

Tool ALTERNATIVE SYLLABUS
(Taking Poetic License)

THE DANCE OF THE SOLIDS

by

John Updike*

All things are Atoms: Earth and Water, Air And Fire, all,
Democritus foretold. Swiss Paracelsus, in's alchemic`lair,
Saw Sulfur, Salt, and Mercury unfold Amid Millennial
hopes of faking Gold. Lavoisier dethroned
Phlogiston; then Molecular analysis made bold
Forays into the gases: Hydrogen
Stood naked in the dazzled sight of Learned Men.

The Solid State, however, kept its grains
Of Microstructure coarsely veiled until
X-ray diffraction pierced the Crystal Planes
That roofed the giddy Dance, the taut Quadrille Where Silicon and Carbon
Atoms will Link Valencies, four-figured, hand in hand
With common Ions and Rare Earths to fill
The lattices of Matter, Glass or Sand,
With tiny Excitations, quantitatively grand.

The Metals, lustrous Monarchs of the Cave,
Are ductile and conductive and opaque
Because each Atom generously gave
Its own Electrons to a mutual Stake,
A Pool that acts as Bond. The Ions take
The stacking shape of Spheres, and slip and flow
When pressed or dented; thusly Metals make
A better Paper Clip than a Window,
Are vulnerable to Shear, and, heated, brightly glow.

Ceramic, muddy Queen of human Arts,
First served as simple Stone.
Feldspar supplied Crude Clay; and Rubies,
Porcelain, and Quartz Came each to light.
Aluminum Oxide
Is typical - a Metal is allied
With Oxygen ionically; no free
Electrons form a lubricating tide,
Hence, Empresslike, Ceramics tend to be
Resistant, porous, brittle, and refractory.

* J. Updike, Midpoint and Other Poems, Alfred H. Knopf, Inc.

Prince Glass, Ceramic's son though crystal-clear,
Is no wise crystalline. The fond Voyeur
And Narcissist alike devoutly peer
Into Disorder, the Disorderer
Being Covalent Bondings that prefer
Prolonged Viscosity and spread loose nets Photons slip through.
The average Polymer Enjoys a Glassy state, but cools, forgets
To slump, and clouds in closely patterned Minuets.

The Polymers, those giant Molecules,
Like Starch and Polyoxymethylene,
Flesh out, as protein serfs and plastic fools,
The Kingdom with Life's Stuff. Our time has seen.
The synthesis of Polyisoprene
And many cross-linked Helixes unknown
To Robert Hooke; but each primordial Bean
Knew Cellulose by heart: Nature alone
Of Collagen and Apatite compounded Bone.

What happens in these Lattices when Heat
Transports Vibrations through a solid mass?
 $T = 3Nk$ is much too neat;
A rigid Crystal's not a fluid Gas.
Debye in 1912 proposed Elastic
Waves called phonons which obey Max Planck's
Great Quantum Law. Although amorphous Glass,
Umklapp Switchbacks, and Isotopes play pranks
Upon his Formulae, Debye deserves warm Thanks.

Electroconductivity depends
On Free Electrons: in Germanium
A touch of Arsenic liberates; in blends
Like Nickel Oxide, Ohms thwart Current.
From Pure Copper threads to wads of Chewing Gum
Resistance varies hugely. Cold and Light
As well as "doping" modify the sum
Of Fermi Levels, Ion scatter, site
Proximity, and other factors recondit.

Textbooks and Heaven only are ideal;
Solidity is an imperfect state.
Within the cracked and dislocated Real
Nonstoichiometric crystals dominate.
Stray Atoms sully and precipitate;
Strange holes, excitons, wander loose; because
Of Dangling Bonds, a chemical Substrate
Corrodes and catalyzes - surface Flaws
Help Epitaxial Growth to fix adsorptive claws.

White Sunlight, Newton saw, is not so pure;
A Spectrum bared the Rainbow to his view.
Each Element absorbs its signature:
Go add a negative Electron to
Potassium Chloride: it turns deep blue,
As Chromium incarnadines Sapphire,
Wavelengths, absorbed, are reemitted through
Fluorescence, Phosphorescence, and the higher
Intensities that deadly Laser Beams require.

Magnetic Atoms, such as Iron, keep
Unpaired Electrons in their middle shell,
Each one a spinning Magnet that would leap
The Bloch Walls whereat antiparallel
Domains converge. Diffuse Material
Becomes Magnetic when another Field
Aligns domains like Seaweed in a swell.
How nicely microscopic forces yield
In Units growing Visible, the World we wield