We need to understand the raw materials that make up planets, as well as the conditions under which planets formed, and the conditions inside planets that these materials exist in today. Here's how we get those:

1. Elemental abundances: predicted by nuclear physics, corroborated by astronomy observations
   - the big bang created mostly hydrogen (~70%) and helium (~30%)
   - all heavier elements are made in stars from nuclear synthesis or from supernovae.

2. Nebular matter properties: make a model of the disk from which planets formed, then use chemistry (at low T/P) to figure out the material conditions
   - when nebulae collapse into stars, angular momentum must be conserved. This is accomplished by: 1) spinning up the star, and 2) creating a flat, extended, rotating disk (from which planets form!)
   - the text & appendix give a few orders of magnitude estimates of disk conditions. The upshot:
     - density \( \sim 10^{-12} \text{ g/cm}^3 \) (9x smaller than \( \rho \) of Earth's atmosphere)
     - temperature \( \sim 10^5 - 1000 \text{ K} \)
   - these extreme conditions mean that species are in disequilibrium. H/He/Ne are gaseous everywhere, and others condense based on temperature/entropy considerations
   - the temperature in the disk rises toward the star, higher radiation allowing definition of "ice lines" beyond which certain species condense. This favors rocky bodies close in, and icy bodies further out

3. Phases within a planet: use equilibrium chemistry, since T/P are high (often)
   - Important, species do not exist inside planets in the same states they formed! This means, e.g. for the ice giants that even though they accumulated ices when forming, these elements are not ices in the planet interiors! P/T conditions are very different in the nebula and in actual planet interiors.