OMICS Group

OMICS Group International through its Open Access Initiative is committed to make genuine and reliable contributions to the scientific community. OMICS Group hosts over **400** leading-edge peer reviewed Open Access Journals and organizes over **300** International Conferences annually all over the world. OMICS Publishing Group journals have over **3 million** readers and the fame and success of the same can be attributed to the strong editorial board which contains over **30000** eminent personalities that ensure a rapid, quality and quick review process. OMICS Group signed an agreement with more than **1000** International Societies to make healthcare information Open Access.

OMICS Journals are welcoming Submissions

OMICS Group welcomes submissions that are original and technically so as to serve both the developing world and developed countries in the best possible way.

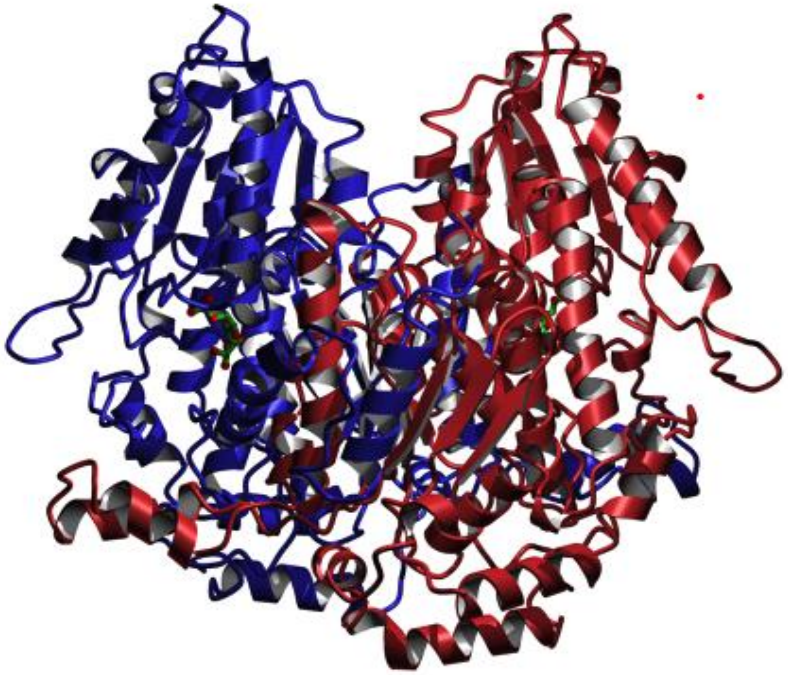
OMICS Journals are poised in excellence by publishing high quality research. OMICS Group follows an Editorial Manager® System peer review process and boasts of a strong and active editorial board.

Editors and reviewers are experts in their field and provide anonymous, unbiased and detailed reviews of all submissions.

The journal gives the options of multiple language translations for all the articles and all archived articles are available in HTML, XML, PDF and audio formats. Also, all the published articles are archived in repositories and indexing services like DOAJ, CAS, Google Scholar, Scientific Commons, Index Copernicus, EBSCO, HINARI and GALE.

For more details please visit our website: http://omicsonline.org/Submitmanuscript.php

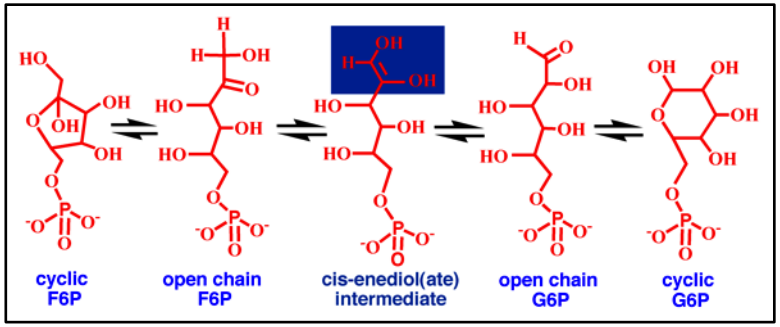
Journal of Data Mining in Genomics & Proteomics



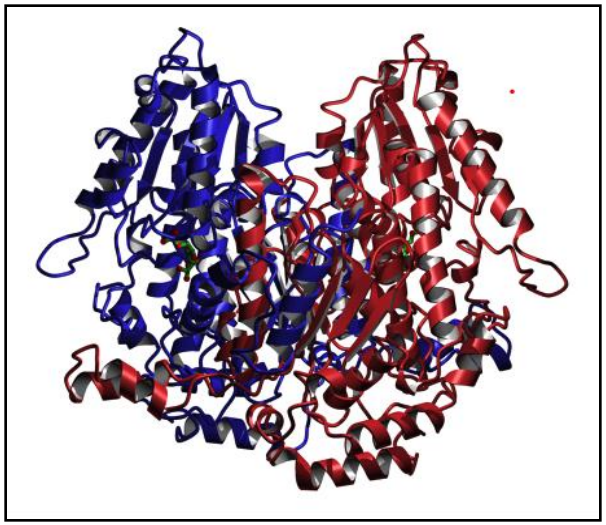
Constance J. Jeffery
University of Illinois at Chicago
cjeffery@moonlightingproteins.org
Journal of Data Mining in
Genomics and Proteomics

Journal of Data Mining in Genomics & Proteomics

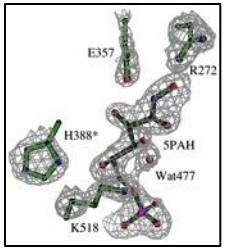
Enzyme in Glycolysis and Gluconeogenesis



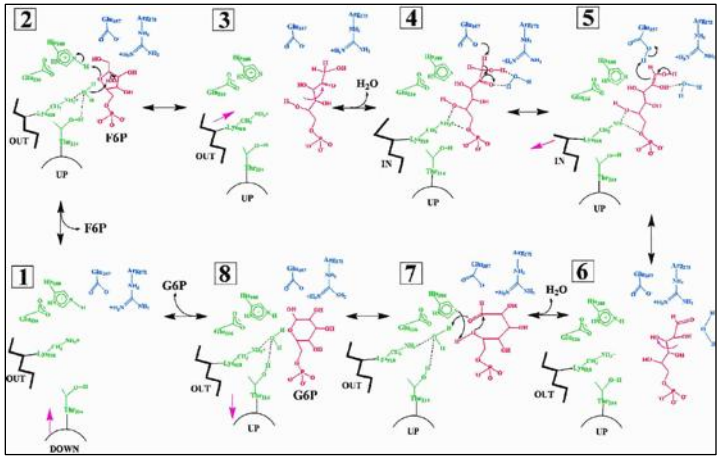
Many published biochemical experiments (Rose, Chirgwin, Noltmann, O'Conner and others) including solvent exchange, labeling, pH profiles (with pKa 6.75 and 9.3), inhibitor studies, etc.
Acid/Base catalysis with proton transfer
Labeling studies suggest: Arg, Glu, Lys, His in active site
Strict specificity for G6P and F6P



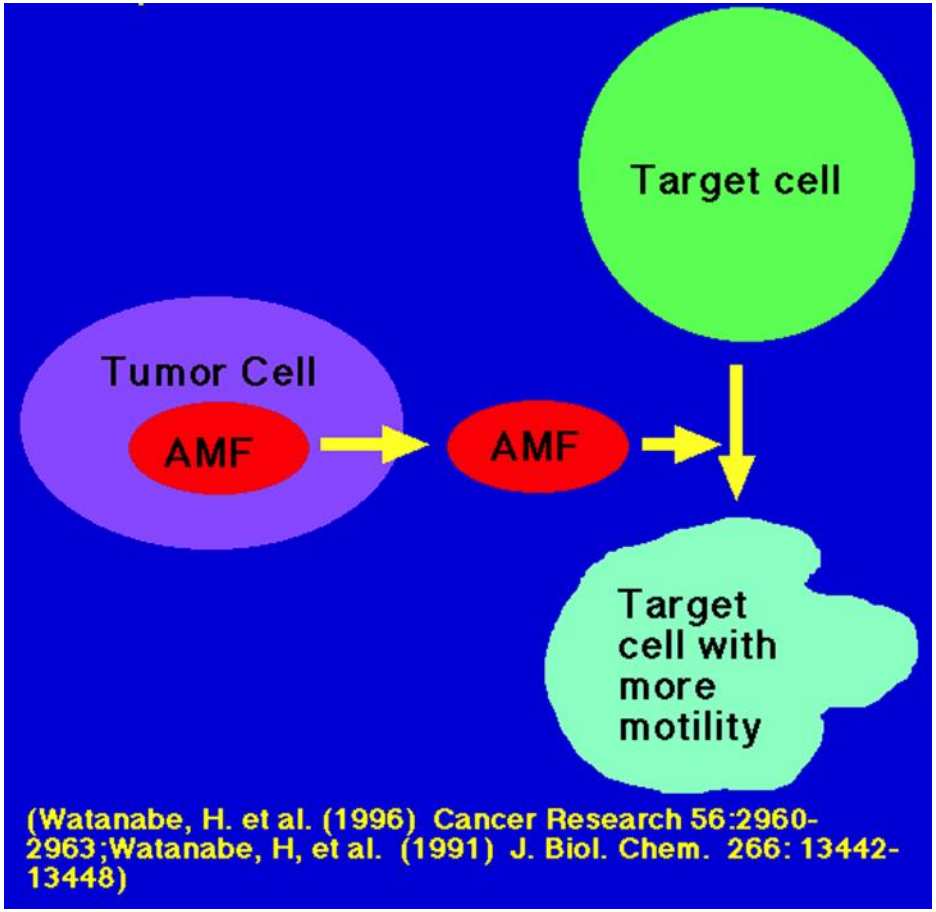
X-ray Crystal Structure



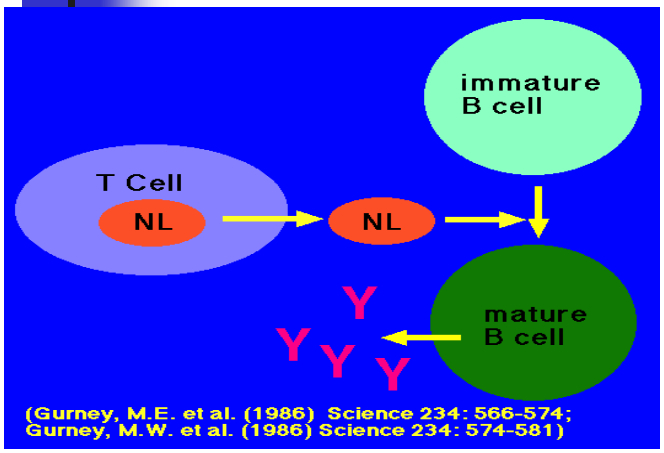
Active Site



Detailed Catalytic Mechanism

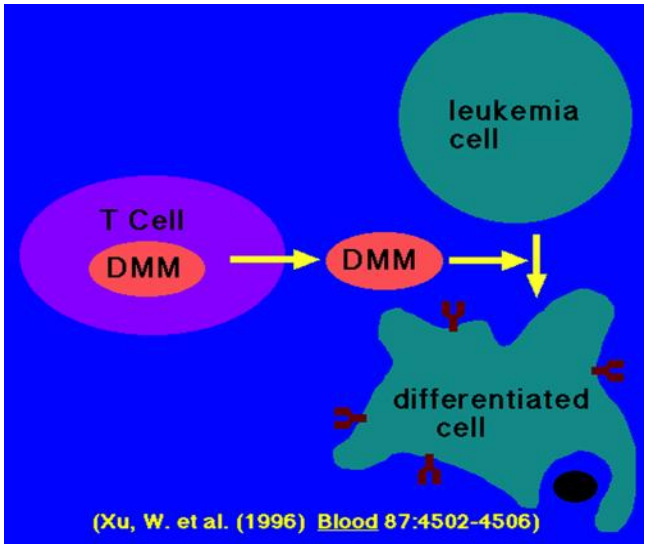


- Tumor-secreted cytokine
- Cell migration in vitro
- Same sequence as PGI!
- AMF and PGI cause cell motility (not hexokinase, phosphofructokinase, or phosphoglycerate mutase)
- AMF has isomerase activity



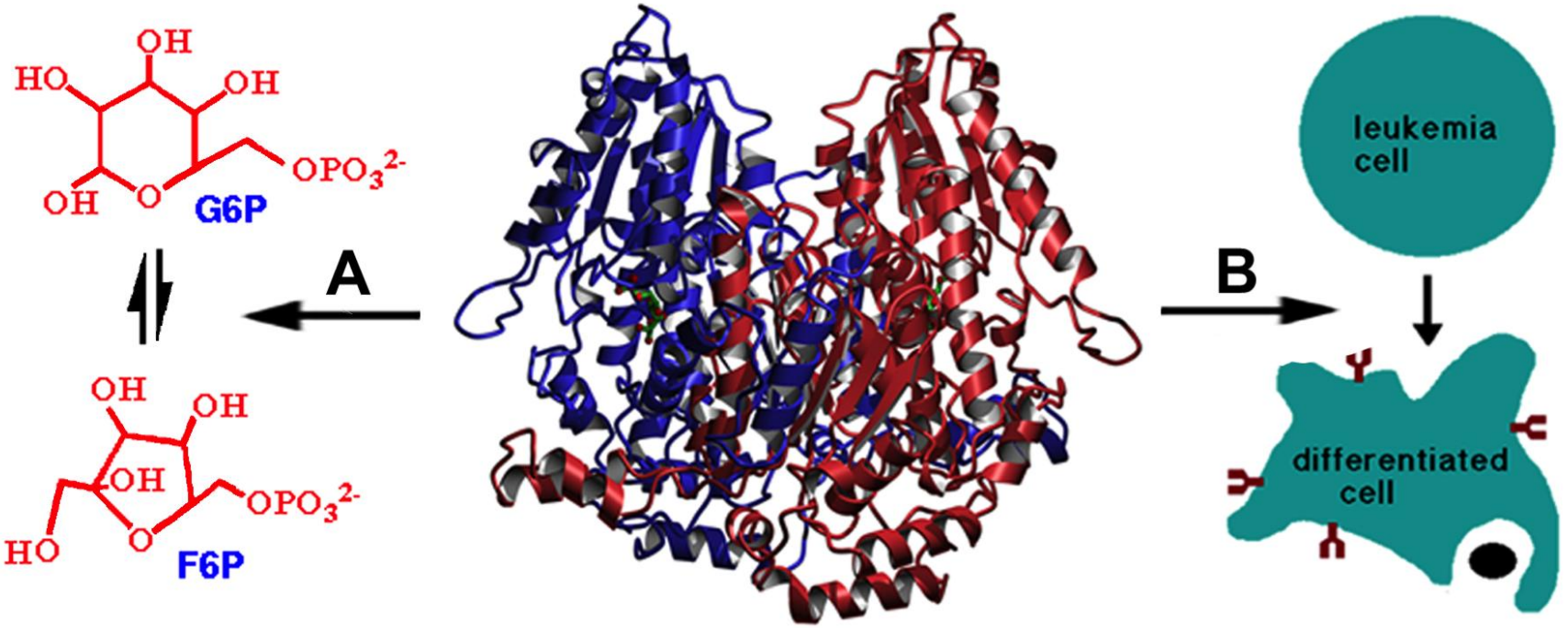
- Secreted by T cells
- Survival of embryonic neurons
- Pre-B cells to mature into Ab secreting cells
- Same sequence as PGI!
- cDNA-transfected COS cells secrete neuroleukin

Differentiation and Maturation Mediator (DMM)



- Wanted to eradicate leukemia cells
- Purified from T cell culture media
- Differentiation of some human leukemia cells
- Same sequence as PGI!
- PGI also causes dosage-dependent differentiation
- Has PGI enzymatic activity

Journal of Data Mining in Genomics & Proteomics



Cytosolic Enzyme

Extracellular Growth Factor

RNA Splice Variants

Gene Fusions

Promiscuous Enzymes

Family of Isoforms or Paralogues

Proteins with pleiotropic effects on multiple pathways

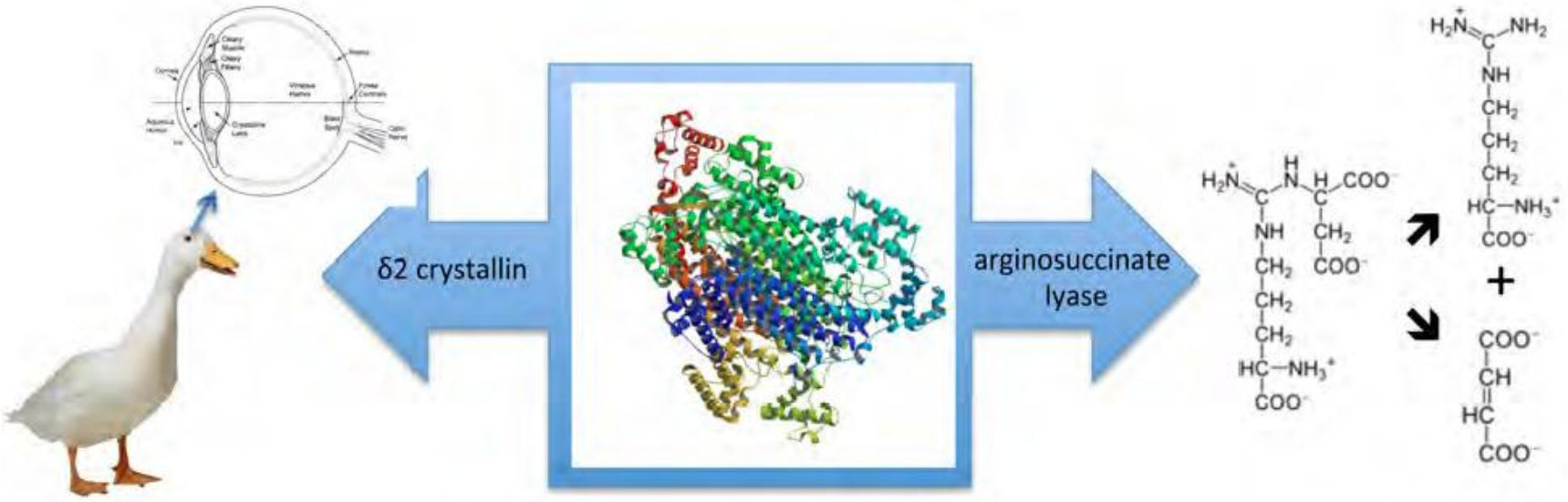
Moonlighting Proteins

One protein with multiple functions

NOT due to:

- **RNA splice variants**
- **Gene fusions**
- **Family of Isoforms or Homologues**
- **Promiscuous enzyme activity**
- **Pleiotropic effects**

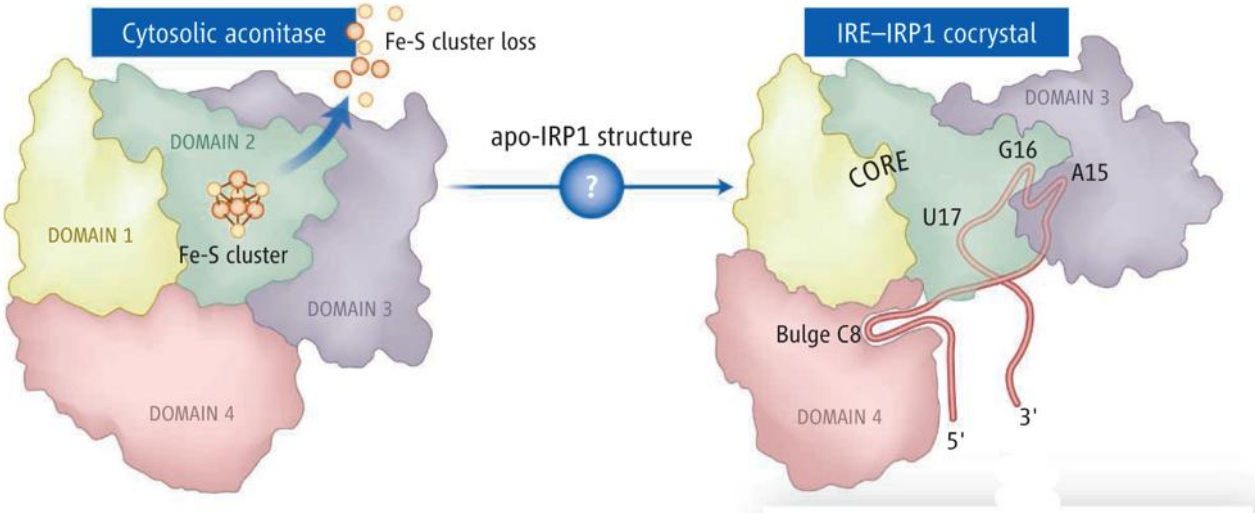
Journal of Data Mining in Genomics & Proteomics



Several crystallins in the lens of the eye are catalytically active ubiquitous enzymes. The delta2 crystallin found in the lens of the eye in ducks is the same enzyme as arginosuccinate lyase in the urea cycle.
(different protein adopted for this role in different species)

Journal of Data Mining in Genomics & Proteomics

Aconitase is the IRE binding Protein



Enzyme in
Citric Acid Cycle
Citrate -> isocitrate

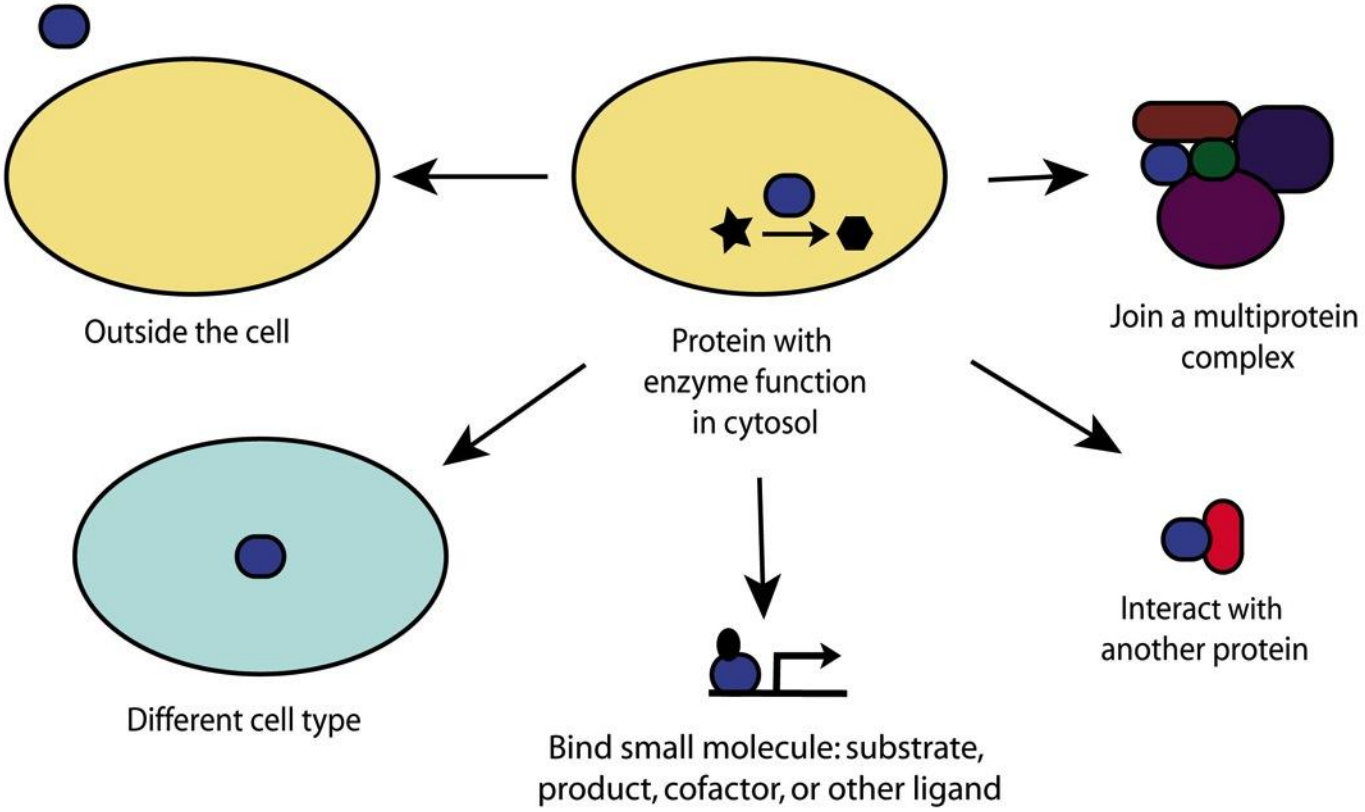
Binds RNA
To regulate translation

Picture from T. A. Rouault, *Science* (2006) 314:1886.

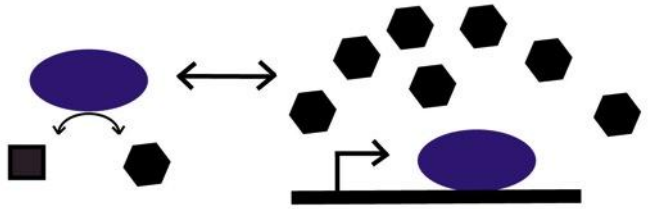
- PGI = NL, AMF, DMM
- aconitase = IRE binding protein (binds RNA)
- Thymidylate synthase (enzyme) = RNA binding protein
- *E. coli* putA (enzyme)= DNA binding transcriptional repressor
- carbinolamine dehydratase = dimerization cofactor DCoH
- Crystallins = argininosuccinate lyase, lactate dehydrogenase, alpha-enolase, etc.
- AniI RNA maturase = homing endonuclease
- DegP (HtrA) protease/chaperone

>200 proteins so far, wide variety of functions

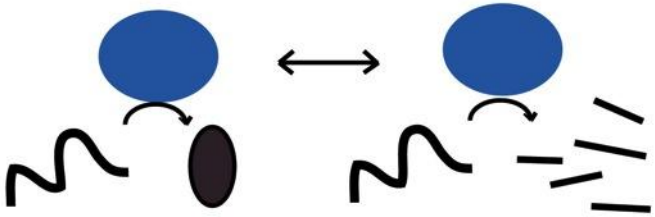
Journal of Data Mining in Genomics & Proteomics



- Feedback mechanism in a biochemical pathway to regulate enzyme synthesis (biosynthetic enzymes that regulate gene expression)



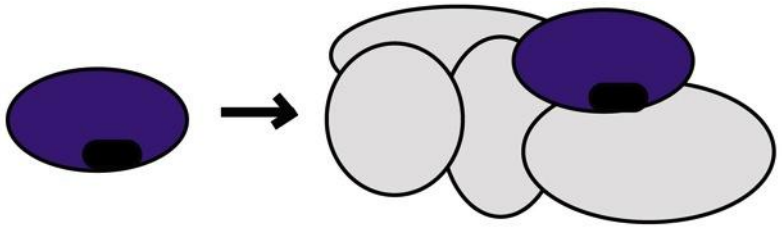
- Switch between biochemical pathways (some chaperones are also proteases)



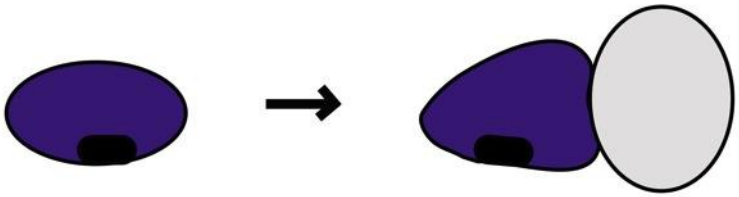
- Evolution uses whatever is available (glycolytic enzymes/ 3 billion years, crystallins /evolution of eye, etc.)

Journal of Data Mining in Genomics & Proteomics

Recruitment
(i.e. some crystallins, work of J. Piatigorsky and L. Howell labs)

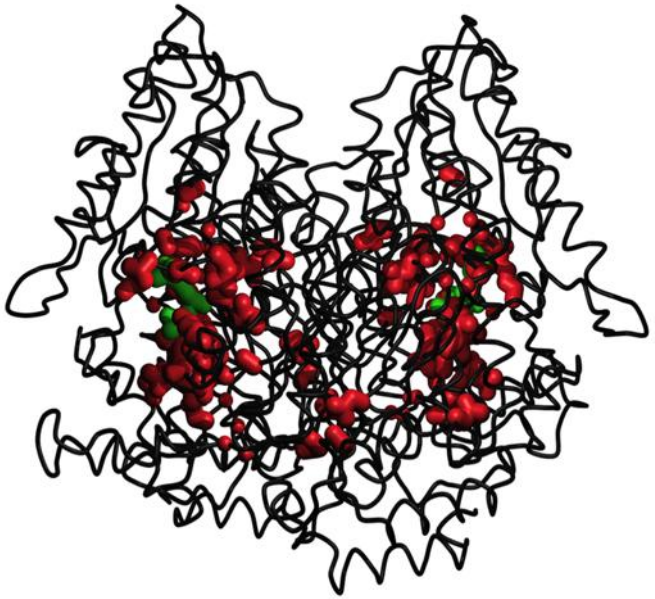


Evolution of an additional binding site on the protein surface
(i.e. I-AniI maturase/ homing endonuclease, structure by B. Stoddard lab)

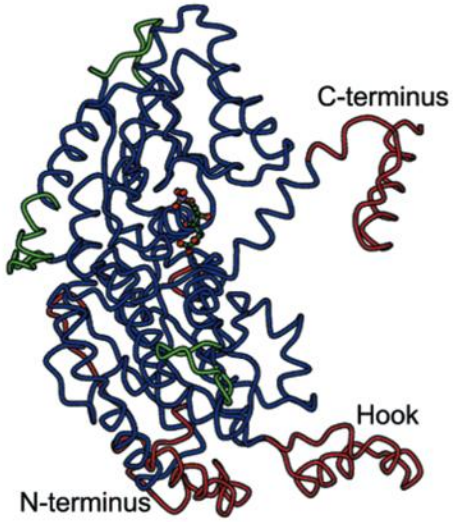


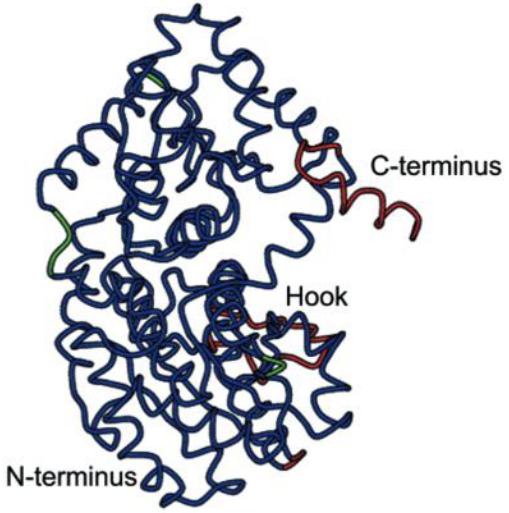
Journal of Data Mining in Genomics & Proteomics

Dimer



Single Subunit





Mammal

Bacteria

- Variety of examples
- Multiple ways to switch functions
- Potential benefits to organism
- Methods of evolving 2nd function could have happened to many proteins

Journal of Data Mining in Genomics & Proteomics

- An increasing number and variety of proteins are being found to moonlight
- The modern cell is complex but organized. Moonlighting proteins can provide one way to coordinate cellular activities, provide a feedback mechanism, and switch between pathways.

Journal of Data Mining in Genomics & Proteomics

Phosphoglucose and Phosphomannose Isomerases

Brandeis
Dagmar Ringe
Greg Petsko
Brian Bahnson
Wade Chien

UIC
Forum Bhatt
Ji Hyun Lee
Diana Arsenieva
Kathy Chang
Vishal Patel
Brian Appavu

Université Paris-XI, Orsay, France
Laurent Salmon
Renaud Hardré

Argonne National Labs
BioCARS staff (APS Sector 14)
Ser-CAT staff (APS Sector 22)

2013 – 2014 lab members
Mathew Mani
Vaishak Amblee
Chang Chen
Navya Josyula
Wangfei Wang
David Dolivo
Victoria Gil
Hannah Lee
Nicole Long
Grant Zwicke
Tanu Mather
Haipin Lui

***Pseudomonas aeruginosa* and *Trypanosoma brucei* Enzymes and Transmembrane Proteins/ Multidrug Resistance**

UIC
Vidya Madhavan
Forum Bhatt
Ryo Kawamura
Sonali Gandhi

Université Paris-XI, Orsay, France
Laurent Salmon
Celine Roux

Funding
NSF
NIH
American Heart Association
American Cancer Society
Society for Biomolecular Sciences
Cancer Federation
UIC Campus Research Board
UIC Lasuri Fund
Chancellor's Undergraduate Research Fund

Proteomics & Bioinformatics Related Journals

- Journal of Data Mining in Genomics & Proteomics
- Journal of Pharmacogenomics & Pharmacoproteomics
- Journal of Proteomics & Bioinformatics
- Fungal Genomics & Biology

Proteomics & Bioinformatics Related Conferences

- 4th International Conferences on Proteomics & Bioinformatics 2014
- 5th International Conferences on Proteomics & Bioinformatics 2015

OMICS Group **Open Access Membership**

OMICS publishing Group Open Access Membership enables academic and research institutions, funders and corporations to actively encourage open access in scholarly communication and the dissemination of research published by their authors.

For more details and benefits, click on the link below:

http://omicsonline.org/membership.php