Family edition

Phone Lab: Test It, Fix It, Test It Again

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

Your child drop tests a phone, fixes what broke, tests it again, and finds out that every fix costs something somewhere else.

What you need

- A computer or Chromebook with a current browser, and a mouse or trackpad.
- The lesson link: mytekdev.com/try/phonelab?lesson=test-it-fix-it-test-it-again&ref=fam-phonelab-3. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/phonelab?lesson=test-it-fix-it-test-it-again&ref=fam-phonelab-3. A short guide opens over the app. The phone is the plain starting phone: an aluminum frame, a glass back, a splash seal, and a back held on with glue. Nothing has been tested.

1. **The drop.** Open Tests and press Drop. The phone falls a meter onto pavement three ways. The result reads "Survived 2 of 3 landings." Face down, the glass held. On a corner, the frame took it. Flat on its back, the back cracked.
2. **The fix.** Press Back to the design, open Materials and pick a Plastic back. The result under Drop is cleared. Press Drop again: "Survived all three landings."
3. **The cost.** Press Pocket. Keys on the glass leave no marks. Keys on the back: scratches. Sand on the back: deep scratches. With the glass back, only the sand left marks.
4. **Dunk.** Press Dunk: "Water got in." Under Water, repair and power pick Dunk for the water seal and test again: "Dry inside." Now press Fix it: the repair score is 4 out of 10 with the plastic back, one lower than it was with the splash seal.
5. **Fix it.** Hold the back on with Screws and press Fix it: 8 out of 10 with the dunk seal still on. With no seal it is 10, and the Dunk test fails again.

> The moment that lands is the Pocket test. Children think the plastic back solved the problem, and the keys show them the bill.

The ideas, in plain words

Engineers test to find the part that fails first, change it, and test again. Each round is an iteration. A result belongs to the design that was tested, so the app clears every result when the phone changes. A fix is a change like any other, and it has effects of its own: a plastic back does not crack and it scratches, a water seal keeps water out and has to be peeled off in a repair, screws make a repair easy and do nothing for water.

In the Pocket test, keys do not mark glass because the metal of a key is softer than glass. The grains in most sand are quartz, which is harder than glass, so sand scratches it. Plastic and bare metal backs are softer than both.

The app's tests give the same result every time for the same phone. A real drop is partly luck: the same phone can survive one fall and crack on the next. The app leaves the luck out so that a result belongs to the design. 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.

Do it together

1. Open mytekdev.com/try/phonelab?lesson=test-it-fix-it-test-it-again&ref=fam-phonelab-3 together. A short guide opens over the app. Open `Tests` and press `Drop`.

   > **If you get stuck:** Click the word Tests, low on the right, to open that part of the panel.
   >
   > **You'll know it worked when:** The phone falls three ways. The result says it survived 2 of 3 landings, and the back cracked.

2. Press `Back to the design`. Open `Materials` and pick a `Plastic` back.

   > **You'll know it worked when:** The Drop result is gone, because this is a different phone now.

3. Open `Tests` and press `Drop` again.

   > **You'll know it worked when:** It survives all three landings.

4. Press `Back to the design`, then press `Pocket`.

   > **You'll know it worked when:** The keys leave scratches on the plastic back. They left none on the glass one.

5. Now press `Dunk`. Ask: what would you change to pass it? Change it, test again, then press `Fix it`.

   > **If you get stuck:** The water seal is under Water, repair and power.
   >
   > **You'll know it worked when:** With a Dunk seal the phone stays dry, and the repair score is lower than it was.

Talk about it

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

- Which landing did the phone fail, and which part gave way?
- You changed the back. Where did the Drop result go, and why?
- What did the plastic back cost you? Which test showed it?
- The dunk seal keeps water out. What did it do to the repair score?
- Is there a phone that passes every test? What would it give up?

> The third question is the real test: a child who goes looking for the cost of a fix, without being asked, has the idea.

For younger and older kids

Younger: For a younger child, stop after the second drop and ask why the first result disappeared.

Older: For a teenager, ask whether one phone can pass every test, and have them try.

Keep going

- Pass all five of Drop, Pocket, Dunk, Charger and Fix it on one phone. Is it possible? What is the closest you can get?
- Pick the Toughest front glass and run Pocket. What changed, and why might that be true of real glass?
- With the plastic back on, make the phone thinner until Drop fails again. Which landing failed, and what hit the ground first?

Bring it into other subjects

- Math: the repair score starts at 10. Glue takes off 3, a glass back with glue 1 more, the glue strips under the battery 1, a splash seal 1 and a dunk seal 2. Work out the score for three phones, then check each in the app.
- Science: geologists rank how hard a material is by what scratches what. Where would a key, glass and sand go on that list?
- English: write the test report for one test: what was tested, how, what happened, and what you recommend.
- At home: find one thing that was made easier to use and harder to repair. What is holding it together?

For your records

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

LESSON	Phone Lab: Test It, Fix It, Test It Again
SUBJECTS	Engineering design, Technology
TIME	45 minutes
WHAT WE DID	Ran drop, scratch, water and repair tests on a 3D phone model, changed the design after each failure, retested it, and identified what each fix cost elsewhere in the design.

SKILLS PRACTICED	Testing a design; Finding what failed; Improving a design in rounds

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/phonelab?lesson=test-it-fix-it-test-it-again

Essential question: How do you fix a design that failed a test without breaking something else?

Warm-up: A phone falls off a table. Three ways it could land: _____, _____, _____. The worst: _____

1. **Vocabulary.** Test, failure point, iteration, fair test, trade-off: write each in your own words.

2. **The test log.** For each test write: the test, the result, the part that failed, what you changed, the result after, and what the fix cost somewhere else. Start with Drop, then Dunk and Fix it.

1. After you changed the back, the Drop result disappeared. Why is that fair?

2. Pick one fix you made. What did it cost somewhere else, and which test showed you?

Quick check

Name: _____

1. After a design is changed, its old test results (A) still count (B) no longer count, because it is a different design (C) count for half

2. A plastic back survived the drop that cracked the glass one. In the Pocket test the plastic back (A) was scratched by keys (B) was not marked (C) cracked

3. Name one fix from today and what it cost somewhere else.

Answers

QUESTION	ANSWER	WHY
1	B	A result belongs to the design that was tested.
2	A	Keys are softer than glass and harder than plastic.
3	A fix and its cost	A plastic back: scratches from keys. A dunk seal: a lower repair score. Screws with no seal: water gets in.

If your state or umbrella school asks, this lesson covers NGSS MS-ETS1-4, 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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