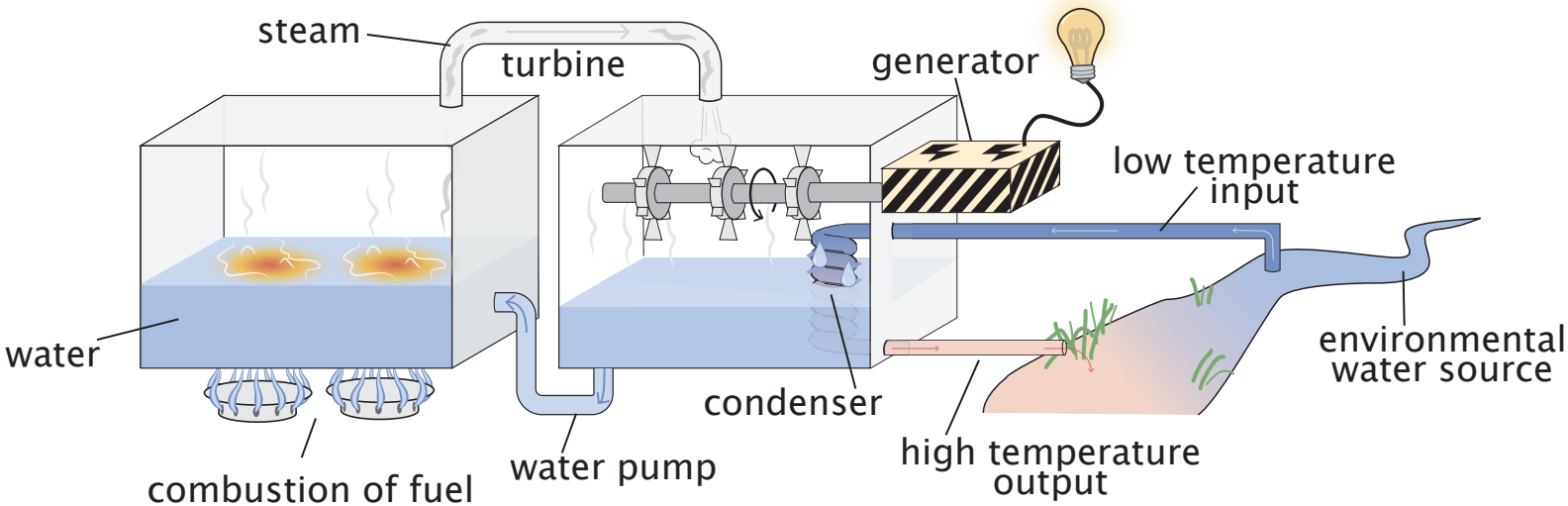
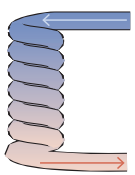
(A)

ELECTRICITY GENERATION BY BOILING WATER



(B)

ESTIMATING ONCE-THROUGH COOLANT VOLUME



$E_{output} \approx 10^{20}$ J / year — global annual thermoelectricity generation

$\Phi_{efficiency} \approx 70\%$

$$E_{input} \approx \frac{E_{output}}{\Phi_{efficiency}} \approx \frac{10^{20}\ \text{J / year}}{0.7} \approx 1.f\times10^{20}\ \text{J /year}$$

$E_{dissipated} \approx E_{input} - E_{output} \approx f\times10^{19}$ J / year

$\Delta T \approx f$ °C

$C_{H_2O} \approx \frac{f\times10^{3}\ \text{J}}{\text{°C} \times \text{kg}}$ — specific heat of H_2O

$\rho_{H_2O} \approx 1$ kg / 1 L

$$V_{H_2O}^{(coolant)} \approx \frac{E_{dissipated}}{C_{H_2O} \times \Delta T \times \rho_{H_2O}} \approx \frac{f\times10^{19}\ \text{J}}{\text{year}} \times \frac{\text{°C} \times \text{kg}}{f\times10^{3}\ \text{J}} \times \frac{1}{f\ \text{°C}} \times \frac{1\ \text{L}}{1\ \text{kg}}$$

$\approx f\times10^{15}$ L / year

(C)

ONCE-THROUGH WITHDRAWAL VOLUME PER 10^6 J

$$W_{once\text{-}through} \approx \frac{f\times10^{15}\ \text{L / year}}{10^{20}\ \text{J / year}} \approx \frac{f\times10\ \text{L}}{10^{6}\ \text{J}}$$