

MECHANISM TO REPRODUCE SCHEMES IN DIFFERENT SCALE

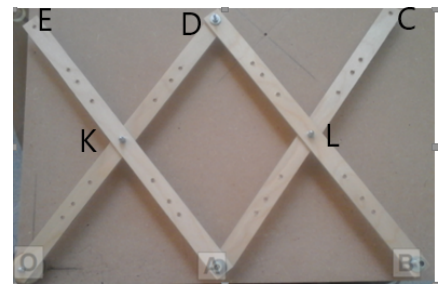
ΠΑΝΤΟΓΡΑΦΟΣ ΤΟΥ *Christoph Scheiner* (1573-1650)

How can we change the size of a shape, without changing its form?

ACTIVITY 1

THE SCHEINER'S PANTOGRAPHE

You have at your disposal a wooden version of Scheiner's pantograph. The wooden sticks bear holes and are connected in every two of them with metal screws, thus creating joints that allow to change the form of the pantograph.



The end of one of the pantograph's sticks (O, in the picture) is bound to the wooden surface, and around that, the system can pivot. It also bears two wooden styluses, one at joint A and one at the free end B.

When one of the stylus (driver -point) follows a rout, then the next stylus (trace-point) is forced to follow the first's ones movement and is thus tracing a similar track.

Experiment – Explore – Form assumptions – Explain-Prove

How is the machine made?

1) Identify the type of quadrilateral that the four joints A, L, D και K of the mechanism formed.

Explain your reasoning.

	Changing elements	Unchanged elements
<p>2) Identify elements of the pantograph that change and elements that remain unchanged when one of the pens moves freely on the plane.</p>		
<p>3) Make a figure that it represents the shape of the pantograph and that provides information about the elements of its structure.</p> <p>Describe in detail the steps that you followed when designing.</p>		

4) Prove that points O, A and B, which are representing the positions of the axis of rotation and of the two pens in your drawing, are collinear.

5) Determine the relationship of the distances of A and B pens from the pivot axis O. Justify your answer.

ACTIVITY 2

What does the machine do and why?

Experiment – Explore – Form assumptions - Explain

- 1) Draw a straight segment on the pantograph board surface
- a) Move the pen A along the straight segment that you designed.

What is the figure of the other pen B?

Compare the two figures (straight segment and its image). What do you notice?

Formulate a conjecture

ANSWER

- b) Move the pen B along the straight segment that you designed.

What is the figure of the other pen A?

Compare the two figures (straight segment and its new image). What do you notice?

Formulate a conjecture

Answer

- c) Find the relationship between the straight segment that you designed

Relationship:

with its two pictures.

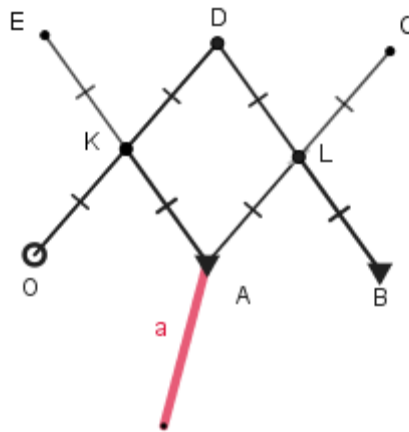
2) In the next figure, you can see a geometric representation of your previous work with the pantograph, in case that the pen A moves along the straight segment that you were designing.

a) Complete the drawing with the figure that the pen B produces.

b) Describe the procedure that you followed to design the figure produced by the pen B on the drawing.

c) Find the relationship that you have drawn from B with straight segment **a**. Justify your opinion.

d) Justify the relationship between straight segment **a** and the figure produced by B based on the structure of the pantograph.



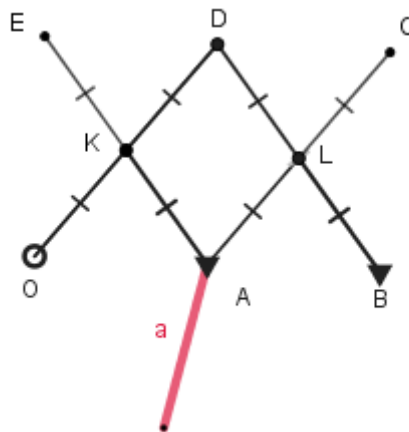
3) In the next drawing, you see a geometric representation of the pantograph and a straight segment a along which the pen A can move.

a) Draw a triangle that it has a straight segment a as its side.

b) Draw the figure that the pen B will produce when the pen A moves around the perimeter of the triangle that you designed.

c) What can you say about the two triangles?

Justify your answer.



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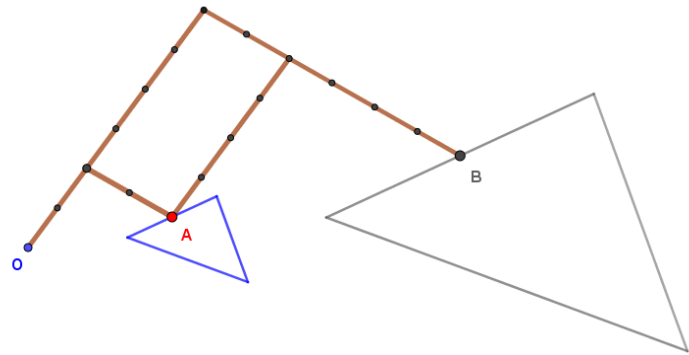
ACTIVIT 3

What does the machine do and why?

Experiment – Explore – Form assumptions – Explain- Prove

The next picture represents a simplified version of another version pantograph of Scheiner.

- a) What is the relationship between the two triangles?
- b) Justify your answer by based the pantograph's structure.



ACTIVITY 4

Modifying the Pantograph

1) Design a model pantograph that quadruples the original shape. Explain how you thought to do your figure.

2) Design a model pantograph that triples the original shape. Explain how you thought to do your design.

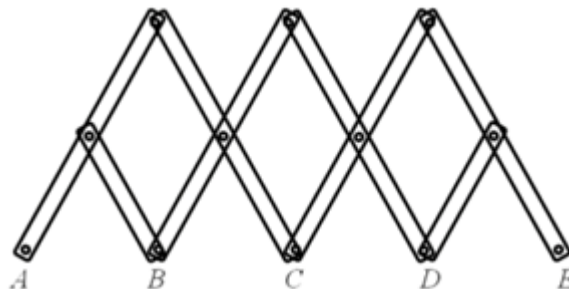
<p>3) <i>Can a pantograph reproduce a shape without changing its shape and size?</i></p> <p>Explain how you thought to do your design.</p> <p>If so, design a model of such a pantograph.</p>	

ACTIVIT 5

In the next picture we see the schematic representation of a pantograph model, which can reproduce copies of an image with different scales by changing:

- the position of the fixed point that acts as the axis of rotation,
- the driver-point describing the original image and
- the tracer-point produces the copy of the original image.

Complete the table.



Pivot point	Driver-point	Tracer-point	Scale factor
A	B	E	4
A	C		1.5
A	E	B	
A			2/3
A	D	E	
	C		3