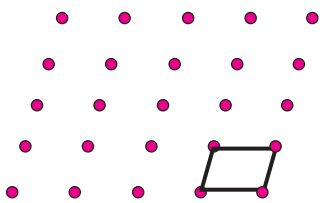
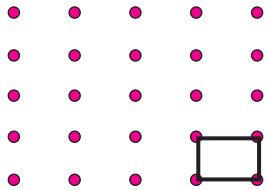
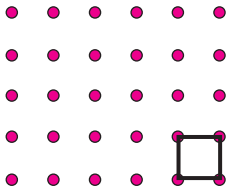
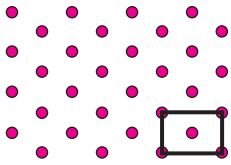
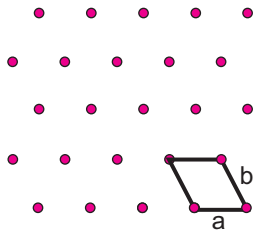
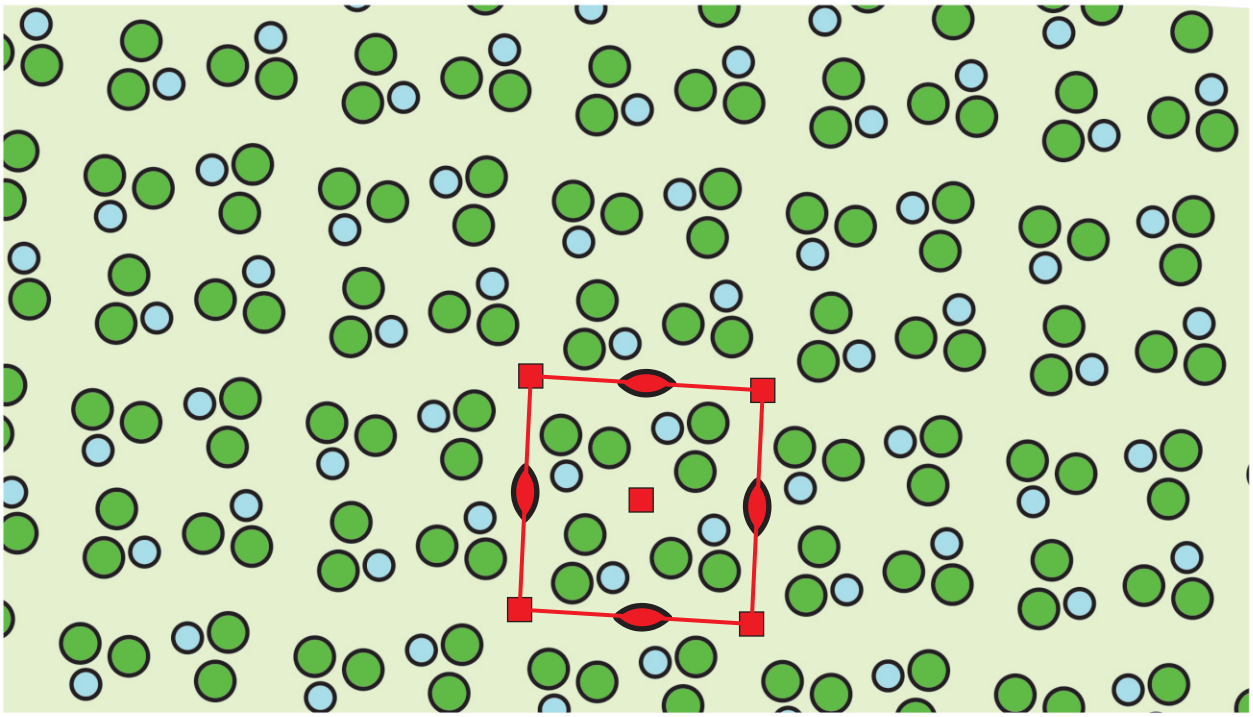
Consider each of the dot patterns below as portions of an infinite pattern that extends in all directions.

Put check marks in the correct columns to show the symmetry that is present in each pattern. Note that rotation axes need not line up on top of a dot. And, mirror planes may not pass through the dots.

The geometric shapes shown with black lines are just to help you see why the patterns are named as they are.

	mirror planes	6-fold axes	4-fold axes	3-fold axes	2-fold axes	inversion centers
Parallelogram 					✓	✓
Rectangle 	✓				✓	✓
Square 	✓		✓		✓	✓
Centered Rectangle 	✓				✓	✓
Rhomb (60° and 120° angles) a = b 	✓	✓		✓	✓	✓



square repeat unit

The pattern above is part of an infinite pattern that extends indefinitely in all directions. Circle yes or no for each of the following questions and put symbols on the drawings as instructed.

Does this pattern have any mirror planes of symmetry? If so, draw solid lines to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 6-fold axis of symmetry? If so, draw a hexagon to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 4-fold axis of symmetry? If so, draw a square symbol to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 3-fold axis of symmetry? If so, draw triangles shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

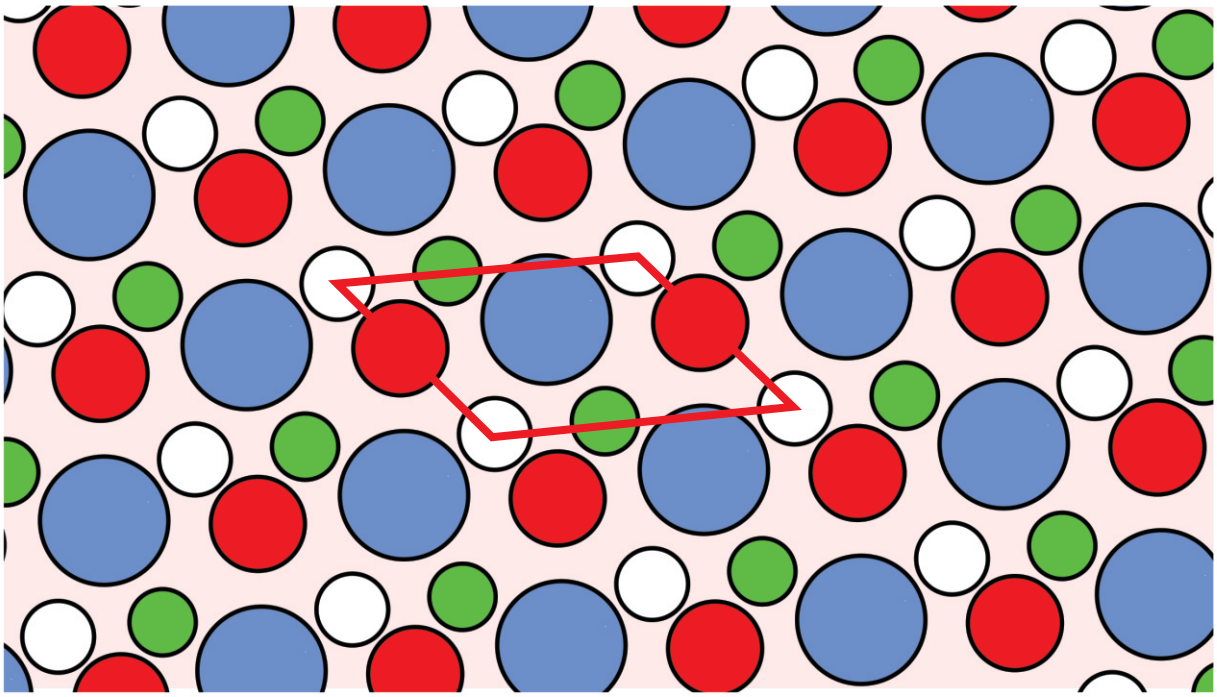
yes no

Does this pattern have a 2-fold axis of symmetry? If so, draw lens shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have an inversion center of symmetry? If so, put a dot where an inversion center is and label it clearly so that I know that you know the correct answer. You do not have to put dots in for all the inversion centers if your answer is clear.

yes no



parallelogram repeat unit

The pattern above is part of an infinite pattern that extends indefinitely in all directions.

Does this pattern have any mirror planes of symmetry? If so, draw solid lines to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer. yes no

Does this pattern have a 6-fold axis of symmetry? If so, draw a hexagon to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer. yes no

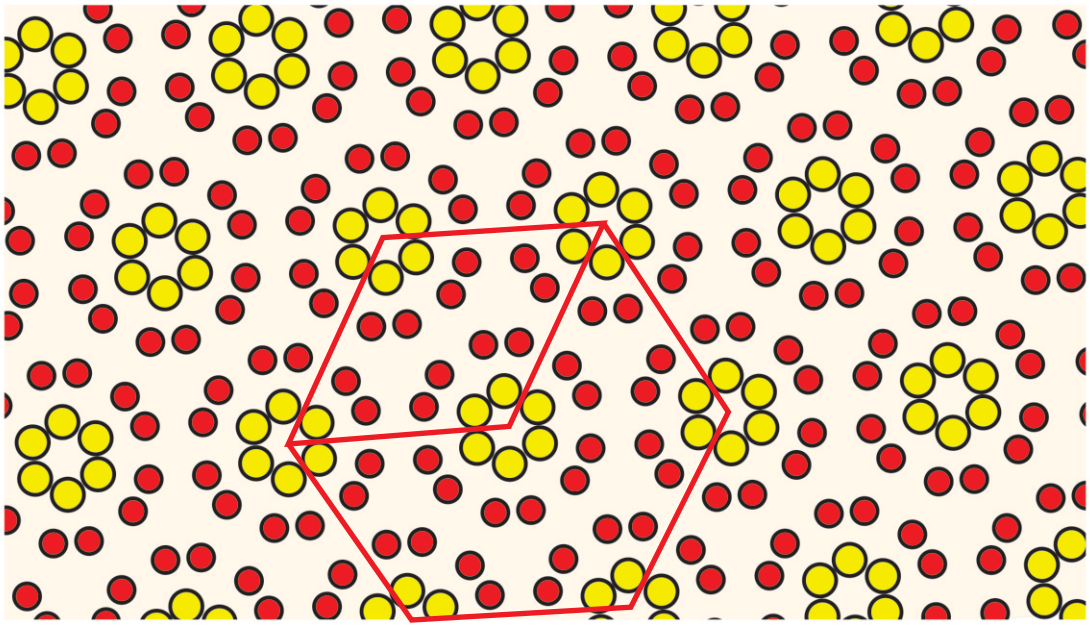
Does this pattern have a 4-fold axis of symmetry? If so, draw a square symbol to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer. yes no

Does this pattern have a 3-fold axis of symmetry? If so, draw triangles shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer. yes no

Does this pattern have a 2-fold axis of symmetry? If so, draw lens shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer. yes no

Does this pattern have an inversion center of symmetry? If so, put a dot where an inversion center is and label it clearly so that I know that you know the correct answer. You do not have to put dots in for all the inversion centers if your answer is clear. yes no

no symmetry other than 1-fold



rhomb shaped repeat unit

The pattern above is part of an infinite pattern that extends indefinitely in all directions.

Does this pattern have any mirror planes of symmetry? If so, draw solid lines to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 6-fold axis of symmetry? If so, draw a hexagon to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 4-fold axis of symmetry? If so, draw a square symbol to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 3-fold axis of symmetry? If so, draw triangles shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

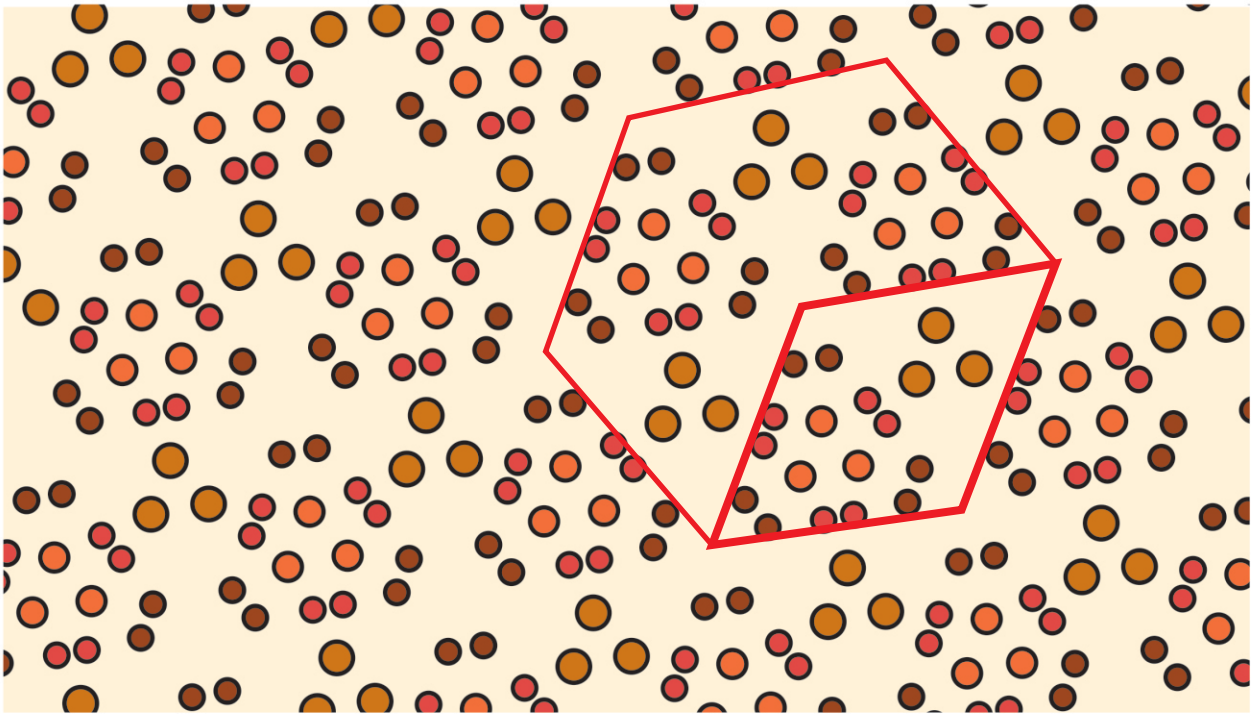
yes no

Does this pattern have a 2-fold axis of symmetry? If so, draw lens shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have an inversion center of symmetry? If so, put a dot where an inversion center is and label it clearly so that I know that you know the correct answer. You do not have to put dots in for all the inversion centers if your answer is clear.

yes no



rhomb shaped repeat unit

The pattern above is part of an infinite pattern that extends indefinitely in all directions.

Does this pattern have any mirror planes of symmetry? If so, draw solid lines to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes (circled) no

Does this pattern have a 6-fold axis of symmetry? If so, draw a hexagon to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no (circled)

Does this pattern have a 4-fold axis of symmetry? If so, draw a square symbol to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no (circled)

Does this pattern have a 3-fold axis of symmetry? If so, draw triangles shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

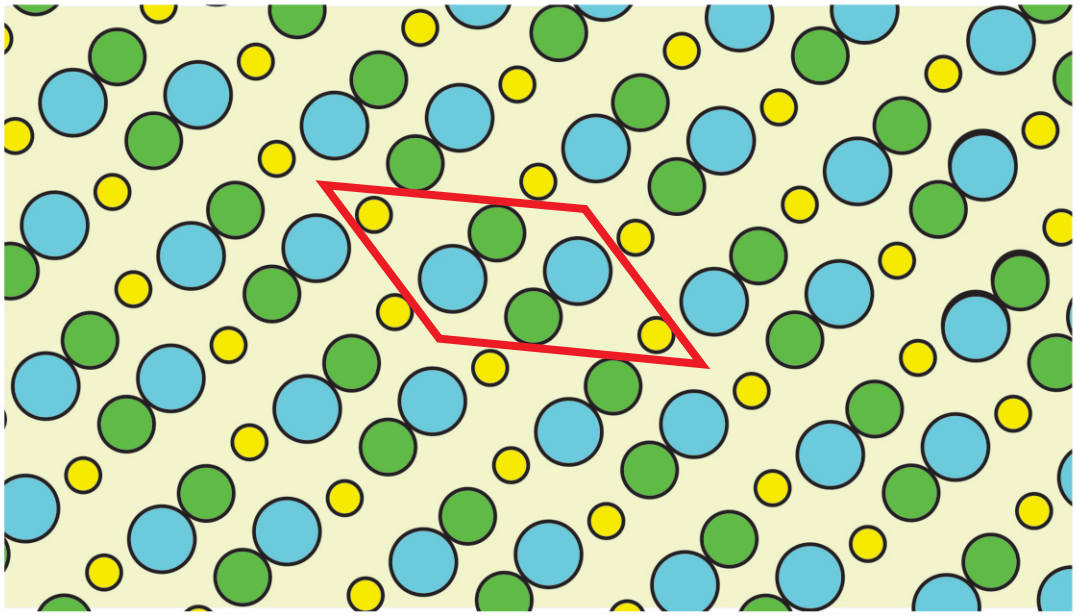
yes (circled) no

Does this pattern have a 2-fold axis of symmetry? If so, draw lens shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no (circled)

Does this pattern have an inversion center of symmetry? If so, put a dot where an inversion center is and label it clearly so that I know that you know the correct answer. You do not have to put dots in for all the inversion centers if your answer is clear.

yes no (circled)



parallelogram repeat unit

The pattern above is part of an infinite pattern that extends indefinitely in all directions.

Does this pattern have any mirror planes of symmetry? If so, draw solid lines to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 6-fold axis of symmetry? If so, draw a hexagon to show where some of them are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 4-fold axis of symmetry? If so, draw a square symbol to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 3-fold axis of symmetry? If so, draw triangles shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have a 2-fold axis of symmetry? If so, draw lens shapes to show where several are. You don't have to show all of them but make sure your answer clearly shows that you know the answer.

yes no

Does this pattern have an inversion center of symmetry? If so, put a dot where an inversion center is and label it clearly so that I know that you know the correct answer. You do not have to put dots in for all the inversion centers if your answer is clear.

yes no

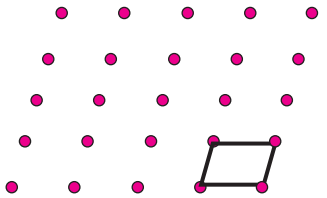
The drawings on pages 2 through 6 of this quiz all have a fundamental pattern unit that repeats to create the whole pattern.

If you remove each fundamental pattern unit and replace it with a dot, you will get one of the dot patterns on the first page of this quiz (also shown below).

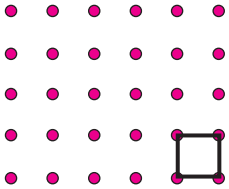
So, go back to pages 2 through 6 and label them to indicate whether the repeating is based on a (choose one):

- parallelogram
- rectangle
- square
- centered rectangle
- rhombus

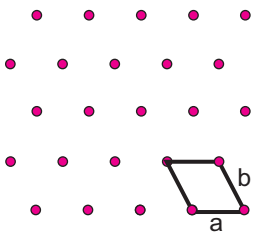
Parallelogram



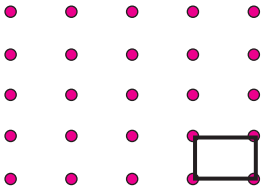
Square



Rhomb
(60° and 120° angles)
a = b



Rectangle



Centered
Rectangle