWAY

GREENWAY'S BUILD A BETTER WORLD CHALLENGE

GUIDE FOR TEACHERS

This document describes how Greenway supports educators throughout the Greenway Challenge and provides examples of how teachers can embed the challenge into their curriculum.

Check out out website for more resources
https://greenwayinstitute.org/build-a-better-world-challenge/

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Goals for the Greenway Challenge

1. To get more students involved in hands-on learning, to promote problem-solving and explorative learning
2. To build students' identity as engineering, and to give them confidence in their design and build skills
3. To provide engineering role models for students, to introduce engineering as a tangible career option
4. To foster a learning environment where all students' ideas are respected, valued, and encouraged.
5. To build educator confidence in using hands-on learning in their classroom, and to illustrate the effective use of rigorous STEM education in a hands-on method.

Hands-on Learning

Greenway believes that students learn to engineer best when they are able to practice the iterative design process, of designing, building, evaluating, and rebuilding, over an extended period of hands-on learning. As such, we encourage educator advisors to push students to begin building as soon as possible in the challenge. As part of their proposal, we encourage teams to build a mini prototype, out of easily accessible materials, (cardboard, paper, popsicle sticks, etc). This serves two purposes, to get students working with their hands, and to get students to think critically about their design choices and material needs.

Methods of embedding the challenge into a middle/high school curriculum

Greenway provides educators with flexibility on how they would like to embed the challenge into their curriculum

Educators have successfully organized challenge team/s in a number of different ways.

- In the past…
    - Some teachers dedicated a day of class time per week over several months
    - Some teachers dedicate time every day over a 2 week/1 month period
    - Some support the challenge as an after-school activity

Embedded learning concepts

STEM understandings learned through the challenge in the past

- Circuits
- AC and DC electricity
- Basics of Trigonometry
- Basic coding
- Digital design
- Fluid dynamics

- Thermodynamics
- Sustainability

Technical STEM skills learned through the challenge in the past

- Project design, design planning
- Sketch-up
- Construction, use of hand tools and machining tools
- Arduino, and microcontrollers
- Soldering, and wiring

Soft Skills taught through the challenge

- Problem-solving
- Communication
- Team-work
- Iterative design

Engineering Resources for Teachers

We at Greenway want to make sure that teachers and students feel supported throughout the challenge, and feel empowered to tackle any challenge they are passionate about.

We encourage students to reach out to their Greenway engineering mentor if they encounter technical struggles throughout the design and build of their projects.

Here are some guides that may be helpful for the challenge.
Check out our website greenwayinstitute.org/build-a-better-world/ for additional resources

Greenway Learning Guides

- **What is solar power and how does it work?**
- **How to connect your solar panel, battery, and charge controller**
- **What does success look like in engineering?**

Alignment: Advance CTE standards, NGSS standards and ABET Outcomes

Greenway's Build a Better World Challenge is designed to give students an opportunity to demonstrate their growing mastery of essential STEM standards, including NGSS, Advance CTE standards. The Challenge is also aligned with ABET outcomes.

To support educators who want to incorporate the Challenge into their curricula, we have listed below key CTE and NGSS standards addressed by this challenge. If you are willing to share examples of how you incorporated the challenge into your curriculum, we welcome the opportunity to share these examples with other sites. Please share at: challenge@greenway.org

How does this engineering challenge align with Advance CTE standards, NGSS standards and ABET (engineering) outcomes?

Students will learn about circuits, charge controllers, water contamination and treatment, pumps and fluid flows. As participants complete the challenge, they will:

1. Develop and demonstrate skills of project management
2. Document their process of Engineering Design
3. Demonstrate Teamwork and Professional Skills
4. Refine a problem/challenge to make it actionable, consistent with design challenge requirements
5. Conduct research to inform prototype design
6. Develop a project proposal with a preliminary design for a prototype and materials budget
7. Build and test a prototype, engage in iterative design to improve performance
8. Presenting the process of design development, and the final prototype, to a panel of experts

This challenge is aligned with the following Advance CTE standards:

ESS01.02.02: Adapt language for audience, purpose, situation. (i.e. diction/structure, style).
ESS01.02.03: Organize oral and written information.
ESS01.02.10: Present formal and informal speeches including discussion, information requests, interpretation, and persuasive arguments.
ESS02.01.06: Communicate information, data, and observations to apply information learned from reading to actual practice.
ESS02.02.03: Write internal and external business correspondence that conveys and/or obtains information effectively.
ESS02.06.01: Prepare oral presentations to provide information for specific purposes and audiences.
ESS02.06.04: Deliver an oral presentation that sustains listeners' attention and interest.
ESS02.06.05: Align presentation strategies to the intended audience.

ESS03.01.02: Analyze elements of a problem to develop creative solutions.
ESS03.01.04 and .05: Create and evaluate ideas, proposals, and solutions to problems.
ESS03.01.07: Generate new and creative ideas to solve problems by brainstorming possible solutions.
ESS03.01.08: Critically analyze information to determine value to the problem-solving task.
ESS07.01.02: Exhibit traits such as empowerment, risk, communication, focusing on results, decision-making, problem solution, and investment in individuals when leading a group in solving a problem.
ESS07.01.03: Exhibit traits such as compassion, service, listening, coaching, developing others, team development, and understanding and appreciating others when acting as a manager of others in the workplace.
ESS07.01.04: Exhibit traits such as enthusiasm, creativity, conviction, mission, courage, concept, focus, principle-centered living, and change when interacting with others in general.
ESS07.01.05: Consider issues related to self, team, community, diversity, environment, and global awareness when leading others.
ESS07.03.02: Promote the full involvement and use of team members' individual talents and skills.
ESS07.03.05: Demonstrate teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution.
SCC04.02: Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.
SCPB01.01: Develop an understanding of how science and mathematics function to provide results, answers, and algorithms for engineering activities to solve problems and issues in the real world.
SCPB01.02 Apply science and mathematics to real-world situations that include the development of plans, processes, and projects where the issue is the solution of a real-world problem.
SCPB03.01: Use scientific and mathematical problem-solving skills and abilities to develop solutions to assigned projects that reflect the real world and their impact on modern society.
SCPB10.01: Demonstrate the knowledge and application of technical skills needed in a chosen scientific and mathematical field.

This challenge is aligned with the following NGSS standards:

1. https://www.nextgenscience.org/sites/default/files/topic-arrangement/HS.HS0621217.pdf
2. https://www.nextgenscience.org/sites/default/files/dci-arrangement/HS-ESS3062117WithFooter.pdf
3. https://www.nextgenscience.org/pe/hs-ps3-3-energy
4. https://www.nextgenscience.org/pe/hs-ess3-4-earth-and-human-activity
5. https://www.nextgenscience.org/pe/hs-ets1-2-engineering-design
6. https://www.nextgenscience.org/pe/hs-ets1-3-engineering-design

This challenge is aligned with the following Vermont transferable skills:

https://education.vermont.gov/sites/aoe/files/documents/edu-proficiency-based-education-transferrable-skills-sample-graduation-proficiencies.pdf

This challenge is aligned with the following ABET standards for engineering education:

To help participants understand how hands-on engineering for the Challenge prepares students for the kind of work they would experience as engineering students in college, this task is also aligned with the following ABET outcomes (for engineering programs):

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3) An ability to communicate effectively with a range of audiences.
4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.