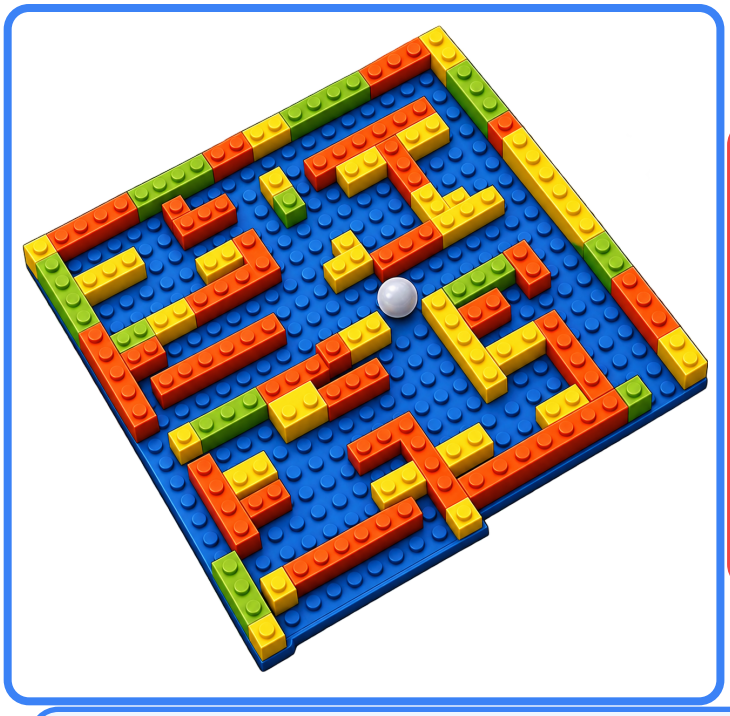
STEM ACTIVITY

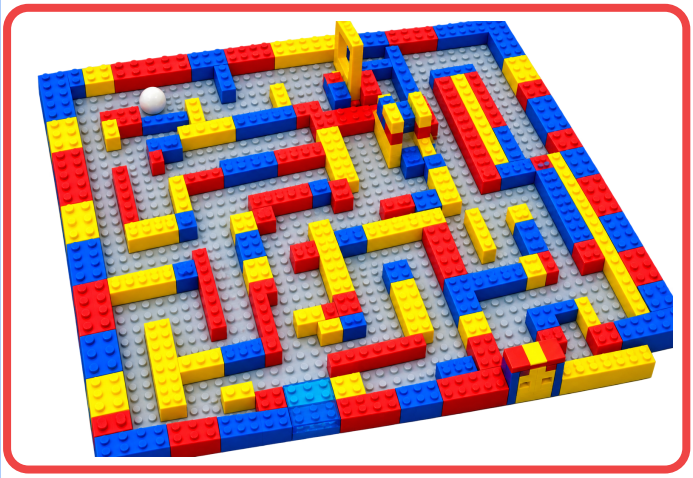
* MARBLE MAZE *

BUILDING ACTIVITY

Design - Build - Test - Improve!

Engineering Design Challenge - Free from MySchoolHero.com





YOUR MISSION:

Be an engineer! Use building bricks to design and build a marble maze with walls, dead ends, and one winning path from START to FINISH. Then test it with a marble - can a friend solve your maze?

You will need: building bricks - a baseplate - one marble - your imagination!

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STEM Lesson: Build a Marble Maze Using LEGOs

"Mission Marble Maze: Design, Build & Test" — with Abstract Concepts / Universal Themes

Grade Level: 3–5

Time Needed: 2–3 class periods (45–60 minutes each)

Standards Alignment

CCSS Mathematics

- **CCSS.MATH.CONTENT.3.MD.B.4** — Measure lengths using rulers marked with halves and fourths of an inch (measuring marble path widths in Team Planning)
- **CCSS.MATH.PRACTICE.MP1** — Make sense of problems and persevere in solving them (test-and-improve cycle)
- **CCSS.MATH.PRACTICE.MP5** — Use appropriate tools strategically (rulers for path width, timers for trials)

CCSS English Language Arts

- **CCSS.ELA-LITERACY.SL.3.1 / SL.4.1 / SL.5.1** — Engage effectively in collaborative discussions (team planning, testing, and problem-solving)
- **CCSS.ELA-LITERACY.W.3.2 / W.4.2 / W.5.2** — Write informative/explanatory texts (reflection journals; Writing Extension: instructions for solving the maze)

NGSS (Science & Engineering)

- **3-PS2-1** — Investigate the effects of balanced and unbalanced forces on the motion of an object
- **3-PS2-2** — Observe and measure an object's motion to predict future motion (marble behavior patterns)
- **3-5-ETS1-1** — Define a simple design problem reflecting a need, including criteria and constraints (design challenge rules)
- **3-5-ETS1-2** — Generate and compare multiple possible solutions based on how well each meets the criteria (team planning)
- **3-5-ETS1-3** — Plan and carry out fair tests, identifying aspects of a model that can be improved (test, observe, improve)

Abstract Concepts / Universal Themes in This Lesson

Each section below is tagged with the icon that matches the thinking students are doing. Use the prompts in the gold boxes as discussion questions or journal stems.

Icon	Dimension	Where it appears
	**Big Idea**	Learning Intentions — gravity and force govern how the marble moves
	**Unanswered Questions**	Essential Questions & test predictions
	**Language of the Discipline**	Background Knowledge — engineering vocabulary
	**Rules**	Design Challenge requirements
	**Details**	Team Planning — labeled maze drawings
	**Patterns**	Test & Observe — how the marble behaves on each run
	**Over Time**	Improve the Design — how the build changes across versions
	**Multiple Perspectives**	STEM Showcase — peer testing and feedback
	**Across Disciplines**	Extensions — math measurement and writing

Universal Generalizations

These abstract concepts fit this lesson best. Post one as the unit generalization and have students collect evidence from their maze builds to prove or disprove it.

FORCE — "Force influences or changes."

- Gravity and pushes set the marble in motion; walls and friction counter it. Students see that a force may be countered with an equal or greater force every time the marble hits a wall or slows on the baseplate.

STRUCTURES — "Structures are only as strong as their parts."

- The maze is a person-made structure whose parts (walls, paths, traps) go together and help one another. One loose brick and the whole maze fails the test — perfect evidence for this generalization.

CHANGE — "Change is necessary for growth."

- The test-and-improve cycle is change in action: every redesign between Version 1 and Version 2 shows that change can be good or bad — and students must decide which changes to keep.

EXPLORATION — "Exploration requires taking risks."

- Testing a maze confronts the unknown: will the marble make it? Trials may result in new findings or confirm old ones, and teams need leadership to decide what to try next.

Learning Intentions / "I Can" Statements

Big Idea: *Forces like gravity and friction control how objects move through a designed path. Engineers use this big idea to predict and improve motion.*

- I can plan and design a marble maze using LEGOs that includes a clear start, finish, dead ends, and traps.
- I can test and improve my design based on how the marble moves through the maze.
- I can collaborate with my team to solve engineering problems creatively.
- I can explain how force, motion, and gravity affect the path of the marble in my maze.

Essential Questions

Unanswered Questions: *Before we build: What do we still not know about how our marble will behave? What questions can only be answered by testing?*

1. What makes a marble maze challenging and fun?
2. How do gravity and force affect how a marble moves through a maze?
3. How can we use the engineering design process to build and improve a marble maze?
4. How do dead ends and traps affect problem-solving and strategy?

Background Knowledge (Mini-lesson Concepts)

Language of the Discipline: *Talk like an engineer! Use the words force, motion, gravity, friction, prototype, dead end, and trap when you plan, test, and explain your maze.*

Before the build, teach or review:

- What is **force** and **motion**?
- How does **gravity** influence objects in motion?
- What is a **maze** (start, finish, dead ends, paths, traps)?
- Introduction to the **engineering design process** (Ask → Imagine → Plan → Create → Test → Improve)

Materials Needed

- LEGO bricks (various sizes and shapes)
- Base plates (large enough for a marble-sized maze)
- Marbles or small balls
- Rulers (for measuring walls or paths)
- Paper/pencil or STEM journals
- Timer (optional, for time challenges)
- Markers/sticky notes (for labeling start/finish)

Procedure

Day 1: Explore & Plan

1. Engage (10 min)

- Show a simple video or image of a marble maze.
- Ask students: What makes a maze hard or easy? How does a marble move through it?

2. Design Challenge Introduction (5 min)

Rules: *Every maze must follow the same rules. Why do engineers work within requirements? What happens to the challenge if a rule is broken?*

- "Your challenge is to design and build a LEGO marble maze that includes:
  - A clear **start** and **finish**
  - At least **2 dead ends**
  - At least **1 trap** (e.g., a false path, drop zone, or obstacle)
  - A **path wide enough** for a marble to roll through."

3. Team Planning (25 min)

Details: *A good blueprint has details! Label every part of your drawing — start, finish, each dead end, the trap, and path widths in centimeters.*

- In small teams (2–3), students draw and label their maze design on paper.
- Use rulers to estimate the width for marble paths.
- Identify where dead ends and traps will go.

Day 2: Build & Test

1. Build (30 min)

- Students construct their maze using LEGOs.
- Place clear labels for Start and Finish.
- Make sure the marble fits and can roll freely.

2. Test & Observe (15 min)

Patterns: *Watch several runs. What patterns do you notice in where the marble speeds up, slows down, or gets stuck? Does it behave the same way every time?*

- Teams test their maze and record:
  - Does the marble reach the finish?
  - Does it get stuck?
  - Do the traps and dead ends work?

Day 3: Improve & Share (Optional)

1. Improve the Design (20–30 min)

Over Time: *Compare Version 1 to Version 2. How has your maze changed over time? What did each round of testing teach you?*

- Based on test results, students make improvements:
  - Fix traps or paths that don't work

- Add new features or challenges
- Try timing how fast the marble travels

2. STEM Showcase (10–20 min)

> **Multiple Perspectives:** *Trade mazes! How does someone who didn't build your maze experience it? What do they notice that your team missed?*

- Teams demonstrate their mazes to classmates.
- Let others try the mazes and provide feedback.

3. Reflection (Optional exit ticket or journal entry):

- What worked well in your design?
- What did you have to change?
- How did teamwork help in solving problems?

Assessment Ideas

- Team design plan (drawing and labels)
- Functioning marble maze (meets all requirements)
- Observation of collaboration and problem-solving
- Reflection or verbal explanation of design choices

Extensions & Differentiation

> **Across Disciplines:** *Where does maze-building connect to math (measurement, angles, data), writing (instructions), and even game design?*

- **Advanced Challenge**: Create a 2-level maze or moving trap
- **Math Integration**: Measure total path length or angle of ramps
- **Writing Extension**: Write instructions for how to solve your maze

Student Directions

Your Mission: Be an engineer! Design and build a LEGO marble maze that a friend can solve.

1. **PLAN** — With your team, draw your maze on paper. Label the Start, the Finish, your 2 dead ends, and your trap. Use a ruler to make sure every path is wide enough for a marble.
2. **BUILD** — Construct your maze on the baseplate with LEGO bricks. Add labels for Start and Finish.
3. **TEST** — Roll the marble through your maze. Watch closely: Does it reach the finish? Where does it get stuck? Do your dead ends and trap work?
4. **IMPROVE** — Fix what didn't work and make your maze even better. Test again!
5. **SHARE** — Trade mazes with another team. Can they solve yours? Listen to their feedback.

Remember the rules — your maze must have:

- A clear Start and Finish
- At least 2 dead ends
- At least 1 trap (false path, drop zone, or obstacle)
- Paths wide enough for the marble to roll through

Marble Maze Rubric

Score each category. Total possible: 20 points.

Category	4 – Expert Engineer	3 – Skilled Builder	2 – Apprentice	1 – Just Starting
Design Plan	Drawing is neat and fully labeled: start, finish, dead ends, trap, and path widths.	Drawing is labeled with most required parts.	Drawing is missing several labels or required parts.	No plan, or plan does not show the maze.
Maze Requirements	Maze has start, finish, 2+ dead ends, 1+ trap, and paths that fit the marble.	Maze has most requirements; one element missing or not working.	Maze is missing two or more requirements.	Maze does not meet the requirements.
Testing & Improving	Team tested multiple times, recorded results, and made clear improvements.	Team tested and made at least one improvement.	Team tested but made little or no improvement.	Team did not test the maze.
Teamwork	Everyone contributed ideas, shared materials, and solved problems together.	Most members contributed and worked well together.	Some conflict or uneven participation.	Team did not work together.
Explanation	Clearly explains how force, motion, and gravity affect the marble using science vocabulary.	Explains the marble's movement with some science vocabulary.	Explanation is unclear or missing key ideas.	Cannot explain how the maze works.

Total: _____ / 20 **Team Members: _____**