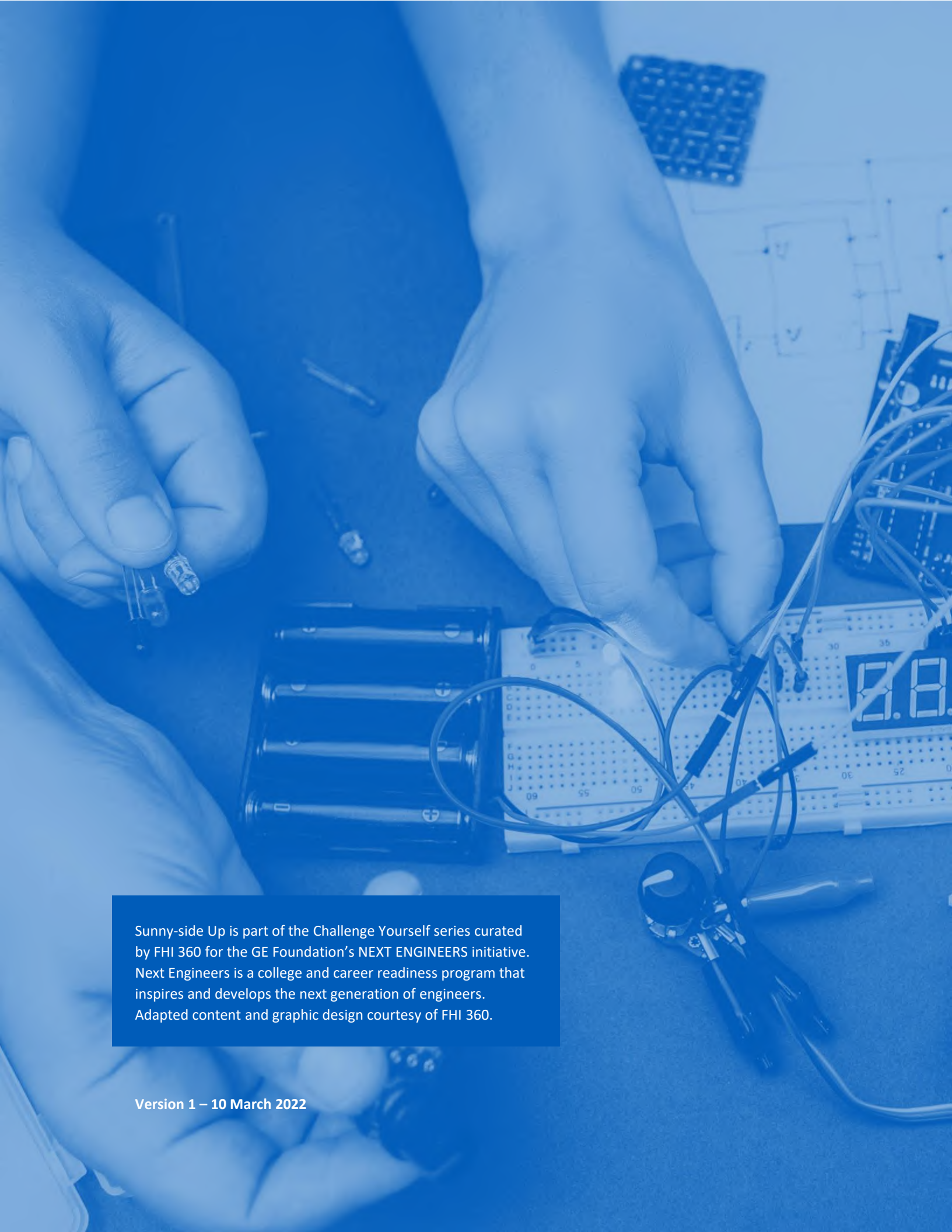
NEXT ENGINEERS

CHALLENGE YOURSELF

Sunny-side Up

Chemical Engineering
Thermal Engineering

GE Foundation



Sunny-side Up is part of the Challenge Yourself series curated by FHI 360 for the GE Foundation's NEXT ENGINEERS initiative. Next Engineers is a college and career readiness program that inspires and develops the next generation of engineers. Adapted content and graphic design courtesy of FHI 360.

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Sunny-side Up

BUILD IT!

Ages	Cost	Time
11+	Low - Medium	Full day

About this challenge

Who doesn't love a scrumptious cooked breakfast? Whether its bacon and eggs, porridge or oats, freshly baked roti or steamed noodles, breakfast is the most important meal of the day. The problem is there isn't always a stove or oven close by. But this is a problem an engineer can solve! So put on your thinking caps and get engineering.

Design and build a way to make the perfect cooked breakfast without using fire, gas or electricity. When you have perfected your amazing breakfast cooking machine, share your deign with the world at **#nextengineersdiy**.

You can design and build on your own or form a design team with some friends. The choice is yours whether you want to share your breakfast or not!

Fried eggs by Pxhere is licensed under a CC0 Public Domain licence https://pxhere.com/en/photo/1614692

Success Criteria

- Your breakfast cooker should be able to cook breakfast for **at least** one person.
- Your breakfast cooker should be able to cook the breakfast in **one hour or less**.
- Your breakfast cooker should be as small and easy to carry as possible.
- Your breakfast cooker should be re-usable.

Constraints

- You cannot use fire, gas or electricity to cook your breakfast.
- You should not spend more than about **US$15** (or its equivalent) on your design.

SUCCESS CRITERIA

These are the things that your design should be able to do or the things that will help tell if your design is a success.

CONSTRAINTS

These are limitations on your design. These are the things you cannot do when designing or what your design should not be like.

What you might need

You can use any materials you like so long as you do not spend more than US$15 (or its equivalent). Remember to get the permission and/or supervision of an adult before you use any tools or equipment.

Here are some materials and equipment that you might find useful.

- Cardboard
- Tin foil
- Glue and a glue gun
- Plastic folder or plastic sheet
- Glass or mirror

Follow the engineering design process

1. Identify and define the problem

Engineers start by asking lots of questions. What problem must be solved? Who has the problem? What do we want to accomplish? What are the project requirements? What are the limitations? What is the goal? Through this process, engineers start to identify the criteria (the conditions the solution must satisfy to be considered successful) and the constraints (the limitations they need to design within). Here are some initial questions you might like to ask yourself.

- What kind of breakfast do you want to cook?
- What kind of temperatures does your breakfast cooker need to produce to cook this food?
- How many people would you like to cook breakfast for?
- How big does your breakfast cooker need to be?

2. Gather information

Engineers dig deep into the problem by collecting information and data about the problem and any existing solutions that might be adaptable. They talk to people from many different backgrounds and specialties to assist with this research.

- What sources of heat are available to you?
- How can you collect and concentrate this heat?
- Do you need to heat up the air or a cooking surface?
- How might you monitor the heat of your breakfast cooker?
- Do you need to be able to change the heat produced by your breakfast cooker?
- What other solutions exist already that you could learn from, adapt, or improve?

3. Generate possible solutions

Now the fun really starts! Engineers start to brainstorm ideas and develop as many solutions as possible, sometimes even crazy ones! This is the time for wild ideas and delayed judgment. It is important to build on the ideas of others while staying focused on the core problem and keeping the criteria and constraints in mind. For example, if there is a budget, can the potential solution be developed within that budget?

- Use the Internet to look for ideas that other people have come up with. What is good about their design? What could you improve upon?
- Once you have brainstormed and gathered a few designs, look at what you have and decide on the one you think is the best. Don't worry, you can always change your mind later.

- Make sketches of your design so that you have an idea of how you are going to build it and what materials, tools and equipment you will need. No use designing something that needs stuff you can't get.

4. Create a prototype

Engineers choose one or more of the most promising solutions to prototype. A prototype is a model that works well enough to test part or all of the solution. The idea with prototypes is to build quickly and cheaply so that the costs of changing your mind or your design are not too high. Use prototypes to learn as much as you can about what works as quickly and as cheaply as you can.

5. Test and evaluate the prototype

Most prototypes fail, but that is good. It tells engineers which ideas they should focus on. Engineers also need to decide if the design really does solve the original problem.

The proof of the pudding is in the eating – literally in this case! You are eventually going to need to put your design to the test. Think about how you are going to test. What aspects are you going to test? What data will you collect? How will you analyze this data?

Remember, there is no shame in failing. All the best engineers fail **ALL THE TIME**. It's what they do when they fail that makes them great. They learn and improve.

6. Refine and/or redesign the solution

After learning through testing, engineers redesign and retest until they have the best solution possible – one that balances the criteria and constraints.

Remember that failure is not the end – its only the beginning. Think about how you can improve your design? Maybe go back to the drawing board if necessary and choose another of your original designs to try.

The most important thing is that you keep testing, learning and improving. After all, the world's most perfect cooked breakfast is at stake!

7. Present or communicate the solution

Finally, engineers reach a point where they are satisfied with their solution. It does not need to be perfect, but it should 'satisfice' - meet the criteria within the constraints. Engineers now communicate their solution to others.

You can share your design however you like – a video, pictures, a blog – and on any platform you like. Just remember to tag **#nextengineersdiy**.

Some helpful resources

Here are some resources that you might find helpful to get you started:

- *Makes S'mores With a Solar Oven*
  https://climatekids.nasa.gov/smores/
- *Gourmet S'mores: The Perfect Gooey Marshmallow*
  https://blog.thermoworks.com/candy-chocolate/toasted-marshmallow-day/

- *How Solar Cooking Work*
  https://science.howstuffworks.com/environmental/green-science/solar-cooking1.htm
- *7 Best Solar Ovens in 2022*
  https://mindseteco.co/solar-ovens/
- *How to build a solar oven – and why*
  https://believe.earth/en/how-to-build-a-solar-oven-and-why/

Challenge yourself

If you need more of a challenge, here are some ideas to take your design to the next level.

- Use your design to roast 30 marshmallows in one hour.
- Cook a full breakfast for your family.
- Cook other types of meals that require different cooking techniques.
- Make a cup of tea.