

MYSTERY PICTURE

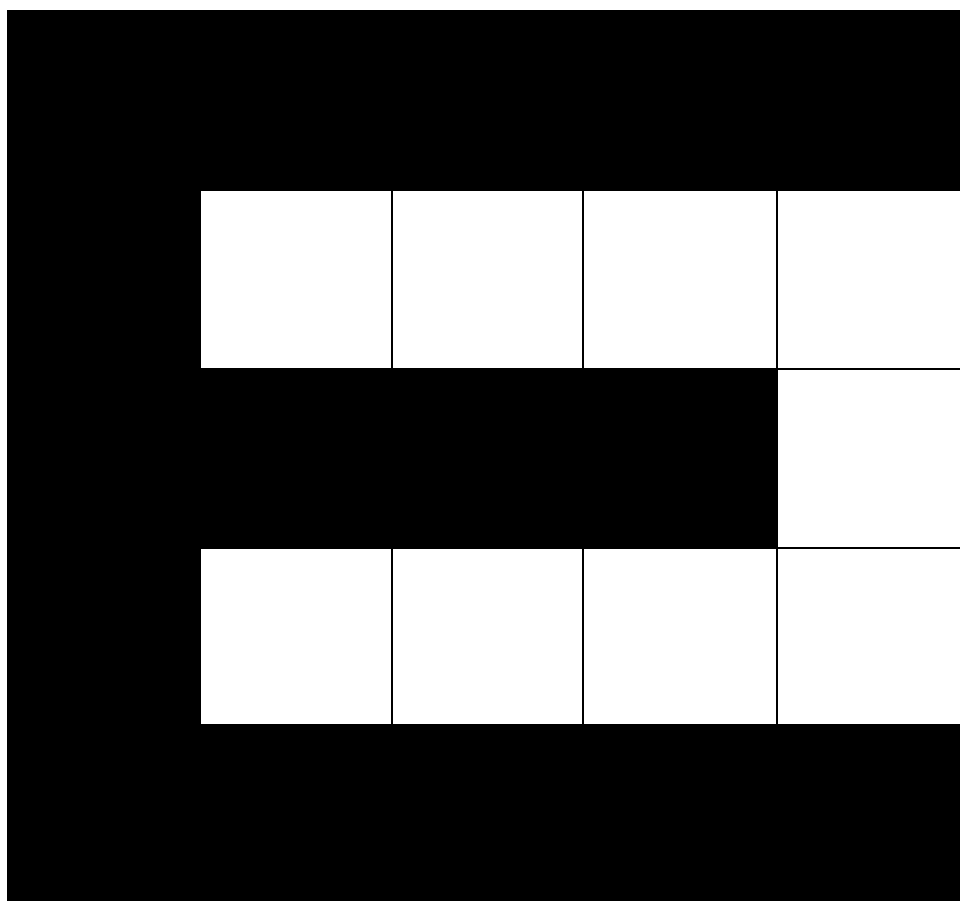


TRANSFORMATIONS AS FUNCTIONS

Is It a Function? Reading a Record of Arrows

25 records · no numbers · wrong answers show in the picture

FREE



Mystery Picture — how to run it

20–30 minutes

1. **Hand out page 3.** That is the whole preparation.
2. **Say this once:** *“Every arrow starts at an input and points at an output the rule gave it. A function gives each input exactly one output. Fill a square only if its record breaks that.”*
3. **Fill the square with slanted lines if the record proves the rule is not a function. Leave it white if it does not.** A picture appears. Sixteen of the 25 are filled.

Student sheet page 3, one per student. The arrow, the input and the output are printed on it as a picture.
Answers page 4 — the finished picture and the reason for every square.

Only the direction of the arrows decides. A square is filled when one dot has two or more arrows leaving it. That dot is one input with two outputs. In six of the nine white squares, two arrows *arrive* at one dot instead. That means two inputs share one output, and a function allows that.

White does not mean “it is a function.” A record shows only a few inputs, but a function must work for every point of the plane. So a record can prove that a rule is *not* a function. It can never prove that a rule is one. The student sheet asks the question this way. Say this aloud when students first argue about a white square.

A point can be an image and a preimage at the same time. In a chain, one dot is the output of one arrow and the input of the next. It touches two arrows, but it is still one input with one output.

Guessing does not work. Every simple guessing rule, such as filling every square where two arrowheads meet, gets at least eight squares wrong.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.

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Mystery Picture

One input, how many outputs?

Name _____

Period _____

Date _____

Each square is a record. A rule was tried on some points. Every arrow runs from an input to an output the rule gave it. A function gives each input exactly one output. Does the record prove the rule is NOT a function? If yes, fill the square with slanted lines. If no, leave it white. When you finish, look at the picture. If it does not look right, check your squares again.



$$P \rightarrow P'$$

P is the preimage, the input. P' is its image, the output



$$T(P) = P'$$

the same statement. T names the rule

1 	2 	3 	4 	5
6 	7 	8 	9 	10
11 	12 	13 	14 	15
16 	17 	18 	19 	20
21 	22 	23 	24 	25

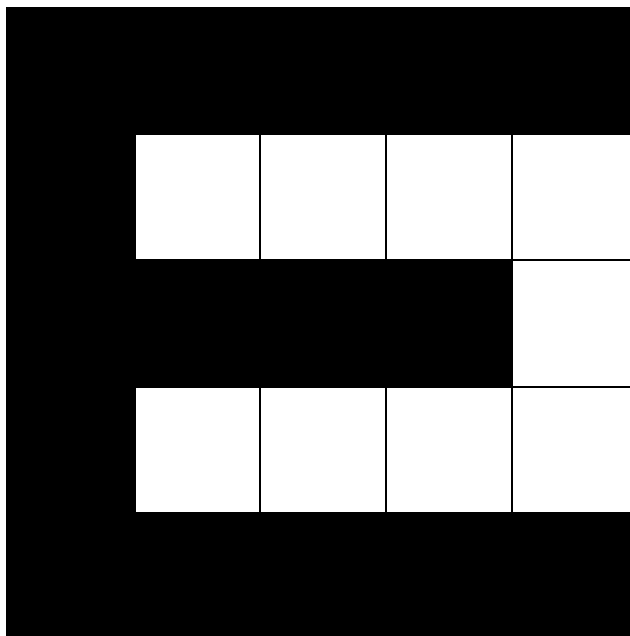


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Mystery Picture — answers

For the teacher

The finished sheet is **the letter E** — a bar across the top, straight down the left side with a bar across the middle, and a bar across the bottom. The table reads left to right, the way the sheet is read; the squares are numbered on the student's sheet.



1–5	FILL One input has two arrows out.	FILL The middle dot has two arrows out.	FILL One dot has two arrows out. (Arrows that meet are allowed.)	FILL One input has three arrows out.	FILL One dot of the loop has two arrows out.
6–10	FILL One dot has two arrows out. (Arrows that meet are allowed.)	white Two inputs share one output. That is allowed.	white A chain. Each input has one arrow out.	white A loop. Each input has one arrow out.	white Two arrows in, one out. That is allowed.
11–15	FILL One dot has two arrows out.	FILL The middle dot has two arrows out.	FILL One input has two arrows out.	FILL One dot has two arrows out. (Arrows that meet are allowed.)	white Three inputs share one output. That is allowed.
16–20	FILL One input has three arrows out.	white Arrows meet at two dots. Each input has one arrow out.	white A chain that ends where two arrows meet. That is allowed.	white Two arrows in, one out. That is allowed.	white Each input has one arrow out.
21–25	FILL One dot has two arrows out.	FILL One dot has two arrows out. (Arrows that meet are allowed.)	FILL One input has two arrows out.	FILL One dot of the loop has two arrows out.	FILL The middle dot has two arrows out.

Every filled square has one dot with two or more arrows leaving it. No white square has such a dot.