

Knowledge stems from experience



DESKTOP LEARNING MODULES

Proven to enhance student understanding

Cartridge system covering different topics

Seven DLM cartridges available at launch

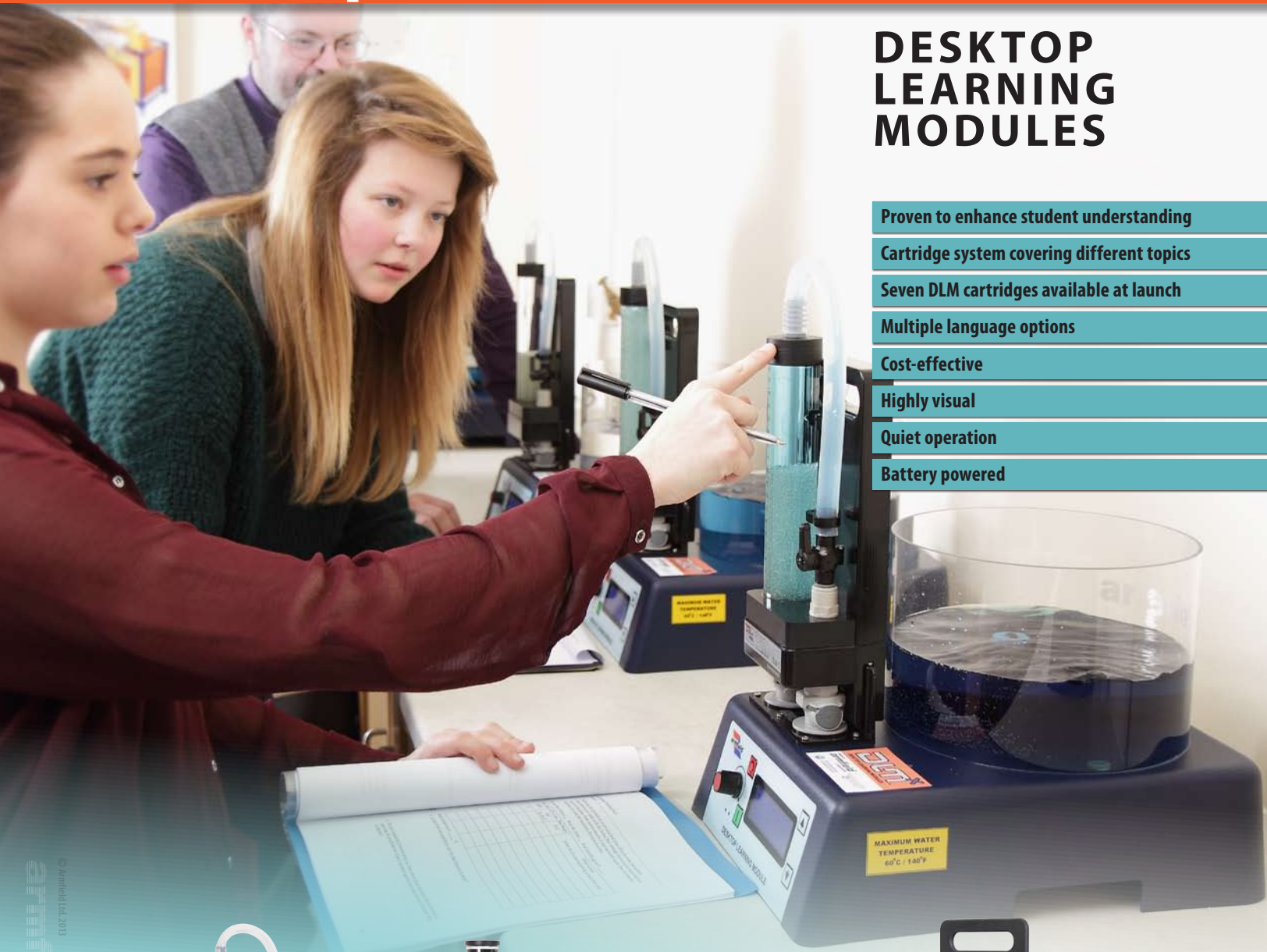
Multiple language options

Cost-effective

Highly visual

Quiet operation

Battery powered



SMALL ENOUGH FOR THE CLASSROOM, RIGOROUS ENOUGH FOR THE LABORATORY!

Designed by
armfield
in conjunction with



WSU funded by NSF grants:
DUE-0618872/DUE-1023121



armfield - learn more!

DESKTOP LEARNING MODULES - DLMX



Small enough to use in the classroom!
Rigorous enough to use in the laboratory!

DLM^x
DESKTOP LEARNING MODULES

**A new concept from Armfield and Washington State University, USA.
This simple teaching system will revolutionise the teaching of fluid mechanics,
thermofluids and heat transfer all in one compact, easy to use system!**

Designed to be highly visual and simple to use, the **DLMX** range illustrates engineering concepts in a groundbreaking and unique way. The equipment is small, portable and battery powered making it ideal for classroom or laboratory. It can be used by the teacher for presentations or can be operated by students to enable closeup understanding of the concepts being taught. The quick easy setup ensures that sensible investigations can be performed in less than ten minutes.

The **DLMX** system is equally at home in the engineering laboratory where more detailed investigations can be performed, complete with analysis of readings.



Students run a series of experiments on a pair of DLMX base units fitted with the DLM-5 Tubular Heat Exchanger cartridge. One unit controls the inner tube flow and the other controls the outer tube flow.

Simple pump speed control and flow rate display

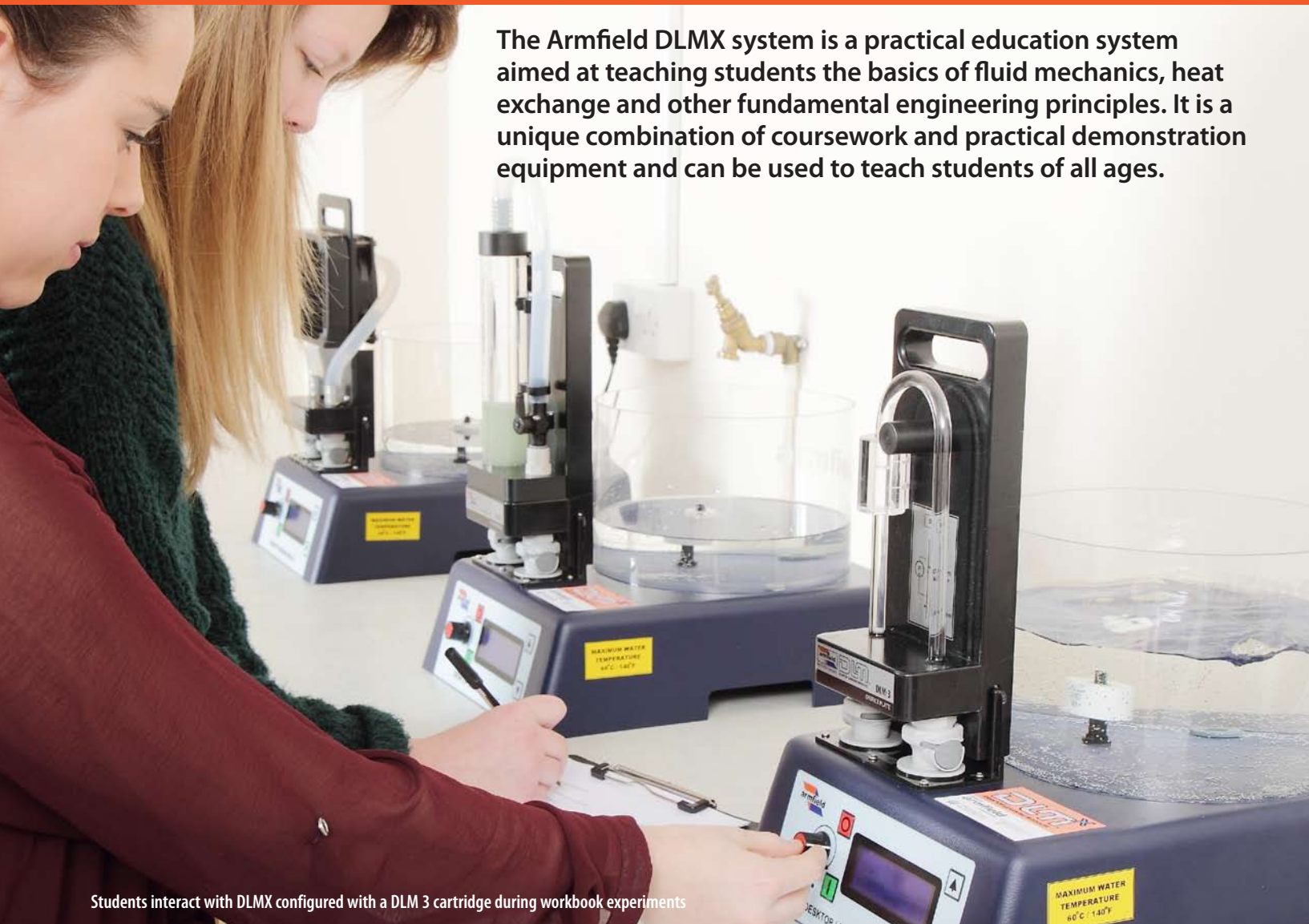


Multiple language support and SI or American Engineering Systems units display options



DLMX BASE UNIT

The Armfield DLMX system is a practical education system aimed at teaching students the basics of fluid mechanics, heat exchange and other fundamental engineering principles. It is a unique combination of coursework and practical demonstration equipment and can be used to teach students of all ages.



Students interact with DLMX configured with a DLM 3 cartridge during workbook experiments

The equipment comprises a small battery operated base unit, into which one of seven different cartridges is plugged. The base unit contains a water reservoir, pump, controls and viewing panel.

The cartridges contain an experimental representation of the topic, and the specific instrumentation required for the particular demonstration. Currently seven different cartridges are available covering fluid mechanics, thermofluids and heat transfer.

The cartridges can be changed in seconds as they use a simple plug in mechanism. As the cartridges include their own microcontroller, the base unit automatically detects the cartridge that is fitted and displays the information accordingly.

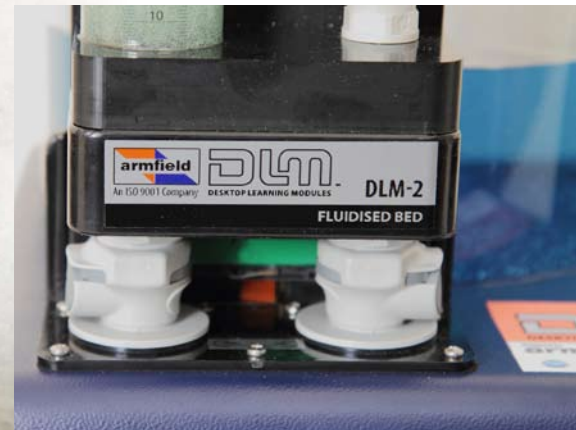
The equipment can be used by a single student, by small groups of students or by a teacher or technician demonstrating to the whole class.

The academic content and coursework is provided by Washington State University. It includes classroom exercises, detailed theory of the processes and suggestions for further work.



Desktop Learning Modules base unit - DLMX

Quick, easy set up using simple plug in cartridge interface.



The base unit comprises a clear acrylic water reservoir, mounted on a robust vacuum formed ABS plastic plinth. Under the plinth is a pump with a variable speed control, flow meter, battery, level sensor and the electrical control circuitry with display.

The simple push fit cartridge interface, provides smartchip and self-sealing hose connections. This mechanism is common to all the DLM cartridges.

The units are battery powered; the internal rechargeable batteries provide more than enough for a long classroom session. The units can also be powered by mains electricity, recharging the batteries at the same time.

Cartridge microcontroller containing sensor calibration



Uses standard laptop charger



Unit can be used while charging



DLM CARTRIDGES

DLM-1
Cross Flow Heat Exchanger



DLM-2
Fluidised Bed



DLM-3
Orifice Plate



DLM-4
Shell and Tube Heat Exchanger



DLM-5
Tubular Heat Exchanger (tube in tube)

Cartridge automatically detected

Display customised to cartridge fitted

No Cartridge Fitted
Flow 0.00 l/min
Battery Volts 13.1

Orifice Plate
Module
Flow 0.00 l/min
Pressure 1 mbar

Fluidised Bed
Module
Flow 3.73 l/min
Dif Press 19.1 mbar

DLM-1 Cross Flow Heat Exchanger

This cartridge demonstrates the function of a fan and radiator to cool water. The DLMX reservoir is filled with hot water, which is pumped through the heat exchanger. The inlet and outlet water temperatures are measured to demonstrate the cooling effect. The relationship between heat transfer and water flow rate can also be investigated.

DLM-2 Fluidised Bed

A highly visual demonstration of a fluidised bed. The onset of fluidisation can be demonstrated and the way the height of the bed varies with the flow rate. The pressure drop across the bed is measured, so the way the pressure varies before the onset of fluidisation and after fluidisation has occurred can be illustrated and compared to theory.

DLM-3 Orifice Plate

The use of an orifice plate to measure flow is demonstrated by measuring the pressure drop across a defined orifice. The geometry of the orifice is in accordance with standard industrial orifice flow meters.

DLM-4 Shell and Tube Heat Exchanger

This cartridge requires two DLMX base units, one filled with hot water, and one filled with cold water. The inlet and outlet temperatures of both fluid streams are measured, enabling the heat transfer coefficient to be measured and an energy balance to be performed. The two flow rates can be individually varied and the flow direction through the shell can be easily changed. The internal geometry of the DLM-4 is based on industrial 2-1 shell and tube heat exchangers.

DLM-5 Tubular Heat Exchanger (tube in tube)

This cartridge requires two DLMX base units, one filled with hot water and one filled with cold water. The inlet and outlet temperatures of both fluid streams are measured, enabling the heat transfer coefficient to be measured and an energy balance to be performed. Reversing the flow in the outer tube demonstrates the difference between co-current and counter-current operation.

DLM-6 Energy Losses in Hydraulic Systems

This cartridge simultaneously measures the pressure drop across a straight pipe, a smooth bend and a right angle bend. Each test section is of the same cross section and same path length, enabling meaningful comparisons to be made. The additional energy losses due to the geometry of the flow path can be clearly seen at different flow rates and the relationship to theory can be established.

DLM-7 Venturi System

The DLM-7 demonstrates the Bernoulli equation, showing how low pressure is generated in the throat of a venturi tube, and how this is affected by flow. The flow recovery is also demonstrated by measuring the total pressure drop across the module. The geometry of the venturi orifice is in accordance with standard industrial venturi flow meters, so the use of a venturi to measure flow can also be demonstrated.



DLM-6
Energy Losses in Hydraulic Systems

DLM-7
Venturi System

SPECIFICATION



- A range of Desktop Learning Modules for teaching fluid mechanics, thermofluids and heat transfer
- Different subject topics covered by interchangeable cartridges, which plug into a common base unit
- Cartridges interchangeable in a few seconds
- Variable flow rates by pulse width modulated controlled pump
- Electronic flow measurement
- Multiple language support display options
- SI or American Engineering Systems units display options
- Rechargeable battery pack - makes it independent of mains supply
- Complete with extensive teaching material compiled by Washington State University, to include classroom exercises, user manual, background theory and teaching assessments
- Cartridges include their own microcontroller
- Range of seven cartridges available:
 - Cross Flow Heat Exchanger
 - Fluidised Bed
 - Orifice Plate
 - Shell and Tube Heat Exchanger
 - Tubular Heat Exchanger
 - Energy Losses in Hydraulic Systems
 - Venturi

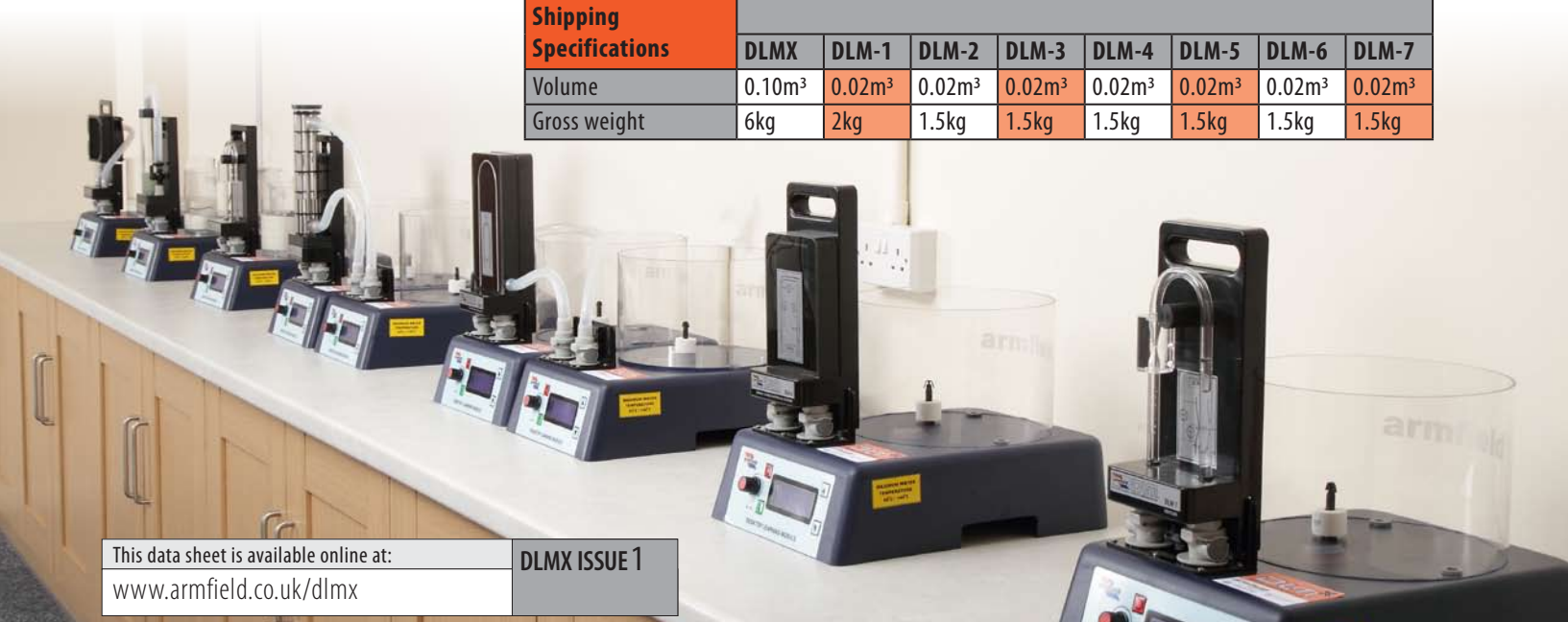


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REQUIREMENTS

Water: Initial cold fill, heat exchangers will require a supply of hot water (up to a max temperature of 60°C)

Overall dimensions	Equipment							
	DLMX	DLM-1	DLM-2	DLM-3	DLM-4	DLM-5	DLM-6	DLM-7
Height	0.250m	0.285m	0.350m	0.270m	0.320m	0.270m	0.270m	0.270m
Width	0.280m	0.160m	0.110m	0.110m	0.110m	0.110m	0.110m	0.110m
Depth	0.390m	0.075m	0.075m	0.075m	0.075m	0.075m	0.075m	0.075m
Shipping Specifications								
	DLMX	DLM-1	DLM-2	DLM-3	DLM-4	DLM-5	DLM-6	DLM-7
Volume	0.10m ³	0.02m ³	0.02m ³	0.02m ³	0.02m ³	0.02m ³	0.02m ³	0.02m ³
Gross weight	6kg	2kg	1.5kg	1.5kg	1.5kg	1.5kg	1.5kg	1.5kg



This data sheet is available online at:
www.armfield.co.uk/dlmx

DLMX ISSUE 1



learn more!

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Innovators in Engineering Teaching Equipment

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