Time-Dependent SEQ

To explore how particle wave functions evolve with time, which is useful for a number of applications as we shall see, we need to consider the time-dependent SEQ:

$$-\frac{\hbar^2}{2m}\frac{d^2\Psi(x,t)}{dx^2}+U(x)\Psi(x,t)=i\hbar\frac{d\Psi(x,t)}{dt}$$

Changes from the time-independent version:

- $E\psi \rightarrow i\hbar\, d\Psi/dt$ — We no longer assume a definite E.
- $\psi(x) \rightarrow \Psi(x,t)$ — The solutions will have time dependence.
- $i = \sqrt{(-1)}$ appears — The solutions will be complex.

This equation describes the complete time and space dependence of a quantum particle in a potential U(x).
It replaces the classical particle dynamics law, F=ma.

The SEQ is linear in Ψ, and so the Superposition Principle applies:
If Ψ_1 and Ψ_2 are solutions to the time-dependent SEQ, then so is any linear combination of Ψ_1 and Ψ_2 (example: $\Psi = 0.6\Psi_1 + 0.8i\Psi_2$)