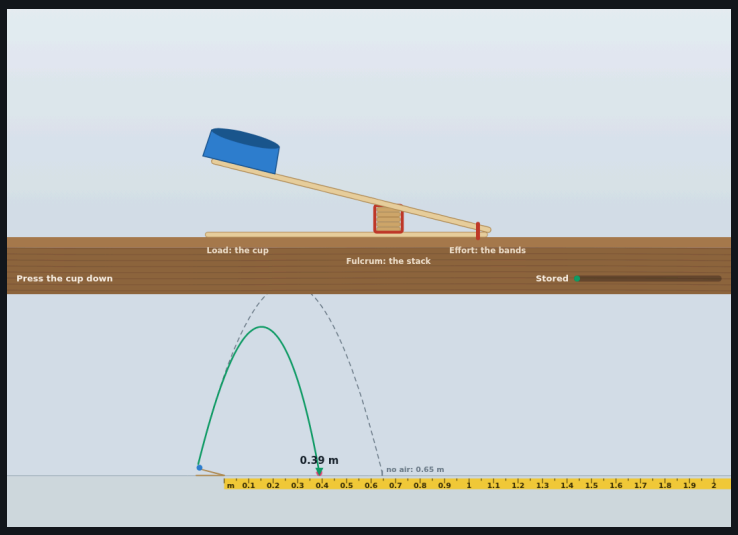
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Catapult Lab: Where Did the Push Go?

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 six-throw table
- 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

Catapult Lab: Where Did the Push Go?

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Students throw three projectiles from the same craft-stick catapult, first from a bottle cap and then from a paper cupcake liner, and read two energy bars after every throw: where the stored energy went when it let go, and how much the air took in the flight. A pom-pom gets about a tenth of the push from a bottle cap and lands at 0.39 m; from a liner it gets about a quarter and lands at 0.78 m.

At a glance

ESSENTIAL QUESTION

When a catapult lets go, where does the energy it stored go?

OBJECTIVES

Students will be able to:

- throw three projectiles from two cups and record how far each went
- read where the stored energy went: to the projectile, swinging the cup and stick, or into heat
- explain why a light cup throws a light projectile farther, using energy transfer
- explain why the air takes more from a pom-pom than from a ping pong ball

VOCABULARY

Energy, Stored energy, Energy transfer, Projectile, Air resistance

STANDARDS

MS-PS3-5

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/catapultlab?lesson=where-did-the-push-go&ref=tpt-catapultlab-1 once on a student computer: it opens on the built catapult with a pom-pom in a bottle cap, and checks that your school's filter allows the app. Run it yourself, about ten minutes: move Press all the way and press Let go (0.39 m), then a ping pong ball (0.29 m), then the paper cupcake liner with the pom-pom (0.78 m). Read the card after each.

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.

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: where does the push go? Write every answer 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. Move Press all the way and press Let go: 0.39 m. Point at the two arcs, then read the card's first bar aloud: about a tenth to the pom-pom, two thirds still swinging the cup and stick, a quarter into heat. **It's working when:** The stick and the cup have to swing too. A 2.5 g bottle cap is six times heavier than a 0.4 g pom-pom, so it keeps most of the push. The paper liner weighs 0.4 g.	Watch, and fill in the vocabulary on the worksheet.
12 to 22	**Guided practice (We do)** Three throws together	Students open the link or scan the QR code. A short guide walks them through the pom-pom, the ping pong ball and the liner. After each, ask: what share went to the projectile? **Watch for:** Students who change the cup and read the old card. The card changes only after Let go is pressed again; the guide says "Throw it to see what the change does".	Fill in the first three rows of the table.
22 to 38	**Independent practice (You do)** Fill the table	Students throw the mini marshmallow from both cups and the ping pong ball from the liner, recording the distance and the first bar's share each time. Walk the room with the What to look for questions. **If they ask:** "The ping pong ball got a bigger share of the push than the pom-pom, and still landed shorter. How can both be true?" The ping pong ball	Finish the table and answer the questions.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two students explain where the liner's extra distance came from, then go back to the warm-up answers. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/catapultlab?lesson=where-did-the-push-go&ref=tpt-catapultlab-1. A short guide opens over the app. The craft-stick catapult is built, with a pom-pom in a bottle cap. The shelf on the right picks the projectile and the cup.

1. **The first throw.** Move Press all the way: the strip says "Pressed 23 mm: on the base". Press Let go. The pom-pom flies high and back over the banded end and lands at 0.39 m. The dashed arc, the same throw with no air, lands at 0.65 m.

2. **The card.** Energy, letting go: to the pom-pom 9%, still swinging the cup and stick 66%, turned into heat, mostly in the bands 25%. Energy, in the flight: still moving when it landed 56%, taken by the air 44%.
3. **Five more throws.** Bottle cap: mini marshmallow 0.52 m (14% to it), ping pong ball 0.29 m (34%). Paper liner: pom-pom 0.78 m (24%), mini marshmallow 1.21 m (33%), ping pong ball 0.50 m (55%).

> The moment that lands is the ping pong ball. It gets more than three times the pom-pom's share of the push and still lands short: it is almost seven times heavier, so that share moves it slower.

Background for the teacher

Pressing the cup bends the top stick and stretches the bands at the banded end. Let go, and they give back about three quarters of what they stored; the rest becomes heat. What comes back has to move everything on the arm: the stick, the cup and the projectile. A heavy cup on a light projectile keeps most of it, so the projectile leaves with only a small share.

A heavier projectile takes a bigger share of the push, but the same energy moves a heavier thing slower. Then the air: it pushes against anything moving through it, and a light, fluffy pom-pom feels it about as much as its own weight at launch. The air takes 44% of the pom-pom's energy and only 12% of the ping pong ball's. Catapult Lab works out each throw from the build: how stiff the stick and the bands are, how heavy the cup and the projectile are, and the air. Two of its numbers are estimates still to be measured (how hard the bands hold the end down, and that they give back 75% of what was stored), so a real catapult can land well short of the drawing or past it. The app never claims more: every speed and energy is shown as "about".

What to look for

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

- Where did most of the push go on your first throw?
- Why does a heavy cup keep so much of it?
- The ping pong ball got a bigger share and landed shorter. How?
- Which projectile does the air slow the most, and how can you tell from the screen?
- Which change made the biggest difference: the cup or the projectile?

> The second question is the real test: a student who says the cup and stick have to move too, and a heavy cup takes more to move, has the idea.

Cross-curricular extensions

- Math: make a bar graph of distance for the six throws, grouped by cup. What does the liner do to every projectile?
- Math: the bottle cap weighs 2.5 g and the pom-pom 0.4 g. How many times heavier is the cap?

- Building: make a real catapult with a bottle cap, then a paper liner, and throw a pom-pom five times from each. Eye protection for everyone the whole time, building too. Light, soft things only: pom-poms, marshmallows, ping pong balls. Aim at a target on the floor, never at a person. A stick can snap and splinter, so press slowly.
- English: write a paragraph that argues, with evidence from the bars, which cup a class should use.

Vocabulary

Energy	What it takes to make something move, or to stretch or bend it.
Stored energy	Energy held in a stretched band or a bent stick, waiting to be let go.
Energy transfer	Energy moving from one thing to another: from the band to the arm to the pom-pom.
Projectile	Something thrown that flies on its own once it leaves the cup.
Air resistance	The push of the air against something moving through it, slowing it down.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and point at the screen as you say each word: the arc, the tape and the colored bars carry the meaning.
- Pair each learner with a partner; the arcs and the colored bars are pictures, the distance is a number.
- Accept the table as numbers and the bar labels copied from the screen.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students for the independent part, one at the app and one filling in the table.
- Zoom the browser to 125%; the card stays readable.
- Allow four throws instead of six, where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "From the liner, the pom-pom got more of the push because ___."
- A check-in after the guide: every student has the three throws in the table before anyone moves on.
- Give only the bottle cap and liner with the pom-pom.

STUDENTS READY FOR MORE

- Set the level to High school: the card gives the energy in millijoules. Add up what went where. Does it come to what was stored?
- Find the projectile and cup that land farthest. Is it the one with the biggest share to the projectile?
- Compare the second bar for the pom-pom and the ping pong ball. Why does the air take so much more from the pom-pom?

Adapting for other grades

Younger students: In grades 4 and 5, set the app to Grades 4 and 5 (distances in centimeters, energy in words) and do the guide together on the projector. Pairs share a computer, one on the mouse and one recording. Skip the third rubric row; total 8, and 6 meets the objectives. At that level the bars have words and no percentages: ask which part of the bar is biggest.

Older students: In high school physics, the card gives millijoules stored, given back and given to the projectile, and the launch speed. Students check that kinetic energy one half m v squared, with the masses on the shelf (pom-pom 0.4 g, ping pong ball 2.7 g), matches the energy given, and compare the share with the mass of the projectile against the mass of the cup.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/catapultlab?lesson=where-did-the-push-go

Essential question: When a catapult lets go, where does the energy it stored go?

Warm-up: You press a catapult down and let go. Where does all that push go? _____

1. **Vocabulary.** Energy, stored energy, energy transfer, projectile, air resistance: write each in your own words.

2. **The throw table.** For each cup (bottle cap, paper liner) and each projectile (pom-pom, mini marshmallow, ping pong ball): how far _____ m; share to the projectile _____ %.

1. Where did most of the push go from the bottle cap? Use the bars.

2. Why did the pom-pom go twice as far from the paper liner?

Catapult Lab: Where Did the Push Go?

Exit ticket

Name: _____

1. A pom-pom in a heavy bottle cap: most of the energy goes (A) to the pom-pom (B) into swinging the cup and stick (C) away as sound

2. The ping pong ball got a bigger share of the push than the pom-pom but landed shorter, because (A) it is heavier, so the same push makes it slower (B) the air took more from it (C) it was pressed less

3. Explain why a lighter cup throws a pom-pom farther.

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3. Explain why a lighter cup throws a pom-pom farther.

Answer key: exit ticket

QUESTION	ANSWER	WHY
1	B	The cup and stick have to swing too; a heavy cap keeps about two thirds of the energy.
2	A	It is almost seven times heavier than the pom-pom, so even a bigger share moves it slower. The air takes less from it, not more.
3	Less of the push stays in the cup	A light cup takes less energy to swing, so more goes to the pom-pom: about a quarter instead of a tenth. "It is lighter" alone is half.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
The throw table	All six throws, each with the distance and the share to the projectile.	At least four throws, each with the distance and the share.	Some throws recorded.	No throws recorded.
Where the energy went	Says the stored energy goes to the projectile, the swinging cup and stick, and heat, and uses the bars as evidence.	Names at least two places the energy went.	Says the energy goes into the projectile only.	No answer.
Explaining the liner	Says the lighter cup keeps less of the push, so more goes to the pom-pom, and cites the shares.	Says the lighter cup lets the pom-pom go farther.	Says the liner is better, with no reason.	No answer.

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

Standards

The lesson is built for MS-PS3-5: students argue from evidence that the energy stored in the catapult is transferred to the projectile, the swinging arm and the air. The app shows the shares, with no energy calculations, inside its boundary.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	**MS-PS3-5**	6-8	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	Students use the energy bars and the distances as evidence that the stored energy went to the projectile, the swinging cup and stick, and the air.

Checked November 2026 against: NGSS MS-PS3-5, Energy.

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/catapult-lab/lessons/where-did-the-push-go/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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