FAMILY STEM · A FATHER–DAUGHTER YEAR

The Print Lab.

A 12-month STEM curriculum built around our Bambu Lab A1 Combo 3D printer — one machine, one year, four arcs. From pressing start on someone else's model to presenting an original invention of your own.

Bambu Lab A1 Combo + AMS lite | Junior Maker · age 6 | Lead Engineer · age 9 | 12 months · 4 arcs · 48 missions

Q1 · MONTHS 1–3

Operate

Learn the machine and the science inside it — how a spool of plastic becomes a real object, one layer at a time.

Q2 · MONTHS 4–6

Design

Move from printing other people's models to creating our own — shapes, measurement, and CAD from scratch.

Q3 · MONTHS 7–9

Engineer

Use the full engineering design process to solve real problems around the house — and learn that failure is data.

Q4 · MONTHS 10–12

Invent

Run real experiments, learn the math of making things, and finish with an original invention each.

LAB RITUALS

- **The Engineer's Notebook** — nothing gets printed until it's drawn.
- **The Fail Shelf** — failed prints stay, with a note on what they taught us. Failure is data.
- **Question of the Week** — one "how does that work?" answered together.
- **The Showcase Shelf** — every build earns its museum spot; showcase nights at months 6 & 12.

LAB SAFETY — REAL TOOLS, REAL RULES

- Dad handles the hot end, the heated bed, and all cutting tools — always.
- PLA filament only — low-odor and the safest material to learn on.
- The printer runs only with an adult in the room. Watch the plate, don't touch it.
- Small parts away from little mouths; every session ends with lab clean-up.

Q1 · MONTHS 1–3

Operate

Learn the machine and the science inside it — how a spool of plastic becomes a real object, one layer at a time.

1 Meet the Machine

“How does a drawing on a screen become a real thing you can hold?”

States of matter · **Machine parts** · **Lab safety**

- Unbox and set up together; walk through every part and name what it does.
- Run the safety brief: what gets hot, what moves, the house rules of the lab.
- First prints from MakerWorld — a Benchy and a name tag for each engineer.
- Watch a full print through the first layers; talk about melting and cooling.

JUNIOR MAKER · 6
Picks the colors, presses start, and narrates what the printer is doing.

LEAD ENGINEER · 9
Learns each printer part by name and runs the pre-print checklist herself.

2 A World of Layers

“How does the computer tell the printer what to do?”

Slicing & algorithms · **Layer height** · **Infill**

- Open Bambu Studio and watch the slicer turn a model into layers.
- Print the same model at two layer heights; compare with a magnifying glass.
- Print a cutaway cube to see the infill patterns hiding inside every print.
- Start the Engineer’s Notebook: draw it before you print it.

JUNIOR MAKER · 6
Counts layers with the magnifier and picks which print feels smoother.

LEAD ENGINEER · 9
Slices a model herself and changes one setting to predict what will happen.

3 Color Lab

“How do four spools become any picture we can imagine?”

Color theory · **Multi-material printing** · **Planning ahead**

- Load the AMS lite and learn how the printer swaps colors mid-print.
- Print a four-color model and watch the color changes happen.
- Turn one of the girls’ own drawings into a two-color printed plaque.
- Mix-and-match challenge: plan a palette before printing, then judge the result.

JUNIOR MAKER · 6
Draws the picture that becomes a real printed plaque with her name on it.

LEAD ENGINEER · 9
Assigns colors to parts in the slicer and estimates how long the print will take.

Q2 · MONTHS 4–6

Design

Move from printing other people's models to creating our own — shapes, measurement, and CAD from scratch.

4 Building with Shapes

"What are all objects really made of?"

3D geometry **Faces, edges & vertices** **CAD basics**

- Shape safari: hunt the house for cylinders, cubes, spheres, and cones.
- First TinkerCAD session — stack, stretch, and cut basic shapes.
- Each engineer designs and prints her own "shape creature."
- Count faces, edges, and corners on the printed creatures.

JUNIOR MAKER · 6
Builds a creature from ready-made shapes with Dad driving the mouse.

LEAD ENGINEER · 9
Uses TinkerCAD on her own account — grouping, hollowing, and aligning shapes.

5 Measure Twice, Print Once

"Why do engineers measure before they build?"

Millimeters **Calipers** **Estimation & volume**

- Learn to read a ruler and digital calipers — in millimeters, like real engineers.
- Design a treasure box sized to fit a favorite toy exactly.
- Test the fit, find the error, fix the design, and print version 2.
- Estimation game: guess sizes in millimeters, then measure to see who's closest.

JUNIOR MAKER · 6
Measures with the "big numbers" on the caliper screen and tests every fit.

LEAD ENGINEER · 9
Owns the measure–design–test–fix loop and learns about leaving clearance.

6 Things That Move

"How can something printed in one piece bend, flap, and roll?"

Joints & hinges **Simple machines** **Print-in-place**

- Print articulated animals that come off the plate already able to move.
- Print a simple gear set and figure out which way each gear turns.
- Design a creature with at least one moving part.
- Mid-year Family Showcase: museum night — the girls present every piece.

JUNIOR MAKER · 6
Curates the museum shelf and gives the guided tour at the showcase.

LEAD ENGINEER · 9
Explains how print-in-place joints work and demos the gear train.

Q3 · MONTHS 7–9

Engineer

Use the full engineering design process to solve real problems around the house — and learn that failure is data.

7 Puzzle Factory

“Can we design something that’s fun because it’s hard?”

Spatial reasoning · **Iteration** · **Testing with users**

- Print a tangram set and race to solve the classic shapes.
- Each engineer designs a maze or jigsaw for the other one to solve.
- Playtest, watch where the player gets stuck, and revise the design.
- Debrief: a puzzle that’s too easy or impossible failed its test.

JUNIOR MAKER · 6
Designs a marble maze with blocks and is chief playtester for every puzzle.

LEAD ENGINEER · 9
Designs a jigsaw nameplate in CAD and tunes difficulty from playtest notes.

8 Light & Art

“How can thickness turn a photo into a glowing picture?”

Light & translucency · **Thickness & contrast** · **Art + math**

- Print a lithophane of a favorite family photo; hold it up to the window.
- Figure out the trick: thin lets light through, thick blocks it.
- Design and print custom stamps, then make wrapping paper with them.
- Print window sun-catchers in translucent colors.

JUNIOR MAKER · 6
Picks the photo, makes stamp art, and hunts the best window light.

LEAD ENGINEER · 9
Experiments with lithophane thickness settings and records what changes.

9 House Fix-It Engineers

“What problems around us could we actually solve?”

Engineering design process · **Empathy interviews** · **Prototyping**

- Problem patrol: find three real annoyances at home worth fixing.
- Interview the “client” (Mom counts!) about what a good fix looks like.
- Sketch, print, install, and get client feedback on each fix.
- Post the design-process poster: ask, imagine, plan, create, improve.

JUNIOR MAKER · 6
Leads problem patrol with a clipboard and installs the finished fixes.

LEAD ENGINEER · 9
Runs one fix end-to-end: interview, sketch, CAD, print, and revision.

Q4 · MONTHS 10–12

Invent

Run real experiments, learn the math of making things, and finish with an original invention each.

10 The Spin Lab

“How do scientists know what’s true instead of guessing?”

Scientific method · **Variables & fair tests** · **Charts & data**

- Print a family of spinning tops that differ in exactly one way.
- Make a prediction, then time every spin with a stopwatch.
- Chart the results and crown the champion — did the data match the guess?
- Design one more top using what the data taught us, and test it.

JUNIOR MAKER · 6
Runs the stopwatch, calls the results, and colors in the chart.

LEAD ENGINEER · 9
Designs the experiment, keeps the test fair, and reads the chart for patterns.

11 Maker’s Market

“What does it cost to make something — and what is it worth?”

Cost per gram · **Pricing & profit** · **Generosity**

- Design and print holiday gifts: ornaments, keychains, cookie cutters.
- Weigh each print and compute what the filament cost to make it.
- Set “prices” and run a family market — or price the gifts at priceless.
- Keep a simple ledger: what we made, what it cost, what it earned.

JUNIOR MAKER · 6
Runs the market stand, makes the price tags, and handles the “money.”

LEAD ENGINEER · 9
Computes cost per gram, sets prices, and keeps the ledger balanced.

12 The Big Invention

“What will YOU invent?”

Capstone project · **Full design cycle** · **Presenting your work**

- Each engineer picks her own invention — any idea, her call.
- Full cycle: notebook sketch, CAD, prototype, test, improve.
- Final Family Showcase: each inventor presents her invention and its story.
- Print graduation medals — designed by the graduates themselves.

JUNIOR MAKER · 6
Invents with Dad as her hands in CAD — but every decision is hers.

LEAD ENGINEER · 9
Runs her capstone solo, from first sketch to final presentation.