Break the Chain



PRIMARY

1

Make it last

Best not to throw away: mend and give away clothes, or refill the bottle.

Watch out: if thrown away, this plastic lasts for ages, because it's very tough.

02/54

PRIMARY

2

Into the bins

The bottle goes in the yellow bin, and clothes in the clothes bin.

Watch out: little mixed or coloured clothing is recycled today, because dyes and blends make it harder.

03/54

PRIMARY

3

Sort by material

Polyester and the bottle are the same plastic: super-long chains of rings and connectors.

Watch out: blends with cotton or elastic are hard to recycle, as they're woven together.

04/54

PRIMARY

4

Chop, wash and dry

It's cut into small pieces, washed and dried. Inside, the tiny chains are still whole.

Watch out: if water is left, there may be fewer useful rings, because water spoils some.

05/54

PRIMARY

5 ★

The chain breaks

In a closed jar, methanol and a catalyst cut the chain. Rings and connectors come apart whole.

Plus: 65 degrees is enough, much less than usual, because another liquid helps.

06/54

PRIMARY

6

What doesn't break

Cotton and elastic don't break: they're taken out with a sieve. Nothing is left of the bottle.

Plus: it works for mixed clothes, because only the polyester is cut.

07/54

PRIMARY

7

Crystals as it cools

The rings don't fit in the cold liquid and form crystals. The connectors stay in it.

Watch out: the skirt's dye, loose in the liquid, stained them pink.

08/54

PRIMARY

8

Recover the liquids

In a factory, the liquids would be heated to separate and reuse them. The connectors would be kept apart. That's distilling.

Watch out: it would use a lot of energy, as there's a lot of liquid to heat.

09/54

SECONDARY

2

Into the bins

The bottle goes in the yellow bin, and clothes in the clothes bin. With general rubbish, they would be burnt or go to landfill.

Watch out: little coloured or mixed polyester clothing is recycled today, because the other fibres and dyes make it harder.

03/54

SECONDARY

1

Make it last

Best of all is what you don't throw away. Looking after, mending, refilling or giving away what you don't use avoids waste and cost.

Watch out: thrown away, this plastic (PET) takes ages to break down, because it's tough and long-lasting, just what makes it useful.

02/54

HOW TO PLAY

Break the Chain

labur.eus/birziplastik-en

2-6 players · ages 10+ · about 20 minutes

01/54

SECONDARY

5 ★

The chain breaks

In a closed jar with methanol, another liquid and a catalyst, PET is cut between ring and connector. Out come rings (DMT) and connectors (EG, ethylene glycol).

Plus: 65 °C is enough, much less than usual, because the other liquid prepares the PET's surface.

06/54

SECONDARY

4

Chop, wash and dry

It's shredded, washed and dried. The PET chains, made of rings and connectors, stay whole. They're super long and too thin to see.

Watch out: if water is left, fewer useful rings may come out, as water turns some into salts. Cotton holds a lot of it.

05/54

SECONDARY

3

Sort by material

It's sorted by material. The polyester in clothes is PET, like the bottle. The skirt is almost all polyester, the fabric only a quarter.

Watch out: blends with cotton or elastane are hard to recycle today, as the fibres are woven together.

04/54

SECONDARY

8

Recover the liquids

In a factory, the liquids would be heated to separate them. Methanol and the other liquid would go back to the jar, and EG would be collected separately. That's distilling.

Watch out: it would use a lot of energy, as each kilo of PET needs about 8 kilos of liquid heated.

09/54

SECONDARY

7

Crystals as it cools

At 20 °C, with no fridge, DMT crystallises as it can no longer stay dissolved. EG doesn't.

Plus: with bottles, up to 97% is recovered, very pure, without adding anything.

Watch out: the skirt's dye, loose in the liquid, stained the crystals.

08/54

SECONDARY

6

What doesn't break

Methanol doesn't break the cotton in the fabric or the elastane in the skirt. They come out whole and are filtered out. Nothing is left of the bottle.

Plus: it works for mixed clothes, because those fibres don't dissolve and survive the reaction.

07/54

PRIMARY

9

Join up again

Rings and connectors could be chained together again into new plastic.

Plus: it would give off almost a third less of the gases that heat the planet, as the waste wouldn't be burnt.

10/54

PRIMARY

10

A new life

That plastic could make bottles or clothes again. That would close the circle.

Watch out: it hasn't been done yet. So far there are only lab tests and calculations.

11/54

QUICK RULES

Guide row 1 to 10. Under the 5, the BOTTLE 5. **Deal:**

	2	3	4	5	6
	8	7	6	5	4

Play cards under their step, next to a card of the same waste item. A 5 opens a row.

Can't play? Draw up to 3. Play the one that fits and your turn ends.

Misplaced card: back to your hand, draw up to 3.

Wild cards (Swap, Repair, Catalyst): one each, once, instead of drawing.

Play your last card to win.

12/54

THE RESEARCH

Taking plastic apart

A team from POLYMAT and Ghent University wants to stop polyester clothes and water bottles ending up burnt or in landfill.

With methanol and another liquid, they broke the plastic chain at 65 degrees. Usually it takes over 250. The pieces come out whole, even from mixed clothes, and could be rejoined.

Watch out: they calculated that recycling this way would give off fewer planet-heating gases, but use more oil, gas and coal.

Luna et al., *Resources, Conservation & Recycling* (2026)

13/54

LET'S TALK

IS IT WORTH IT?

When you finish, look at the pluses and watch-outs on the guide row.

1. By the calculation, if new plastic from oil gives off 10 of the gases that heat the planet, this recycling would give off about 7, as the waste is no longer burnt. But it would use more oil, gas and coal. Is it worth it?
2. Heating the liquids to separate them would use the most energy (step 8). What would you change?
3. The skirt's dye stained the crystals (step 7). What would you do with coloured clothes?

14/54

LET'S TALK

BEFORE RECYCLING

Outside the game, at home or in class:

1. Look at the labels on your clothes. How many are one material and how many are blends?
2. Best of all is what isn't thrown away (step 1). What could you mend, refill or pass on?
3. Cotton and elastane, the stretchy thread, come out whole (step 6). What could they be used for?

15/54

CREDITS

Zientzia Jolasak, a POLYMAT project. Version 1.0 (19/11/2026).

DESIGN Beñat Olave (POLYMAT). Mechanic inspired by a classic card game.

SCIENCE · Based on Luna et al., Resources, Conservation & Recycling 226, 108686 (2026), with the participation of POLYMAT (UPV/EHU) and Ghent University.

Illustrations generated with AI (Gemini). Icons: Lucide (ISC) and our own.

FUNDED BY

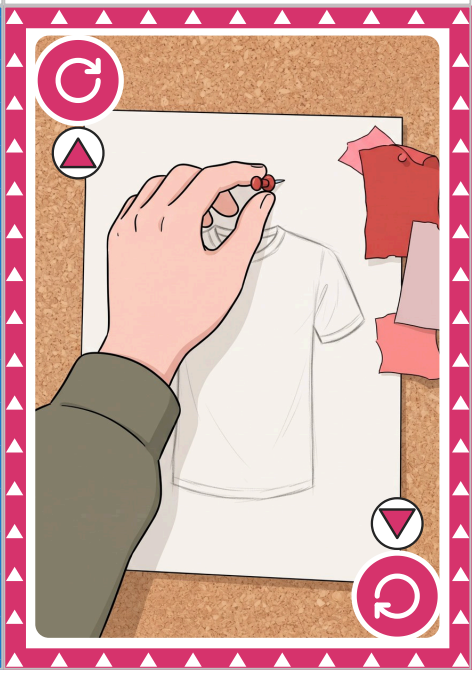
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Ezagutza Zabaltzen 2026 · Zientziarekin Solasean eta Jolasean project

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16/54





SECONDARY

10

A new life

That PET could make bottles or clothes again, without burning or burying the waste. That would close the circle.

Watch out: it hasn't been done yet. The factory is a calculation that assumes everything would work at large scale as in the lab.

SECONDARY

9

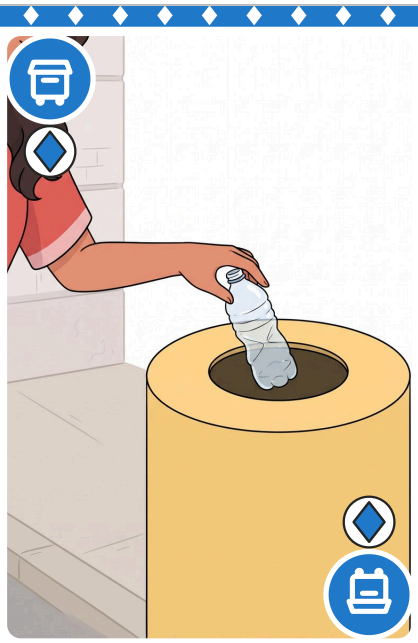
Join up again

DMT and EG could become PET again. It's only been calculated.

Plus: it would emit 29% less CO_2 than oil-based PET, because the waste is no longer burnt.

Watch out: it would use more oil, gas and coal. The article doesn't explain why.

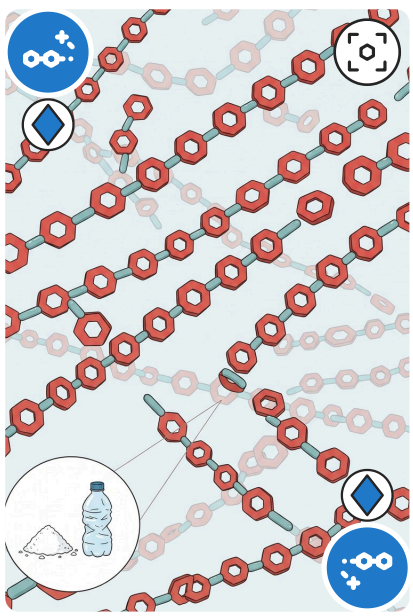


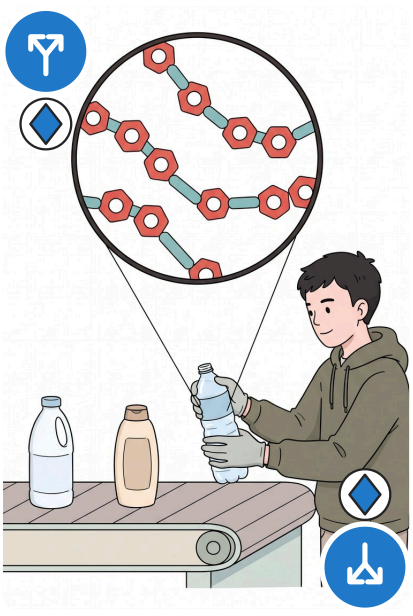




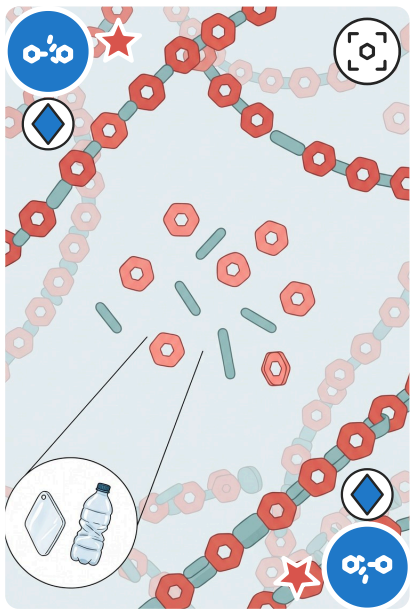






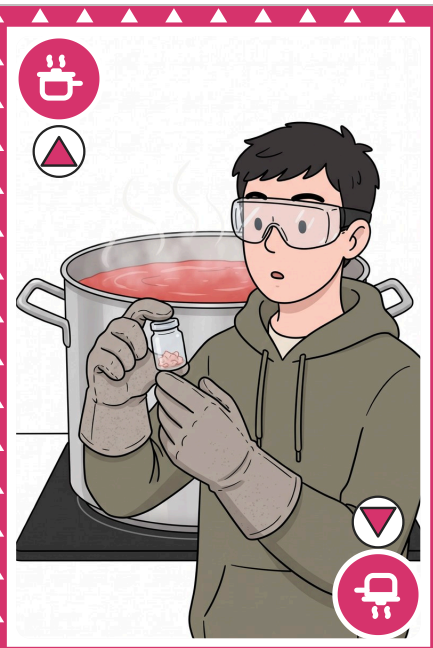


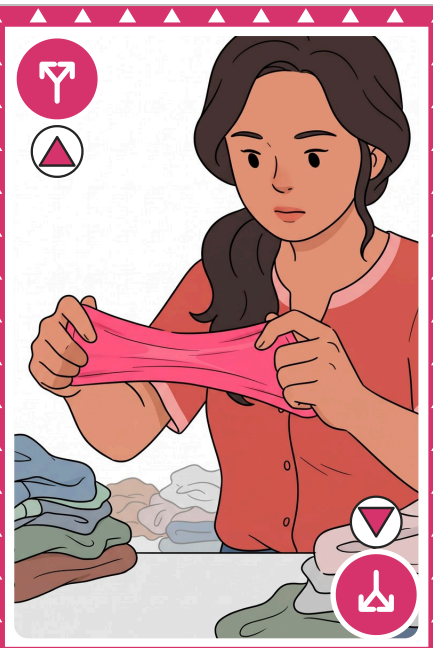


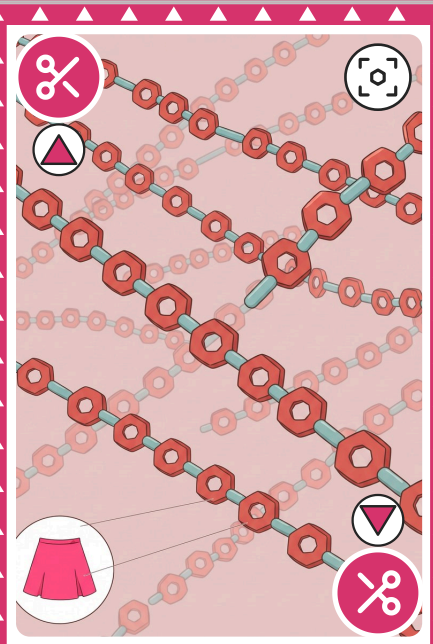



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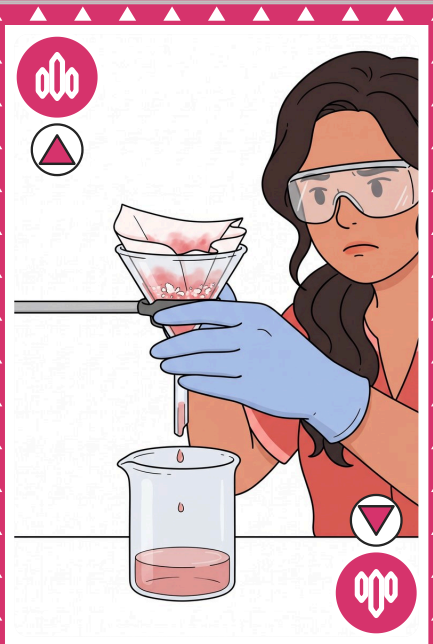




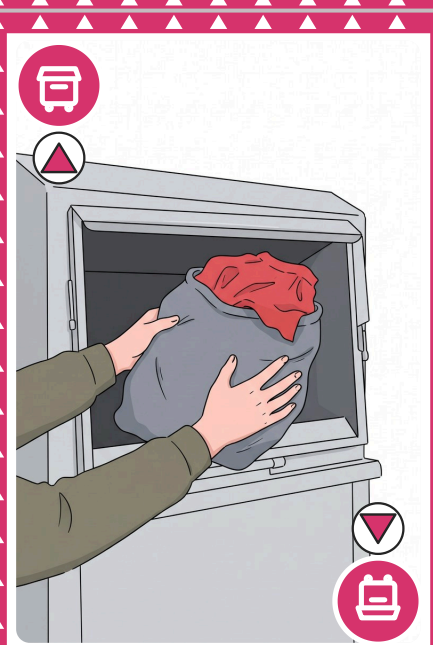








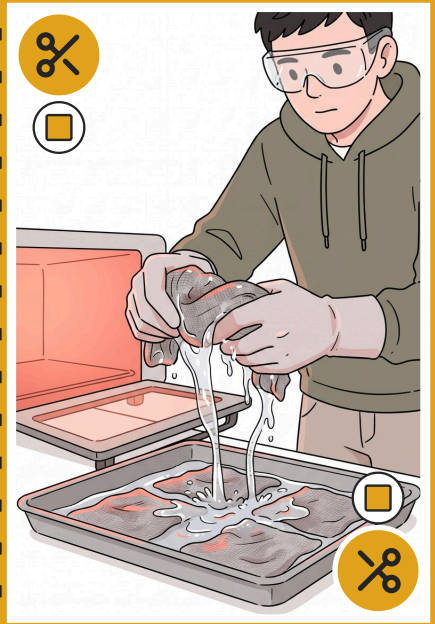




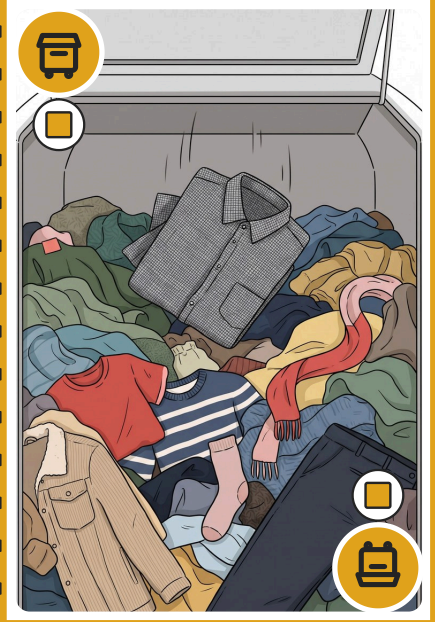


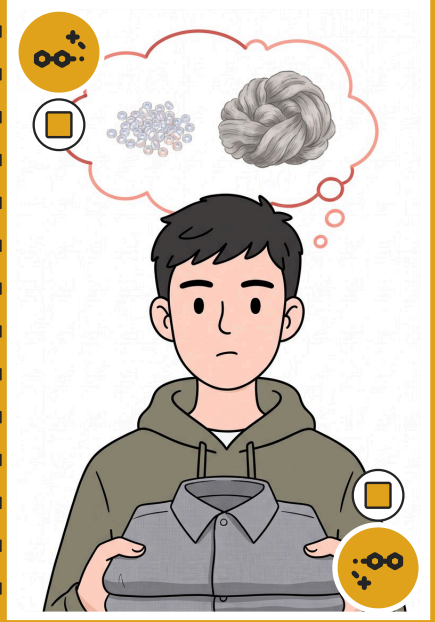

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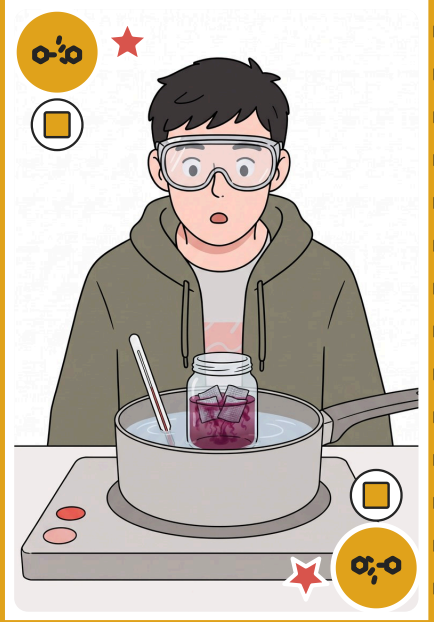


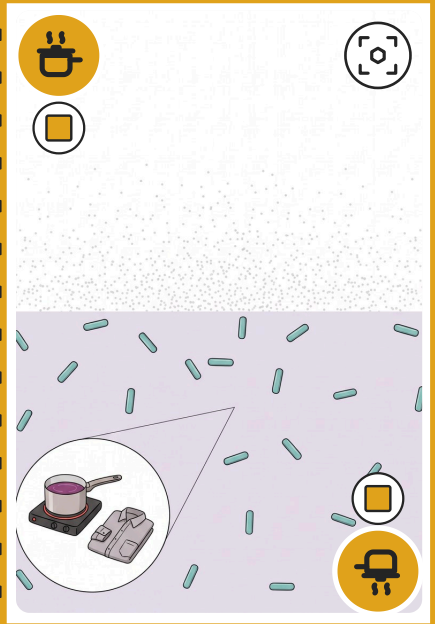




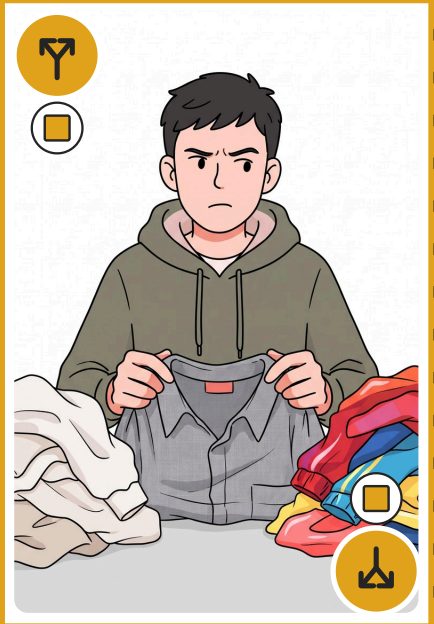






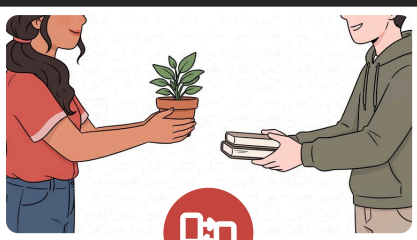







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WILD CARD

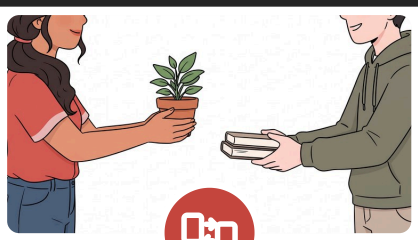


SWAP

Take a card blind from someone and give them one of yours.

One use only. If the card you get fits, play it.

WILD CARD

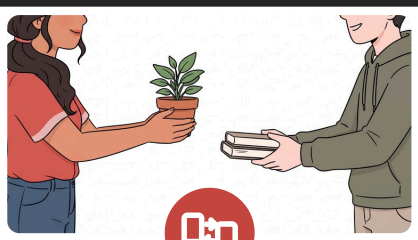


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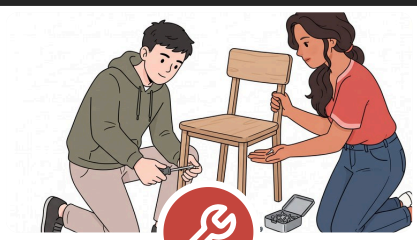


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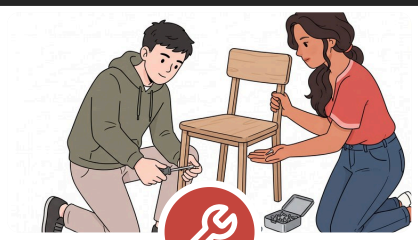


REPAIR

Take the top card of the deck and put one of yours underneath.

One use only. If the card you get fits, play it.

WILD CARD

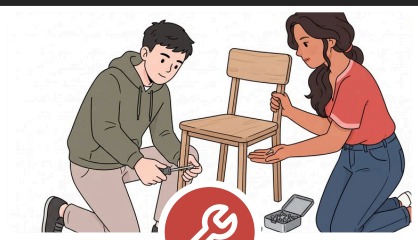


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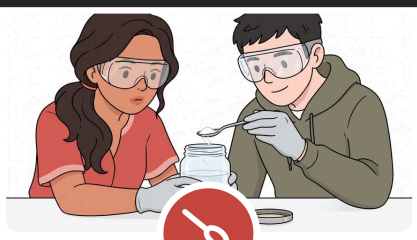


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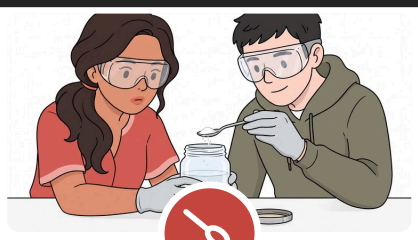


CATALYST

Put one of yours at the bottom of the deck, but never your last.

One use only. Then put it next to guide card 5: it stays in the jar.

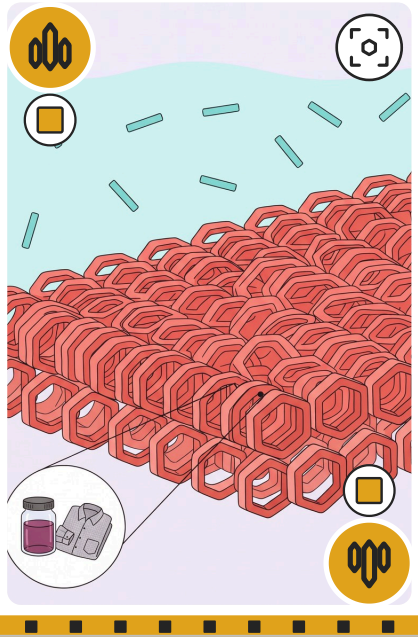
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