2. The rate of change
   - Rate of chemical steps
     - Collision theory
     - Energy requirement
     - Dependence on concentrations and temperature
     - Rate constants. Order of reaction.

3. The activated complex
   - The transition state.
   - Rate as an approach to equilibrium.
   - Equilibrium and transition state, except for physics and chemistry.

4. Light and chemical change
   - Light as energy quanta.
   - Photoelectric effect.
   - Photoemission.
   - Radiation and the effects of X-rays, etc.

5. Very fast reactions and kinetics
   - Chemistry reaction on a very fast.
   - Techniques and methods.

6. Changes of state
   - Phase changes.
     - Solid, liquid, gas.
     - Fusion and evaporation.
     - Melting and boiling.

7. Molecular dynamics
   - Statics and dynamics of molecules.
   - Analogy with mechanics.
   - Phase changes.
   - Equations of state.
   - Chemical equilibrium.

8. Molecular interactions
   - Molecular forces.
   - Electronic and intermolecular forces.

9. The second law of thermodynamics
   - The second law.
   - Entropy and the arrow of time.

10. Approach to equilibrium
    - Equilibrium of state of a system.
    - Concept of equilibrium.
    - Chemical equilibrium.

11. Chain reactions
    - Chain reaction.
    - Nuclear reaction.
    - Explosion.
MOLECULAR DYNAMICS

1. Static and Dynamic Worlds
   Shape and change of shape
   Analogy with mechanics
   Physical and chemical changes - examples
   Direction and rate of change
   Equilibrium as end of change
   Mechanical equilibrium
   Atoms, molecules and their motion

2. Molecules in Motion
   Nature of heat - form of energy - First Law
   Kinetic energy
   Random motion of molecules.
   Internal motion
   Vibration and rotation
   Collisions - converting collisions

3. Entropy and the Second Law
   Idea of disorder
   Measuring disorder
   The Second Law
   Entropy
   The Relation to heat and energy
   Work from change

4. Approach to equilibrium
   Equilibrium as state of greatest disorder
   Examples of physical and chemical equilibrium.
   The concept of free energy.
   The arrow of time.

5. Changes of state - Patterns of Physical Change
   Physical change of molecular order.
   Why water freezes and ice melts.

6. Patterns of chemical change
   Change in steps
   Addition
   Decomposition
   Chain reactions
   Polymerisation
   Explosion

7. The Rate of change
   Rate of elementary steps
   Collision theory
   Energy requirements
   Dependence on concentration and temperature
   Rate constants
   Order of reaction.

8. The Activation Barrier
   The transition state
   Rates as an approach to equilibrium into transition state.
   Examples from physics and chemistry.

9. Light and Chemical Change
   Light as energy quanta.
   Excited electrons in molecules
   Examples of photoreactions
   Photosynthesis
   Other radiations and their effects.
   X and γ rays
   Electrons
10. **Very fast reactions and biochemical change**

- Elementary reactions are normally fast
- Experimental study - new techniques and methods of atoms
- Unstable species - free particles
- Excited states
- Lifetimes
- Fast biochemical reactions
- Photobiology and radiation biology