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Beyond the genome (BTG) is a (PGDB) pathway genome database: HumanCyc

Miles Trupp*, Tomer Altman, Carol A Fulcher, Ron Caspi, Markus Krummenacker, Suzanne Paley, Peter D Karp

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HumanCyc is a manually curated database of enzymatic reactions and metabolic pathways that can be used as a versatile reference resource or as a tool for analyzing 'omics' data sets in the context of metabolic pathways. The HumanCyc database was generated from the annotated genome using the Pathway Tools [1] software package written by SRI International (SRI). The software assists users in analyzing genomic data by predicting the metabolic network of an organism, presenting pathway and genome data in user-friendly and intuitive displays, and providing tools for missing enzyme identification, 'omics' data analyses and comparative studies.

The HumanCyc website (<http://humancyc.org/>) and the downloadable HumanCyc software support a variety of query, visualization and analysis tools. Users can find and display existing metabolites, pathways and enzymes. Users can also define groups of metabolites or proteins and perform enrichment analysis of an 'omics' data set to determine over- represented substrates, pathways or enzymes. It is possible to color code a 'zoomable' human metabolic network diagram with metabolomic, proteomic or transcriptomic data for visual analysis of patterns in data sets. The software colors entities in the diagram to reflect their measured levels in user-uploaded 'omics' data sets.

By connecting metabolites to reactions to enzymes to genes, HumanCyc facilitates the integration of multiple 'omics' data types. It describes 255 human metabolic pathways, 3315 human enzymes, 1862 biochemical reactions, and 1359 human metabolites. HumanCyc is linked to human genome resources such as Ensembl, GeneCards, Entrez Gene, OMIM, PubChem and UniProt.

Curation of the HumanCyc knowledge base is proceeding in conjunction with the Pharmacometabolomics Research Network (PMRN), a multi-year

collaboration to develop tools and provide resources for the metabolomics community. To this end, we have focused on curation of information from the scientific literature concerning chemical compounds and enzymes of interest to the PMRN and the larger field of metabolomics, including pathways for metabolism of xenobiotics, nutrients and metabolites produced by the gut microbiome.

HumanCyc is a component of the SRI maintained BioCyc databases, which number nearly 700, mostly prokaryotic and PGDBs. BioCyc databases contain 9000 compounds, including many produced by the human microbiome and plant dietary nutrients. Future work will include expansion of the BioCyc collection to keep pace with genome sequencing from the Human Microbiome Project and allow analysis of these Human Microbiome PGDBs and the impact of interspecies interactions on human metabolism.

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Reference

1. Karp PD, *et al*: Pathway Tools version 13.0: Integrated Software for Pathway/Genome Informatics and Systems Biology. *Briefings in Bioinformatics* 2010, **11**:40-79.

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