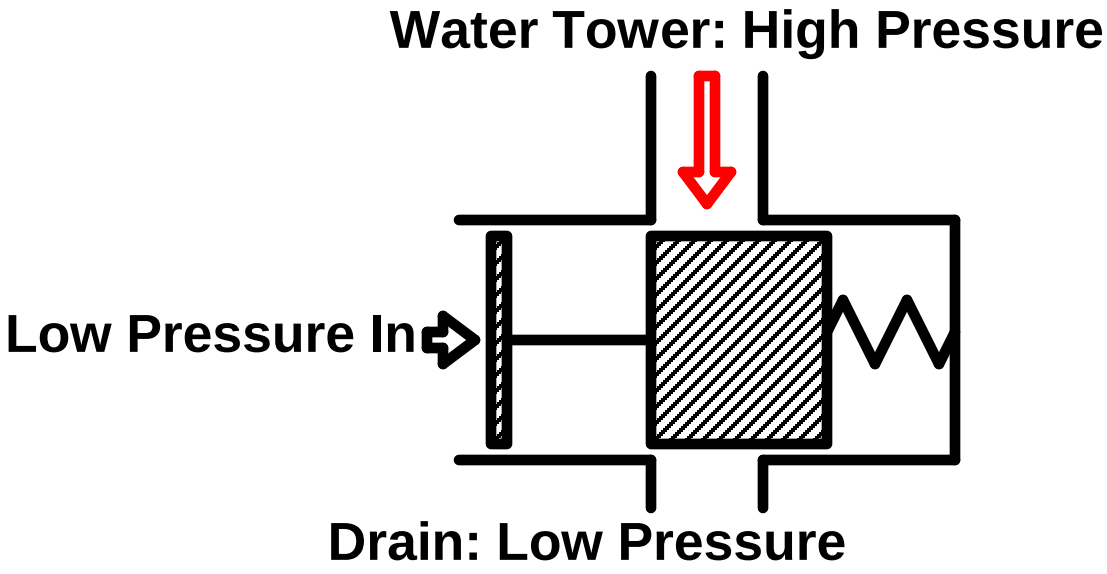
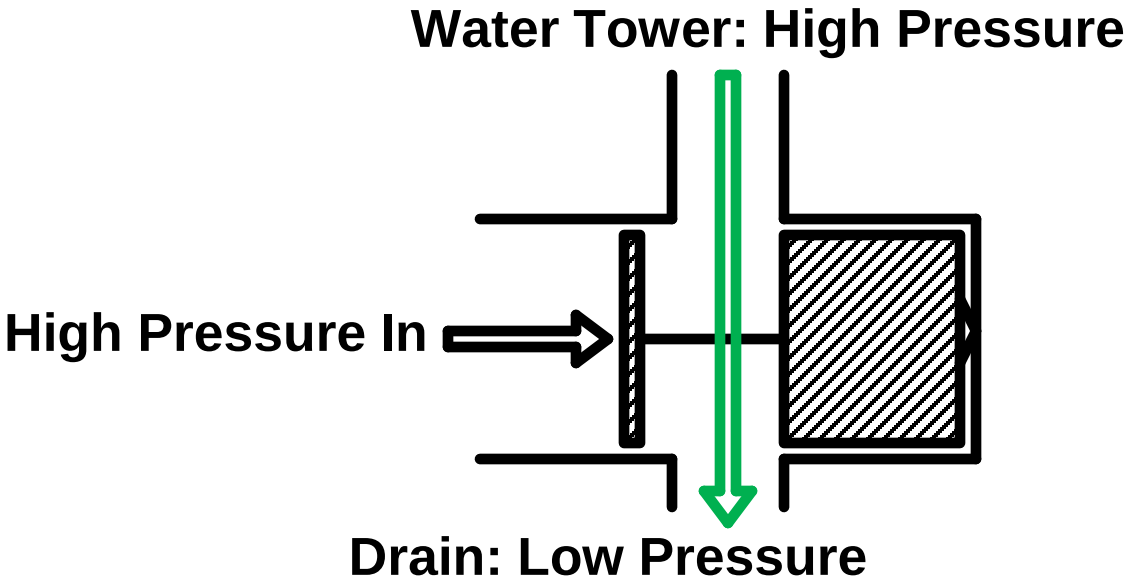
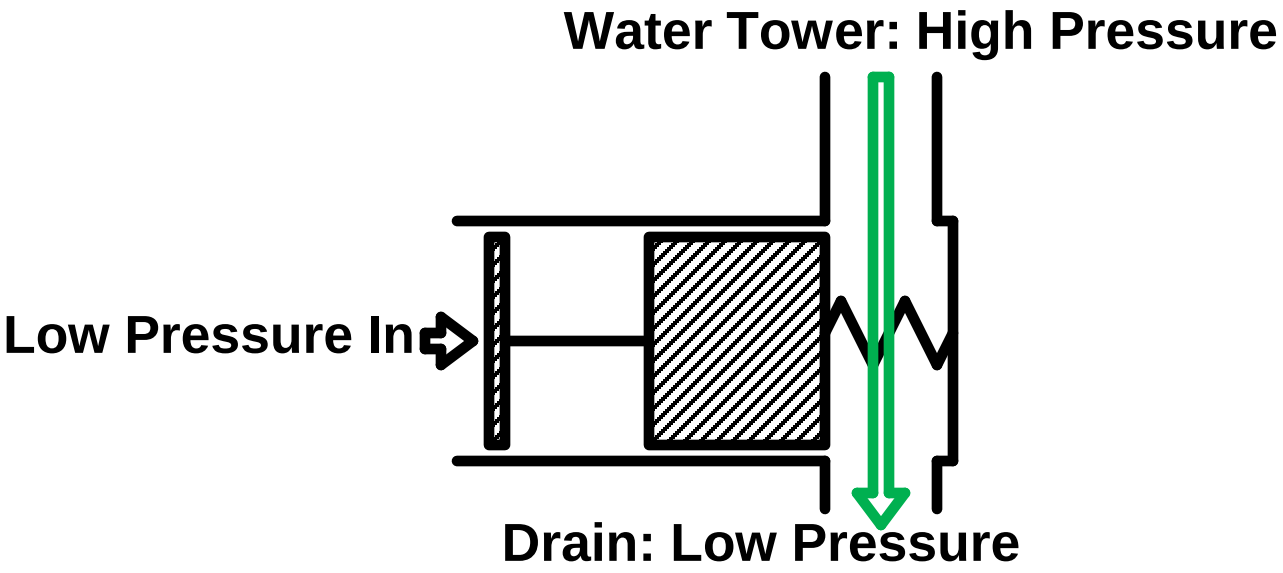
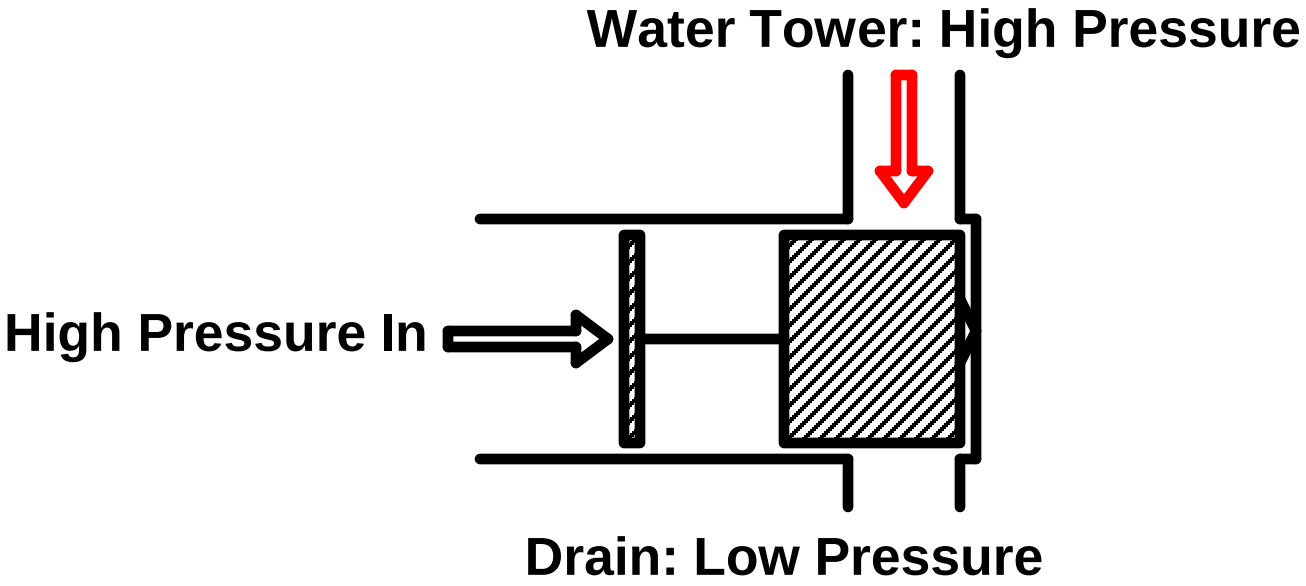
Pressure Controlled Faucet





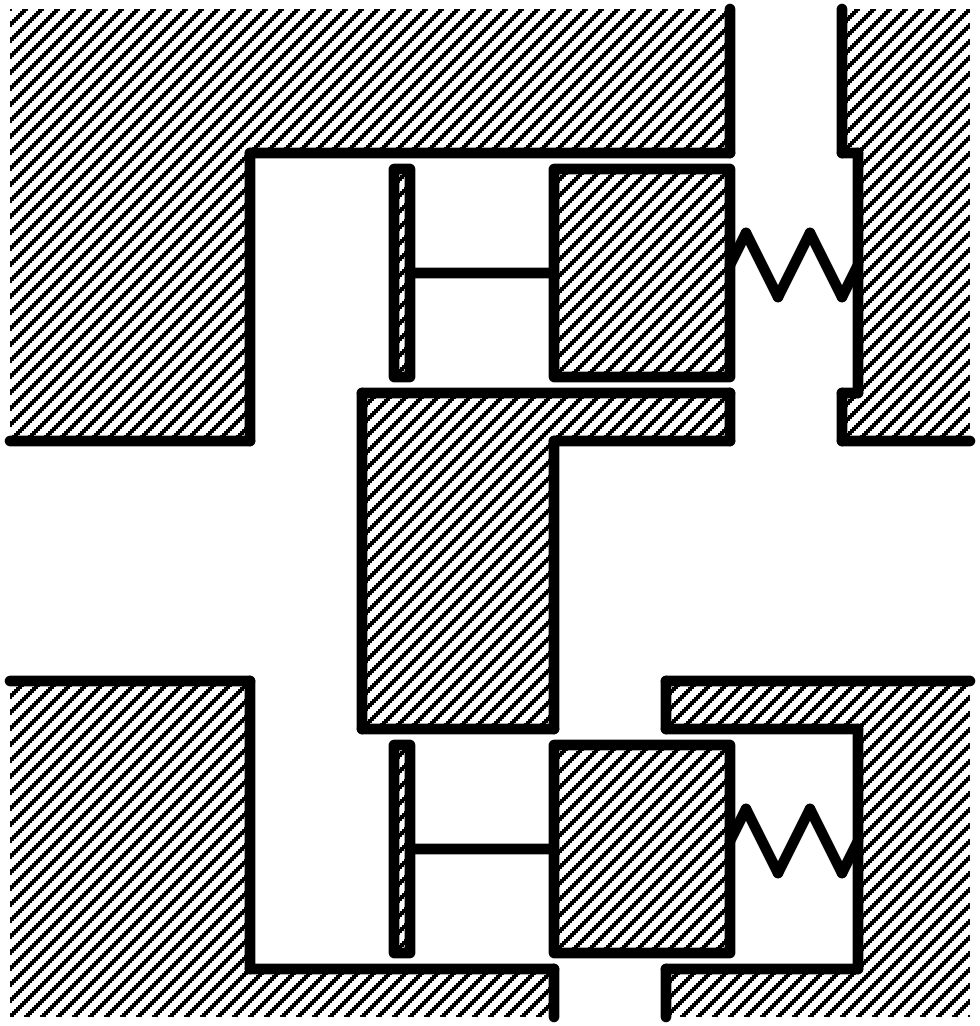
Opposite behavior: Complementary Device



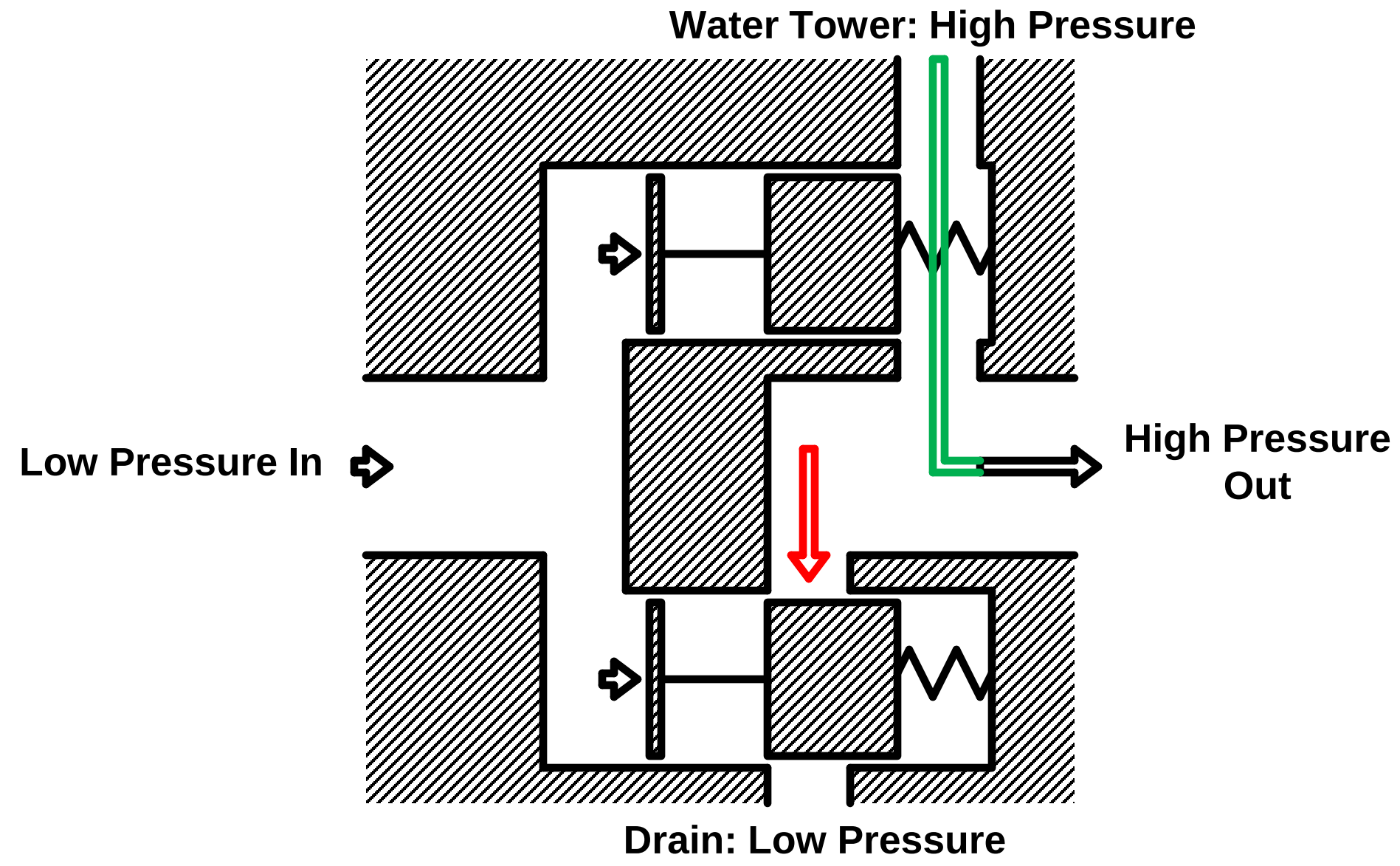


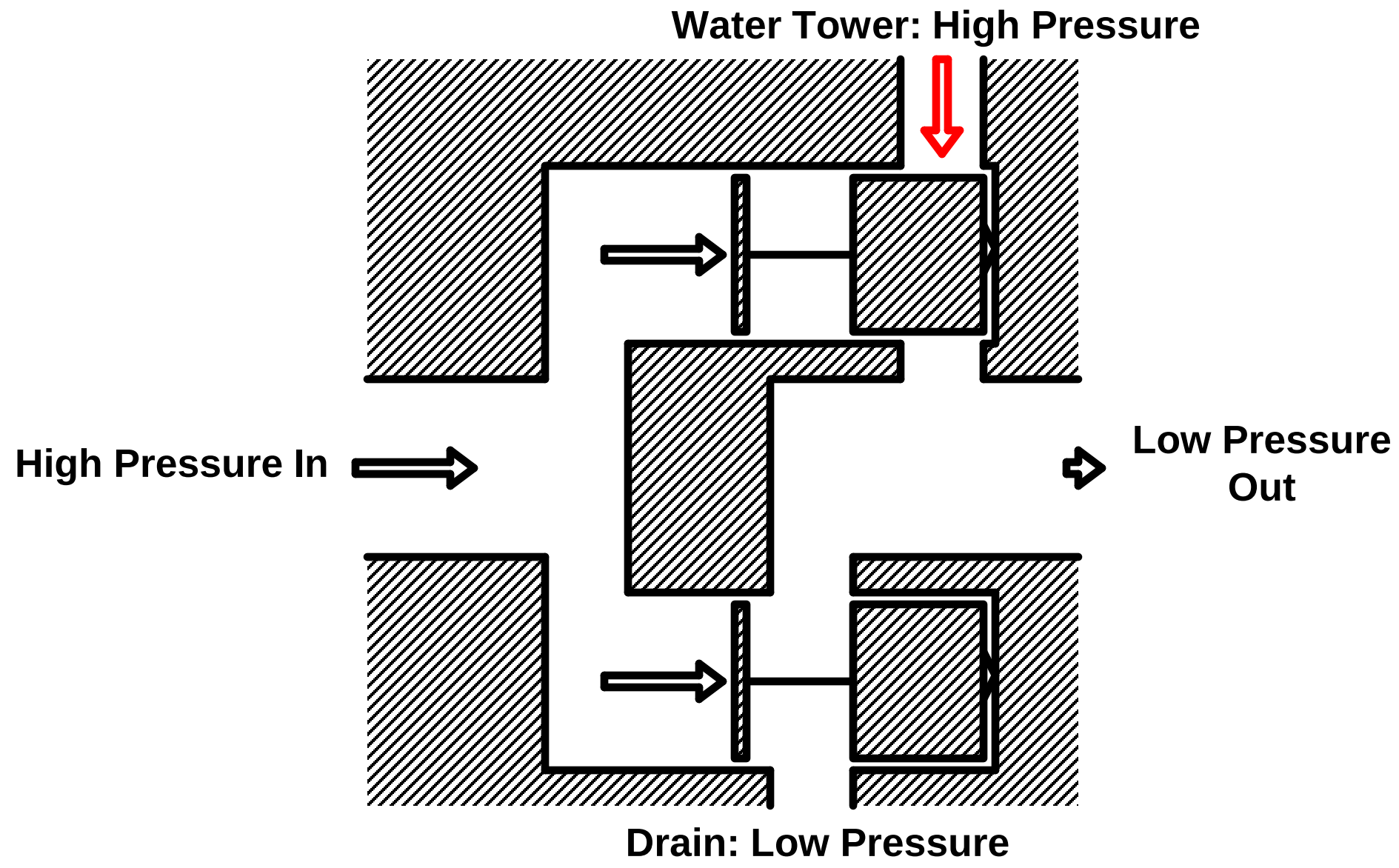
Let’s Build Something. What does it do

Water Tower: High Pressure



Drain: Low Pressure


Water Tower: High Pressure
Low Pressure In
High Pressure Out
Drain: Low Pressure

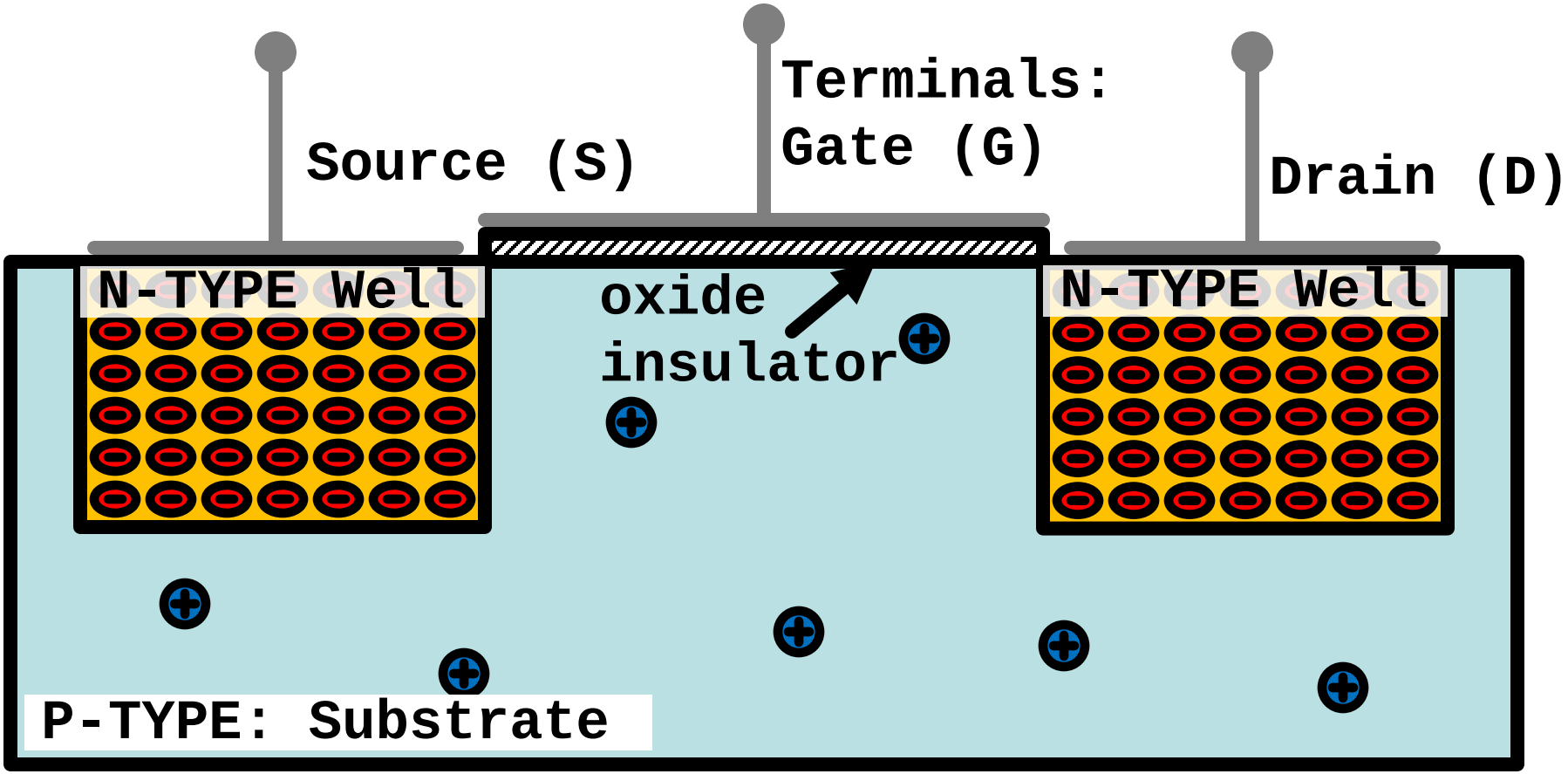

Water Tower: High Pressure
High Pressure In
Low Pressure Out
Drain: Low Pressure

MOSFET - Structure

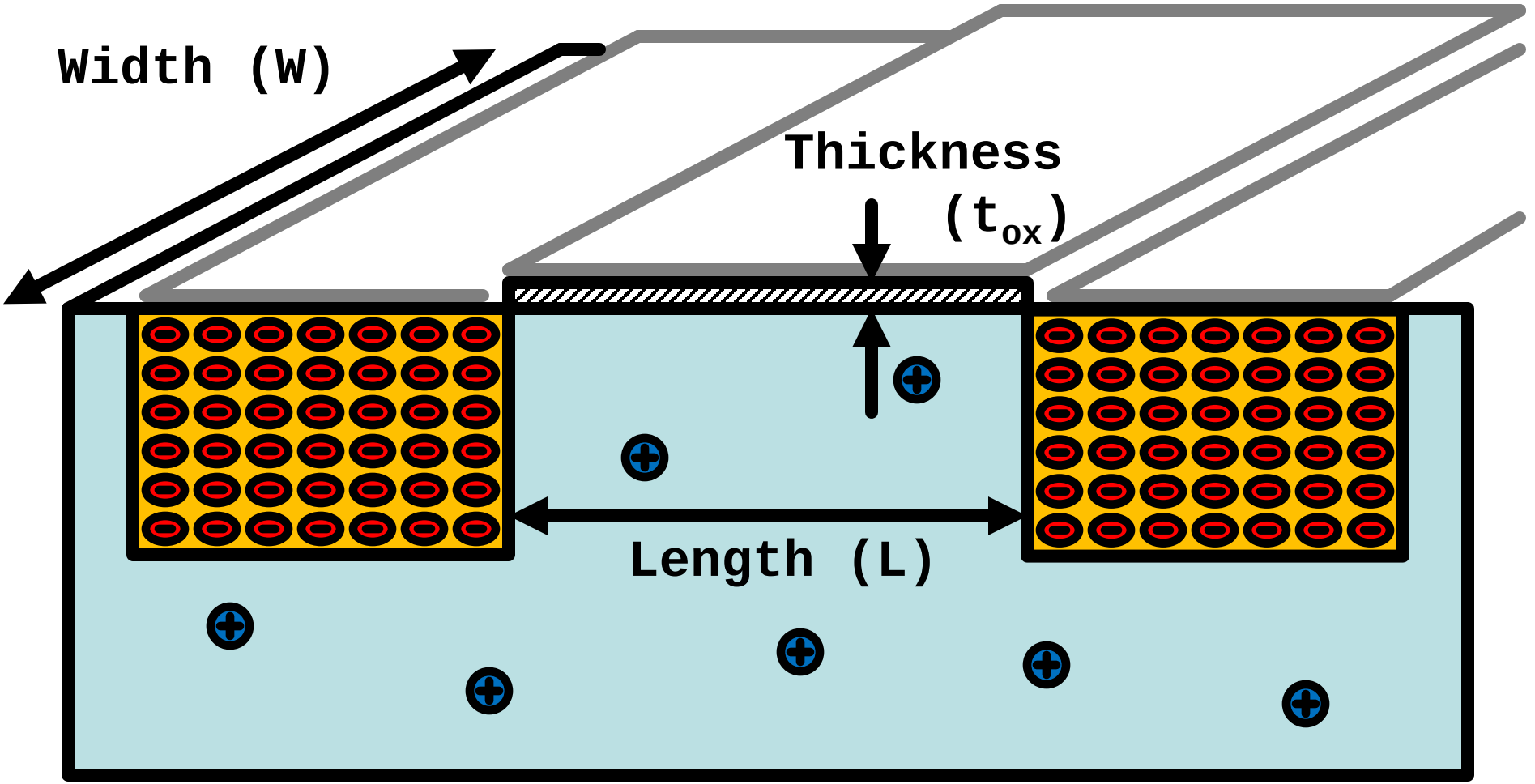
Properties

Oxide Insulator: ε_{ox}=

N-Type: μ_n=

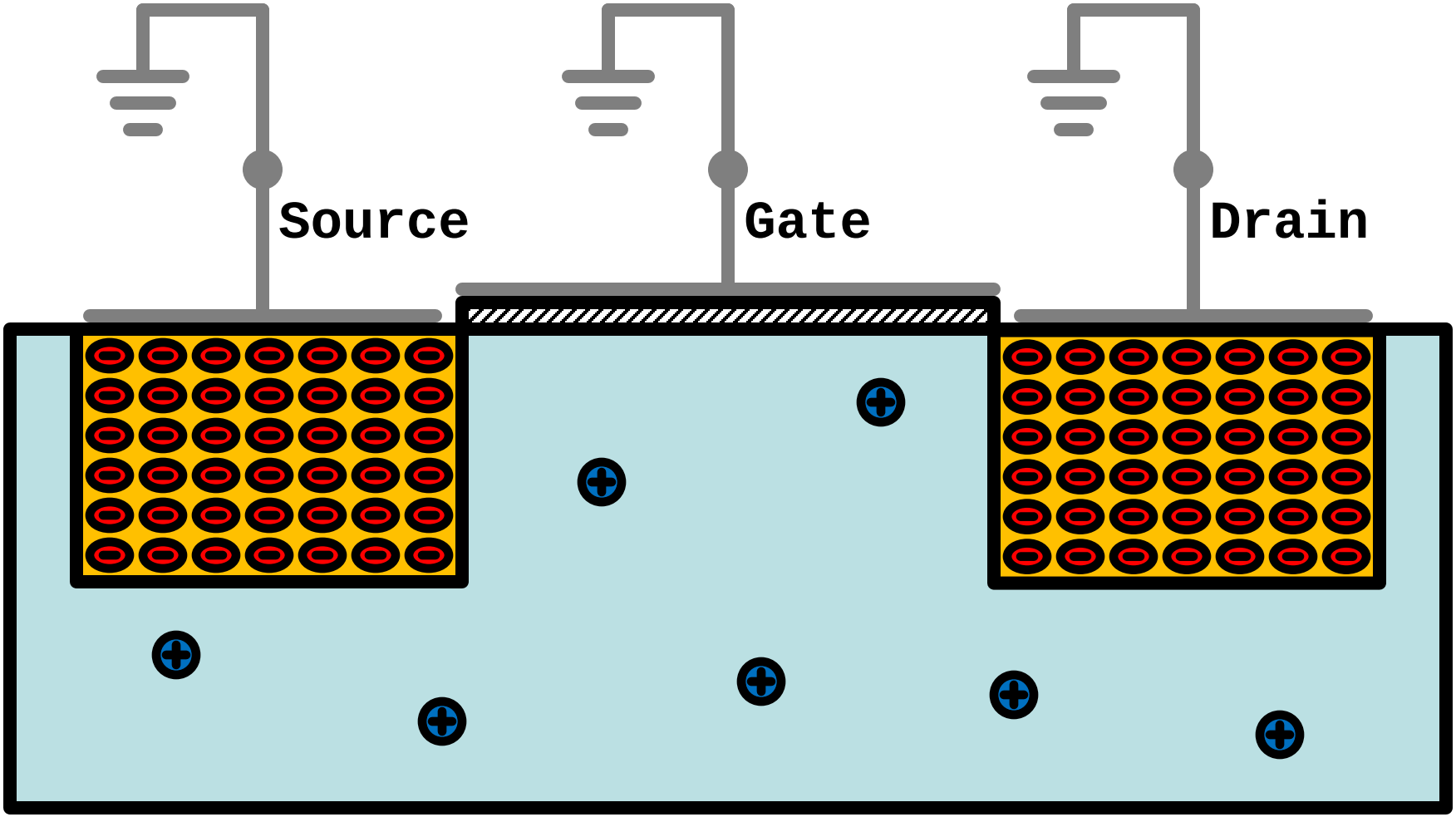


MOSFET - Dimensions

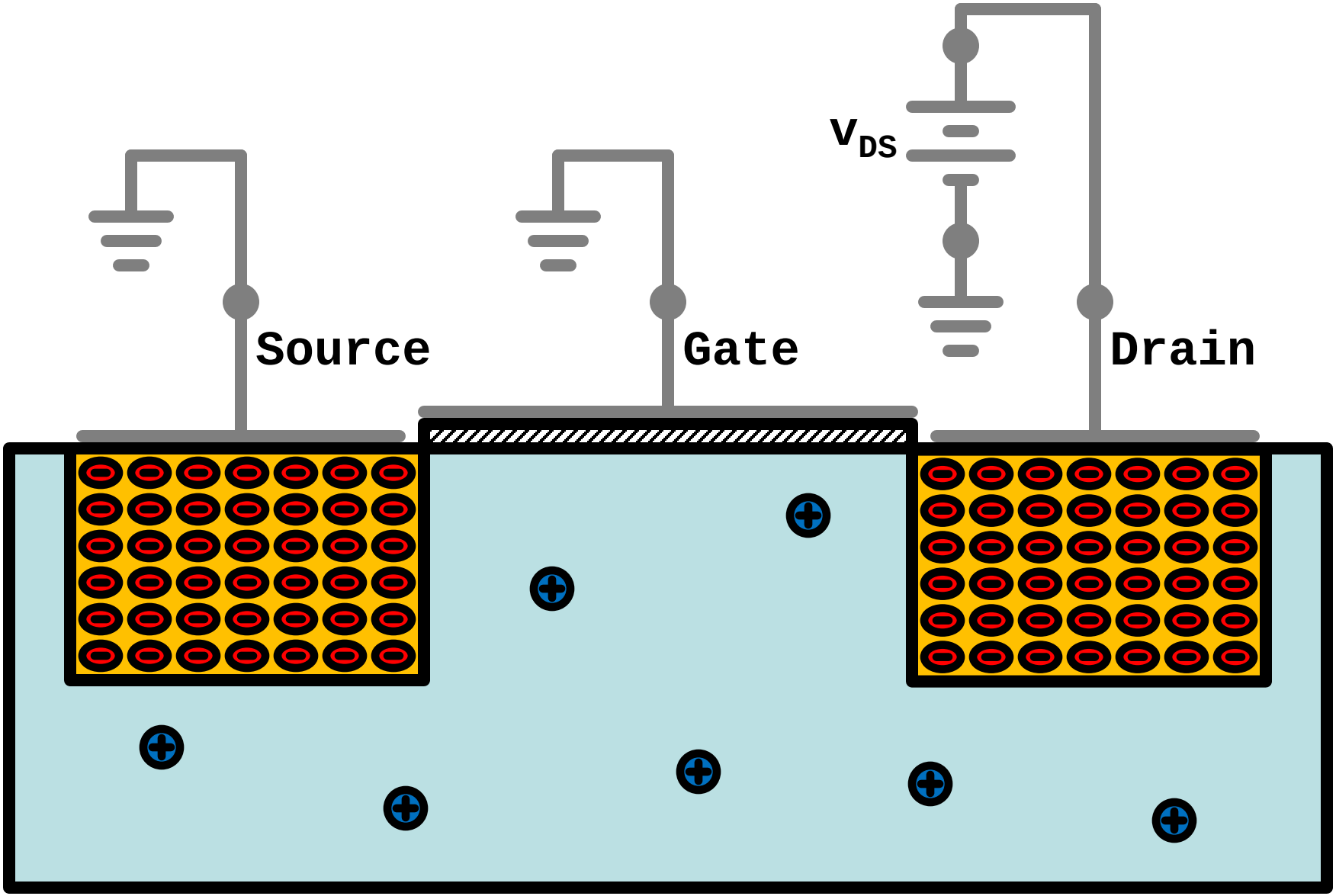


MOSFET – Operation and Modes

No current flows into the gate.
Try to make current flow into the drain.

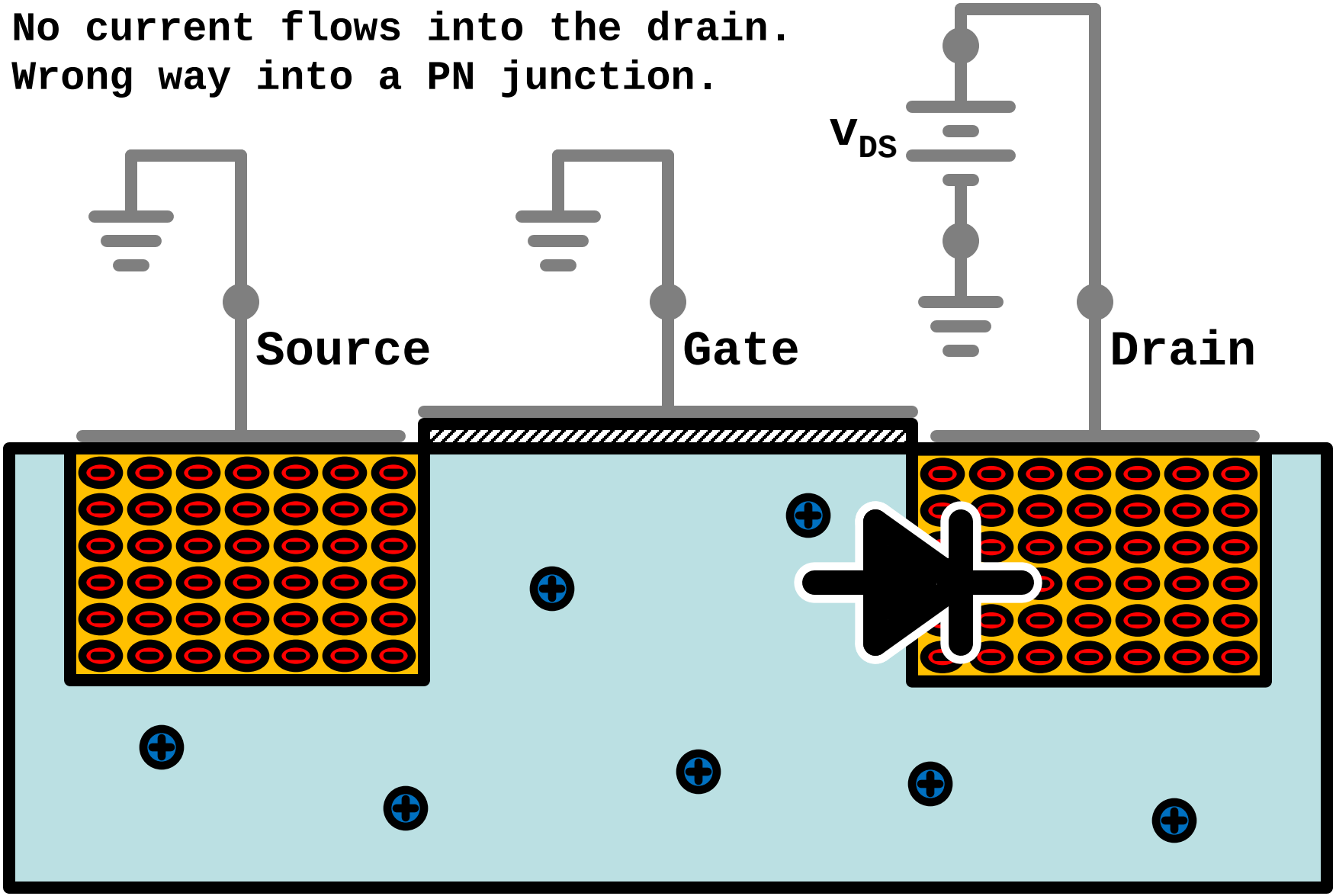


MOSFET – Operation and Modes

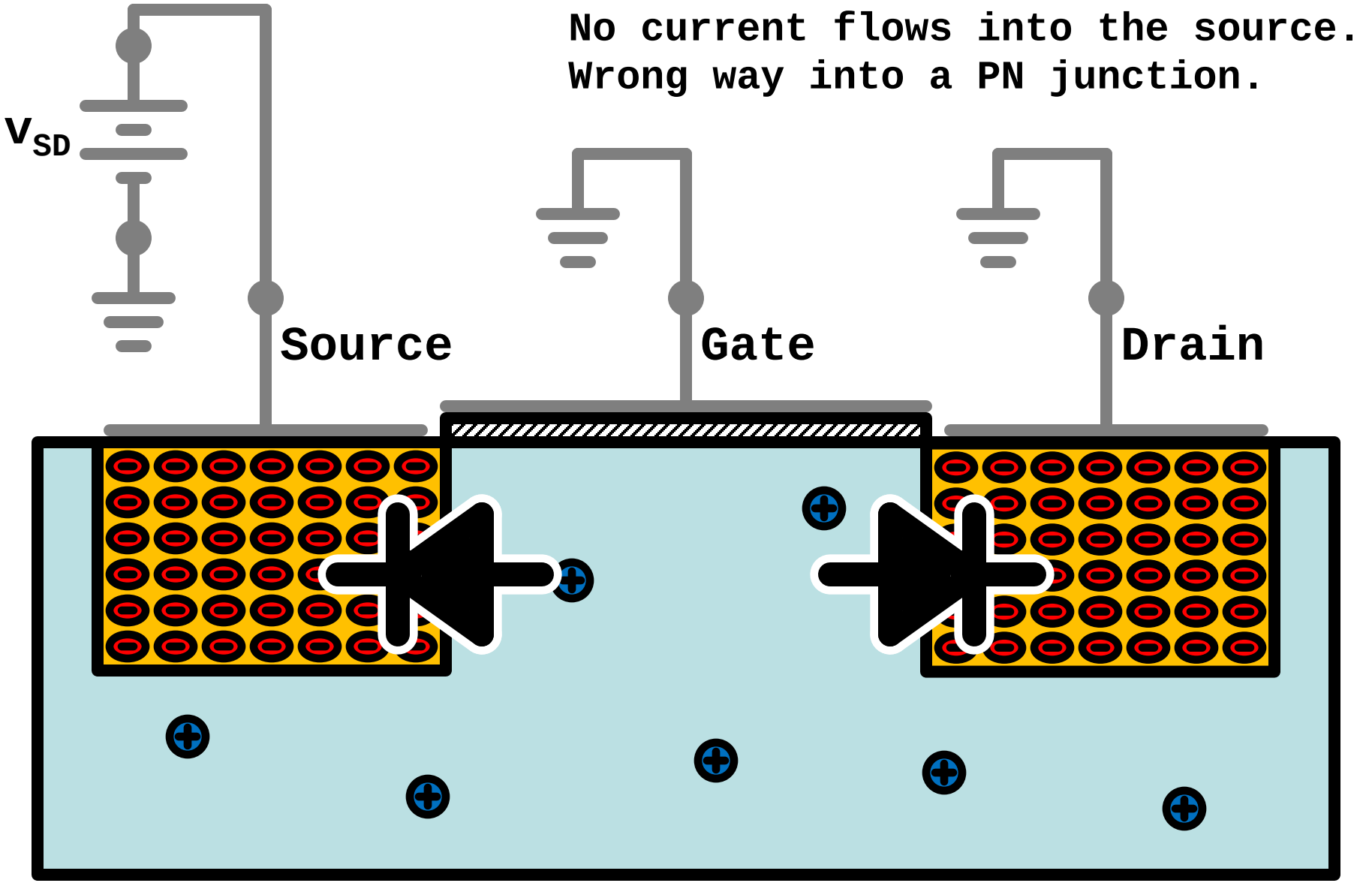


MOSFET – Operation and Modes

No current flows into the drain.
Wrong way into a PN junction.

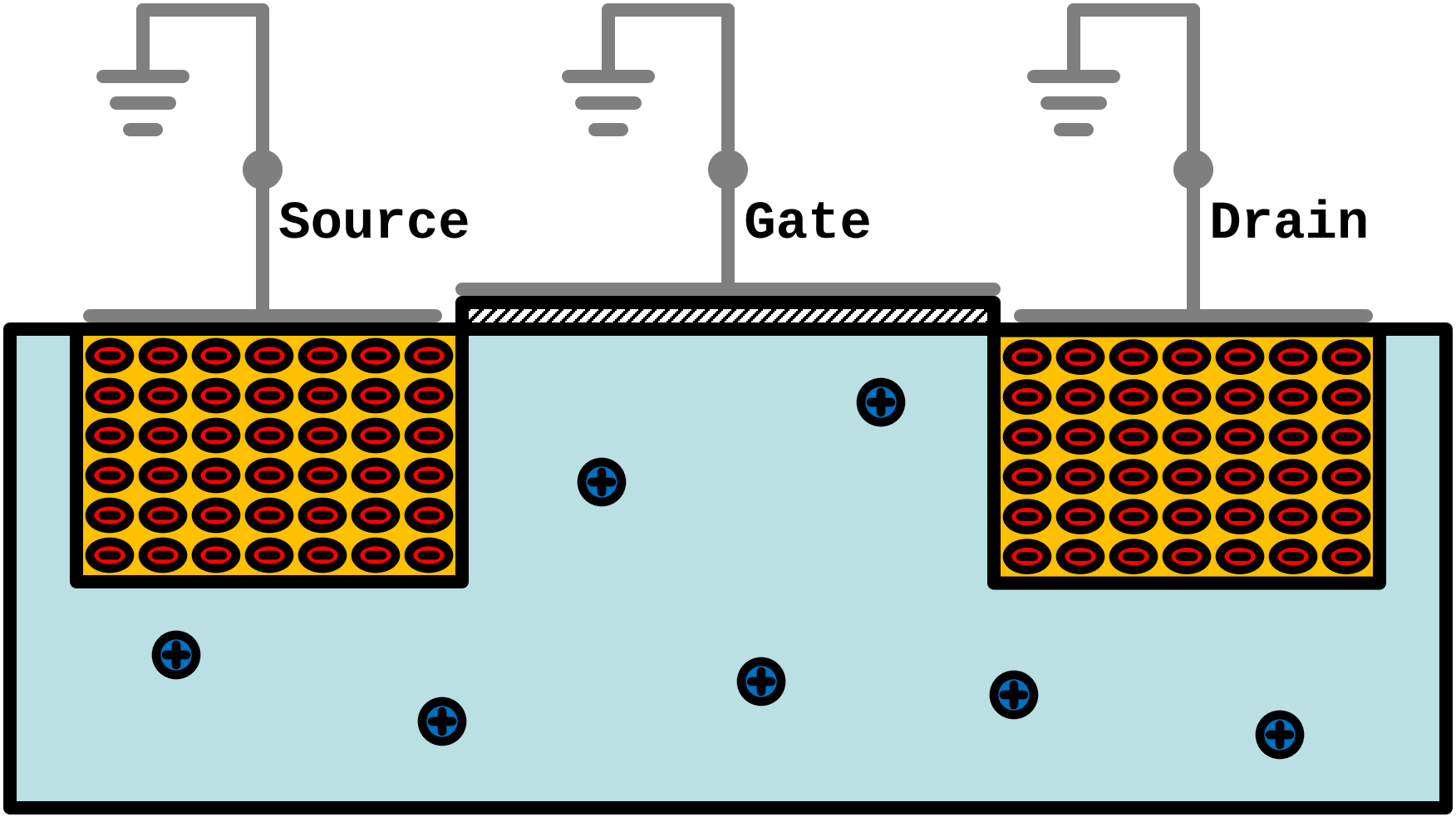


MOSFET – Operation and Modes

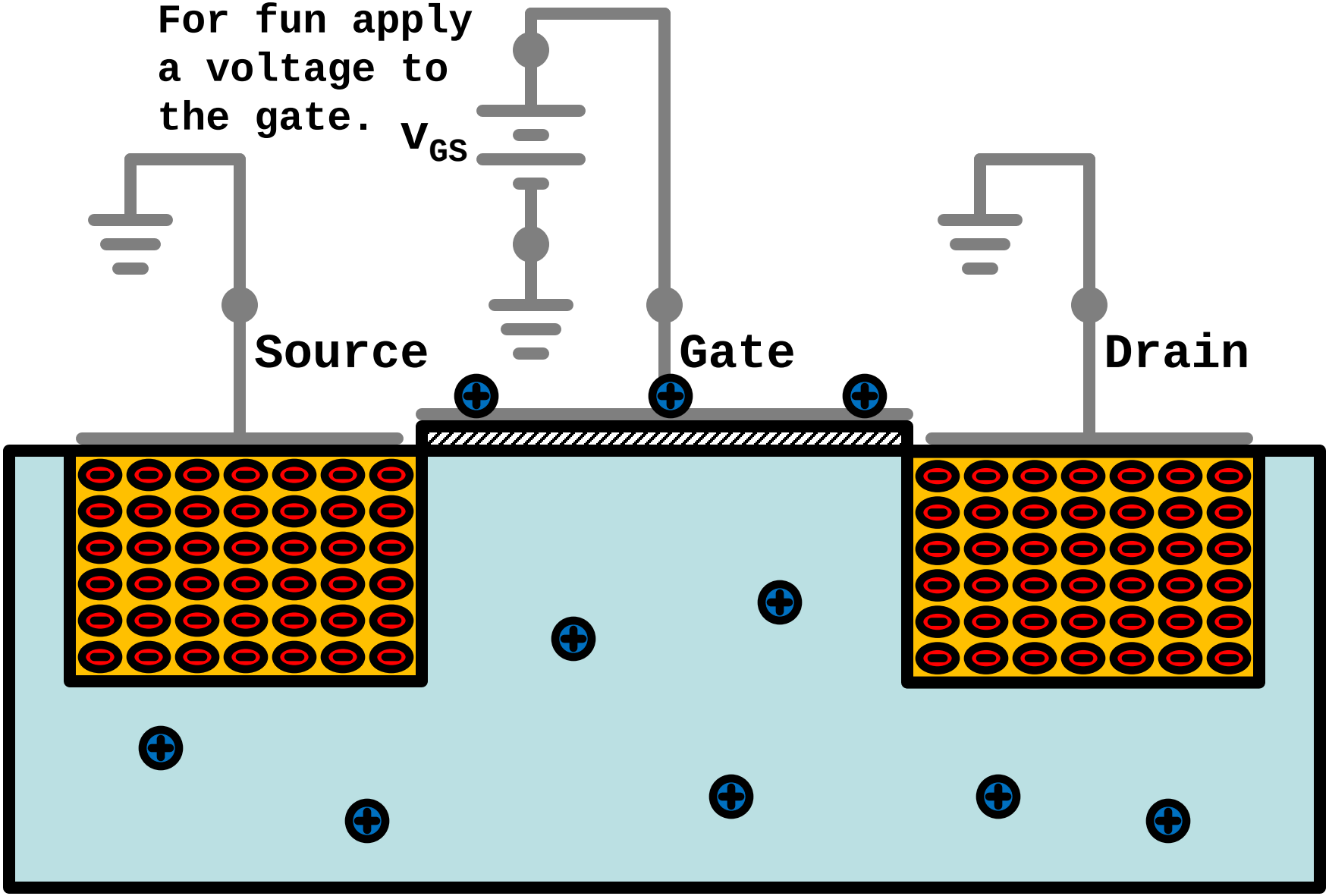


MOSFET – Operation and Modes

For fun apply a voltage to the gate.

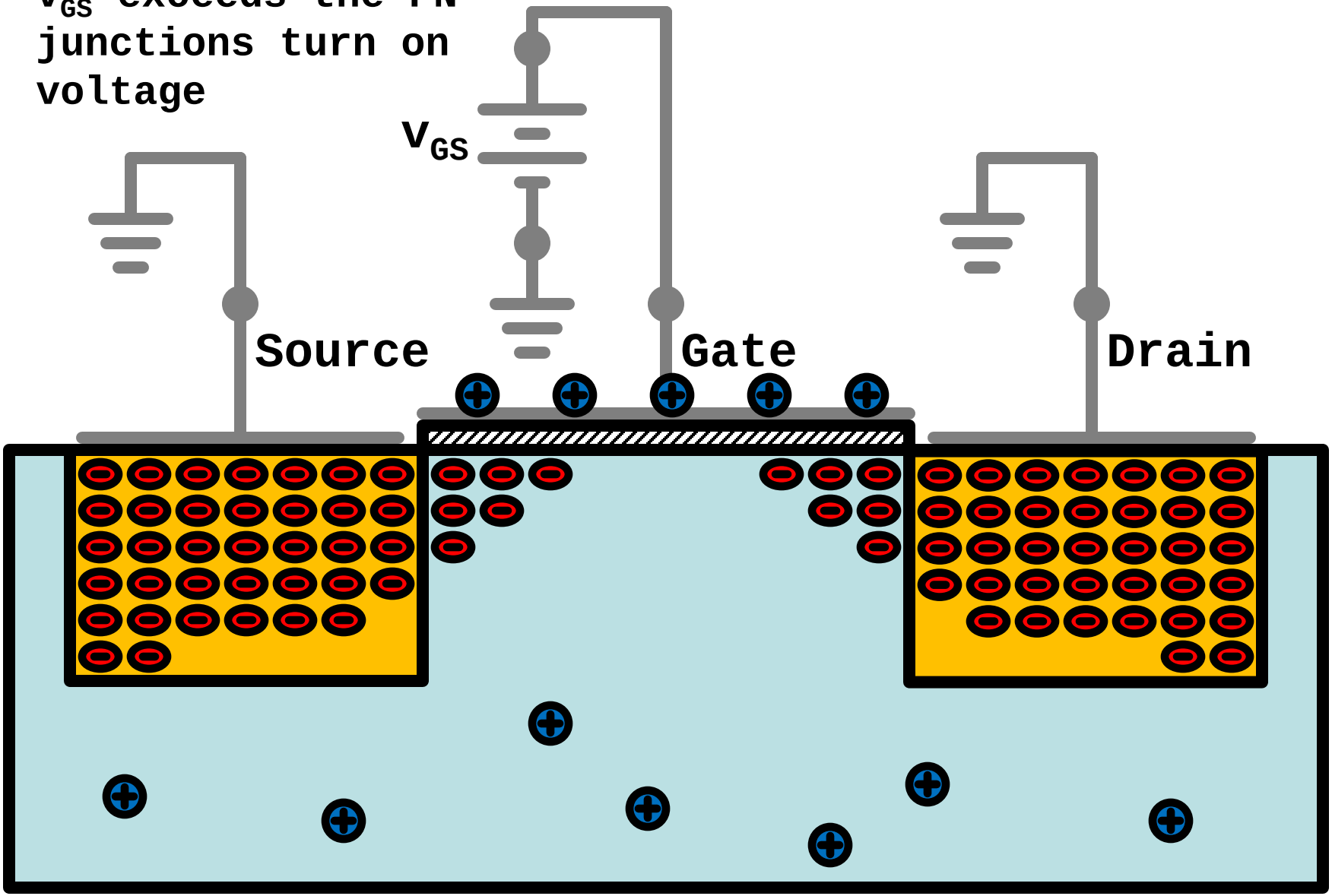


MOSFET – Operation and Modes



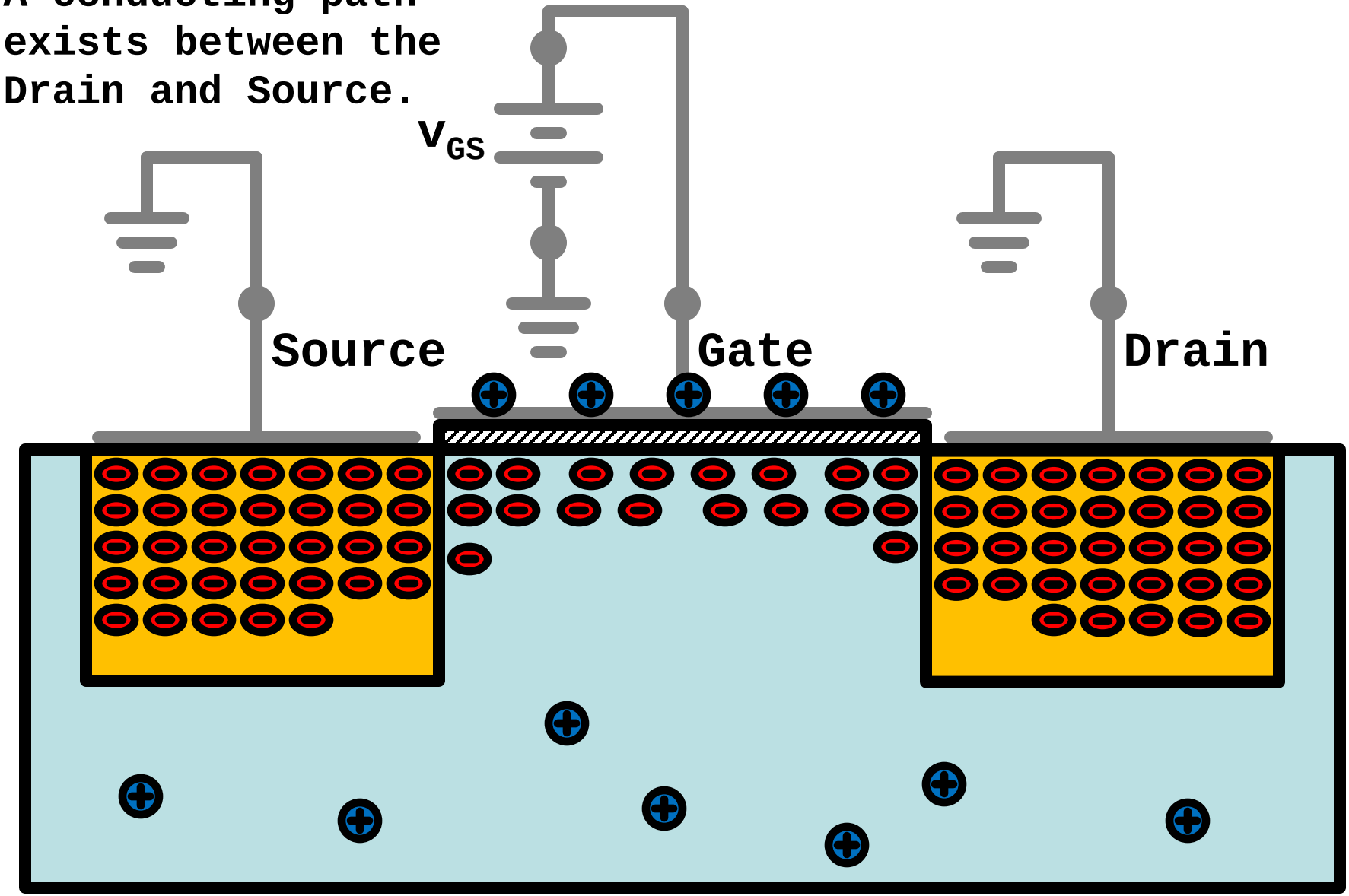
MOSFET – Operation and Modes

v_{GS} exceeds the PN junctions turn on voltage



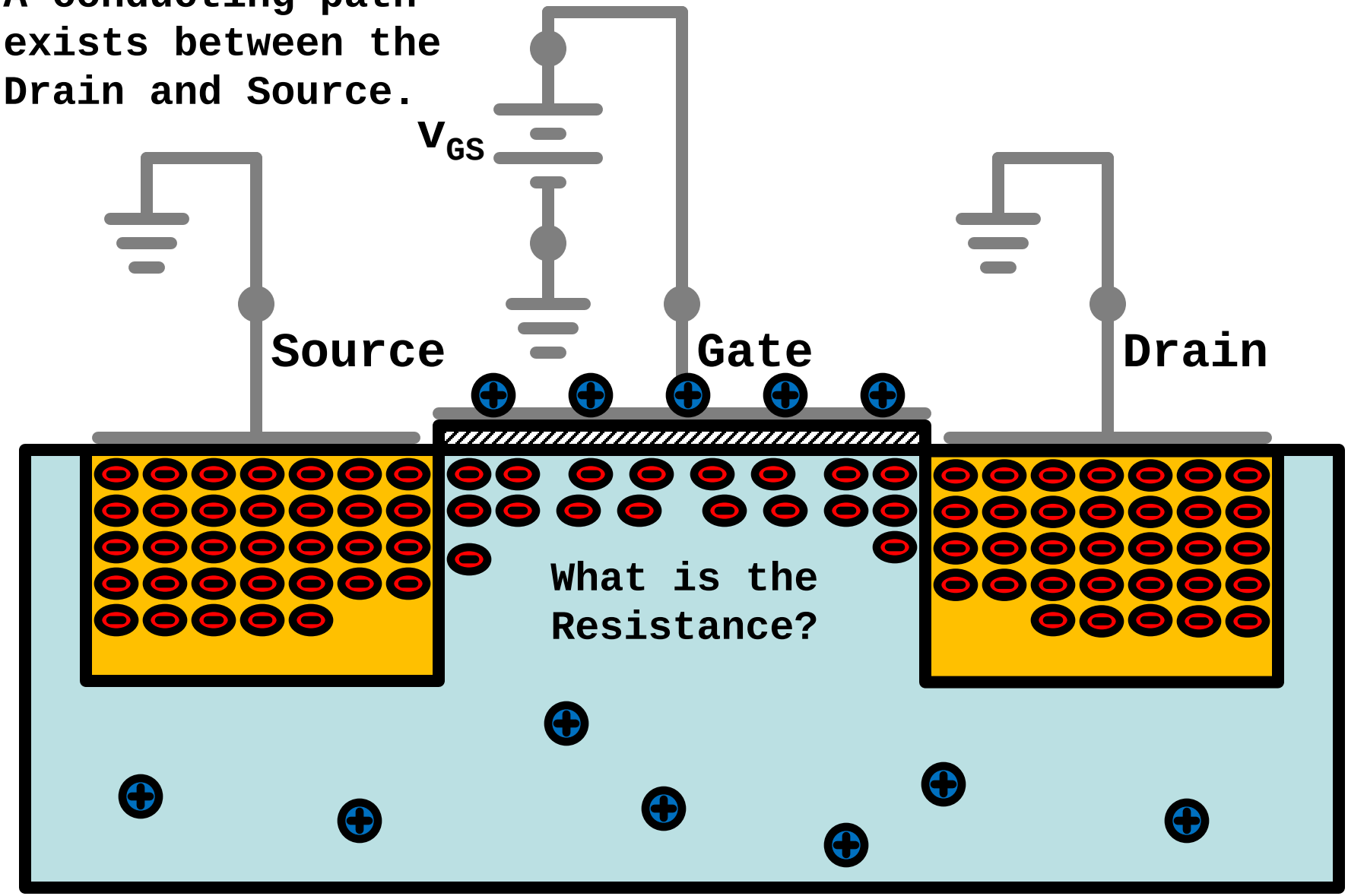
MOSFET – Operation and Modes

A conducting path exists between the Drain and Source.



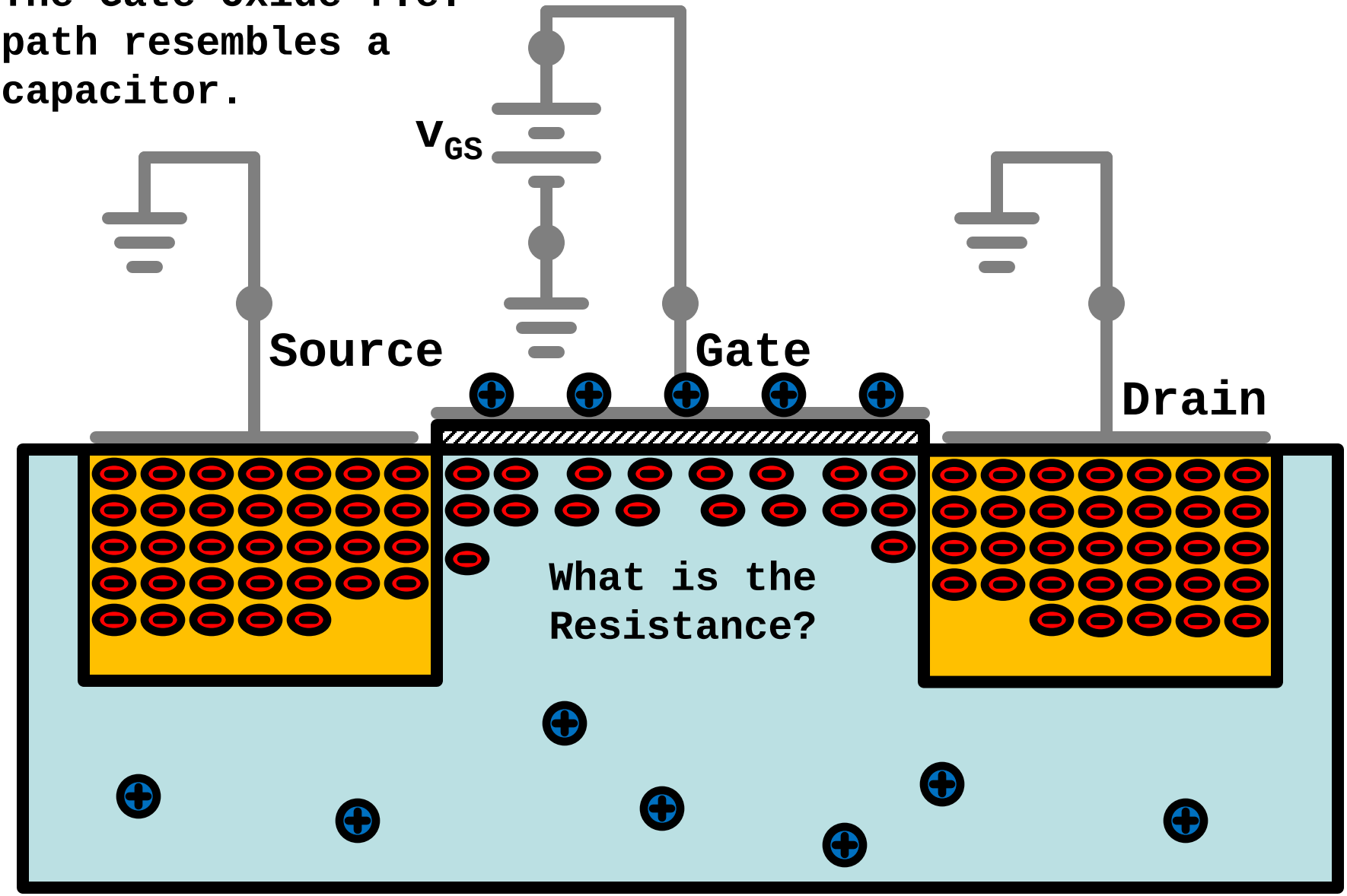
MOSFET – Operation and Modes

A conducting path exists between the Drain and Source.



MOSFET – Operation and Modes

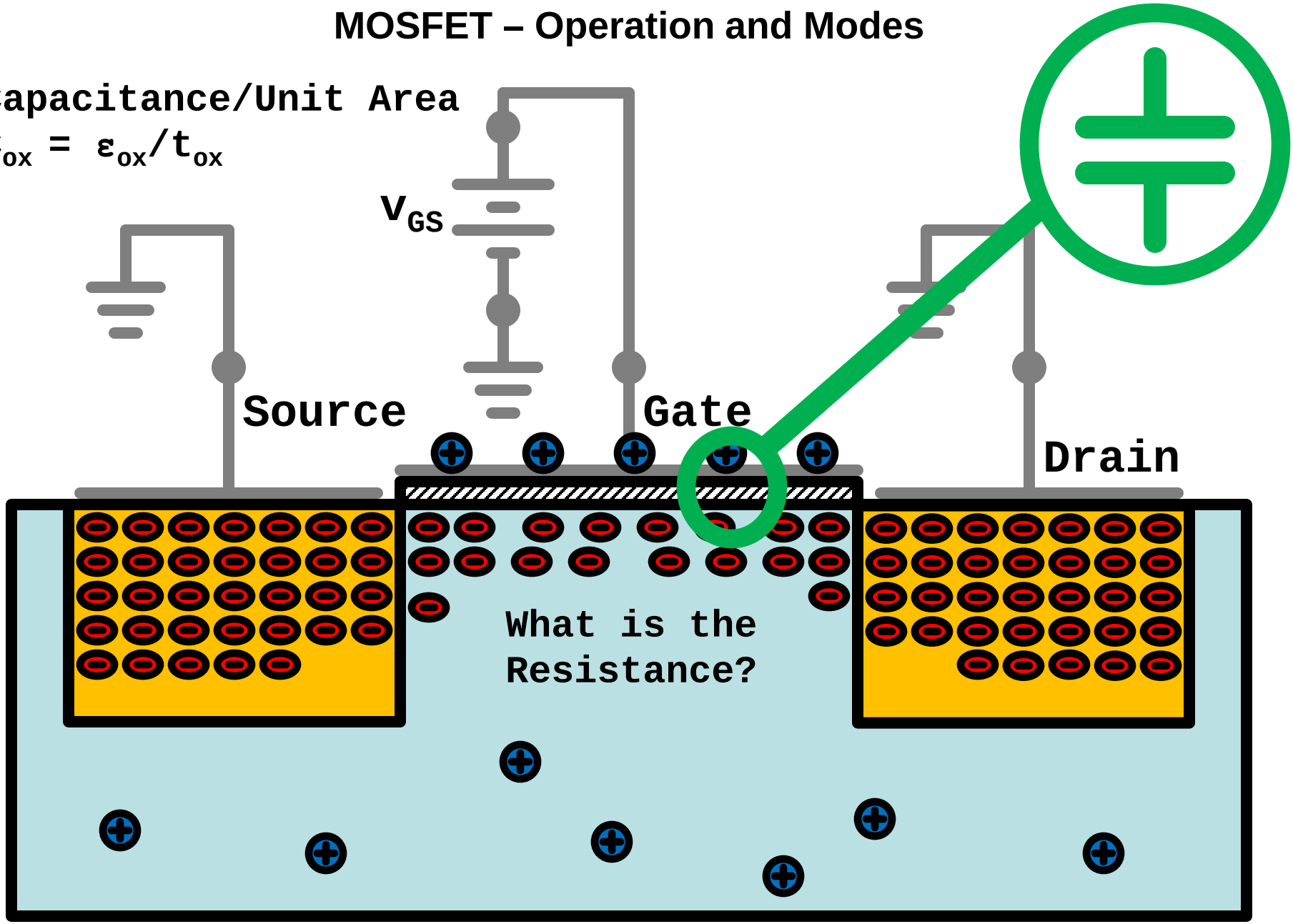
The Gate-Oxide-f.e. path resembles a capacitor.



MOSFET – Operation and Modes

Capacitance/Unit Area

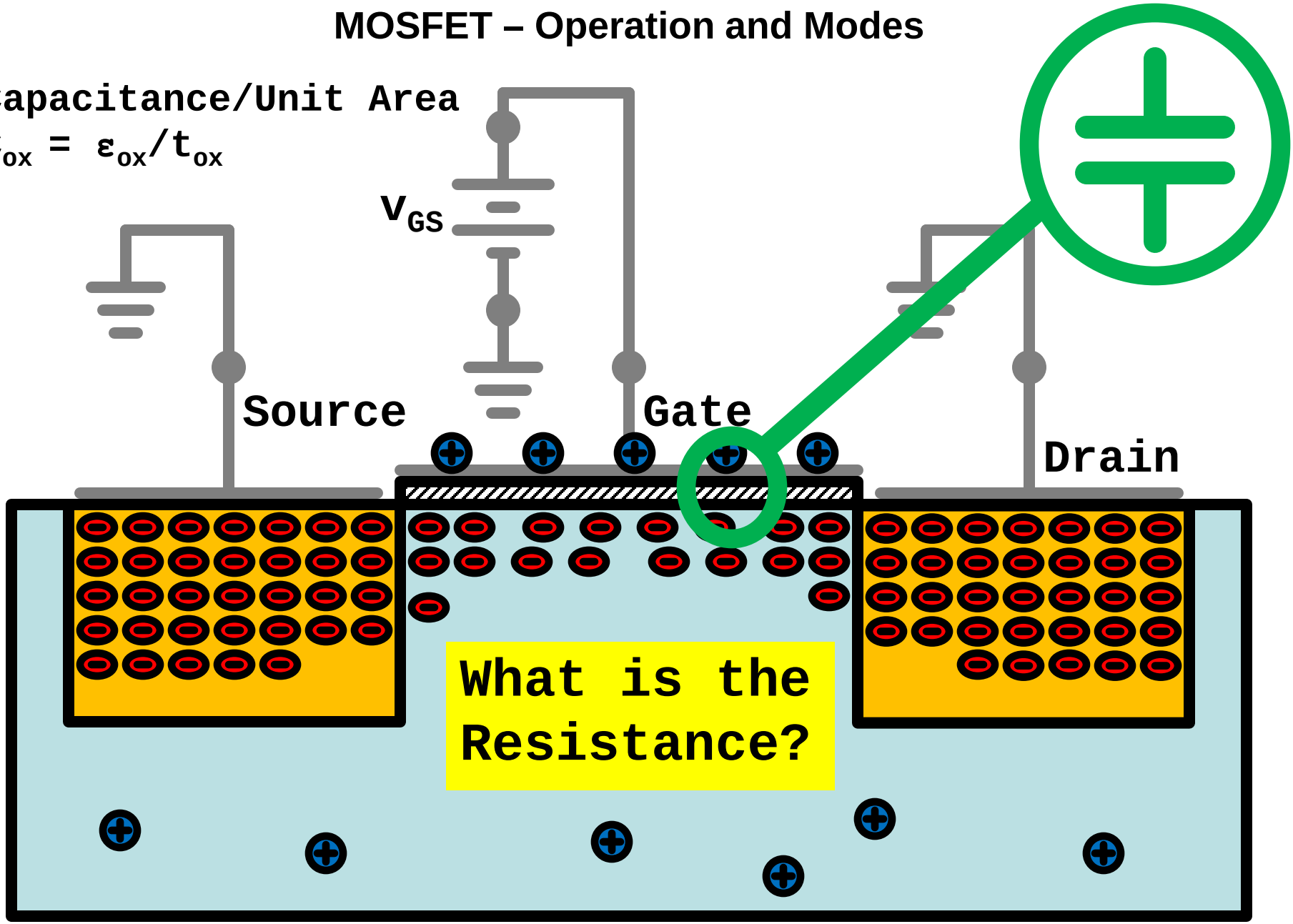
$C_{ox} = \varepsilon_{ox}/t_{ox}$



MOSFET – Operation and Modes

Capacitance/Unit Area

$C_{ox} = \varepsilon_{ox}/t_{ox}$



Resistance Calculation

v_{GS} exceeds the PN junctions turn on voltage, V_t.

Capacitance/Unit Area: $C_{ox} = \varepsilon_{ox}/t_{ox}$

Area = W·L (from MOSFET Dimensions Slide)

Total Charge ($Q=C \cdot V$): $Q = (C_{ox} \cdot W \cdot L) \cdot (v_{GS} - V_t)$

Charge/Unit Length = $Q/L = (C_{ox} \cdot W) \cdot (v_{GS} - V_t)$

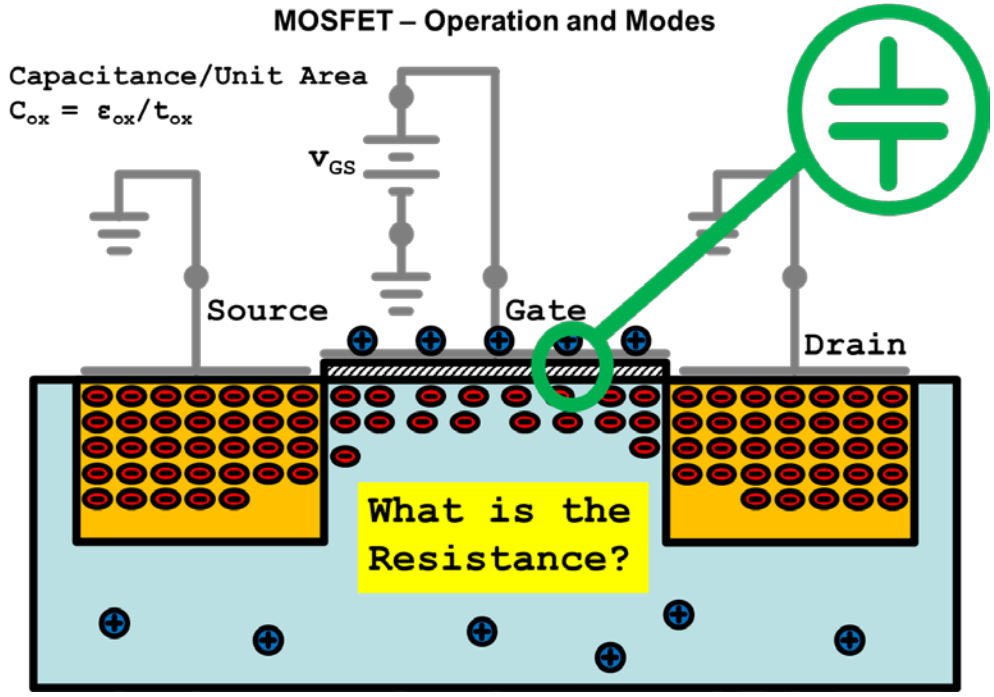
Conductance/Unit Length = mobility·Charge/Unit Length

Conductance/Unit Length = $(\mu_n) \cdot (C_{ox} \cdot W) \cdot (v_{GS} - V_t)$

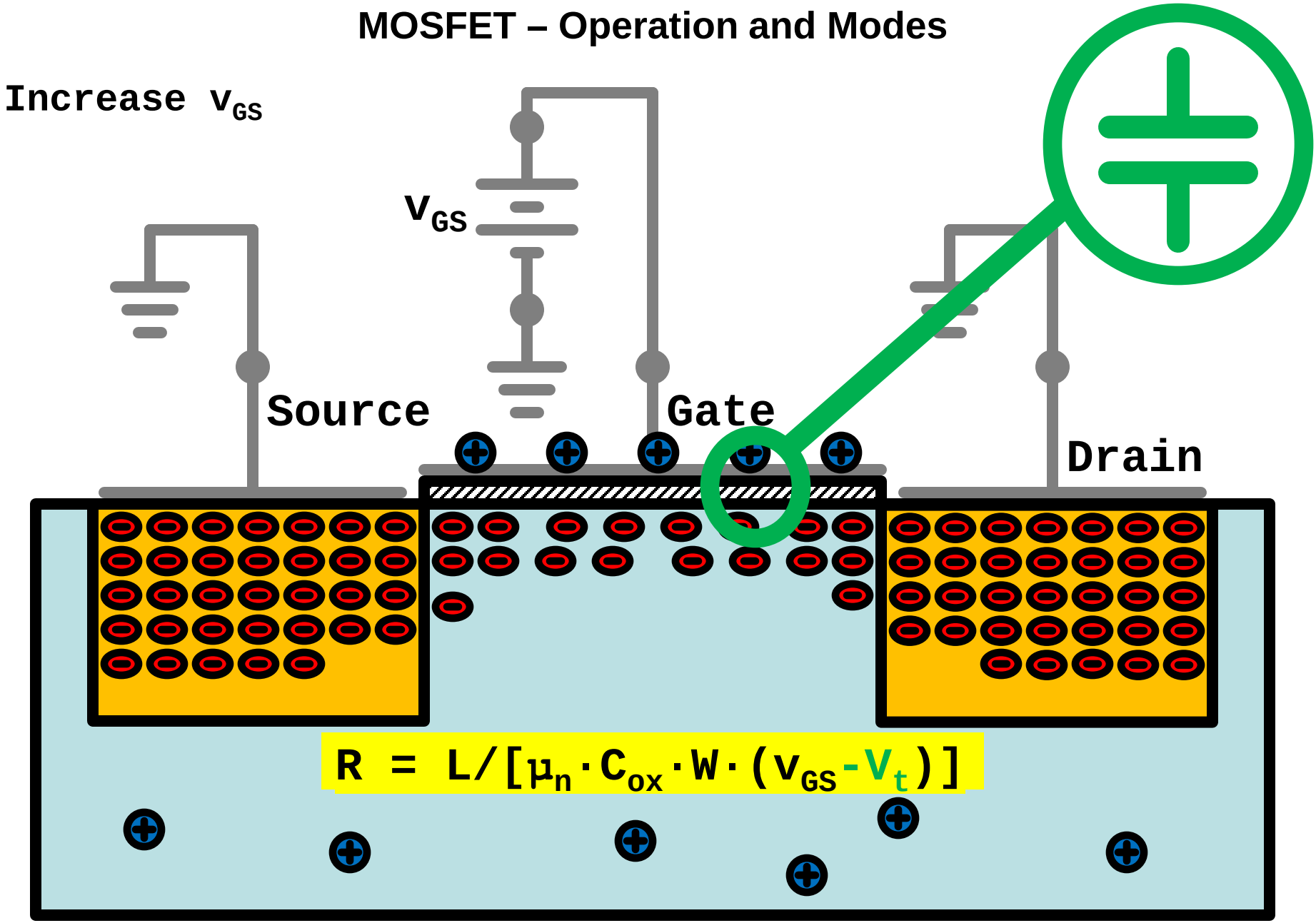
Resistance/Unit Length = 1/(Conductance/Unit Length)

Resistance = Length·Resistance/Unit Length

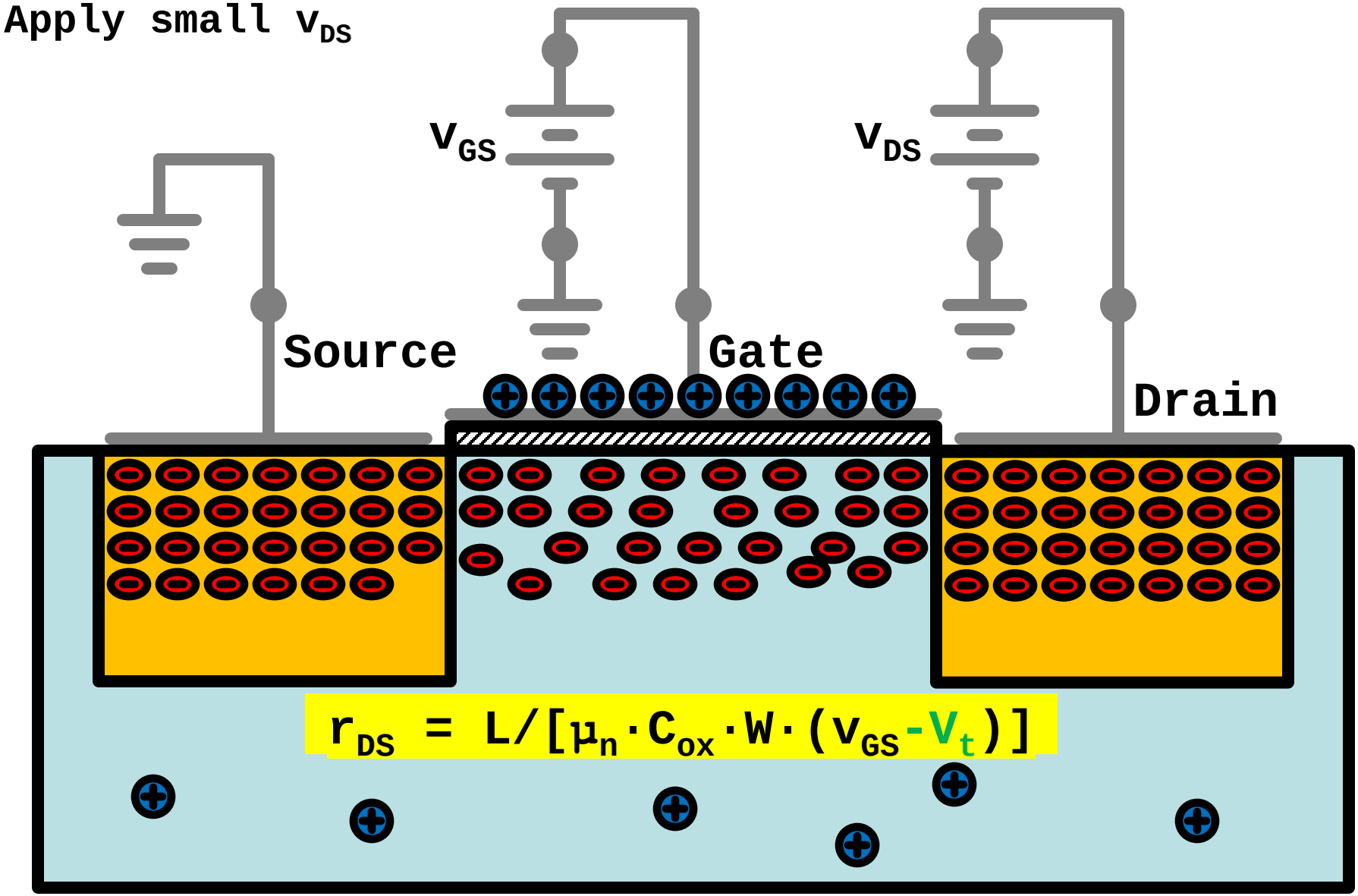
$$R = L/[\mu_n \cdot C_{ox} \cdot W \cdot (v_{GS} - V_t)]$$



MOSFET – Operation and Modes



MOSFET – Operation and Modes



MOSFET – Operation and Modes