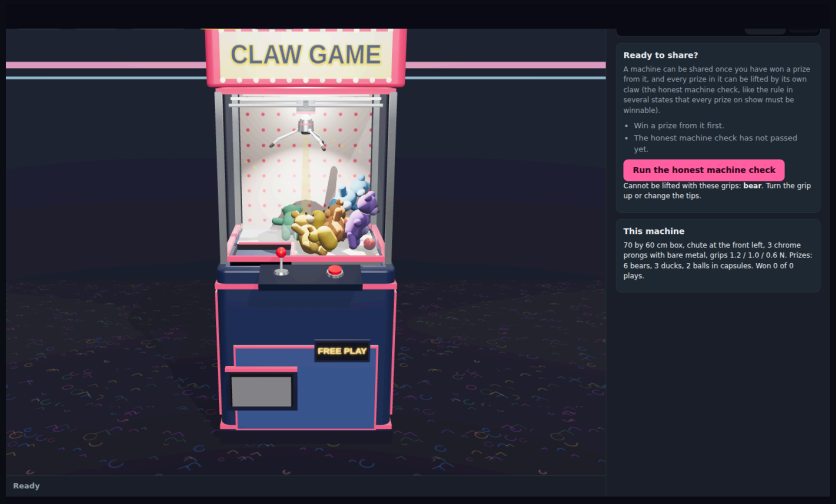
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Claw Game Maker: Build a Fair Machine

Grades 6-8 · 45 minutes

Physical science · Engineering



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 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 design log
- 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 high school physics
- Standards: NGSS

Claw Game Maker: Build a Fair Machine

Grades 6-8 · 45 minutes · Physical science, Engineering

The starter machine is unfair: big bears and boxed toys that its weak, bare-metal claw cannot lift, and the honest check says so by name. Students fix it one change at a time, checking after each: grips, tips, pad angle, prongs, the pile. Then they tune it so careful robots win about one play in three, and share it for classmates to play. By the end they have run a design loop against a real constraint and a real test.

At a glance

ESSENTIAL QUESTION

How do you make a claw machine that is fair to the player and still fun?

OBJECTIVES

Students will be able to:

- state the criteria (fun to play, about one win in three) and the constraint (every prize can be won) for the machine
- use the honest machine check and the robot players as tests, and change one thing at a time between them
- explain each change in terms of friction, cradling or the pile
- share a machine that passes the check, and play a classmate's

VOCABULARY

Criteria, Constraint, Honest machine check, Iteration, Trade-off

STANDARDS

MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, 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
- Optional: a second class period for sharing and playing one another's machines

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/clawmaker?lesson=build-a-fair-machine&ref=tpt-clawmaker-4 once on a student computer: open Build, Share and Run the honest machine check. It fails and names the kinds. Turn the grips up in Build, Claw, pick rubber pads, and run it again. About five minutes.

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 with WebGL, 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.

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: is an unwinnable prize wrong, or just hard? Take both sides, then show the rule on the slide.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app with the unfair starter. Run the honest check: it names the big bear and the boxed toy. Show The two tests and What you can change. Make one change on the projector, run the check again, and write it in a design log line on the board. **It's working when:** Say the loop out loud every time: change, test, result, next.	Fill in the vocabulary.
12 to 22	**Guided practice (We do)** Pass the check together	Students open the link. The guide runs the check, sends them to Build, Claw to change one thing, and back to the check until it passes. Walk the room and ask what each change was for. **Watch for:** Students who turn every grip to 12 N at once. It passes, and the robots will then win nearly every play; they will have to come back down.	Follow the guide and log every change and result.
22 to 38	**Independent practice (You do)** Tune and share	Students run the robots and tune toward about 7 wins in 20 while the check still passes, logging each round. Then they share the machine and play one from a classmate, writing what the maker did to make it hard. **If they ask:** "The grip that lifts the boxed toy makes the bears easy. What else could lift the box without turning the grip up?" The trade-off	Tune, share, play a classmate's, and fill in the design log.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide and take two or three trade-offs. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/clawmaker?lesson=build-a-fair-machine&ref=tpt-clawmaker-4. The unfair starter: three big bears, three boxed toys, four bears and two capsule balls, under a claw with bare metal tips and grips of 1.2, 1.0 and 0.6 newtons.

1. **The check.** Open `Build`, `Share`, and press `Run the honest machine check`. It names the kinds that cannot be lifted: the big bear and the boxed toy, and at these grips the bear too.
2. **One change.** Open `Claw`. Pick rubber pads. Run the check: the bear passes, the big bear and the box still fail.

3. **Again.** Turn the Grab, Lift and Carry grips up to 4, 3.5 and 2.8 N. Run the check: the big bear passes. The box needs about 4 N with three prongs or 2 N with four: pick 4 prongs.
4. **Tune.** Open `Test` and run the robots. If they win most plays, bring a grip down or the pad angle back, and check again. About 7 of 20 is the target.
5. **Share.** Win a prize from it yourself (the check asks for that too), then share it. Classmates play it from the share page.

> The check fails by name, so every change has a target. A machine that passes with every grip at 12 N is fair and dull, and the robots say so.

Background for the teacher

This is MS-ETS1 with a real constraint and a real test. The constraint comes from the trade: several states require that every prize on show in a crane game be obtainable with the claw as set, and the app's honest machine check is modeled on it. The criterion is play: a machine the robots win nine times in ten is a vending machine, and one they never win is a thief; one in three is a game.

The trade-offs are the physics of the first two parts of this series. A boxed toy has flat sides nothing can get under, so it needs a squeeze: about 4 N per prong with three rubber-padded prongs, or about 2 N with four. A grip that high makes the plush bears nearly certain, so students look for other levers: more prongs, longer prongs, a different pile.

The robots are the model that generates data for iterative testing (MS-ETS1-4). Twenty plays is a rough measure; students who want to be sure run sixty.

What to look for

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

- What did the check say, and what did you change for it?
- Why did rubber pads fix the bear but not the box?
- What lifted the box in the end, and what did that do to the bears?
- What is your machine's rate now, and how do you know?
- What did a classmate do that you did not think of?

> The third question is the real test: a student who can name the trade-off and how they settled it has run the loop.

Cross-curricular extensions

- Math: with a dollar a play and prizes that cost three dollars, which win rate makes the machine pay for itself?
- Civics: find whether your state has a rule on crane games and what it says.
- Art: design the cabinet and the sign in Build, Cabinet, for a theme of your own.

- English: write the fair-play notice a careful operator would post on the machine.

Vocabulary

Criteria	What a good design must do: here, be fun to play, with careful players winning about one play in three.
Constraint	A rule the design must obey: here, every prize kind in the box can be lifted at the machine's own grips.
Honest machine check	The app's test: the maker has won a prize from it, and every prize kind can be lifted on the bench at its grips.
Iteration	One round of change, test, and look at the result. A design takes several.
Trade-off	Making one thing better makes another worse. A grip that lifts the boxed toy makes the bears too easy.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and say criterion, constraint and trade-off as you point at the two tests.
- Pair each learner with a partner; the design log is a table of changes and results.
- Accept the log as the app's own words copied: which kinds failed, which passed.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students, one changing and one logging.
- Zoom the browser to 150%.
- Allow passing the check alone, without the tuning, where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "I changed ___ because the check said ___."
- Do the first two changes together on the projector.
- Use the Kid level: the grips read weak, medium and strong.

STUDENTS READY FOR MORE

- Make the box winnable without turning the grip up: four prongs, longer prongs, or a pile that stands it on end.
- Tune two machines to the same rate, one by grip and one by the pile, and compare how they feel to play.
- Put your own 3D model from the library in the box and make it winnable.

Adapting for other grades

Younger students: In grades 4 and 5, set the level to Kid, pass the check with the guide and share; drop the third rubric row; total 8, and 6 meets the objectives.

Older students: In high school, add a cost: each newton of grip and each prong costs a point, and the design must pass the check at the lowest cost.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/clawmaker?lesson=build-a-fair-machine

Essential question: How do you make a claw machine that is fair to the player and still fun?

Warm-up: An unwinnable prize: wrong, or just hard? What would you change first? _____

1. **Vocabulary.** Criteria, constraint, honest machine check, iteration, trade-off: write each in your own words.

2. **The design log.** Each round: what I changed, why, the test I ran, the result.

3. **The rate.** Robots won ____ of 20 with the check passing. A classmate's machine: ____ of 20, and what they did: _____

1. What was your hardest trade-off, and how did you settle it?

2. Why does the check ask that the maker has won a prize too?

Exit ticket

Name: _____

1. A constraint is (A) something a design must do well (B) a rule a design must obey (C) a change you try

2. The honest check fails on the boxed toy. The best next step is (A) turn every grip to 12 N (B) change one thing for the box and check again (C) take every prize out

3. Name one trade-off in a fair claw machine and how you would settle it.

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Exit ticket

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3. Name one trade-off in a fair claw machine and how you would settle it.

Answer key: exit ticket

QUESTION	ANSWER	WHY
1	B	Criteria are what it should do well; a constraint is what it must obey.
2	B	One change, one test; a maximum grip passes the check and ruins the play.
3	For example: the grip that lifts the box makes the bears easy	Settle it with another lever: more prongs, longer prongs, hooked pads, or a different pile. A full answer names the test used.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Design log	Every change logged with the reason, the test and the result, and a trade-off named.	Every change logged with the test and the result.	Some changes logged.	No log.
Constraint	Passes the honest check and explains each failing kind in terms of friction, cradling or the pile.	Passes the honest check.	Fails on one kind.	Not run.
Criteria	Robots win between 5 and 9 of 20 while the check passes, and a classmate's machine was played and described.	Robots between 5 and 9 of 20 while the check passes.	Tuned but outside the range, or the check no longer passes.	Not tuned.

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

Standards

The lesson is built for MS-ETS1-1 to 4: criteria and a constraint, evaluation against tests, comparison across designs, and a model that generates data.

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 state the criteria and the constraint, with the state rule as the limit.
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 evaluate each change against the honest check and the win rate.
NGSS	**MS-ETS1-3**	6-8	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	Students compare their machine with a classmate's and combine what worked.
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.	The robot players generate data for iterative testing.

Checked November 2026 against: NGSS MS-ETS1 Engineering Design (MS-ETS1-1 to MS-ETS1-4), New Jersey Administrative Code 13:3-7.4, crane games: prizes must be obtainable by the claw as set.

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/claw-game-maker/lessons/build-a-fair-machine/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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