

# Capacitors

May 23<sup>rd</sup> 2025

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# Today's lecture

- What is a capacitor?
- 'Capacitance'  $C$
- What are capacitors used for

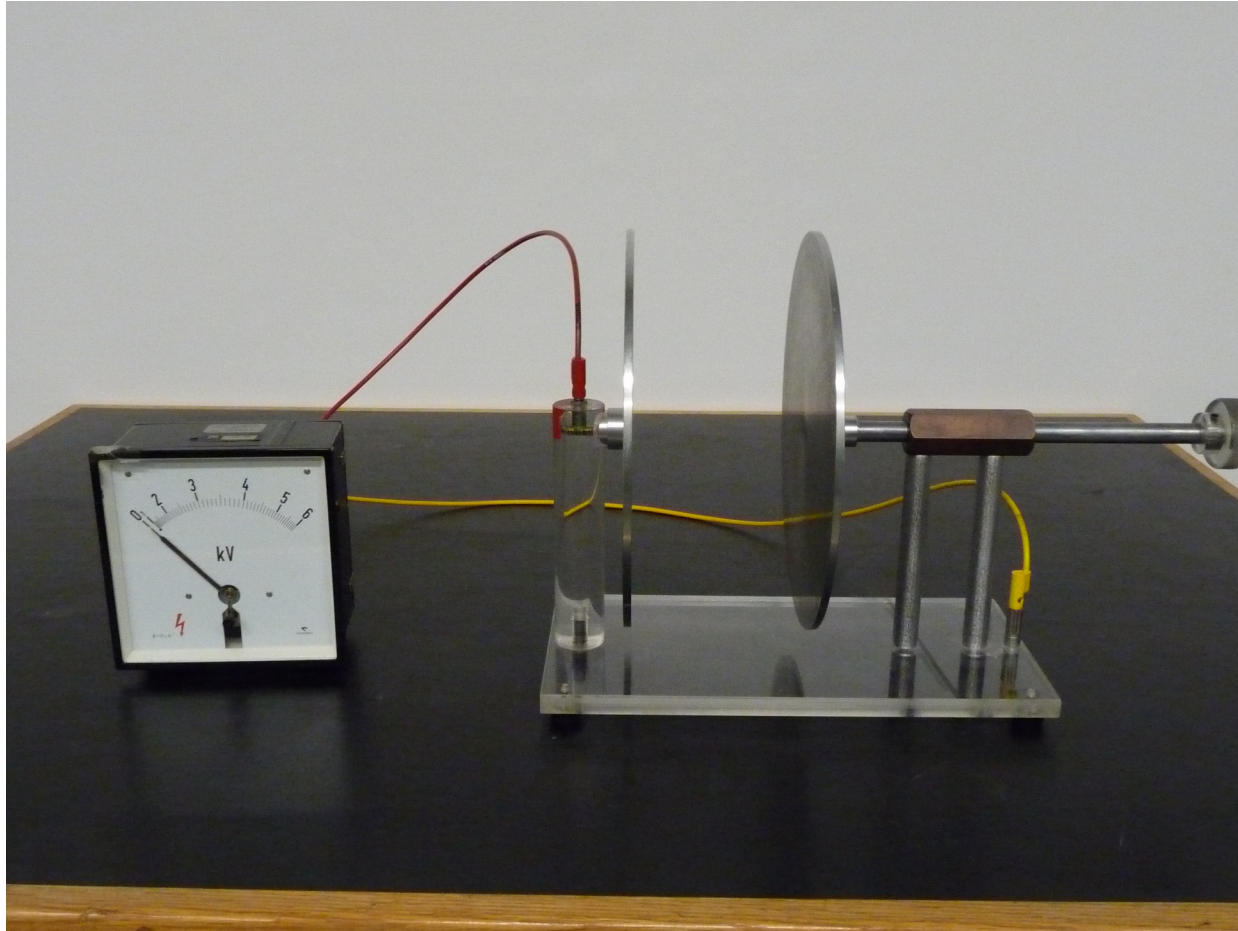
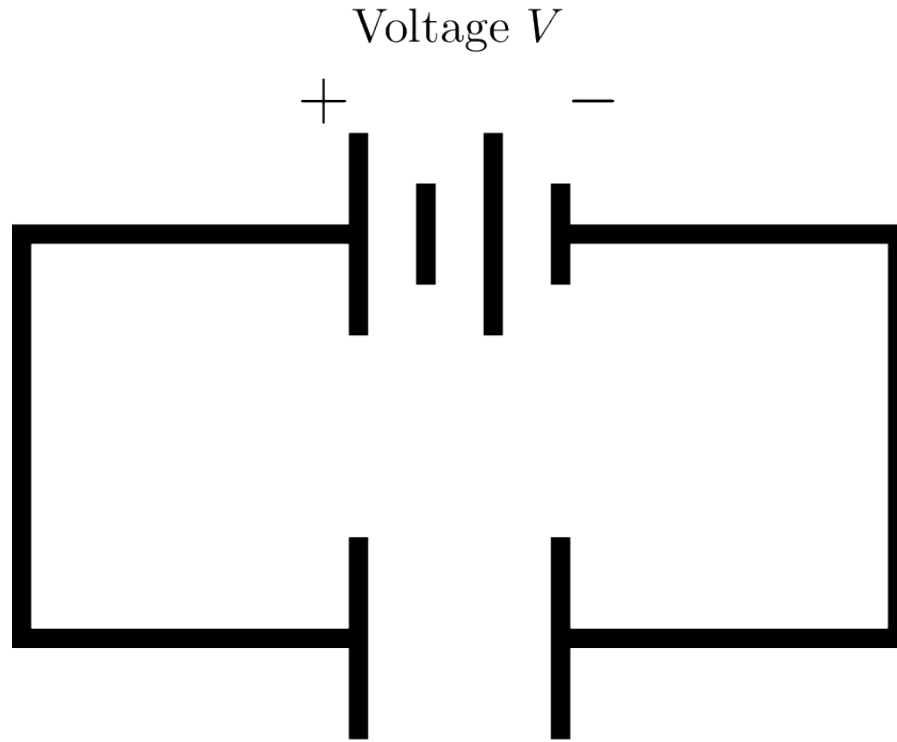


Image: Washington University Physics

# Connecting to a battery



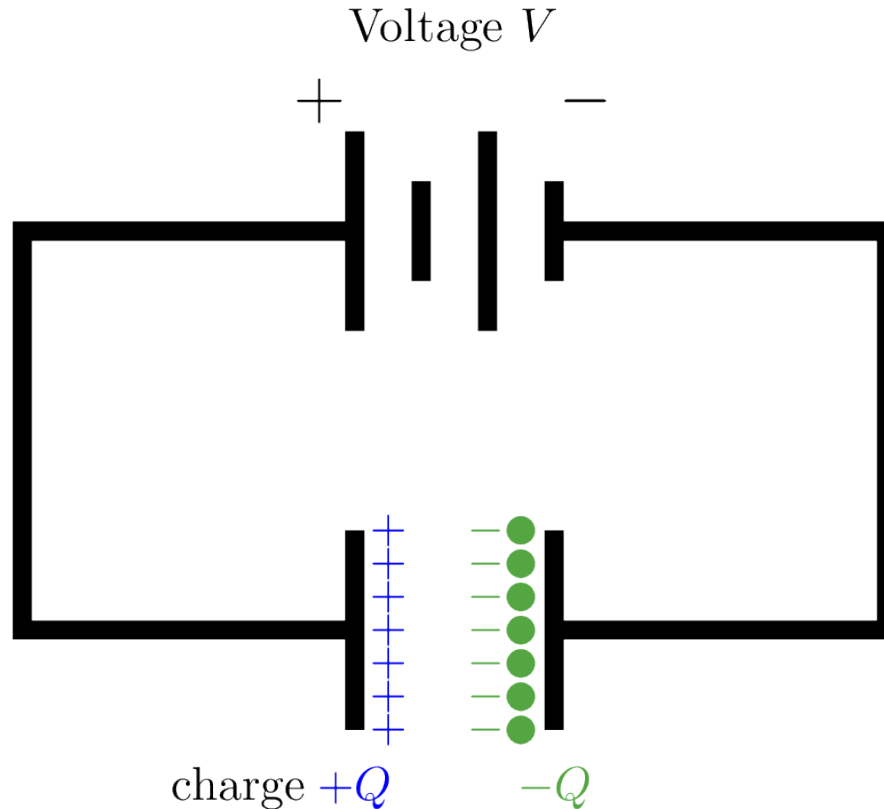
# Connecting to a battery

Charge imbalance  $\propto$   
potential difference

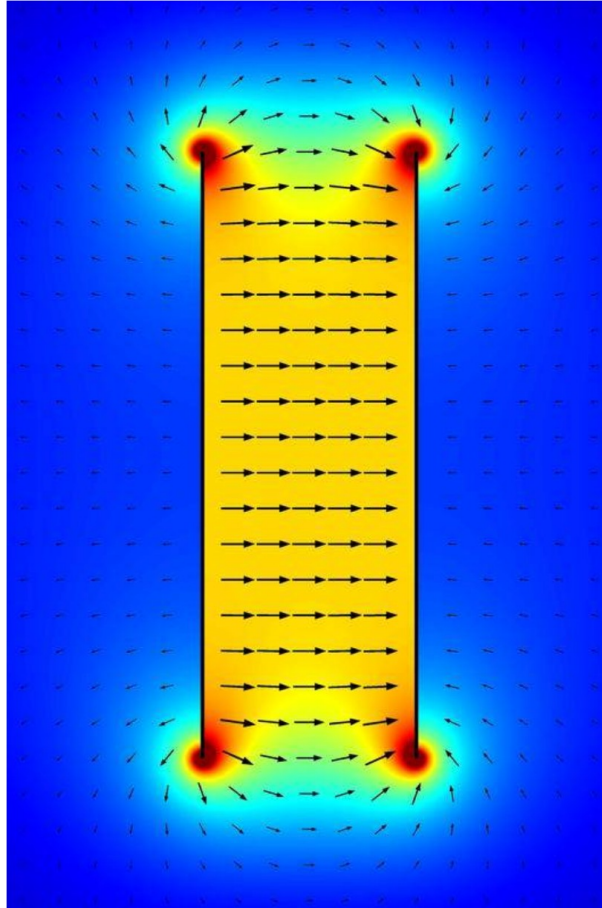
$$Q = CV$$

$C =$  **Capacitance**

$$\begin{aligned} &[\text{Coulomb}] [\text{Volt}]^{-1} \\ &= [\text{Farad}] \end{aligned}$$



# The field inside a capacitor

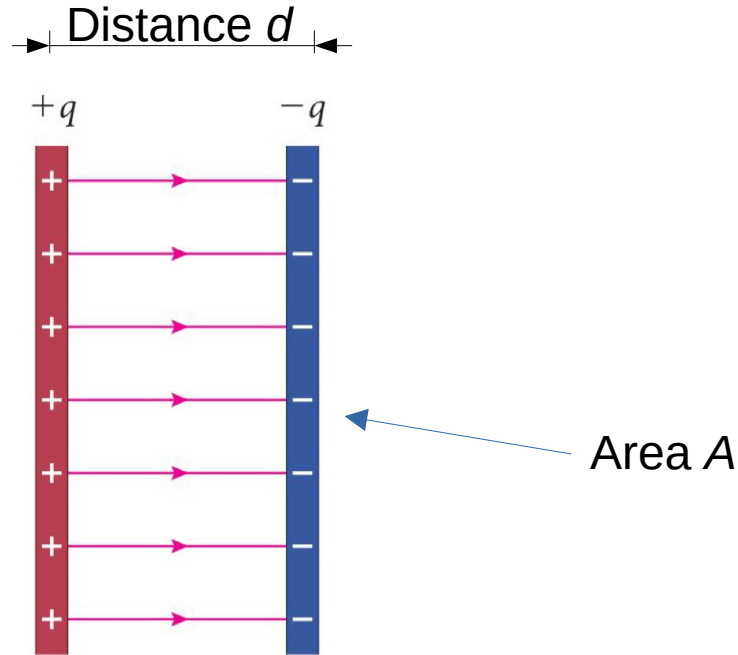


# The field inside a capacitor

## Gauss' law

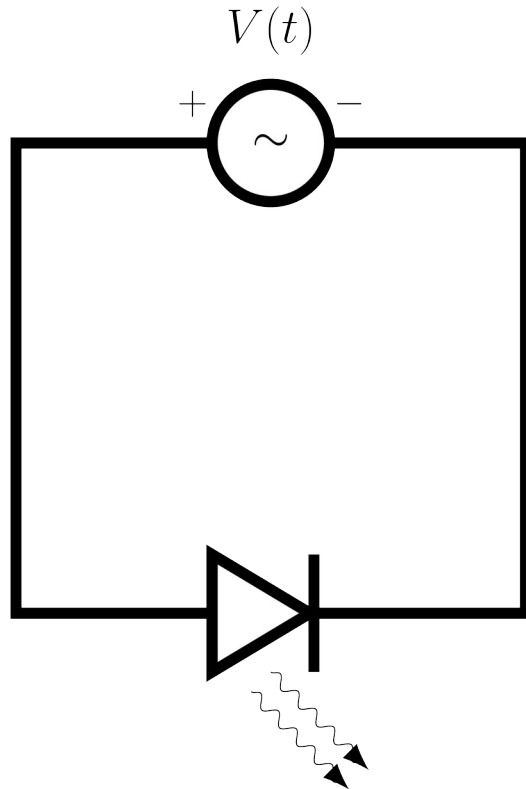
Electric flux through  
surface = Charge  
enclosed /  $\epsilon_0$

$$EA = Q/\epsilon_0$$



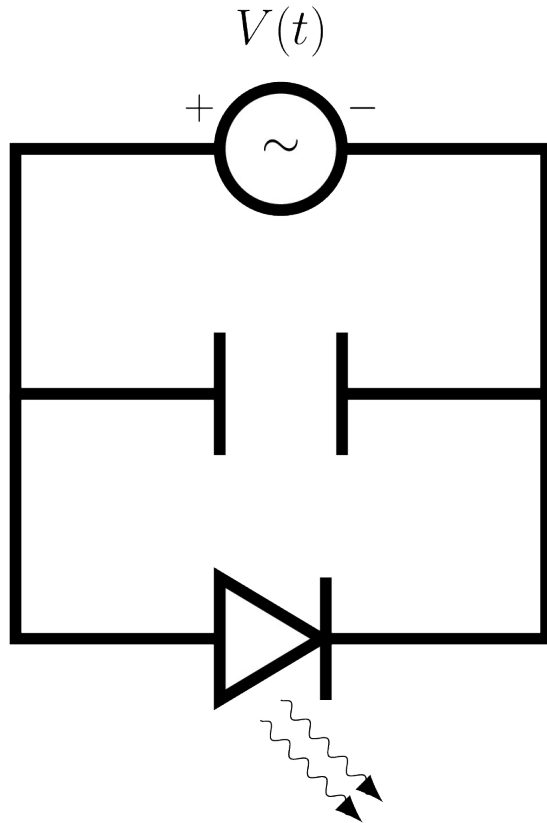
The ideal parallel-plate capacitor

# Using a capacitor

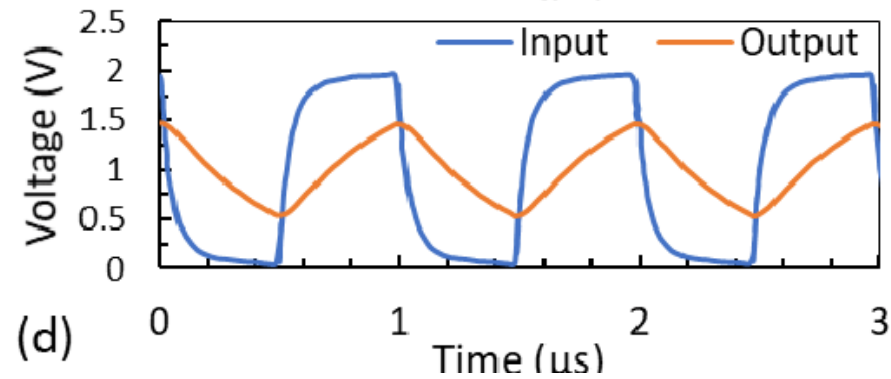




# Using a capacitor



# Time-varying signals



# Further reading

- Knight *Physics for Scientists and Engineers*, **Sec. 23.5 & Ch. 28**
- 'The Engineering Mindset' - Capacitors (YouTube)
- Notes for this lecture (and these slides):

[https://github.com/maxmcginley/capacitors\\_lectures](https://github.com/maxmcginley/capacitors_lectures)

