Save the Day

Program Type: Classroom Program	***Audience Type:*** Grade 3 - 8

Description: Students use a card game to generate ideas for designs that will help someone in various disaster scenarios. Students use the engineering process to create their designs and focus on being creative.

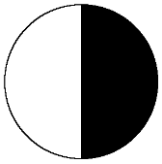
LEARNING OBJECTIVES

For Next Generation Science Standards alignment, see end of outline.

- Students will design a tool for a specific person in a disaster scenario and adapt their design to add constraints.

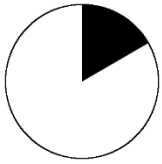
TIME REQUIRED

Advance Prep



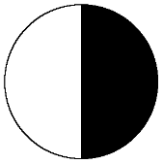
30 minutes

Set Up



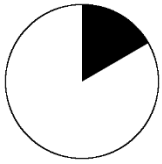
10 minutes

Activity



30 minutes

Clean Up



10 minutes

SITE REQUIREMENTS

- Tables or floor space able to fit groups of 3-4 students

PROGRAM FORMAT

Segment	Format	Time
Introduction	Large group discussion	10 min
Assembly Trials	Group activity	30 min
Wrap-Up	Large group discussion	10 min

SUPPLIES

Permanent Supplies	Amt	Notes
Design Challenge cards	1 set	Included in appendix 1 See Note 1
Design Challenge sheet	1/group	Included in appendix 1
Scrap paper	2-3/person	
Pencils/markers	1/person	
Building Supplies (optional)	1 set/group	See "Suggested Supplies" below

Note 1: A similar pre-packaged game is Extraordinaires® Design Studio (Deluxe version), published by The Creative Hub. It is available online from major retailers such as Amazon and through Barnes & Noble. Feel free to follow the gameplay included with the game, or use the cards with any of the playing options suggested here. More information available at www.extraordinaires.com

Suggested Supplies
If you choose a playing option that involves building, have a selection of supplies with 4-8 units of each building material assembled in a container for each group. The below items are suggested building materials, but you may use any similar items.

- Rubber bands
- Popsicle sticks
- Tongue depressors
- Straws
- Cardboard
- Cardstock or cereal boxes
- Craft foam sheets
- Paper clips
- Binder clips
- Brads
- Pipe cleaners
- String
- Sticky tack
- Bamboo skewers

ADVANCE PREPARATION

- Print and cut Design Challenge cards
- Print Design Challenge sheet for each group
- If using blank cards, fill them out with objects/users of your choice

SET UP

- Assemble building supply kits for each group, if using
- Set up space for groups of 3-4 to sit together
- Separate Design Challenge Cards into categories

INTRODUCTION

10 minutes

Let students speculate before offering answers to any questions. The answers given are provided primarily for the instructor's benefit.

Suggested script is shaded. Important points or questions are in **bold**. Possible answers are shown in *italics*.

Welcome everyone! Today we're going to use our imaginations and creativity to design inventions that can be used in some extraordinary situations to keep people and animals safe, comfortable, and happy.
To get our engineering creativity rolling, we've got a card game that will give us ideas for who, what, and the situation we need to design for.
These our situation cards – the extraordinary events we will design for. Some are serious and some are kind of silly. [Show cards and list off a few. Stop on one you think students are interested in and will have ideas around.]

What are some problems we might encounter in this situation?
(*Safety risks, technology not working, systems collapse, people are scared…)*

Here are our object cards. These are the things we will be designing. The categories are vague, so they can

include lots of things. [Show cards and list off a few. Stop on one you think students are interested in and will have ideas around.]

What are some things that fit in this category?
(Encourage and ask leading questions until you get a broad range of answers. Example: "Something to clean yourself with" – Soap, shower, car wash, scrub brush, shampoo, tongue, hand sanitizer, etc.)

Finally, engineers know that not everyone can use an object in exactly the same way, because different people and animals have different needs. These are our User Cards, aka. who you have to design for. [Show cards and list off a few. Stop on one you think students are interested in and that fits well with the previous two cards.]

Now we are going to combine all three cards! **What sort of [object] could you invent for a [user] to use in a [situation]? Turn and talk with the person next to you to come up with a few ideas.** Remember, use your imagination – it's okay to be silly!

Let students talk for 1-2 minutes, then have volunteers share out briefly. When the group seems to understand the activity, divide them into groups of 3-4, introduce them to the materials and begin the activity.

GROUP ACTIVITY

30 minutes

The goal of the game is for teams of students to design an object to suit a specific user in a disaster, and then revise that design when a constraint is introduced.

Basic Gameplay
Each group pulls two cards from the "Object," "User," and "Disaster" categories. The group then discusses amongst themselves and chooses one of each card that they think will be a good combination. They then can place their chosen combination on the color-coded Design Challenge sheet and leave it where all group members can see it.

Planning (5-7 minutes)
Each group begins with several minutes of discussion and sketching. Here are some questions to pose:

- **"What objects fit in this category?"** (Ex: "Something to wear" *shirt, pants, coat, swimsuit, costume, armor, uniform…)*
- **"What problems will come up in this disaster?"** (Ex: "Drought" *limited water, heat, dust, food can't grow, habitat loss)*
- **"What do we know about this user?"** (Ex: "Elephant" *elephants are large, heavy, and use their trunk for grabbing items)*
- **"How will this disaster affect this user?"**
- **"Will this user need any special adaptations to use this object?"** (Ex: *babies can't read, wheelchair users need ramps, pets don't have thumbs, etc.)*

Creating (10-15 minutes)
Let groups begin to design a model by either drawing it or building it with the building supplies. (Using building materials is recommended, especially with younger students; the concrete task promotes creativity and detailed thinking, and it is easier for the entire group to participate.)
If they are not building, ask them to create a detailed drawing with labels.
Questions to pose:

- **"What does this part do?"**
- **"How does this [object] help the [user] in the [disaster]?"**
- **"How does the [user] hold/wear/use your invention?"**

Improvement (5-10 minutes)
As each group reaches the "mostly done" stage, choose a constraint card that would be an appropriate challenge for each group and places it on their Design Challenge Sheet. Look for constraint cards that would prompt new ideas for each group based on their current design (for example: giving the "portable" constraint to a group with a design too large to move). Students then have 5-10 more minutes to improve the design to suit the constraint.

Sharing (5-10 minutes)
Gather all groups with their finished projects and have a sharing circle for them to explain their designs.

If there is limited time, or a large group, pair up groups and have them present to each other.

Variations on Basic Gameplay

1. All students create designs for the same object, user, and disaster.
2. All students create different objects for the same user and disaster.
3. Speed up the pace: Impose short time limits for each stage of play, draw instead of build, and do several rounds of designs.
4. Groups choose challenge cards for each other.
5. Use the blank card templates to create cards that are specific to the interests of your class or personalized.
6. Have groups evaluate their own designs or the design of another group. (Example categories: *Safety, Ease of Use, Reliability, Comfort, Effectiveness, Uniqueness).*

CLEAN UP

10 minutes

Students disassemble their creations or choose who brings it home.

NEXT GENERATION SCIENCE STANDARDS

	Practices
✓	Asking questions and defining problems
	Developing and using models
	Planning and carrying out investigations
	Analyzing and interpreting data
	Using mathematics and computational thinking
✓	Constructing explanations and designing solutions
	Engaging in argument from evidence
✓	Obtaining, evaluating, and communicating information

	Crosscutting Concepts
	Patterns
✓	Cause and effect
	Scale, proportion, and quantity
	Systems and system models
	Energy and matter
✓	Structure and function
	Stability and change

	Disciplinary Core Idea	3	4	5	MS
Physical Science					
PS1	Matter and Its Interaction	n/a	n/a		
PS2	Motion and Stability: Forces and Interactions		n/a		
PS3	Energy	n/a			
PS4	Waves and Their Applications in Technologies for Information Transfer	n/a		n/a	
Life Science					
LS1	From molecules to organisms: Structures and processes				
LS2	Ecosystems: Interactions, Energy, and Dynamics		n/a		
LS3	Heredity: Inheritance and Variation of Traits		n/a	n/a	
LS4	Biological Evolution: Unity and Diversity		n/a	n/a	
Earth & Space Science					
ESS1	Earth's Place in the Universe	n/a			
ESS2	Earth's Systems				
ESS3	Earth and Human Activity	✓	✓		
Engineering, Technology, and Applications of Science					

ETS1	Engineering Design	✓	✓	✓	✓

DCI Grade Band Endpoints

3-5 ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (By the end of Grade 5)

3-5 ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (By the end of Grade 5)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (By the end of Grade 5)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (By the end of Grade 5)

3-5 ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (By the end of Grade 5)

MS ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (By the end of Grade 8)

MS ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (By the end of Grade 8)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (By the end of Grade 8)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (By the end of Grade 8)
- Models of all kinds are important for testing solutions. (By the end of Grade 8)

MS ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (By the end of Grade 8)

- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (By the end of Grade 8)

3-5 ESS3.B: Natural Hazards

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions, severe weather, floods, coastal erosion). Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (By the end of grade 5)

Performance Expectations

3-5-ETS1-1.	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2.	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
MS-ETS1-1.	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2.	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
3-ESS3-1.	Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
4-ESS3-2.	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

References