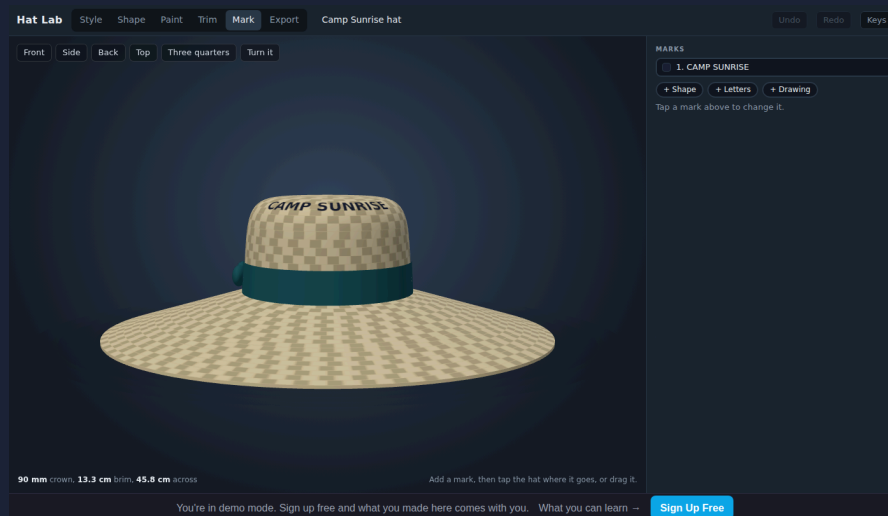


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Hat Lab: Design a Sun Hat to a Client's Brief

Grades 4-8 · 45 minutes

Engineering · Math



Slides, rubric and answer key

Print and go

No student accounts

Engineering design

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 the design brief and a QR code
- 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 2-3 and 9-12
- Standards: NGSS engineering design and Common Core math

Hat Lab: Design a Sun Hat to a Client's Brief

Grades 4-8 · 45 minutes · Engineering, Math

A summer camp sends back the ball cap it ordered: the counselors' necks and ears burn by lunch. Students read the camp's brief, four requirements with numbers in them, and find that the cap can never pass, because its bill only shades the front. They design a hat in Hat Lab that fits a 56 cm head, has a brim of at least 76 mm (3 inches) all the way around, stays under 12 cm tall and carries the camp's name, check each requirement against the measurements under the hat, and hand it to a classmate who signs off the brief.

At a glance

ESSENTIAL QUESTION

How do designers know when a design is done?

OBJECTIVES

Students will be able to:

- explain the difference between a requirement a design must meet and a choice the designer is free to make
- read the app's measurements and decide whether each requirement in a brief is met
- change a design one step at a time until it meets every requirement in the brief
- check a classmate's design against the brief and say which requirement it misses, if any

VOCABULARY

client, brief, requirement, constraint, brim, crown, circumference

STANDARDS

3-5-ETS1-1, MS-ETS1-2, 5.MD.A.1

TIME AND MATERIALS

45 minutes, grades 4-8.

- 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 project

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/hatlab?lesson=design-a-sun-hat-to-a-brief&ref=tpt-hatlab-1 once on a student computer to see the starter ball cap and to check that your school's filter allows it. No account is needed.

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the student's hat and the signed brief on the worksheet, scored with the rubric out of 12.

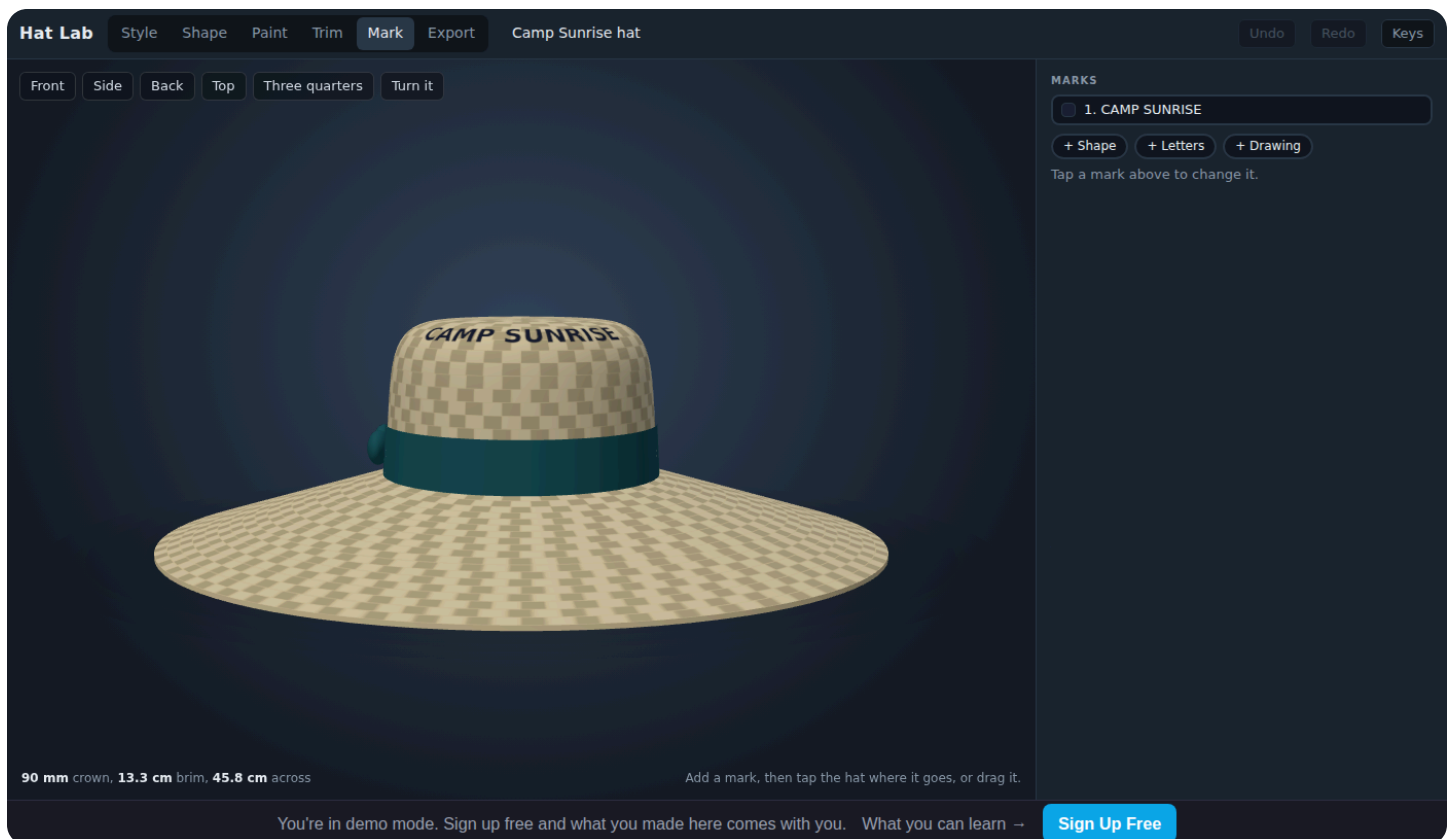
TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. The 3D hat is drawn by the computer's graphics, so older computers may turn it more slowly. Students need no account and no email: the link works signed out, and nothing they make is stored on our server unless they choose to save it to an account. If your school blocks new sites, ask IT to allow mytekdev.com.

Before you teach: do it once yourself

Meet the brief yourself once before class, about ten minutes.

1. **Open the lesson.** Go to mytekdev.com/try/hatlab?lesson=design-a-sun-hat-to-a-brief&ref=tpt-hatlab-1. The navy ball cap named Camp hat opens, with **Style** open. Press **Back** above the hat: the cap from behind, with nothing shading the neck. The line under the hat says 10.4 cm crown, 72 mm bill, 34.3 cm across.
2. **Size first.** In **Style**, pick **Bucket hat**. Open **Shape** and drag the size slider under Size to 56 cm. It says US 7, with 56 cm, UK 6 7/8, about M under it. **Brim width** reads 54 mm.
3. **Widen the brim.** Drag **Brim width** until it reads 76 mm or more. The brim number in the line under the hat changes with it.
4. **Try two more.** Pick **Cowboy hat**: the size stays at 56 cm, but **Crown height** reads 12.6 cm, over the limit, so drag it lower. Then pick **Sun hat**: 90 mm crown and 13.3 cm brim as it comes.
5. **Add the name.** Open **Mark** and press **+ Letters**. A mark that says ABC appears; type **CAMP SUNRISE** in the Letters box, then tap the front of the hat. Press **Front** to check it.



The Sun hat at 56 cm with the camp's name: the line under the hat is where students read the crown and the brim.

If you see something else: picking a new style puts every Shape slider back to that style's start, so a brim you widened is gone; the size, the name and the marks stay. The starter is 57 cm, not 56: a brim widened to 76 mm before the size is set reads 75 mm once the size drops to 56 cm.

Background in plain words

Designers work for a client, and the client's needs are written down before anyone designs: that is the brief. Each requirement in a good brief can be checked with a yes or no, which usually means it has a number in it. A constraint is a requirement that sets a limit, like no taller than 12 cm. Anything the brief does not mention, such as color or pattern, is the designer's choice.

A design is done when it meets every requirement, not when it looks finished. That is why students read the app's numbers instead of judging by eye, and why the order matters: Hat Lab grows the whole hat with the head size, so every other number has to be read after the size is set. The camp's problem is a good example of a requirement ruling out a whole kind of design: a ball cap's bill shades only the front, so no bill length can shade the neck.

STUDENTS ASK	A GOOD ANSWER
Can I make it purple?	Yes. The brief does not say the color, so that is your choice. Choices are where the hat becomes yours.
It looks done. Is it?	Only if every requirement on the brief has a number next to it that meets it.
Why 76 mm?	The Skin Cancer Foundation recommends a brim of at least 3 inches all the way around. 3 inches is $3 \times 25.4 = 76.2$ mm.
Isn't a wider brim always better?	It gives more shade, but it takes more material. The brief sets the smallest brim that does the job; past that, it is a trade-off.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 7	Warm-up Hook	Show the title, essential question and Today I can slides (about 1 minute). Then have students open the link or scan the QR code on the worksheet: Hat Lab opens on the camp's ball cap. A short guide runs along the bottom; tell students to do its first step only, which is to press Back above the hat and look at the cap from behind, then wait. Read the camp's note on the worksheet aloud: the counselors' necks and ears burn by lunch. Ask: "Why?" (The bill shades only the front of the face.)	Look at the cap from the back, and answer the question.
7 to 15	Direct instruction (I do) Model it	Show the vocabulary slide, then the brief slide. Read the four requirements and point out that each one has a number you can check. Say: a limit like the height is a constraint, and the brief does not say the color or the style; those are the designer's choices. Show the Why 76 mm slide, and point out that the app says mm up to 99 mm, then cm: 13.3 cm is 133 mm. Then, on the projector, open Shape: the Size section shows the head the hat fits (US 7 1/8 is 57 cm around), the sliders say each part's size, and the line under the hat says the crown, the brim or bill, and the width. Point out that a ball cap's number says bill, and a bill is not all the way around, so the cap can never meet the brief, however long the bill.	Watch, and fill in the What the brief needs column on the worksheet.

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
15 to 23	Guided practice (We do) A hat that fits	Together: open Style and pick the Bucket hat, which has a brim all the way around. Open Shape and slide the size to 56 cm (US 7). Read Brim width: about 54 mm, not enough. Drag Brim width until it reads 76 mm or more. Say: setting the size first matters, because the whole hat grows and shrinks with the head, and every number changes with it. Before moving on, check that every student has a hat at 56 cm with a brim that reads 76 mm or more. Watch for: A student who widened the brim before setting the size: the starter is 57 cm, so a brim set to 76 mm there reads 75 mm at 56 cm. Set the size, then read the brim again.	Pick a hat with a brim all the way around, set the size, widen the brim, and write the numbers on the brief.
23 to 37	Independent practice (You do) Meet the brief	Walk the room and ask the questions under What to look for. Students may keep the bucket hat or pick another style: any hat with a brim all the way around can pass if they change it to fit, but a few will fail the height limit (the cowboy hat's crown is 12.6 cm at this size, and Crown height must be dragged lower on Shape). Students put the camp's name on the front in Mark: press + Letters, type the name (up to 12 letters, spaces count: CAMP SUNRISE fits), then tap the front of the hat. Then they choose colors in Paint and trims in Trim. Repeat the rules: a requirement is met only when the number says so, and set the size first. Watch for: Switching style puts every Shape slider back to the new style's start, so a widened brim or lowered crown is lost; the size and the name stay. After any style change, read every number again. Watch for: A new Letters mark says ABC. The camp's name goes in the Letters box, not in the hat's name at the top.	Meet all four requirements, write each measured number on the brief, then make the hat their own.
37 to 45	Closure Sign it off, and exit ticket	Students trade seats. Each one checks a classmate's hat against the brief by reading the numbers in the app, ticks each requirement that is met, and signs the bottom of the classmate's worksheet, or writes which requirement is missed. Ask the essential question again, then hand out the exit ticket. Watch for: A checker who drags a slider changes the classmate's numbers. Undo at the top right puts it back.	Check a classmate's hat against the brief and sign it off, then answer the exit ticket on their own.

What to look for

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

- Which requirements have you met? Show me the number for each.
- Your crown says 90 mm. Is that under 12 cm?
- Why can the ball cap never meet the brief?

- Which parts of your hat are your choice, and which does the brief decide?
- You changed the size and the brim number changed too. Why?
- Your classmate's hat looks great. Does it meet the brief? How do you know?

The last one is the real test. A student who checks the numbers instead of trusting how the hat looks understands that a design is done when it meets its requirements, not when it looks finished.

Cross-curricular extensions

- Math: 1 inch is 2.54 cm. The Skin Cancer Foundation's 3 inches is how many millimeters? ($3 \times 25.4 = 76.2$ mm, which the brief writes as 76 mm.)
- Science: the sun is high at noon and low in the evening. Which part of a counselor does a 76 mm brim shade at noon, and which does it miss in the evening? (At noon the face, ears and neck; in the evening low light comes in under the brim onto the face.)
- English: write the camp a three-sentence letter that explains how your hat meets their brief.
- Lesson 2 uses the same hat sizes: what does US 7 measure? (The head's width if it were a perfect circle, in inches.)

Vocabulary

client	The person or group a design is made for.
brief	The client's list of what the design must do, written before the design starts.
requirement	One thing the brief says the design must do. You can check it with a yes or no.
constraint	A limit the design must stay inside, like a hat no taller than 12 cm.
brim	The part of a hat that sticks out from the bottom edge and makes shade.
crown	The part of a hat that covers the top of the head.
circumference	The distance all the way around something, like around a head just above the ears.

Differentiation

ENGLISH LEARNERS

- Post the vocabulary with a picture for each word: a brim, a crown, a ruler around a head.
- Model each step on the projector before students try it, and point at the number as you read it.
- Let students tick the brief with yes and no instead of writing the numbers.

STUDENTS WITH IEPS OR 504 PLANS

- Where the IEP allows a modified assignment, meet the first two requirements (size and brim); the height limit and the name become extensions.
- Pair students: one moves the sliders, the other reads each number aloud and writes it on the brief.
- Raise the browser zoom so the numbers under the hat are easier to read.

- Read the exit ticket aloud, or let students answer by pointing at their screen.

STUDENTS WHO NEED MORE SUPPORT

- Start students on the Sun hat, which meets the brim and height requirements as soon as the size is right.
- Give a sentence starter for signing off: "Requirement ... is met because the app says ..."
- Check in at minute 28: is the size set to 56 cm before the other numbers were read?

STUDENTS READY FOR MORE

- Pick the Cowboy hat and lower its crown until it meets the height limit. What else changed?
- The camp also wants a hat for the campers, whose heads are about 53 cm around. Change the size and check the brief again: does your hat still pass?
- Write a fifth requirement for the camp, with a number in it, and design to it.

Adapting for other grades

Younger students: For grades 2 and 3, do the guided part together on the projector, keep everyone on the Sun hat, and score only the first two rubric rows (out of 8; 6 or more meets the objectives).

Older students: For grades 9 to 12, add a requirement on cost: each centimeter of brim adds material, so ask for the narrowest brim that still meets 76 mm, and a short design note on the trade-off between shade and material.

Student worksheet

Name: _____ Date: _____



Open the app: scan the QR code, or go to mytekdev.com/try/hatlab?lesson=design-a-sun-hat-to-a-brief

Essential question: How do designers know when a design is done?

From Camp Sunrise: "The caps you sent shade our eyes, but our counselors' necks and ears are burned by lunch. Please design us a new hat."

WHAT THE BRIEF NEEDS	MY NUMBER, READ FROM THE APP	MET?
Fits a head with a 56 cm circumference		
A brim of at least 76 mm, all the way around		
No taller than 12 cm (the crown)		
The camp's name on the front		

- Pick a style.** Open **Style**. Pick a hat with a brim all the way around.
- Size first.** Open **Shape**. Slide the size to 56 cm. Then read **Brim width** and the crown under the hat. The app says mm up to 99 mm, then cm: 13.3 cm is 133 mm.
- Add the name.** Open **Mark**, press **+ Letters**, type the camp's name (up to 12 letters: CAMP SUNRISE fits), then tap the front of the hat.

1. Why could the ball cap never meet the brief?

Signed off by: _____ Missed requirement, if any: _____

Exit ticket

Name: _____

1. Which hat can never meet a brief that asks for a brim all the way around? (A) a bucket hat, (B) a ball cap, (C) a sun hat.
2. The brief asks for a brim of at least 76 mm. The app says Brim width 68 mm. The hat: (A) meets it, (B) misses it: widen the brim, (C) misses it: make the crown shorter.
3. You change the size from 56 cm to 60 cm, and the brim number gets bigger. Why?

Exit ticket

Name: _____

1. Which hat can never meet a brief that asks for a brim all the way around? (A) a bucket hat, (B) a ball cap, (C) a sun hat.
2. The brief asks for a brim of at least 76 mm. The app says Brim width 68 mm. The hat: (A) meets it, (B) misses it: widen the brim, (C) misses it: make the crown shorter.
3. You change the size from 56 cm to 60 cm, and the brim number gets bigger. Why?

Answer key: exit ticket

From the app's own measurements at 56 cm: the Sun hat meets the brim and height requirements as made (13.3 cm brim, 90 mm crown); the Bucket hat's brim reads 54 mm and passes once Brim width reads 76 mm; the Boater reads 69 mm; the Cowboy hat's brim passes (90 mm) but its crown is 12.6 cm, over the limit.

QUESTION	ANSWER	WHY
1	B	A ball cap has a bill, which sticks out at the front only. The brief asks for shade all the way around.
2	B	68 mm is less than 76 mm, so the brim requirement is missed. The fix is a wider brim; the crown has nothing to do with it.
3	The whole hat grows with the head, so every part, the brim too, gets bigger in proportion	Full credit for saying the hat scales with the size, or that a bigger head needs a bigger hat.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Meets the brief	All four requirements are met, and the hat also does something the brief did not ask for, explained on the worksheet.	All four requirements are met.	Two or three requirements are met.	One requirement or none is met.
Checks with numbers	Every requirement on the brief has the number read from the app next to it, and the student explains why the size is set first.	Every requirement on the brief has the number read from the app next to it.	Some requirements have a number; others are ticked without one.	Requirements are ticked without any numbers.
Signs off a classmate's hat	Checks every requirement on a classmate's hat with the app's numbers, and names the fix for any that is missed.	Checks every requirement on a classmate's hat with the app's numbers.	Checks some requirements, or signs without reading the numbers.	Does not check the classmate's hat.

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

Standards

These NGSS engineering design standards describe a design problem with criteria and constraints, and a solution evaluated against them. Students design to a client's brief with numbers in it and check each requirement against the app's measurements.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	3-5-ETS1-1	3-5	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	Students read a client's need (shade for the neck and ears) as a brief with criteria (size, brim) and a constraint (height), before they design.
NGSS	MS-ETS1-2	6-8	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	Students check a classmate's hat against every requirement, using the app's measurements, and sign it off or name the requirement it misses.
Common Core Math	5.MD.A.1	5	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. Represent and interpret data.	Students check millimeter and centimeter readings against the brief, such as a 90 mm crown against the 12 cm limit and a 13.3 cm brim against 76 mm.

Checked October 2026 against: NGSS 3-5 engineering design, NGSS middle school engineering design, Skin Cancer Foundation: hats with a brim of at least 3 inches all around, Common Core State Standards, Grade 5 Measurement and Data.

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. Work stays in the browser tab until it is closed.

To keep students' work, and see every student's hat 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/hat-lab/lessons/design-a-sun-hat-to-a-brief/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time. A student who started at the worksheet link and then signs up keeps what they made.

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