SAVVAS

Engineer IT!

Maker Crate

Engineering Design Challenges

Experience IT!

It's the Science of Doing.

Think. Tinker. Test.

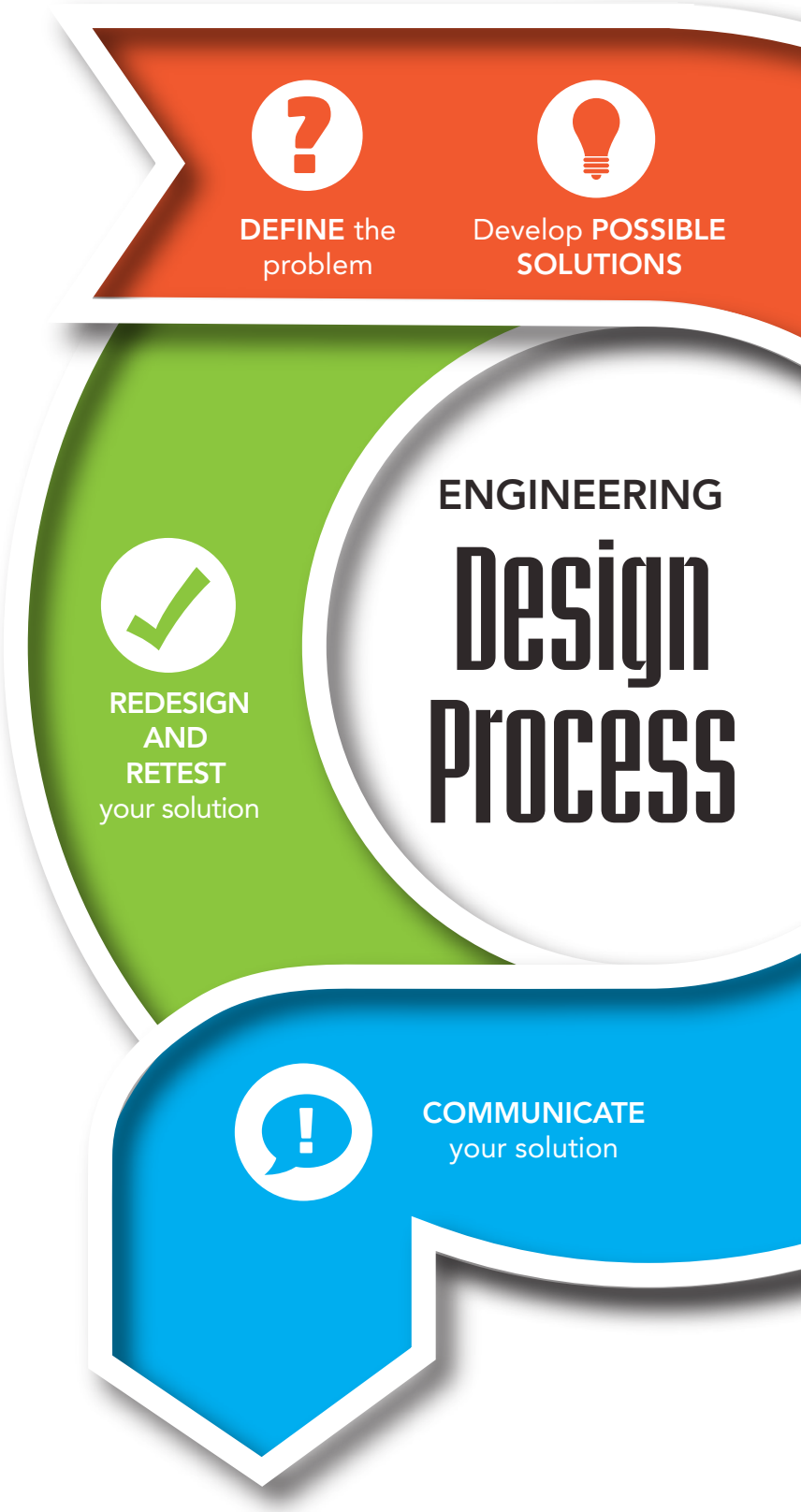
The materials in your *u*Engineer IT! Maker Crate provides a variety of parts and pieces for students to design and build solutions. Inspire, invent, and innovate endless creations using all the materials made available within the organized drawers.

Go online to see a full list of materials found in each Maker Crate Kit. Savvas.com/ExperienceIT

The Engineering and Design Process

Buildings, machines, structures, and systems! Engineers follow a process to develop new products or systems to meet human needs or wants. Engineers use scientific reasoning, invent procedures, analyze results, and communicate with people who will evaluate and rely on the design solution.

Introduce and implement the Engineering Design Process to assist students in identifying problems and realizing their ideas.



PHASE 1

Plan

Identify a problem or challenge

Understand the criteria and constraints

Brainstorm possible solutions

Design and build a working model (prototype)

PHASE 2

Test

Analyze prototype results data and identify needed changes

Modify the prototype to address the data analysis

Repeat the sequence until a final model is achieved

PHASE 3

Present

Organize the evidence to support the design decisions

Present the final design with the collected evidence

Compare/evaluate the other competing designs

Create Your Own Design Challenges!

Design challenges are idea starters and keep the spirit of the Next Generation Science Standards* alive in the classroom. Students can imagine being part of an engineering and design team while creating solutions to an identifiable problem. A design challenge has three distinct parts.

The Scenario:

provides a context for the design challenge. It identifies potential design criteria or constraints students need to consider before building their solution. These define challenge limits and can be modified for different age groups and abilities.

The Suggested Materials:

describes tips as to which kit materials could be utilized to build their solution. It should not be considered a restrictive list, but is offered as a place to start. Students should have the freedom to use all, add to the list, or not use any of the suggested materials. Remember: this is their design to meet their solution.

The Data Collection:

guides students as to what data they might need to collect and analyze.

Examples of some design challenges are found on the following pages.

Design Challenge: Amusement Theme

Have you ever been to a carnival or amusement park? Tea cups spin and twirl around. Ferris Wheels climb high in the sky while you rock back and forth in your seat. Horses, seals, and ducks move up and down on the merry-go-round. These are common rides you can experience at amusement parks. Many of them are gas-powered and produce by-products that pollute the sky. Others run on electricity which can be quite costly. How can you assist this industry by solving some of these challenges below?

- Create a model amusement ride that runs on solar energy.
- Build a zip-line device that can move objects across a given distance and back again.
- Design a way to move people through the park or up and down a slope.
- Design a new type of amusement park attraction or ride.

Design Challenge: Construction Theme

Some of the world's greatest inventions started in a garage! The computer industry, for example, was started by someone who had an unique idea to join some simple circuits together. Motorcycles were created by 20-year-old William Harley. He had the crazy idea to design an engine-powered bicycle! Sometimes the next 'best thing' starts with thinking about something we use every day and asking yourself, "How can I make using this easier or better?" or "Can I make some slight modifications to make this fit another use?" Take a moment to think about the challenges below. What can you design that could make a difference in the world?

- Design a structure to support a given weight and/or uses the least amount of materials.
- Create a catapult that tosses an object a given distance.
- Build a bridge of a specific length that will support the most weight.
- Construct a prosthetic device that mimics a hand, an arm, a leg, a wing, a beak, a claw, or even a fin!
- Be creative and develop a new design for a better flycatcher, a new type of pet feeder, or a new door alarm.

Design Challenge: Energy Theme

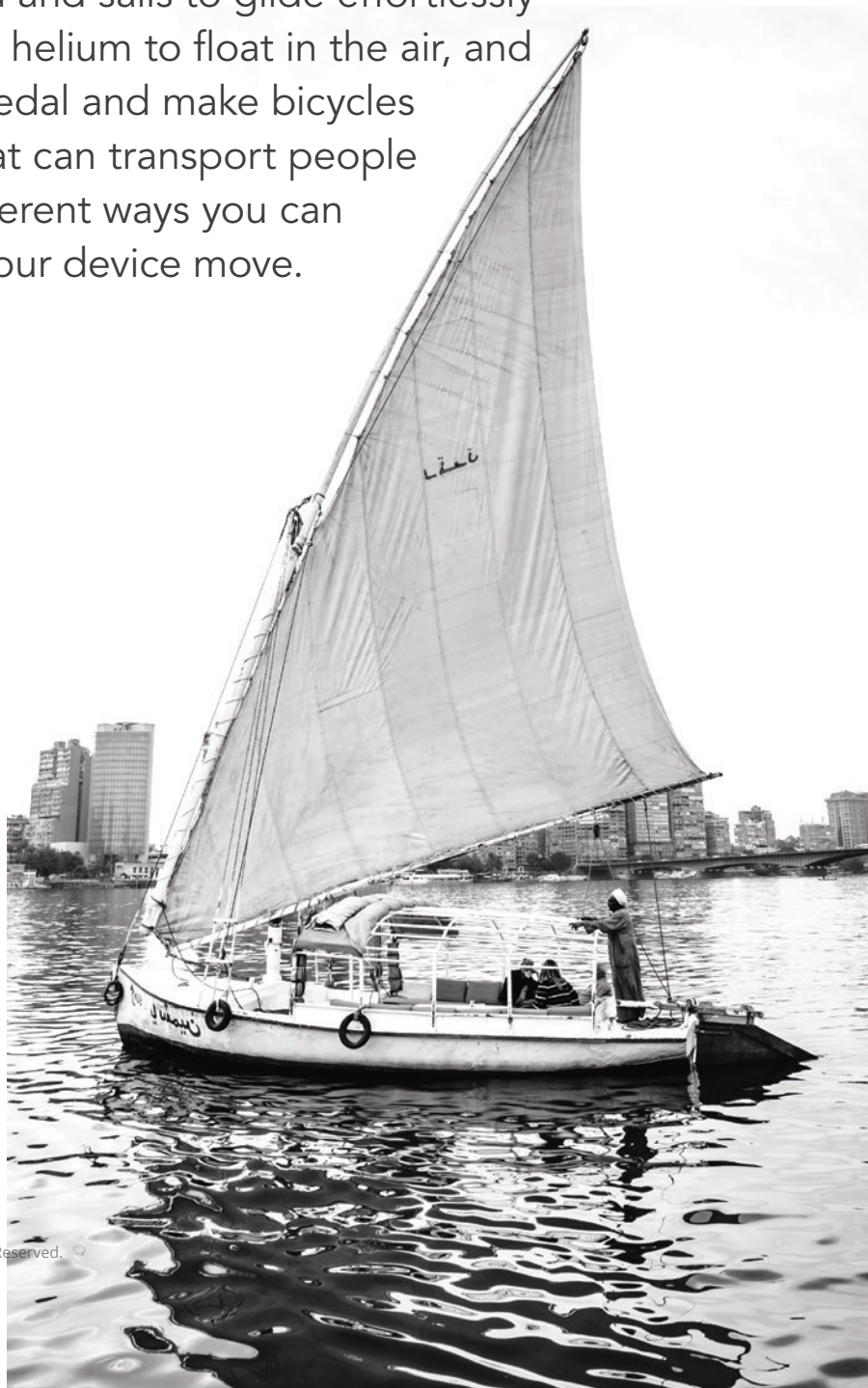
There are many different forms of energy. Light, heat, and sound are forms of energy. Look around and see if you can recognize where energy plays a part in the world around you. How can you use the different forms of energy to benefit your community, school, or family and friends?

- Construct a device that uses wind energy to perform a task — lift a mass, move water, or generate electricity.
- Create a model house that uses solar energy to power its lights and heat.
- Design a game that uses moving water as its source of energy.
- Build a Rube Goldberg Machine™ that models multiple transfers of energy. How many energy transfers can you make occur?

Design Challenge: Transportation Theme

We rely on energy to help us get from Point A to Point B. There are many ways people harness resources to utilize energy in order to move things. For example, some boats use a combination of wind and sails to glide effortlessly across water. Balloons use helium to float in the air, and people use their feet to pedal and make bicycles move. Design a device that can transport people or things. Think of the different ways you can harness energy to make your device move.

- Build the fastest, lightest, or smallest device.
- Make a device that must travel a given distance.
- Design and build a device to carry cargo or navigate an incline.
- Try using different resources to power your device or create a sail that captures the wind.



Plan IT!

1. In order to find a solution for the engineering problem, you will need to consider some criteria and constraints.

CRITERIA

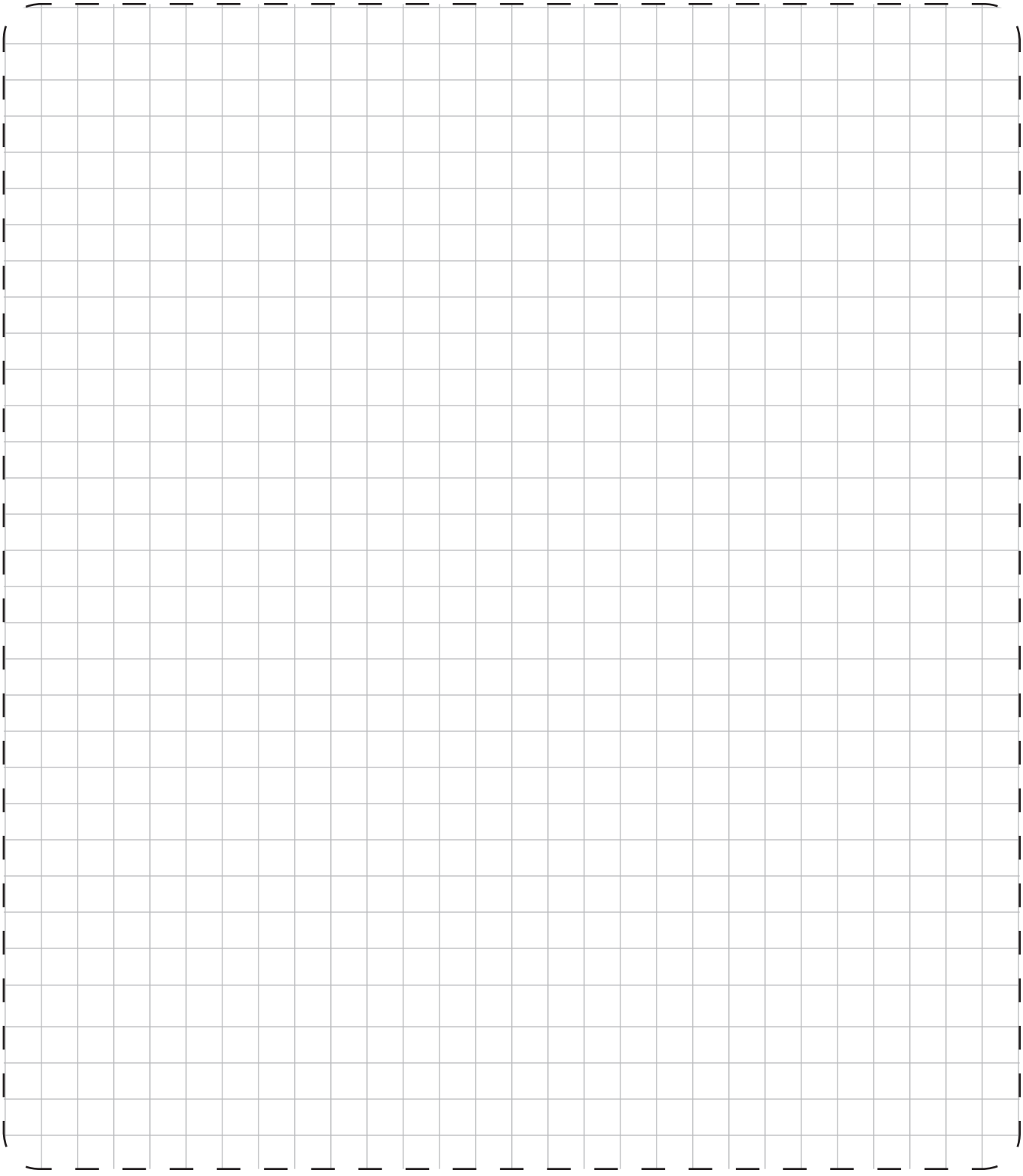
CONSTRAINTS

2. Research and find idea examples. Make a list of the key parts and possible materials you may need to model your idea.

MATERIALS

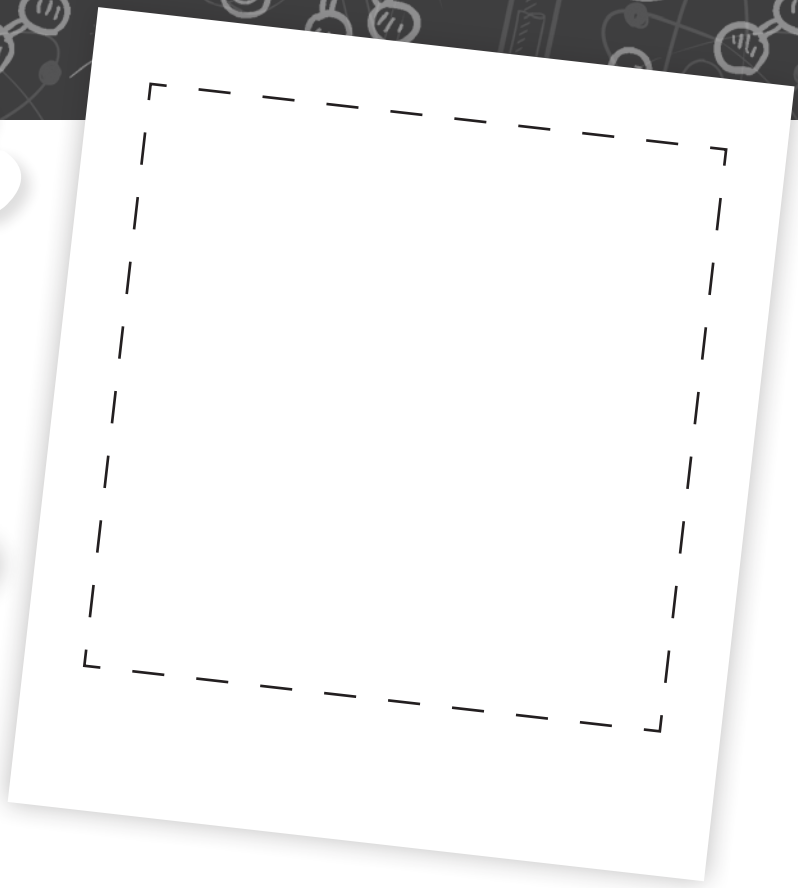
Design IT!

Make a sketch of your design solution.



Build IT!

Build your model and document it with a photo.



Test IT!

Describe a test you could perform to determine if you model meets the criteria of the design problem.

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Evaluate IT! Refine IT!

Perform the test. Record your observations and evaluate the results. Does it meet the criteria of the problem?

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Propose some changes you could use to improve the design.

Test and compare the results with your original design.

Communicate IT!

Present your findings! Plan out your presentation. Explain how your design works and why you made the decisions you did. Explain if any of your redesigns showed improvement and why.

elevate science

Download Additional Activities

Sign up for a free demo account at Savvas.com/ExperienceIT

Elevate Science offers additional *u*Engineer IT! activities online in the Savvas Realize™ digital course. As an added bonus, littleBits™ partners with *Elevate Science* to provide innovative activities and STEM Invention Toolboxes, offering even more enhancements for an engineering experience or STEM classroom.

Let's go social!

Post your students' design challenge solutions and share your own design challenges.

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