

5.3 Spaghetti and Marshmallow Pyramid Challenge

During the 200-minute STEAM programme, 3rd graders will develop creativity, problem solving, critical thinking, resilience, valuing people, curiosity, a sense of wonder and openness through 7 phases of building spaghetti and marshmallow pyramids. The activity develops these skills while students create models of pyramids and identify points, lines and angles. Teams practice problem solving, as well as evaluating others' ideas and being open to them by designing stable structures within strict quantitative constraints to avoid wasting resources. Through two tests of construction (prototyping, evaluation and improvement), learners strengthen their resilience and flexibility by adjusting their designs in case of structures faltering or breaking. The project concludes with a reflection where students compare their results and use geometric vocabulary to explain their team's success.

Basic Information Sheet

Age group	Student number	Duration	Number of stages	Subjects connection and relevance
3 rd grade (core activity; extensions for Grades 4–5 in “Difficulty level tailoring notes”)	Whole class (max ~30 students)	180–200 minutes (plus optional extension time)	7 stages	Mathematics – Geometry (3D shapes + Euclid-style vocabulary: point/line/parallel/angle)

STEAM Event Summary

The Spaghetti Marshmallow activity is designed to get learners working together to build and test their designs with an emphasis on radical collaboration and bias to action. This STEAM exercise is a great way to push students to build, test, and iterate. This activity also encourages critical thinking by asking students to synthesize what they learned quickly to create new designs. Students must also demonstrate resilience in the face of challenges or frustrations.

SPIRIT Skill Focus

- Problem-solving
- Critical thinking
- Flexibility
- Resilience

Complementary/Secondary SPIRIT Skill(s)

- Valuing people and nature (resource stewardship: limited materials, reuse, waste minimization)

National curriculum Link and Objectives

- Recognize and use geometry vocabulary: point, line/straight line, parallel lines, angle
- Identify and compare solids: triangular pyramid, square pyramid, rectangular pyramid
- Understand that pyramids are named by their base shape
- Apply spatial reasoning and geometric language while building a 3D model
- Collaborate to plan, test, improve, and reflect on a design under constraints

Real-world STEAM Connection and Problem definition

- Connection (student perspective):

Engineers and architects build strong structures with limited materials. They have to look closely at models, plan carefully, test ideas, fix failures, and avoid wasting resources.

- Problem definition (student perspective):

“How can our team use limited spaghetti and marshmallows to build a stable rectangular pyramid with a 4×3 rectangular base that matches the teacher’s model, while using materials wisely and learning to describe what we see with geometry words?”

Materials at a Glance

- Tablets/LMS access (optional in-class replay of videos if needed)
- Exit-ticket printouts (from flipped videos)
- 3 prebuilt rectangular pyramid models (4×3 rectangular base) visible at each table
- Dry spaghetti sticks (limited supply per team)
- Marshmallows (limited supply per team)
- Chart paper and markers (team plan + notes)
- Timer/stopwatch
- Constraint sheet (resource limits + waste minimization prompt)
- Quick observation checklist sheets (points/lines/parallel/angles)

Indoor/Outdoor and Classroom layout

Indoor

- Tables arranged in pods (4–6 students per team)
- One model pyramid per pod (or 3 models distributed across the room)
- Whiteboard/chart area for whole-class question + final reflection
- “Materials station” with pre-measured team packs (to support fairness and stewardship)

Notes on Research-based approach and integration

Students arrive with baseline concept input from short videos (flipped classroom), freeing class time for hands-on investigation, building, and iteration. They begin by observing a real model and identifying geometric features (research), then create and test a prototype under constraints (design), and finally compare results and reflect on both strategies and resource use (connect). The two-trial structure plus peer “snowball” exchange mirrors real engineering cycles: observe → plan → test → learn → improve.

Lesson Flow Overview (linked to details below)

Stage	Title	Brief Description	SPIRIT Skills	Duration	Link to Details
1st	Geometry Warm-Up and Naming Pyramids	Teams combine exit-ticket ideas and answer: “Why are pyramids called triangular/square/rectangular?” using base shape evidence.	• Critical thinking	15 minutes	STAGE 1 – Geometry Warm-Up and Naming Pyramids
2nd	Model Investigation	Students individually inspect the rectangular pyramid model and identify points, lines, parallel lines, and angles using a checklist.	• Critical thinking	20 minutes	STAGE 2 – Model Investigation
3rd	Team Action Plan and Stewardship Rules	Teams share notes, assign roles, and create a build plan that includes material-saving rules	• Problem-solving • Valuing people and nature	20 minutes	STAGE 3 – Team Action Plan and Stewardship Rules
4th	Build Trial 1	Teams build under time and material limits, adapting quickly when pieces break or wobble.	• Resilience • Problem-solving	30 minutes	STAGE 4 – Build Trial 1
5th	Mid-Debrief + Snowball Exchange	Teams evaluate what happened, exchange one tip with another team, and choose one change to try.	• Flexibility • Critical thinking	30 minutes	STAGE 5 – Mid-Debrief + Snowball Exchange
6th	Build Trial 2	Teams rebuild using their chosen change and aim for better stability + less waste.	• Flexibility • Resilience	30 minutes	STAGE 6 – Build Trial 2
7th	Group reflection and Model Comparison	Teams compare to the model, name one geometry insight, one strategy insight, and one stewardship takeaway.	• Critical thinking • Valuing people and nature	30 minutes	STAGE 7 – Group reflection and Model Comparison

Tips and Tricks for dealing with challenges (for the whole STEAM program)

- Normalize failure: “Engineers expect breaks and rebuilds - that’s normal. ”Use the mantra Break → Breathe → Rebuild.
- Use a visible timer with checkpoints (“Half time - check your base!”).
- Encourage reuse: broken spaghetti pieces can become braces/supports.
- If teams get stuck, ask: “What is the smallest change you can test next?”
- Make stewardship visible: each team keeps a “reuse pile” and “waste corner
- Noise/chaos: Use a quick signal (“Scientist hands!”) for freeze + reset.
- Unequal participation: Role cards + rotate roles between Trial 1 and Trial 2.

Difficulty level tailoring notes

A) Grade-level tailoring (content depth)

- Grade 3 (Core):
 - Identify pyramid names by the base shape
 - Find points/lines/parallel lines/angles using a guided checklist
 - Build for stability and match the model “as close as possible”
- Grade 4 (Extension):
 - Count faces/edges/vertices and compare to the model
 - Classify angles more explicitly (right/acute/obtuse) using a reference chart
 - Add a simple “stability score” (stands 10 seconds = success)
- Grade 5 (Extension):
 - Add an “efficiency score” (stable structure + minimal waste)
 - Require claim–evidence reasoning: “We changed X because Y happened.”
 - Explore the scaling question: “What changes if the base becomes 5×4?”

B) Skill-level tailoring (same task, different scaffolds)

- Problem-solving
 - Beginner: Provide a 3-step plan card (Base → Corners → Apex) + role cards. Prompt: “What’s the first smallest step?”
 - Intermediate: Teams write their own plan + choose one stability strategy before building.
 - Advanced: Teams follow the one-change rule between Trial 1 and Trial 2 and explain cause–effect.
- Critical thinking
 - Beginner: “Point-and-name” checklist with visuals (point/line/parallel/angle).
 - Intermediate: Add evidence sentence: “It’s a rectangular pyramid because the base is a rectangle.”
 - Advanced: Compare model vs build using two criteria (accuracy + stability) and justify with evidence.
- Flexibility
 - Beginner: Provide a “Try next” menu (shorten edge / rebuild base / add brace / swap roles).
 - Intermediate: Adopt one peer suggestion from snowball exchange and explain why it fits.
 - Advanced: Evaluate two suggestions, reject one with a reason, implement the best.
- Resilience
 - Beginner: Class mantra: “Break → breathe → rebuild.” Assign a “reset role.”
 - Intermediate: Record one challenge + one coping action (“We felt stuck when... so we...”).
 - Advanced: Frame failure as data: “Trial 1 taught us... so Trial 2 we...”
- Valuing people and nature
 - Beginner: “Reuse once before taking new.” Keep a reuse tray.
 - Intermediate: Quick tally: used / reused / wasted + one improvement goal for Trial 2.
 - Advanced: Efficiency claim: “We improved stability while wasting less because.)

STEAM Program Debriefing and Reflection Questions

- What made your pyramid stronger or weaker?
- What did you do when your plan didn't work the first time?
- How did feedback change your second design?
- What did you do to avoid wasting materials?
- Why does the base shape decide the pyramid's name?

5.3.2. Stage details and Activities Flow

STAGE 1 – Geometry Warm-Up and Naming Pyramids

How does this develop particular SPIRIT skills

- Builds critical thinking by classifying pyramids and justifying answers using base-shape evidence
- Encourages students to select the most accurate explanation based on observation

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Critical thinking: explain that pyramids are named by their base shape and give one example.
- Critical thinking: use at least two geometry words correctly (base, face, point/vertex, edge/line).

Academic/Curriculum Objective connection

- Identifying and naming 3D shapes based on defining features
- Using geometry vocabulary in speech and reasoning.

Materials and tools needed for implementation

- Exit-ticket sheets (from videos)
- Chart paper + markers
- Teacher model pyramid (visible).

Preparation notes

- Prepare a prompt card: “Name comes from the base.”
- Have visuals ready: triangle → triangular, square → square, rectangle → rectangular.

Guided Questions

- “What shape is the base?”
- “If the base is a rectangle, what do we call the pyramid?”
- “Which part decides the name: the faces or the base?”

Stage Debriefing Questions (Optional)

- “How did you use evidence, not guessing, to choose your answer?”

Tips and Tricks for dealing with stage challenges

- **Challenge:** Students confuse base and face.
Tip: Physically point to the bottom and say: “Base = bottom shape. Name comes from base.”
- **Challenge:** Some students stay quiet.
Tip: Use sentence stems: “I think it is ____ because ____.”

STAGE 2 – Individual Model Investigation and Note-Taking

How does this develop particular SPIRIT skills

- Develops critical thinking through careful observation and pattern noticing
- Builds precision by connecting vocabulary (point/line/parallel/angle) to a real object

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Critical thinking: identify one point (vertex) and one line (edge) on the model.
- Critical thinking: find one pair of parallel lines on the base and explain “they don’t meet.”
- Critical thinking: point to one angle and describe it as a “corner where two lines meet.”

Academic/Curriculum Objective connection

- Identify points, lines, parallel lines, and angles in 2D/3D forms
- Strengthen geometry vocabulary through observation.

Materials and tools needed for implementation

- Teacher model pyramid(s)
- Student observation checklist sheets
- Pencils
- Optional: angle/parallel-lines visual reference card.

Preparation notes

- Ensure each student can see a model clearly (one model per pod is ideal).
- Provide clipboards if students move around.

Guided Questions

- “Where is a point (vertex)?”
- “Which spaghetti edge is a straight line?”
- “Can you find two lines on the base that go the same direction?”
- “Where is a corner (angle) on the base?”

Stage Debriefing Questions (Optional)

- “Which geometry word was easiest to find? Which was hardest?”

Tips and Tricks for dealing with stage challenges

- **Challenge** (beginner): Vocabulary feels abstract.
Tip: Use matching language: “Marshmallow = point, spaghetti = line.” Provide picture checklist.
- **Challenge** (advanced): Students finish quickly.
Tip: Add evidence sentence: “It’s rectangular because the base is a rectangle.”

STAGE 3 – Group Brainstorm and Action Plan (with Stewardship Rules)

How does this develop particular SPIRIT skills

- Builds problem-solving by converting observations into a plan with roles and steps
- Develops valuing people and nature by setting resource rules before building.

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Problem-solving: write a step-by-step build plan and assign roles.
- Problem-solving: choose one stability strategy (base first / reinforce corners / add braces).
- Valuing people and nature: agree on two resource rules (reuse pile, measure before snapping, avoid waste).

Academic/Curriculum Objective connection

- Apply planning and reasoning to a 3D construction task
- Connect resource constraints to responsible decision-making.

Materials and tools needed for implementation

- Team plan sheet + role cards
- Chart paper + markers
- Constraint sheet (materials limit + reuse rule).

Preparation notes

- Pre-pack each team's materials in a tray (no refills until after Trial 1 reflection).
- Prepare a "Try-next" menu card for teams that get stuck.

Guided Questions

- "What should we build first: base or top?"
- "How will we make corners strong?"
- "How will we make sure everyone has a job?"
- "What will we do with broken pieces?"

Stage Debriefing Questions (Optional)

- "Does everyone agree on the plan? What is your team's first step?"

Tips and Tricks for dealing with stage challenges

- **Challenge:** Teams argue too long.
Tip: Use a quick vote + choose a leader to finalize the plan in 30 seconds.
- **Challenge:** Teams waste spaghetti early.
Tip: Add "reuse tray" and rule: "Reuse once before taking new."

STAGE 4 – Build Trial 1 (Design and Test)

How does this develop particular SPIRIT skills

- Strengthens resilience by working through breakage and time pressure
- Builds problem-solving through real-time troubleshooting and stability decisions

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Problem-solving: build a first prototype with a recognizable 4×3 rectangular base and attempt an apex.
- Resilience: respond to a challenge by choosing a next step (rebuild/brace/swap role).
- Valuing people and nature: place broken or unused pieces into a reuse pile, not the trash.

Academic/Curriculum Objective connection

- Apply spatial reasoning and geometric accuracy to a hands-on model
- Use geometric language while building (base/edge/vertex).

Materials and tools needed for implementation

- Team spaghetti + marshmallows
- Timer/stopwatch
- Quick build log (Trial 1).

Preparation notes

- Set clear safety/food rules (marshmallows are connectors, not snacks).
- Set time checkpoint reminders (e.g., “Check base at 5 minutes.”).

Guided Questions

- “Is your base flat and rectangular?”
- “Do your corners feel strong?”
- “What is wobbling - and what can you change?”
- “What is the smallest fix you can try first?”

Stage Debriefing Questions (Optional)

- What worked best in Trial 1? What broke first?”

Tips and Tricks for dealing with stage challenges

- **Challenge** (resilience): Students get frustrated when it collapses.
Tip: Use mantra: Break → Breathe → Rebuild and assign a “reset role.”
- **Challenge** (problem-solving): Teams try many fixes at once.
Tip: Teacher prompts: “Try one change, then test again.”

STAGE 5 – Mid-Trial Debrief and Snowball Pairing

How does this develop particular SPIRIT skills

- Develops flexibility by accepting feedback and adjusting direction
- Strengthens critical thinking by selecting the most useful suggestion based on evidence

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Critical thinking: name one cause of failure using evidence (“base uneven,” “weak corners”).
- Flexibility: choose one peer suggestion and explain why it fits their problem.
- Resilience: speak about mistakes as learning (not blame).

Academic/Curriculum Objective connection

- Peer review and improvement cycle (observe → evaluate → revise)
- Use clear reasoning and evidence in discussion.

Materials and tools needed for implementation

- Sticky notes
- Mid-trial reflection prompts sheet.

Preparation notes

- Pre-assign pairing partners so snowball takes 2 minutes, not 10.
- Provide sentence stem for feedback: “Try ___ because ___.”

Guided Questions

- “What is one thing you want to improve?”
- “What suggestion did the other team give you?”
- “Which one change will you test next?”

Stage Debriefing Questions (Optional)

- “Which feedback felt most helpful and why?”

Tips and Tricks for dealing with stage challenges

- **Challenge:** Teams copy feedback without thinking.
- **Tip:** Require the “because” sentence before they rebuild.
- **Challenge:** Too many suggestions overwhelm the team.
Tip: “Pick one change only” rule for Trial 2.

STAGE 6 – Second Build Trial (Implement Adjustments)

How does this develop particular SPIRIT skills

- Strengthens flexibility by testing a revised strategy
- Builds resilience by improving calmly under pressure and recovering quickly

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Flexibility: apply one planned change from Stage 5 consistently.
- Problem-solving: improve stability compared to Trial 1 (stands independently for a chosen time).
- Valuing people and nature: reuse at least one broken piece as a brace/support if possible.

Academic/Curriculum Objective connection

- Iterative design: revise based on feedback and evidence
- Improve geometric accuracy and stability through planning

Materials and tools needed for implementation

- Remaining spaghetti + marshmallows
- Timer/stopwatch
- Trial 2 build log

Preparation notes

- Remind teams: “One-change rule” (especially for developing/advanced learners).
- Rotate roles if needed so participation is fair.

Guided Questions

- “What is the one change you are testing?”
- “What looks stronger than Trial 1?”
- “How did your base shape stay rectangular?”
- “What did you reuse instead of wasting?”

Stage Debriefing Questions (Optional)

- “Did your one change help? How do you know?”

Tips and Tricks for dealing with stage challenges

- **Challenge:** Teams change too many things at once.
Tip: Enforce “one-change rule,” then test and observe.
- **Challenge:** Second collapse causes giving up.
Tip: Prompt: “What did Trial 1 teach us?” then reset with the mantra and rebuild one small section first.

STAGE 7 – Group Reflection and Model Comparison

How does this develop particular SPIRIT skills

- Develops critical thinking through comparison and evidence-based conclusions
- Strengthens valuing people and nature by reflecting on resource use and responsible choices
- Supports resilience by recognizing growth and effort

What do we want to achieve regarding SPIRIT skill development (student understanding and/or behaviour)?

As a result of this activity, students will be able to:

- Critical thinking: compare their pyramid to the model using geometry words and one cause–effect explanation.
- Resilience: name one challenge they overcame and how they handled it.
- Valuing people and nature: state one stewardship choice they made (reuse, fewer materials, careful planning).

Academic/Curriculum Objective connection

- Use geometry vocabulary to describe 3D structures
- Reflect on design choices and outcomes using evidence

Materials and tools needed for implementation

- Teacher model pyramid
- Reflection sheet (geometry + skills reflection)
- Optional: “gallery walk” labels (Team A, Team B...).

Preparation notes

Prepare reflection sentence stems:

- “Our pyramid is similar because...”
- “It is different because...”
- “We improved by...”
- “We wasted less by...”

Guided Questions

- “How is your pyramid similar to the model?”
- “What did you change from Trial 1 to Trial 2?”
- “What did you learn about the base and the name?”
- “How did you use materials wisely?”

Stage Debriefing Questions (Optional)

- “What would you do first if you built it again tomorrow?”

Tips and Tricks for dealing with stage challenges

- **Challenge:** Students only say, “ours is better/worse.”
Tip: Require one “because” sentence with evidence: “It leaned because...”
- **Challenge:** Some students don’t want to mention mistakes.
Tip: Normalize: “Mistakes are data.” Ask for “one lesson learned” rather than “one failure.”