Teacher's & Workshop Guide: Ring 2 - The Logic Builder

Polya Studio Discovery Series

Introduction to the Workshop

Welcome to Ring 2 of the Polya Studio. In Ring 1, the students learned to verify the truth. In Ring 2, they will learn to **Design within Constraints**. This is the essence of Engineering and Logic.

Your role as the Guide is to let them "dream big" and then crash into reality. You will set up a project that is impossible to build with their starting resources, forcing them to use logic to find a compromise.

The goal of Ring 2 is for students to discover that **Creativity needs Logic**. A beautiful design is useless if you cannot afford to build it. They will learn to use "The Logic Triangle" to balance their Wish, the Cost, and their Budget.

Part 1: The Station Setup

You must prepare the physical station to create an immediate conflict between "what they want" and "what they have."

First, provide a large pile of building materials. You need two types:

1. **"Wood" Blocks:** These are cheap. Label them **"$1"**.
2. **"Stone" Blocks:** These are premium/heavy. Label them **"$2"**.

Second, provide a **"Wallet"**. Give the team exactly **$20** in play money (or 20 counters). This is their hard constraint.

Third, display a **"Dream Blueprint"** (The Trap). Show a picture or a drawing of a magnificent castle made almost entirely of Stone blocks. If they were to build it, it would cost $40 or $50.

When the students arrive, the trap is set: They have a blueprint that inspires them, but a budget that restricts them.

Part 2: The Workshop Dialogue

Stand back. Allow the students to start building. They will almost certainly run out of money before they finish the roof. Use this script to guide their discovery.

| **Teacher's Nudge (The Guide)** | **Student's Action (The Discovery)** | | "Here is the Dream Blueprint. You have your budget of $20. Can you build this for me?" (Point to the expensive Stone castle picture.) | The team gets excited. They grab the expensive Stone blocks ($2 each) because they look the best and match the picture. They start building the foundation and walls using only Stone. | | (Wait for the Friction Point. Watch as they spend their money. They will reach $20 and realize they only have half a building.) | **The Friction Point.** The students stop. They have no money left, but the building has no

roof. They might ask for more money or say, "It's impossible!" | | "I cannot give you more money. The bank is closed. What is the rule for the blocks?" | They look at the price tags. "Stone is $2. Wood is $1." | | "And what is the rule for your Wallet?" | They count their empty chips. "We only had $20." | | "So, the Dream is too expensive. Don't guess. Draw the Problem." (Hand them the whiteboard.) | The team stops building. They move to the whiteboard to calculate why they failed. | | "Draw the Logic Triangle. Draw the Wish, the Cost, and the Budget." | **The Visualization.** They draw the Castle (The Wish). They write the math: "20 Stone x $2 = $40" (The Cost). They write "$20" (The Budget). | | "Where is the Blocker?" | They circle the gap between $40 (Cost) and $20 (Budget). "We are $20 short." | | "If you cannot change the Budget, you must change the Design. How can you fix this using Logic?" | **The Resolution.** They look at the cheaper Wood blocks ($1). "We can swap some Stone for Wood." "Maybe we make the walls Wood ($1) and only the corners Stone ($2)?" | | "Prove it before you build it. Write the equation." | They write a plan: "10 Wood ($10) + 5 Stone ($10) = $20." They realize this combination works. They rebuild the structure successfully. |

Part 3: The Visual Rule (The Logic Triangle)

Once they have successfully built their "Hybrid Castle" (using both Wood and Stone), gather them around the whiteboard. Draw the Logic Triangle diagram. This is the tool they will use for every engineering problem in the future.

The top point of the triangle is **The WISH** (The Design).

- *This is what you WANT to build.*

The bottom left point of the triangle is **The COST** (The Math).

- *This is what the materials actually cost (Price x Quantity).*

The bottom right point of the triangle is **The BUDGET** (The Limit).

- *This is what you HAVE.*

The Rule: If the **Cost** is heavier than the **Budget**, the Triangle falls over. To fix it, you must go back to the top (The Wish) and change your mind. You must swap expensive things for cheap things until the triangle balances.

Part 4: Teacher's Quiz (Pedagogy Check)

Question 1 Why do we give them a "Dream Blueprint" that is too expensive? A) To be mean. B) To force them to encounter the constraint and use logic to solve it. *Correct Answer: B*

Question 2 When they run out of money, what should you do? A) Give them a loan so they can finish. B) Ask them to "Draw the Problem" and calculate the cost of their design. *Correct Answer: B*

Question 3 What is the "Pivot" in this exercise? A) Quitting the project. B) Swapping expensive Stone for cheaper Wood to fit the budget. *Correct Answer: B*

Part 5: Student's Quiz (Concept Check)

Question 1 You want to build a robot. You have $100. The motor costs $60 and the battery costs $50. Can you build it? A) Yes, if I build it fast. B) No, because $60 + $50 = $110, which is greater than my budget. *Correct Answer: B*

Question 2 If your design is too expensive, what is the logical move? A) Cry and ask for more money. B) Change the design (The Wish) to use cheaper parts. *Correct Answer: B*

Question 3 What is the Superpower of Ring 2? A) Building whatever you want. B) Designing a plan that actually fits your budget. *Correct Answer: B*

Closing Note

By the end of this session, your students have practiced **Logic**. They learned that a "great idea" is only great if it is possible. They moved from being "Dreamers" (who ignore costs) to "Engineers" (who balance dreams with reality).