

STEM Challenges Pack

MJK Educators | Hands-on learning for Kenyan homes, for every curriculum

Science, Technology, Engineering and Mathematics, explored through hands-on challenges using everyday materials. Most materials can be found at home, in a local duka or outdoors. Challenges work with the Kenyan Competency Based Curriculum (CBC), IGCSE / Cambridge, the IB (PYP, MYP and DP) and other programmes.

What's inside: 15 challenges across four categories: Building & Engineering, Kitchen Science, Maths in Action, and Technology & Coding (Unplugged).

Age Bands

- **Early (ages 4 to 7):** roughly CBC Pre-Primary and Lower Primary, IB PYP early years
- **Middle (ages 8 to 12):** roughly CBC Upper Primary, IB PYP, Cambridge Primary
- **Older (ages 13 to 18):** roughly CBC Junior and Senior School, IB MYP and DP, Cambridge Lower Secondary and IGCSE

Curriculum Links

Each activity has a short note showing where it fits. These are guides, not official alignments. Check your syllabus or scheme of work for exact outcomes.

- **CBC:** competencies such as critical thinking, creativity, communication, collaboration, digital literacy, self-efficacy, citizenship and learning to learn
- **IGCSE / Cambridge:** assessment objectives such as knowledge, application, analysis and practical skills
- **IB:** approaches to learning (thinking, research, communication, social, self-management) and inquiry cycles

Safety: Always supervise. Keep sharp tools, hot water, fire and chemicals away from young children. Wear goggles for experiments where splashing is possible. Never taste experiment materials. Marbles and small parts are choking hazards for children under 3, so keep them away from younger siblings.

Record it: Take photos, keep work samples and note what your child learned. These make useful portfolio entries (see our Record Keeping Template).

How to Use This Pack

The engineering design cycle is a repeatable framework for every challenge:

1. **Ask:** What problem are we solving?
2. **Imagine:** Sketch at least three ideas.
3. **Plan:** Choose one and list materials and steps.
4. **Build:** Make a first version.
5. **Test:** Measure and record results.
6. **Improve:** Change one thing at a time and retest.
7. **Share:** Explain what worked and why.

Curriculum links: CBC problem solving and creativity; IGCSE planning and evaluating investigations; IB MYP design cycle and DP internal assessments.

	For CBC families	For IGCSE / IB families	For faith-based families
Why use it	Links to Science & Technology, Mathematics and core competencies	Builds inquiry, design thinking and practical skills for coursework	Opportunities to explore creation, stewardship and wonder
Evidence	Portfolio: photos, write-ups, observation notes	Lab-style reports and design journals	Nature journaling and reflection

Category A: Building & Engineering Challenges

Challenge 1: The Tallest Tower

Ages: Early to Older (4–18) | **Time:** 30–45 minutes | **Materials:** Newspaper, tape, scissors

THE ACTIVITY

Build the tallest free-standing tower you can using only newspaper and tape. It must stand for 60 seconds without support.

ADAPTATIONS

- **Early (4–7):** Build together; focus on “tall” and “standing”
- **Middle (8–12):** Measure height; try to beat your own record
- **Older (13–18):** Add a budget (e.g. 20 sheets of paper maximum); calculate cost per cm

WHAT TO OBSERVE

- Problem-solving strategies
- Iteration and improvement
- Understanding of balance and stability

CURRICULUM LINKS

- CBC: Science & Technology (structures), Mathematics (measurement)
- IGCSE: Physics (forces, stability), Design & Technology
- IB: Approaches to Learning (thinking skills), Design cycle
- Faith-based: Stewardship of materials, patience

Extension: Write a design journal entry: what worked, what failed, what you would change.

Challenge 2: Bridge Builders

Ages: Middle to Older (8–18) | **Time:** 45–60 minutes | **Materials:** Straws, paper clips, tape, small weights (coins, stones)

THE ACTIVITY

Build a bridge that spans a 30 cm gap and holds as much weight as possible.

ADAPTATIONS

- **Middle (8–12):** Focus on holding any weight
- **Older (13–18):** Test to failure; graph weight against design features

WHAT TO OBSERVE

- Understanding of triangles and strength
- Testing and fair comparison
- Data recording

CURRICULUM LINKS

- CBC: Science & Technology (structures), Mathematics (measurement, data)
- IGCSE: Physics (forces), Maths (data handling)
- IB: Design, inquiry

Challenge 3: Water Filtration

Ages: Middle to Older (8–18) | **Time:** 45–60 minutes | **Materials:** Plastic bottle, sand, gravel, charcoal, cotton, muddy water

THE ACTIVITY

Design a water filter that turns muddy water clear. Cut the bottle in half (adult task), turn the top upside down as a funnel, and layer the materials inside. Compare the water before and after.

CURRICULUM LINKS

- CBC: Science & Technology (water), Social Studies (water access)
- IGCSE: Chemistry (separation techniques), Biology (water and health)
- IB: Global contexts (sustainability)
- Faith-based: Stewardship, service

Safety note: Filtered water is NOT safe to drink. Clear water can still carry germs. This is a demonstration only.

Extension: Research water treatment in Kenya. Visit a local water point if possible.

Challenge 4: Marble Run

Ages: Early to Middle (4–12) | **Time:** 30–45 minutes | **Materials:** Cardboard tubes, tape, marbles

THE ACTIVITY

Build a marble run that takes at least 10 seconds for the marble to reach the bottom.

WHAT TO OBSERVE

- Understanding of gravity and slope
- Problem-solving when the marble falls off
- Creativity in design

CURRICULUM LINKS

- CBC: Science & Technology (forces, motion), Mathematics (time, measurement)
- IGCSE: Physics (gravity, friction)

Challenge 5: Earthquake-Proof Building

Ages: Middle to Older (8–18) | **Time:** 45–60 minutes | **Materials:** Toothpicks, marshmallows, a tray to shake

THE ACTIVITY

Build a structure that survives a simulated earthquake (shaking the tray for 10 seconds). Try adding cross-braces and a wider base, then retest.

CURRICULUM LINKS

- CBC: Science & Technology (structures), Social Studies (disaster preparedness)
- IGCSE: Physics (forces), Geography (natural hazards)
- IB: Global contexts (sustainability, disaster risk)

Category B: Kitchen Science

Challenge 6: Baking Soda & Vinegar Reactions

Ages: Early to Middle (4–10) | **Time:** 20–30 minutes | **Materials:** Baking soda, vinegar, containers, food colouring (optional)

THE ACTIVITY

Explore chemical reactions. How much gas can you produce? Can you inflate a balloon with the reaction? Work outdoors or on a tray, as it gets messy.

WHAT TO OBSERVE

- Prediction and observation
- Understanding of cause and effect
- Vocabulary: reaction, gas, acid, base

CURRICULUM LINKS

- CBC: Science & Technology (matter, reactions)
- IGCSE: Chemistry (acids and bases, gases)

Challenge 7: Density Tower

Ages: Middle (8–14) | **Time:** 30 minutes | **Materials:** Honey, golden syrup, water, oil, food colouring, tall jar

THE ACTIVITY

Layer liquids of different densities. Predict the order before you pour. Pour slowly down the side of the jar, heaviest liquid first.

CURRICULUM LINKS

- CBC: Science & Technology (matter, density)
- IGCSE: Chemistry (density, separation)

Extension: Drop small objects in and see where they settle.

Challenge 8: Invisible Ink

Ages: Middle (7–12) | **Time:** 20–30 minutes | **Materials:** Lemon juice, cotton buds, paper, heat source (lamp or iron, adult supervision)

THE ACTIVITY

Write a secret message that only appears when heated. Let the paper dry fully, then warm it gently. An adult should handle the heat source.

CURRICULUM LINKS

- CBC: Science & Technology (chemical changes)
- IGCSE: Chemistry (oxidation)

Safety: Adult supervision is required for the heat source. Never use an open flame.

Challenge 9: Grow a Crystal

Ages: Middle to Older (8–18) | **Time:** 1–2 weeks | **Materials:** Salt or sugar, water, jar, string, pencil

THE ACTIVITY

Grow the biggest crystal you can over two weeks. Dissolve as much salt or sugar as you can in hot water (adult task), hang a string in the jar and watch.

WHAT TO OBSERVE

- Daily changes
- Effect of temperature and concentration
- Recording data over time

CURRICULUM LINKS

- CBC: Science & Technology (matter, solutions)
- IGCSE: Chemistry (crystallisation, saturation)

Challenge 10: Kitchen pH Testing

Ages: Older (10–18) | **Time:** 30–45 minutes | **Materials:** Red cabbage, hot water, household liquids (lemon juice, soap, milk, vinegar, baking soda solution)

THE ACTIVITY

Make a natural pH indicator by soaking chopped red cabbage in hot water (adult task), then test household liquids and sort them from acid to alkaline by colour.

CURRICULUM LINKS

- CBC: Science & Technology (acids and bases)
- IGCSE: Chemistry (pH, indicators)

Safety: Do not taste any of the test liquids, and do not mix household cleaners together.

Category C: Maths in Action

Challenge 11: Kitchen Measurement Maths

Ages: Early to Middle (4–12) | **Time:** 30–60 minutes | **Materials:** Measuring cups, recipe, ingredients

THE ACTIVITY

Double or halve a recipe using fractions, then cook and taste the result.

WHAT TO OBSERVE

- Understanding of fractions
- Practical application
- Accuracy and precision

CURRICULUM LINKS

- CBC: Mathematics (fractions, measurement)
- IGCSE: Maths (ratio, proportion)

Challenge 12: Data Hunt

Ages: Middle (8–14) | **Time:** 30–45 minutes | **Materials:** Clipboard, paper, pencil

THE ACTIVITY

Collect data around your home or neighbourhood (e.g. number of cars by colour, types of trees, family water use) and present it in a graph.

CURRICULUM LINKS

- CBC: Mathematics (data handling)
- IGCSE: Maths (statistics)
- IB: Maths (inquiry)

Challenge 13: Budget Builder

Ages: Older (10–18) | **Time:** 45–60 minutes | **Materials:** Supermarket flyers or shelf prices, calculator, paper

THE ACTIVITY

Plan a family meal for a set budget in Kenya shillings. Compare prices, calculate totals and find savings.

CURRICULUM LINKS

- CBC: Mathematics (money, operations)
- IGCSE: Maths (number, finance)
- Life skills: Financial literacy

Category D: Technology & Coding (Unplugged)

Challenge 14: Algorithm Adventures

Ages: Early to Middle (6–12) | **Time:** 20–30 minutes | **Materials:** Paper, pencil

THE ACTIVITY

Write step-by-step instructions (an algorithm) for a simple task: making a sandwich, brushing teeth, walking to the shop. Swap with a family member and follow the steps exactly.

CURRICULUM LINKS

- CBC: Science & Technology (computational thinking)
- IGCSE: Computer Science (algorithms)
- IB: Thinking skills

Challenge 15: Binary Code Names

Ages: Middle to Older (8–18) | **Time:** 30 minutes | **Materials:** Paper, pencil, beads and string (optional)

THE ACTIVITY

Write your name in binary code. Make a bracelet or keychain with two bead colours representing the code.

CURRICULUM LINKS

- CBC: Science & Technology (digital literacy)
- IGCSE: Computer Science (data representation)

STEM Portfolio Evidence Checklist

- Photos of builds and experiments
- Design journals or write-ups
- Data tables and graphs
- Predictions and observations
- Reflections: what worked, what didn't, what's next

Bringing It All Together

Cross-Curricular Project Examples

1. Our Compound Ecosystem (4 weeks)

A nature study (science), a measured map (maths), a field journal (English), an art piece based on your findings (art) and a presentation to family.

2. Clean Water Challenge (3 weeks)

Build a filter (STEM), research water sources in your county (geography), design a poster (art) and write a letter to a local leader (civics, English).

3. Mini Duka Enterprise (4 weeks)

Design a product (design), cost and price it (maths), make packaging (art), sell at a community event and reflect on profit (business and financial literacy).

Mapping Activities to Different Curricula

If you follow	Use these activities for	Evidence to keep
CBC	Competency development and community service learning	Learner portfolio, observation notes, projects
IGCSE / Cambridge	Practical skills, coursework preparation, fieldwork and investigations	Lab reports, sketchbooks, data tables
IB (PYP, MYP, DP)	Inquiry units, service, design cycle, internal assessment practice	Process journals, reflections, project logs
Other or blended	Skills practice and enrichment	Work samples and reflections

Tips for Parents

- Start small: one challenge, craft or outdoor trip a week is enough.
- Let children choose some projects. Ownership increases motivation.
- Ask open questions: what do you notice, what do you think will happen, why?
- Celebrate mistakes as part of the learning process.
- Mix ages: older children can mentor younger ones.
- Link activities to goals in your learning plan so they count as real learning, not just fun.
- Join other homeschool families for group projects, which also builds social skills.

MJK Educators provides these ideas for general educational use. Always supervise children, assess risks before each activity, and adapt to your child's age, ability and needs. Curriculum links are guides, not official alignments: check your syllabus or scheme of work for exact outcomes.