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Grade K-2 STEM Challenge

You Are an Engineer!

Inspired by engineering careers in the Indiana Uplands.

Published by Regional Opportunity Initiatives

GRADE K-2 STEM CHALLENGE

You Are an Engineer!

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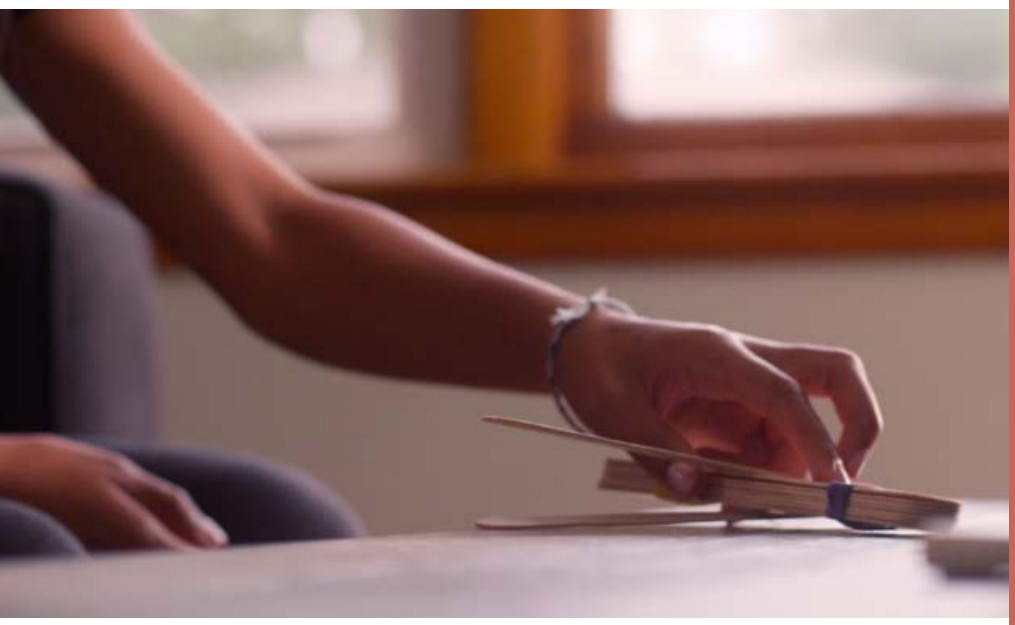
Students will design a "grabber" tool that can pick up different objects and place them in a box.



CAREER CONNECTION AND LESSON OVERVIEW

The Indiana Uplands are filled with opportunities for students who have a strong grounding in science, technology, engineering, and mathematics. An engineer is a person who designs and builds complex products, machines, systems, or structures. Engineers want to know how and why things work. They have scientific training that they use to make practical things. Engineers often specialize in a specific branch of engineering.

The disciplines of engineering can be divided into four main categories, chemical, civil, electrical and mechanical engineering. Each main discipline will provide you with a “taste” of the various skills and knowledge required to work in any field related to the discipline.

For more information about engineering in the Uplands, visit www.regionalopportunityinc.org/uplands-careers

LESSON TIMELINE

DAY 1 60 Minutes

- Show the inspiration video, "Suzy Builds a Catapult"
- Introduce the Engineering Design Process
- Students build grabber tool prototype

DAY 2 60 Minutes

- Test and improve tool design
- Object and container testing

DAY 3 50 Minutes

- Share grabber designs
- Share test results
- Communicate successes and challenges

Recommended Supplies

For the class:

A variety of building supplies, including:

- Wide popsicle sticks or tongue depressors
- Rubber bands (several sizes)
- Plastic Spoons
- Straws
- Chenille sticks
- Other household objects

Items to pick up:

- Paper clips
- Cotton balls
- Sheet of paper

Container to place objects into (small boxes)

For each student:

- Ruler
- Pencil
- Handout

IN THIS CHALLENGE, STUDENTS WILL:

- Design and build a “grabber” tool that can pick up a variety of differently shaped objects.
- Test how well the grabber can pick up different objects and place them in a box.
- Record and share their findings.

Standards

Science & Engineering Process Standards

SEPS.1 Posing Questions (for science) and defining problems (for engineering)
SEPS.2 Developing and using models and tools
SEPS.4 Analyzing and interpreting data
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)
SEPS.8 Obtaining, evaluating, and communicating information

English/Language Arts

K.SL.3.1 Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
1.SL.3.1 Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
2.SL.3.1 Determine the purpose for listening (e.g., to obtain information, to enjoy humor) and paraphrase or describe key ideas or details from a text read aloud or information presented orally or through other media.

Engineering Standards

K-2.E.2 Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
K-2.E.3 Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.

Math Standards

K.M.1 Make direct comparisons of the length, capacity, weight, and temperature of objects, and recognize which object is shorter, longer, taller, heavier, warmer, cooler, or holds more.
1.M.1 Use direct comparison or a nonstandard unit to compare and order objects according to length, area, capacity, weight, and temperature.
2.M.2 Estimate and measure the length of an object by selecting and using appropriate tools, such as rulers, yardsticks, meter sticks, and measuring tapes to the nearest inch, foot, yard, centimeter and meter.

Planning and Implementation

YOU ARE AN ENGINEER!

Essential Vocabulary

- ENGINEER: a person who invents, designs, analyzes, builds, and tests objects and systems to make improvements or solve problems.
- ENGINEERING DESIGN PROCESS: A series of steps that a student or engineer follows to come up with an optimal solution to a problem.
- PROTOTYPE: a first model of something from which other models are developed or copied.

In this challenge, students will:

- Watch Suzy Builds a Catapult.
- Design and build a "grabber" tool that can pick up a variety of differently shaped objects.
- Test how well the grabber can pick up the different objects, carry them across the room, and place them in a box.
- Record and share their findings with their peers.

Day 1

Introduction (20 minutes)

Prepare students for the lesson by telling them that you will showing them a short video about a little girl who wants to be an engineer when she grows up. Introduce the KNOW, WONDER, LEARN chart and record student responses to the questions:

"What do you KNOW about being an engineer?"

"What do you WONDER about being an engineer?"

Show the video of Suzy explaining why she wants to be an engineer using one of the short videos provided:

- Suzy Builds a Catapult (1:43), available www.regionalopportunityinc.org/suzy/
- Suzy Builds a Catapult: Meet an Engineer (2:48)

Prompt students to complete the KNOW and WONDER sections of the KNOW, WONDER, LEARN chart with class. If preferred, individual student KWL charts are included in this publication. As the class discusses, add questions and facts that students learned about engineers from the video.

Introduce the Challenge

Highlight for students that, as seen in the video, engineers create things to solve problems or change items to make them work better. They use something called the Engineering Design Process (EDP) to do this. Use the graphic below or the handout on page S1) to illustrate the steps of the EDP for the students.

> "You will be using the EDP to help an engineering company design a new kind of grabber tool. The workers for this company are required to move lots of different items to a collection box and they are using a different grabber for every object... that isn't efficient at all! The company's junior engineers have been challenged to design a grabber that will carry any object and make the workers' job easier and more efficient."

Show students the three objects they must pick up and move (the paper clip, the cotton ball, and the sheet of paper.) Ask students to brainstorm ways to pick items up, carry them, and set them down without using their bare hands. You may want to have students brainstorm ideas for each item individually and then pick ideas that might work for all three.

Explain that they are the junior engineers for this project and that they will be working in their group to build a grabber, test it, and make improvements.

Ask, Imagine, Plan, Create (40 Minutes)

Give students copies the Engineering Design Process handout (or project it for the class) and explain the sections and steps. Introduce students to the materials provided to build their grabber prototypes. Explain that students will have time on their own to come up with ideas for their grabber and then work with their group to share ideas and build a prototype using their bet ideas.

- Remind students that the grabber is for grabbing the items, NOT for grabbing each other!
- When working in a group students will have to take turns with materials and sharing ideas so that good ideas are not lost. Encourage students to draw out their plans before sharing with the group.

Allow students time individually to complete the IMAGINE section of their handout by drawing two ideas for a grabber. Next, assign students a partner or a small group (3-4 classmates) to share their ideas and decide on how they will build their grabber. Remind students that engineers usually try many ideas before coming to a decision on how to design a prototype. Pieces of each person's design might come together to make the best solution. Listening to your partners is important! Groups should decide what they want to build and draw a picture of this in their PLAN section.

Give students time to construct their grabber as a group. Time allowed can vary but let them have at least half an hour to work on their prototypes. If needed, this work time can be spread across multiple days.

Day 2

Test and Improve (60 Minutes)

Introduce the testing area where each small group can test their grabber prototype. Explain that during testing, students should watch for which parts of the design work well as well as problems that could be improved upon. Each group should test their grabber by lifting their object, carrying it a short distance, and dropping it into a box.

During testing, prompt students to look for ways they might change or improve their design. Students will record the results of each test in the CREATE section of their Engineering Design Process Handout. To address nonstandard and/or standard measurement standards, have students note how far the grabber was able to carry the objects (using steps, floor tiles, etc).

Once all groups have tested their prototypes, ask students:

- Does your grabber work for all objects?
- If it doesn't work for all objects, how could you revise it to make it more useful?

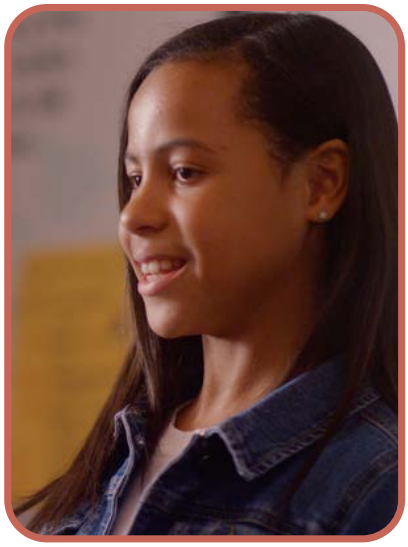
Students will then work in their groups to imagine ways in which they could improve the design. They will record these ideas in the IMPROVE section of their Engineering Design Process handout. Prompt students to share their ideas with each other and draw the agreed upon improvements to their grabber in the IMPROVE section of the Engineering Design Process handout. Students should continue the Test/Improve cycle until they have a model that will pick up all three items.

Communicate (50 Minutes)

Prompt students to share their grabber designs with the class as well as any improvements they made after testing. Sharing should include:

- A demonstration of the grabber design.
- Improvements made to the design and why those were chosen.
- Which, if any, of the objects were easier to carry with their grabber than others.
- One thing that went really well about this challenge.
- One thing that was difficult about this challenge.

As a class, revisit the KWL chart and fill in what students have LEARNed from the challenge about engineers or the engineering design process. If time allows, let students add anything new that they WONDER about now after the challenge. What questions do they still have?



Career Exploration and Extension

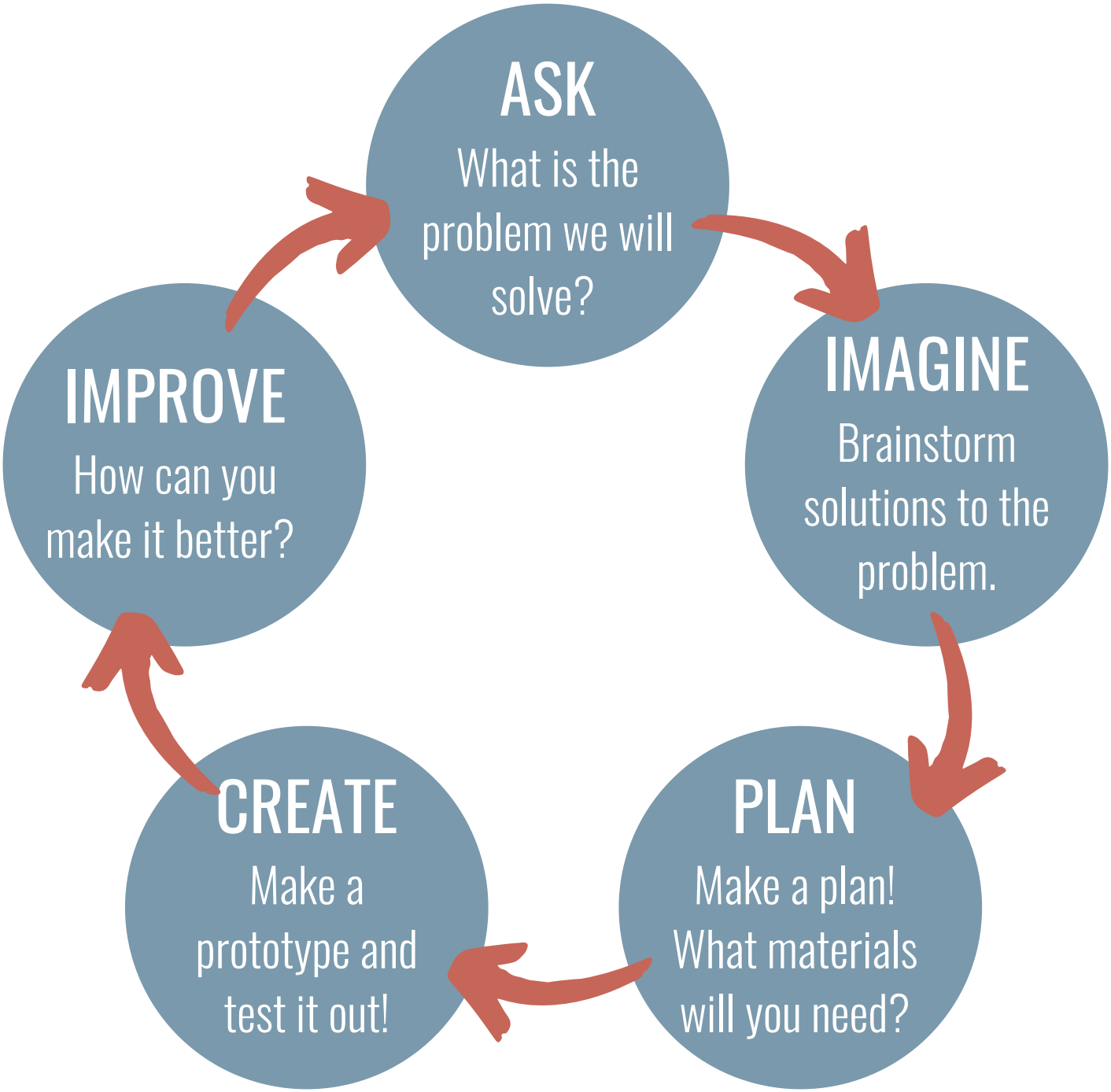
Prompt students to think about and research what a career as an engineer might entail.

- What does an engineer do all day?
- What kinds of problems do engineers solve?
- What kind of training would a student need to become an engineer?

Name: _____

You Are an Engineer!

Engineering Design Process Cycle



Name: _____

You Are an Engineer!

Know, Wonder, Learn Chart

KNOW	
WONDER	
LEARN	

Name: _____

You Are an Engineer!

Student Data Sheet

GRABBER INSTRUCTIONS:

1. You have been given three objects that you must be able to pick up and safely carry: a paperclip, a cotton ball, and a sheet of paper.
2. Your teacher has provided a collection of materials for you to build a grabber that can pick up all three of these objects (one at a time!) Think about what would make carrying each item easier. You will need to use this grabber to carry the things across the room without touching them with your hands!.
3. Once you have built your grabber, test it! Does it work well for a paperclip, a cotton ball, and a piece of paper? How could you fix it so it works on all three?

ASK What is the problem we are going to solve?	
How can we create a grabber that will pick up a paper clip, a cotton ball, and a sheet of paper and place them in a box?	
IMAGINE Brainstorm solutions to the problem above. Record your ideas in words or pictures.	
Idea 1:	Idea 2:

Name: _____

PLAN Draw the grabber you and your group will build. What materials will you use?	CREATE You will have _____minutes. Use this time to build the prototype you planned.

TEST
Did it work?

Test 1 Did it pick up:	The paper clip? _____ The cotton ball? _____ The sheet of paper? _____
Test 2 Did it pick up:	The paper clip? _____ The cotton ball? _____ The sheet of paper? _____
Test 3 Did it pick up:	The paper clip? _____ The cotton ball? _____ The sheet of paper? _____

Name: _____

IMPROVE

Change the prototype that your group created to make it better!

What did you change?

Why did you change it?

Name: _____

COMMUNICATE

Share your prototype with the class or another group.

What went well during this STEM challenge?

What part of this STEM challenge was difficult?

I learned ---

ACKNOWLEDGEMENTS

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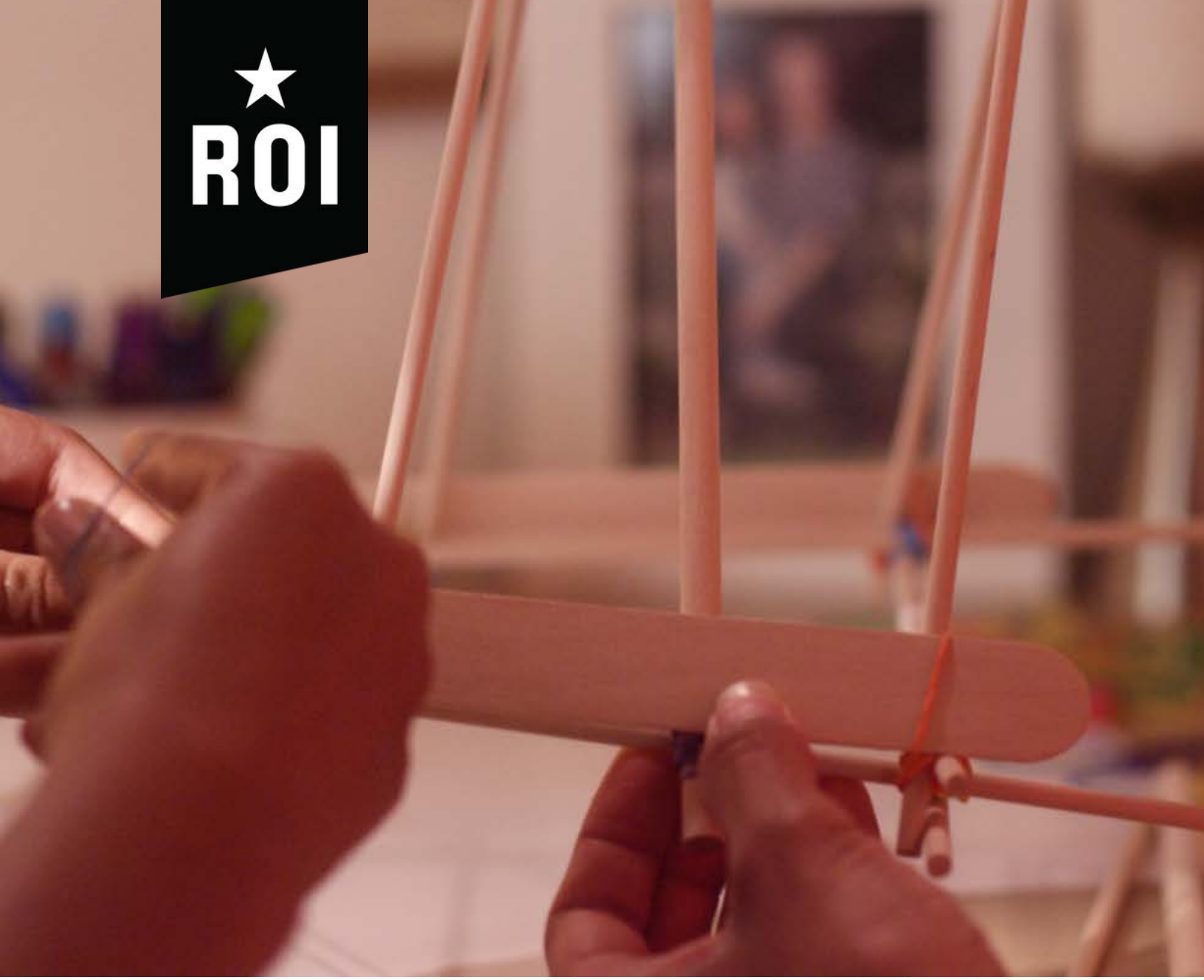
IMAGE AND CONTENT CREDITS

Images

Stock photography courtesy of Canva.com

Still video images from "Suzy Builds a Catapult," available at www.regionalopportunityinc.org/suzy/



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