Joseph Candler, Jr. Memorial Foundation
STEM Activity Pack

Fun, hands-on projects that spark curiosity and confidence in science, math, and technology.

Who it's for

K–12 (with grade-band tips). Designed for families, after-school programs, youth groups, and classrooms.

Goals

- Build confidence through doing (design → test → improve).

- Make math and science practical, playful, and relevant.

- Highlight career pathways in STEM—especially for girls and underrepresented students.

- Practice data collection, teamwork, and communication.

How to use this pack

- Run as a 60–90 minute event (pick 3–4 activities) or a 4-week series (1–2 per session).

- Set up **stations** with clear instruction sheets and materials in bins.

- Encourage the **engineering cycle**: Plan → Build → Test → Improve → Share.

Safety and inclusion

- Use child-safe scissors; adult supervision for any heat source (noted below).

- Offer visual instructions and sentence starters ("I notice…", "I wonder…").

- Provide seated and standing options; invite multiple ways to show learning (drawing, speaking, building).

Master Materials (low-cost)

Always useful: paper, index cards, pencils, markers, masking tape, scissors, rulers, plastic cups, craft sticks, rubber bands, straws, paper clips, aluminum foil, string, binder clips, pennies/washers, balloons, glue, zip bags, food coloring, baking soda and vinegar (or Alka-Seltzer), vegetable oil, dish soap, cardboard (pizza boxes), clear plastic wrap, aluminum foil, thermometers (optional), graph paper.

Activity 1 — Straw Rocket Launch (Engineering + Math)

Time: 25–35 min | **Best for:** Grades 2–8
Materials (per team): paper, tape, scissors, ruler, straw (or fat straw + thin straw), target on floor.

Steps

1. Roll paper around a straw to make a snug rocket body; tape.

2. Pinch/tape one end closed (nose cone); add 2–3 fins.

3. Place on launch straw and **blow**; measure distance; repeat 3 trials.

What's happening: Aerodynamics, force, and drag.
Math tie-in: Make a data table of distances; compute average; graph design vs. distance.
Try this: Change fin size or nose cone shape; compare 30° vs 45° vs 60° launch angles.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 2 — Foil Penny Boats (Buoyancy)

Time: 20–30 min | **Best for:** Grades 2–8
Materials: small tub of water, aluminum foil squares, pennies, paper towels.

Steps

1. Build a boat from one foil sheet.

2. Float and add pennies one by one; record the **max load**.

3. Redesign to improve capacity.

Concept: Buoyant force vs. weight; surface area and stability.
Math: Record loads, find mean/median; bar chart of Version 1 vs. Version 2.
Tip: Wide, flat hulls hold more than tight balls.

Teacher's/Presenter's Notes:

Activity 3 — Spaghetti Bridges (Structures)

Time: 40–60 min | **Best for:** Grades 4–12
Materials: dry spaghetti (or craft sticks), tape/hot glue (with adult), string, cup, pennies.

Steps

1. Research triangle strength; sketch design.

2. Build a bridge spanning 25–35 cm.

3. Hang cup from center; add pennies until failure; record load.

Concept: Tension/compression; triangles distribute force.
Math: Strength-to-mass ratio; graph load vs. design type.
Try this: Truss vs. arch; allow only tape for added challenge.

Teacher's/Presenter's Notes:

Joseph Candler, Jr. Memorial Foundation

Activity 4 — Balloon-Powered Cars (Newton's Third Law)

Time: 35–45 min | **Best for:** Grades 3–9
Materials: balloon, straws, bottle caps (wheels), skewers/toothpicks, tape, cardboard chassis.

Steps

1. Build a simple car chassis with wheels that spin freely.

2. Tape balloon to a straw; inflate and pinch; release to propel.

3. Measure distance; iterate.

Concept: Action–reaction, friction, mass.
Math: Distance vs. balloon size; time and speed (distance ÷ time).
Fix it: If wheels wobble, add spacers (beads or straws).

Teacher's/Presenter's Notes:⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Activity 5 — Kitchen Chemistry: Invisible Ink

Time: 20–30 min (+ drying) | **Best for:** Grades 3–8
Materials: lemon juice or baking soda solution, cotton swabs, white paper; **reveal with** warm lamp/hair dryer/iron (adult only) or grape juice (acid-base indicator).

Steps

1. Write message with lemon juice; dry.
   2A) **Heat method (adult):** Gently warm to reveal brown text.
   2B) **Indicator method:** Paint over with purple grape juice; letters change color.

Concept: Oxidation (browning) or acid–base reactions.
Safety: Adult handles heat; keep paper moving to avoid scorching.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 6 — DIY Lava Lamp (Density and Gas)

Time: 15–20 min | **Best for:** Grades K–8
Materials: clear bottle, ¾ cup oil, ¼ cup water + food coloring, Alka-Seltzer (or baking soda + vinegar in a bag to bubble CO_2).

Steps

1. Add colored water, then oil.

2. Drop quarter tablet; observe blobs moving.

Concept: Oil/water density + gas lifts droplets; they sink when gas escapes.
Extension: Time different tablet sizes; plot bubble duration.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 7 — Solar Oven S'mores (Energy)

Time: 40–60 min (sunny day) | **Best for:** Grades 3–9
Materials: pizza box, foil, black paper, plastic wrap, tape, skewers for prop, thermometer (optional), s'mores fixings.

Steps

1. Cut a flap in lid; line flap with foil; line box base with black paper; seal window with plastic wrap.

2. Angle flap to reflect sunlight inside; place food; measure temp every 5–10 min.

Concept: Greenhouse effect, reflection, absorption.
Math: Temperature vs. time graph; calculate rate of change.
Safety: Food safety and clean surfaces; hand-sanitizer station.

Teacher's/Presenter's Notes:

Joseph Candler, Jr. Memorial Foundation

Activity 8 — Binary Bracelets (CS + Math)

Time: 25–35 min | **Best for:** Grades 3–9
Materials: beads in two colors, string, simple binary chart (A–Z = 1–26 then to binary) or 5-bit code.

Steps

1. Convert initials to binary (e.g., A=00001).

2. Thread beads (one color=0, other=1) to encode.

Concept: Information is stored as 0/1; patterns matter.
Extension: Encode a secret word; try error-checking (add a parity bead).

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 9 — Math Art Tessellations (Geometry)

Time: 30–45 min | **Best for:** Grades 2–8
Materials: index cards, scissors, tape, colored pencils.

Steps

1. Cut a small shape from one side of card; tape onto opposite side (translation).

2. Trace tile repeatedly to cover paper; color patterns.

Concept: Transformations (translation/rotation), symmetry, area/tiling.
Extension: Explore rotations for more advanced designs.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 10 — Data Detective Nature Count (Stats)

Time: 25–40 min | **Best for:** Grades 3–12
Materials: clipboard, data sheet, timer, colored pencils.

Steps

1. Choose a small outdoor area (or window).

2. For 10 minutes, tally birds, insects, plants, colors, or sounds.

3. Make a bar chart or pictograph; discuss patterns.

Concept: Sampling, categories, variability, visualization.
Extension: Repeat weekly; compare habitats; compute mean/median/mode.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 11 — Straw Pan Flute (Sound Waves)

Time: 20–30 min | **Best for:** Grades 2–8
Materials: straws, tape, scissors, ruler.

Steps

1. Cut straws to different lengths (e.g., 14 cm to 7 cm in 1 cm steps).

2. Tape together; blow across tops; order by pitch.

Concept: Shorter air columns → higher frequency (pitch).
Math: Plot length vs. pitch order; discuss inverse relationships.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Activity 12 — Intro Coding: Animate a Name (Scratch or MakeCode)

Time: 30–60 min | **Best for:** Grades 3–9
Materials: Laptop/tablet; Scratch (online or app) or MakeCode.

Steps (Scratch example)

1. Create a new project; add **Letter** sprites.

2. For each letter: **when green flag clicked → play sound → change color → move**.

3. Add **when key pressed** events to trigger animations.

Concept: Events, sequences, loops; computational thinking.
Extension: Add a timer, score, or interactions; discuss careers in coding.

Teacher's/Presenter's Notes:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Simple Data Sheets (copy/paste to print)

A. Distance/Data Table (Rockets/Cars)

Trial	Design Notes	Distance (cm)
1		
2		
3		
Average: _____ cm		

B. Nature Count Tally

Category	Tally	Total
Birds		
Insects		
Plants/Flowers		
Sounds		

C. Reflection Prompts

- What did we try? What changed between versions?

- What evidence shows improvement?

- What would we try next with more time?

Volunteer roles (quick script)

- **Greeter:** "Welcome! Pick any station. Start by reading the card, then jump in—we'll circulate to help."

- **Coach:** Ask open questions ("What do you notice?", "How might we test that?") instead of giving answers.

- **Timer/Data Helper:** Keeps stations moving; helps with measuring, graphing, and cleanup.

Budgeting for 24 students (rough)

- General consumables (tape, scissors, markers, cups, straws, sticks, foil, balloons, pennies, oil, food coloring): **$45–$75**

- Optional thermometers, extra kits: **$15–$25**
  Tip: Ask local grocers or hardware stores for donations; reuse bins and rulers.

Accessibility and equity tips

- Offer **picture-based** instructions and bilingual labels if needed.

- Provide **pre-cut** materials for fine-motor challenges.

- Celebrate **process** over product; highlight diverse STEM role models.

- Invite girls to lead demos; form mixed teams with rotating roles (Designer, Builder, Tester, Recorder).

Family extensions at home

- Try **"10-Minute Tinker Time"** after dinner twice a week.

- Keep a **STEM drawer** (recyclables + tape + string).

- Read a short article or watch a kid-friendly STEM clip, then ask: "What's one thing this makes you curious about?"

Station Card (Straw Rocket Launch)

STATION: STRAW ROCKET LAUNCH

- **Materials (per student/team):** 1 straw, paper, tape, scissors, ruler, target.

- **Steps:**

    1. Wrap paper around straw, tape, and make a nose cone.

    2. Add fins for stability.

    3. Place rocket on straw launcher. Blow and launch!

    4. Record distance (3 trials).

- **STEM Concept:** Force + aerodynamics.

- **Think About:**

    o What changes when you adjust the fins?

    o Which angle launches farthest?

- **Challenge:** Try a new design and compare.

Sample Printable Data Sheet (Rocket Distance)

Rocket Launch Data Table

Trial	Distance (cm)	Notes (Design)
1		
2		
3		

Average Distance: _____

STATION: STRAW ROCKET LAUNCH

Reflection Questions:

- Which design flew farthest?_____

  _____

  _____

  _____

- What would you change next time?_____

  _____

  _____

  _____

- Did teamwork help your results?_____

  _____

  _____

  _____

Other Data Sheet Templates

Foil Boats Load Test

Boat Version	Max Pennies Held	Notes
1		
2		

Balloon Car Speed Test

Trial	Distance (cm)	Time (sec)	Speed (cm/sec)

Nature Count Tally

Category	Tally	Total
Birds		
Insects		
Flowers/Plants		
Sounds		