Artistic triangles

What do you see?

*Many artists use mathematical relationships to inspire their work. **Max Bill** used mathematics extensively to create his prints, paintings and sculptures.*

Hommage à Santomaso by Max Bill © DACS 2010

What mathematics can you see here?

What **mathematical conjectures** can you make?

Find good arguments to support your conjectures.

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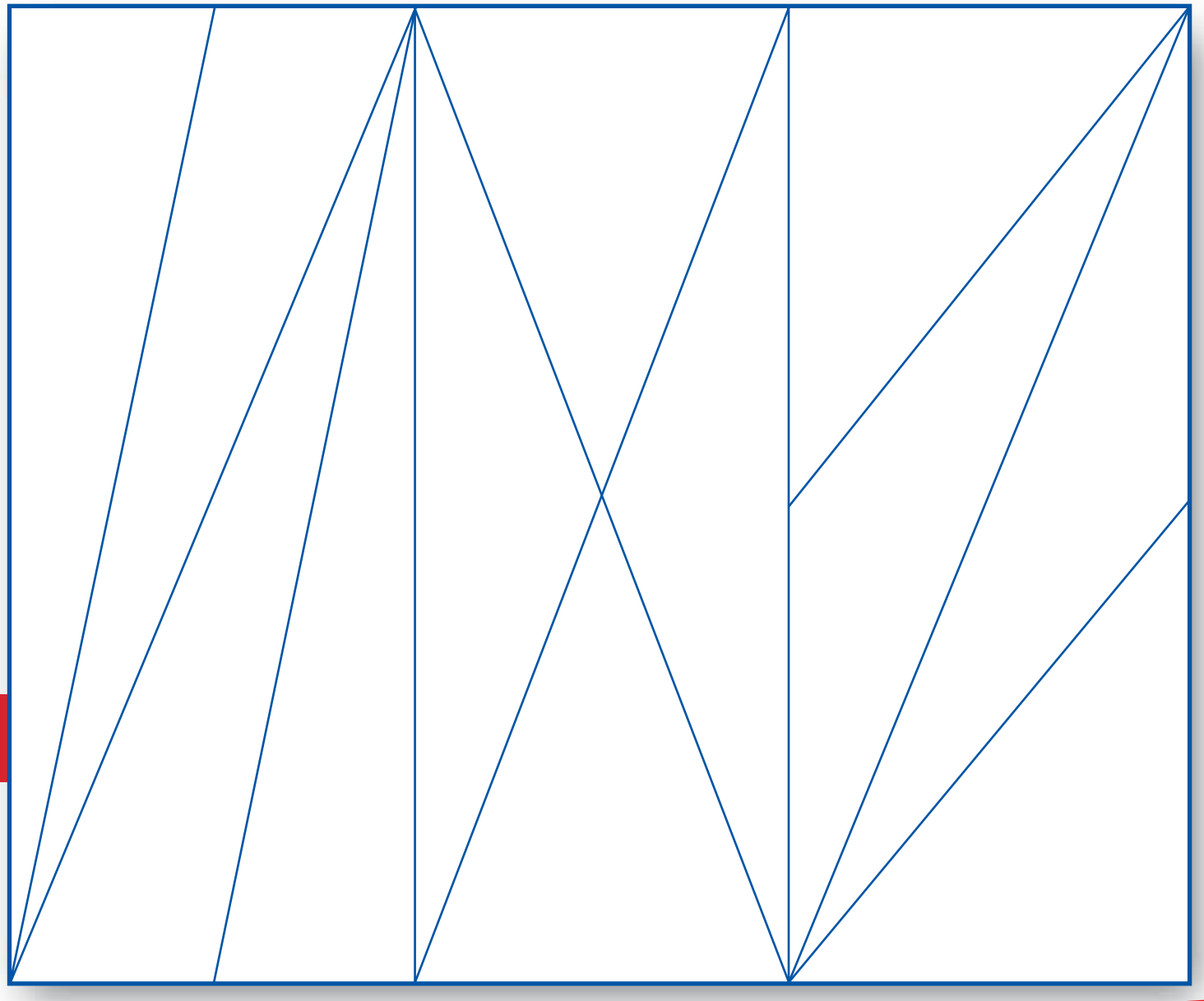
What do you see?



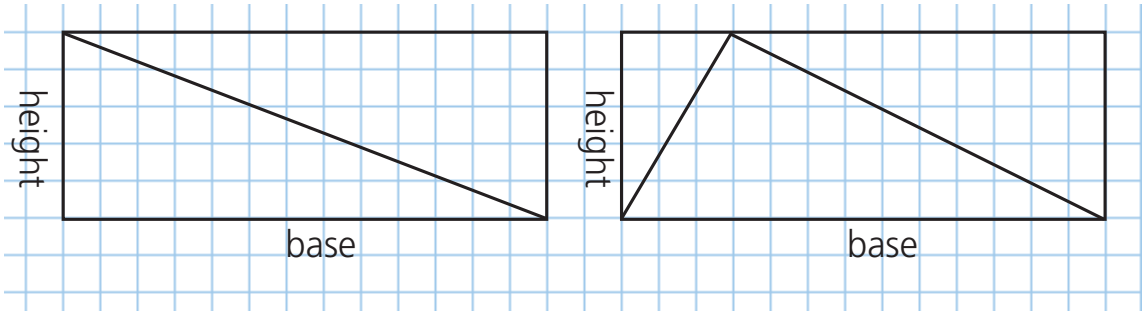
Outline sheet

Artistic triangles

The area of a triangle

Max Bill © DACS 2010

The area of a rectangle is base x height.

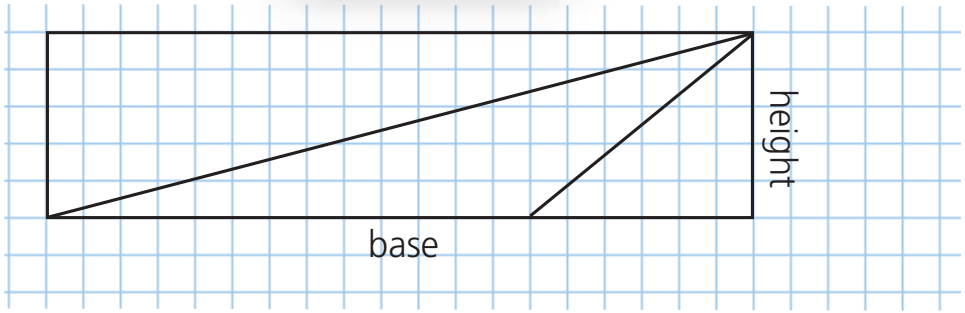


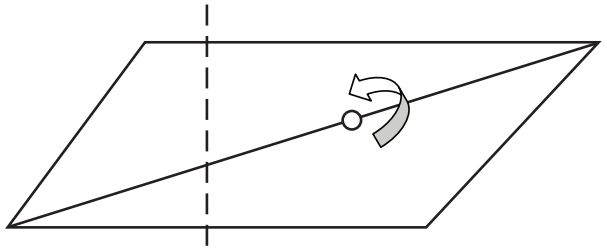
- Draw a right angle triangle
- Draw a rectangle as shown
- Cut out the pieces and rearrange to show the triangle is half the rectangle.

The area of the triangle is half x base x height.

- Draw a scalene triangle
- Draw a rectangle as shown
- Cut out the pieces and rearrange to show the triangle is half the rectangle.

The area of the triangle is half x base x height.





This one is harder.

- Rotate the triangle to make a parallelogram.
- Cut out the parallellogram.
- Cut through the parallelogram along its height.
- Rearrange to make a rectangle.

The area of the triangle is half x base x height.

If two triangles have the same base and the same height, they are equal in area.

Use this result to find sets of triangles which have the **same area** in the painting *(Hommage à Santomaso.)*

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Topic

Many artists use mathematical ideas in their work. This topic and **More artistic triangles** focus on the work of Max Bill, one of whose themes was equal areas. This provides an opportunity for work on triangles and, according to the knowledge and strengths of the pupils, other polygons as well. The topic includes both geometric and algebraic thinking.

Mathematical activities

What do you see?

The area of a triangle.

Careers link-up

What business and professional skills do artists and designers need to succeed? You can use the video clips detailed below at the beginning of this extended project or between the two topics or at the end.

Planning for teaching – some suggestions

Slides of many of Max Bill's designs are readily available through Internet search engines. Bill said that art should be 'the expression of the human spirit, intended for the human spirit, and it should have the sharpness, the clarity and the perfection that must be expected from the human spirit'. The **concrete art** movement of which he was a part used ordered systems and gave life to these through the resources of colours, space, light and movement. Bill thought that art should find a mathematical mode of thought to guarantee control of the creative principles.

It is ideal if the topic is taught as cross-curricular with input from the art department. The first activity is likely to take a couple of lessons to complete. The silkscreen print *Hommage à Santomaso* from Max Bill's work is provided on **What do you see?** With the pupils working in groups, hand out one copy of the image to each group. It is worth laminating these to preserve their quality. Begin by asking the pupils what mathematics they see in it. Encourage them to comment on, for example, types of triangles, dissection, equal areas, reflective and rotational symmetry, ratio and proportion and fractions. Share their observations in a whole class discussion and ask them to reflect on how these various aspects contribute to the artistic impact of the piece.

Max Bill © DACS 2010

Ask the pupils: what fraction of the piece do you think each colour represents? Draw out from them that their answer depends on a conjecture that the triangles all have equal areas. Ask them to find convincing arguments to support this conjecture. The **What do you see? outline sheet** allows pupils to cut up and rearrange the pieces, using translations and rotations of pieces to superimpose pairs of triangles as part of such an argument. In each of the three rectangles two such rearrangements are possible. The non-identical triangles can be paired to make two larger congruent triangles; or the two identical triangles can be paired to make pairs of congruent parallelograms.

Planning for teaching – some suggestions *(continued)*

Ask each group to produce a poster illustrating the congruences and explaining how they have used these to justify the statement that all the triangles have equal areas. Have copies of the **What do you see? outline sheet** available in the four colours of the original for the group to cut up to support this work.

The area of a triangle offers a practical and dynamic way to re-visit the formula for finding the area of a triangle. Finding the area of triangles orientated so that the height falls outside the triangle often causes difficulty for pupils. Pupils will need squared paper and scissors to engage with the practical activity designed to deepen their understanding of and intuitions about equal areas. Once the practical activity is complete you may wish to show the file **The area of a triangle in GeoGebra**.

Bring these activities together in a whole class discussion in which you revisit the *Hommage à Santomaso* to find further ways of linking the triangles. For example, the pupils now have a direct way of linking the first two triangles on the left to each other and the last two triangles on the right to each other. Encourage them to notice other links, for example, to the first triangle on the left and the obtuse angled triangles in the centre rectangle. Help them to find as many groupings as possible: in preparation for **More artistic triangles**.

Careers link-up

If you look up Max Bill on Wikipedia – you can see he was an architect, painter, artist and designer – and he started with an apprenticeship as a silversmith and went on to work alongside many famous artists.

Creative Choices is the sector skills site for Creative and Cultural skills careers
http://www.creative-choices.co.uk/index.php

Watch these two short film clips and ask the question: what business and professional skills are important to designers and artists taking up this career now?

http://www.creative-choices.co.uk/knowledge/inside-story/five-things-design-student-should-know

http://www.creative-choices.co.uk/knowledge/inside-story/visual-arts/video-surviving-as-an-artist

Want to know more?

Contact STEM Subject Choice and Careers

info@careersinstem.co.uk

The Centre for Science Education
Sheffield Hallam University
City Campus, Howard Street
Sheffield S1 1WB

Tel: 0114 225 4870

A Department for Education initiative to promote subject choice and careers in Science, Technology, Engineering and Maths (STEM) delivered by the Centre for Science Education at Sheffield Hallam University and Babcock.

or for more information on careers go to Maths careers at www.mathscareers.org.uk/
or Future Morph at www.futuremorph.org/<http://www.futuremorph.org/