

Teaching Material

The material serves for the applicable acquisition of the concept of parallelism. There the concept is contextualized by the circle term and the following quality of the circle is exploited: The two intersections of all diameters of a circle with the circle periphery have always the same distance from one another. This quality has to be discovered in the experiment. Due to the fact that it has to be transmitted to other forms it may be recorded as basic quality of parallelism resp. for its substantiation.

Needed Equipment

2 double-rolls “circles” (diameter 12 cm):



1 double-roll “circles with bump” (diameter without bump 12 cm):



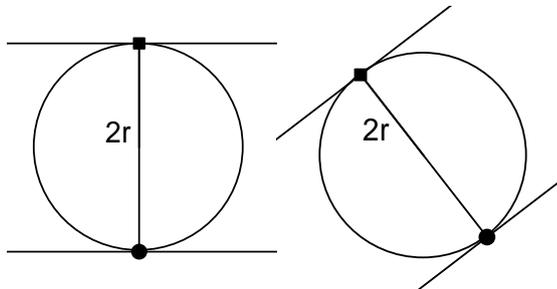
1 or more double-rolls “Orbiforms” (“same-thickness”, corner distance 12 cm):



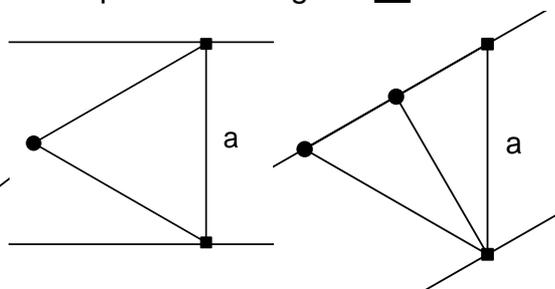
Definition of an „Orbiform“:

An orbiform is a plane with the following feature: The distance between the points of contact of two parallel and not equal tangents at a circle is always the same.

A circle is an orbiform.



An equilateral triangle is no orbiform.



Constructional definition of an “Orbiform”

An orbiform is a plane figure you can construct as follows:

Draw a regular polygon (equilateral triangle, square, pentagon, and so on).

Draw a circle around one of the corners of the polygon through two opposite laying vertices which are next to each other. Repeat this procedure for all corners.

Information:

A circle is an orbiform which results from a square with arcs with a radius equal to the side length of the square.

The **ScienceMath** project: **Concept of Parallelism**
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Two boards, one with two small boards on it as runway:



Depending on the learning group: two spirit levels on the boards:



Structure and performance

In all experimental arrangements two of the double rolls are placed on a board; the second board is laid on top. Then the upper board is waved on the rolls and the position of the boards to one another and – if present – the two spirit levels are regarded on four different positions on the board.

In this the following rolls are used in sequence:

1. the two “circles”
2. one “circle” and one “circle with bump”
3. one “circle” and one “orbiform”



Result:

In no. 1 and 3 the two boards always move parallel to each other. In no. 2 the two boards are not parallel in the field of the bump because there the distance between the points of contact of the boards with the two double rolls is not like. Since the boards in no. 3 move parallel to each other at any time the distance between the contact points has to be the same.

Further activity:

This may lead to the question whether there are more orbiforms and may motivate the production of further orbiforms for example of pentagons etc. (see also worksheets)

worksheets

Experiment Rolls



“circle with bump” - “circle” - “orbiform”

Experimental arrangement:

Place two of the double rolls on one of the boards.

Lay the other board on top.

Move the upper board over the rolls and watch the position of the boards.
Watch also the two spirit levels in four different situations of the rolls.

Repeat the experiment three times in following order:

1. Use the two double rolls “circles”
2. Use one double roll “circle” with one double roll “circle with bump”
3. Use one double roll “circle” and one double roll “orbiform”

Describe your observations.

Orbiforms

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Task 1:

- A circle is a special case of an orbiform. Which regular polygon is the basis for that?
- Examine by construction.

Task 2:

- Inform yourself about the construction of a pentagon, hexagon and so on
- Construct one or more of those figures out of paperboard or wood and cut or saw it.
- Make experiments and watch.