



Unit Description

Title	Patterns and geometric transformations in the plane
Age of students/grade	10/11 years
Length of the unit	2 x 50 minutes
Mathematical topic	Axial and point symmetric transformations
Prerequisite knowledge	<ul style="list-style-type: none">• Basic geometric concepts• Geometric figures
Materials needed	<ul style="list-style-type: none">• Info sheet 1 (for lesson 1)• Task sheet 1 (for lesson 1)• Info sheet 2 (for lesson 2)• Task sheet 2 (for lesson 2)
Objectives	<p>The student</p> <ul style="list-style-type: none">• knows the concepts of axial and point symmetry• knows the concept of perpendicular bisection• can recognize axial and point symmetry in given figures and objects• can complete partially given figures by applying axial or point symmetry• can construct a perpendicular bisector of a given line segment
Notes on work with migrant students	<ul style="list-style-type: none">• In task 4, migrant students are asked to draw the flag of their country of birth or the country of their family origin. Students considering themselves non-migrant students can e.g. draw the flag of a country where family members live or used to live

Lesson plan:**Lesson 1 (50 minutes)**

Time	Method	Content and comments
ca. 10 min	Exposition and Teacher-student-communication	The teacher introduces the concepts of axial and point symmetry (info sheet 1). Students can ask questions, and either copy the definitions into their notebook, or they receive info sheet 1 as a handout.
ca. 20 min	Partner work	Students work in pairs on tasks 1 and 2.
ca. 10 min	Small group work	Students work in small groups on task 3.
ca. 10 min	Small group work, then presentation for whole class	Students work in small groups on task 4 and present their results to the whole class.

Homework: Go to your kitchen and look for utensils or appliances with one or more symmetry properties. Think about whether it is an axial or point symmetry. Sketch the objects onto a piece of paper and bring it with you to the next lesson.

Lesson 2 (50 minutes)

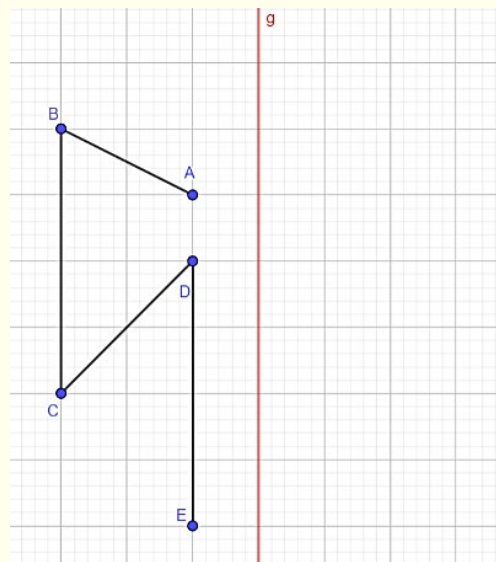
Time	Method	Content and comments
ca. 10 min	Small group work	Students work in small groups on task 5, using the results of the homework. This provides a connection to real-life situations.
ca. 15 min	Small group work, then presentation for whole class	Students work in small groups on task 6 and present their results to the whole class.
ca. 10 min	Exposition and Teacher-student-communication	The teacher introduces the concept of perpendicular bisection (info sheet 2). Students can ask questions, and either copy the information into their notebook, or they receive info sheet 2 as a handout.
ca. 15 min	Individual work, teacher-student-communication	Students work on task 7 individually. Then one student can present the results of a) on the blackboard, and another one the results of b).

- **Axial symmetry:**

Figures that can be made to coincide with themselves by reflecting them on a straight line are called axially symmetrical. The straight line is the axis of symmetry.

Example:

Using a triangle ruler, construct a mirror image of the given figure, using line g as an axis of symmetry. Name the vertices accordingly, i.e. the mirror vertex of A is called A', the mirror vertex of B is B' etc.



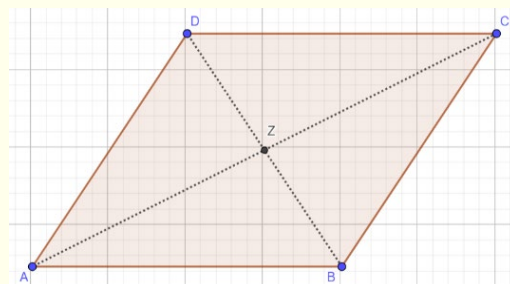
- **Point symmetry:**

If a figure is not symmetrical with respect to an axis but with respect to a point, it is referred to as point symmetry. Figures that can be made to coincide with themselves by reflecting them at a point are called point-symmetrical.

A point-symmetrical figure has a centre of symmetry around which the figure can be rotated by 180° . The rotated figure is congruent with the figure in the starting position.

Example: Parallelogram

Z is the centre of symmetry, vertices A and C, and vertices B and D are symmetric with respect to Z; also, all points on one side of the parallelogram are symmetric to a point on the opposite side of the parallelogram.



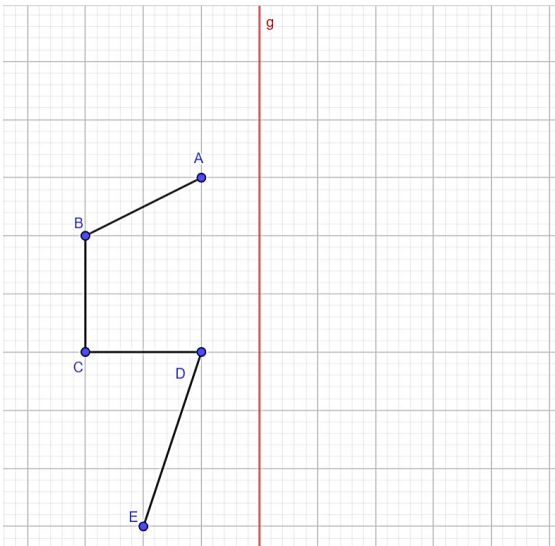
Special case: Each circle is point symmetric and rotational symmetric with respect to its centre point. Each line through the centre is a symmetry axis, i.e. a circle has infinitely many symmetry axes.

Task sheet 1

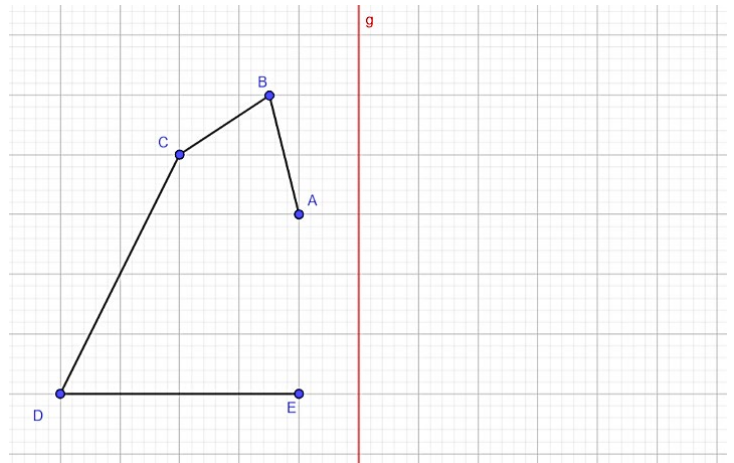
Task 1 (partner work):

- Complete each picture to form an axially symmetrical figure. Use the red line as symmetry axis and label the new points A' , B' , etc.!
- Cut out the fourth figure after mirroring it and check whether it is actually symmetrical by folding it. Think about the role played by the fold line!

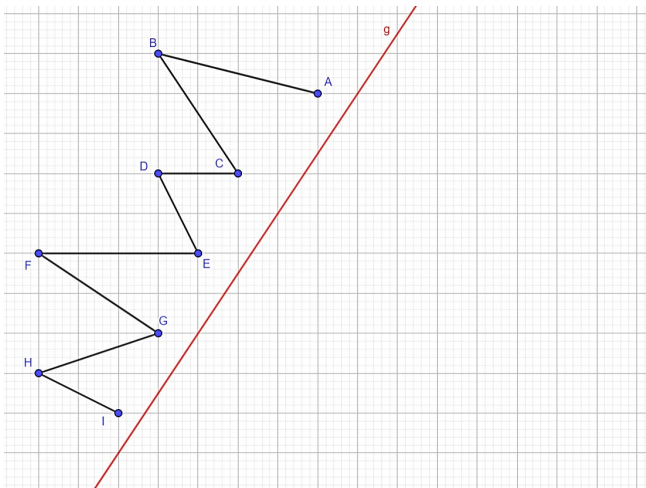
a)



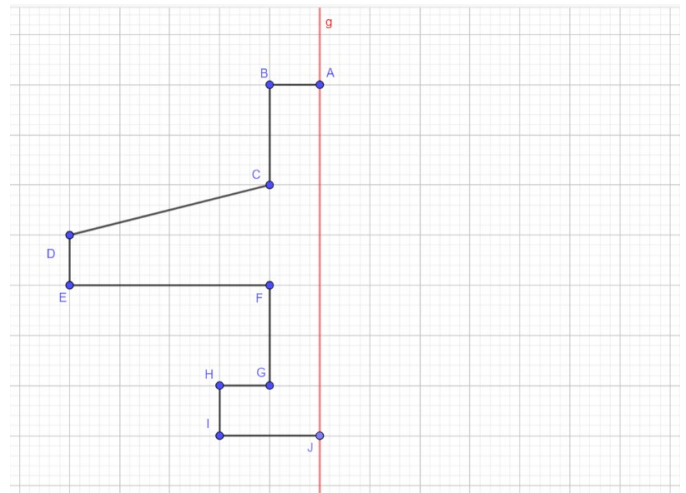
b)



c)



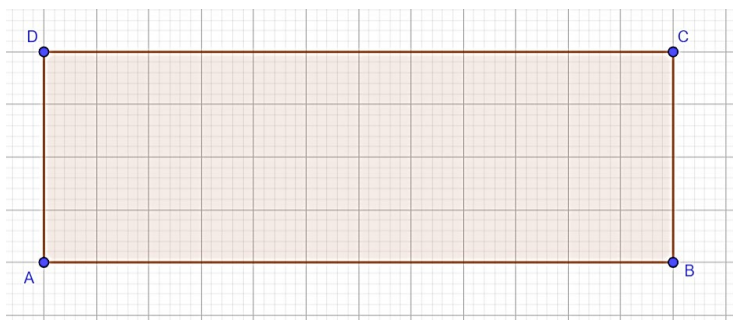
d)



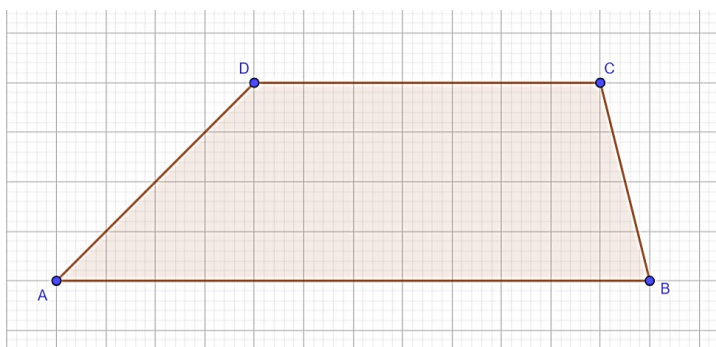
Task 2 (partner work):

Consider whether the figures are point-symmetrical and, if so, draw the centre of symmetry (S).

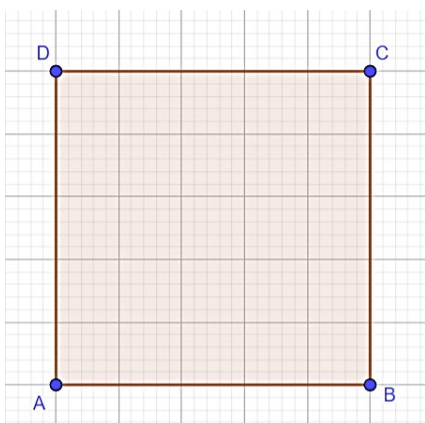
a)



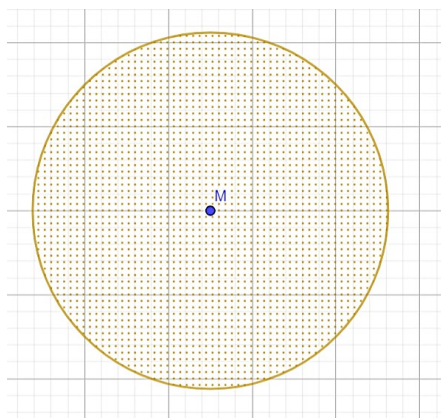
b)



c)



d)



Task 3 (in small group work):

- a) Draw three geometric figures with only one axis of symmetry!
- b) Draw three geometric figures with more than one axes of symmetry!

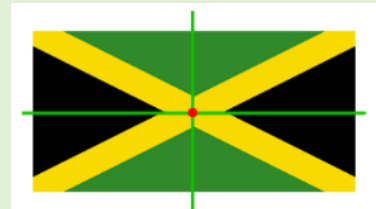
Task 4 (first in small group work, then presentation of results for the whole class):

Sketch the flag of your country of birth on a sheet of paper and consider whether it is axisymmetric or point-symmetric. If it is axially symmetrical, draw all the axes of symmetry on the flag. Then collect as many different flags as possible from the whole class, draw them in colour on an A4 sheet of paper and draw in the axes of symmetry. Ask the teacher to visibly place all the collected flags in the classroom (e.g. on a pinboard).

Note: If there is only one flag for the country of birth in a group, students can sketch the flag of a country where some family members live, or a country they have visited

Example:

The Jamaican flag is axially symmetric with two axes of symmetry. It is also point-symmetrical.



Info sheet 2

Perpendicular bisector

The perpendicular bisector bisects ("cuts in half") the line segment AB and is normal to the line segment AB. All points on the perpendicular bisector are equidistant from points A and B.

Construction:

Points A and B are connected with a line segment.

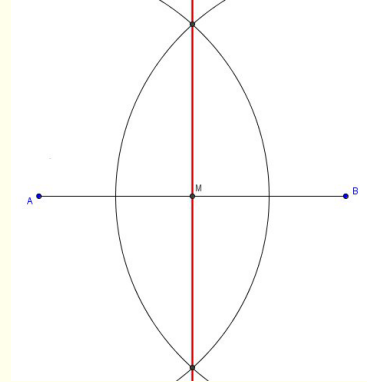
An arc is drawn around points A and B using a compass.

The radius of the arc must be the same in both cases,

And it must be greater than half the length of the line segment.

The perpendicular bisector then runs through the intersection points of the two arcs.

The perpendicular bisector is also the axis of symmetry of AB.



Task sheet 2

Task 5: „Let's bake biscuits!“ (small group work)

- a) Which of these biscuit cutters have axes of symmetry and which do not?
If there is an axis of symmetry, draw it in colour!
Are there biscuit cutters that are point-symmetrical? If so, which ones?



- b) Look at the kitchen utensils (or their sketches) you brought with you (which was the homework). Discuss in your group whether they are axially symmetric or point-symmetric!
- c) Students can bring their favourite biscuit recipe with them and distribute them to the other group members. Motivated students can bring self-baked biscuits with symmetric shapes to the next lesson and distribute them.

Task 6 (first in small group work, then in the whole class):

- a) There are words that are axially symmetric, e.g. TOOT, BOB or EVE.

Each student in the group comes up with two axially symmetric words in their first language.
The internet can be used as a resource.

The words shall then be shown and their meaning explained to the other group members, and their translation into the language of instruction shall be introduced.

Example:

EBBE (axially symmetric word in German):

Explanation: Regularly recurring fall in sea level, which becomes visible as the sea recedes.

Translation: Low tide

- b) There are words that being read from back to front also form meaningful words. Such words are called palindromes (note: sometimes, “palindrome” is used in a strict sense meaning only axially symmetric words, i.e. words that read the same from back to front as from front to back; here we use “palindrome” in a broader sense), e.g. TEN – NET, EVIL – LIVE

Each student in the group comes up with two palindromes in their first language.

Again, The internet can be used as a resource.

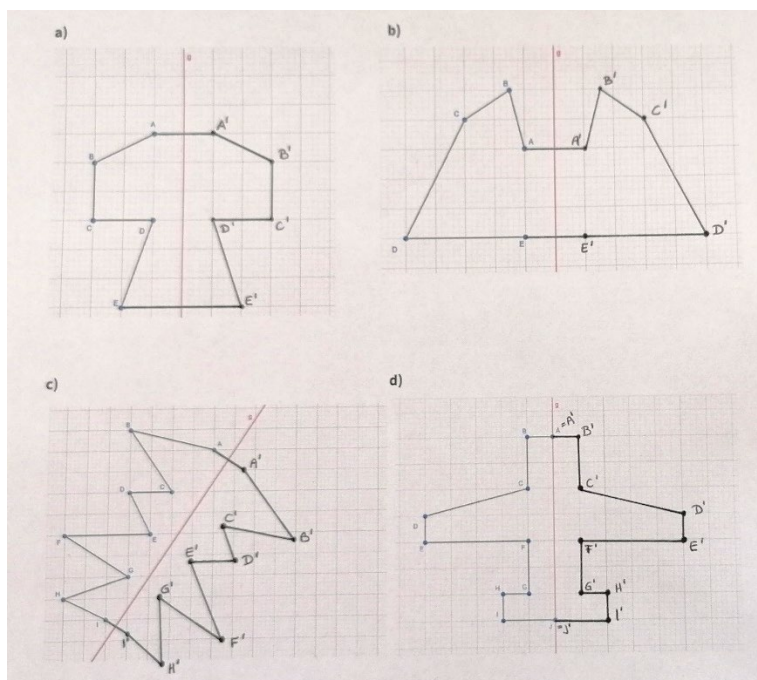
The words shall then be shown and their meaning explained to the other group members, and their translation into the language of instruction shall be introduced.

Task 7:

- a) Construct the perpendicular bisector of the line segment AB , where $A = (0|7)$ and $B = (6|4)$.
- b) Given are the points $C = (2|5)$ and $D = (12|7)$. Enter the coordinates of the centre point M of the line segment CD . Then divide the line segment CD into four parts of equal length using perpendicular bisection.

Solutions

Task 1:



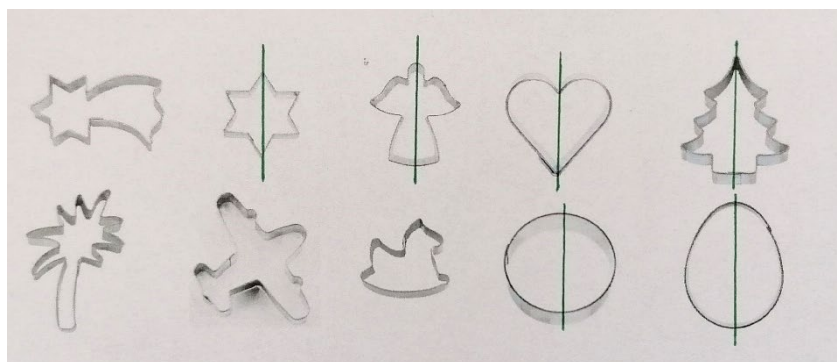
Task 2:

Figures a) c) and d) are point-symmetrical.

Task 5:

- a) The following biscuit cutters have at least one axis of symmetry: Star, angel, heart, tree, circle, egg
The following biscuit cutters are (also) point-symmetrical: Star, circle

Axes of symmetry:



Task 7:

The centre point has the coordinates $M = (7|6)$.

Construction:

