Key processes in geometry and measures

Geometry in Key Stages 3 and 4 is the study of points, lines and planes and the shapes that they can make, together with the study of plane transformations. A key aspect is the use and development of deductive reasoning in geometric contexts. Geometrical activities can be linked to drawing, construction and loci, and work on measures and mensuration. By ensuring that pupils have a range of suitable experiences you can develop their knowledge and understanding of shape and space and their appreciation of the ways that properties of shapes enrich our culture and environment.

Representing

Developing a mental facility to recognise geometric features is an important skill which underpins all geometric representation. In order to represent a situation geometrically, pupils have to make assumptions about the major features which are important to the context and then decide how to present these features in their 'mind's eye', on paper, on a screen or through a physical model. Pupils need to be given the opportunity to explore problems, trying out different representations and choosing between them. This will involve:

- visualising and estimating
- sketching
- constructing accurate diagrams
- building models, both physical and virtual
- representing in algebraic or numerical form, including appropriate use of units.

Contexts need to include those in which pupils work with both static and dynamic images, including 2-D images of 3-D objects, and should make use of appropriate ICT packages.

Analysing – use mathematical reasoning

Geometrical reasoning makes a distinctive contribution to mathematics and its applications. Pupils need opportunities to develop language with which to describe what they see and to explain their thinking. They engage with geometrical reasoning when they:

- visualise and work with images, explaining relationships within an image; for example, transforming an image and identifying what changes and what stays the same
- identify and classify geometrical patterns, including symmetrical designs in nature or from human artefacts
- form simple assumptions (e.g. about points and lines), developing short chains of reasoning to deduce properties of shapes, such as the angle sum of a triangle.

Analysing – use appropriate mathematical procedures

Procedures that pupils will use when working on geometrical situations involve manipulating geometric images, using and applying techniques and accurate notation, and measurements. This will include:

- visualising points, lines, shapes and solids, including changes of perspective and dynamic images
- sketching points, lines, shapes and solids, including nets of solids and the use of geometric conventions
- drawing accurately annotated diagrams (on paper and on screen), including elevations, cross-sections and scale drawings

- building models of 3-D objects, including those interpreted from 2-D drawings
- calculating and estimating lengths, areas, volumes and angles using appropriate formulae, when solving problems involving measures.

Interpreting and evaluating

Aspects of interpreting and evaluating in geometry and measures include:

- interpreting features of a diagram or other representation and relating those features to the context or situation represented
- considering the appropriateness and accuracy of measurements and consistency of units
- evaluating results or conclusions to a geometrical problem
- appreciating the difference between evidence from particular cases and the generality of geometrical proof.

Communicating and reflecting

Aspects of communicating and reflecting in geometry and measures include:

- using diagrams to communicate findings effectively
- setting out the steps of a deductive argument in a logical order, using precise language and symbolism to give clear reasons for each step
- making connections between deduced properties and definitions of shapes
- considering alternative solutions and identifying commonalities such as equivalent stages of a solution
- choosing from a range of forms through which to communicate solutions; for example, between diagrams and symbols, physical models, static and dynamic images, scale drawing and sketching.

Resources for geometry and measures

A range of resources to support the development of key processes within geometry and measures are included in the 'Ideas for rich tasks' folder within the *Secondary mathematics planning toolkit*:

- *Interacting with mathematics in Key Stage 3 – Geometrical reasoning*:
  - *Y9 geometrical reasoning* (mini-pack, resource sheets and problem bank)
- *Teaching mental mathematics from level 5*:
  - *Shape and space*
  - *Measures and mensuration in shape and space*
- Standards Unit *Improving learning in mathematics*:
  - *Mostly shape and space* (Sessions SS1–SS8)
- *ICT in mathematics*:
  - *Mathematics with ICT in Key Stage 3: Geometry lessons*