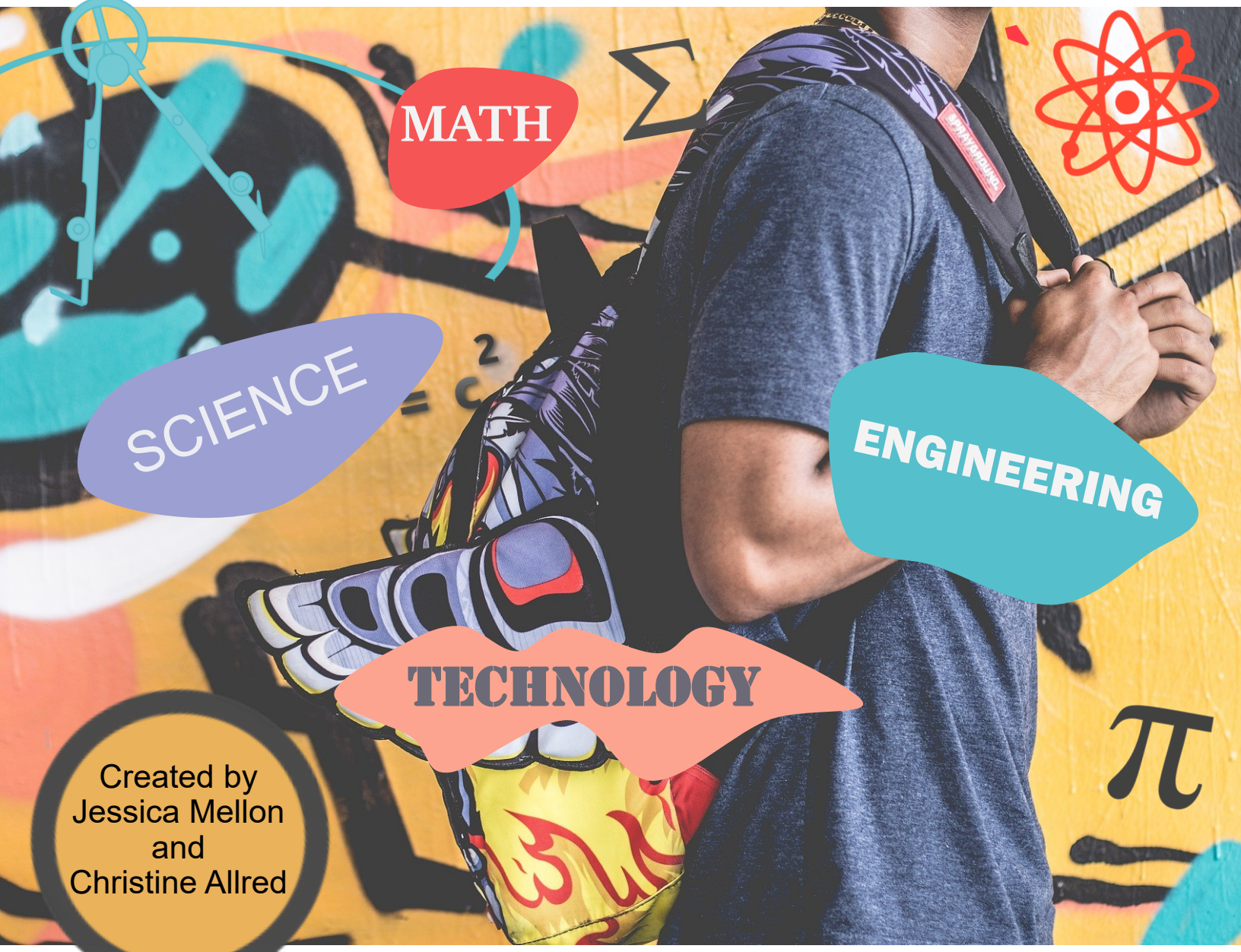
EC-14 | June 2022

4-H STEM ADVENTURES

Facilitator Guide



Created by
Jessica Mellon
and
Christine Allred

STEM learning with low cost, easy to find materials

UNIVERSITY OF MARYLAND EXTENSION

18 USC 707

FRAMEWORK

This facilitator guide is intended for 4-H professionals, classroom teachers, after-school or summer camp educators, 4-H club leaders, and home school parents. Two different approaches are offered. The "Guided" approach is intended for younger children (ages 8 to 10). This approach provides step-by-step instruction and handouts that utilize the engineering design process.

The "Exploratory" approach is intended for older children (ages 11 to 13) or for situations where the youth has unlimited time to explore. The Exploratory track challenges are open-ended and allow youth to develop their own solutions.

During the COVID-19 pandemic, 4-H programming had to adapt quickly to a virtual environment. As 4-H educators, we recognized a need for youth to continue to develop their STEM skills and interests. We created these hands-on challenges and videos to meet that need. Youth can solve these challenges in multiple ways using items found at home. All materials listed are suggestions. Youth are encouraged to think flexibly when it comes to sourcing the items needed to complete the challenges.

In 4-H, members "learn by doing." The three step model of "**DO, REFLECT, APPLY**" encourages members to "Do" an activity, "Reflect" on what worked and what didn't, and then "Apply" what they have learned to their everyday lives. Look for the directives "Do," "Reflect," and "Apply" in the following challenges. The directives will be in **ORANGE**.

This facilitator guide was created by:

Jessica Mellon
4-H Educator
University of MD Extension
Allegany County
One Commerce Drive,
Cumberland, MD 21502
301-724-3320
jmellon2@umd.edu

Christine Allred
4-H Educator (former)
University of MD Extension
St. Mary's County
26737 Radio Station Way, Ste E-2
P.O. Box 663
Leonardtown, MD 20650
301-475-4484
cmallred@umd.edu

Graphic design by:
Joni Reed
Administrative Assistant
University of MD Extension
Allegany County
One Commerce Drive
Cumberland, MD 21502
301-724-3320
jonireed@umd.edu

All images are in the public domain and are made available via Pixabay and Unsplash platforms.

This publication, *4-H STEM Adventures Facilitator Guide* (EC-14) is a part of a collection produced by the University of Maryland Extension within the College of Agriculture and Natural Resources.

The information presented has met UME peer-review standards, including internal and external technical review. For help accessing this or any UME publication contact: itaccessibility@umd.edu

For more information on this and other topics, visit the University of Maryland Extension website at extension.umd.edu

TABLE OF CONTENTS

INTRODUCTION

TARGET AUDIENCE

Youth ages 8 to 13

TIME FRAME

45 - 60 minutes per challenge

LEARNING OBJECTIVES

Youth will gain knowledge of science, technology, engineering, and mathematics (STEM) vocabulary and concepts while developing their life skills.

FACILITATOR GUIDE ICONS

MATERIALS

A list of suggested materials to be used.

STEM VOCABULARY

Important vocabulary words integral to the STEM challenge are in **GREEN.**

LIFE SKILLS

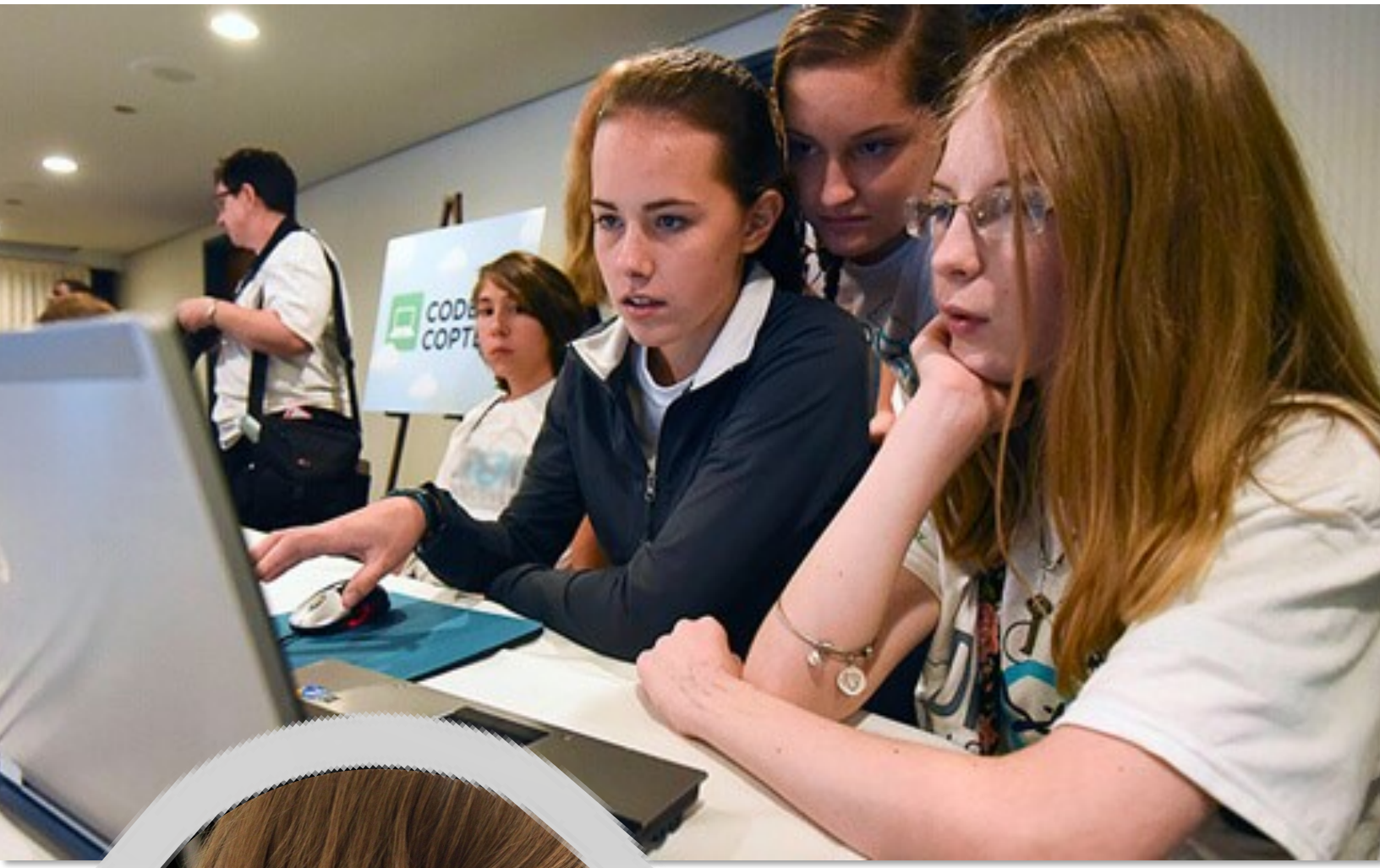
4-H LIFE SKILLS

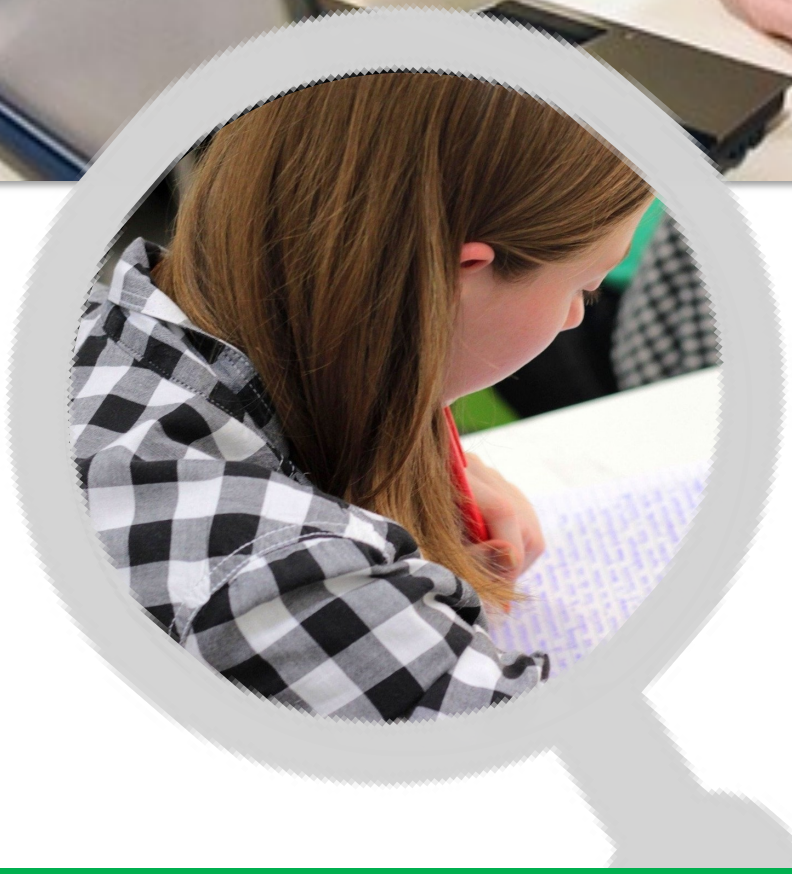
These practical life skills encourage life long learning, problem solving and other skills critical to success.

SUCCESS INDICATORS

Youth will successfully:

1. Build a marble maze that moves a marble from start to finish
2. Build a paper tower as tall as they are
3. Build a catapult that launches projectiles
4. Build a marble roller coaster that moves a marble from top to bottom
5. Build a mini golf course that includes obstacles
6. Build a mobile that balances





YOUTH RELATED PRIORITY NEED

STEM challenges foster creativity in the Arts and Sciences

GUIDED VS. EXPLORATORY APPROACH

Adult facilitators have the option of choosing either exploratory or guided approaches to each challenge. Both approaches have pros and cons. Choose the approach that best suits the youth with whom you are working.

GUIDED APPROACH

Provides structure, promotes good instruction-following habits, increases rate of success, and limits creative solutions.

Generally best for classroom settings, finite blocks of time, and youth ages 8 to 10.

EXPLORATORY APPROACH

Encourages creativity and deductive reasoning, lacks structure, takes more time, and risks frustration for the youth.

Generally best for out-of-school-time settings, large blocks of time, and youth ages 11 to 13.

CHALLENGE #1: MARBLE MAZE (EXPLORATORY)

YOUTH WILL BUILD A MARBLE MAZE THAT MOVES A MARBLE FROM START TO FINISH

MATERIALS: Paper plates with high side walls, marble, straws, scissors, tape, and glue.

VOCABULARY: **ITERATION:** The process of creating multiple versions of a project to make improvements. For this project, you'll make **ITERATIONS** to improve your maze design.

4-H LIFE SKILL: **PLANNING:** For this project, you can **PLAN** by thinking of a design and using a pencil to trace the path of the marble.

4-H LIFE SKILL: **RESILIENCE:** If the straws do not keep your marble on your plate, you can practice **RESILIENCE** by making corrections and trying again until it works.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge:

https://go.umd.edu/mmchallenge

Design and build a game where players try to move a marble from a start to a finish spot on the paper plate by tilting the plate to direct it around the straw obstacles.

To create the game, plan the path that the marble should take by tracing the path with a pencil. Place drinking straws beside the path. Cut straws, as needed, to fit. Tape or glue the straws to the plate to secure them. When the maze is ready, challenge your family members or friends to move the marble through the maze.

CHALLENGE #1: MARBLE MAZE (GUIDED)

YOUTH WILL BUILD A MARBLE MAZE THAT MOVES A MARBLE FROM START TO FINISH

MATERIALS: Marble, 3 paper plates with high sides, 10 straws, clear tape, and scissors.

VOCABULARY: **ITERATION:** The process of creating multiple versions of a project to make improvements. For this project, you'll make **ITERATIONS** to improve your maze design.

4-H LIFE SKILL: **PLANNING** For this project, you can **PLAN** by thinking of a design and using a pencil to trace the path of the marble.

4-H LIFE SKILL: **RESILIENCE** If the straws do not keep your marble on your plate, you can practice **RESILIENCE** by making corrections and trying again until it works.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge at https://go.umd.edu/mmchallenge

then follow steps 1-5 on the following page.

CHALLENGE #1: MARBLE MAZE (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Build a maze on your paper plate so that when you tilt the plate, the marble will roll from START to END. The materials you can use are: paper plates, straws, marble, pencil, scissors, tape or glue.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make your maze. Consider choosing a pattern, shape, or a geometric design to get started.

STEP 3. PLAN POSSIBLE SOLUTIONS

Based on your imagined solutions, **PLAN** the path for the marble to roll. Draw it on the paper plate with a pencil. Mark the START and END.

STEP 4. CREATE YOUR MAZE

Cut straws to fit on both sides of the path to keep the marble on the path. Tape or glue the straws to the paper plate. Test your maze. Move the marble from the start of your maze to the end by tilting the plate. Can you do it? This is the first **ITERATION,** or version, of your design.

STEP 5. IMPROVE YOUR DESIGN

Look at your marble maze. Do you need to change anything to make your maze work better? You can go back to Step 1 and identify any problems with your maze.

Start the process again to make the changes for your next **ITERATION.**

CHALLENGE #1: MARBLE MAZE

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: https://go.umd.edu/mmsolution

- How many **ITERATIONS** of your game did you make? How was the first version of your maze different from the last version?
- How did **PLANNING** the path of your marble affect the process of creating your game?
- Did you experience any setbacks while making the maze? How did you show **RESILIENCE** and overcome the setbacks?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

- What effect did challenging your family or friends to try your maze have on how you felt about it?
- Share an example of another time in your life when **PLANNING** a project made it easier to complete.
- When else have you had the opportunity to practice resilience?

REFERENCES:

D'Augustino, T. D. (2016, March 16). *4-H family engineering night engages youth in science*. Michigan State University. https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science

Kessler, C. *Make a paper plate maze STEM challenge*. Raising lifelong learners. https://raisinglifelonglearners.com/make-a-paper-plate-maze-stem-challenge/

CHALLENGE #2: TALL TOWER (EXPLORATORY)

YOUTH WILL BUILD A PAPER TOWER AS TALL AS THEY ARE

MATERIALS: Paper and tape.

VOCABULARY: **CONSTRAINT: CONSTRAINT** means "a limitation". For this project, the **CONSTRAINT** is the materials you may use to build your tower. You may only use paper and tape.

4-H LIFE SKILL: **PROBLEM SOLVING:** As you build the tower, you will encounter multiple problems. Figuring out a solution to each difficulty will help you to achieve your goal.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/ptchallenge

Design and build a tower as tall as you using only paper and tape.

You may consider shaping your paper into cylinders or triangles to make the columns, and using the paper as platforms or supports for the levels of your tower.

CHALLENGE #2: TALL TOWER (GUIDED)

YOUTH WILL BUILD A PAPER TOWER AS TALL AS THEY ARE

MATERIALS: Paper and tape.

VOCABULARY: **CONSTRAINT: CONSTRAINT** means “a limitation”. For this project, the **CONSTRAINT** is the materials you may want to use to build your tower. You may only use paper and tape.

LIFE SKILLS

4-H LIFE SKILL: **PROBLEM SOLVING:** As you build the tower, you will encounter multiple problems. Figuring out a solution to each difficulty will help you to achieve your goal.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: **https://go.umd.edu/ptchallenge**

then follow steps 1-5 on the following page.

CHALLENGE #2: TALL TOWER (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Design and build a tower as tall as you are using only paper and tape.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make your tower. Do towers go straight up or do they have multiple levels and supports? How can you roll or fold paper so it can stand up?

STEP 3. PLAN POSSIBLE SOLUTIONS

Roll paper into cylinders and secure with tape. Does this seem like a good support for your tower? Can you fold paper in half to make different levels? Sketch out your design.

STEP 4. CREATE YOUR PAPER TOWER

1. Roll 4 pieces of paper and tape the edges to make cylinders. Stand them up next to each other.
2. Fold a sheet of paper in half and lay it across the top of the cylinders to complete the level. Tape it to the cylinders.
3. Roll 4 more pieces and tape them standing up on the story, and add a half sheet on top to complete the level.
4. Repeat until it is as tall as you or as tall as you would like.

STEP 5. IMPROVE YOUR DESIGN

Look at your tower. Is it standing straight without falling over? Do you need to change anything to make your tower stand taller?

You can go back to Step 1, and start the process again to make the changes for your next iteration to improve your tower.

CHALLENGE #2: TALL TOWER

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: https://go.umd.edu/ptsolution

Was this challenge harder or easier than you predicted it to be?

What problems did you encounter while constructing your tower? How did you **SOLVE** each one?

What other materials would you have used if you were not limited by the materials **CONSTRAINT**?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

What might be examples of **CONSTRAINTS** that engineers face while working on their projects?

Why are **CONSTRAINTS** important?

Share a time in your life when you used **PROBLEM SOLVING** to overcome an obstacle.

REFERENCES:

D'Augustino, T. D. (2016, March 16). *4-H family engineering night engages youth in science.* Michigan State University. https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science

Donelly, G. (n.d.). *Make it! DIY: home engineering.* Kid Museum. https://kid-museum.org/make-it/home-engineering/

CHALLENGE #3: CATAPULT (EXPLORATORY)

YOUTH WILL DESIGN AND BUILD A CATAPULT THAT CAN LAUNCH A SMALL PROJECTILE

MATERIALS: Craft sticks, unsharpened pencils, an empty tissue box, paint stirrers, chopsticks, straws, skewers, plastic spoons, milk caps, rubber bands, pompoms, paper cups, glue, ruler, pencil, and a recording sheet.

VOCABULARY:

POTENTIAL ENERGY: Stored energy. When the rubber bands are stretched and the catapult is ready to be released, the energy in the rubber bands is **POTENTIAL ENERGY**.

KINETIC ENERGY: Energy of motion. When the rubber band is released and moves the catapult arm to launch the projectile, the type of energy becomes **KINETIC.**

LIFE SKILLS

4-H LIFE SKILL:

RECORD KEEPING: As you perform multiple tests of each projectile, keep **RECORDS** to determine which projectile consistently launched the farthest.

PERSONAL SAFETY: When launching, choose only soft projectiles that won't hurt yourself, other people, your pets or your walls.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: **https://go.umd.edu/catchallenge**

CHALLENGE #3: CATAPULT (GUIDED)

YOUTH WILL DESIGN AND BUILD A CATAPULT THAT CAN LAUNCH A SMALL PROJECTILE

MATERIALS: 8 craft sticks, 5 rubber bands, plastic spoon, pompom, pencil cap eraser, ruler, pencil, recording sheet, and calculator (optional).

VOCABULARY:

POTENTIAL ENERGY: Stored energy. When the rubber bands are stretched and the catapult is ready to be released, the energy in the rubber bands is **POTENTIAL ENERGY**.

KINETIC ENERGY: Energy of motion. When the rubber band is released and moves the catapult arm to launch the projectile, the type of energy becomes **KINETIC.**

LIFE SKILLS

4-H LIFE SKILL:

RECORD KEEPING: As you perform multiple tests of each projectile, keep **RECORDS** to determine which projectile consistently launched the farthest.

PERSONAL SAFETY: When launching, choose only soft projectiles that won't hurt yourself, other people, your pets or your walls.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/catchallenge
then follow steps 1-5 on the following page.

CHALLENGE #3: CATAPULT (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Design and build a catapult that can launch a craft pompom and pencil cap eraser. Measure and record how far each lands from the catapult.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make your catapult. Consider how you'll build a base that is sturdy enough to hold the launch arm. You could build a frame out of craft sticks, unsharpened pencils, paint stirrers, or chopsticks. Another idea for a base is to start with an empty tissue box. Add an "arm" that can move to launch the projective. Bending a plastic spoon is one idea. Another idea is to glue a paper cup or milk cap onto a craft stick and then attach it to the base. A straw on top of a skewer will allow it to rotate, and adding a rubber band on the opposite end of the "arm" will add more power to your catapult.

STEP 3. PLAN POSSIBLE SOLUTIONS (SKETCH IT HERE):

STEP 4. CREATE YOUR CATAPULT AND TEST IT

Try different projectile types to see which type launches the farthest. Remember to keep **PERSONAL SAFETY** in mind when selecting your projectiles. Projectile ideas are pompoms, eraser caps, dried beans, and popcorn kernels. Repeat the launch of each projectile at least three times to get an average (the sum of the distances divided by the number of launches).

STEP 5. IMPROVE YOUR DESIGN

Do you need to change anything to make your catapult work better by increasing the **POTENTIAL ENERGY**? You can go back to Step 1, and start the process again to make the changes to improve your catapult.

CHALLENGE #3: CATAPULT RESULTS

Recording Sheet (in inches)

	Pompom Distance	Eraser Distance
Trial One		
Trial Two		
Trial Three		
Trial Four		

1. Add the pompom distances: ___ + ___ + ___+ ___ = ___ (sum)

2. Divide the total pompom distance by 4 to calculate the average. ____ (sum) ÷ 4 = _____ (average)

3. Add the eraser distances: ___ + ___ + ___+ ___ = ___ (sum)

4. Divide the total eraser distance by 4 to calculate the average. ____ (sum) ÷ 4 = _____ (average)

5. On average, which went farther? Circle one: Pompom Eraser

CHALLENGE #3: CATAPULT

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: **https://go.umd.edu/csolution**

Which projectile flew the farthest? Did it fly the farthest every time? How did **KEEPING RECORDS** and finding an average help you decide?

Why do you think one projectile flew farther than the other?

Why was **PERSONAL SAFETY** one of the 4-H life skills for this challenge?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

Think of another time you kept **RECORDS** of something. Why was it useful?

What are examples of ways that adults **KEEP RECORDS** of things? Why do you think they do that?

REFERENCES:

D'Augustino, T. D. (2016, March 16). *4-H family engineering night engages youth in science*. Michigan State University. **https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science**

Donelly, G. (n.d.). *Make it! DIY: home engineering.* Kid Museum. **https://kid-museum.org/make-it/home-engineering/**

CHALLENGE #4: MARBLE ROLLER COASTER (EXPLORATORY)

YOUTH WILL BUILD A MARBLE ROLLER COASTER THAT MOVES A MARBLE TOP TO BOTTOM

MATERIALS: Paper plates with tall sides, paper bowls, paper towel rolls, plastic cups, blocks, hot glue, scissors, tape.

VOCABULARY:

POTENTIAL ENERGY: Stored energy or energy of position. When the marble is in place at the top of the roller coaster, it has **POTENTIAL ENERGY** because it is in a high position and a tendency to roll down the track due to gravity.

KINETIC ENERGY: Energy of motion. While the marble is rolling down the track, it has **KINETIC ENERGY**.

LIFE SKILLS

4-H LIFE SKILL: **CRITICAL THINKING:** You will need to **THINK CRITICALLY** about how to adjust the roller coaster track and supports to keep the marble on the track.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: **https://go.umd.edu/rcchallenge**

CHALLENGE #4: MARBLE ROLLER COASTER (GUIDED)
YOUTH WILL BUILD A MARBLE ROLLER COASTER THAT MOVES A MARBLE TOP TO BOTTOM

MATERIALS: 15 paper plates with tall sides, 10 plastic cups, scissors, tape and a marble.

VOCABULARY:

POTENTIAL ENERGY: Stored energy or energy of position. When the marble is in place at the top of the roller coaster, it has **POTENTIAL ENERGY** because it is in a high position and a tendency to roll down the track due to gravity.

KINETIC ENERGY: Energy of motion. While the marble is rolling down the track, it has **KINETIC ENERGY**.

4-H LIFE SKILL: **CRITICAL THINKING:** You will need to **THINK CRITICALLY** about how to adjust the roller coaster track and supports to keep the marble on the track.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/rcchallenge
then follow steps 1-5 on the following page.

CHALLENGE #4: MARBLE ROLLER COASTER (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Design and build a roller coaster track for a marble to go from a start position, down a track, to a cup at the bottom.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make your roller coaster. You can cut the curved rims off of paper bowls and paper plates to make the track for the marble to roll down. Tape the rims of cups together to make the supports that will raise the start of the track.

STEP 3. PLAN POSSIBLE SOLUTIONS (SKETCH IT HERE)

STEP 4. CREATE YOUR MARBLE ROLLER COASTER

1. Use your scissors to cut the curved rims from your paper plates or bowls.
2. Tape the rims together to make a track.
3. Tape cups together to make a support structure, and tape the start of the track to the top of the cups to increase the potential energy.
4. Place a cup at the end of the track to catch the marble.
5. Try it! The **POTENTIAL ENERGY** of the ball at the top of the track becomes kinetic energy as it travels down the track.

STEP 5. IMPROVE YOUR DESIGN

Do you need to change anything to make your roller coaster better? Perhaps you need to add more materials to help the marble stay on the track around the curves. You can go back to Step 1, and make the changes to improve your roller coaster.

CHALLENGE #4: MARBLE ROLLER COASTER

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: **https://go.umd.edu/rcsolution**

Did the marble travel faster in some parts than others? Why do you think that is?

What was the most difficult part of creating the roller coaster? How did you use **CRITICAL THINKING** to overcome the challenge?

Where did the marble have the greatest amount of **POTENTIAL ENERGY**? The least amount?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

What are other examples of **POTENTIAL** and **KINETIC ENERGY** in your everyday life?

Why do engineers need to have an understanding of **POTENTIAL** and **KINETIC ENERGY**?

REFERENCES:

Brown, B. (n.d.). *The best STEM challenge ever*. Teach outside the box. **https://teachoutsidethebox.com/2017/04/best-stem-challenge-ever/**

D'Augustino, Tracy D. (2016, March 16). *4-H family engineering night engages youth in science*. Michigan State University. **https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science**

Dees, S. (2012, September 5). *Paper plate marble track.* Frugal fun for boys and girls. **https://frugalfun4boys.com/paper-plate-marble-track/**

CHALLENGE #5: MINI GOLF COURSE (EXPLORATORY)

YOUTH WILL BUILD A MINI GOLF COURSE THAT INCLUDES OBSTACLES

MATERIALS: Gift wrap tube, meter stick, cardboard, masking tape, ball, plastic cups, toys and other materials found around your home.

VOCABULARY: **LAW OF REFLECTION:** The angle at which light moves toward a smooth surface is the same as the angle at which the light leaves the smooth surface. In other words, the incoming angle (angle of incidence) is the same as the outgoing angle (angle of reflection). This principle is the same for objects bouncing off of a flat surface. When banking a ball off of a wall, the angle at which it leaves the wall will be the same as the angle at which it came toward the wall. We use this in playing pool, indoor soccer, hockey, and basketball.

LIFE SKILLS

4-H LIFE SKILL: **PLANNING:** A mini golf course is designed to present a bit of a challenge. When you **PLAN** your holes, try to include at least one obstacle per hole that blocks the path of the ball from start to finish. It could be placing a book in between the start and the finish, or it could be designing a hole that curves around a wall.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/mgchallenge

CHALLENGE # 5: MINI GOLF COURSE (GUIDED)
YOUTH WILL BUILD A MINI GOLF COURSE THAT INCLUDES OBSTACLES

MATERIALS: Paper towel or other cardboard tube such as a gift wrap tube, card board, masking tape, ball, plastic cups, other materials found around your home

VOCABULARY: **LAW OF REFLECTION:** The angle at which light moves toward a smooth surface is the same as the angle at which the light leaves the smooth surface. In other words, the incoming angle (angle of incidence) is the same as the outgoing angle (angle of reflection). This principle is the same for objects bouncing off of a flat surface. When banking a ball off of a wall, the angle at which it leaves the wall will be the same as the angle at which it came toward the wall. We use this in playing pool, indoor soccer, hockey, and basketball.

LIFE SKILLS

4-H LIFE SKILL: **PLANNING:** A mini golf course is designed to present a bit of a challenge. When you **PLAN** your holes, try to include at least one obstacle per hole that blocks the path of the ball from start to finish. It could be placing a book in between the start and the finish, or it could be designing a hole that curves around a wall.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/mgchallenge
then follow steps 1-5 on the following page.

CHALLENGE #5: MINI GOLF COURSE (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Design and build a mini golf course using items you have around your home. Plan at least one hole that uses a "bank shot" to get to the cup.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make your golf club and course. Here are some ideas to get you started. You can use a paper towel or gift wrap tube for the shaft of the golf club, and tape cardboard from a cereal box or a folded paper plate to one end as the head of the club.

The most fun mini golf courses have obstacles. What creative things can you use as obstacles in your golf course? Toys, books, and furniture legs make good obstacles. Remember to try to bank the ball off of a wall or book to use the **LAW OF REFLECTION**.

STEP 3. PLAN POSSIBLE SOLUTIONS

Plan how you want to make the golf club. Plan how and where you are going to set up your golf course. Decide where each hole starts, where the ending cup will be placed, and what obstacles will be placed in between.

STEP 4. CREATE YOUR MINI GOLF COURSE

1. Fold a paper plate or cardboard around one end of the tube and tape the ends together to make the head of the golf club. Tape the head to the tube so that it will hold together.
2. Set up your golf course so that each hold has a beginning, obstacles, and a cup. Try to bank the ball off of something to see the law of reflection in action.
3. Challenge your family to try to get the ball to the end cup at each hole in as few hits as possible.

STEP 5. IMPROVE YOUR DESIGN

Do you need to change anything to make your golf club or golf course better or more challenging? You can go back to Step 1, and start the process again to make the changes to improve your golf course.

CHALLENGE #5: MINI GOLF COURSE

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: **https://go.umd.edu/mgsolution**

Did your final mini golf course look exactly like the **PLAN** you created? Why or why not?

How did understanding the **LAW OF REFLECTION** help you design and play your game?

What effect did challenging your family members to play your mini golf course have on how you felt about it?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

If you have played mini golf before, how was your game similar or different to it?

Now that you have successfully created a mini golf course, what other games could you recreate with household materials? Could you develop a new game to challenge your family members?

REFERENCES:

D'Augustino, T. D. (2016, March 16). *4-H family engineering night engages youth in science*. Michigan State University. **https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science**

Finio, B. (n.d.). *Mini golf physics.* Science buddies. **https://www.sciencebuddies.org/stem-activities/mini-golf-physics**

CHALLENGE # 6: MOBILE (EXPLORATORY)

YOUTH WILL BUILD A MOBILE THAT BALANCES

MATERIALS: Construction paper, thread, fishing line, string, skewers, sticks, straws and tape.

VOCABULARY: **LEVER:** A rod with a fixed point, called a fulcrum. **LEVERS** can be used to change the direction and the amount of a force. The shapes of your mobile will be attached to a **LEVER**. If the two shapes are exactly the same, they will balance. However, if your shapes are different sizes, you will have to adjust the location of the fulcrum to make it balance. If you move the fulcrum closer to the larger object, it reduces the force of the larger object.

LIFE SKILLS

4-H LIFE SKILL: **PROBLEM SOLVING:** Building a mobile that balances will be difficult. You will need to **PROBLEM SOLVE** to balance your mobile as you continue to add more objects.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: https://go.umd.edu/mchallenge

CHALLENGE #6: MOBILE (GUIDED)
YOUTH WILL BUILD A MOBILE THAT BALANCES

MATERIALS: 5 pieces of construction paper, string, 6 skewers and clear tape.

VOCABULARY: **LEVER:** A rod with a fixed point, called a fulcrum. **LEVERS** can be used to change the direction and the amount of a force. The shapes of your mobile will be attached to a **LEVER**. If the two shapes are exactly the same, they will balance. However, if your shapes are different sizes, you will have to adjust the location of the fulcrum to make it balance. If you move the fulcrum closer to the larger object, it reduces the force of the larger object.

LIFE SKILLS

4-H LIFE SKILL: **PROBLEM SOLVING:** Building a mobile that balances will be difficult. You will need to problem solve to balance your mobile as you continue to add more objects.

DO: YOUTH COMPLETE THE ACTIVITY

Watch the challenge: **https://go.umd.edu/mchallenge**

then follow steps 1-5 on the following page.

CHALLENGE #6: MOBILE (GUIDED STEPS ONE THROUGH FIVE)

STEP 1. IDENTIFY THE PROBLEM

Design and build a mobile as a decoration for your home that balances all of the **LEVERS** used.

STEP 2. IMAGINE SOLUTIONS

Think about all of the possible ways you can make a mobile. Decide on a theme for your mobile such as interesting shapes, colors, or pictures. How many **LEVERS** would you like to use?

STEP 3. PLAN POSSIBLE SOLUTIONS

Plan how you want to make your mobile. Sketch your design to show where your **LEVERS** and fulcrums will be and where you will attach your construction paper shapes.

STEP 4. CREATE YOUR MOBILE AND TEST IT

1. Cut lengths of string to match your design.
2. Cut shapes out of construction paper. Begin with two shapes. Use a small piece of tape to attach the string to the shape.
3. Tie the other end of the string to either end of a rod. There should be one shape attached to each side of the rod. Tie another string to the middle of the rod as a hanger. You have created a **LEVER.**
4. The place where the hanger string attaches to the rod is the fulcrum. Slide the fulcrum toward the larger shape until it balances. Use a small piece of tape to secure the locations of the fulcrum and shapes once they are balanced.
5. Continue making balanced **LEVERS**, and then attach them to the other **LEVERS** and rebalance them to build a multi-layer mobile.

STEP 5. IMPROVE YOUR DESIGN

Do you need to change anything to make your mobile balance? Can you add any other interesting features?

CHALLENGE #6: MOBILE

REFLECT: GUIDE YOUTH THROUGH THE REFLECTION PROCESS

See a solution here: **https://go.umd.edu/msolution**

Was balancing the **LEVERS** harder or easier than you predicted it to be?

What was the most difficult part of creating a mobile? How did you use **PROBLEM SOLVING** to overcome it?

APPLY: CHALLENGE THE YOUTH TO APPLY WHAT THEY'VE LEARNED TO OTHER PARTS OF THEIR LIVES

What are other examples of **LEVERS** in our world?

Think of another project you've done that incorporated art and science.

REFERENCES:

D'Augustino, T. D. (2016, March 16). *4-H family engineering night engages youth in science*. Michigan State University. **https://www.canr.msu.edu/news/4_h_family_engineering_night_engages_youth_in_science**

Lohner, S. (n.d.). *Balance the forces within a mobile.* Science buddies. **https://www.sciencebuddies.org/stem-activities/mobile**