Unit Overview: Similar Triangles

Summary of learning goals

As part of the Special Topic **Mechanical Linkages and Deductive Geometry** this unit looks at geometry behind everyday tools and objects, in this case ironing tables and pantographs. The lessons aim to show students that there is mathematics in the world around them. With the aid of physical models and computer simulation, the lessons move from a view of geometry as a study static of diagrams to encompass movement.

The properties of similar triangles are involved in explaining why an ironing table stays horizontal and how a pantograph enlarges a drawing. An important goal is to give students' experience of deductive reasoning and a reason to engage in it.

Australian Curriculum: Mathematics (Year 9)

ACMMG220: Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar.

- Establishing the conditions for similarity of two triangles and comparing this to the conditions for congruence.
- Using the properties of similarity and ratio, and correct mathematical notation and language, to solve problems involving enlargement (for example, scale diagrams).
- Using the enlargement transformation to establish similarity, understanding that similarity and congruence help describe relationships between geometrical shapes and are important elements of reasoning and proof.

Summary of lessons

Who is this unit for?

The unit is for students who are learning about similar triangles. The lessons stand alone, and teachers may select either one or both. It is hoped that these lessons may appeal to a wide range of students, building on their interest in these everyday objects.

Lesson 1: Ironing Table

When an ironing table with legs that pivot is raised or lowered, the top always stays parallel to the floor. In this lesson students investigate the triangles formed by the pivoting legs. They make physical models, observe computer simulations and explain with geometry why the table is always horizontal. Students investigate different leg lengths and pivot positions to ensure similar or congruent triangles are formed. Three designs of ironing table are included, involving different geometry.

Lesson 2: Pantograph

Students construct a physical model of an enlarging pantograph and use a computer simulation to explore how the copied image compares with the original drawing. They use their knowledge of parallelogram properties and similar triangles to explain how the pantograph works. By investigating pantographs further, students can extend their understanding of scale factors, generalise earlier findings and can design their own pantographs.

Reflection on this sequence

Rationale

When devising these tasks in deductive reasoning in geometry, the guiding principles have been:

- Providing rich visual imagery, both static and dynamic.
- Providing an opportunity for students to use the language of geometry.
- Providing meaningful context that can motivate argumentation and conjecturing.
- Highlighting the need for deductive reasoning as an answer to the question 'why'.
- Providing links with other STEM subjects, in particular, engineering and technology.
- Providing links with history through historical inventions.

A strong feature of these lessons is that students are able to see and manipulate the linkages. Students operate the real linkage whenever possible, they make physical models out of plastic strips or light card, and they use pre-prepared dynamic geometry computer simulations.

The tactile experience of operating the actual tool or a physical model of the linkage provides an instant sense of satisfaction and gives insight into the way in which the linkage moves. The provided dynamic geometry computer simulations show the geometry more clearly, and enable accurate measurements to be made. Students can observe what stays the same and what varies as the dynamic geometry models are operated.

reSolve Mathematics is Purposeful

Lessons in this unit show mathematics as both a way of modelling the real world and as an abstract discipline. The linkages are used in practical everyday tools, and analysis of the tools leads to conjecture, argumentation and proof. There are clear links to STEM, including engineering.

reSolve Tasks are Challenging Yet Accessible

For many students, motivation for this unit will come from their own experience with these objects. Using the physical and computer models assists students to visualise the motion and they can use them to develop and test conjectures. The expectations for the deductive reasoning can be moderated by the teacher, and structured approaches to support are offered.

reSolve Classrooms Have a Knowledge Building Culture

Students work together to build models, make and test conjectures and develop argumentation.