Family edition

Phone Lab: The Best Phone Lost

Ages 11-14 · about 45 minutes, in one sitting

Your child compares two phones designed for a grandparent, finds that the better one costs too much, and builds a third that takes the best of both.

What you need

- A computer or Chromebook with a current browser, and a mouse or trackpad.
- The lesson link: mytekdev.com/try/phonelab?lesson=the-best-phone-lost&ref=fam-phonelab-4. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/phonelab?lesson=the-best-phone-lost&ref=fam-phonelab-4. A short guide opens over the app. The customer is a grandparent: "A big screen that is easy to read and a battery that goes well past a day, for under $700." Two designs are already kept, and the phone on the screen is the same as Design 2.

1. **Compare.** Press Compare. Design 1 is the Big shape, 10.0 millimeters thick: 7,450 mAh, more than a day, 220 grams, a shop price of $830. Its last row reads "breaks a must". Design 2 is the Big shape with an LCD screen, 8.0 thick: 4,500 mAh, about a day, 177 grams, $690, and "50 out of 100".
2. **The thick body.** Close the table. Pull Thickness up to 10.0. The battery holds 6,550 mAh. The shop price is now $700, which is not under $700, so the box reads "Breaks a must".
3. **Pay for it.** Under Materials pick a Plastic frame. The price falls to $680 and the box reads "Meets the brief: 69 out of 100". The phone weighs 197 grams.
4. **Keep and compare.** Press Keep this design, then Compare. Three designs, the same rows. Thickness 11.0 with the plastic frame reaches 83 and sells for $690. A Plastic back is cheaper still and lowers the score to 65 at 10.0: it is thicker than glass, so the battery behind it is smaller.

> The moment that lands is the last row of the first comparison. Design 1 wins the rows a child cares about and loses.

The ideas, in plain words

Comparing designs fairly takes a system: the same measures for every design, read side by side, against what the customer asked for. Engineers often use a table for this, sometimes with a weight on each row. The Compare table is that system. Its last row is the customer's verdict, and a design that breaks a must gets no score there, however good the rows above it look.

Neither starting design is right. Design 1 has the long day and costs too much, mostly because of its screen. Design 2 swaps to an LCD screen, which is cheaper and thicker, so it leaves less room for the battery. The better answer

takes the thick body from one and the cheap screen from the other, then finds the money somewhere the customer will not miss it. That is what the standard means by combining the best characteristics of each.

The phone in the app is a model: a simple stack of layers. Real phones fit their parts together more cleverly, and a real thin phone holds more battery than this one does, because its makers spread the battery wider. How much a battery holds for its size and how heavy each material is come from published figures. How deep a camera is, how many hours a charge lasts and how a drop goes are estimates, set so that a normal phone comes out normal. The shop price is the cost of the parts times about two and a half.

Do it together

1. Open mytekdev.com/try/phonelab?lesson=the-best-phone-lost&ref=fam-phonelab-4 together. A short guide opens over the app. Read the box `For: a grandparent`, then press `Compare`.

   > **You'll know it worked when:** Two designs sit side by side. Design 1 lasts far longer, and the last row says it breaks a must. Design 2 has 50 out of 100.

2. Ask: why did the better phone lose? Then close the table.

   > **You'll know it worked when:** Design 1 sells for $830 and the limit is $700.

3. Open `Size and thickness` and pull `Thickness` up to 10.0.

   > **You'll know it worked when:** The battery lasts longer, the price reaches $700, and the must breaks.

4. Open `Materials` and pick a cheaper `Frame` until the must says yes.

   > **If you get stuck:** Plastic is the cheapest frame.
   >
   > **You'll know it worked when:** With a plastic frame it sells for $680 and meets the brief with 69 out of 100.

5. Press `Keep this design`, then `Compare`. Ask: which of the three would you hand to the grandparent, and which number shows it?

   > **You'll know it worked when:** Design 3: it is the only one that meets the must and beats 50.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- Which design lasts longer? Which one meets the brief?

- Why did Design 1 lose?
- What did your Design 3 take from Design 1? What did it take from Design 2?
- When you made it thicker, the must broke. What crossed the line?
- Which design would you hand to the grandparent, and which row shows it?

> The last question is the real test: a child who points at a row of the table, not at how the phone looks, has the idea.

For younger and older kids

Younger: For a younger child, stop at the first Compare and ask which phone they would pick and why the app disagrees.

Older: For a teenager, ask for the highest score they can reach under $700.

Keep going

- What is the highest score you can reach under $700? Record the phone that gets it.
- Design 1 is $130 over. What is the fewest changes that bring it under $700, and what do they do to its score?
- Pick a different customer and decide which of your three designs suits them best. Does the winner change?

Bring it into other subjects

- Math: Design 1 sells for $830 and the limit is $700. What percent over is it? How much would the parts have to fall, if the shop price is about two and a half times the parts?
- Science: an LCD screen has a light behind it that is always on. Why would that make the screen thicker?
- English: write the email to the grandparent that explains which phone you chose and why, with two numbers in it.
- At home: compare two things your family could buy, on the same three rows. Which row decides it?

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Phone Lab: The Best Phone Lost
SUBJECTS	Engineering design, Technology
TIME	45 minutes
WHAT WE DID	Compared two phone designs against one customer's criteria and constraint in a 3D model, built a third design combining the strengths of both, and justified the choice with numbers.
SKILLS PRACTICED	Evaluating competing designs; Using evidence; Combining solutions

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/phonelab?lesson=the-best-phone-lost

Essential question: How do you decide which of several designs is best, and prove it?

Warm-up: Two friends each say their phone is the best. How could you find out who is right?

1. **Vocabulary.** Evaluate, evidence, criteria, constraint, solution: write each in your own words.

2. **The comparison table.** For Design 1, Design 2 and your Design 3 write: battery (mAh), how long it lasts, weight (grams), shop price, A big screen (out of 100), A long day (out of 100), and the last row.

3. **Beat it.** Each try: what I changed _____ shop price _____ score _____

1. Design 1 lasts far longer than Design 2 and has the same screen. Why did it lose?

2. Which design would you hand to the grandparent? Give the number that shows it is the best.

Quick check

Name: _____

1. To compare two designs fairly you (A) pick the one that looks better (B) read both on the same measures (C) ask who made each one

2. Design 1 had the longest day of the three and sold for $830. For a customer who must pay under $700 it is (A) the best design (B) not a solution, because it breaks a must (C) the second best design

3. Your Design 3 used parts of two other designs. Name one thing it took from each.

Answers

QUESTION	ANSWER	WHY
1	B	The same rows for every design is what makes a comparison fair.
2	B	A design that breaks a constraint is not a solution to this problem, whatever it scores.
3	One thing from each	The thick body, or the long day, from Design 1. The LCD screen, or the lower price, from Design 2.

If your state or umbrella school asks, this lesson covers NGSS MS-ETS1-2, NGSS MS-ETS1-3.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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