Apicomplexan parasites are a major threat to the health of humans and their domestic animals. We are using Toxoplasma gondii as a genetic model to dissect parasite cell biology and metabolism. One of our main interests has been the apicoplast, a unique parasite organelle derived from an algal endosymbiont. Genome analyses suggest that the apicoplast is engaged in a variety of biosynthetic activities that could be targeted for drug development. We have tested this hypothesis by conditional gene ablation of critical enzymes and transporters. We defined those apicoplast functions critical for survival and pathogenesis and linked them to the overall metabolism and nutrient uptake of the parasites. While Toxoplasma offers excellent experimental tools this is not the case for the related apicomplexan Cryptosporidium. *Cryptosporidium* is well recognized as an opportunistic pathogen in immunosuppressed patients in particular those with HIV-AIDS. Recent large-scale epidemiological surveys found that after rotavirus, *Cryptosporidium* is the most important cause of severe diarrhea in infants. Similarly *Cryptosporidium* is a major threat to the health of young livestock. Currently there are neither vaccines nor fully effective drug treatments available to face this challenge. We have used comparative genomic and forward genetic approaches to identify suitable drug targets. These efforts let to the discovery of horizontally transferred genes and to several classes of chemical inhibitors for the enzymes they encode. Most recently we have focused our efforts on the development of genetic tools for *Cryptosporidium parvum*.