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Phone Lab: Thin Has a Price

Grades 6-8 · 45 minutes

Engineering design · Technology



Slides, rubric and answer key **Print and go** **No student accounts**

Chromebook friendly

What's included

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- A ten-minute walkthrough to rehearse before class, and background in plain words for the teacher
- A 45-minute lesson sequence: warm-up, direct instruction, guided practice, independent practice, closure
- Slides for the board: a PowerPoint file that also opens in Google Slides
- A student worksheet with a QR code and a data table for four thicknesses
- A 3-question exit ticket, two to a page, with an answer key
- A rubric: 3 criteria, 4 levels, scored out of 12
- Differentiation for English learners, students with IEPs or 504 plans, and students who need more support or more challenge
- Cross-curricular extensions, and notes for teaching it in grades 4 and 5 and in grades 9 and 10
- Standards: NGSS engineering design

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Students start with a plain phone, 8.0 millimeters thick, that lasts about a day. They pull it down to 6.0 and the card changes: the battery holds 2,850 mAh where it held 4,500, the phone runs out by dinner, and the camera sticks out 4.0 millimeters. They open the phone into seven layers and see that the glass, the screen and the back are as thick as they were. The battery is the layer that gave way. They record four thicknesses in a table, find the pattern, and choose one.

At a glance

ESSENTIAL QUESTION

When a phone gets thinner, what does it give up, and why?

OBJECTIVES

Students will be able to:

- describe a trade-off: getting more of one thing by giving up some of another
- collect data from a model by changing one thing and recording what else changes
- use the layers of a phone to explain why the battery is the part that shrinks
- choose a thickness for a phone and defend the choice with numbers

VOCABULARY

Trade-off, Model, Layer, Capacity, Data

STANDARDS

MS-ETS1-4

TIME AND MATERIALS

45 minutes, grades 6-8.

- One computer or Chromebook per student
- A projector
- The worksheet and exit ticket, one copy each per student
- The rubric, one copy per student if you grade the work

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/phonelab?lesson=thin-has-a-price&ref=tpt-phonelab-1 once on a student computer: it opens on a plain gray phone, and checks that your school's filter allows the app. Run it yourself, about ten minutes: open Size and thickness and pull Thickness to 6.0 (the card says runs out by dinner, holds 2,850 mAh, and the cameras stick out 4.0 millimeters), press Open it up (the tag on the battery reads 3.4 millimeters thick), then pull Thickness up to 10.0 (the battery is 7.4 millimeters thick and the cameras are flush with the back).

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet, scored with the rubric.

TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. Students need no account and no email: the link works signed out, and nothing they do is stored on our server unless they choose to save. The phone is turned by dragging, with a mouse or a trackpad. There are no brands, logos or real phone models in the app.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 5	**Warm-up** Hook	Show the title, essential question and Today I can slides (about 1 minute). Then the warm-up: thinner, or lasts longer? Why not both? Write the reasons on the board.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app with the starter open. Read the card aloud: about a day, 166 grams, the cameras stick out 2.0 millimeters. Say that the phone is a model, and that the card is its data. Open Size and thickness and pull Thickness down one notch at a time while students watch the card. Stop at 7.0 and ask what changed besides the thickness. **It's working when:** Change one thing and read everything. The card shows what each number was, in orange, for a short while after a change.	Watch, and fill in the vocabulary on the worksheet.
12 to 22	**Guided practice (We do)** Make it thin, open it up	Students open the link or scan the QR code. A short guide walks them through 6.0 millimeters, Open it up, and back up until the cameras are flush. When phones are open, ask: which layer changed size? **Watch for:** Students who say "the whole phone got smaller inside". Have them read the battery tag, change the thickness by 1.0, and read it again: only that layer moved.	Follow the guide. Read the tag on the battery at 6.0 and again when the cameras are flush.
22 to 38	**Independent practice (You do)** The data table	Students set Thickness to 10.0, 8.0, 7.0 and 6.0 and record the card each time, and the battery tag with the phone open. Then they choose a thickness for their own phone and write what they gave up. Walk the room with the What to look for questions. **If they ask:** "Each time the phone lost a millimeter, how much thinner did the battery get? Why not less?" The pattern	Fill in the table, find the pattern, and choose a thickness.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two students say the thickness they chose and what they gave up. Go back to the warm-up reasons. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/phonelab?lesson=thin-has-a-price&ref=tpt-phonelab-1. A short guide opens over the app. The phone is plain gray, 72 by 150 millimeters and 8.0 thick. The card on the right says the battery lasts about a day and holds 4,500 mAh, the phone weighs 166 grams, and the cameras stick out 2.0 millimeters.

1. **Make it thin.** Open Size and thickness and pull Thickness down to 6.0. The card reads "runs out by dinner", "holds 2,850 mAh", 140 grams, and "stick out 4.0 millimeters". Under each line that moved, the old value shows in orange for a short while.
2. **Open it up.** Press Open it up. The phone comes apart into cover glass, screen, battery, board, cameras, frame and back. The tag on the battery reads "3.4 millimeters thick".
3. **Make it thick.** With the phone open, pull Thickness up to 10.0. The battery tag reads 7.4 millimeters, and the card says the cameras are flush with the back, the battery holds 6,150 mAh and lasts more than a day, and the phone weighs 192 grams.
4. **The table.** At 8.0: 4,500 mAh, about a day, 166 grams, cameras out 2.0 millimeters, battery 5.4 thick. At 7.0: 3,650 mAh, about a day, 153 grams, 3.0 millimeters, battery 4.4 thick.

> The moment that lands is the battery tag. Students expect everything inside to shrink a little. One layer takes the whole change.

Background for the teacher

In the app a phone is a stack. The cover glass, the screen and the back each need a fixed thickness, and the board needs a little room of its own. Together they take 2.6 millimeters of any phone. The battery gets what is left: 5.4 millimeters of an 8.0 millimeter phone, and 3.4 of a 6.0 millimeter one. So a millimeter off the phone is a millimeter off the battery, and on this phone that is 800 to 850 mAh each time.

A camera needs depth behind its lens to focus light. The main camera here needs 10 millimeters of body to sit inside. In a thinner body it sticks out, a millimeter more for each millimeter the phone loses. The weight falls by 13 grams a millimeter, most of it battery.

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.

What to look for

Ask these while students work. A student who has understood the lesson can answer them without help:

- You changed one thing. How many numbers on the card moved?
- Which layer changed size when you made the phone thinner? Which ones did not?
- Why do the cameras stick out of the thin phone and not the thick one?
- The battery holds 2,850 mAh at 6.0. Does that number tell you how long it lasts? What does?
- What did you give up for the thickness you chose?

> The second question is the real test: a student who says the battery gets whatever room the other layers leave has the idea.

Cross-curricular extensions

- Math: plot battery capacity against thickness from the table. Is it a straight line? Predict the capacity at 9.0, then check it in the app.
- Science: a battery stores energy. Why would a bigger battery of the same kind hold more?
- English: write the three sentences an honest advertisement for the 6.0 millimeter phone would have to include.
- At home: find how thick a phone in your house is, and ask its owner what they would trade for a longer day.

Vocabulary

Trade-off	Getting more of one thing by giving up some of another.
Model	A simpler version of a real thing that you can change and test.
Layer	One flat part of the phone. Seven of them are stacked front to back.
Capacity	How much a battery holds, counted in mAh (milliamp hours). It says how much is stored, not how long it lasts.
Data	Numbers or results you record so you can compare them.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and point at the screen as you say each word: the card, the layers and the numbers carry the meaning.
- Pair each learner with a partner; the table is numbers copied from the card.
- Accept "more" and "less" with an arrow beside each number in place of sentences.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students for the table, one at the app and one recording.
- Zoom the browser to 125%; the card stays readable.
- Allow three thicknesses instead of four, where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "I made it thinner, and it cost me ___."
- A check-in after the guide: every student has read the battery tag twice before anyone starts the table.
- Give the 8.0 row already filled in: 4,500 mAh, about a day, 166 grams, 2.0 millimeters.

STUDENTS READY FOR MORE

- Keep the thickness at 8.0 and change the Frame to Steel, then Titanium. What moved on the card, and what did not?
- Under Screen, switch the Panel to LCD. The battery got smaller and nobody changed the thickness. Open it up and find out why.
- Find the thinnest phone that is still on at 10 at night. Which test tells you?

Adapting for other grades

Younger students: In grades 4 and 5, do the guide together on the projector, with pairs sharing a computer, one changing the phone and one recording. Skip the third rubric row; total 8, and 6 meets the objectives. Use the words "room inside" for capacity until students have opened the phone.

Older students: In grades 9 and 10, set the level to High school. Have students plot battery capacity against thickness for six thicknesses, find the slope, and say what the slope means in words. Then ask where the line would cross zero, and what that thickness is made of.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/phonelab?lesson=thin-has-a-price

Essential question: When a phone gets thinner, what does it give up, and why?

Warm-up: Would you rather have a thinner phone, or one that lasts longer? _____ Why not both?

1. **Vocabulary.** Trade-off, model, layer, capacity, data: write each in your own words.

2. **The data table.** Set Thickness to 10.0, 8.0, 7.0 and 6.0. For each, write: battery (mAh), how long it lasts, weight (grams), how far the cameras stick out, and how thick the battery is with the phone open.

3. **My thickness.** I chose _____ millimeters.

1. Which layer got thinner when the phone did? Why that one? Use what you saw in Open it up.

2. What did you gain with the thickness you chose, and what did you give up? Give a number for each.

Phone Lab: Thin Has a Price

Exit ticket

Name: _____

1. A trade-off is (A) a mistake in a design (B) getting more of one thing by giving up some of another (C) a test a design fails

2. When the phone got thinner, the battery shrank because (A) the battery was worn out (B) the glass, the screen and the back keep their thickness, so the battery gets what is left (C) a thin phone uses more power

3. Name one thing, besides the battery, that got worse when the phone got thinner.

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Answer key: exit ticket

QUESTION	ANSWER	WHY
1	B	Thin was paid for with battery. Nothing was a mistake.
2	B	The other layers need the same thickness in any phone, so every millimeter comes out of the battery.
3	The cameras stick out more	A camera needs depth behind its lens. "It runs out sooner" is the battery again; accept it only with a reason.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
The data table	All four thicknesses, each with the battery, how long it lasts, the weight and the cameras.	At least three thicknesses recorded.	One or two thicknesses recorded.	No data recorded.
Explaining the battery	Says the glass, the screen and the back keep their thickness, so the battery gets what is left, and points to the open phone.	Says a thinner phone has less room for the battery.	Says the battery got smaller, with no reason.	No answer.
The trade-off	Names the thickness chosen, what was gained and what was given up, with a number for each.	Names what was gained and what was given up.	Names a thickness with no cost.	No answer.

Total: ____ / 12. A score of 9 or more meets the objectives.

Standards

NGSS middle school engineering design. Students use a model to generate data: they change one thing about a design and record what else changes.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	**MS-ETS1-4**	6-8	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Students use a model of a phone to generate data across four thicknesses and change the design in response. They use the model; they do not develop it.

Checked November 2026 against: NGSS MS-ETS1 Engineering Design.

Optional: save student work in a free class

The whole lesson runs at the link on the worksheet, with no accounts and no sign-up.

To keep students' work, and see it all in one place, make a free class. It takes about ten minutes, once, and covers every lesson in this series: mytekdev.com/tools/class-setup

Students in a class open mytekdev.com/tools/phone-lab/lessons/thin-has-a-price/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time.

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