mytekDev

Phone Lab: Musts and Wants

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 table for each change and its score
- 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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A hiker needs a phone. It must survive a dunk in a creek and all three drops, and it should be light and last a long day. The starting phone breaks both musts. Students add a dunk seal, find the back still cracks, and change the back until both musts say yes: the phone meets the brief with 65 out of 100. Then they raise the score one change at a time, and find that a thicker phone with a glass back would score higher and still fails, because it breaks a must.

At a glance

ESSENTIAL QUESTION

What is the difference between what a design must do and what it should do well?

OBJECTIVES

Students will be able to:

- tell a constraint (a must) from a criterion (a want) in a design problem
- change a design until it meets every constraint
- improve a design against its criteria without breaking a constraint
- write the criteria and constraints for a customer in their own words

VOCABULARY

Criteria, Constraint, Brief, Trade-off, Customer

STANDARDS

MS-ETS1-1

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=musts-and-wants&ref=tpt-phonelab-2 once on a student computer: it opens with the hiker as the customer, and checks that your school's filter allows the app. Run it yourself, about ten minutes: read the box For: a hiker (both musts say not yet), open Water, repair and power and pick Dunk (one yes), open Materials and pick a Plastic back (both yes, and Meets the brief: 65 out of 100), then pick a Plastic frame (71 out of 100).

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: a backpack must do one thing and you would like it to do another. Sort the answers into two columns 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 box For: a hiker aloud. Point at the two musts, which say not yet, and the two wants, which have bars. Name the columns on the board: constraints and criteria. Ask which the class should fix first, and why. **It's working when:** A must is yes or no. A want is how much. The app shows no score at all while a must is broken, because a phone that fails the brief has not earned one.	Watch, and fill in the vocabulary on the worksheet.
12 to 24	**Guided practice (We do)** Meet the musts	Students open the link or scan the QR code. A short guide walks them through the dunk seal and the back, and has them keep the first design that meets the brief. Ask: the dunk seal fixed one must. Why did the other still say not yet? **Watch for:** Students who pick a metal back. It survives the drops too, and scores 63. It also stops wireless charging, which this customer did not ask about. Let them find it in the Charger test later.	Follow the guide. Write the first score in the table.
24 to 38	**Independent practice (You do)** Raise the score	Students change one thing at a time and record the change and the score, keeping the design when it improves. Walk the room with the What to look for questions. **If they ask:** "You made it thicker for a longer day and the score went up. What happens to the score if you put the glass back on?" A broken must	Fill in the table and keep the best design.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two students read their best score and the change that got them there. Ask who broke a must along the way, and what the app said. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/phonelab?lesson=musts-and-wants&ref=tpt-phonelab-2. A short guide opens over the app. The phone is the plain starting phone, and the box For: a hiker is on the right, under the card. It reads: "It has to live through a dunk in a creek and a drop on a rock, and still be light enough to carry all day."

1. **The brief.** Must: survives a dunk, not yet. Must: survives all three drops, not yet. Light to carry, 80. A long day, 36. The last line reads "Breaks a must, so it does not meet the brief yet."
2. **The first must.** Open Water, repair and power and pick Dunk under Water seal. The first must says yes. The drops still say not yet: the glass back cracks when the phone lands flat on its back.
3. **The second must.** Open Materials and pick a Plastic back. Both musts say yes and the last line reads "Meets the brief: 65 out of 100". The plastic back is thicker than glass, so the battery is a little smaller: 4,250 mAh.
4. **Raising the score.** A Plastic frame: 71. Thickness 9.0 with the aluminum frame: 67. Thickness 10.0: 68. The Small shape: 68. No cameras at all: 70.
5. **The trap.** Put the Glass back on at any point and the drops say not yet again. The score disappears, whatever the wants add up to.

> The moment that lands is the missing score. Students who have been chasing points lose all of them at once, and that is what a constraint is.

Background for the teacher

Engineers split what a customer asks for into two kinds. A constraint is a limit: a price that cannot be passed, a test that has to be survived. A criterion is a measure of how good the design is: lighter, longer lasting. A design is judged on its criteria only after it has met every constraint. The app calls them musts and wants, and shows no score while a must is broken.

The hiker's two wants pull against each other. A longer day needs a bigger battery, and a bigger battery is heavier. Light to carry counts for 60 of the 100 points and a long day for 40, so the best designs here are light ones. The score reads the design itself, so it moves with every change and no test has to be run first.

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:

- Which lines in the box are musts and which are wants? How can you tell?
- The dunk seal fixed one must. What fixed the other?
- Your last change made the score go down. Which want lost points, and why?
- What happens to the score when a must breaks?
- Say the hiker's brief in your own words: what must the phone do, and what should it be good at?

> The fourth question is the real test: a student who says the score does not count until the musts are met has the idea.

Cross-curricular extensions

- Math: the score is 60 percent Light to carry and 40 percent A long day. Work out the score for bars of 90 and 27, then check it against the app.
- Science: why does a phone with a bigger battery weigh more? What else in the phone adds weight?
- English: write a brief for someone you know: two musts and two wants, each in one sentence.
- At home: pick something in your kitchen and name one constraint and one criterion its designer had.

Vocabulary

Criteria	What a design should do well. Each one can be scored: lighter is better, a longer day is better.
Constraint	A line a design cannot cross. Break one and the design fails, whatever it scores.
Brief	What the customer asked for: their musts and their wants.
Trade-off	Getting more of one thing by giving up some of another.
Customer	The person a design is for.

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.
- Use must and want all lesson, and add constraint and criteria beside them on the board.
- Accept the table as the name of the control changed and the number from the screen.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students for the independent part, one at the app and one recording.
- Zoom the browser to 125%; the customer box stays readable.
- Allow three changes instead of five, where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "The phone must ___. It should be good at ___."
- A check-in after the guide: every student has a kept design that meets the brief before anyone goes on.
- Suggest the first change: under Materials, try a Plastic frame.

STUDENTS READY FOR MORE

- Pick a second customer under Customers and meet their musts. Which of your changes for the hiker now work against you?
- Find two different phones that both meet the hiker's brief with the same score. What is different about them?
- Write a brief for a new customer: two musts and two wants. Swap briefs with someone and design for

theirs using the card.

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. Say must and want, and leave constraint and criteria for the last five minutes.

Older students: In grades 9 and 10, have students work out how the score is made: the two wants are weighted 60 and 40. Ask them to predict the score from the two bars before they read it, and to say what a designer would do differently if the weights were swapped.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/phonelab?lesson=musts-and-wants

Essential question: What is the difference between what a design must do and what it should do well?

Warm-up: A backpack for school. It must: _____ I would like it to: _____

1. **Vocabulary.** Criteria, constraint, brief, trade-off, customer: write each in your own words.

2. **The hiker's brief.** Musts: _____ and _____ Wants: _____ and _____

3. **The change table.** For each change write what you changed, whether both musts still say yes, and the score. Start with the first design that meets the brief.

1. What is the difference between a must and a want? Give one of each from the hiker.

2. Can the phone with the highest score fail the brief? Explain how.

Phone Lab: Musts and Wants

Exit ticket

Name: _____

1. A constraint is (A) something a design should do well (B) a line a design cannot cross (C) the score a design gets

2. A phone scores well on Light to carry and A long day, and it does not survive a dunk. For the hiker it (A) meets the brief (B) fails the brief (C) meets half the brief

3. Write one want (criterion) a designer could score for a phone.

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Answer key: exit ticket

QUESTION	ANSWER	WHY
1	B	A constraint is yes or no. Criteria are what gets scored.
2	B	Surviving a dunk is a must. A design that breaks a must fails, whatever it scores.
3	Anything that can be more or less	Lighter, a longer day, cheaper, a bigger screen. "Survives a dunk" is yes or no, so it is a constraint.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Meeting the constraints	A kept design that meets both musts, with the changes that did it named.	A kept design that meets both musts.	A design that meets one must.	No design meets a must.
Improving on the criteria	At least three changes recorded with the score after each, and the best one kept.	Two changes recorded with scores.	One change recorded.	No changes recorded.
Telling them apart	Explains that a must is yes or no and a want is scored, with an example of each from the hiker, and says a broken must fails the design.	Gives one must and one want from the hiker.	Lists what the hiker asked for without sorting it.	No answer.

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

Standards

NGSS middle school engineering design. Students read a design problem as criteria and constraints and design to meet them.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	**MS-ETS1-1**	6-8	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Students sort a customer's brief into criteria and constraints, meet the constraints first, and write the criteria and constraints in their own words. The effects on the natural environment named in the standard are not part of this lesson.

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/musts-and-wants/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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