

## SCHEMA CATALOGO

<b>Scuola</b>	Liceo Scientifico "Giovanni Marinelli"
<b>Autori</b>	Enrico Munini
<b>Titolo del modulo</b>	Introduction to isometries
<b>classe</b>	Prima
<b>livello linguistico</b>	Lower-intermediate
<b>obiettivi disciplinari</b>	Riconoscere le principali isometrie, saper comporre isometrie, usare un software di geometria dinamica per comporre isometrie.
<b>contenuti disciplinari</b>	Isometrie e loro composizione.
<b>punto del programma</b> (eventuali prerequisiti)	Prerequisiti: criteri di congruenza, composizione di funzioni, conoscenza elementare di un software di geometria dinamica
<b>numero di ore</b>	4
<b>materiale</b> (libri, software, DVD, videocassette, fotocopie...)	Fotocopie, software in inglese GeoGebra
<b>supporti</b> (laboratorio, lavagna luminosa, video...)	Lavagna, gessi colorati, laboratorio di informatica, videoproiettore
<b>compresenza (SI/NO)</b>	Eventuale compresenza dell'insegnante di lingua

# LESSON PLAN

## INTRODUCTION TO ISOMETRIES

1<sup>a</sup> lezione (in classe)

Presentazione attività CLIL.

Attività di brainstorming (Activity 1.doc)

Sapere/saper fare:

- Define reflection, rotation, translation and glide reflection and find the image of a figure under a given isometry.
- Given two figures that are images of each other under an isometry, find the isometry and describe it completely.
- Find the image of a figure under the composition of two or more isometries and determine whether the resulting figure is a reflection, rotation, translation, or glide reflection image of the original figure.

Consegna del glossario, modificabile ed ampliabile dagli allievi, (Glossary.doc), spiegazioni ed esempi.

Attività 2 (Activity 2.doc)

Per casa: Attività 3 e 4 (Activity 3.doc e Activity 4.doc)

2<sup>a</sup> lezione (in laboratorio)

Correzione e discussione degli esercizi per casa.

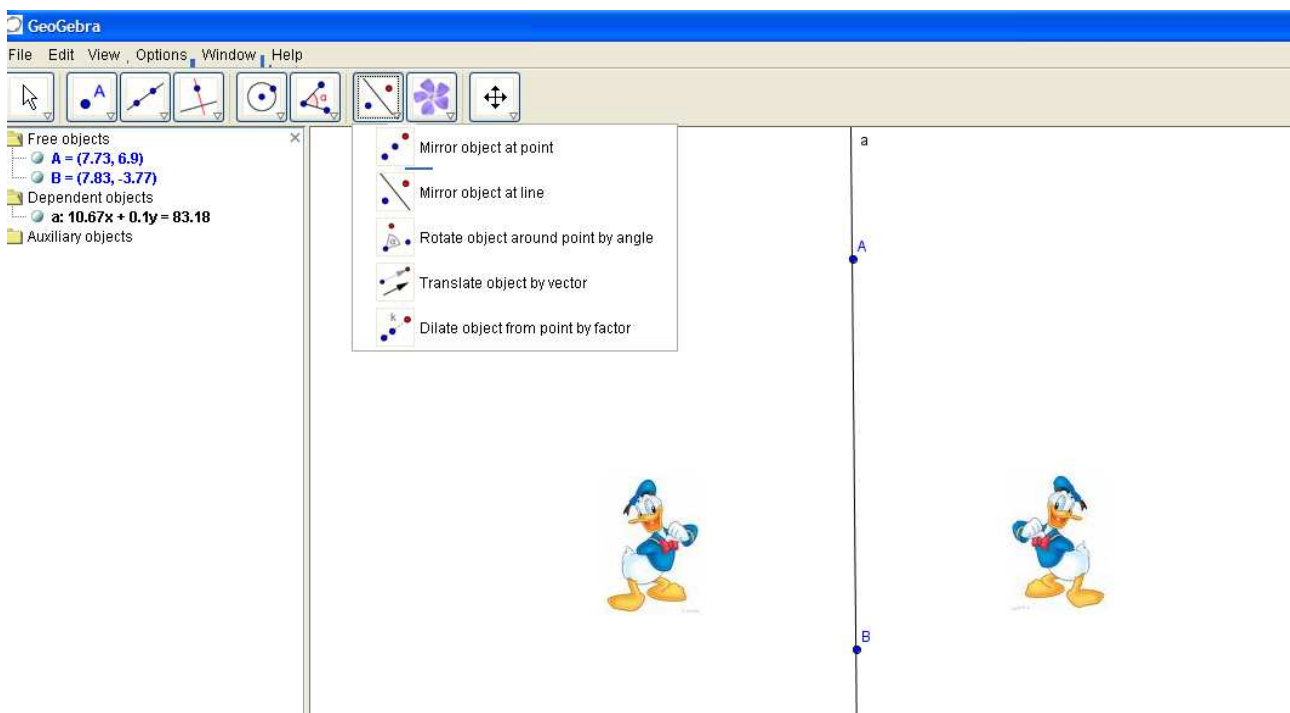


Illustrazione del software GeoGebra (comandi in inglese)

Composizione di isometrie: traslazioni, rotazioni con lo stesso centro e simmetrie (Activity 5.doc, Activity 6.doc e Activity 7.doc)

Per casa: sintesi delle precedenti attività (Activity 8.doc)

3<sup>a</sup> lezione (in laboratorio)

Composizione di simmetrie assiali (Activity 9.doc)

Per casa: studio del Summary.doc

4<sup>a</sup> lezione (in classe)

Test a scelta multipla (10 domande, 5 punti risposta corretta, 1 risposta non data, 0 risposta errata Test.doc). Sufficienza 35 punti.

# GLOSSARY

**ISOMETRY:** a transformation that preserves lengths. Also called rigid transformation.

**GLIDE (REFLECTION):** a type of transformation that combines a reflection with a translation along the direction of the mirror line.

**REFLECTION:** a type of transformation that use a line that acts like a mirror, called the line of reflection.

**ROTATION:** a type of transformation in which a figure is turned about a fixed point, called the center of rotation.

**TRANSLATION:** a type of transformation that moves all points of a figure by the same distance in the same direction.

**DIRECT ISOMETRY:** an isometry that preserves orientation or order (the order of the lettering in the figure and the image are the same, either both clockwise or both counterclockwise).

**OPPOSIT (or INDIRECT) ISOMETRY:** an isometry that doesn't preserve orientation or order (the order of the lettering is reversed, either clockwise becomes counterclockwise or counterclockwise becomes clockwise).

**FIXED POINT:** A point that doesn't change after transformation.

**STRAIGHTEDGE:**



**COMPASS:**



**PROTRACTOR:**



# ACTIVITY 1

d) Match the figures (1, 2 and 3) with the corresponding type of isometry (a, b and c).

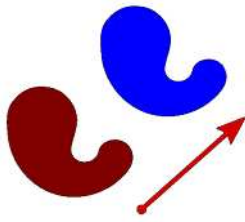


Fig. 1

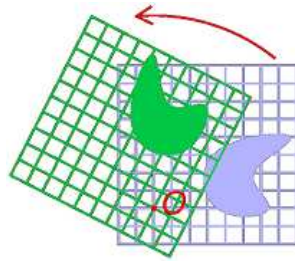


Fig. 2



Fig. 3

- a) rotation
- b) translation
- c) reflection (mirror isometry)

figure	isometry

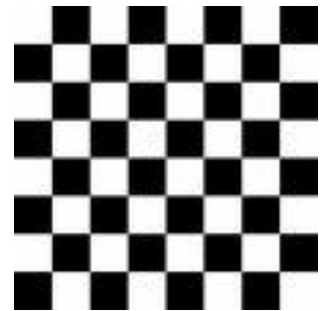
- Determine the number of lines of simmetry



N° \_\_\_\_\_



N° \_\_\_\_\_

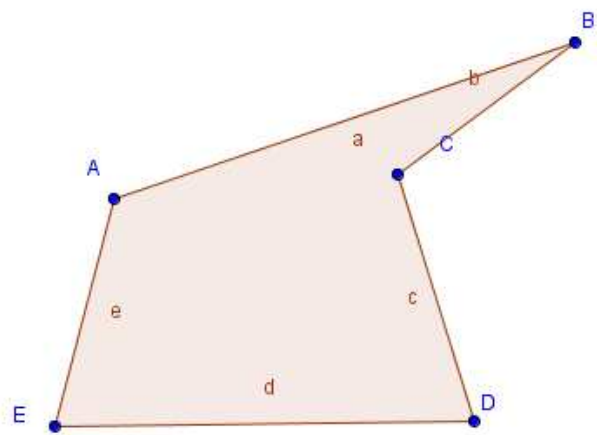
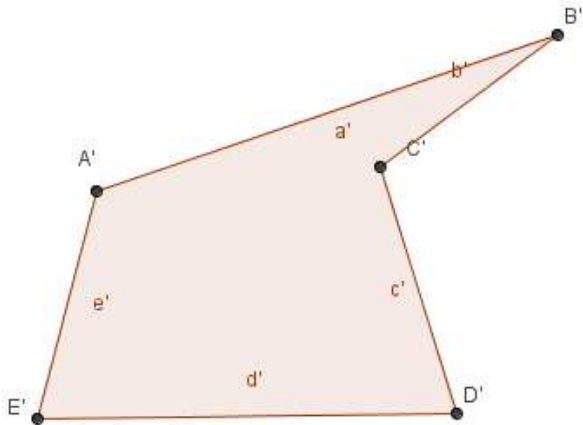


N° \_\_\_\_\_

## ACTIVITY 2

**Task:** Identify the type of isometry and describe it completely.

**Hints:** Connect the corresponding points (A-A', B-B', ...). What do you see?



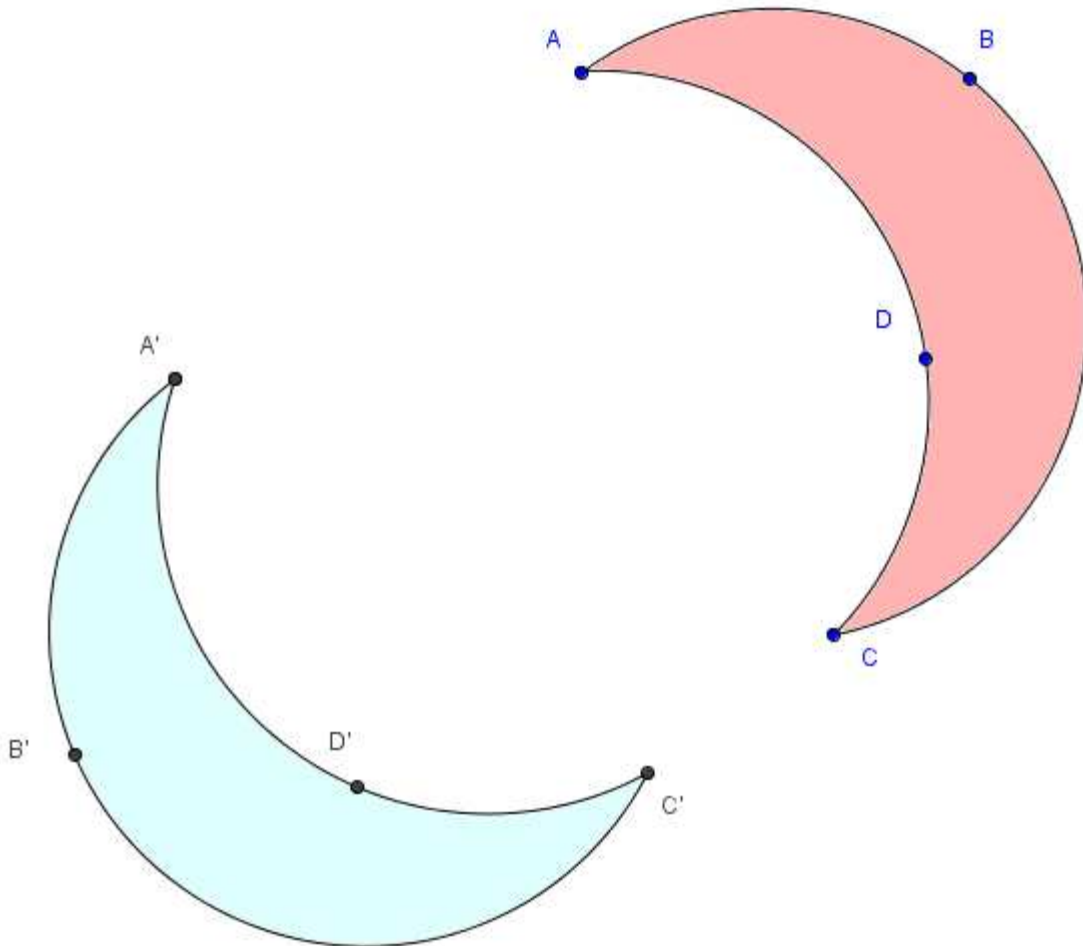
**Referring to the figure above, mark the correct answer(s) for each column:**

ISOMETRY	DESCRIBED BY	TYPE	FIXED POINT
Glide	Centre	Direct	Zero
Reflection	Angle ( ____ °)	Opposite	One
Rotation	Line		Infinite
Translation	Vector (modulus ____ cm)		

# ACTIVITY 3

**Task:** Identify the type of isometry and describe it completely.

**Hints:** Draw the segments  $AA'$ ,  $BB'$ , ... and draw their axis. What



do you see?

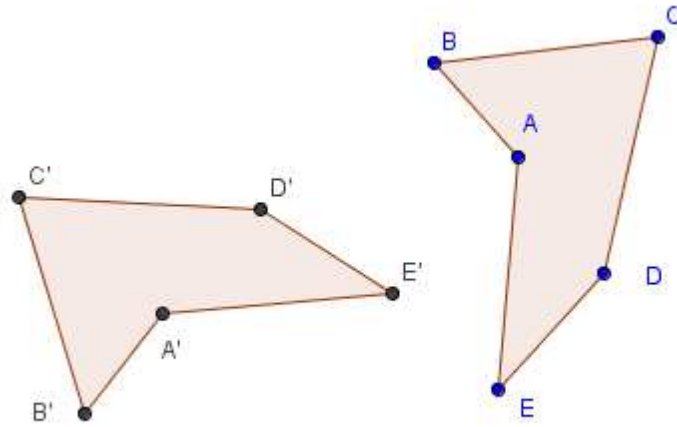
**Referring to the figure above, mark the correct answer(s) for each column:**

ISOMETRY	DESCRIBED BY	TYPE	FIXED POINT
Glide	Centre	Direct	Zero
Reflection	Angle ( ____ °)	Opposite	One
Rotation	Line		Infinite
Translation	Vector (module ____ cm)		

# ACTIVITY 4

**Task:** Identify the type of isometry and describe it completely.

**Hints:** Draw the segments  $AA'$ ,  $BB'$ , ... and draw their axis. What do you see?



**Referring to the figure above, mark the correct answer(s) for each column:**

ISOMETRY	DESCRIBED BY	TYPE	FIXED POINT
Glide	Centre	Direct	Zero
Reflection	Angle ( ____ °)	Opposite	One
Rotation	Line		Infinite
Translation	Vector (modulus ____ cm)		

## LABORATORY - ACTIVITY 5

**Goal:** Is the composition of isometries always commutative?

**Follow the instruction below and finally mark the correct answers :**

1. Draw a polygon P1.
2. Draw two vectors  $u$  and  $v$ .
3. Translate the polygon P1 by vector  $u$  (let P2 the new polygon).
4. Translate the polygon P2 by vector  $v$  (let P3 the new polygon).
5. Translate the polygon P1 by vector  $v$  (let P4 the new polygon).
6. Translate the polygon P4 by vector  $u$  (let P5 the new polygon).

**Is  $P3 = P5$  ?      YES / NO**

**Is  $T_u \circ T_v = T_v \circ T_u$  ?      YES / NO**

# LABORATORY - ACTIVITY 6

**Goal:** Is the composition of isometries always commutative?

**Follow the instruction below and finally mark the correct answers :**

1. Draw a point A.
2. Draw a polygon P1.
3. Rotate the polygon P1 around A by angle *alfa* (let P2 the new polygon).
4. Rotate the polygon P2 around A by angle *beta* (let P3 the new polygon).
5. Rotate the polygon P1 around A by angle *beta* (let P4 the new polygon).
6. Rotate the polygon P4 around A by angle *alfa* (let P5 the new polygon).

**Is  $P3 = P5$  ?**

**YES / NO**

**Is  $R_{A,alfa} \circ R_{A,beta} = R_{A,beta} \circ R_{A,alfa}$  ?** YES /  
NO

# LABORATORY - ACTIVITY 7

**Goal:** Is the composition of isometries always commutative?

**Follow the instruction below and finally mark the correct answers :**

1. Draw a line  $a$  through two points.
2. Draw a line  $b$  through two points.
3. Draw a polygon  $P_1$ .
4. Mirror the polygon  $P_1$  at line  $a$  (let  $P_2$  the new polygon).
5. Mirror the polygon  $P_2$  at line  $b$  (let  $P_3$  the new polygon).
6. Mirror the polygon  $P_1$  at line  $b$  (let  $P_4$  the new polygon).
7. Mirror the polygon  $P_1$  at line  $a$  (let  $P_5$  the new polygon).

**Is  $P_3 = P_5$  ?                      YES / NO**

**Is  $S_a \circ S_b = S_b \circ S_a$  ?                      YES / NO**

## ACTIVITY 8

**Goal:** Is the composition of isometries always commutative?

Answer the following question.

e) Is the composition of translations commutative? Yes / No

f) Is the composition of rotations with the same center commutative? Yes / No

g) Is the composition of simmetries commutative? Yes / No

h) Is the composition of isometries commutative? Yes / No

# LABORATORY - ACTIVITY 9

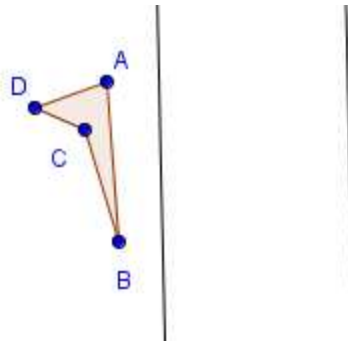
Complete the theorem.

**Theorem 1** The product of any two reflections in the plane is a translation or rotation.

In particular, if the mirror lines \_\_\_\_\_  
then their product is a translation by vector  $v$  with  
direction \_\_\_\_\_ and  
modulus \_\_\_\_\_ .

If the mirror lines \_\_\_\_\_  
their product is a rotation through  
angle \_\_\_\_\_  
with center \_\_\_\_\_

**Hint:** Begin with something like the following:



# SUMMARY

An isometry is a transformation which preserves distances (thus it also preserves angles, orthogonality and parallelism).

There are four different plane isometries:

- the translations: no fixed point (identity if the vector is null)
- the rotations: one fixed point, the center (identity if the angle is null)
- the reflections: a line of fixed points (the axis)
- the glide reflections: compositions of a reflection and a translation

An isometry of the plane is the the composition of at most three reflections; thus the translations (compositions of two reflections with parallel axis) and the rotations (compositions of two reflections with non parallel axis) preserve the orientation, and the reflections and glide reflections change it (a glide reflection is the composition of three reflections with at least two non parallel axis).

# TEST

Class \_\_\_\_\_ Name \_\_\_\_\_ Date \_\_\_\_\_

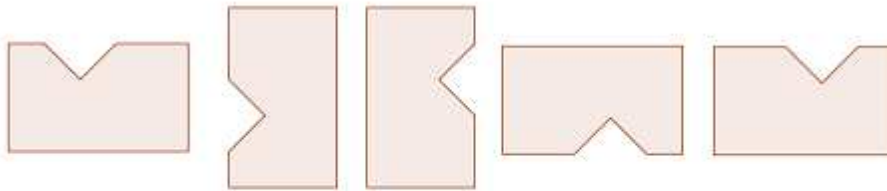
1	2	3	4	5	6	7	8	9	10

1. What type of transformation is shown?



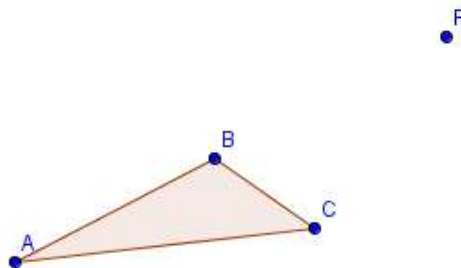
- a) translation
- b) reflection
- c) rotation
- d) direct isometry
- e) other

2. Which of the following is not a rotation of the figure at right?



- a)
- b)
- c)
- d)
- e)

3. Rotate the figure  $60^\circ$  counterclockwise about P.



4. The direct isometries are:

- a) translations and symmetries    b) rotations and symmetries  
c) rotations and translations    d) rotations    e) other

5. The opposite isometries are:

- a) translations and rotations    b) glides and symmetries  
c) symmetries and translations    d) glides    e) other

6. Let  $S_a$  a reflection in the line  $a$ . The composition  $S_a \circ S_a$  is a:

- a) symmetry    b) translation    c) identity    d) rotation    e) other

7. An isometry with an only fixed point is a:

- a) rotation    b) translation    c) reflection    d) glide    e) other

8. The compositions of two reflections with parallel axis is

- a) rotation    b) translation    c) reflection    d) glide    e) other

9. The compositions of two reflections with non parallel axis is

- a) rotation    b) translation    c) reflection    d) glide    e) other

10. An isometry of the plane is the the composition of at most  $N$  reflections.

- a)  $N=2$     b)  $N=3$     c)  $N=4$     d)  $N=5$     e) other