Science 10

## Unit B: Energy flow in technological systems

# Engines and the idea of energy

# Fuel use in Watt's engine

- Early steam engines repeatedly heated and cooled the same cylinder.
- Watt's separate condenser kept the working cylinder hotter and reduced wasted thermal transfer.




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# Engines before the laws

- Practical engines came first; repeated observations and measurements helped scientists formulate the laws later.
- Less energy is used to reheat the cylinder during each cycle, so more input supports useful mechanical work.
- Connect trial-and-error engine improvements to the later formulation of thermodynamic laws.

# Key terms

**heat engine**

A device that transforms thermal energy into mechanical work through a repeating cycle.

**steam engine**

A heat engine that uses steam pressure to drive mechanical motion.

**efficiency**

Useful energy output divided by total energy input, usually expressed as a percentage.

**thermodynamics**

The study of energy transfer, thermal processes, and work.

# Invention of the engine

- Early heat engines improved when builders tried a change and measured whether it worked.
- Watt redesigned the engine so less heat was wasted reheating the cylinder each cycle.




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# Concept of energy

- Rumford and Joule showed that mechanical work and heating are connected.
- First Nations and Inuit technologies using thermal energy transfer.
- People were already moving thermal energy with tools long before the laws were written down.




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## Design change and evidence

- Explain one Watt design change and connect it to a reduced thermal-energy loss.
- A complete answer names one design change, compares before and after, and gives a physical reason the efficiency improved.