


Gear Action

PRIMARY Level 4 Design Creativity Technology / Mathematics

GEAR ACTION

Time Frame: 4 hours (4 activities + LdV Exhibition visit)

Suitable VELS Outcomes

Communication

LEVEL 4 Listening, viewing and responding and Presenting

Listening, viewing and responding
Students ask clarifying questions about ideas and information they listen to and view. They develop interpretations of the content and provide reasons for them. They explain why peers may develop alternative interpretations. They describe the purpose of a range of communication strategies, including non-verbal strategies, and evaluate their effectiveness for different audiences.

Presenting
At Level 4, students summarise and organise ideas and information, logically and clearly in a range of presentations. They identify the features of an effective presentation and adapt elements of their own presentations to reflect them. Using provided criteria, they evaluate the effectiveness of their own and others' presentations.

Design Creativity Technology

LEVEL 4 Investigating and designing, Producing and Evaluating

Investigating and designing
Students contribute to the development of design briefs that include some limitations and specifications. Individually and in teams, they use a range of methods to research and collect data in response to design briefs. They generate and communicate alternative design ideas in response to a design brief and use words, labelled sketches and models, to demonstrate that they are aware of environmental and social constraints. Students describe how their intended product will function or be used, and what it will look like in the context of the requirements of the design brief. They identify evaluation criteria from design briefs and use them to justify design choices.

Producing
Students use their production plan and select and work safely with a variety of materials/ingredients and systems components to produce functional products and/or systems. They use a range of measuring, marking, joining/combining techniques to alter materials and finishing/presentation methods, and operate tools and equipmentmaterials and finishing/presentation methods, and operate tools and equipment competently, showing consideration of safety and hygiene, and record their progress.

Analysing and evaluating
At Level 4, students reflect on their designs as they develop them and use evaluation criteria, identified from design briefs, to justify their design choices. They modify their designs/products/systems after considered evaluation of feedback from peers and teachers, and their own reflection. They describe the impact products and technological systems have on people and the environment.

English

Gear Action

LEVEL 4

Speaking and listening
Students plan, rehearse and make presentations for different purposes. They sustain a point of view and provide succinct accounts of personal experiences or events. They adjust their speaking to take account of context, purpose and audience, and vary tone, volume and pace of speech to create or emphasise meaning.

Mathematics

LEVEL 4 Number, Space and Working mathematically

Number
Students use decimals, ratios and percentages to find equivalent representations of common fractions (for example, 3/4 = 9/12 = 0.75 = 75% = 3 : 4 = 6 : 8). They add, subtract, and multiply fractions and decimals (to two decimal places) and apply these operations in practical contexts, including the use of money.

Space
They create two-dimensional representations of three dimensional shapes and objects found in the surrounding environment. They develop and follow instructions to draw shapes and nets of solids using simple scale. They describe the features of shapes and solids that remain the same (for example, angles) or change (for example, surface area) when a shape is enlarged or reduced. They apply a range of transformations to shapes and create tessellations using tools (for example, computer software).

Students use the ideas of size, scale, and direction to describe relative location and objects in maps. They use compass directions, coordinates, scale and distance, and conventional symbols to describe routes between places shown on maps

Working mathematically

Students use the mathematical structure of problems to choose strategies for solutions. They explain their reasoning and procedures and interpret solutions. They create new problems based on familiar problem structures.

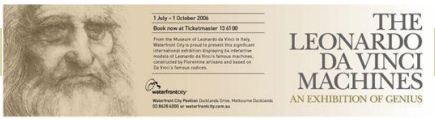
Thinking Processes

Reasoning, processing and inquiry

Students develop their own questions for investigation, collect relevant information from a range of sources and make judgments about its worth. They distinguish between fact and opinion. They use the information they collect to develop concepts, solve problems or inform decision making. They develop reasoned arguments using supporting evidence.

Creativity

At Level 4, students use creative thinking strategies to generate imaginative solutions when solving problems. They demonstrate creativity in their thinking in a range of contexts and test the possibilities of concrete and abstract ideas generated by themselves and others.



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Reflection, evaluation and metacognition

At Level 4, students use a broad range of thinking processes and tools, and reflect on and evaluate their effectiveness. They articulate their thinking processes. They document changes in their ideas and beliefs over time.

For Leonardo teaching resources: refer to School Programs Resource list

Download Student Activity sheets on Leonardo's gears to accompany Exhibition visit.

Context

Since Leonardo could not depend on any 'prime movers' such as gas, electricity or the internal combustion engine Leonardo investigated ways of converting reciprocating motion to rotary motion, a basic need for all machinery. To achieve this he experimented with ratchets, gears, cams, pulleys, cranks and linkages, and racks and pinions. He harnessed wind power, muscle power and power in springs and flywheels.

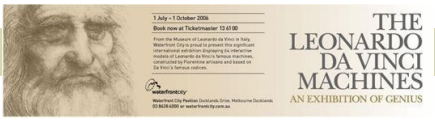
Student Challenge

Understand gears and ratios. The types of gears used and their appropriate application. Make a model of gearing action. Learn from Leonardo's machines about the use of gears to perform different tasks.

Teacher Overview

This unit of work is designed to demonstratively introduce to students the concepts and application of gears. Role playing and tinkering is a fun way to engage students and teach about the every day application of gears. Leonardo da Vinci is an eminently suitable designer/inventor to learn gear-use from. This unit can be extended by linking it with a design task such as designing a gear-engaged buggy. It can be run as a level 3 or level 4 unit.

Suggested material resources :



Gear Action

Activity 1
Clear space in centre of room.

old bicycle with working gears

Assortment of kitchen/toolbox tools

- can opener
- bottle opener
- egg beater
- hand drill
- shifting spanner
- zip fastener
- rack and pinion steering

Making gear model task
Graph paper, pencil, rubber, ruler, Compass with pencil, protractor, Split pins, 8 mm washers, card, stapler, scissors, (cutting mat, rule and craft knife perhaps preferable)

Activity 1 : 1 hour

Class discuss: What is a gear? What do they do? Why are they important?

A Gear

- A gear is a toothed wheel designed to transmit **torque** (rotational force) to another gear or toothed component.
- So it can turn a wheel faster or slower, or moves a wheel in a different direction.
- The teeth (or cogs) of a gear are shaped to minimize wear, vibration and noise, and to maximize the efficiency of power transmission.

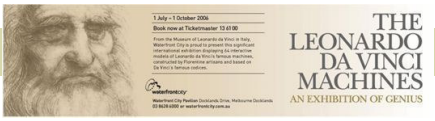
(variations of the above!)

Examples of objects which use gears?

T collects responses on board.

Get to know components of a gear: **teeth (or cogs)**, **wheel**, **axle**

Discuss: When you ride a bicycle, when would you use first gear?
When would you use third gear?



Gear Action

Role play examples of gears:

- set up 2 teams in a circle ; one of 6 students, one of 12 students
- left hand on hip and all hold hands in middle
- change numbers in each group to represent the changing of gears in a gear box (also known as gear ratios)
- have timekeepers who create steady beat

First gear Circle of 6 make the 12 students move	Driver must maintain constant speed at all times- note the speed of the • driver circle • driven circle
Second gear Circle of 8 make the 10 students move	Driver must maintain constant speed at all times- note the speed of the • driver circle • driven circle
Third gear Circle of 9 make the 9 people move	Driver must maintain constant speed at all times- note the speed of the • driver circle • driven circle
Overdrive Circle of 11 people make the 7 people move	Driver must maintain constant speed at all times- note the speed of the • driver circle • driven circle

Activity 2 : 1 hour

Game: Role- play of a device which uses gears.

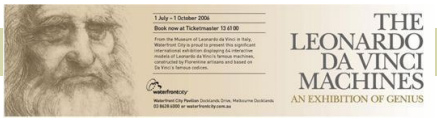
Form teams of 4:
Discreetly hand each group an object from your collection.

Get each group to work out as a team how to role-play how each object works.

Other teams to guess what object is.

Introduce **types** of gears:

- rack and pinion
- spur
- worm
- bevel.



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Rack and Pinion - The rack at the top is used to convert rotary motion into reciprocating motion from the gears below.

Spur - Two gears applying force in opposite directions cause the gears themselves to spin in opposite directions.

Worm – A screw type shaft turns with a toothed gear which causes change in force and regulated its speed.

Bevel - Two toothed wheels spin each other in opposite directions. These gears work best when meshed at a ninety degree angle.

What types of gears do the tools we have here, use?

Sketch examples of these objects in books.

Introduce LdV and his notebooks with sketches. Many of his inventions use gears. These have been made into models which can be seen at the exhibition.

- Study of Gears
- Transformation of linear to circular motion
- Gear with a circular mechanism

Activity 3: 1 hour

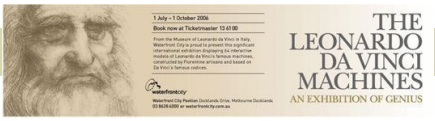
Design brief:

In pairs design and make a working model of a gearing system you would like to make.

If it is different to the one you have already drawn;
make a sketch of it. You might show an example of

- Gearing up
- Gearing down
- Changing direction of movement
- Transferring circular movement to up and down movement

(Teacher demonstration of a planning drawing, using a compass, split pins, card gear marking)



Gear Action

Using materials available, decide on scale of model. Draw templates on graph paper.

Produce.

Homework. Collect a picture or bring in photograph (or actual object) of a device which uses the kind of gearing system you have designed.

Activity 4 : 1 hour

Continue production
Demonstrate your model to class alongside your picture.
What is the ratio of gears you have constructed ?

Activity 5

L d V exhibition visit.