

MYSTERY PICTURE

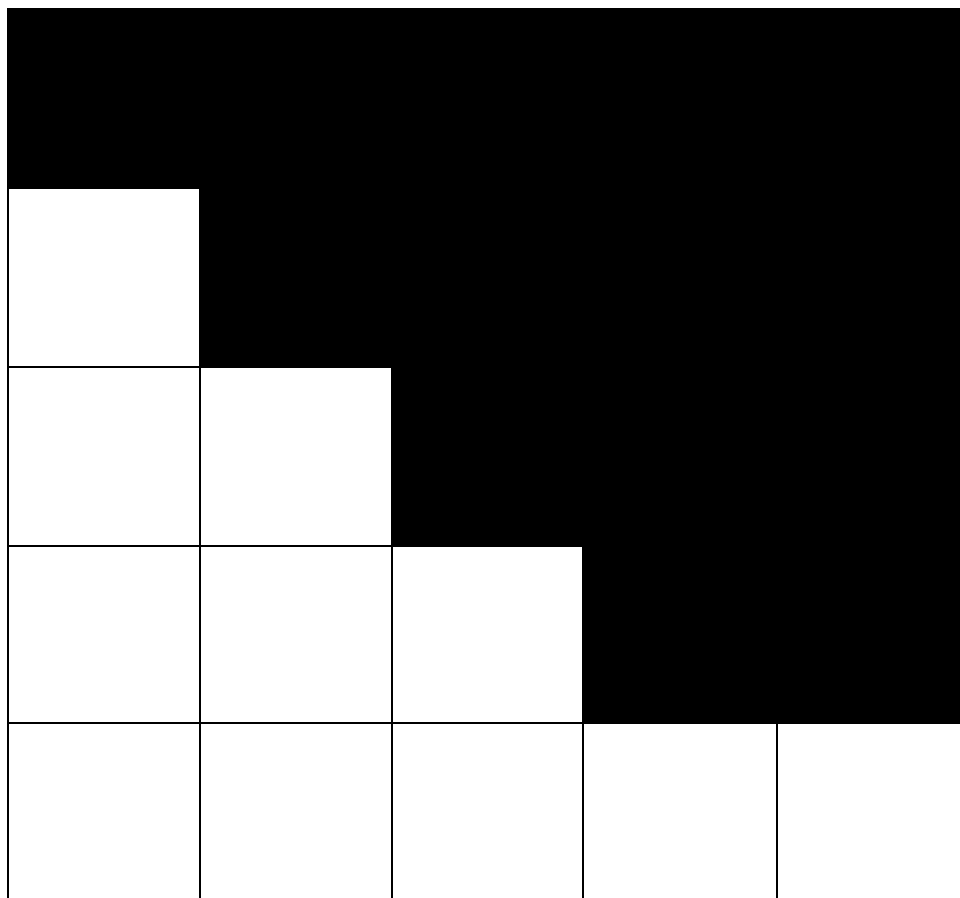


DILATIONS: CENTER AND SCALE FACTOR

Dilations: Is P' the Image?

25 squares · a compass and a ruler · wrong answers show in the picture

FREE



1. **Hand out page 3**, one per student, with a compass and a ruler each.
2. **Say this once:** *“Draw the ray from O through P. P’ must be on that ray. Then use the compass, not your eyes, to check how far P’ is from O.”*
3. **Students fill a square with slanted lines if P’ is the image, and leave it white if not.** A picture appears. Fourteen of the 25 are filled.

Student sheet	page 3, one per student. Three small pictures on it show the center and the scale factor, a factor more than 1, and a factor less than 1.
Answers	page 4: the finished picture and the reason for every square.

Students do no arithmetic. Every scale factor is 2, 3, $\frac{1}{2}$ or $\frac{1}{3}$. The student opens the compass from O to whichever of P and P’ is closer to O. Then they step it along the ray from O. For 2 or $\frac{1}{2}$, two steps must land on the other point. For 3 or $\frac{1}{3}$, three steps must. When the factor is more than 1, P must be the closer point. When it is less than 1, P’ must be the closer point.

The eleven white squares show four common mistakes. In two, P’ is the right distance from O but on the wrong side of O. This is the most common mistake when students draw an image: they draw a line through O where they need a ray. In two, the factor is turned upside down, so P’ is closer to O when it should be farther, or the other way around. In five, P’ is on the ray but not at the right distance, as happens when a student judges by eye. In two, P’ is the right distance from O but not on the ray.

Why the compass matters. A student who checks the side and the direction but never uses the compass gets five squares wrong (6, 12, 18, 21, 24). A student who uses the compass but never checks which side of O P’ is on gets four wrong (11, 17, 22, 25).

Guessing does not work. Every simple guessing rule, such as filling every square where O, P and P’ look like one straight line, gets at least five squares wrong. The picture then has holes that a student can see.

What it does not test. It uses only the factors 2, 3, $\frac{1}{2}$ and $\frac{1}{3}$. It does not ask students to draw an image on blank paper.



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

Is P' the image of P ?

Name _____

Period _____

Date _____

Each square shows a center O , a point P , a point P' and a scale factor k . Is P' the image of P ? Check three things.

1. Draw the ray from O through P . P' must be on this ray.

2. Open the compass from O to the point closer to O . Step it along the ray from O . For $k = 2$ or $\frac{1}{2}$, two steps must land on the other point. For $k = 3$ or $\frac{1}{3}$, three steps must land on the other point.

3. If k is more than 1, P' must be farther from O than P . If k is less than 1, P' must be closer.

If all three are true, fill the square with slanted lines. If not, leave it white. A picture appears. If part of it is missing, or one square does not fit, check that square again.

center O · scale factor k $k = \text{image distance} \div \text{original distance}$		k more than 1 P' is farther from O than P		k less than 1 P' is closer to O than P	
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 	

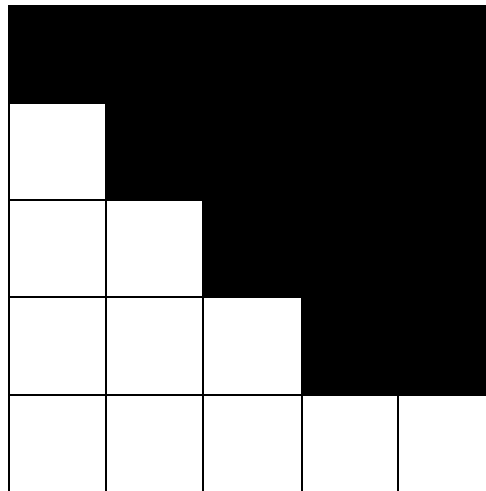


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Mystery Picture — answers

For the teacher

The finished picture is **a triangle**. The table reads left to right, as the sheet does. In it, k is the scale factor printed under each square.



1–5	FILL · $k = 2$ P' is on the ray from O through P, and two compass steps the length of OP land on P'.	FILL · $k = \frac{1}{2}$ P' is on the ray from O through P, and two compass steps the length of OP' land on P.	FILL · $k = 3$ P' is on the ray from O through P, and three compass steps the length of OP land on P'.	FILL · $k = \frac{1}{3}$ P' is on the ray from O through P, and three compass steps the length of OP' land on P.	FILL · $k = 2$ P' is on the ray from O through P, and two compass steps the length of OP land on P'.
6–10	white · $k = \frac{1}{3}$ P' is on the ray, but three compass steps the length of OP' do not land on P.	FILL · $k = 3$ P' is on the ray from O through P, and three compass steps the length of OP land on P'.	FILL · $k = \frac{1}{2}$ P' is on the ray from O through P, and two compass steps the length of OP' land on P.	FILL · $k = 2$ P' is on the ray from O through P, and two compass steps the length of OP land on P'.	FILL · $k = 3$ P' is on the ray from O through P, and three compass steps the length of OP land on P'.
11–15	white · $k = \frac{1}{2}$ P' is the right distance from O, but on the other side of O from P.	white · $k = 3$ P' is on the ray, but three compass steps the length of OP do not land on P'.	FILL · $k = \frac{1}{3}$ P' is on the ray from O through P, and three compass steps the length of OP' land on P.	FILL · $k = 3$ P' is on the ray from O through P, and three compass steps the length of OP land on P'.	FILL · $k = \frac{1}{2}$ P' is on the ray from O through P, and two compass steps the length of OP' land on P.
16–20	white · $k = 3$ P' is on the ray, but closer to O than P. With k more than 1, it must be farther.	white · $k = \frac{1}{3}$ P' is the right distance from O, but it is not on the ray from O through P.	white · $k = 2$ P' is on the ray, but two compass steps the length of OP do not land on P'.	FILL · $k = \frac{1}{2}$ P' is on the ray from O through P, and two compass steps the length of OP' land on P.	FILL · $k = \frac{1}{2}$ P' is on the ray from O through P, and two compass steps the length of OP' land on P.
21–25	white · $k = 2$ P' is on the ray, but two compass steps the length of OP do not land on P'.	white · $k = \frac{1}{2}$ P' is the right distance from O, but on the other side of O from P.	white · $k = 3$ P' is on the ray, but closer to O than P. With k more than 1, it must be farther.	white · $k = 2$ P' is on the ray, but two compass steps the length of OP do not land on P'.	white · $k = 2$ P' is the right distance from O, but it is not on the ray from O through P.

No square depends on sharp eyes. In every white square, P' is at least 3.5 mm away from where the image should be. When P' is on the ray at the wrong distance, the compass steps miss the other point by at least 4 mm. In every filled square, P' is exactly where the image should be.