Radiation detectors have been an essential tool of the physical sciences for over 100 years and during that time many new detector materials have been discovered, developed, and put into widespread use. Nonetheless there are many applications where the performance of available materials falls far short of what should be possible. This talk will review the current efforts in understanding the fundamental limits of detector materials, the use of first-principles calculations and supercomputers to guide the selection of new candidates, and the use of high-throughput synthesis and measurement techniques to discover which of those candidates provides improved performance.