

Robotic Fashion And motored components

Robotic Textile

Robotic Textiles (also known as "soft robotics" in fashion) are functional fabrics that can sense, move, and react to their environment, effectively acting as wearable machines. Unlike traditional clothing, which is static, robotic textiles integrate mechanical and electronic systems directly into the fibers or structure of the garment.



1. Physics Knowledge

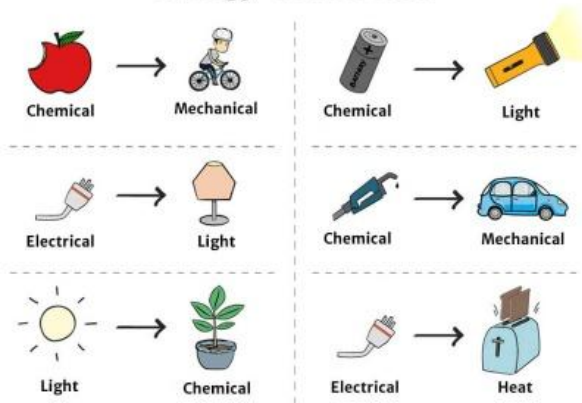
Energy Transformation

Junior Secondary Science

In robotic textiles, movement is not magic—it is a chain of energy changes. We track how energy stored in a battery flows through circuits to create physical "pull" or motion in the fabric muscles.

The energy transformations that take place in common processes (Education Bureau [EDB], 2025, p. 66)

Energy Conversion



2. Physics Knowledge

Building Complete Circuit

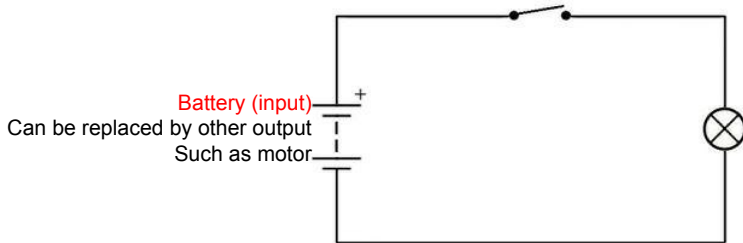
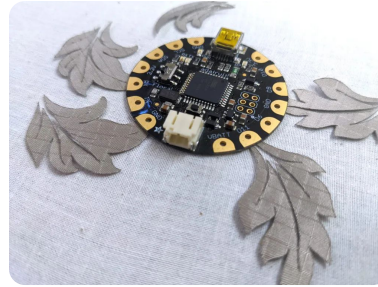
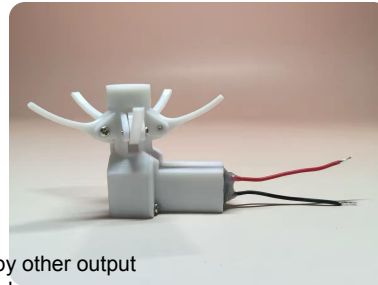
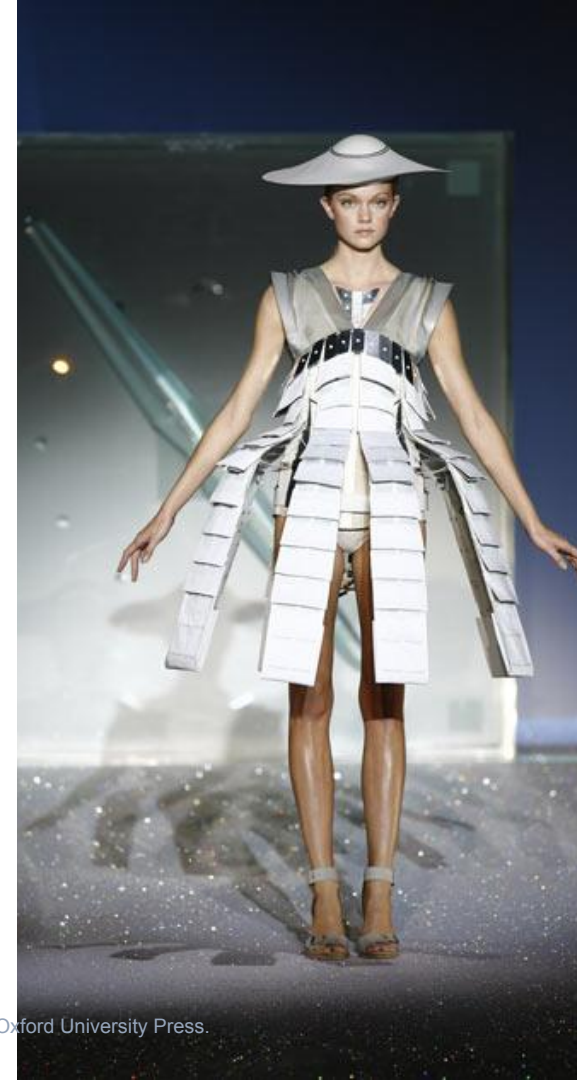
Junior Secondary Science

- **Completed Circuit**
- **Output and Input**

Smart wearables rely on closed loops to function. In order to build these systems, understanding how input and output components are arranged in paths that allow electricity to flow.

Identify series circuits and parallel circuits. Connecting completed circuit(Education Bureau [EDB], 2025, p. 65)

Basic Electrical Circuit



3. Physics Knowledge

Gears and Mechanics

Junior Secondary Science | Physics at Work for HKDSE

Mechanical movement in wearable robotic joints starts with motion laws. A part moves based on distance-time relationships.

"Use formula (speed = distance / time) to calculate the average speed of a moving object." (Education Bureau, 2025, p. 36)

"Describe the effect of a net force on the speed and/or direction of motion of an object." (Education Bureau, 2015, p. 26)

$$F=ma$$

NEWTON'S SECOND LAW

Chung, C. T., Mak, W. K., & Wong, C. K. (2023). Junior secondary science (Mastering concepts and skills): Book 2B (Section 11.1, pp. 167-181). Oxford University Press.

Education Bureau. (2025). *Science (Secondary 1–3) curriculum framework*. Curriculum Development Council.

Education Bureau. (2015). *Physics curriculum and assessment guide (Secondary 4–6)*. Curriculum Development Council.

Wong, S. L., Pang, W. C., Lie, H. Y., & Li, C. H. (2023). *Physics at work for HKDSE: Book 2* (Chapter 2, pp. 35-92). Oxford University Press.



4. Physics Knowledge

Motorized elements

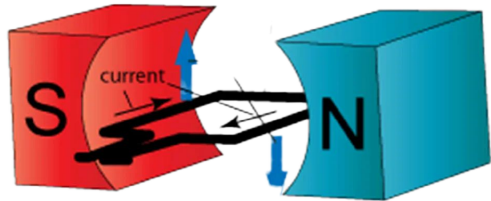
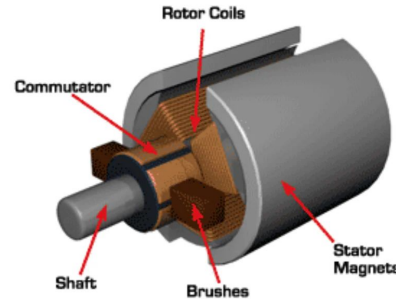
Physics at Work for HKDSE

Controlling motion is essential for robotic wearable joints. We explore how changing physical design—like wire coil density—optimizes rotational torque.

"Determine the turning effect on a current-carrying coil in a magnetic field." (*EDB, 2015, p. 43*)



"Investigate factors affecting the strength of the electromagnet." (*EDB, 2025, p. 66*)



Education Bureau. (2025). Science (Secondary 1–3) curriculum framework. Curriculum Development Council.

Education Bureau. (2015). Physics curriculum and assessment guide (Secondary 4–6). Curriculum Development Council.

Wong, S. L., Pang, W. C., Lie, H. Y., & Li, C. H. (2023). Physics at work for HKDSE: Book 2 (Chapter 5, pp. 195-228). Oxford University Press.

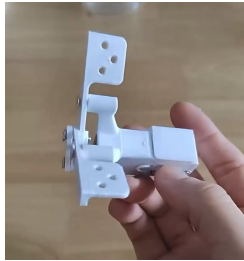
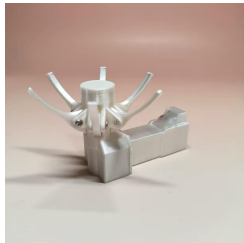
Wong, S. L., Pang, W. C., Lie, H. Y., & Li, C. H. (2023). Physics at work for HKDSE: Book 4 (Section 5.2, Section 6.1-6.2, pp. 193-241). Oxford University Press.

Integrating Motorized Elements in Fashion Design

Motors allow garments to change shape, silhouette, or structure creating a dynamic, living aesthetic.

While integrating the motor, Considering the friction between moving structural elements/cables and textile linings is critical so small motors don't stall due to fabric drag.

- **Hooke's Law ($F = K \Delta X$):** Flexible dynamic joints and tension cables pulling fabric depend directly on spring constants and elastic deformation limits of textiles.



5. Physics Knowledge

Power efficiency

Physics at Work for HKDSE

Understanding Power Output

Power (P) is the rate at which a battery delivers energy, calculated as $P = V \times I$ (where V is voltage and I is current). Because button batteries are designed for small, low-drain devices, their power output is generally very low compared to larger power sources.

*Determine the output power of an electric motor.
Designing and constructing electric circuit to perform a simple function (EDB, 2015, p29).*



Voltage: Different chemistries provide different nominal voltages:

- **Alkaline:** 1.5 V.
- **Silver Oxide:** 1.55 V.
- **Lithium:** 3.0 V.



5. Physics Knowledge

Power efficiency

Current is measured by Multimeter

- **No-load current:** Typically ranges from **50mA to 150mA** when the motor is spinning freely without any external resistance.
- **Operating current:** When under a light load, the motor will typically draw between **150mA and 400mA**.



Optics & Light

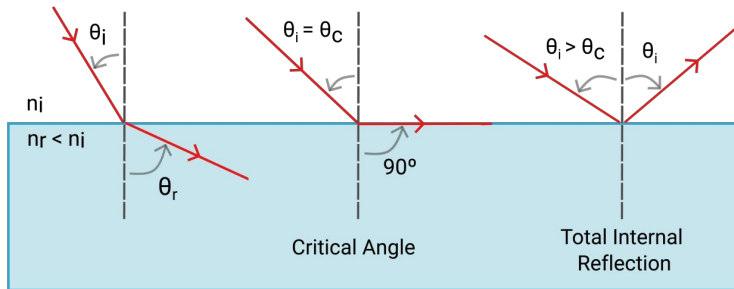
HKDSE Waves / S1–S3 Light

What is **Total Internal Reflection (TIR)**?

- TIR occurs when light travels from an optically denser medium (e.g., plastic/ optical fibers) towards a less dense medium (e.g., air).

The **Critical Angle (C)**:

- If the angle of incidence is greater than the critical angle, the light cannot refract out. Instead, it is 100% reflected back inside the material.
- Flexible optical fibers weaves into the textile so that TIR traps the light inside the threads, guiding it perfectly along the curves of the garment to create a stunning, self-illuminating effect.



Robotic fashion in the runway



Anrealage 2026ss

Robotic fashion in the runway



Iris van Herpen 2019 FW Haute Couture

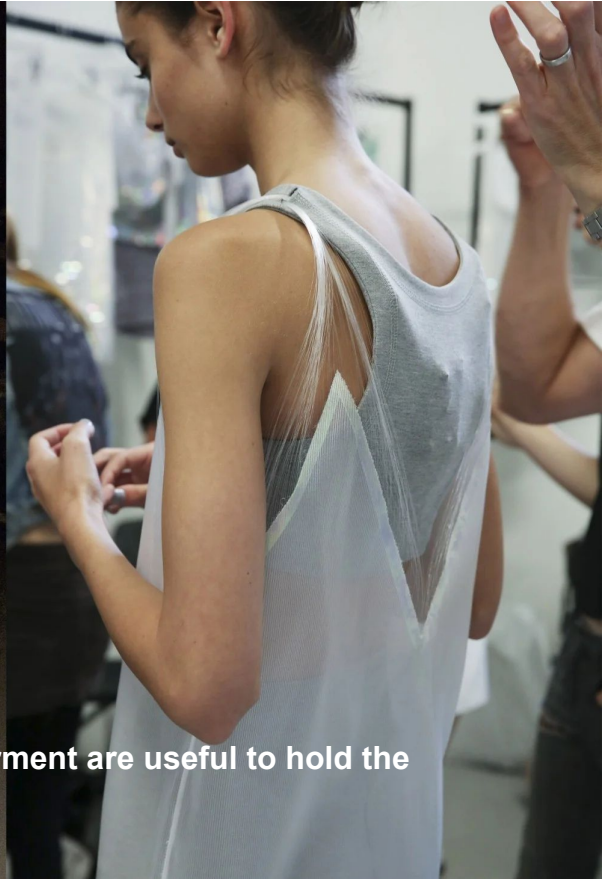
Tips in making wearables

How to hide the components?

1. *Find the smallest components*
2. *Make use of undergarment*
3. *Hide it under structured area*
4. *Find area to open seam or hole to house the components*



Structural fabric and tight undergarment are useful to hold the components



Integrating Motorized Elements in Fashion



Integrating Motorized Elements in Fashion

