Family edition

Claw Game Maker: Build a Fair Machine

Ages 11-14 · about 45 minutes, in one sitting, with more if they want to share

Your child designs a fair claw machine in Claw Game Maker, starting from one that is not. The point is a design loop: change one thing, test it, read the result, and keep the machine fun while every prize stays winnable.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/clawmaker?lesson=build-a-fair-machine&ref=fam-clawmaker-4. No account, no email and nothing to install; a free account to share the machine.

Before you start: try it once yourself

Open mytekdev.com/try/clawmaker?lesson=build-a-fair-machine&ref=fam-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. Friends 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.

The ideas, in plain words

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 children 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; children who want to be sure run sixty.

Do it together

1. Open mytekdev.com/try/clawmaker?lesson=build-a-fair-machine&ref=fam-clawmaker-4 together. Open Build, Share, and Run the honest machine check.

   > **You'll know it worked when:** It fails and names the big bear and the boxed toy.

2. Open Build, Claw. Change one thing: rubber pads, or a higher grip, or hooked pads. Run the check again.

   > **If you get stuck:** The check names what still fails; change one thing for that kind.
   >
   > **You'll know it worked when:** Each change is for a reason your child can say.

3. When it passes, open Test and run the robots. Aim for about 7 wins in 20.

   > **You'll know it worked when:** If they win nearly every play, turn a grip down and check again.

4. Talk about the trade-off: what made the box liftable, and what did that do to the bears?

   > **You'll know it worked when:** Your child can name one trade-off and how they settled it.

Talk about it

Ask these while you work together. A child who has understood it 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 friend do that you did not think of?

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

For younger and older kids

Younger: For a younger child, set the level to Kid and stop when the check passes.

Older: For a teenager, make the boxed toy winnable without turning the grip up: more prongs, longer ones, or a pile that stands it on end.

Keep going

- 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.

Bring it into other subjects

- 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.

For your records

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

LESSON	Claw Game Maker: Build a Fair Machine
SUBJECTS	Engineering, Physical science
TIME	45 minutes
WHAT WE DID	Ran a design loop on a claw machine simulation: stated criteria and a constraint, changed one thing at a time, tested with an honest-machine check and robot players, and shared the result.
SKILLS PRACTICED	Engineering design; Testing against a constraint; Reading data from a model

Activity sheet (optional)

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 friend'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?

Quick check

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.

Answers

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.

If your state or umbrella school asks, this lesson covers NGSS MS-ETS1-1, NGSS MS-ETS1-2, NGSS MS-ETS1-3, NGSS MS-ETS1-4.

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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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