

2018 STEM Fair Teacher Guide

Creative problem solving, investigation, and innovation.

Process

Step 1: Ask

What is the problem? How have others approached it? What are the constraints?

Step 2: Imagine

What are some solutions? Brainstorm ideas. Choose the best one.

Step 3: Plan

Draw a diagram. Make a list of materials you will need.

Step 4: Create

Follow your plan and create something. Test it out! Collect possible data.

Step 5: Improve

What works? What doesn't? What could be better? Modify design to make it better.
Test it out again!

Step 6: Summarize (ELA)

What will the product do? Why was it made the way it was? What challenges were experienced? What revisions were made? (Example: Written summary report)

Step 7: Presentation (Tech)

Create a audio or visual presentation and explain the design to an adult. (Example: google slide presentation, prezi, tri-fold board)

Timeline/ Due Dates

Step 1: _____ (approx. 1 week)

Step 2: _____ (approx. 1 week)

Step 3: _____ (approx. 1 week)

(teacher/family bring in recyclables for 1 month to use for designs)

Step 4: _____ (approx. 2 weeks)

Step 5: _____ (approx. 1 week)

Step 6: _____ (approx. 2 weeks)

Step 7: _____ (approx. 1 week)

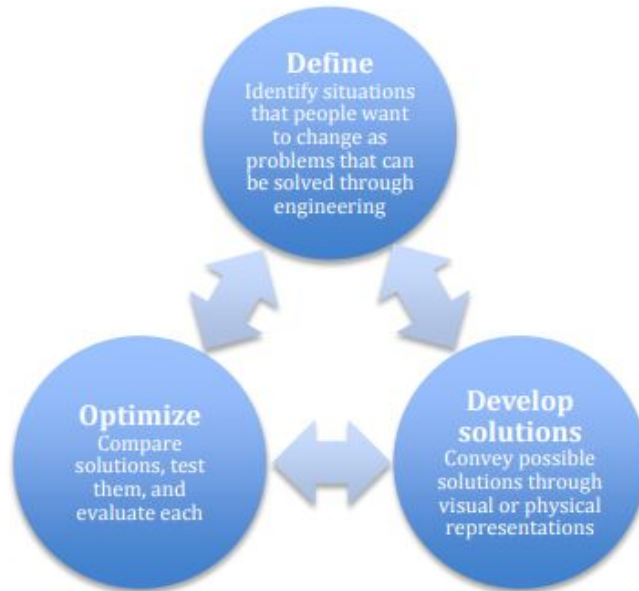
Standards Alignment

K-2 NGSS Engineering Design Standards

- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Grades K-2

Engineering design in the earliest grades introduces students to “problems” as situations that people want to change. They can use tools and materials to solve simple problems, use different representations to convey solutions, and compare different solutions to a problem and determine which is best. Students in all grade levels are not expected to come up with original solutions, although original solutions are always welcome. Emphasis is on thinking through the needs or goals that need to be met, and which solutions best meet those needs and goals.



K-2 STEM Innovation Themes (Whole Class or Groups)

Create new, extreme shoes with innovative features

Question/Problem: With so many existing shoe designs, how can I design a shoe completely different from all the rest?

Guiding Questions: What are the current limits to shoes? How can we break the mold?

- Did you focus on the function or design of the shoe? Why?
- How did you go beyond what is common with shoes?

Design a moving sculpture (robot) that could be used in the real world.

Question/Problem: What features might a moving (robotic) sculpture have?

Guiding Questions: What makes a moving sculpture interesting?

- How might moving sculptures be used in the world?
- What was the most interesting part of your design?

Design a new adaptive invention using a pair of sunglasses as the base.

Question/Problem: How could I fuse sunglasses with another idea or invention to make them even better?

Guiding Questions: How did you modify your sunglasses?

- Did you change the physical design, add technology, or do something else?
- What made you decide on the best features of your sunglasses to focus on?

Design a spaghetti/straw bridge.

Question/Problem: How can I build a strong, stable structure?

Guiding Questions: How did you design your structure?

- What could your structure support? A golf ball? A pound of sugar?
- What changes did you make after testing your bridge?

Design a shelter to protect people or animals from the weather (natural disasters).

Question/Problem: How can I protect myself from weather?

Guiding Questions: What would be needed during bad weather?

- Are there any dangerous materials to avoid?
- What made you decide on the best features of your shelter?
- Did you decide to use roles when inventing? Why or why not?

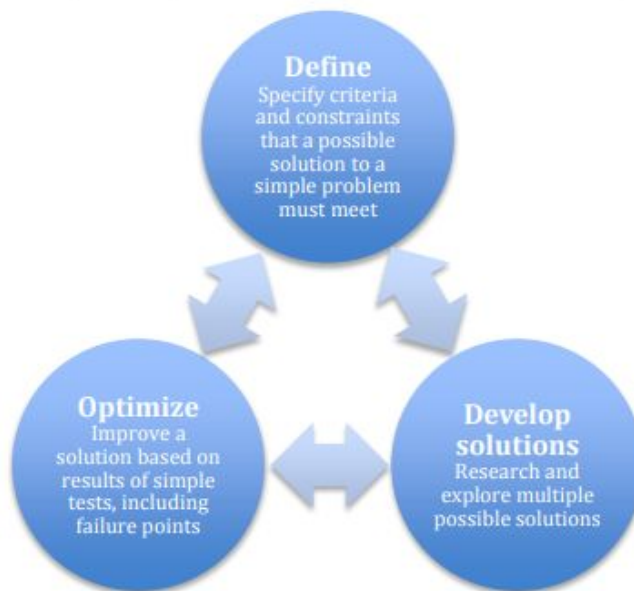
3-5 NGSS Engineering Design Standards

- 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.



Grades 3-5

At the upper elementary grades, engineering design engages students in more formalized problem solving. Students define a problem using criteria for success and constraints or limits of possible solutions. Students research and consider multiple possible solutions to a given problem. Generating and testing solutions also becomes more rigorous as the students learn to optimize solutions by revising them several times to obtain the best possible design.



3rd Grade STEM Innovation Themes (Small groups or Individual)

Create a game that promotes health and wellness.

Question/Problem: How will we make a fun game to play that is different from other games, that promotes better health?

Guiding Questions: What does health and wellness mean to you?

- How might a game promote health and wellness?
- What topics might encompass health and wellness?

Design a new type of sporting equipment or a game with innovative features.

Question/Problem: What might be a fun goal for a game to have?

Guiding Questions: What are your most favorite games and why?

- What are your least favorite games and why?
- What makes a game appealing and why?
- What are the most rewarding parts and most frustrating parts of a game?
- What type of a game did you design?
- Did you use any existing games as inspiration?
- What is the strategy and main objective?

Design a home to save animals across the country.

Question/Problem: What type of habitat does an animal require for survival?

Guiding Questions: What is your animal?

- What did you make for your animal? Why?
- What needs does your animal have?
- Is your animal threatened in any way? (ex: oil spill, hunting, poaching)

4th Grade STEM Innovation Themes (Small groups or Individual)

How can you design and use circuits to enhance wardrobe or products.

Question/Problem: What are some items in your life that you could enhance using technology?

Guiding Questions: What types of things do you do in your life that could be better?

- What are some of the most interesting ways that you can think of to use simple circuits in clothing, accessories, or other products?
- How do you think people's lives will change with the increase of wearable technology?
- What did you design? What was your inspiration?
- If you had unlimited access to materials, what else would you create?

Create a lamp with innovative features never thought of before.

Question/Problem: What features do common lamps lack?

Guiding Questions: How might I make a lamp that is energy efficient?

- When do I need light most, but do not have it accessible?
- How can a lamp be a decoration?
- How do you use lamps or lights?
- Where could light be included that is currently missing?

Design a home to save animals across the country.

Question/Problem: What type of habitat does an animal require for survival?

Guiding Questions: What is your animal?

- What did you make for your animal? Why?
- What needs does your animal have?
- Is your animal threatened in any way? (ex: oil spill, hunting, poaching)

5th Grade STEM Innovation Themes (Pairs or Individual)

Design a prototype of their ultimate personal transportation device for the future.

Question/Problem: What might transportation look like 50 years from now?

Guiding Questions: Was it easy or difficult to think of new ideas for transportation?

Why

- When you think about the transportation of the future, what does the environment that these vehicles operate in look like?
- In what medium does your transportation work (water, air, land, or all)?
- Does your transportation resemble any vehicles that already exist? Is it a new innovation or an adaptation of an existing invention?
- Does your vehicle have any special features or functions? If so, what are they?

Identify something missing from daily life. Design a unique individual prototype

Question/Problem: What is something you wish you had in your life that does not yet exist?

Guiding Questions: Was it easy or difficult to think of new ideas? Why?

- Are your ideas centered around functional, emotional, or social wants/needs?
- What did you create for a prototype? What is unique about it?
- How motivated are you to try to design a solution to something that does not exist?

Design a passage to a planet.

Question/Problem: How can I transport myself to another planet?

Guiding Questions: How can you solve problems in space?

- What benefit does your transport device have to the planet?
- What features does your device have that makes it unique?

Open - Ended Design

Question/Problem: What is something that doesn't exist that you wish did?

Guiding Questions: Was it easy or difficult to think of new ideas? Why?

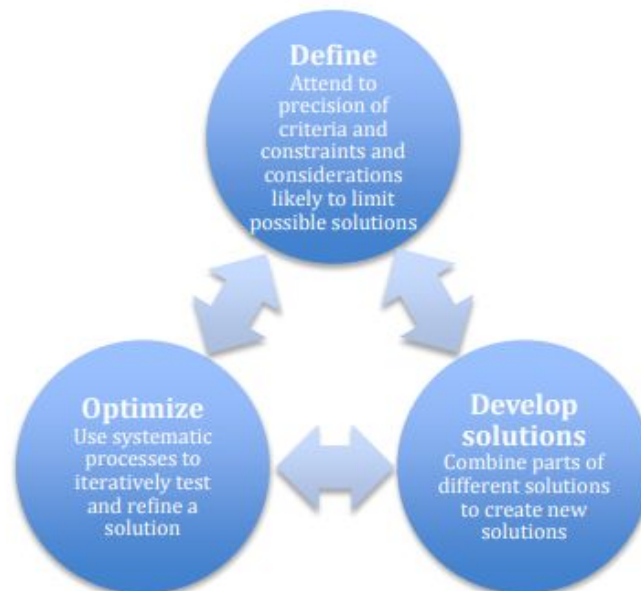
- What did you create for a prototype? What is unique about it?
- How motivated are you to try to design a solution to something that does not exist?

MS NGSS Engineering Design Standards

- 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.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Grades 6-8

At the middle school level, students learn to sharpen the focus of problems by precisely specifying criteria and constraints of successful solutions, taking into account not only what needs the problem is intended to meet, but also the larger context within which the problem is defined, including limits to possible solutions. Students can identify elements of different solutions and combine them to create new solutions. Students at this level are expected to use systematic methods to compare different solutions to see which best meet criteria and constraints, and to test and revise solutions a number of times in order to arrive at an optimal design.



6th Grade STEM Innovation Themes (Pairs or Individual)

Design futuristic earbuds.

Question/Problem: How can earbuds be improved?

Guiding Questions: What is wrong with the current product?

- What do you think needs to be changed that would make people want to buy the new earbuds?
- What kind of challenges did you come across when designing?

Create a new, best-selling phone case with innovative features.

Question/Problem: Wouldn't it be nice if my phone.....?

Guiding Questions: How might we design a phone case that is new?

- What do my friends and family seem to complain about when using their phones?
- Did you sketch a design first before you gathered materials for building, or does gathering materials help you think about your design?
- What is the most innovative phone case you have ever seen? How could you improve and be inspired by it?

Design a prototype power source.

Question/Problem: How can I create a device that will support alternative energy?

Guiding Questions: What did you design? Why?

- What energy source are you providing?
- What is the benefit of your energy source compared to electricity?
- What are the restrictions and benefits of your energy source to a community?

Open - Ended Design

Question/Problem: What is something that doesn't exist that you wish did?

Guiding Questions: Was it easy or difficult to think of new ideas? Why?

- What did you create for a prototype? What is unique about it?
- How motivated are you to try to design a solution to something that does not exist?

Summarize

Provide a summary of your project. Be sure to answer the following questions in your individual, group, or class report.

- What was the purpose of your product?
- How did you come up with your plan to create the product?
- Why was it made the way it is?
- What materials were used?
- What challenges did you encounter?
- What makes your creation unique?
- What changes did you make after testing? Why?
- Are there changes you would still make to improve your creation?
- Who could use your device? Would it help someone else?
- Was it easy or difficult to think of your idea? Why?

Presentation

Create a visual or audio presentation that explains your design to an audience of all ages. Examples would be: Google Slide Presentation, Prezi, Movie Maker, Tri-Fold Board. (Helpful hint: Use a chromebook to take pictures during your project if you want photos).