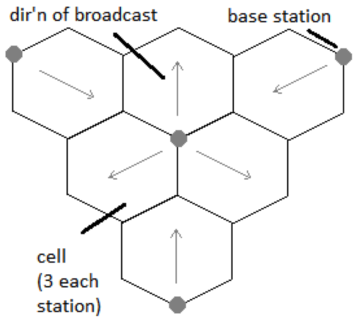
# 8.2.1 THE WAVE MODEL

**The wave model can be used to explain how current technologies transfer information**

1.1 Describe the **energy transformations** required in a **mobile telephone**

- Voice (**sound**) vibrates in diaphragm of microphone (**kinetic**), creating **electrical** signals
- Signals transferred as **radio** waves to an antennae on tower (base station) then travels to switching station

sound → (kinetic) → electrical → radio




→ MOBILE

- Signal transferred into another base station (**electrical**) and converted back to **sound** energy (→ electrical → radio → sound)

→ FIXED TELEPHONE

- Signal transferred through copper (**electrical**) or optic fibre (**light**) to another switching station (→ electrical or light → sound)

1.2 Describe waves as a **transfer of energy disturbance** that may occur in **one, two or three dimensions**, depending on the **nature** of the wave and the **medium**

- Wave is a **travelling disturbance** that transfers energy **not matter**
- Can travel in different number of dimensions
  - **1D** – **slinky spring, rope** – medium is confined to the spring/string (1 direction)
  - **2D** – **water wave** from a point source – medium confined to surface of water (2 dimension direction)
  - **3D** – **sound, light** – medium is the air (3D space)

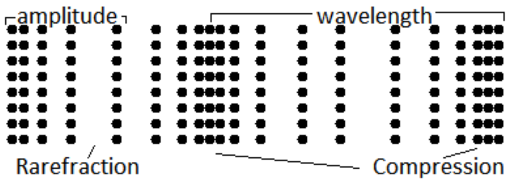
1.3 Identify that **mechanical waves** require a **medium for propagation** while **electromagnetic waves** do not

- **Mechanical waves** travel **through a medium**, through **oscillation** (vibration) of particles
  - Some loss of energy from friction
- **Electromagnetic waves** can **self-**propagate by **oscillating and alternating electric and magnetic fields**

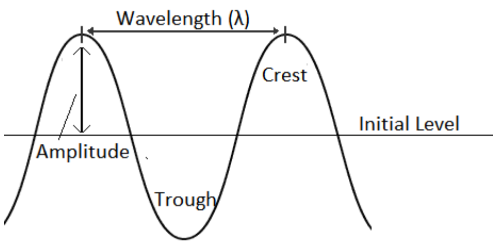
1.4 Define and apply the following **terms** of the wave model: medium, displacement, amplitude, period, compression, rarefaction, crest, trough, transverse waves, longitudinal waves, frequency, wavelength, velocity

- **Medium**: material in which the wave is travelling, e.g. wood, steel, air

- **Transverse Waves**: particles travel at **right angles** to the direction of transfer
- **Longitudinal Waves**: particles travel **parallel** to the direction of transfer
- **Compression**: (longitudinal wave) region of **higher** density of the medium
- **Rarefaction**: (longitudinal wave) region of **lower** density of the medium



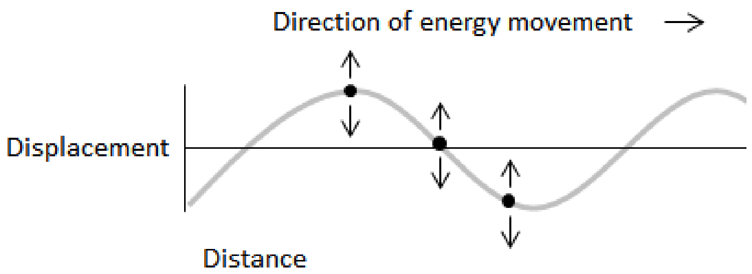
- **Displacement**: **distance** from zero displacement/equilibrium
- **Amplitude**: **amount of energy** wave is carrying – max amplitude is max displacement (a crest or trough)
- **Wavelength (λ)**: distance between **two corresponding points**
- **Crest**: **highest** point and **maximum** displacement of a wave
- **Trough**: **lowest** point and **maximum** displacement of a wave

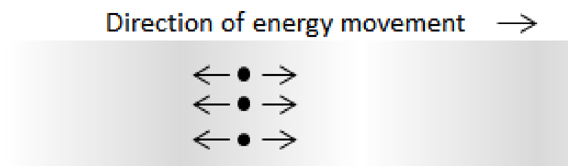



- **Period (T)**: **time taken** for one wave/pulse to pass a fixed point
- **Frequency (f)**: number of waves **passing a fixed point** (in a second)
  - Hertz; in sound, determines pitch
  - $f = \frac{1}{T}$
- **Velocity (v)**: how **fast** the wave travels

1.5 Describe the relationship between **particle motion** and the **direction of energy propagation** in transverse and longitudinal waves

- Transverse waves – particles move **perpendicular** to direction of energy propagation, e.g. light, water
- Longitudinal waves – particles move **parallel** to direction of energy propagation, e.g. sound, spring




1.6 Quantify the relationship between velocity, frequency and wavelength for a wave: $\boldsymbol{v = f\lambda}$

$$v = \frac{distance}{time} = \frac{number\ of\ waves\ \times wavelength}{time} = \frac{number\ of\ waves}{time} \times wavelength = f\lambda$$

- Therefore, $\boldsymbol{v = f\lambda}$, where v is **velocity** (m/s), f is **frequency** (hertz), λ is **wavelength** (m)