Postulates of Quantum Mechanics

The book lists six "postulates" of quantum mechanics. The postulates are by no means standard like Newton's laws or the Laws of Thermodynamics; however, they are a nice way to state the underlying assumptions of quantum mechanics. At this point in time they may be a little abstract; however, in the next chapter when studying spin 1/2 particles we will make use of all of these postulates.

1. The physical system is described by the wave function, $|\psi(t)\rangle$. (This means that there is no additional information besides the wave function. In particular there are no "hidden variables.")

2. Every measurable quantity is described by an operator. (The two observables which we have introduced thus far are the position and momentum operators.)

3. The only possible result of a measurement is one of the eigenvalues of the observable operator. (Thus, a position measurement will give a position, x, which is an eigenvalue of the position operator.)

4. The probability of measuring a particular eigenvalue, a_n, of an observable operator, A, is $|\langle\psi_n|\phi\rangle|^2$, where $|\phi\rangle$ is the state of the system and $|\psi_n\rangle$ is the eigenvector of A with eigenvalue a_n. If there is more than one eigenvector of A with eigenvalue a_n, then one must sum over the probabilities $|\langle\psi_n|\phi\rangle|^2$.

5. If a measurement on a state $|\phi\rangle$ of the physical quantity described by the operator A gives the eigenvalue a_n, then the state of the system immediately following the measurment is
$$\frac{P_n|\phi\rangle}{\sqrt{\langle\phi|P_n|\phi\rangle}}, \text{ where } P_n = |\psi_n\rangle\langle\psi_n|.$$
If there is more than one state with the eigenvalue, a_n, then one must sum over all the states with a_n in the projection operator P_n.

6. The wave function evolves in time according to the Schrodinger equation,
$$i\hbar\frac{d}{dt}|\psi(t)\rangle = H(t)|\psi(t)\rangle,$$
where $H(t)$ is the observable associated with the total energy of the system.