RCSB Protein Data Bank Advisory Committee Meeting

October 30th 2014

RCSB PDB
PROTEIN DATA BANK

Overview

Stephen K. Burley

Leadership Transition

- Stephen K. Burley, Director
  - Overall direction of RCSB PDB as of July 2014
  - Formally responsible for Rutgers and UCSD
- Helen M. Berman, Associate Director
  - External Partnerships related to hybrid or integrative structure determination methods
  - Unchanged roles in SBKB/NDB/EMDataBank
- Philip E. Bourne–exited early in 2014
  - Associate Director for Data Science, NIH

Advisory Groups

Advisory Committees

- **RCSB PDB AC**: Cynthia Wolberger (Johns Hopkins)
- **wwPDB AC:** Soichi Wakatsuki (Stanford/SLAC)

Working Group

- **PDBx/mmCIF**: Paul Adams (LBL)

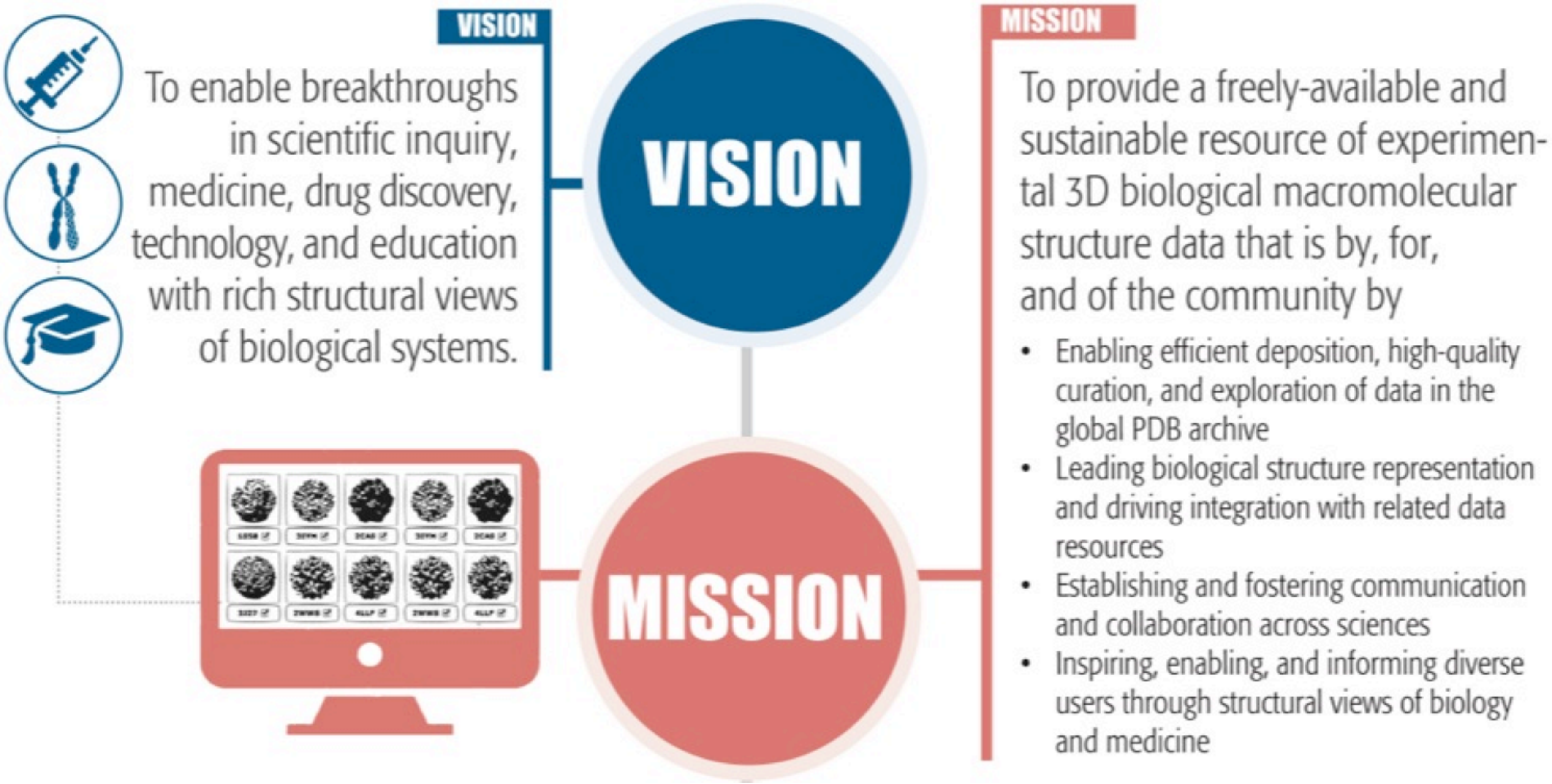
wwPDB Task Forces and Workshops

- **X-ray Validation:** Randy Read (Univ of Cambridge)
- **3DEM Validation:** Richard Henderson (MRC-LMB), Andrej Sali (UC San Francisco)
- **NMR Validation:** Gaetano Montelione (Rutgers), Michael Nilges (Institut Pasteur)
- **Small-Angle Scattering:** Jill Trewhella (Univ Sydney)
- **Hybrid Methods:** Andrej Sali (UC San Francisco), Torsten Schwede (Univ Basel), Jill Trewhella (Univ Sydney)

2014 Strategic Planning

- July meeting with Leadership Team to draft Core Values, Vision, and Mission
- Reviewed broadly → additional refinements
- Informed drafting of project, team, and individual objectives

Vision & Mission



VISION

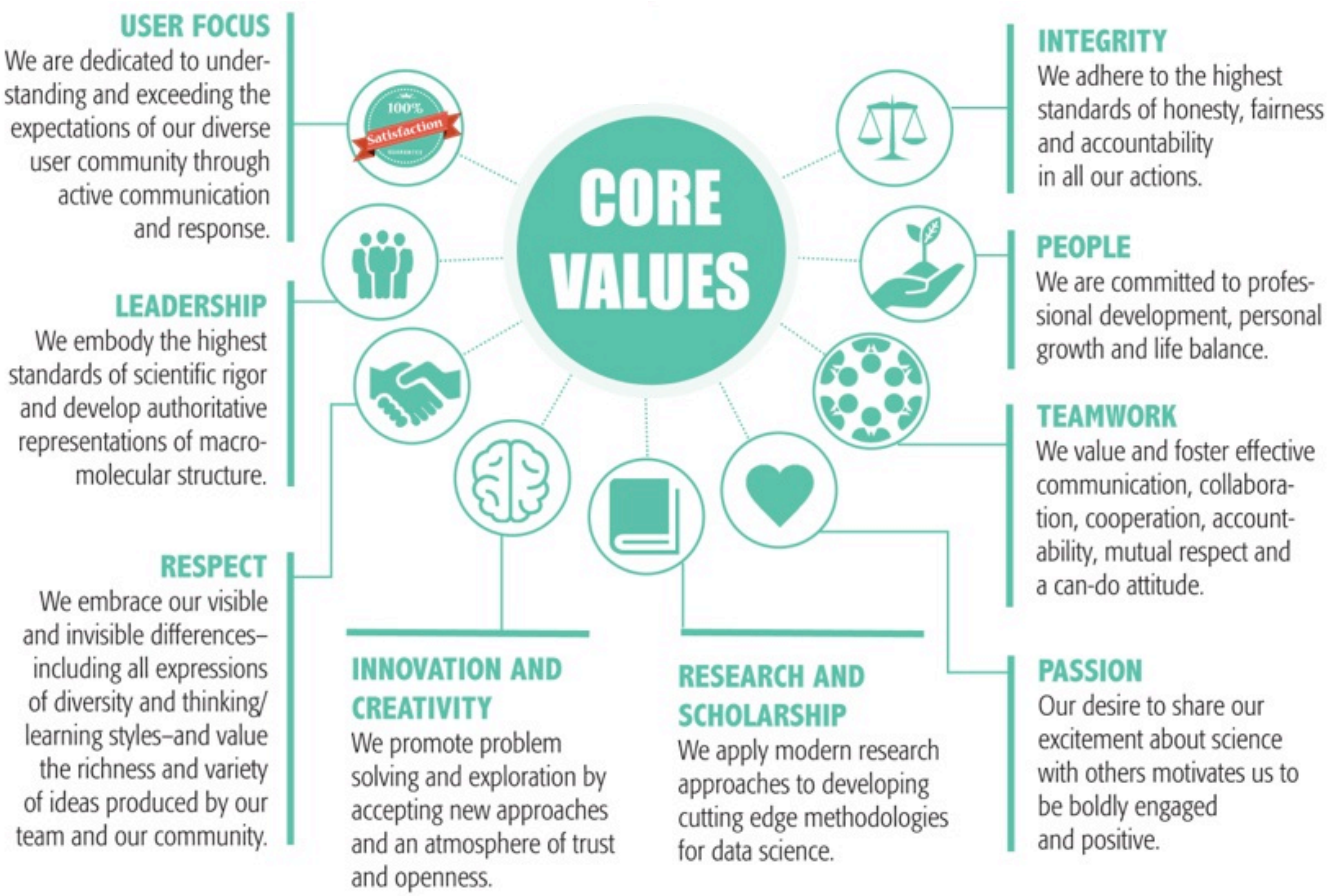
To enable breakthroughs in scientific inquiry, medicine, drug discovery, technology, and education with rich structural views of biological systems.

MISSION

To provide a freely-available and sustainable resource of experimental 3D biological macromolecular structure data that is by, for, and of the community by

- Enabling efficient deposition, high-quality curation, and exploration of data in the global PDB archive
- Leading biological structure representation and driving integration with related data resources
- Establishing and fostering communication and collaboration across sciences
- Inspiring, enabling, and informing diverse users through structural views of biology and medicine

Core Values



CORE VALUES

USER FOCUS
We are dedicated to understanding and exceeding the expectations of our diverse user community through active communication and response.

LEADERSHIP
We embody the highest standards of scientific rigor and develop authoritative representations of macromolecular structure.

RESPECT
We embrace our visible and invisible differences–including all expressions of diversity and thinking/learning styles–and value the richness and variety of ideas produced by our team and our community.

INNOVATION AND CREATIVITY
We promote problem solving and exploration by accepting new approaches and an atmosphere of trust and openness.

RESEARCH AND SCHOLARSHIP
We apply modern research approaches to developing cutting edge methodologies for data science.

INTEGRITY
We adhere to the highest standards of honesty, fairness and accountability in all our actions.

PEOPLE
We are committed to professional development, personal growth and life balance.

TEAMWORK
We value and foster effective communication, collaboration, cooperation, accountability, mutual respect and a can-do attitude.

PASSION
Our desire to share our excitement about science with others motivates us to be boldly engaged and positive.

Response to 2013 Recommendations

AC: Integration of KB and RCSB PDB

Response: **Deferred until the fate of KB determined**

AC: Review PDB-101 materials for effectiveness, and outreach efforts for cost effectiveness

Response: **Fall 2014 survey informing redesign efforts**

AC: Development of online courses with external funding

Response: **Submitted proposal under review**

AC: Major redesign of **rcsb.org** website

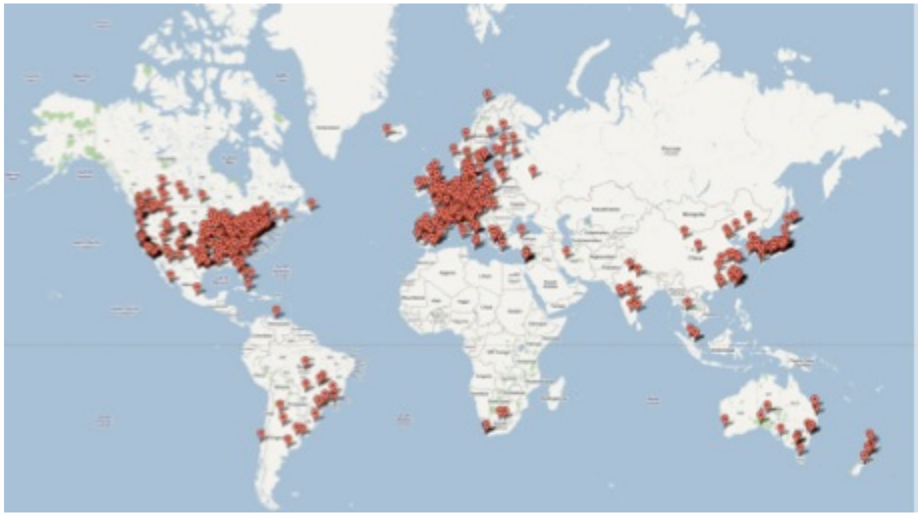
Response: **In progress (Phase 1); Addressed in Data Out**

AC: Suppression of structure title in unreleased entries

Response: **Implemented as explicit depositor option in the new system**

PDB Depositors

~850 new entries/month

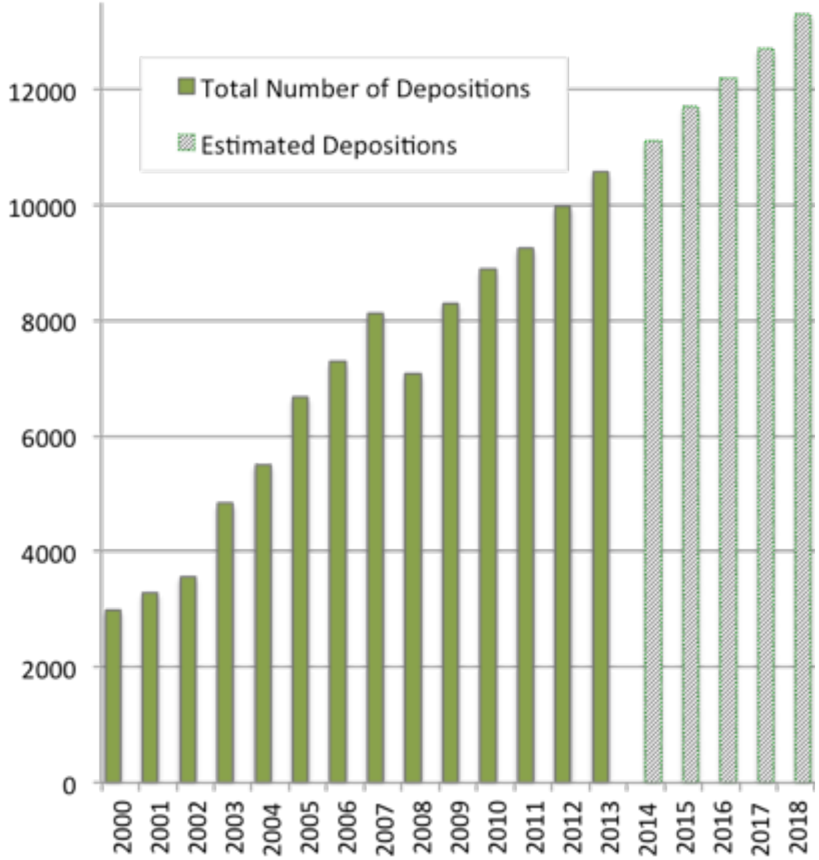


PDB User Access

2013 FTP and RSYNC Download Traffic
433 million downloads

🟥 RCSB PDB: 312 million 🟦 PDBe: 81 million 🟩 PDBj: 40 million

Growing Number of PDB Depositions



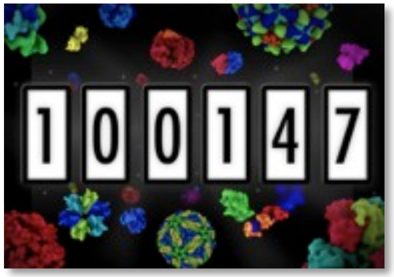
2013: 10566 depositions
49% increase in the number of global depositions since 2008

Ensuring Data Are Freely and Globally Available

- Partners
  - RCSB PDB (Research Collaboratory for Structural Bioinformatics, Rutgers/UCSD)
  - PDBj (Osaka University)
  - PDBe (EMBL-EBI)
  - BioMagResBank (University of Wisconsin, Madison)
- Collaborate on the guiding policies for unified data processing (Data In) and archive management
- Each partner website offers diverse services and views of the data (Data Out)

wwPDB Milestones; September 2013-October 2014

- Archive Growth: 100,000 structure milestone
- PDBx implemented in X-ray software packages
- Large structures released as “non-split” PDBx files
- Stand-alone X-ray validation server in production
- Validation reports released for all X-ray entries
- Common Deposition & Annotation System (D&A) in production for X-ray (NMR/EM pending)
- Workshops and Meetings
- Funding (stable for now, but slightly ↓)



wwPDB AC Closeout; October 10, 2014 EBI, Hinxton, UK

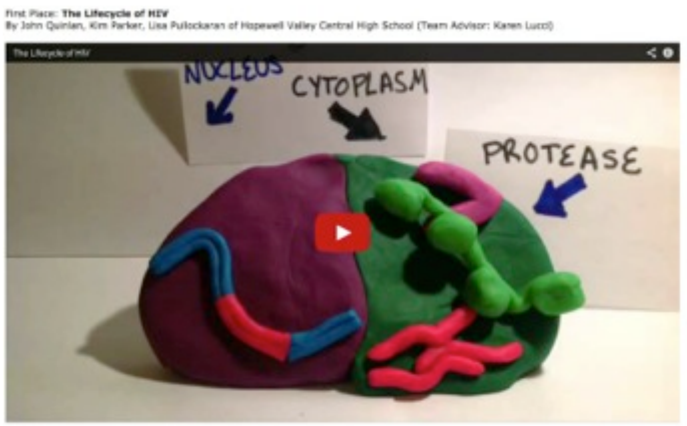
- Overall: continuing growth of archiving, significant progress on X-ray D&A, strongly recommend switching to X-ray D&A ASAP, implementation of PDBx very positive, continuous improvements
- Advisors encourage the wwPDB to meet the projected timelines of NMR & EM D&A
- Collaboration of the 4 PDB centers continues to be excellent
- Recommend stronger representation of EM as part of wwPDB given the increased importance of the cryoEM field, in particular higher resolution (ca. 3Å) structures using single particle imaging method
- RCSB PDB Leadership Transition: effective, well planned and executed
- Achieved the global workload balance owing to D&A implementation
- Funding efforts
  - RCSB: non-competitive NSF funding (2014 - 2018)
  - PDBe: Wellcome Trust and others
  - PDBj: Oct 2013 review, FY2014 new scheme due to started
  - BMRB: NIGMS R01 funding started for 5 years (2014 - 2019)

RCSB PDB Milestones; September 2013-October 2014

- Improved site usability and new structure annotations
  - Integration of membrane protein annotation
  - Mapping PDB structures to human genes
  - Beta site of redesigned home page
  - Mobile web support and visualization
  - Infrastructure and process improvements

RCSB PDB Milestones; September 2013-October 2014

- IYCr calendar and events
- Return of *Art of Science* exhibit
- Video Challenge
- High school curriculum development
- World AIDS Day Symposium
- Targeted outreach



First Place: **The Lifecycle of HIV**
By John Quinlan, Kim Parker, Lisa Pulickaran of Hopewell Valley Central High School (Team Advisor: Karen Lucci)

The Lifecycle of HIV
NUCLEUS
CYTOPLASM
PROTEASE

Agenda

Overview & Management	Stephen Burley
Outreach & Education	Christine Zardecki Shuchismita Dutta
Data In	Martha Quesada John Westbrook Jasmine Young
Data Out	Peter Rose Andreas Prlić

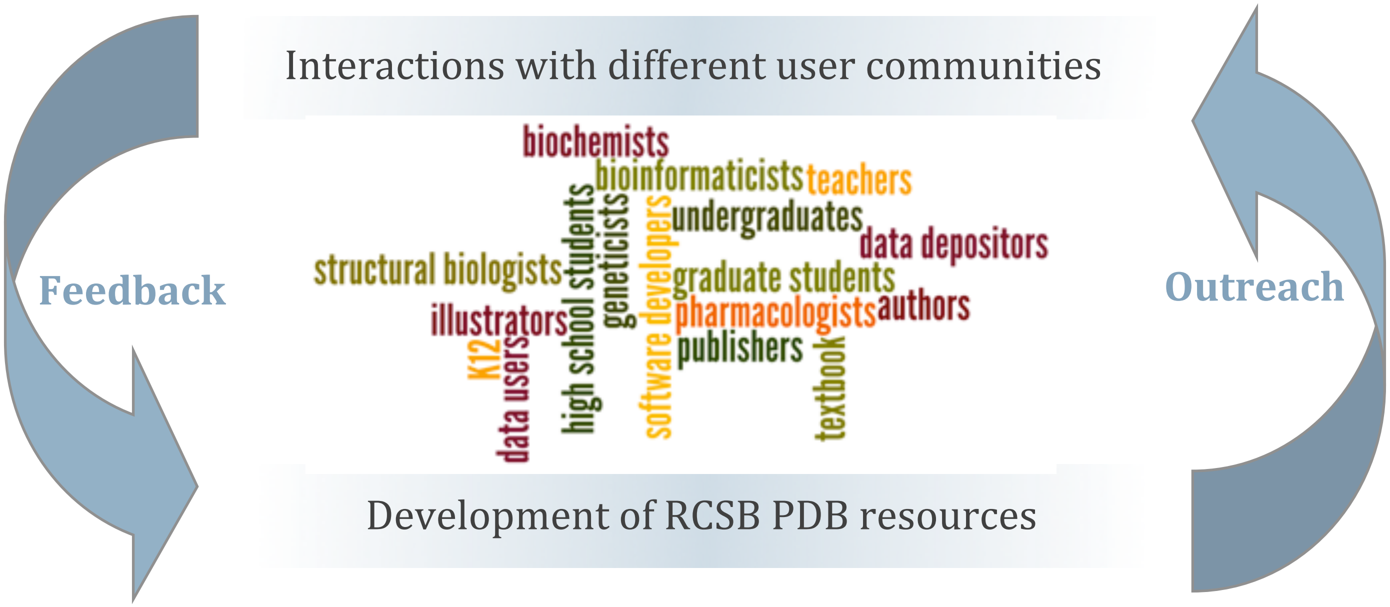
Outreach and Education

Christine Zardecki

Shuchismita Dutta

Goals

- To facilitate RCSB PDB Vision & Mission in the interests of science, medicine, and education
- To inspire, enable, and inform diverse users through structural views of biology and medicine



Interactions with different user communities

Feedback

biochemists
bioinformaticists
teachers
undergraduates
data depositors
structural biologists
high school students
geneticists
software developers
graduate students
illustrators
pharmacologists
authors
publishers
K12
data users
textbook

Outreach

Development of RCSB PDB resources

Diverse User Communities

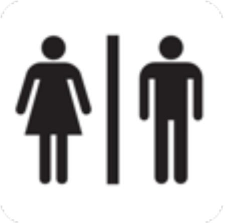
Who are our users?	What are they using?	How do we know?
Biologists: structural biology, biophysics, biochemistry, genetics, Immunology, pharmacology, cell and molecular biology, …	RCSB PDB website, deposition tools, data	Publication requests, website usage, annotator and Help Desk requests, community outreach, surveys
Other scientists: bioinformatics, software developers, …	Web Services, search engines, data	Publication requests, website usage, Help Desk requests, community outreach, surveys
Students & teachers	PDB-101	Increase in web hits, email, meeting interactions, specialized workshops/events
Media: Writers, textbook authors, patient advocacy groups, …	Images, data, information, outreach material, e.g., posters	Publications, image requests
General public: Curious/interested individuals, artists, sculptors, …	Images, *Molecule of the Month*, external media	Concerts, media, Wikipedia

JOHN KUAN
Student
2014:
100,000 Structures

2014 Survey: Who Uses PDB-101?

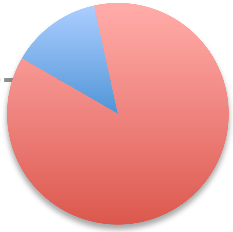
Based on ~700 Responses

Demographics


37% 60%

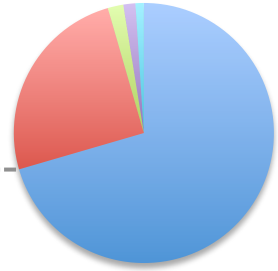
83% have never deposited a structure

Ethnicity



- 🟦 Hispanic or Latino (13%)
- 🟥 Other (87%)

Race

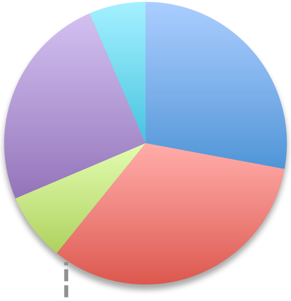


- 🟦 White (72%)
- 🟥 Asian (25%)
- 🟩 American Indian or Alaska Native (2%)
- 🟪 Black or African American (<2%)
- 🟦 Native Hawaiian or Other Pacific Islander (1%)

Where do they work?

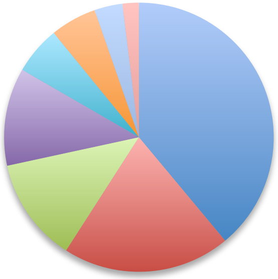
- **College/University (74%)**
- Research Institute (12%)
- Government (2%)
- Pharma/drug discovery/biotech (3%)
- K12 (8%)

Breakdown



- 🟦 Undergrad (28%)
- 🟥 Graduate (32%)
- 🟩 Postdoc (8%)
- 🟪 Faculty (25%)
- 🟦 Staff (6%)

Research Area



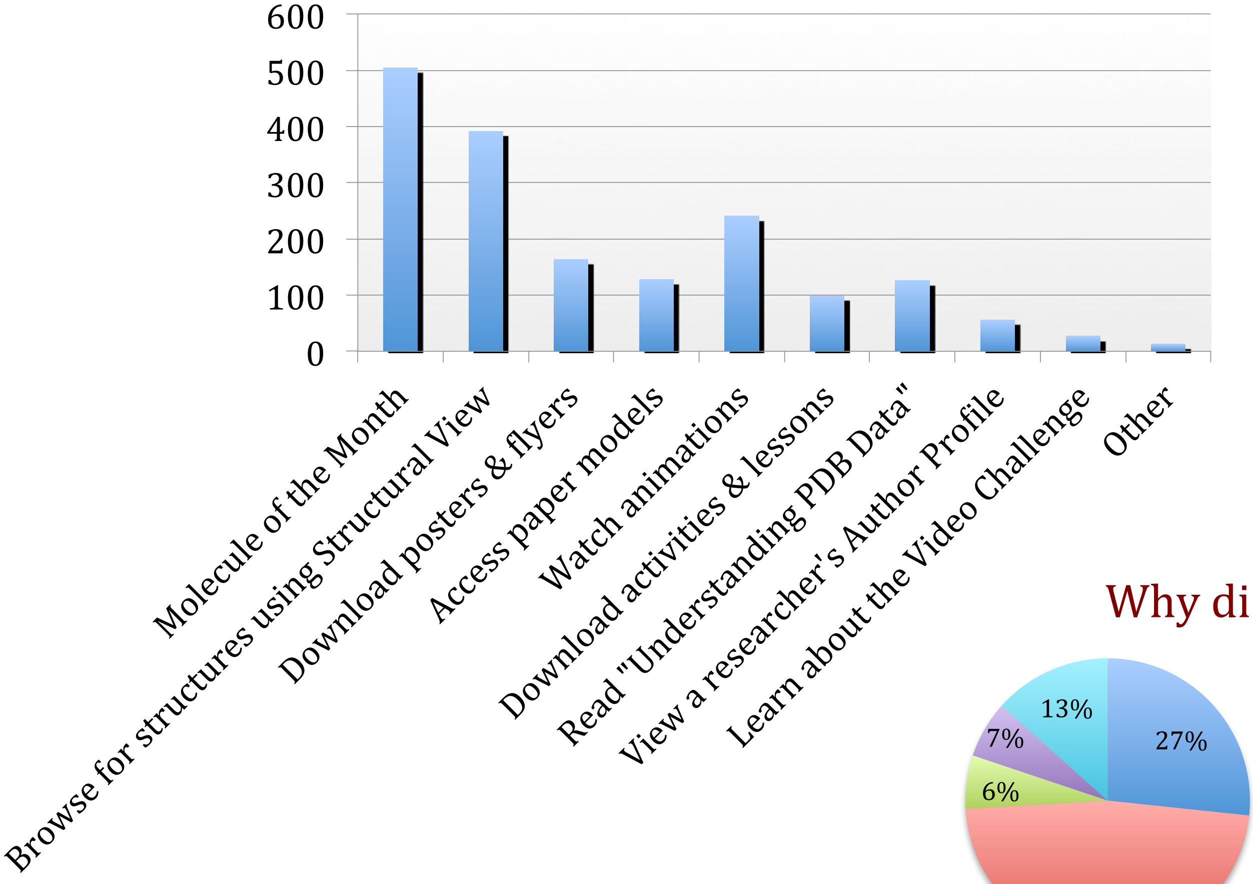
- 🟦 Life Sciences (39%)
- 🟥 Chemistry (20%)
- 🟩 Medical Sciences (12%)
- 🟪 Computational Sciences (12%)
- 🟦 Pharmacology (6%)
- 🟧 Other (6%)
- 🟦 Physics (3%)
- 🟥 Math/Statistics (2%)

College/ University Type

- University (409)
- 4-year college (56)
- Historically Black College/University (3)
- Women's college (2)

What Do PDB-101 Users Do?

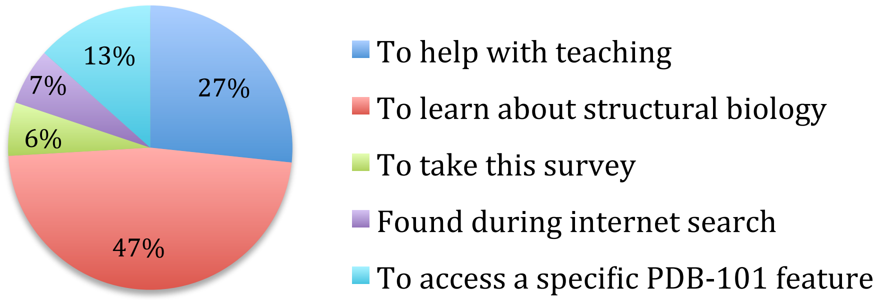
Why do they use PDB-101?



Users visit…

PDB-101 (2014)	rcsb.org (2012)
Daily (6%)	Daily (17%)
Weekly (27%)	Weekly (38%)
Monthly (20%)	Monthly (16%)
Occasionally (39%)	Occasionally (22%)
Never (8%)	Never (7%)

Why did they visit PDB-101 today?



Outreach Activities: Recent Highlights

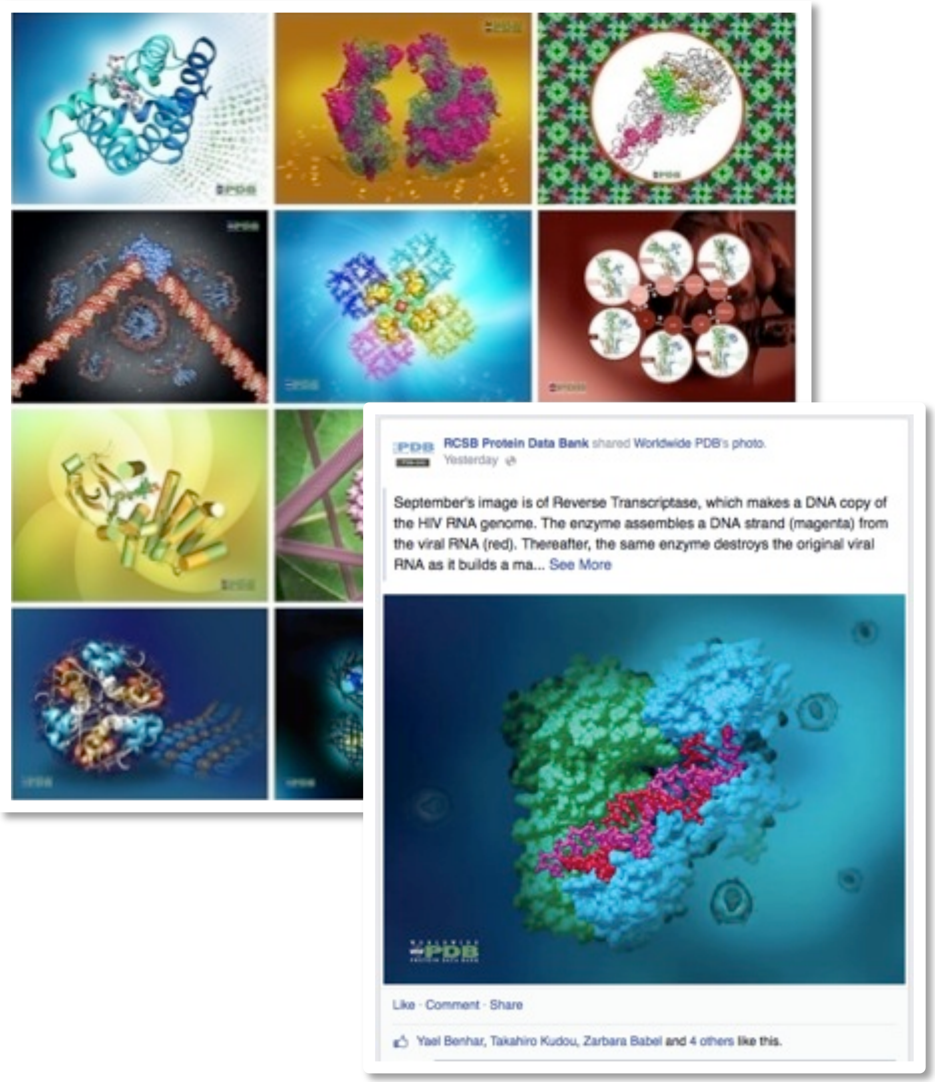
100,000 Structures in the PDB!
May 14, 2014

International Year of Crystallography

Des « pierres angulaires »
2014

~5500 wwPDB calendars were distributed to classrooms and at scientific and educational meetings worldwide, including the IYCr Opening Ceremony, and promoted throughout the year.

Calendar images are available for use without restrictions at wwpdb.org


RCSB Protein Data Bank shared Worldwide PDB's photo.
Yesterday

September's image is of Reverse Transcriptase, which makes a DNA copy of the HIV RNA genome. The enzyme assembles a DNA strand (magenta) from the viral RNA (red). Thereafter, the same enzyme destroys the original viral RNA as it builds a ma... See More

Like · Comment · Share
Yael Benhar, Takahiro Kudou, Zarbara Babel and 4 others like this.

IYCr and Science Festivals

USA Science & Engineering Festival (April 25-27, Washington DC)

- Exhibit booth
  - Photo booth
  - Materials from IUCr/USNCCr
  - RCSB PDB materials
- ~100 visitors per hour
  - Mostly pre-high school students and their parents
  - Built ~600 DNA structures and close to 1000 viruses

ACA Education Workshop (May 24, Albuquerque, NM)

- Virus/DNA model building in the New Mexico Museum of Natural History & Science
- Parallel with teacher workshop, crystallization station, and public lecture by Dr. Doris Schattschneider on MC Escher

Build a Virus Model!
G
T
A
PROTEIN DATA BANK

IYCr and *Art of Science*

- Paris, France in May 2014
  - Villejuif Bio Park and Sup'Biotech Open House
- Small ACA grant for IYCr-related outreach will support show sent to
  - Applications and Research Laboratory High School (Ellicott City, MD), to be scheduled
  - McPherson College (McPherson, KS), November
  - Delbarton School (Morristown, NJ), November 2014 – January 2015
- Spring 2015: Rutgers Art History Library

Outreach to Diverse Communities

Annual Biomedical Research Conference for Minority Students (ABRCMS)

November 13-16, 2013, Nashville, TN

- Exhibit booth visited by ~ 250 students and administrators
  - Distributed materials, including ~200 IYCr calendars
  - Many very familiar with PDB structures
  - Students enjoyed the photobooth, and voted for GFP as their favorite protein (pictures on Facebook), the DNA paper model, and the Krebs Cycle flyer

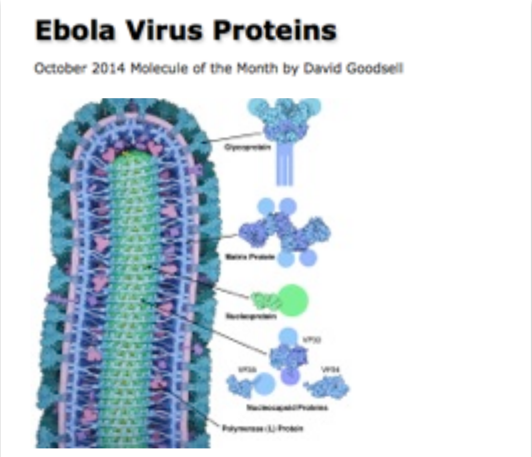
Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS)

October 16-18, 2014, Los Angeles, CA

- PDB-related symposium with HMB speaking attended by ~130

PDB-101: *Molecule of the Month*

- Popular entry point to PDB-101
- Topics are now strategically planned to correspond with related RCSB PDB activities, topical events
- Incorporated with social media efforts
- Frequently used by textbooks and other media
- Increased integration with educational activities

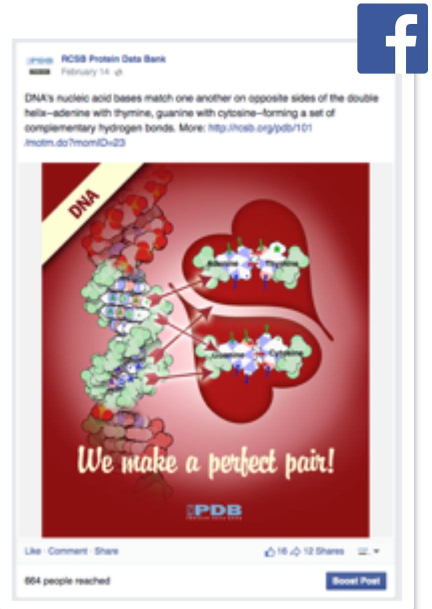


Ebola Virus Proteins

October 2014 Molecule of the Month by David Goodsell

Glycoprotein
Matrix Protein
Nucleoprotein
VP30
VP35
VP24
Nucleocapsid Proteins
Polymerase (L) Protein

More than 14,000 views since October 7



RCSB Protein Data Bank
February 14

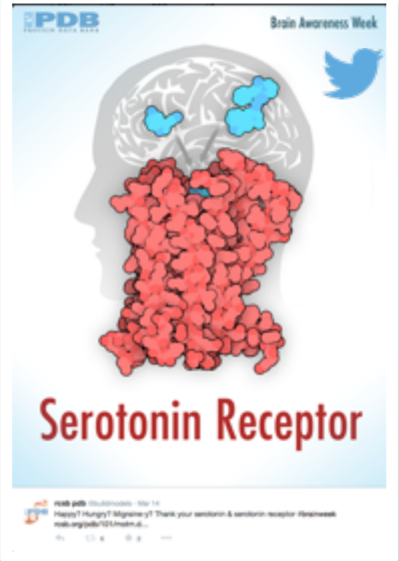
DNA's nucleic acid bases match one another on opposite sides of the double helix—adenine with thymine, guanine with cytosine—forming a set of complementary hydrogen bonds. More: http://rcsb.org/pdb/101/motm.do?momID=23

DNA
We make a perfect pair!
PDB
Like · Comment · Share
16
12 Shares
664 people reached
Boost Post

Collect, compare and make your own Big Picture Protrumps at www.wellcome.ac.uk/bigpicture/proteins

You'll also find lots of online teaching resources for the classroom.

Immunoglobulin
Collagen
Ha
ATP
Insulin
Supporting structures
wellcome.ac.uk/bigpicture
Big Picture



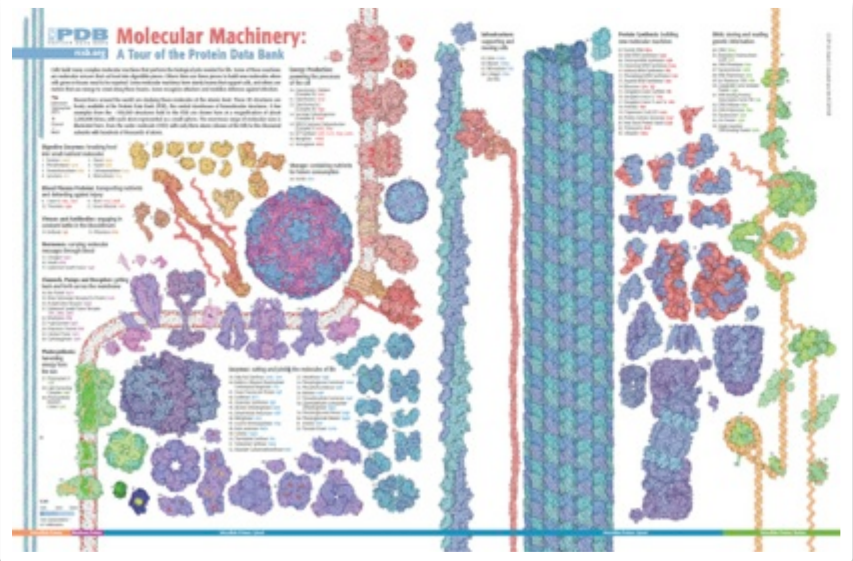
PDB
Brain Awareness Week
Serotonin Receptor

rcsb pdb · Mar 14
Happy? Hungry? Migraine-y? Thank your serotonin & serotonin receptor #brainweek rcsb.org/pdb/101/motm.d...

PDB-101: *Molecular Machinery*

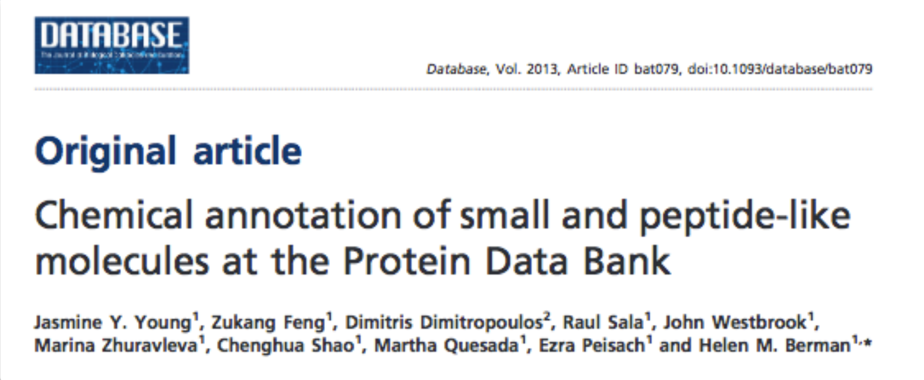
- Original poster
  - Released in 2002
  - Printed twice
  - Distributed thousands
  - Consistently requested
- 2014
  - Released when we hit 100K structures in May
  - Downloaded ~1000 times already
  - Interactive version will link to *Molecule of the Month* and more

NJ Today
JOHN KUAN
Student


PDB
Molecular Machinery:
A Tour of the Protein Data Bank

Recent Publications

- RCSB PDB *Mobile*: iOS and Android mobile apps to provide data access and visualization to the RCSB Protein Data Bank (2014) *Bioinformatics* doi: 10.1093/bioinformatics/btu596
- The Protein Data Bank archive as an open data resource (2014) *Journal of Computer-Aided Molecular Design* doi:10.1007/s10822-014-9770-y
- Systematic Detection of Internal Symmetry in Proteins Using CE-Symm (2014) *Journal of Molecular Biology* 426: 2255-2268 doi: 10.1016/j.jmb.2014.03.010
- Improving the representation of peptide-like inhibitor and antibiotic molecules in the Protein Data Bank (2014) *Biopolymers* 101:659-668 doi:10.1002/bip.22434
- Establishing the Next Generation of the Protein Data Bank (2014) *The Winnower* doi: 10.15200/winn.140076.68556
- Chemical annotation of small and peptide-like molecules at the Protein Data Bank (2013) *Database* doi:10.1093/database/bat079



DATABASE

Database, Vol. 2013, Article ID bat079, doi:10.1093/database/bat079

Original article

Chemical annotation of small and peptide-like molecules at the Protein Data Bank

Jasmine Y. Young[1], Zukang Feng[1], Dimitris Dimitropoulos[2], Raul Sala[1], John Westbrook[1], Marina Zhuravleva[1], Chenghua Shao[1], Martha Quesada[1], Ezra Peisach[1] and Helen M. Berman[1,*]

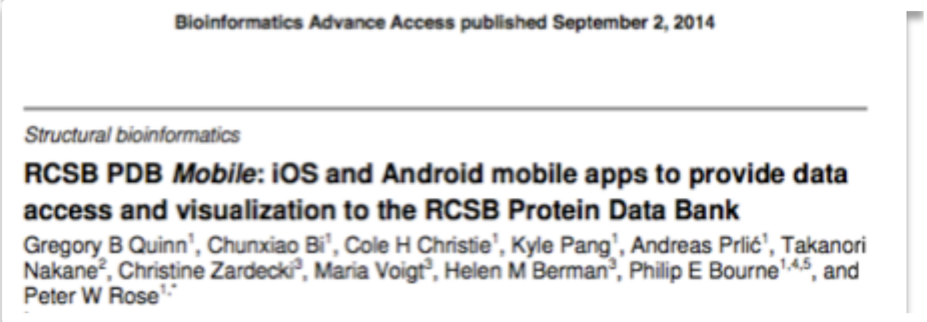
Improving the Representation of Peptide-Like Inhibitor and Antibiotic Molecules in the Protein Data Bank

Shuchismita Dutta,[1] Dimitris Dimitropoulos,[2] Zukang Feng,[1] Irina Persikova,[1] Sanchayita Sen,[3] Chenghua Shao,[1] John Westbrook,[1] Jasmine Young,[1] Marina A. Zhuravleva,[1] Gerard J. Kleywegt,[3] Helen M. Berman[1]

J Comput Aided Mol Des
DOI 10.1007/s10822-014-9770-y

The Protein Data Bank archive as an open data resource

**Helen M. Berman · Gerard J. Kleywegt ·
Haruki Nakamura · John L. Markley**



Bioinformatics Advance Access published September 2, 2014

Structural bioinformatics

RCSB PDB *Mobile*: iOS and Android mobile apps to provide data access and visualization to the RCSB Protein Data Bank

Gregory B Quinn[1], Chunxiao Bi[1], Cole H Christie[1], Kyle Pang[1], Andreas Prlić[1], Takanori Nakane[2], Christine Zardecki[3], Maria Voigt[3], Helen M Berman[3], Philip E Bourne[1,4,5], and Peter W Rose[1,*]

RCSB PDB
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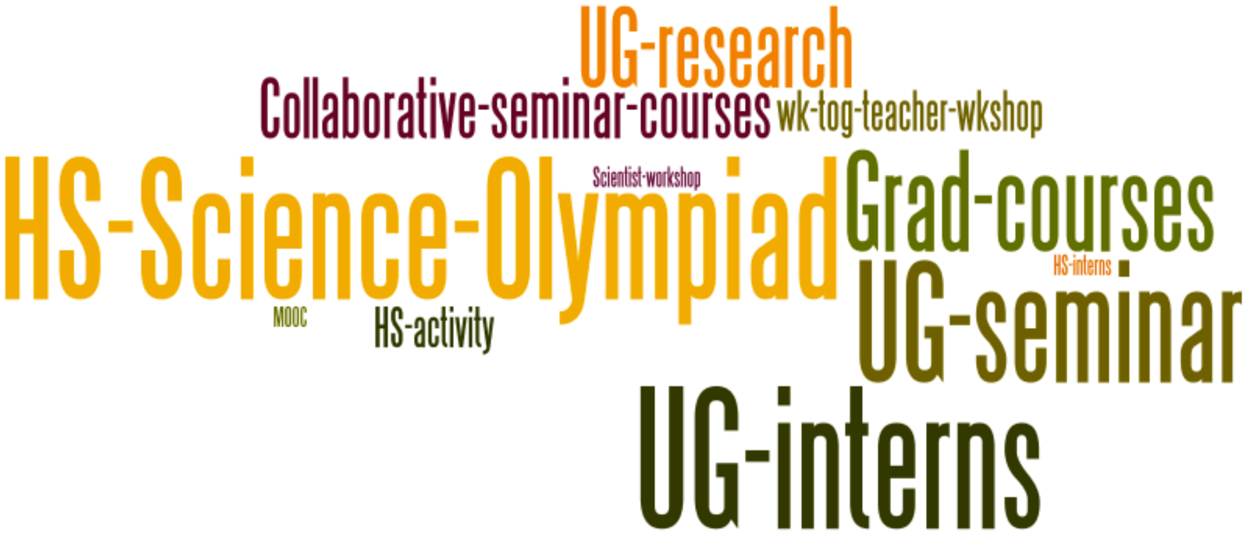
Educational Experiences


UG-research
Collaborative-seminar-courses
wk-tog-teacher-wkshop
HS-Science-Olympiad
Scientist-workshop
Grad-courses
HS-interns
UG-seminar
MOOC
HS-activity
UG-interns

Training For Specific Audiences

Who are our users?

Biologists: structural biology, biophysics, biochemistry, genetics, Immunology, pharmacology, cell and molecular biology, …

Other scientists: bioinformatics, software developers, …

Students & teachers

Media: Writers, textbook authors, patient advocacy groups, …

General public: Curious/interested individuals, artists, sculptors, …

Scientists/College or University Faculty

Graduate Students

Undergraduate Students

High School Teachers

High School Students

Interdisciplinary Boot Camp:

Training Biologists, Physicists, and more

- What?
  - 2 weeks in January 2014
  - Focused on Fluorescent Proteins
  - Exposure to experimental and computational approaches
- Who?
  - >100 registrants
  - Students, Postdocs, Faculty
- Outcome
  - Very well received!
  - SAS Investment!
  - Repeat Boot Camp in January 2015
  - Nucleic Acids focused Boot Camp planned for 2016
  - Alternation thereafter

BioMaPS Institute for Quantitative Biology

Graduate Program in Computational Biology and Molecular Biophysics

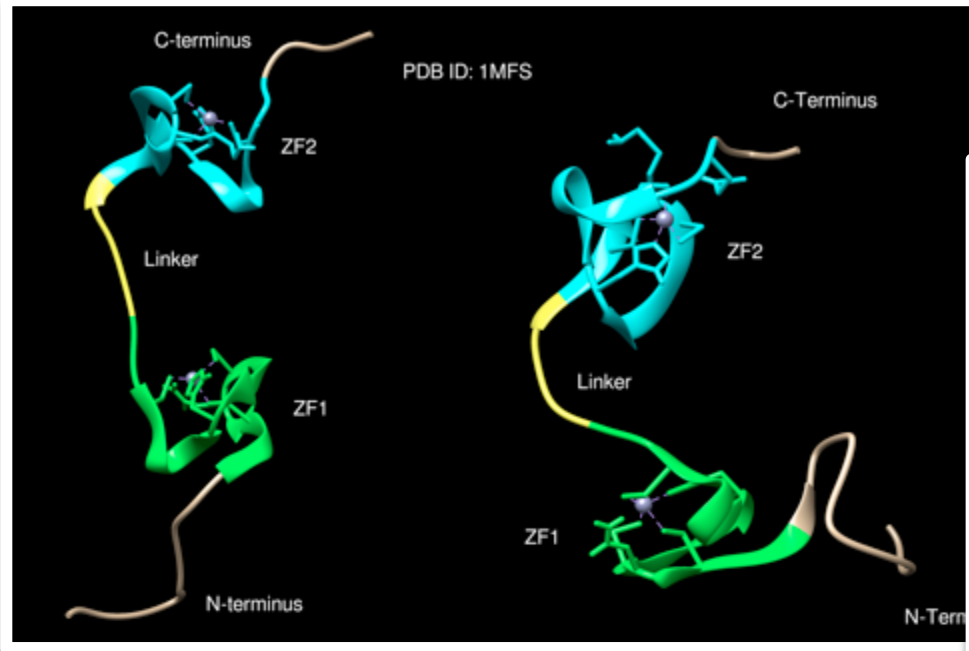
Interdisciplinary
Quantitative Biology
BOOT CAMP
January 6-17, 2014
Rutgers University, Piscataway, NJ

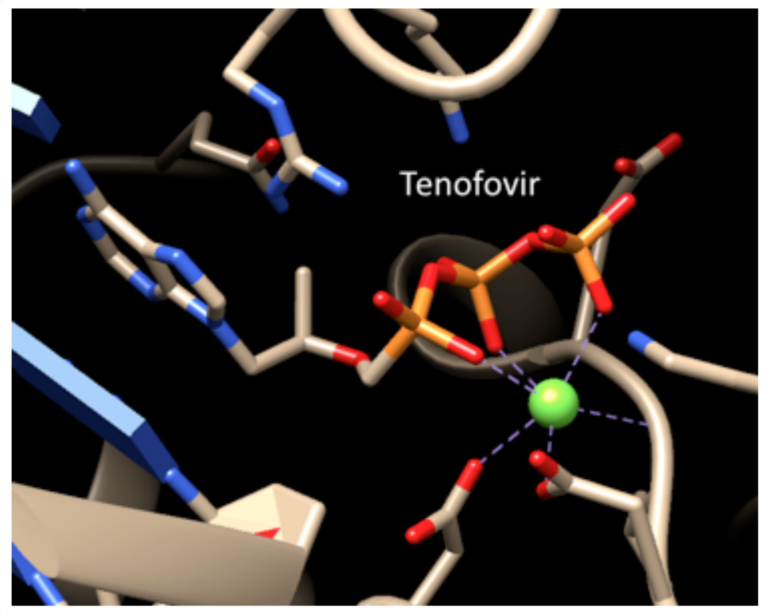
PROGRAM

Undergraduate Training

- MAP Course ➔Structural View of Biology
- Theme – HIV/AIDS

MAP
Molecular Anatomy Project


C-terminus
PDB ID: 1MFS
C-Terminus
ZF2
ZF2
Linker
Linker
ZF1
ZF1
N-terminus
N-Term



From student reports, Rutgers Univ., 2014

Research Projects

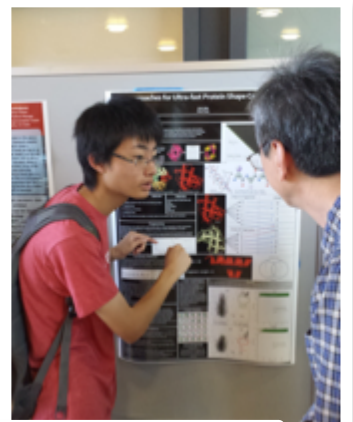
At UCSD

- **SDSC 2014 Research Experience for High School Students**
  - Ezra Kosviner (Computational Model of Naeglariapore A)
  - Kevin Wu (Fast structure alignments)
- **UCSD 2014 STARS Program**
  - Henry Truong (Multiscale rendering of large assemblies)
- **UCSD CSE 199 Special Studies Course**
  - Varun Sharma (Visualization with WebGL)
- **UCSD Undergraduate Research (Fast structure alignments)**
  - Alan Yeung, Albert Chang, Arvind Rao
- **Volunteer from SDSU**
  - Roshni Bhattacharya (Analyzing genetic variation data in PDB)

At RU

- **Independent study**
  - Zaeem Billah (Developing a Disease view: HIV/AIDS)
  - Lauren Benzinger (Developing a Disease view: Diabetes)
- **Volunteer from Rutgers**
  - Alex Nazarro (Preparing for Curriculum Development Program)

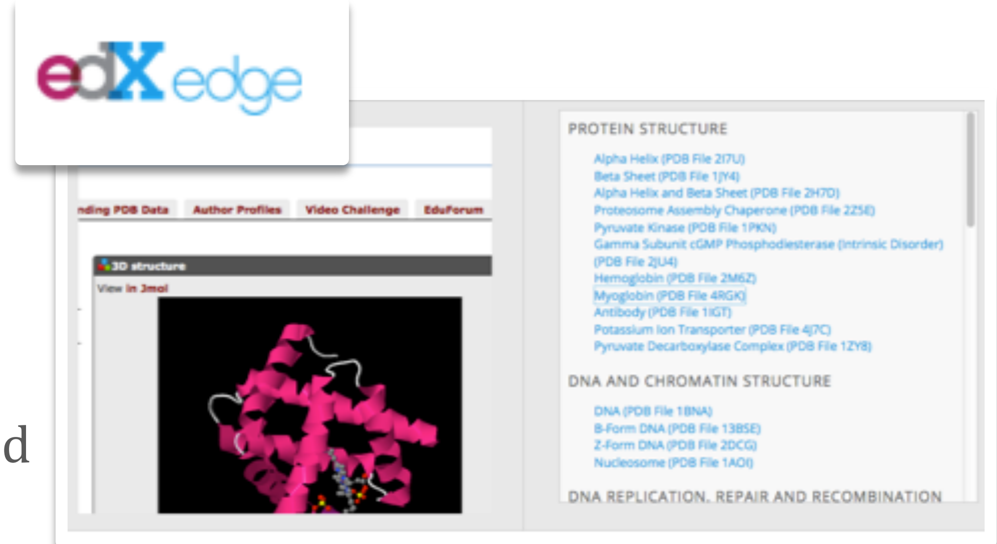
California State Science Fair
1st Place



Certificate of Excellence
Alex Nazarro

e-Learning

- Massive Open Online Courses (MOOCs)
  - BIOC 300 (June 2014 ROC) Paradigms in Biochemistry and Cell Biology
  - Upcoming courses starting in January 2015
  - Collaborating to include questions/ exercises so students can use various RCSB PDB resources
- Develop materials and lesson plans introducing fundamentals of structural biology for use in
  - RU courses (e.g. MAP course 2015, Quantitative Biology Boot Camp)
  - HS classes (e.g. Collaborative Curriculum Development Program on HIV/AIDS)



PROTEIN STRUCTURE

Alpha Helix (PDB File 2I7U)
Beta Sheet (PDB File 1JY4)
Alpha Helix and Beta Sheet (PDB File 2H7D)
Proteosome Assembly Chaperone (PDB File 2Z5E)
Pyruvate Kinase (PDB File 1PKN)
Gamma Subunit cGMP Phosphodiesterase (Intrinsic Disorder) (PDB File 2JU4)
Hemoglobin (PDB File 2M6Z)
Myoglobin (PDB File 4RGK)
Antibody (PDB File 1IGT)
Potassium Ion Transporter (PDB File 4J7C)
Pyruvate Decarboxylase Complex (PDB File 1ZY8)

DNA AND CHROMATIN STRUCTURE

DNA (PDB File 1BNA)
B-Form DNA (PDB File 13BSE)
Z-Form DNA (PDB File 2DCG)
Nucleosome (PDB File 1AOI)

DNA REPLICATION, REPAIR AND RECOMBINATION

PDB on edX, Rice University, 2014

Kathleen Matthews
Stewart Memorial Professor
of Biochemistry & Cell Biology
Rice University

Reaching High School Students

Goal:

- Promoting awareness about biomolecular structures

Approach:

- Teach teachers
  - Specialized workshops
  - Year-long programs
- Teachers teach students
- Challenge students to assess learning
  - Video challenge

National HS Teacher Workshop,
Princeton Univ., 2014

HS Teacher Workshop,
Colorado, 2014

Working Together to Visualize:

A Molecular Structural View of HIV/AIDS

2013-2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013									Announce Program	Teacher workshop/ webinar		World AIDS Day 2014 HS student learning
2014	HS student learning	Video Challenge				Select winners						

- Teacher workshops – technical training
- Public symposia – theme based learning
- Video challenge – Assessment

Working Together to
Visualize
A Molecular Structural View of HIV/AIDS
GLOBAL HEALTH!
2013-2014
Health

Flexible HIV-1 Reverse Transcriptase Inhibition by Rilpivirine

1 Begins with single-stranded HIV-1 RNA

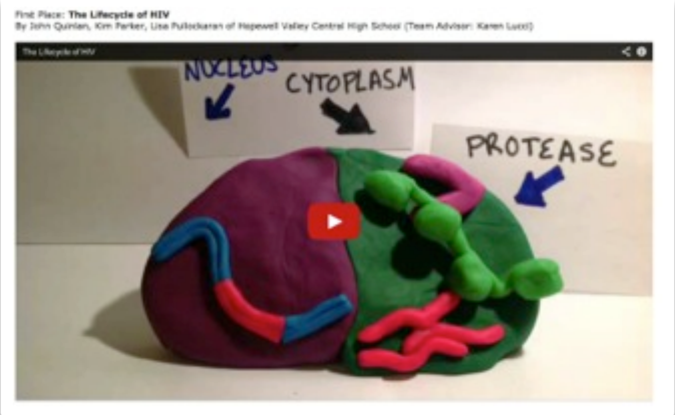
2 Polymerase site transcribes DNA over RNA template

3 Nuclease site cleaves RNA template

4 Polymerase site transcribes complementary DNA strand

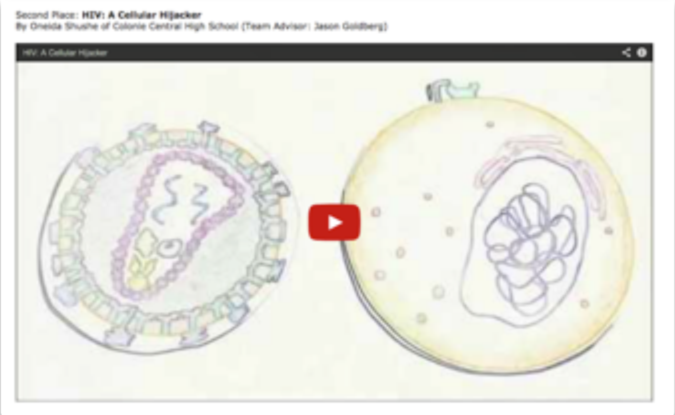
HS Video Challenge 2014

- Challenge:
  - Create short videos (two minutes or less) that tell a story about any topic related to structural biology of HIV/AIDS
  - Must include a visualization/animation of two or more PDB structures
- Resources:
  - Collection of MOM features
  - Video tutorials
  - Resources for making videos
- Entries:
  - 23 Videos
  - 7 schools/4 states
  - First place viewed ~500 times
- Judges:
  - 8 (scientists, clinicians, educators or scientific animators)
  - General public
  - AIDS Education Training Center National Resource Center
- Prizes:
  - Judges' Award
  - Viewers' Choice Award
  - Service to the Community Award



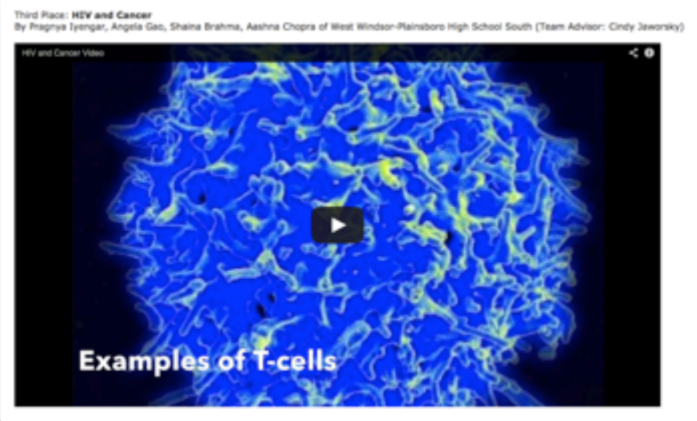
First Place: **The Lifecycle of HIV**

By John Quinlan, Kim Parker, Lisa Pulickaran of Hopewell Valley Central High School (Team Advisor: Karen Lucci)



Second Place: **HIV: A Cellular Hijacker**

By Oneida Shushe of Colonie Central High School (Team Advisor: Jason Goldberg)



Third Place: **HIV and Cancer**

By Pragnya Iyengar, Angela Gao, Shaina Brahma, Aashna Chopra of West Windsor-Plainsboro High School South (Team Advisor: Cindy Jaworsky)

Lessons Learned

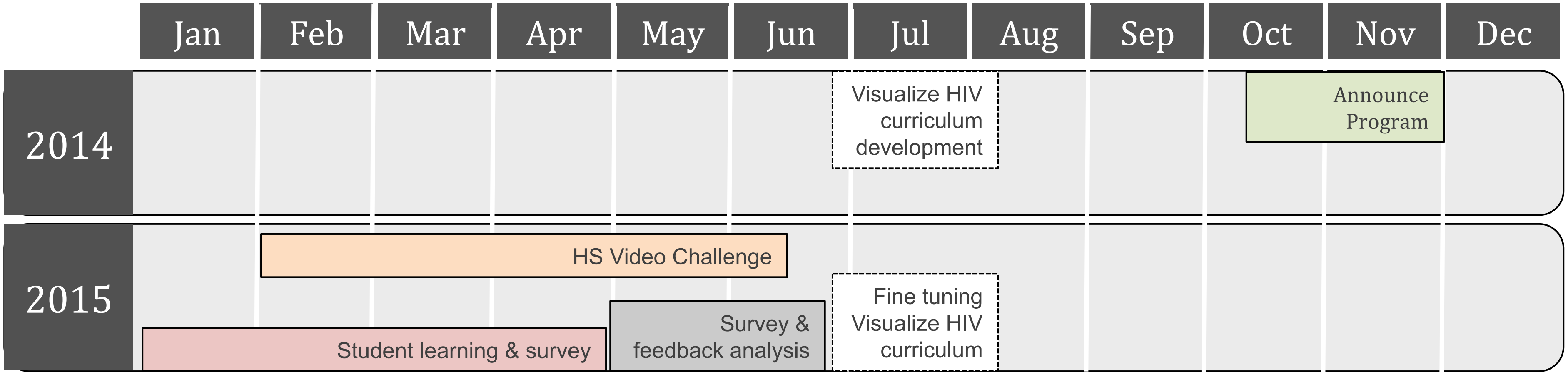
Teacher Workshops	Future Plans
Teachers need prepared lesson plans	Collaborative Curriculum Development Program
The discussion on HIV/AIDS needs context e.g. learning about biological molecules, Immune system, infections, treatments, practical awareness	

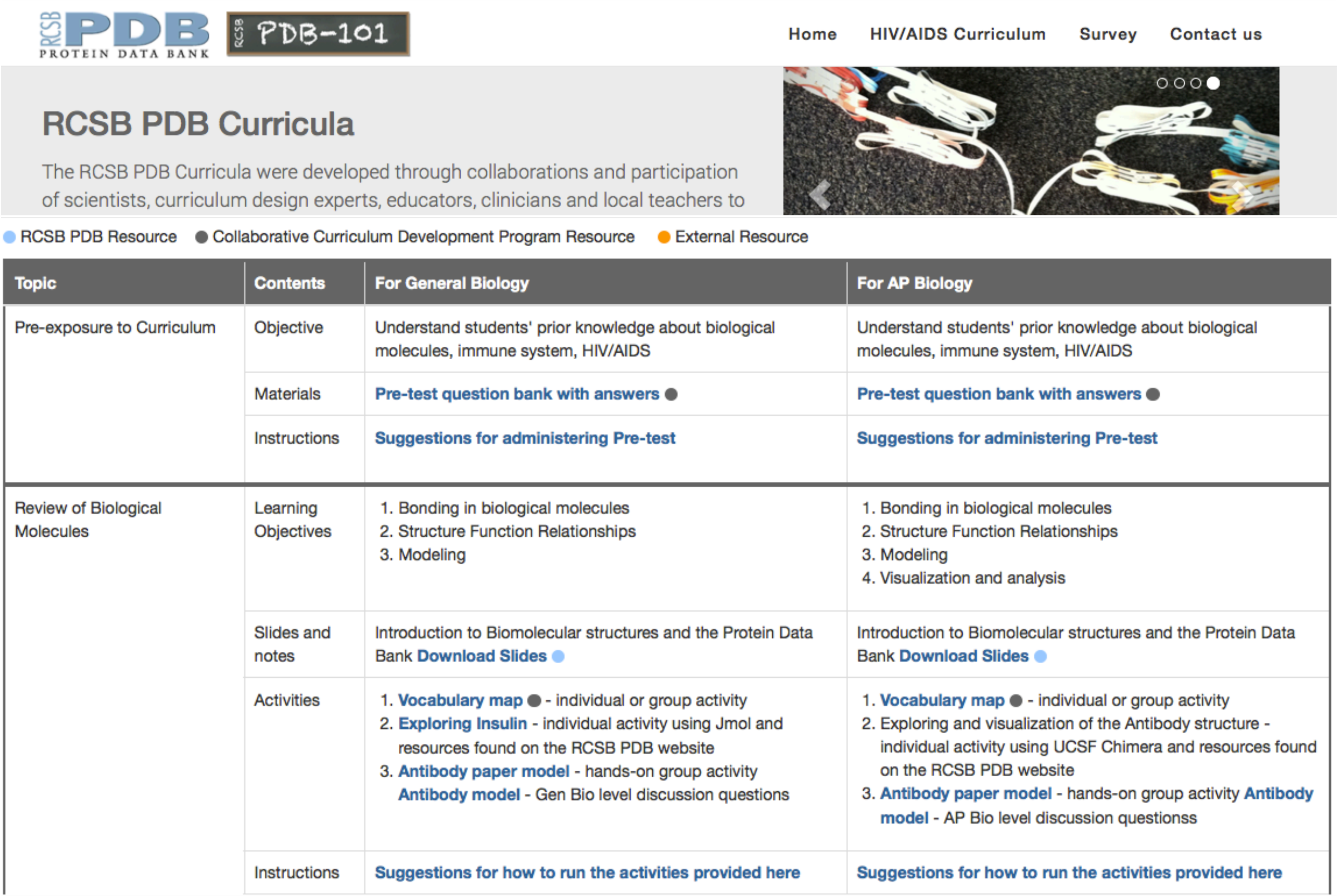
World AIDS Day Symposium	Future Plans
Patient experiences are valuable	World AIDS Day Symposium December 5th 2014
General audiences and patients want to learn more	

HS Video Challenge	Future Plans
Repeat same theme in 2015	HS Video Challenge on structural view of HIV/AIDS Spring 2015
May include more focused topics and suggested structures	

Targeting HS Teachers and Students

- Collaborative Curriculum Development Program (2014): on HIV/AIDS
  - 5 HS teachers from NJ HS + educators, scientists, clinicians
  - Developed Curricula
    - General Bio/Honors Bio
    - Advanced Placement Bio
- Presented to teachers (@ NJSC 2014)
- Testing and Participation in Video Challenge (2014-2015)


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2014
Visualize HIV curriculum development
Announce Program
2015
HS Video Challenge
Fine tuning Visualize HIV curriculum
Survey & feedback analysis
Student learning & survey



RCSB PDB Curricula

The RCSB PDB Curricula were developed through collaborations and participation of scientists, curriculum design experts, educators, clinicians and local teachers to

🔵 RCSB PDB Resource ⚫ Collaborative Curriculum Development Program Resource 🟠 External Resource

Topic	Contents	For General Biology	For AP Biology
Pre-exposure to Curriculum	Objective	Understand students' prior knowledge about biological molecules, immune system, HIV/AIDS	Understand students' prior knowledge about biological molecules, immune system, HIV/AIDS
	Materials	**Pre-test question bank with answers** ⚫	**Pre-test question bank with answers** ⚫
	Instructions	**Suggestions for administering Pre-test**	**Suggestions for administering Pre-test**
Review of Biological Molecules	Learning Objectives	1. Bonding in biological molecules 2. Structure Function Relationships 3. Modeling	1. Bonding in biological molecules 2. Structure Function Relationships 3. Modeling 4. Visualization and analysis
	Slides and notes	Introduction to Biomolecular structures and the Protein Data Bank **Download Slides** 🔵	Introduction to Biomolecular structures and the Protein Data Bank **Download Slides** 🔵
	Activities	1. **Vocabulary map** ⚫ - individual or group activity 2. **Exploring Insulin** - individual activity using Jmol and resources found on the RCSB PDB website 3. **Antibody paper model** - hands-on group activity **Antibody model** - Gen Bio level discussion questions	1. **Vocabulary map** ⚫ - individual or group activity 2. Exploring and visualization of the Antibody structure - individual activity using UCSF Chimera and resources found on the RCSB PDB website 3. **Antibody paper model** - hands-on group activity **Antibody model** - AP Bio level discussion questionss
	Instructions	**Suggestions for how to run the activities provided here**	**Suggestions for how to run the activities provided here**

Science Olympiad: Protein Modeling

- Students build 3D models, answer questions on structure and function
- MSOE CBM - RCSB PDB collaboration
- 2015 Topic: Genome Editing
- Funds:
    - 2015: (NIH) SEPA, SEDAPA, 3DMD and Vertex Pharma
    - 2016: NIDA and 3DMD

Next SO Nationals at University
of Nebraska, Lincoln, NE
in May 2015

Science Olympiad
Leadership meeting,
Orlando FL, May 2014

Educational Experiences: Future

- Targeting High School teachers and students
  - Collaborative Curriculum on HIV/AIDS
    - Testing and improving the curriculum
  - HS Video Challenge 2015 - on HIV/AIDS
    - Reaching out nationwide
  - Science Olympiad 2015 - Genome Editing
- Designing course materials/Question Banks for
  - MOOCs - collaborating with other faculty and scientists
  - Educators and students in a range of institutions
  - Rutgers Boot Camp
- Facilitating a Structural View of Biology for all
  - Preparing for next theme focus (Diabetes)
  - Preparing for 2015 Spring MAP course

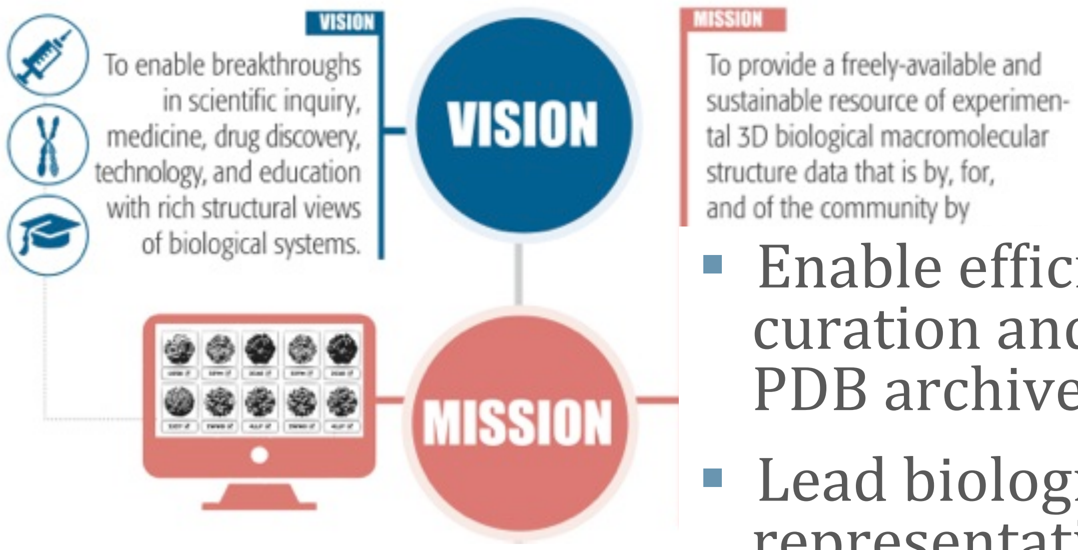
Data Deposition and Annotation

Martha Quesada

John Westbrook

Jasmine Young

Vision, Mission, and Goals



To enable breakthroughs in scientific inquiry, medicine, drug discovery, technology, and education with rich structural views of biological systems.

To provide a freely-available and sustainable resource of experimental 3D biological macromolecular structure data that is by, for, and of the community by

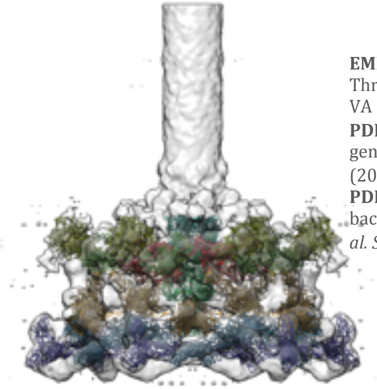
- Enable efficient deposition, high-quality curation and exploration of data in the PDB archive
- Lead biological structure representation and driving integration with related data resources
- Establishing and fostering communication and collaboration across sciences
- Inspiring, enabling and informing diverse users through structural views of biology and medicine

Common Deposition & Annotation System (D&A)

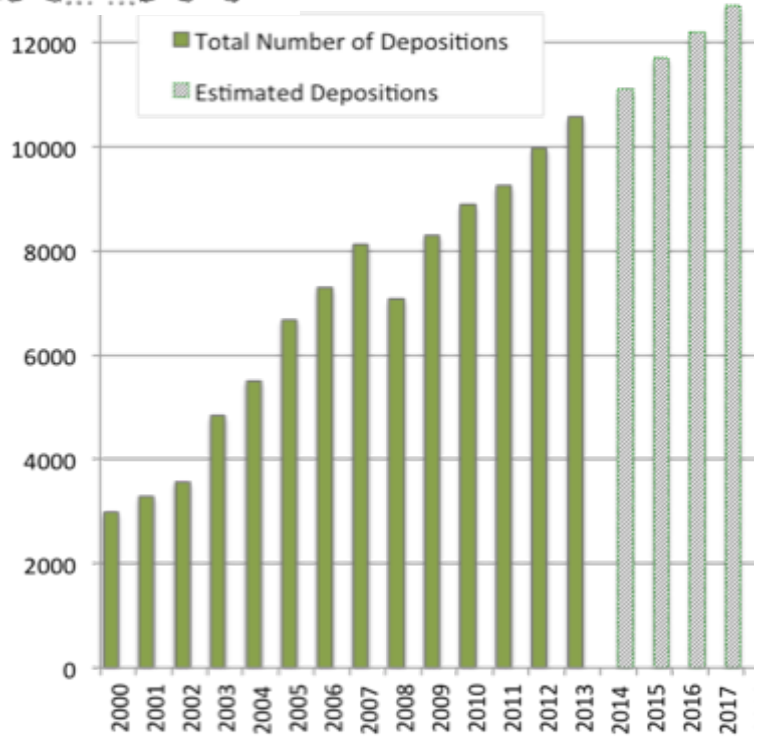
Project goal: Create the next generation deposition and annotation system supporting the PDB Vision

Strategy:

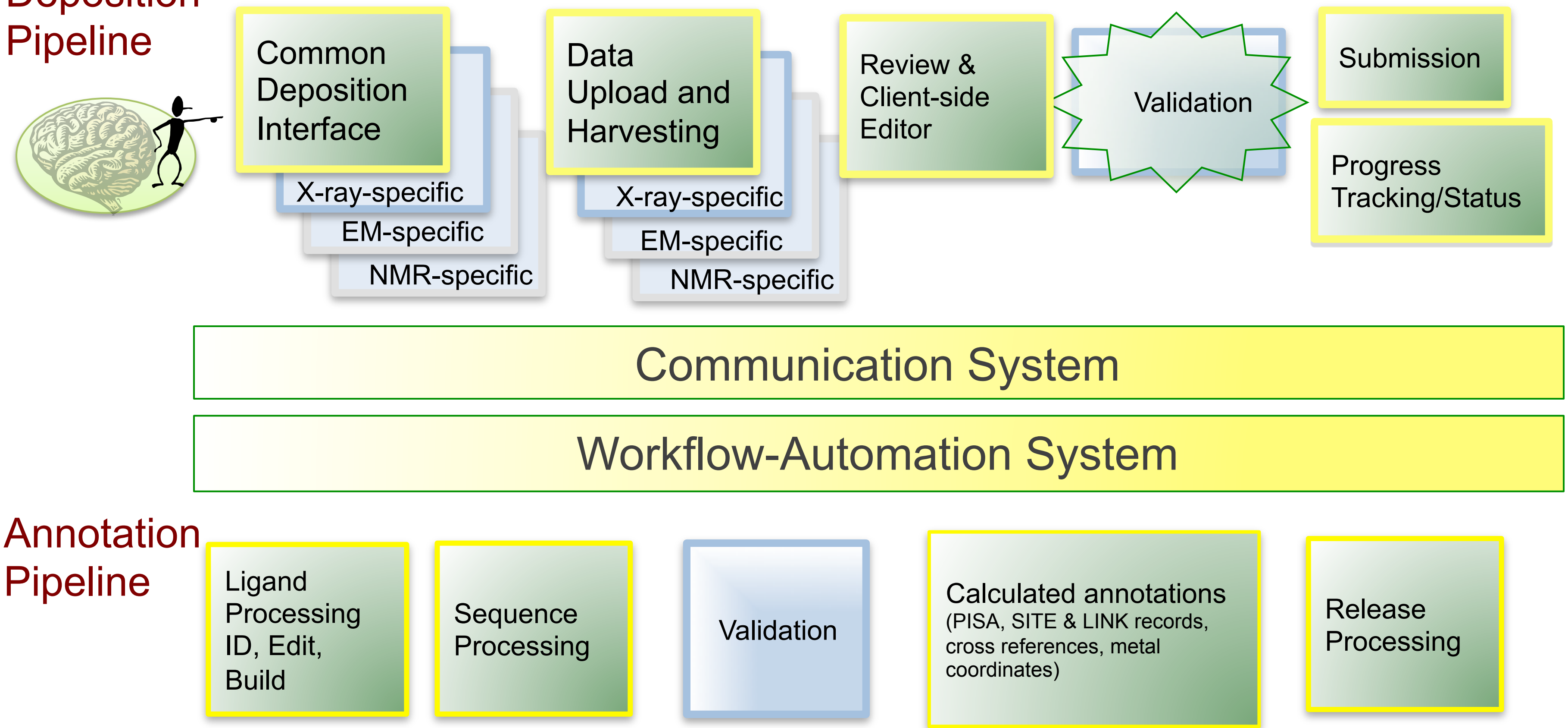
- Maximize data quality
  - Improve data validation
  - Standardize file formats
  - Ensure more complete data capture
- Support larger and more complex structures
- Improve efficiency
  - Automation and validation of routine tasks
  - Simplification of global process



EMD-1048; PDB IDs 1pdf, 1pdi, 1pdj, 1pdl, 1pdm, 1pdp: Three-dimensional structure of bacteriophage T4 baseplate. VA Kostyuchenko *et al. Nat. Struct. Biol.* 10, 688-93 (2003); **PDB ID 2fl8**: Evolution of bacteriophage tails: Structure of T4 gene product 10. PG Leiman *et al. J. Mol. Biol.* 358, 912-21 (2006); **PDB ID 3h3w**: The structure of gene product 6 of bacteriophage T4, the hinge-pin of the baseplate. AA Aksyuk *et al. Structure* 17, 800-808 (2009)



wwPDB Common D&A Pipeline



Deposition Pipeline

Common Deposition Interface

X-ray-specific

EM-specific

NMR-specific

Data Upload and Harvesting

X-ray-specific

EM-specific

NMR-specific

Review & Client-side Editor

Validation

Submission

Progress Tracking/Status

Communication System

Workflow-Automation System

Annotation Pipeline

Ligand Processing ID, Edit, Build

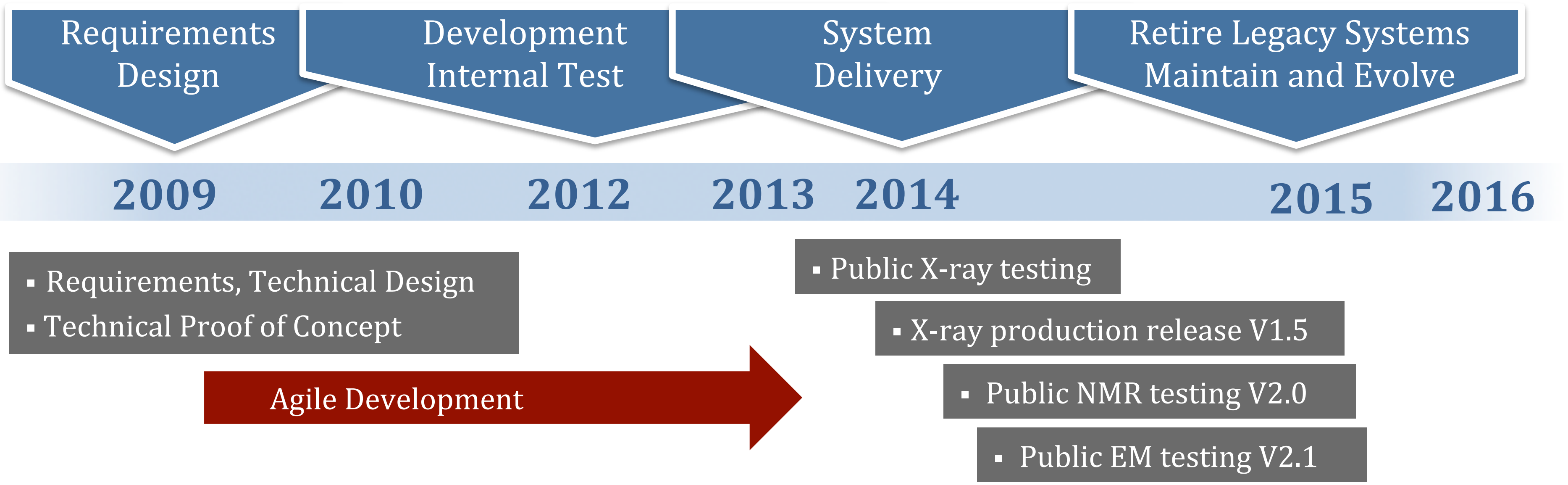
Sequence Processing

Validation

Calculated annotations (PISA, SITE & LINK records, cross references, metal coordinates)

Release Processing

wwPDB Common D&A Project



Requirements Design

Development Internal Test

System Delivery

Retire Legacy Systems Maintain and Evolve

2009 2010 2012 2013 2014 2015 2016

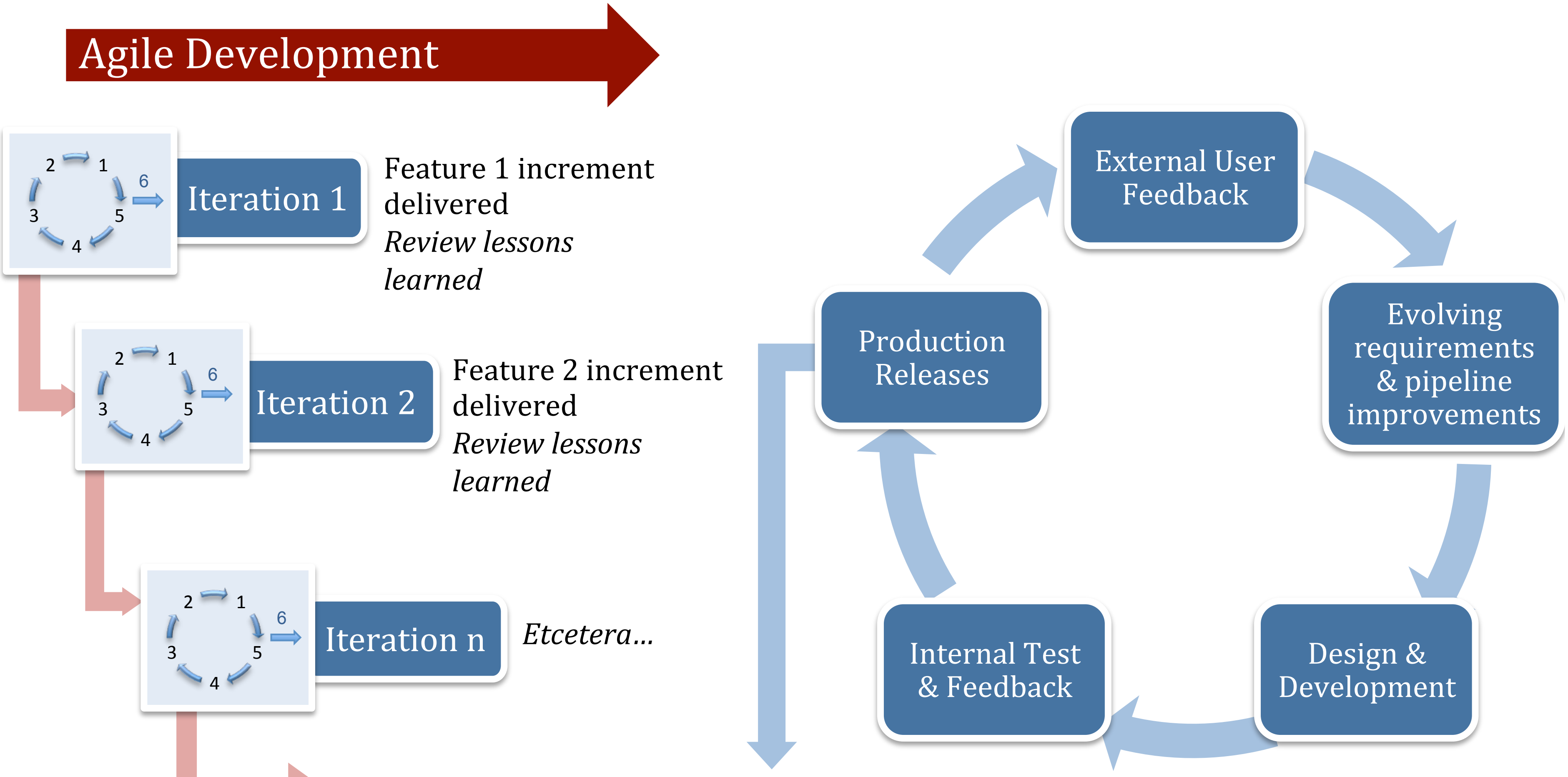
- Requirements, Technical Design
- Technical Proof of Concept

Agile Development

- Public X-ray testing
- X-ray production release V1.5
- Public NMR testing V2.0
- Public EM testing V2.1

- **January 2014: X-ray production release (V1.0)**
- Fall 2014: NMR public testing to begin (V2.0)
- End of 2014: 3DEM public testing to begin (V2.1)
- 2015: Q3 Retire legacy systems
  - Parallel deposition systems (new and legacy) available to depositors during transition period

Deployment and Life Cycle Management



Agile Development

Iteration 1

Feature 1 increment delivered
Review lessons learned

Iteration 2

Feature 2 increment delivered
Review lessons learned

Iteration n

Etcetera…

External User Feedback

Evolving requirements & pipeline improvements

Design & Development

Internal Test & Feedback

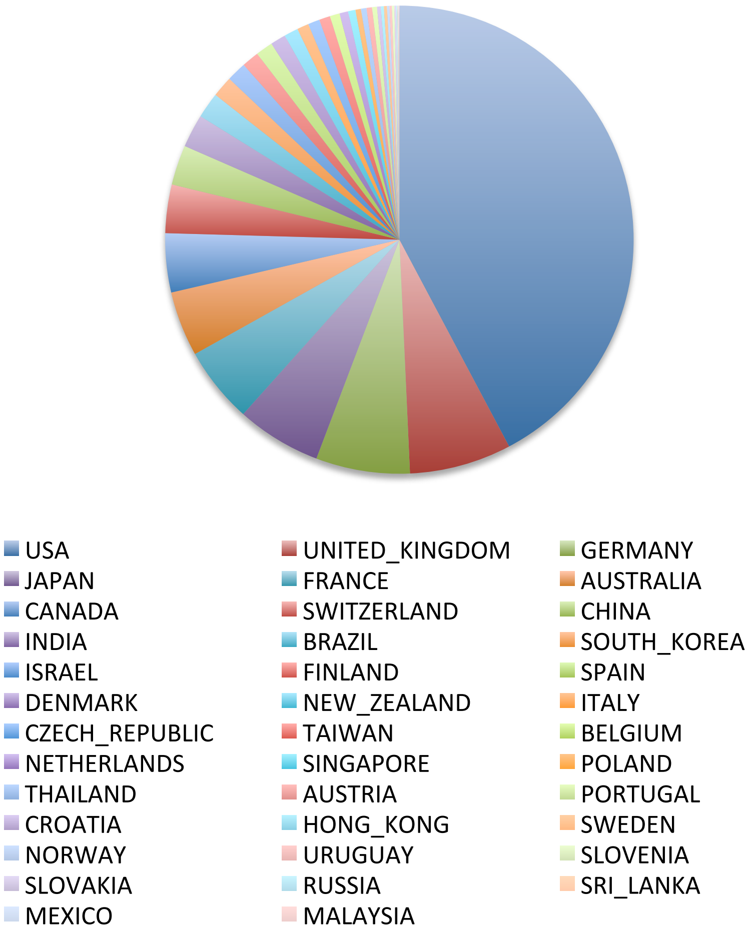
Production Releases

INCREMENTAL RELEASES
(V1.0-1.5, V2.0-2.1)

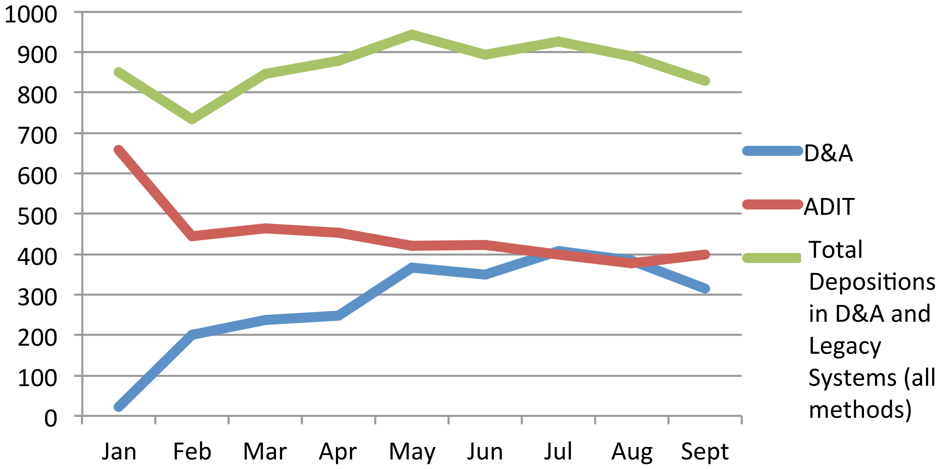
D&A System Usage: January 27 – September 30, 2014

- More than 2600 structures deposited and fully annotated
- More than 900 released
- More than 940 unique PIs

Number of Depositions by Country



Number of depositions per month



2014 Depositions by Geography

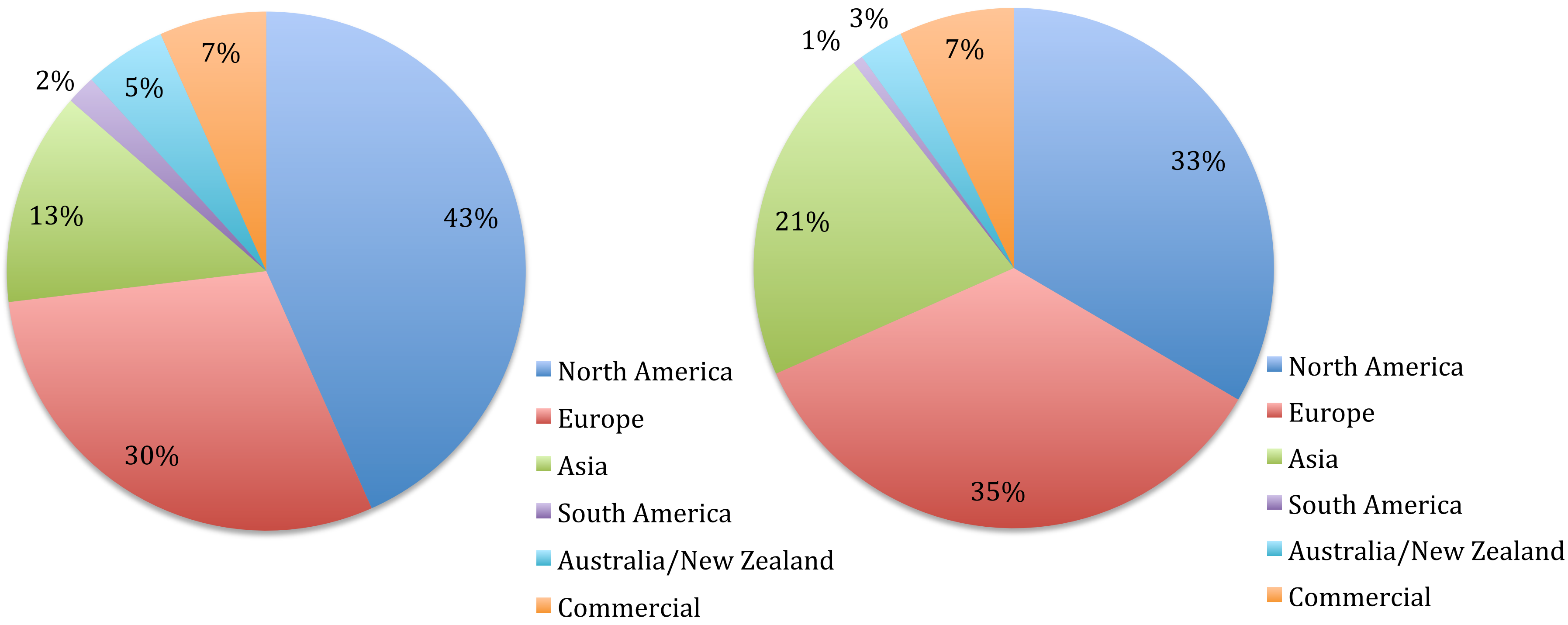
January 1 – September 30, 2014

D&A System

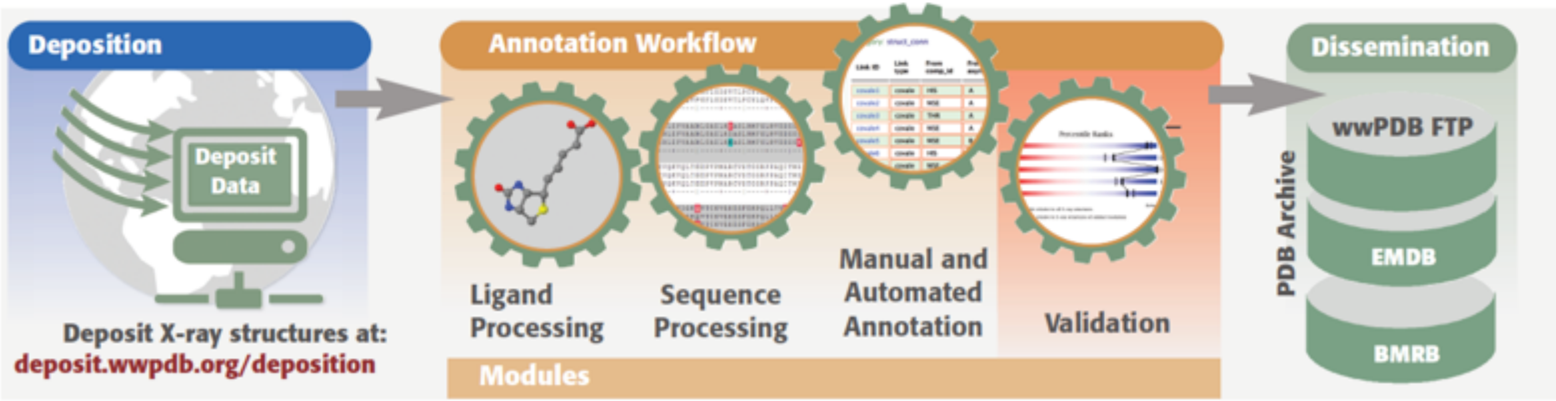
(2531 entries, 33%)

Legacy System

(5260 entries, 67%)



Key Deposition & Annotation Features


Deposition
Deposit Data
Deposit X-ray structures at:
deposit.wwpdb.org/deposition
Annotation Workflow
Ligand Processing
Sequence Processing
Manual and Automated Annotation
Validation
Modules
Dissemination
PDB Archive
wwPDB FTP
EMDB
BMRB

- **Data format:** Extensible, dictionary-driven PDBx/mmCIF produces more uniform data across the archive
- **Validation:** Geometry and experimental data checking during deposition and annotation is based on recommendations from expert task forces (X-ray, EM, NMR)
- **Deposition efficiency:** ability to replace coordinate and/or experimental data files pre- and post-submission
- **Enhanced communication:** "In context" correspondence with wwPDB annotators and ability to preview and download the PDBx/mmCIF entry file prior to submission
- **Improved annotation:** Improved ligand chemistry and polymer sequence checks with visual inspection provided during deposition

Deposition Data Format; PDBx/mmCIF Format

- PDBx addresses limitations in molecular size and complexity and extensibility of existing PDB format
- PDBx/mmCIF produced by major X-ray packages (CCP4/REFMAC and Phenix)
- PDBx/mmCIF Deposition Working Group recommending new content
- Working Group meets virtually ~monthly
- October 2014 Workshop finalized recommendations for X-ray data files and chemical restraints

PDBx/mmCIF
Home
Dictionaries▾
Documentation▾
Downloads
Contact Us
Search current dictionary
PDB

PDBx/mmCIF Dictionary Resources

This site provides information about the format, dictionaries and related software tools used by the Worldwide Protein Data Bank (wwPDB) to define data content for depositon, annotation and archiving of PDB entries.

Browse the current dictionary »

Dictionaries

- Browse the current dictionary»
- Search dictionaries»

Documentation

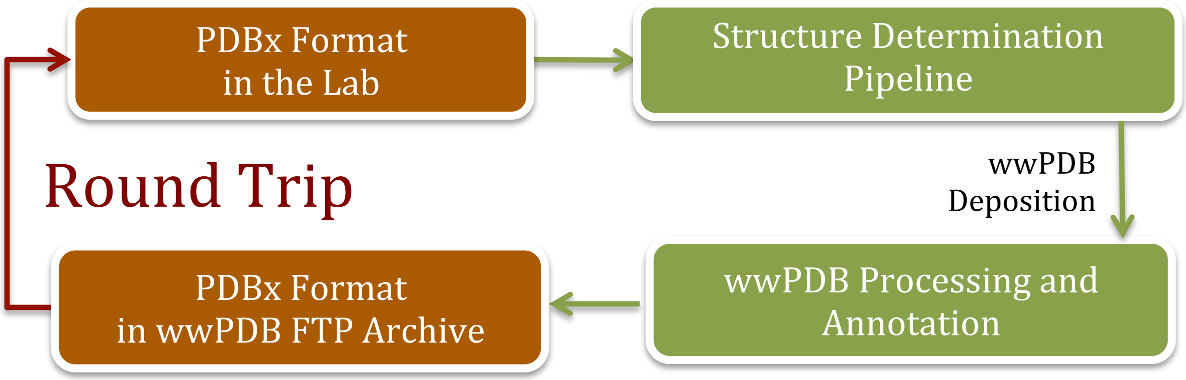
- PDB -> PDBx/mmCIF

FAQs

Questions about PDBx/mmCIF format,

© 2014 wwPDB

Workshop Participants, September 2011


PDBx Format in the Lab

Structure Determination Pipeline

wwPDB Deposition

wwPDB Processing and Annotation

PDBx Format in wwPDB FTP Archive

Round Trip

Workshop Participants, October 2014

PDBx and Release of Consolidated Large Structures

- New D&A system accepts, processes, and distributes depositions of any size in PDBx

July 9th 2014

- “Combined” single files representing large structures in both PDBx and PDBML formats released in a transitional FTP area for public review

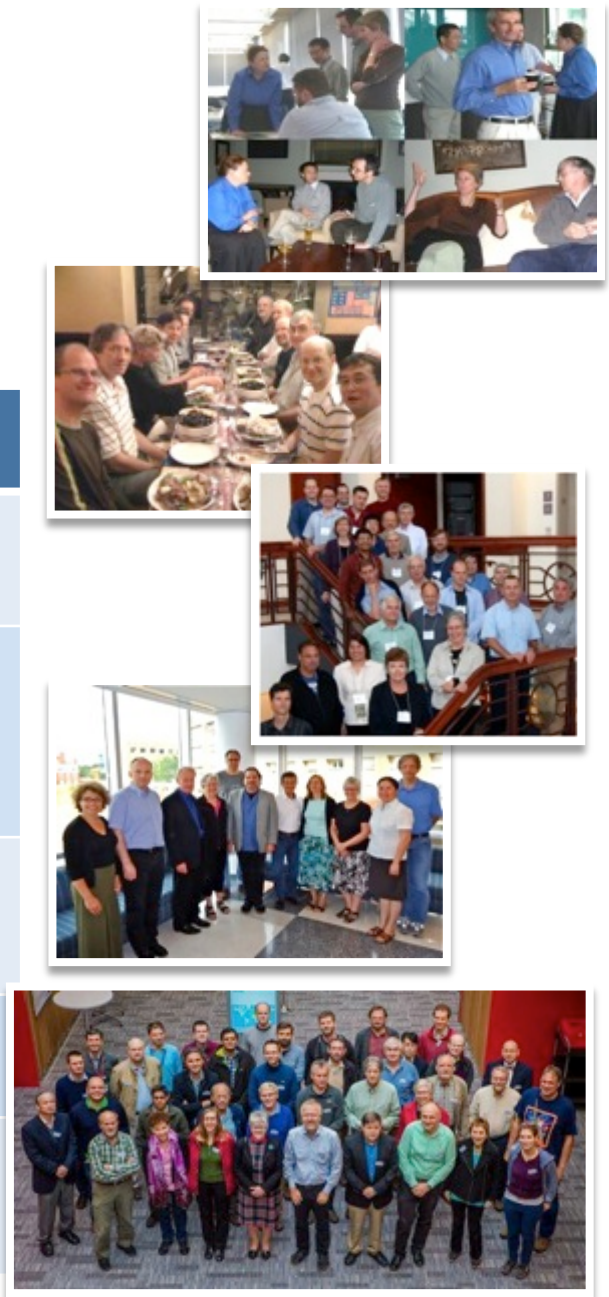
December 10th 2014

- Single files will be moved to the main FTP archive and split entries obsoleted
  - Best-effort PDB format-like bundles available in separate directory for existing and future large entries
  - Searches for split entries return the new “combined” entry

wwPDB Task Forces

Methods-specific (Validation) Task Forces and Workshops convened to develop recommendations re additional validation measures and archival needs/opportunities for non-traditional techniques

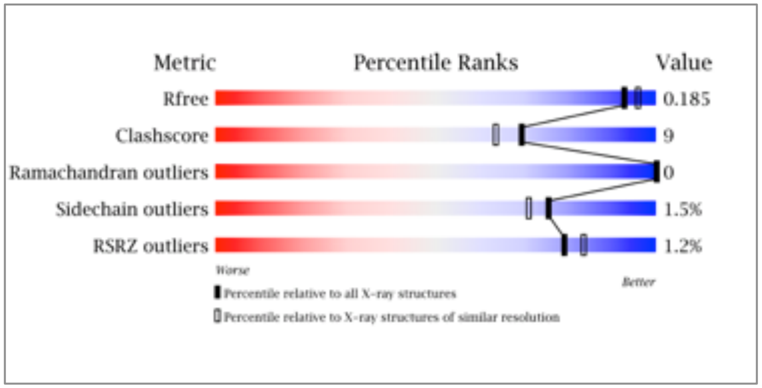
Task Force	Meeting/ Workshop	Chair(s)/Membership	Outcome
X-ray Validation Task Force	2008 (2015)	Randy Read (Univ of Cambridge) 17 members	(2011) *Structure* 19: 1395-1412
NMR Validation Task Force	2009, 2011, 2013 (x2) (2015)	Gaetano Montelione (Rutgers) Michael Nilges (Institut Pasteur) 10 members	(2013) *Structure*, 21: 1563-1570
3DEM Validation Task Force	2010	Richard Henderson (MRC-LMB) Andrej Sali (UCSF) 21 members	(2012) *Structure* 20: 205-214
Small-Angle Scattering Task Force	2012, 2014	Jill Trewhella (Univ Sydney) 6 members	(2013) *Structure* 21: 875-881
Hybrid Methods Workshop	2014	Andrej Sali (UCSF), Torsten Schwede (Univ Basel), Jill Trewhella (Univ Sydney) 27 members	(To be published)



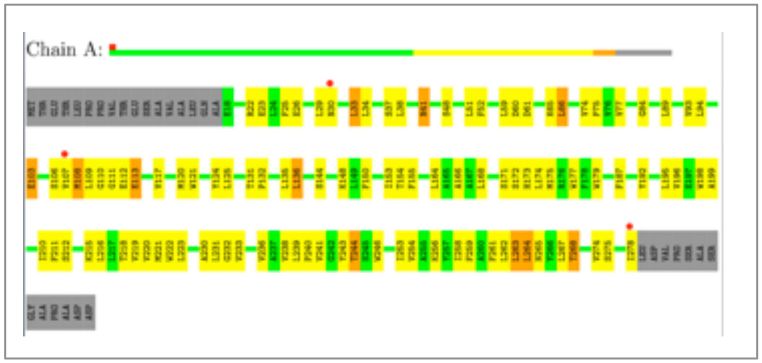
New Validation Reporting (v1.0)

- **Model Quality (all methods)**
  - Bond lengths and angles (outlier info, RMS-Z)
  - Chirality, planarity
  - Close contacts (including worst clashes, MolProbity clash score)
  - Torsion angles (Ramachandran statistics, protein rotamers)
  - Ligand geometry (Mogul analysis)
- **Residue Plots (all methods)**
  - Residues with model-quality outliers (0, 1, 2, >2)
  - Residues with RSR-Z > 5 are highlighted
  - Residues not observed
- **Method Specific**
  - X-ray: Model *versus* Electron Density
  - NMR: Ensemble RMSD in well-defined region
  - EM: model/map fit (in development/testing)

Overall Quality Summary

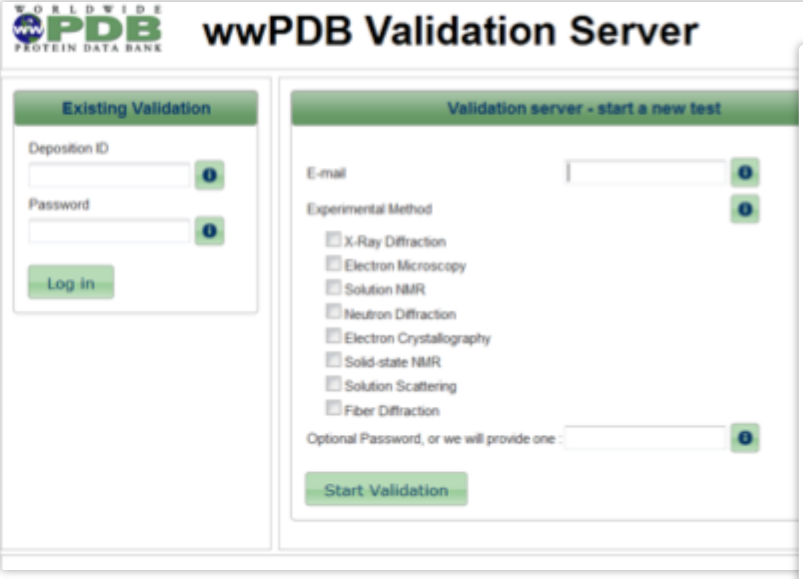


Residue Plots



Standalone Validation Server

- Validation now supports X-ray, NMR and EM in the new system (NMR and EM in testing)
- Generate validation reports for pre-deposition evaluation using the new wwPDB standalone Validation Server at http://wwpdb-validation.wwpdb.org/
- Validation Reports for all released X-ray structures are available for download from the PDB archive



wwPDB Validation Server

Existing Validation

Deposition ID

Password

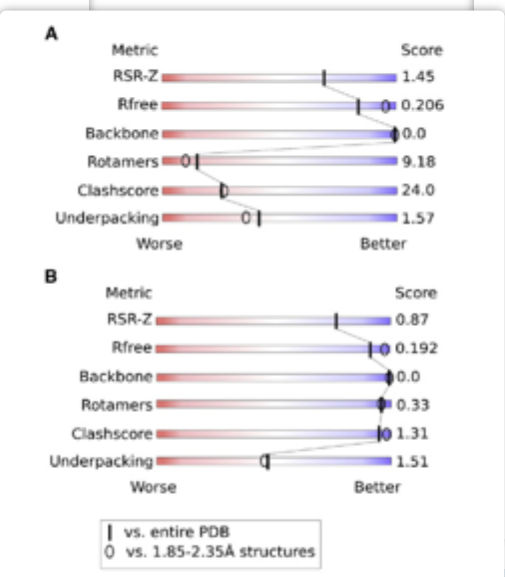
Validation server - start a new test

E-mail

Experimental Method

☐ X-Ray Diffraction
☐ Electron Microscopy
☐ Solution NMR
☐ Neutron Diffraction
☐ Electron Crystallography
☐ Solid-state NMR
☐ Solution Scattering
☐ Fiber Diffraction

Optional Password, or we will provide one :



wwPDB X-ray Structure Validation Report

Aug 13, 2013 – 09:45 AM BST

PDB ID : 1CBS
Title : CRYSTAL STRUCTURE OF CELLULAR RETINOIC-ACID-BINDINGPROTEINS I AND II IN COMPLEX WITH ALL-TRANS-RETINOIC ACID AND A SYNTHETIC RETINOID
Authors : Kleywegt, G.J.; Bergfors, T.; Jones, T.A.
Deposited on : 1994-09-28
Resolution : 1.80 Å(reported)

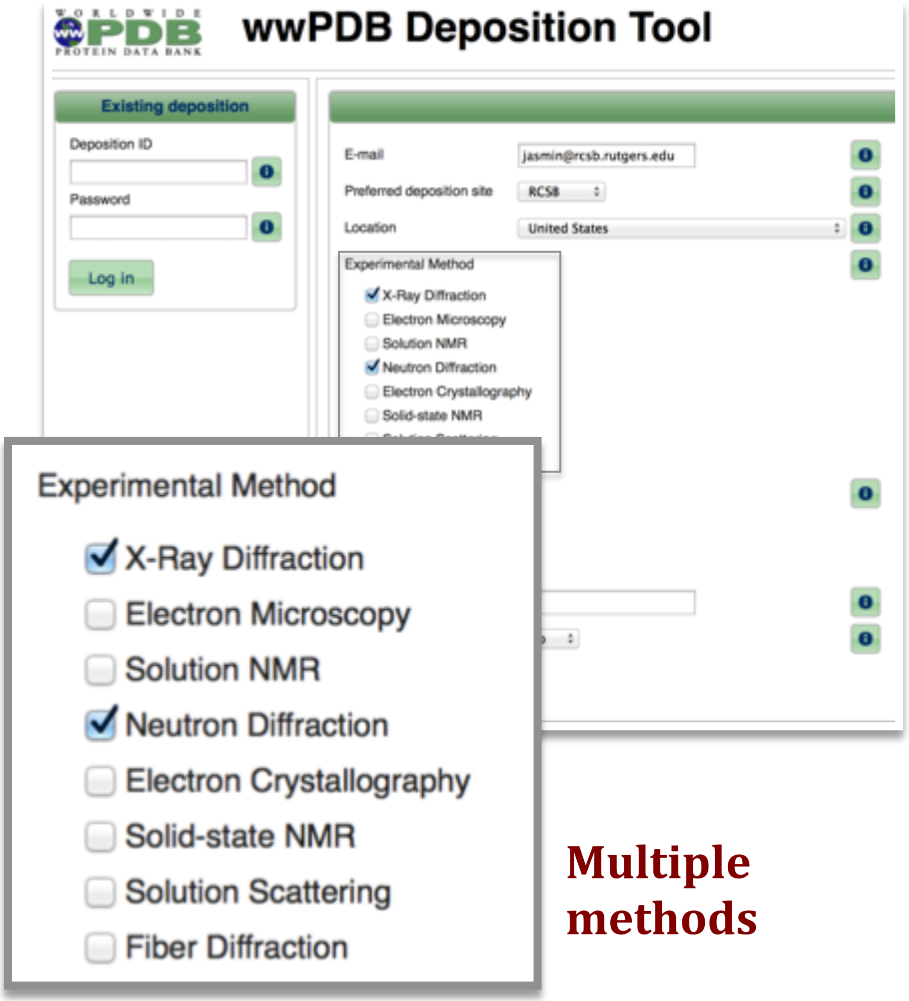
DISCLAIMER
This is a preliminary version of a new style of wwPDB validation report.
We welcome your comments at validation@mail.wwpdb.org

CONFIDENTIAL: VALIDATION REPORT

Deposition Pipeline

Depositors can

- Base new entries on previous depositions
- Upload replacement files mid-deposition (e.g., new coords)
- Provide more complete entries *via* mandatory data items
- View community-defined validation prior to submission
- Review and download annotated files post-deposition
- Communicate with expert annotators during deposition process using web-based tools


WORLDWIDE PDB PROTEIN DATA BANK
wwPDB Deposition Tool
Existing deposition
Deposition ID
Password
Log in

E-mail: jasmin@rcsb.rutgers.edu

Preferred deposition site: RCSB

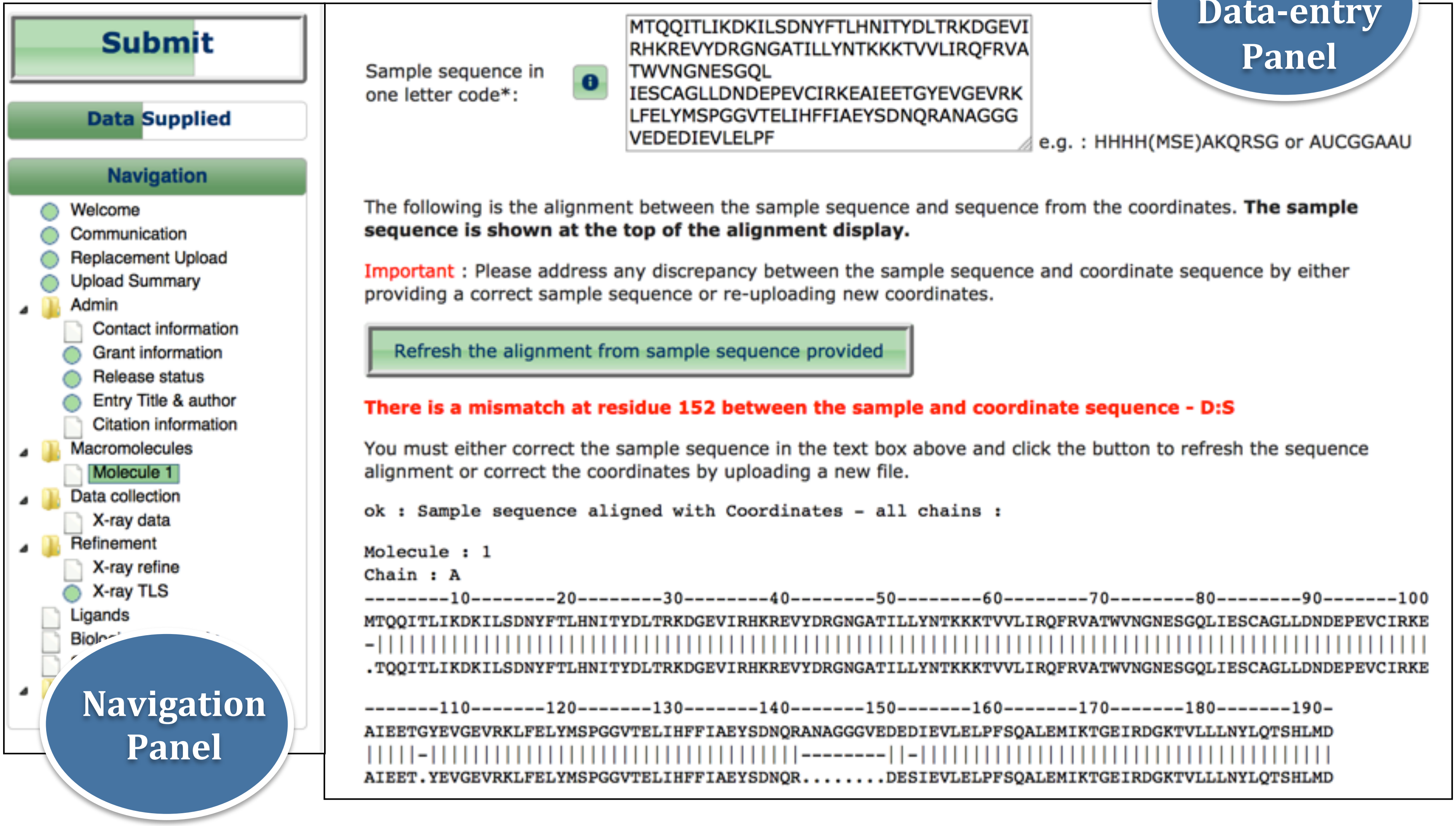
Location: United States

Experimental Method

☑ X-Ray Diffraction
☐ Electron Microscopy
☐ Solution NMR
☑ Neutron Diffraction
☐ Electron Crystallography
☐ Solid-state NMR
☐ Solution Scattering
☐ Fiber Diffraction

Multiple methods

Deposition User Interface



- ○ Welcome
- ○ Communication
- ○ Replacement Upload
- ○ Upload Summary
- Admin
  - Contact information
  - ○ Grant information
  - ○ Release status
  - ○ Entry Title & author
  - Citation information
- Macromolecules
  - Molecule 1
- Data collection
  - X-ray data
- Refinement
  - X-ray refine
  - ○ X-ray TLS
- Ligands
- Biolo

Sample sequence in one letter code*:

MTQQITLIKDKILSDNYFTLHNITYDLTRKDGEVI
RHKREVYDRGNGATILLYNTKKKTVVLIRQFRVA
TWVNGNESGQL
IESCAGLLDNDEPEVCIRKEAIEETGYEVGEVRK
LFELYMSPGGVTELIHFFIAEYSDNQRANAGGG
VEDEDIEVLELPF

e.g. : HHHH(MSE)AKQRSG or AUCGGAAU

The following is the alignment between the sample sequence and sequence from the coordinates. **The sample sequence is shown at the top of the alignment display.**

Important : Please address any discrepancy between the sample sequence and coordinate sequence by either providing a correct sample sequence or re-uploading new coordinates.

There is a mismatch at residue 152 between the sample and coordinate sequence - D:S

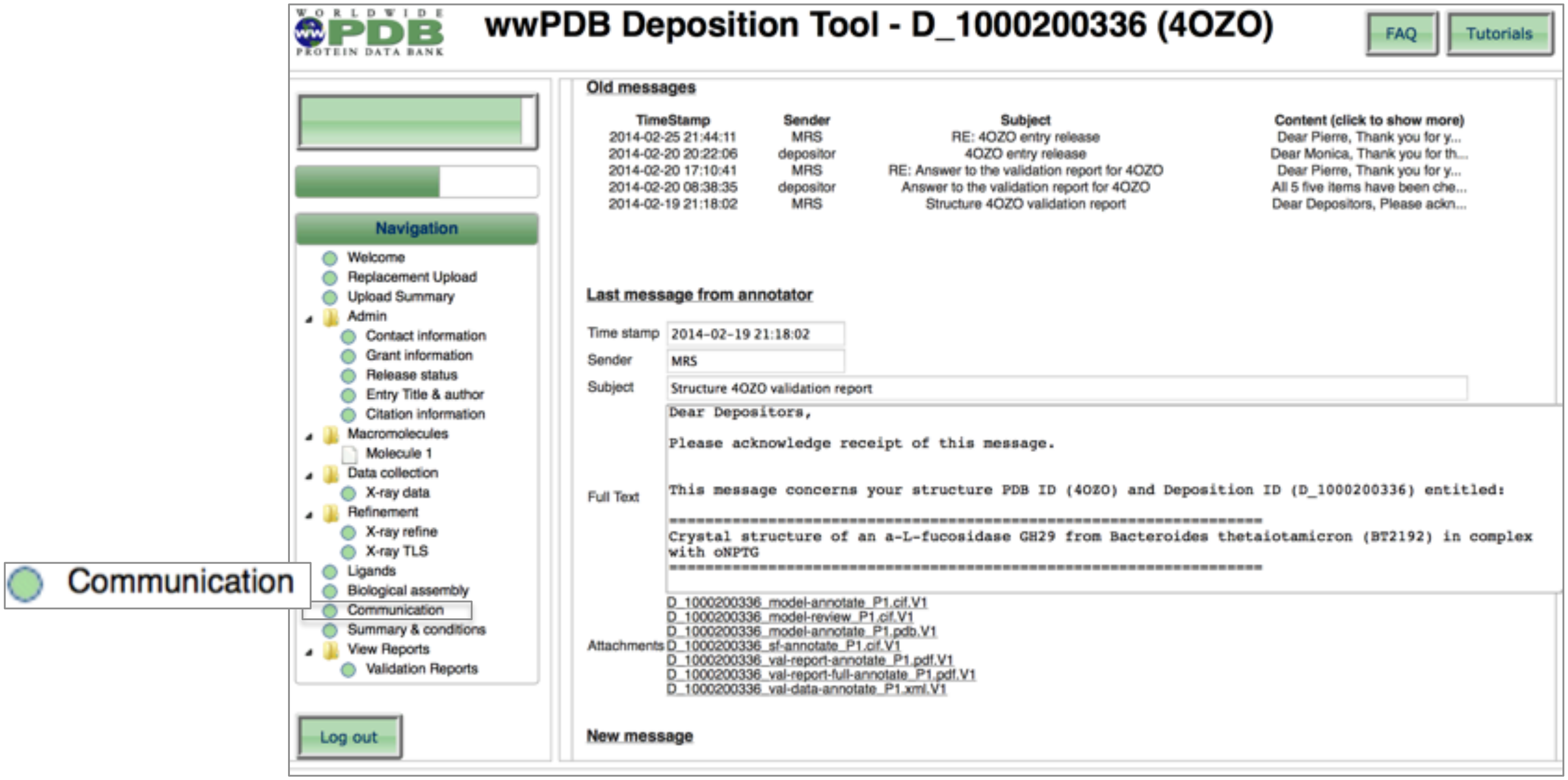
You must either correct the sample sequence in the text box above and click the button to refresh the sequence alignment or correct the coordinates by uploading a new file.

```
ok : Sample sequence aligned with Coordinates - all chains :

Molecule : 1
Chain : A
--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100
MTQQITLIKDKILSDNYFTLHNITYDLTRKDGEVIRHKREVYDRGNGATILLYNTKKKTVVLIRQFRVATWVNGNESGQLIESCAGLLDNDEPEVCIRKE
-|||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
.TQQITLIKDKILSDNYFTLHNITYDLTRKDGEVIRHKREVYDRGNGATILLYNTKKKTVVLIRQFRVATWVNGNESGQLIESCAGLLDNDEPEVCIRKE

-------110-------120-------130-------140-------150-------160-------170-------180-------190-
AIEETGYEVGEVRKLFELYMSPGGVTELIHFFIAEYSDNQRANAGGGVEDEDIEVLELPFSQALEMIKTGEIRDGKTVLLLNYLQTSHLMD
|||||-|||||||||||||||||||||||||||||||||||--------||-|||||||||||||||||||||||||||||||||||||||
AIEET.YEVGEVRKLFELYMSPGGVTELIHFFIAEYSDNQR........DESIEVLELPFSQALEMIKTGEIRDGKTVLLLNYLQTSHLMD
```

Report & Data-entry Panel

Navigation Panel

Communication User Interface


WORLDWIDE PDB PROTEIN DATA BANK
wwPDB Deposition Tool - D_1000200336 (4OZO)
FAQ
Tutorials
Navigation
Welcome
Replacement Upload
Upload Summary
Admin
Contact information
Grant information
Release status
Entry Title & author
Citation information
Macromolecules
Molecule 1
Data collection
X-ray data
Refinement
X-ray refine
X-ray TLS
Ligands
Biological assembly
Communication
Summary & conditions
View Reports
Validation Reports
Log out
Communication

Old messages

TimeStamp	Sender	Subject	Content (click to show more)
2014-02-25 21:44:11	MRS	RE: 4OZO entry release	Dear Pierre, Thank you for y...
2014-02-20 20:22:06	depositor	4OZO entry release	Dear Monica, Thank you for th...
2014-02-20 17:10:41	MRS	RE: Answer to the validation report for 4OZO	Dear Pierre, Thank you for y...
2014-02-20 08:38:35	depositor	Answer to the validation report for 4OZO	All 5 five items have been che...
2014-02-19 21:18:02	MRS	Structure 4OZO validation report	Dear Depositors, Please ackn...

Last message from annotator

Time stamp: 2014-02-19 21:18:02

Sender: MRS

Subject: Structure 4OZO validation report

Full Text:

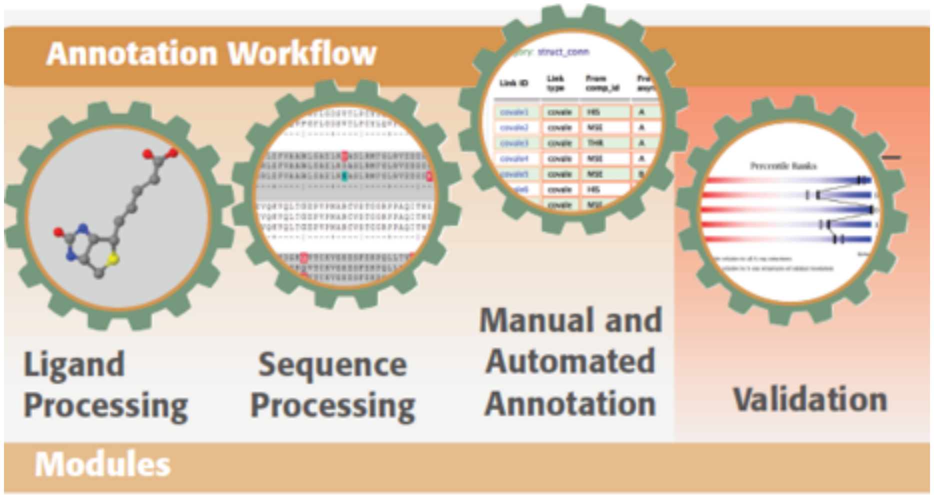
```
Dear Depositors,

Please acknowledge receipt of this message.


This message concerns your structure PDB ID (4OZO) and Deposition ID (D_1000200336) entitled:

=====================================================================
Crystal structure of an a-L-fucosidase GH29 from Bacteroides thetaiotamicron (BT2192) in complex
with oNPTG
=====================================================================
```

Attachments:
D_1000200336_model-annotate_P1.cif.V1
D_1000200336_model-review_P1.cif.V1
D_1000200336_model-annotate_P1.pdb.V1
D_1000200336_sf-annotate_P1.cif.V1
D_1000200336_val-report-annotate_P1.pdf.V1
D_1000200336_val-report-full-annotate_P1.pdf.V1
D_1000200336_val-data-annotate_P1.xml.V1

New message

This page supports review and download of validation reports and processed data files, and all communication with wwPDB annotation staff, including release requests.

Annotation System

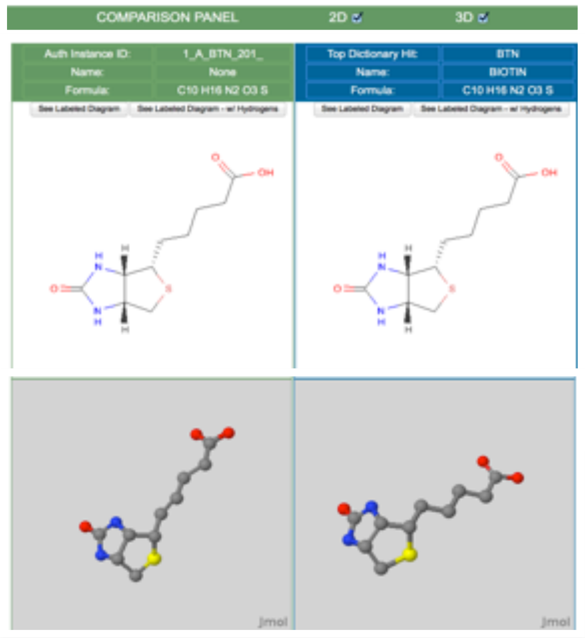

Annotation Workflow
Ligand Processing
Sequence Processing
Manual and Automated Annotation
Validation
Modules

- Enables workload balancing and increased productivity
- Better quality assurance of ligand chemistry and polymer sequences
- Validation suites based on recommendations from expert task forces; X-ray validation pipeline available as a stand-alone server
- System supports all accepted experimental methods
- All data management in PDBx/mmCIF

Ligand Annotation: Improved Chemistry Assessment

- Batch searching against Chemical Component Dictionary (CCD) and automated ligand ID assignment
- Automatic capture and display of Author-provided chemical information
- Comparison Panel
  - 2D and 3D views of ligand for review
  - ID assignment
- **Enhanced with local ligand density fit**
- **Paper published**

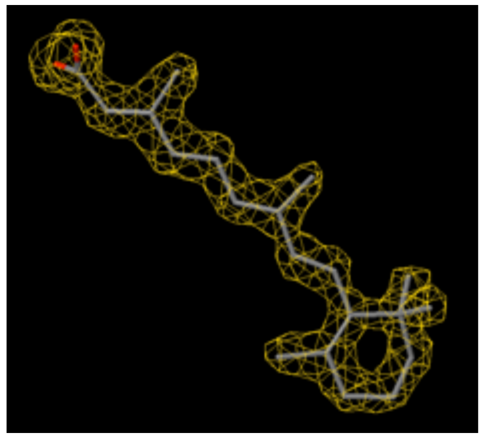
J. Y. Young, Z. Feng, D. Dimitropoulos, R. Sala, J. Westbrook, M. Zhuravleva, C. Shao, M. Quesada, E. Peisach, H. M. Berman. (2013) Chemical annotation of small and peptide-like molecules at the Protein Data Bank. *Database* 2013: bat079.

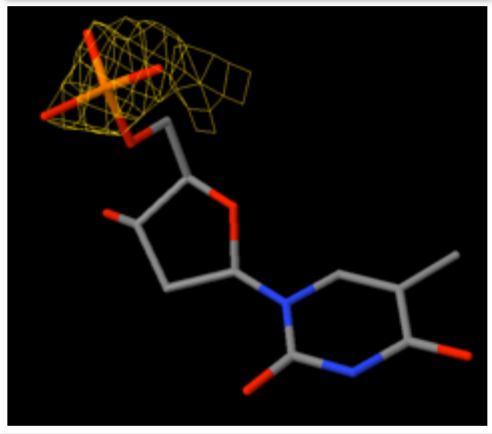

COMPARISON PANEL
2D ☑
3D ☑
See Labeled Diagram
See Labeled Diagram - w/ Hydrogens
See Labeled Diagram
See Labeled Diagram - w/ Hydrogens
O
OH
H
N
O
N
H
S
Jmol
Jmol

Auth Instance ID: 1_A_BTN_201_
Name: None
Formula: C10 H16 N2 O3 S

Top Dictionary Hit: BTN
Name: BIOTIN
Formula: C10 H16 N2 O3 S

Deposited instance from coordinates (left) and the closest match in the dictionary (right)





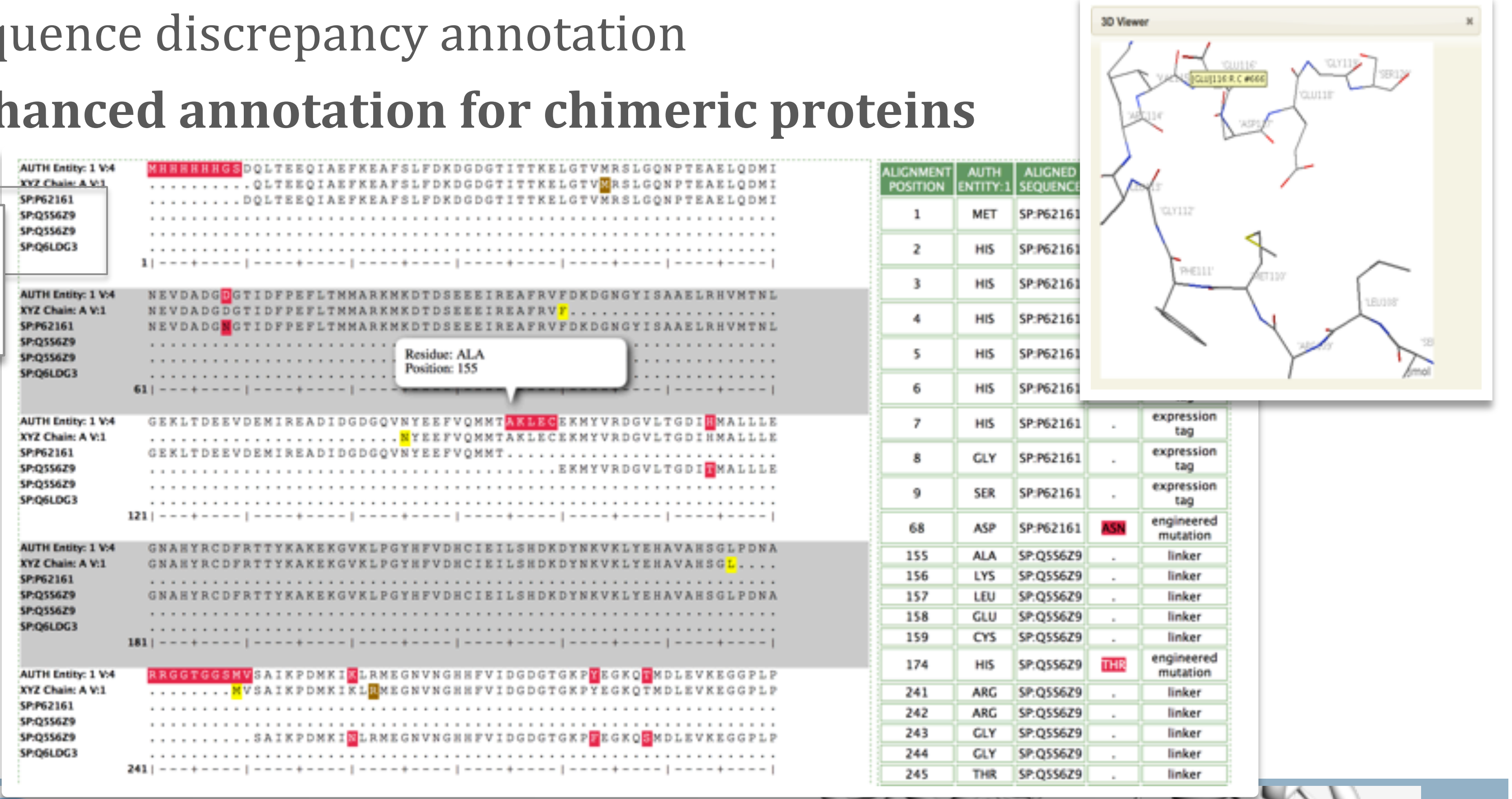
Local ligand density display (1.5 sigma omit map)
Top: REA in entry 1CBS with LLDF=1.31 (RSR=0.10, CC=0.95)
Bottom: TMP in entry 3HW4 with LLDF=6.77 (RSR=0.41, CC=0.70)

Sequence Annotation: ↑ Data Consistency

- Biological sequence checked against atomic coordinate sequence and cross-referenced to UniProt/GenBank
- 3D structure view
- Sequence discrepancy annotation
- **Enhanced annotation for chimeric proteins**

SP:P62161
SP:Q5S6Z9
SP:Q5S6Z9
SP:Q6LDG3

Four sequence references



```
AUTH Entity: 1 V:4    MHHHHHHGSDQLTEEQIAEFKEAFSLFDKDGDGTITTKELGTVMRSLGQNPTEAELQDMI
XYZ Chain: A V:1      ..........QLTEEQIAEFKEAFSLFDKDGDGTITTKELGTVMRSLGQNPTEAELQDMI
SP:P62161             .........DQLTEEQIAEFKEAFSLFDKDGDGTITTKELGTVMRSLGQNPTEAELQDMI
SP:Q5S6Z9             ............................................................
SP:Q5S6Z9             ............................................................
SP:Q6LDG3             ............................................................
                    1 |----+----|----+----|----+----|----+----|----+----|----+----|

AUTH Entity: 1 V:4    NEVDADGDGTIDFPEFLTMMARKMKDTDSEEEIREAFRVFDKDGNGYISAAELRHVMTNL
XYZ Chain: A V:1      NEVDADGDGTIDFPEFLTMMARKMKDTDSEEEIREAFRVF....................
SP:P62161             NEVDADGNGTIDFPEFLTMMARKMKDTDSEEEIREAFRVFDKDGNGYISAAELRHVMTNL
SP:Q5S6Z9             ............................................................
SP:Q5S6Z9             ............................................................
SP:Q6LDG3             ............................................................
                   61 |----+----|----+----|----+----|----+----|----+----|----+----|

AUTH Entity: 1 V:4    GEKLTDEEVDEMIREADIDGDGQVNYEEFVQMMTAKLECEKMYVRDGVLTGDIHMALLLE
XYZ Chain: A V:1      .........................NYEEFVQMMTAKLECEKMYVRDGVLTGDIHMALLLE
SP:P62161             GEKLTDEEVDEMIREADIDGDGQVNYEEFVQMMT..........................
SP:Q5S6Z9             .......................................EKMYVRDGVLTGDITMALLLE
SP:Q5S6Z9             ............................................................
SP:Q6LDG3             ............................................................
                  121 |----+----|----+----|----+----|----+----|----+----|----+----|

AUTH Entity: 1 V:4    GNAHYRCDFRTTYKAKEKGVKLPGYHFVDHCIEILSHDKDYNKVKLYEHAVAHSGLPDNA
XYZ Chain: A V:1      GNAHYRCDFRTTYKAKEKGVKLPGYHFVDHCIEILSHDKDYNKVKLYEHAVAHSGL....
SP:P62161             ............................................................
SP:Q5S6Z9             GNAHYRCDFRTTYKAKEKGVKLPGYHFVDHCIEILSHDKDYNKVKLYEHAVAHSGLPDNA
SP:Q5S6Z9             ............................................................
SP:Q6LDG3             ............................................................
                  181 |----+----|----+----|----+----|----+----|----+----|----+----|

AUTH Entity: 1 V:4    RRGGTGGSMVSAIKPDMKIKLRMEGNVNGHHFVIDGDGTGKPYEGKQTMDLEVKEGGPLP
XYZ Chain: A V:1      ........MVSAIKPDMKIKLRMEGNVNGHHFVIDGDGTGKPYEGKQTMDLEVKEGGPLP
SP:P62161             ............................................................
SP:Q5S6Z9             ............................................................
SP:Q5S6Z9             ..........SAIKPDMKINLRMEGNVNGHHFVIDGDGTGKPFEGKQSMDLEVKEGGPLP
SP:Q6LDG3             ............................................................
                  241 |----+----|----+----|----+----|----+----|----+----|----+----|
```

Residue: ALA
Position: 155

ALIGNMENT POSITION	AUTH ENTITY:1	ALIGNED SEQUENCE		
1	MET	SP:P62161		
2	HIS	SP:P62161		
3	HIS	SP:P62161		
4	HIS	SP:P62161		
5	HIS	SP:P62161		
6	HIS	SP:P62161		
7	HIS	SP:P62161	.	expression tag
8	GLY	SP:P62161	.	expression tag
9	SER	SP:P62161	.	expression tag
68	ASP	SP:P62161	ASN	engineered mutation
155	ALA	SP:Q5S6Z9	.	linker
156	LYS	SP:Q5S6Z9	.	linker
157	LEU	SP:Q5S6Z9	.	linker
158	GLU	SP:Q5S6Z9	.	linker
159	CYS	SP:Q5S6Z9	.	linker
174	HIS	SP:Q5S6Z9	THR	engineered mutation
241	ARG	SP:Q5S6Z9	.	linker
242	ARG	SP:Q5S6Z9	.	linker
243	GLY	SP:Q5S6Z9	.	linker
244	GLY	SP:Q5S6Z9	.	linker
245	THR	SP:Q5S6Z9	.	linker

Annotation Training and Transition

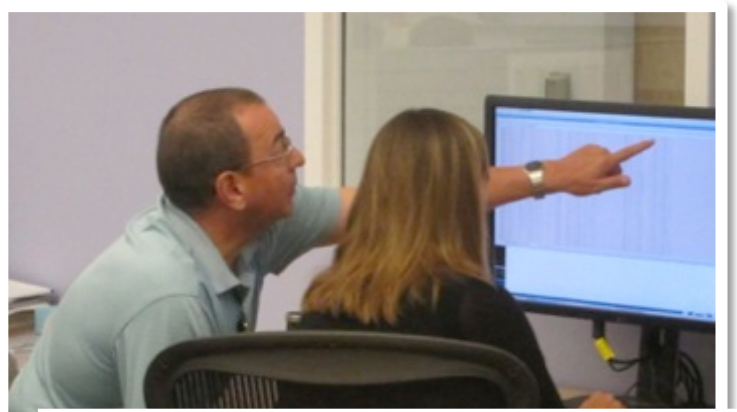
RCSB PDB training

- Staff migrating to new system throughout 2014
  - Testing and training
  - Processing with both new and legacy systems in parallel
- Stephen Burley trained; processed two production entries

wwPDB training

- wwPDB processing guidelines developed
- VTC training carried out
- Annotator Summit in June 2014

RCSB PDB currently hosting production system, serving US, EU, and Japan



Efficiencies/Advances: Current Status

Efficiencies

- Greater efficiency for routine structures
- Evolving processing of large and complex structure
- Workflow flexibility still evolving
- Detailed efficiency measurements to be carried out in 2015

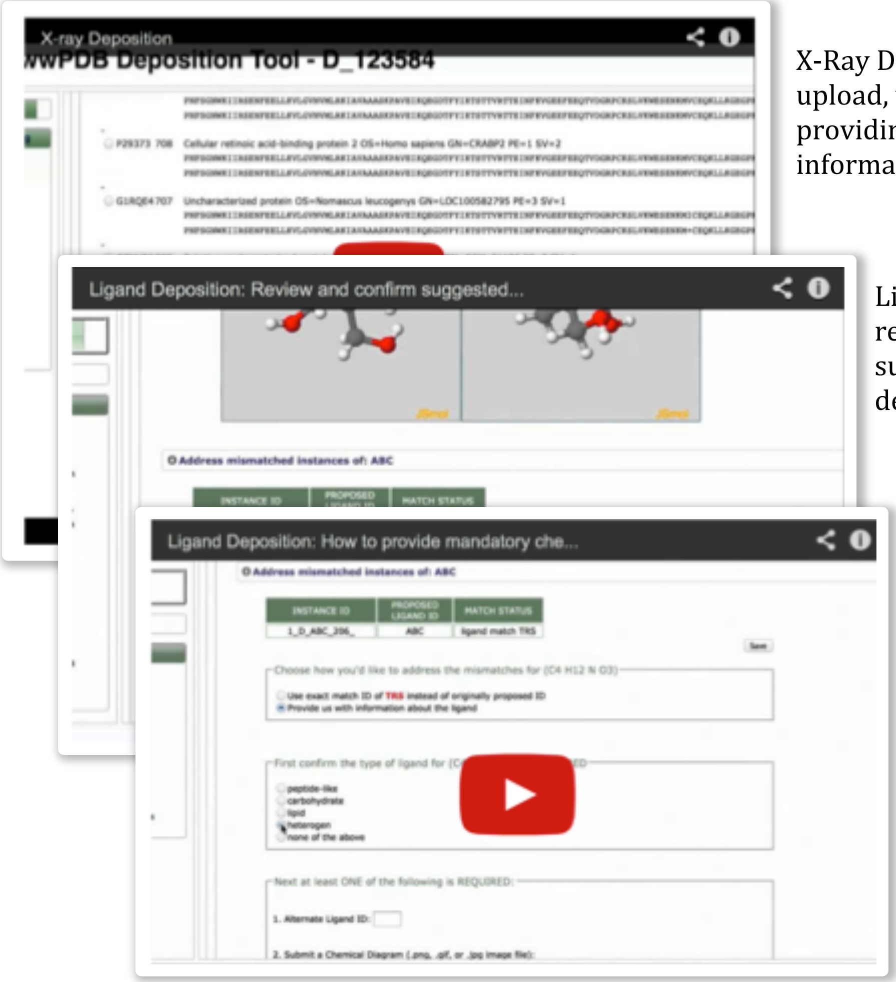
Advances

- Improved support for large structures
- Workflow ensures completeness of annotation
- Enhanced validation
- More automated processing for ligands and sequences
- Tracking enabled
- Enable processing multiple entries in parallel

Depositor Resources

- Info at wwpdb.org
    - System overview
    - Step-by-step instructions
    - Video tutorials
    - FAQ
- Live and/or video demos at ACA and IUCr meetings

Tour of Deposition System



X-ray Deposition

wwPDB Deposition Tool - D_123584

Ligand Deposition: Review and confirm suggested...

Ligand Deposition: How to provide mandatory che...

X-Ray Deposition: file upload, validation, and providing mandatory information

Ligand Deposition: review and confirm suggested matches to deposited ligands

Ligand Deposition: how to provide mandatory chemical information

Feedback

External Users (Depositors)

- Daily communication between annotators and depositors
- ACA, IUCr meetings: demonstrations, posters and booth

Internal Users (Annotators)

- Continuous testing
- Internal training
- 9 months of production experience
- Weekly cross-site review of issues

37
The wwPDB Deposition & Annotation System
PDB
2014:
100,000+
Structures
in the PDB
DEPOSITED
100,000+
PDB Structures

Common Feedback from External Users

What they like most

- Easy navigation
- Straightforward input forms

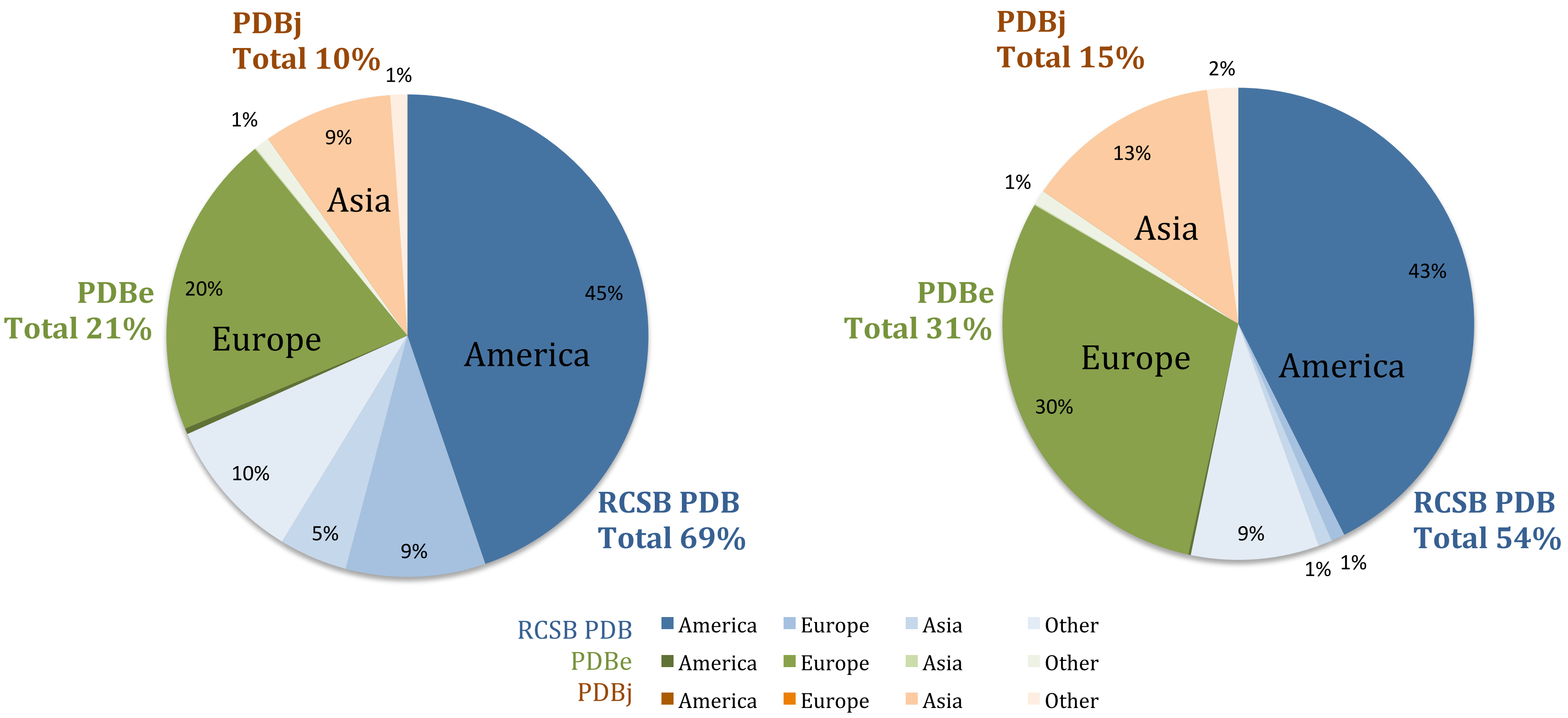
Suggestions under discussion

- Include annotator message content in alerts emailed to Depositors (in progress)
- Support for simultaneous depositions
- Ability to access depositions by Author rather than session ID

Global Workload Distribution

Launch of the D&A System
January-September 2014

Start of "Workload Share"
June-September 2014

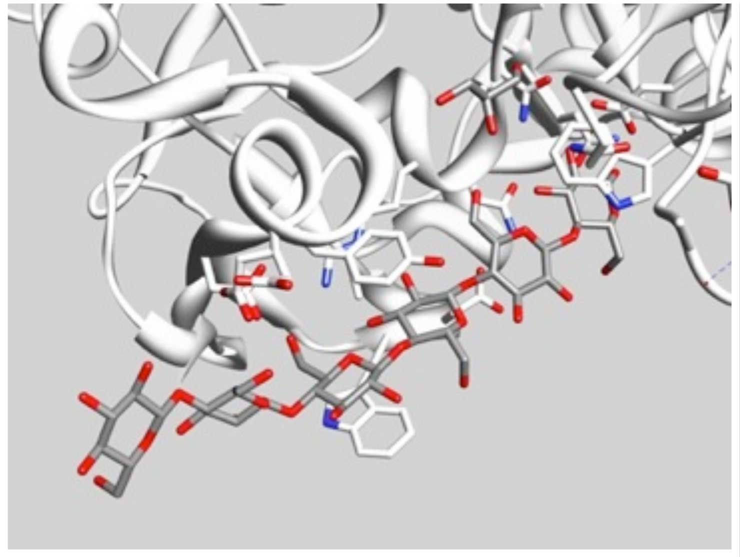


What challenges remain?

- Extend and harden existing system for all methods
- Improving efficiency for very large structures
- Enable greater automation of depositor replacement of coordinates post submission
- Improve usability of processing tools for annotation and the flexibility of current workflow
- Incorporate additional data checking to improve data quality and processing efficiency
- Improve support for legacy PDB file format variants

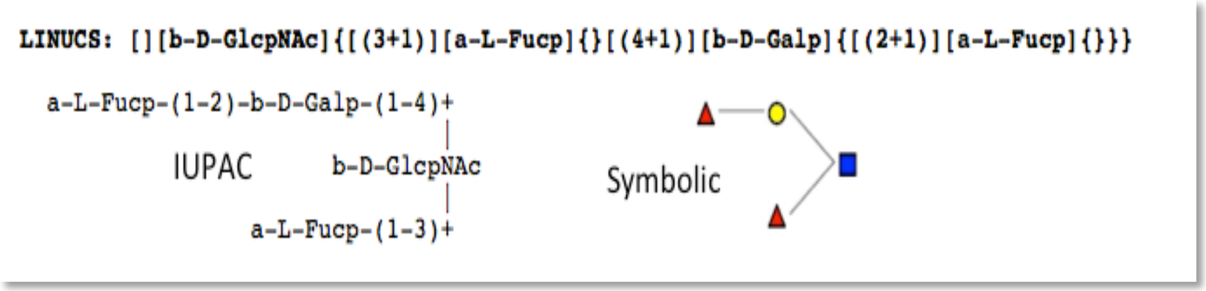
Future Remediation

- Residual B factors (2015)
- Non-crystal frame (2015)
- Archival mmCIF update: multiple reflection data sets and V5.0 (2015)
- Representation of Carbohydrates



Carbohydrate Remediation

Funding Proposal	**Proposal for Mizutani Foundation (MF) funding submitted September 01, 2014. Waiting for decision by Spring 2015**
Goals	▪ Gather input from community experts on new search and delivery functionalities for the glycosciences community ▪ Enable searches for carbohydrates in PDB archive
Plans Forward	▪ Identify and analyze carbohydrate-containing entries ▪ Remediate batches of carbohydrate containing files using the Deposition & Annotation pipeline ▪ Create standard representation for branched polymers

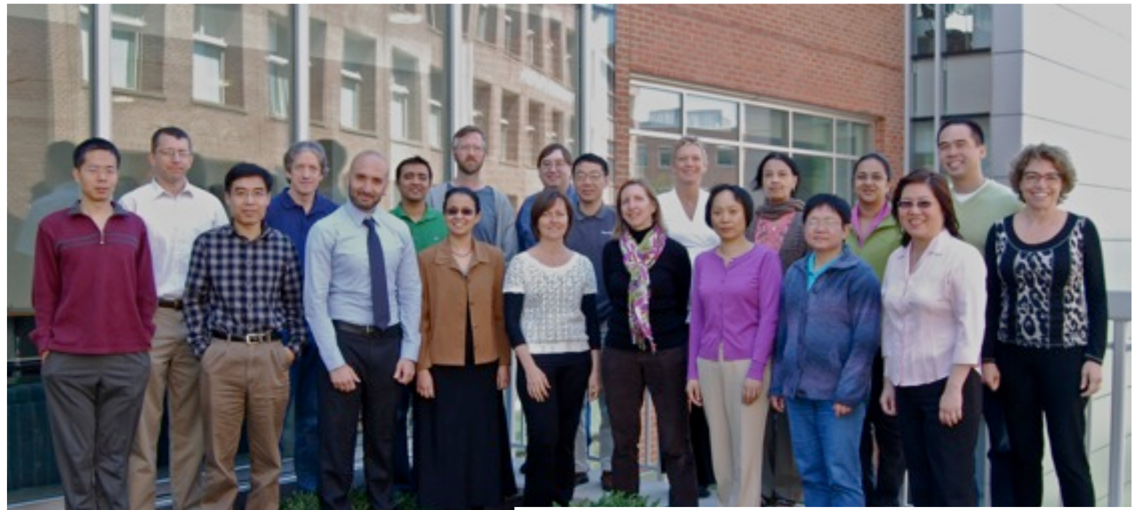

LINUCS: [][b-D-GlcpNAc]{[(3+1)][a-L-Fucp]{}[(4+1)][b-D-Galp]{[(2+1)][a-L-Fucp]{}}}
a-L-Fucp-(1-2)-b-D-Galp-(1-4)+
IUPAC
b-D-GlcpNAc
a-L-Fucp-(1-3)+
Symbolic

PDB ID: 2wmg MA Higgins *et al. J.Biol.Chem.* 284, 26161-26173 (2009)

Plans for 2014/2015

- 2014
- wwPDB D&A system for all methods in production testing
- 2015
- Assess efficiency/usability and harden new D&A system
- Retire legacy deposition systems at RCSB PDB and PDBe
- Archival mmCIF updates
- Enabling industrial structure deposition
- Secure funding for Carbohydrate Remediation
- Explore the way forward for hybrid structure and data deposition
- Begin discussions re PDB “franchises” in India and China (with wwPDB partners)

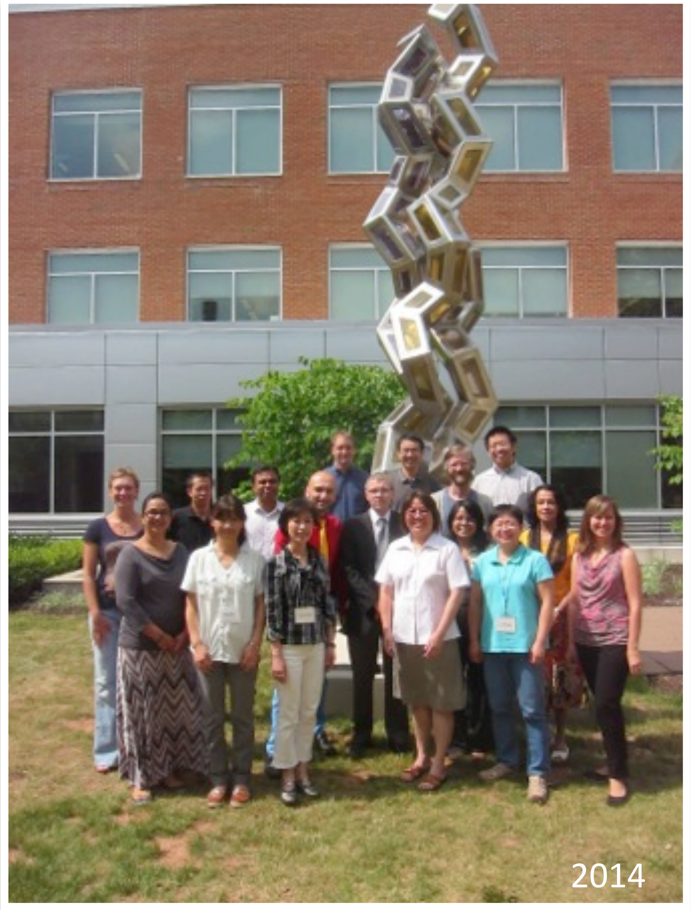
RCSB PDB Data Deposition and Annotation Team



2013

wwPDB D&A Team

2010



2014

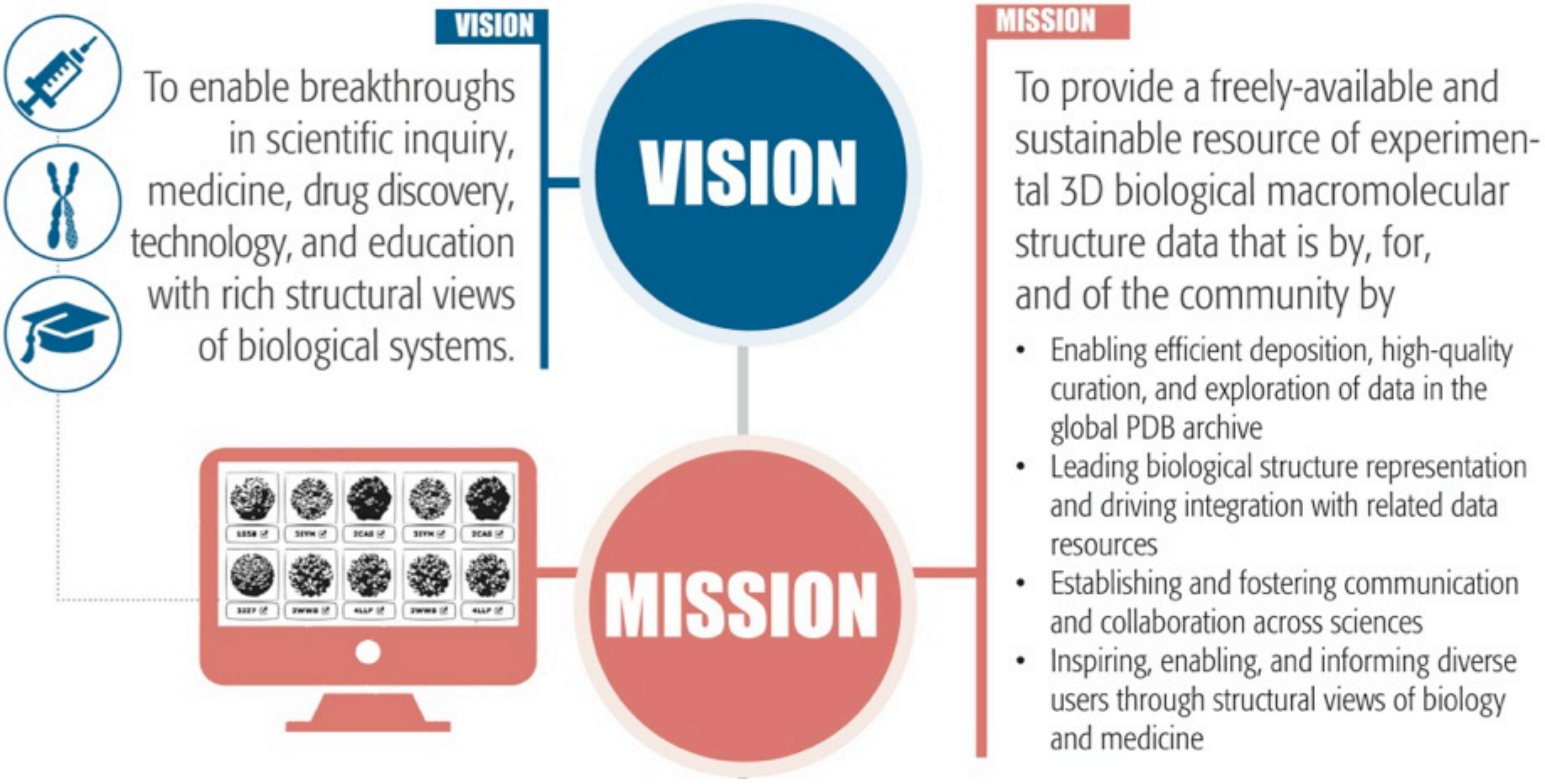
wwPDB Annotator Summit

Data Access and Exploration

Peter Rose

Andreas Prlić

Vision and Mission



VISION

To enable breakthroughs in scientific inquiry, medicine, drug discovery, technology, and education with rich structural views of biological systems.

MISSION

To provide a freely-available and sustainable resource of experimental 3D biological macromolecular structure data that is by, for, and of the community by

- Enabling efficient deposition, high-quality curation, and exploration of data in the global PDB archive
- Leading biological structure representation and driving integration with related data resources
- Establishing and fostering communication and collaboration across sciences
- Inspiring, enabling, and informing diverse users through structural views of biology and medicine

Primary Goals

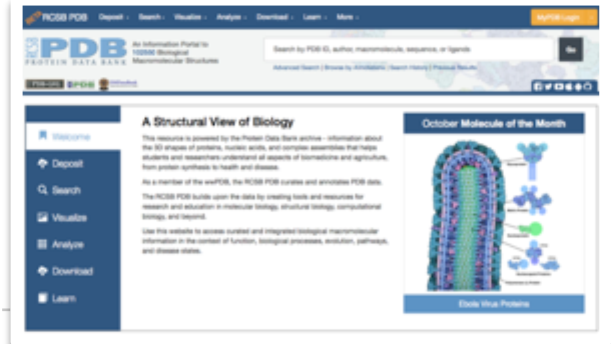
- Enable efficient exploration of the PDB archive
- Enhance User experience
- Design data stores supporting efficient query
- Modularize services to enhance extendibility, scalability, and maintainability
- Develop geometry and interaction query capabilities
- Expand programmatic access *via* Web Services

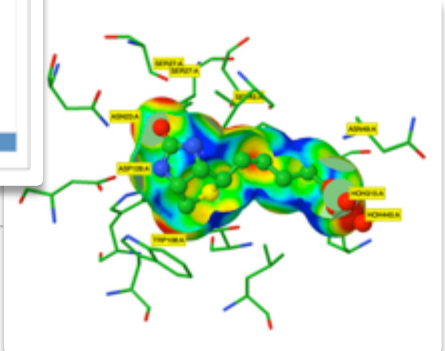
SAN DIEGO SUPERCOMPUTER CENTER at UC SAN DIEGO
DATA to DISCOVERY
Pioneering a New Era of Scientific Investigation

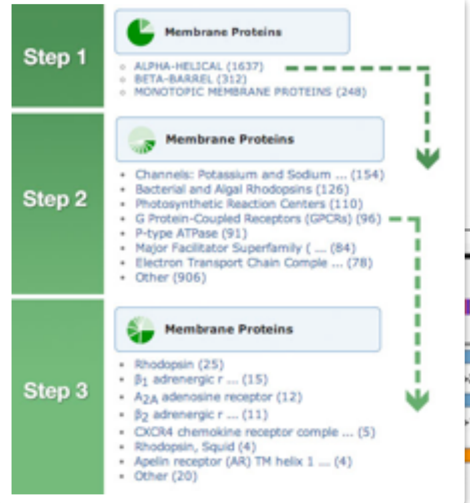
Recent Accomplishments

Improved website usability, new structure annotations, improved processes

- Home page redesign
- JS for web support and visualization
- Membrane protein annotation/query
- Mapping structures to human genes


RCSB PDB
Deposit
Search
Visualize
Analyze
Download
Learn
More
MyPDB Login
PDB
PROTEIN DATA BANK
Welcome
Deposit
Search
Visualize
Analyze
Download
Learn
A Structural View of Biology
October Molecule of the Month
Ebola Virus Proteins





Step 1

Membrane Proteins

- ALPHA-HELICAL (1637)
- BETA-BARREL (312)
- MONOTOPIC MEMBRANE PROTEINS (248)

Step 2

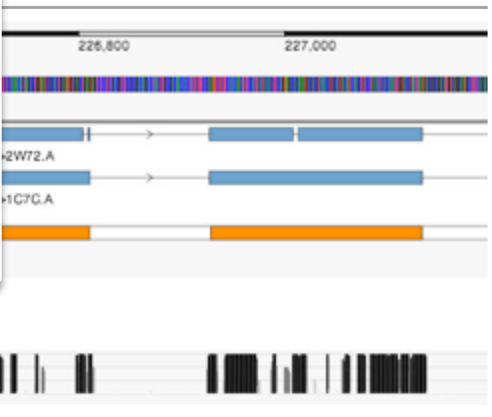
Membrane Proteins

- Channels: Potassium and Sodium ... (154)
- Bacterial and Algal Rhodopsins (126)
- Photosynthetic Reaction Centers (110)
- G Protein-Coupled Receptors (GPCRs) (96)
- P-type ATPase (91)
- Major Facilitator Superfamily (... (84)
- Electron Transport Chain Comple ... (78)
- Other (906)

Step 3

Membrane Proteins

- Rhodopsin (25)
- β_1 adrenergic r ... (15)
- A_{2A} adenosine receptor (12)
- β_2 adrenergic r ... (11)
- CXCR4 chemokine receptor comple ... (5)
- Rhodopsin, Squid (4)
- Apelin receptor (AR) TM helix 1 ... (4)
- Other (20)


226,800
227,000
2W72.A
1C7C.A

Improving Website Usability

- Design focus
    - Reduce information overload and redundancy
    - Support diverse User groups
    - Optimize User workflows
    - Employ modern (yet proven) web technologies
- Scope
    - Phase 1
        - Home Page (November 2014)
        - Search Engine optimization, make website mobile friendly, usage tracking, review User feedback (January 2015)
    - Phase 2 (through September 2015)
        - Redesign of secondary pages, including query results and Structure Summary pages
        - Redesign PDB-101website

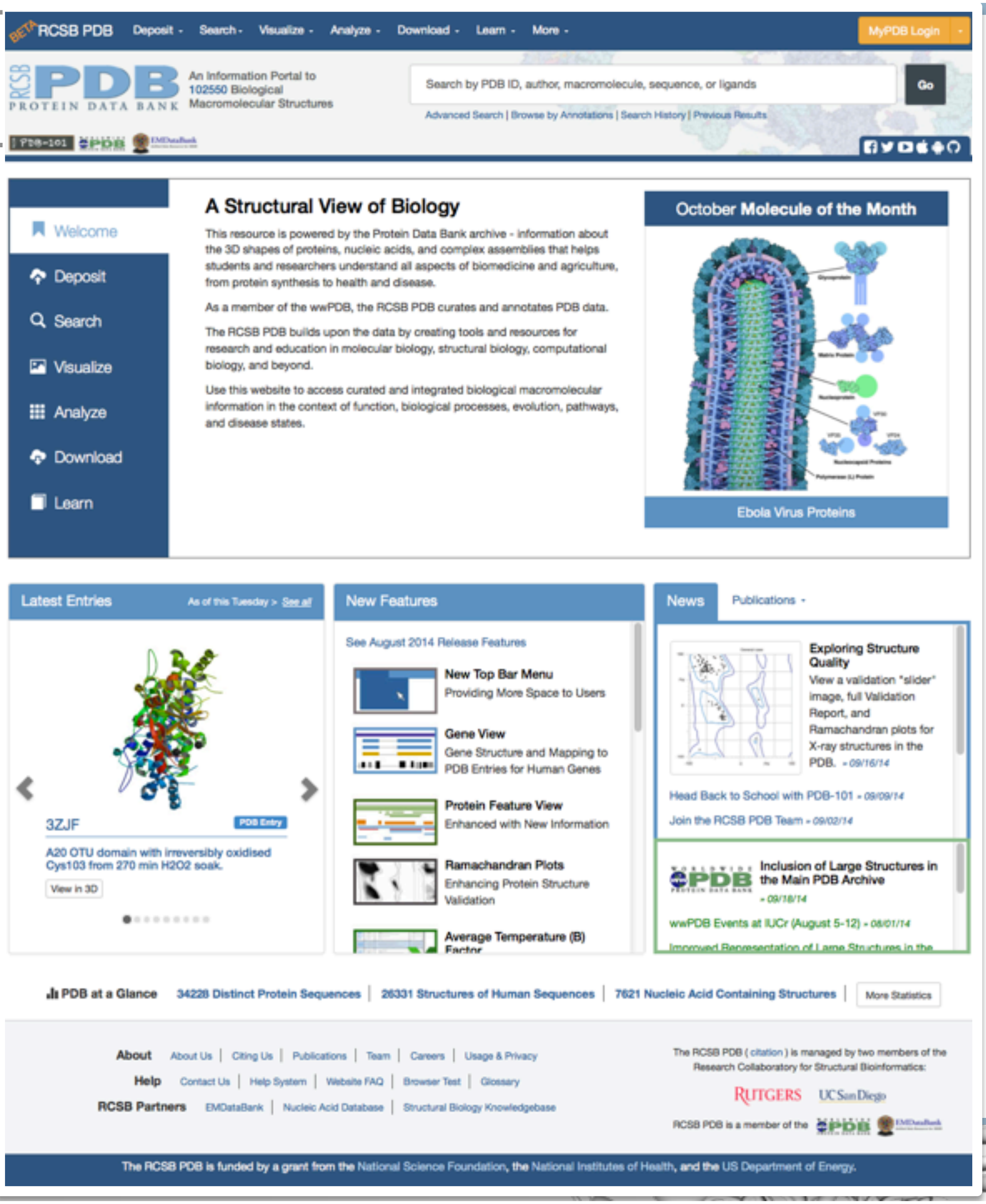
Header accessible from every page

Common tasks

New Features

Static footer

Topic Panels change based on selected task



RCSB PDB
Deposit
Search
Visualize
Analyze
Download
Learn
More
MyPDB Login
An Information Portal to 102550 Biological Macromolecular Structures
Search by PDB ID, author, macromolecule, sequence, or ligands
Go
Advanced Search | Browse by Annotations | Search History | Previous Results
Welcome
Deposit
Search
Visualize
Analyze
Download
Learn

A Structural View of Biology

This resource is powered by the Protein Data Bank archive - information about the 3D shapes of proteins, nucleic acids, and complex assemblies that helps students and researchers understand all aspects of biomedicine and agriculture, from protein synthesis to health and disease.

As a member of the wwPDB, the RCSB PDB curates and annotates PDB data.

The RCSB PDB builds upon the data by creating tools and resources for research and education in molecular biology, structural biology, computational biology, and beyond.

Use this website to access curated and integrated biological macromolecular information in the context of function, biological processes, evolution, pathways, and disease states.

October Molecule of the Month

Ebola Virus Proteins

Latest Entries As of this Tuesday > See all

3ZJF PDB Entry

A20 OTU domain with irreversibly oxidised Cys103 from 270 min H2O2 soak.

View in 3D

New Features

See August 2014 Release Features

New Top Bar Menu Providing More Space to Users

Gene View Gene Structure and Mapping to PDB Entries for Human Genes

Protein Feature View Enhanced with New Information

Ramachandran Plots Enhancing Protein Structure Validation

Average Temperature (B) Factor

News Publications

Exploring Structure Quality View a validation "slider" image, full Validation Report, and Ramachandran plots for X-ray structures in the PDB. - 09/16/14

Head Back to School with PDB-101 - 09/09/14

Join the RCSB PDB Team - 09/02/14

Inclusion of Large Structures in the Main PDB Archive - 09/18/14

wwPDB Events at IUCr (August 5-12) - 08/01/14

PDB at a Glance 34228 Distinct Protein Sequences | 26331 Structures of Human Sequences | 7621 Nucleic Acid Containing Structures | More Statistics

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Help Contact Us | Help System | Website FAQ | Browser Test | Glossary

RCSB Partners EMDataBank | Nucleic Acid Database | Structural Biology Knowledgebase

The RCSB PDB (citation) is managed by two members of the Research Collaboratory for Structural Bioinformatics:

RUTGERS UC San Diego

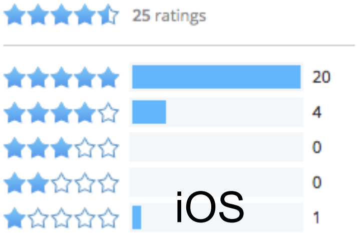
RCSB PDB is a member of the wwPDB EMDataBank

The RCSB PDB is funded by a grant from the National Science Foundation, the National Institutes of Health, and the US Department of Energy.

Live Demo of New Website

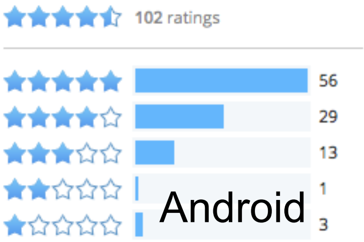
- Topic panels and subpanels
- Top menu bar
- New features and news sections
- Context specific feedback form
- Responsive for mobile devices

RCSB PDB Mobile


25 ratings

Stars	Ratings
★★★★★	20
★★★★☆	4
★★★☆☆	0
★★☆☆☆	0
★☆☆☆☆	1

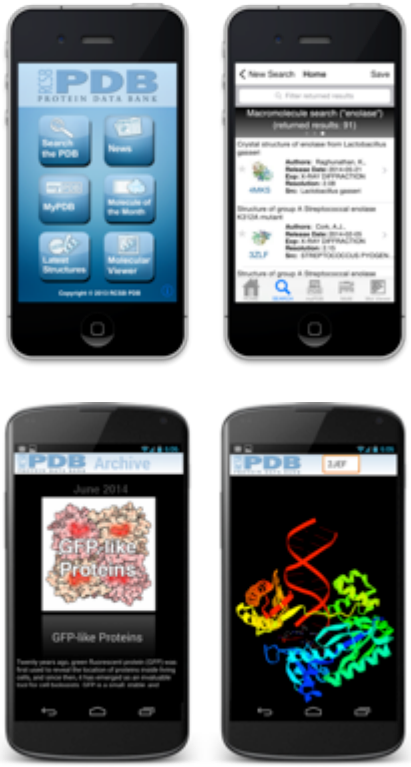
iOS

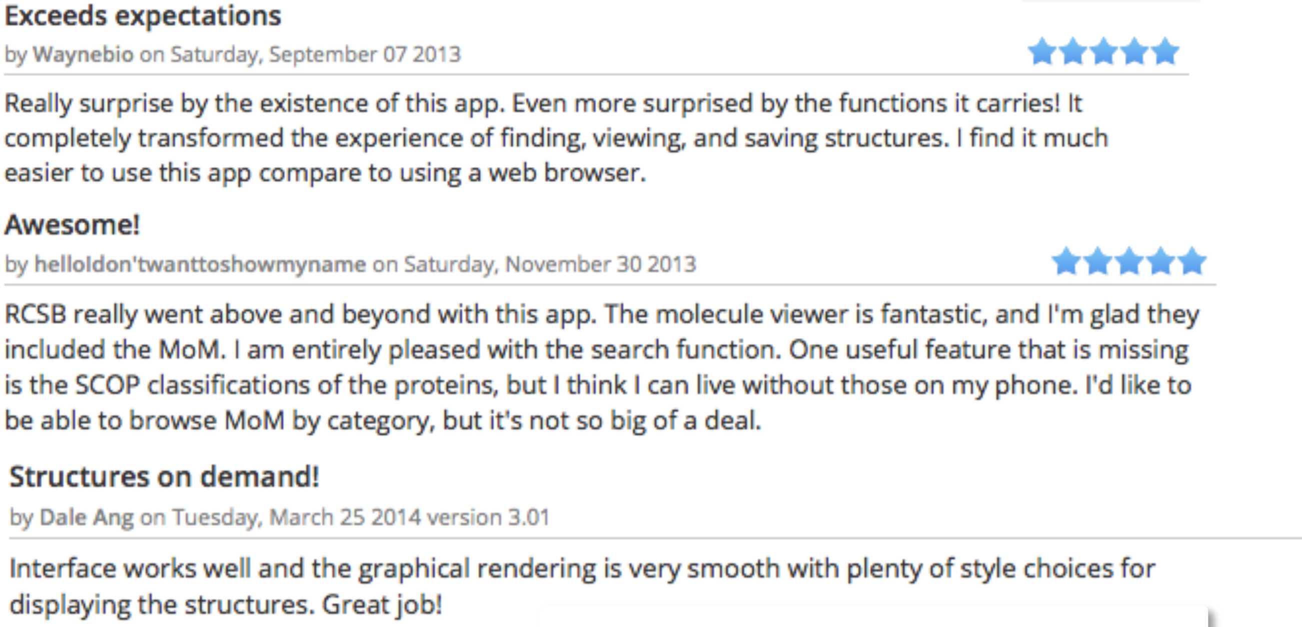

102 ratings

Stars	Ratings
★★★★★	56
★★★★☆	29
★★★☆☆	13
★★☆☆☆	1
★☆☆☆☆	3

Android

Fully supported on iOS and Android




Exceeds expectations

by Waynebio on Saturday, September 07 2013 ★★★★★

Really surprise by the existence of this app. Even more surprised by the functions it carries! It completely transformed the experience of finding, viewing, and saving structures. I find it much easier to use this app compare to using a web browser.

Awesome!

by helloIdon'twanttoshowmyname on Saturday, November 30 2013 ★★★★★

RCSB really went above and beyond with this app. The molecule viewer is fantastic, and I'm glad they included the MoM. I am entirely pleased with the search function. One useful feature that is missing is the SCOP classifications of the proteins, but I think I can live without those on my phone. I'd like to be able to browse MoM by category, but it's not so big of a deal.

Structures on demand!

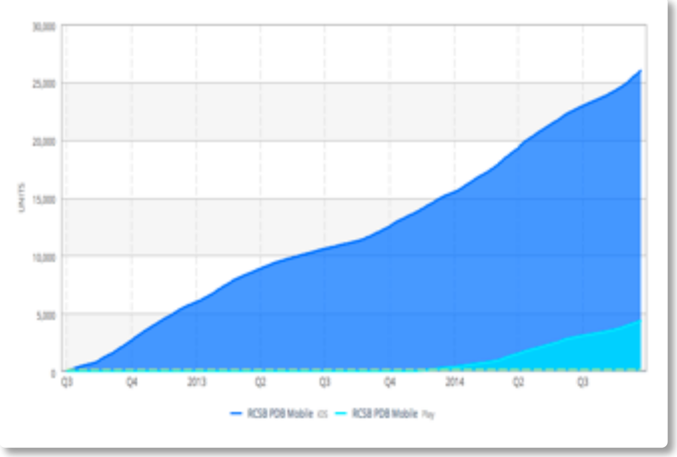
by Dale Ang on Tuesday, March 25 2014 version 3.01

Interface works well and the graphical rendering is very smooth with plenty of style choices for displaying the structures. Great job!

Downloads

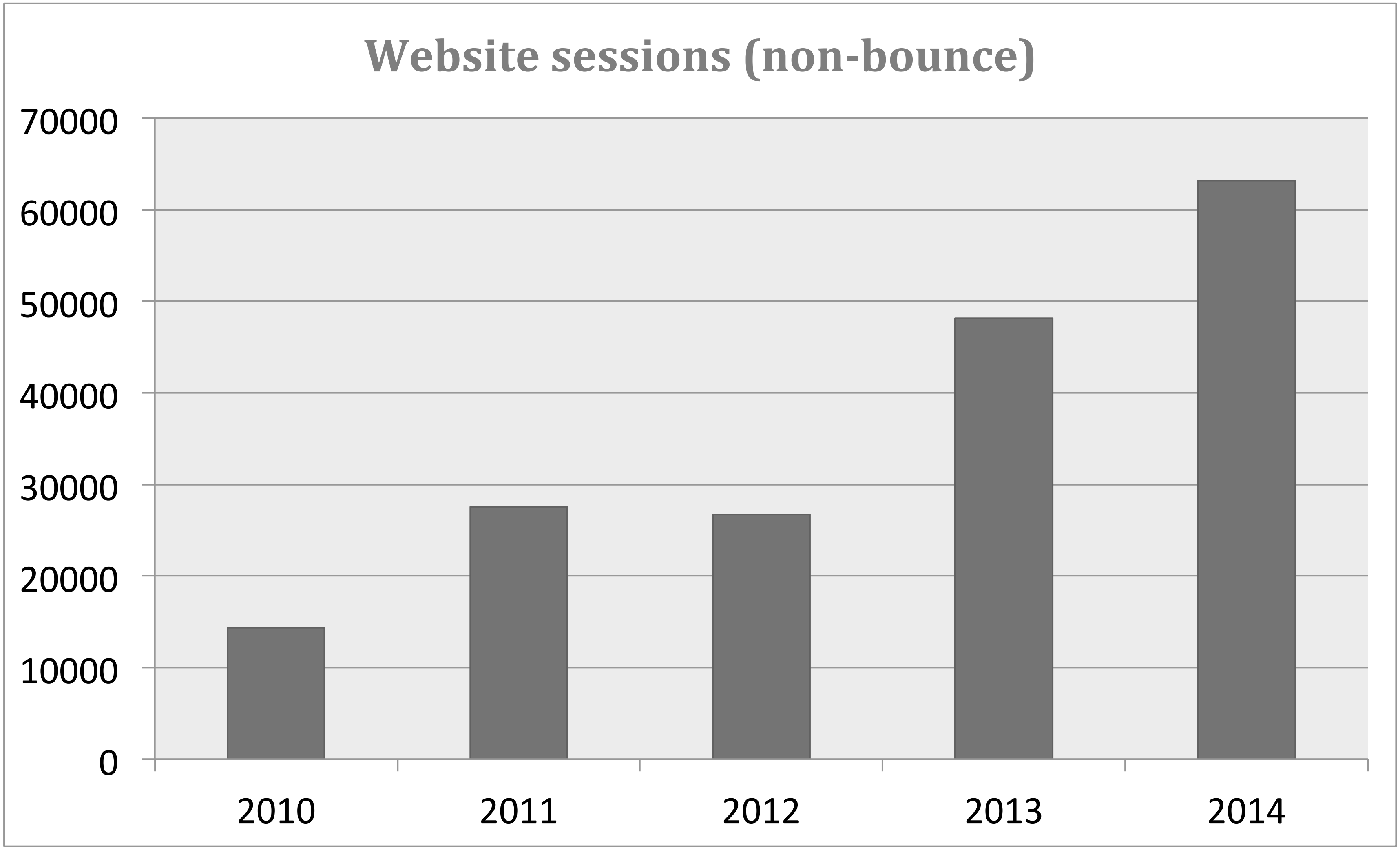
iOS: 22,000

Android: 4,500



RCSB PDB Mobile: iOS and Android mobile apps to provide data access and visualization to the RCSB Protein Data Bank (2014) *Bioinformatics* doi:10.1093/bioinformatics/btu596

Mobile Use of Website

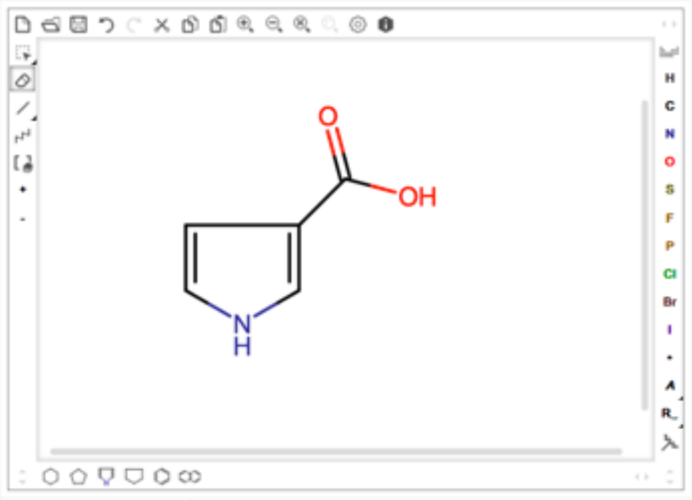


~1% ~2% of all traffic

Mobile Web Support/Visualization

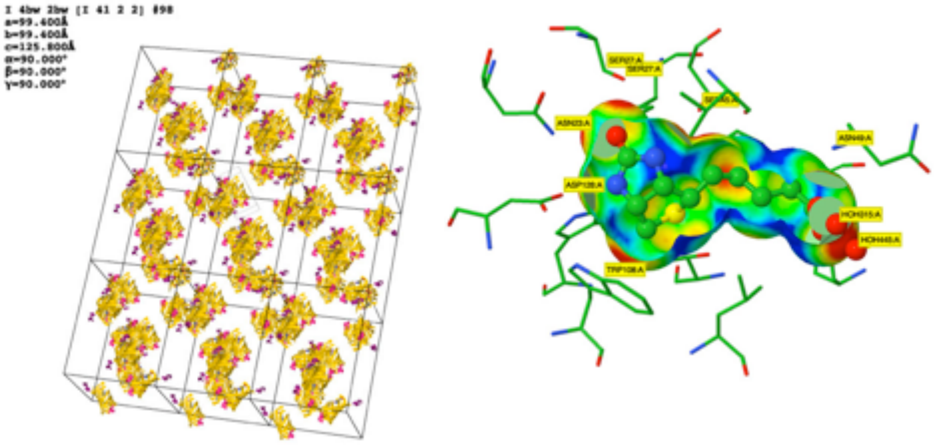
- New JavaScript applications run on devices and web browsers that do not support Java (phones, tablets)

Chemical Structure Searching


H
C
N
O
S
F
P
Cl
Br
I
O
OH
N
H

MarvinJS (ChemAxon)

3D Visualization

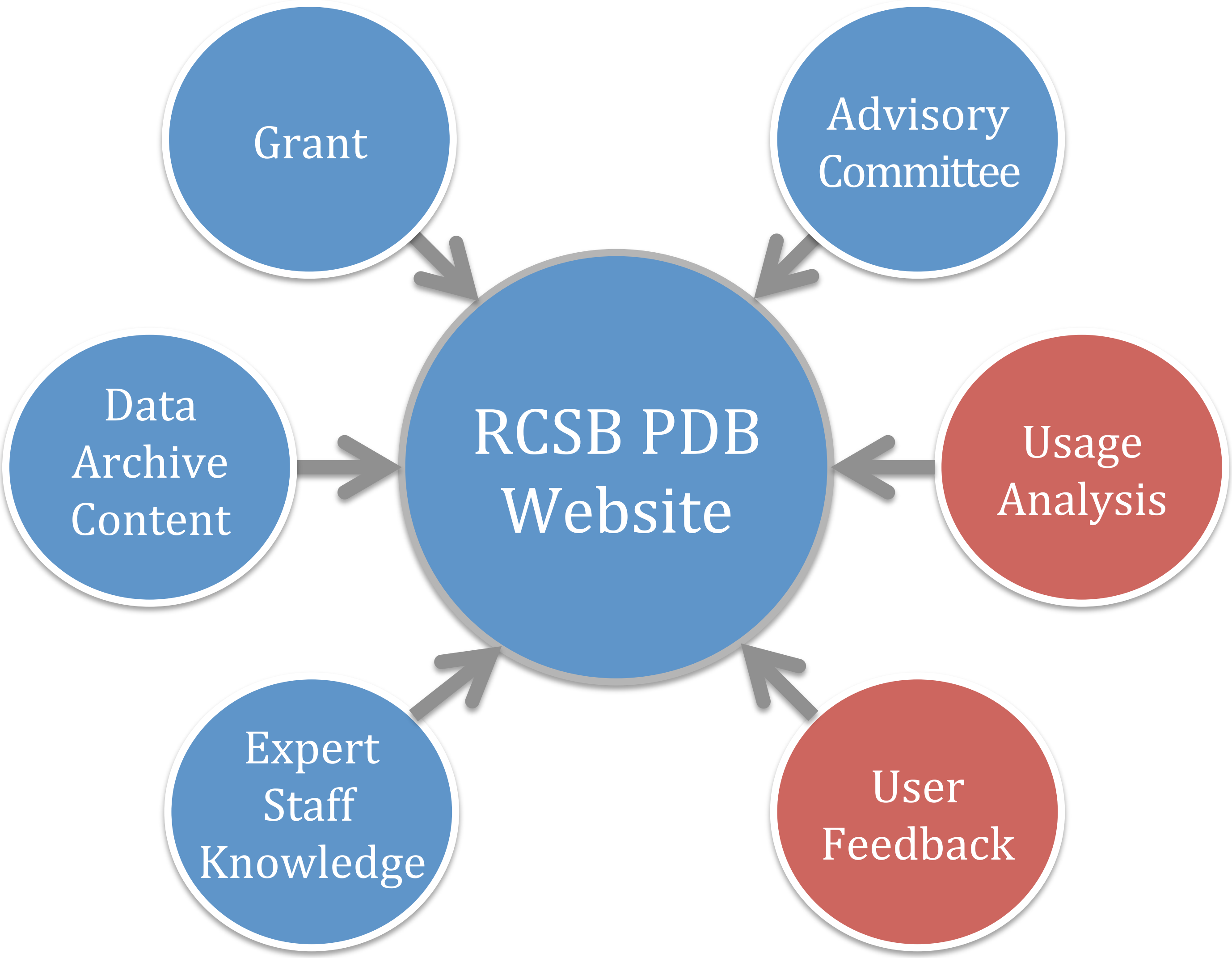

I 4bw 2bw [I 41 2 2] #98
a=99.400Å
b=99.400Å
c=125.800Å
α=90.000°
β=90.000°
γ=90.000°

crystal packing

binding site

JSmol (Robert Hanson)

Factors Influencing Our Decisions



Grant

Advisory Committee

Data Archive Content

RCSB PDB Website

Usage Analysis

Expert Staff Knowledge

User Feedback

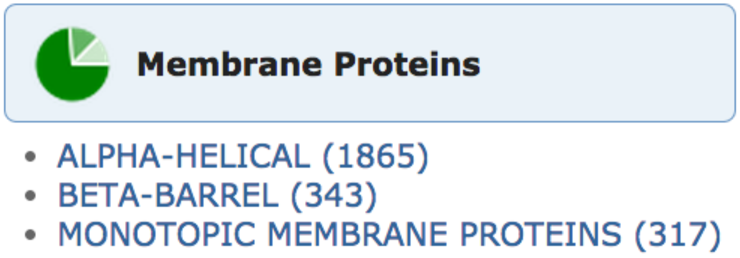
Feedback from Help Desk, Analytics

- What membrane proteins are in the PDB?
- What can we learn when we search by gene-identifier?

Membrane Protein Annotation/Query

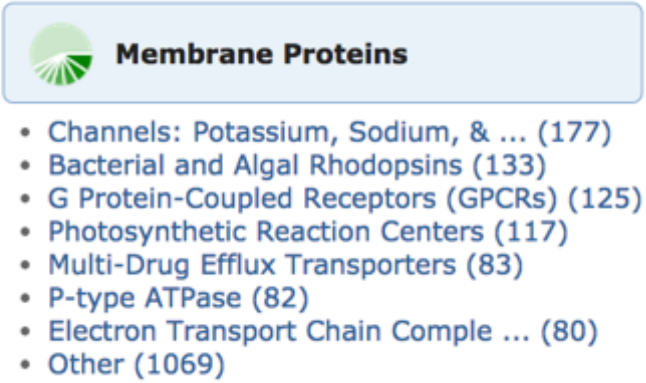
- Integration with mpstruc database (UC Irvine)
  - mpstruc currently annotates ~1500 PDB entries
  - Collaboration with Structural Biology Knowledgebase
- Extended to homologs using RCSB PDB sequence clusters
  - ~2500 membrane proteins annotated

Browse Membrane Proteins



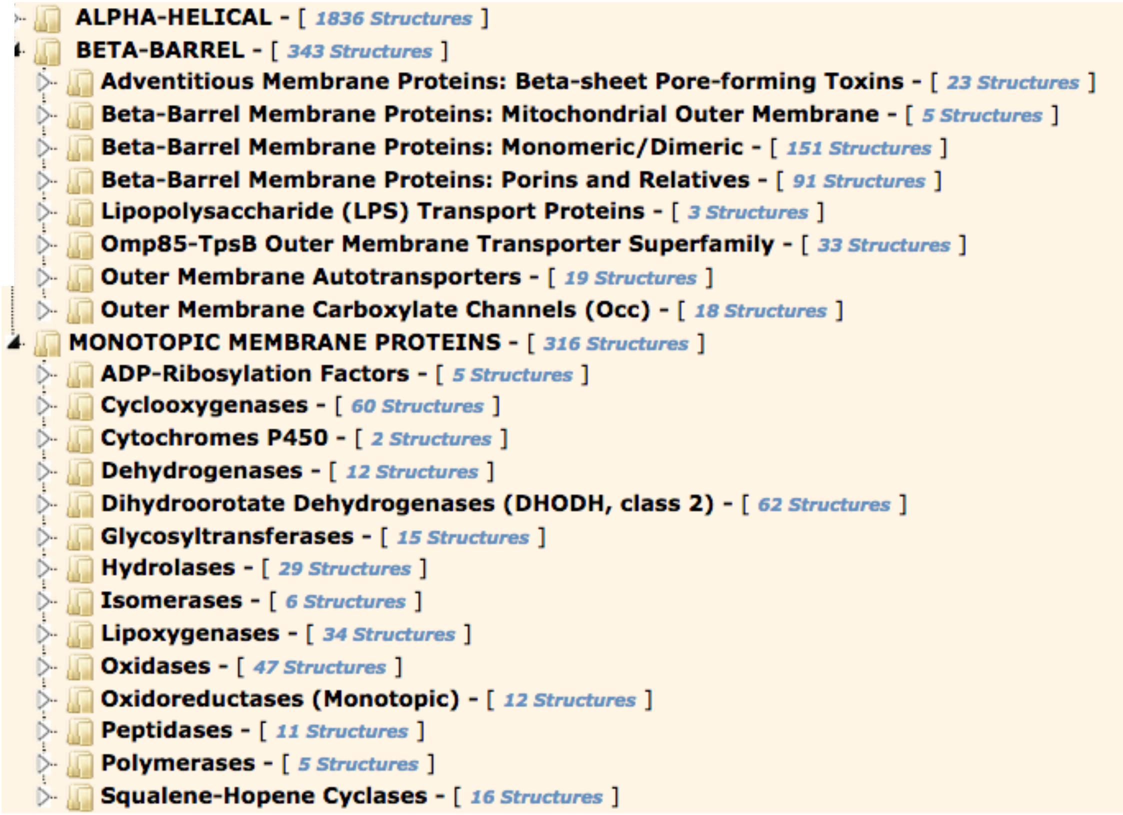
Membrane Proteins

- ALPHA-HELICAL (1865)
- BETA-BARREL (343)
- MONOTOPIC MEMBRANE PROTEINS (317)



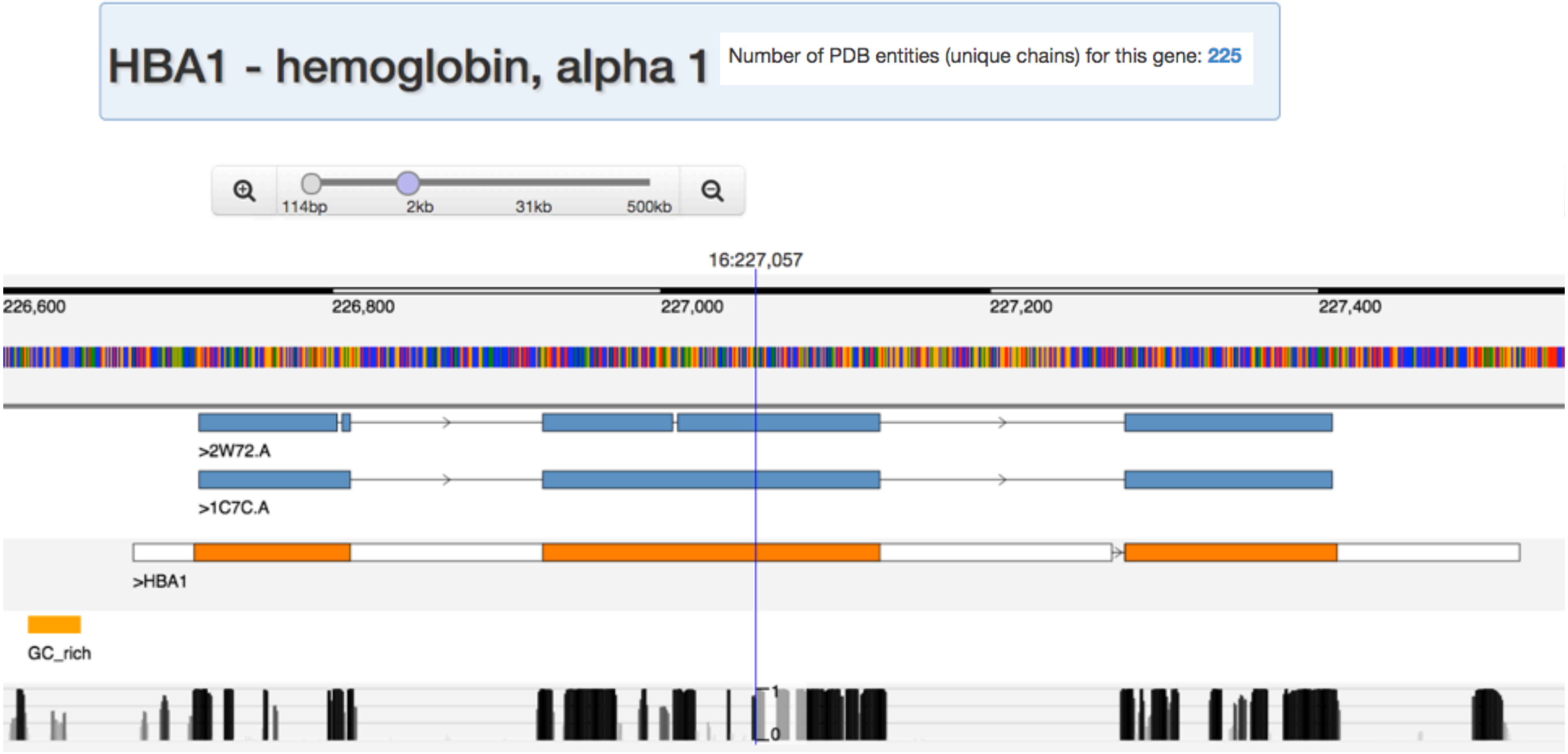
Membrane Proteins

- Channels: Potassium, Sodium, & ... (177)
- Bacterial and Algal Rhodopsins (133)
- G Protein-Coupled Receptors (GPCRs) (125)
- Photosynthetic Reaction Centers (117)
- Multi-Drug Efflux Transporters (83)
- P-type ATPase (82)
- Electron Transport Chain Comple ... (80)
- Other (1069)



- **ALPHA-HELICAL** - [*1836 Structures*]
- **BETA-BARREL** - [*343 Structures*]
  - **Adventitious Membrane Proteins: Beta-sheet Pore-forming Toxins** - [*23 Structures*]
  - **Beta-Barrel Membrane Proteins: Mitochondrial Outer Membrane** - [*5 Structures*]
  - **Beta-Barrel Membrane Proteins: Monomeric/Dimeric** - [*151 Structures*]
  - **Beta-Barrel Membrane Proteins: Porins and Relatives** - [*91 Structures*]
  - **Lipopolysaccharide (LPS) Transport Proteins** - [*3 Structures*]
  - **Omp85-TpsB Outer Membrane Transporter Superfamily** - [*33 Structures*]
  - **Outer Membrane Autotransporters** - [*19 Structures*]
  - **Outer Membrane Carboxylate Channels (Occ)** - [*18 Structures*]
- **MONOTOPIC MEMBRANE PROTEINS** - [*316 Structures*]
  - **ADP-Ribosylation Factors** - [*5 Structures*]
  - **Cyclooxygenases** - [*60 Structures*]
  - **Cytochromes P450** - [*2 Structures*]
  - **Dehydrogenases** - [*12 Structures*]
  - **Dihydroorotate Dehydrogenases (DHODH, class 2)** - [*62 Structures*]
  - **Glycosyltransferases** - [*15 Structures*]
  - **Hydrolases** - [*29 Structures*]
  - **Isomerases** - [*6 Structures*]
  - **Lipoxygenases** - [*34 Structures*]
  - **Oxidases** - [*47 Structures*]
  - **Oxidoreductases (Monotopic)** - [*12 Structures*]
  - **Peptidases** - [*11 Structures*]
  - **Polymerases** - [*5 Structures*]
  - **Squalene-Hopene Cyclases** - [*16 Structures*]

Gene View: Mapping PDB → Genes

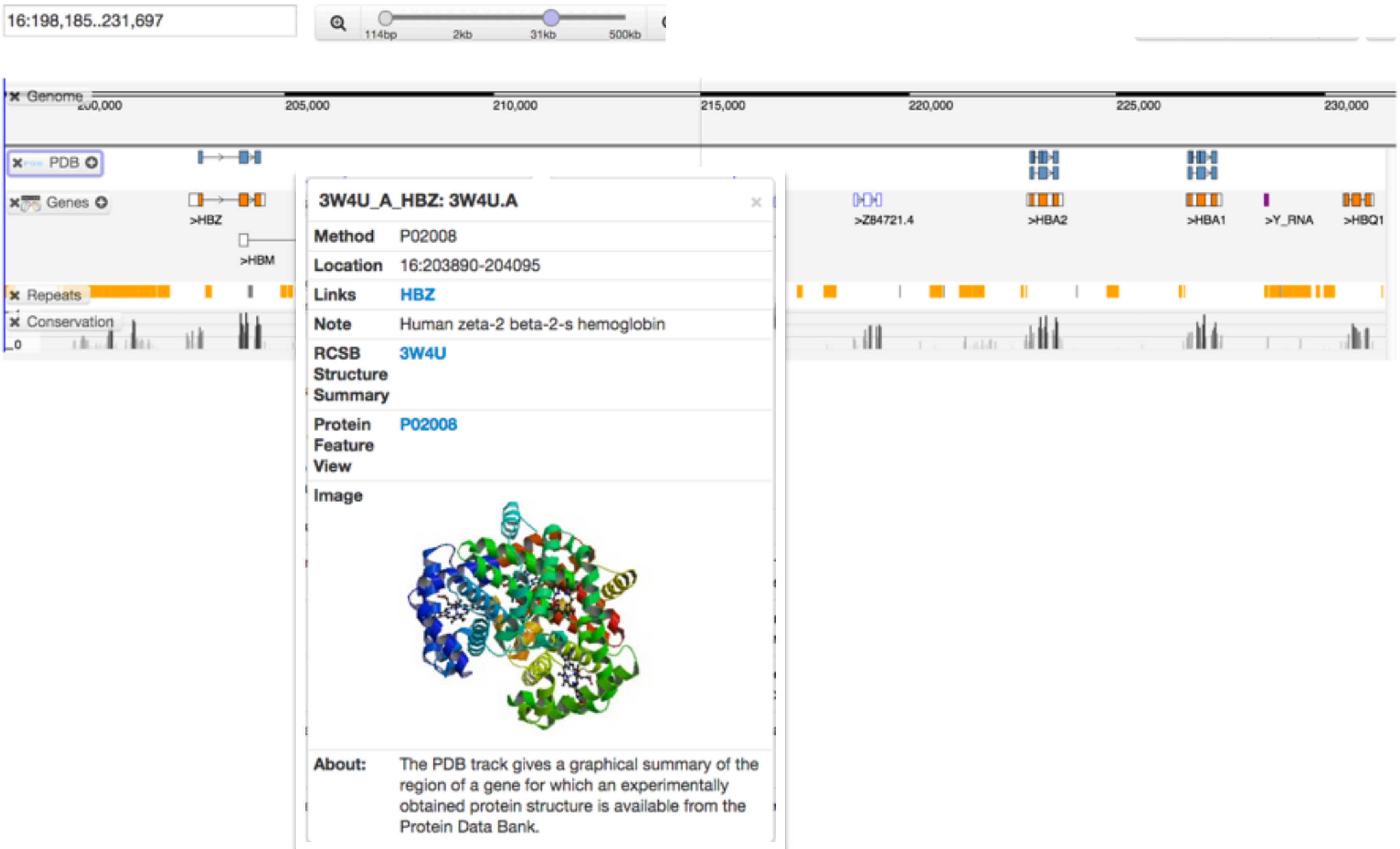


HBA1 - hemoglobin, alpha 1

Number of PDB entities (unique chains) for this gene: 225

114bp
2kb
31kb
500kb
16:227,057
226,600
226,800
227,000
227,200
227,400
>2W72.A
>1C7C.A
>HBA1
GC_rich
1
0

Gene View→Scroll, Zoom, Interact


16:198,185..231,697
114bp
2kb
31kb
500kb
Genome
200,000
205,000
210,000
215,000
220,000
225,000
230,000
PDB
Genes
>HBZ
>HBM
>Z84721.4
>HBA2
>HBA1
>Y_RNA
>HBQ1
Repeats
Conservation
0

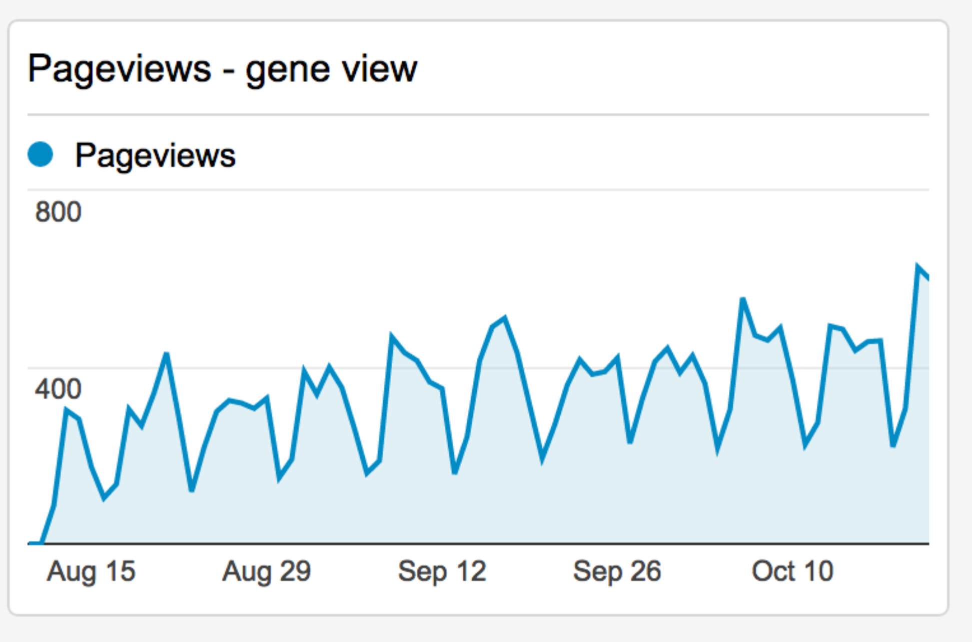
3W4U_A_HBZ: 3W4U.A

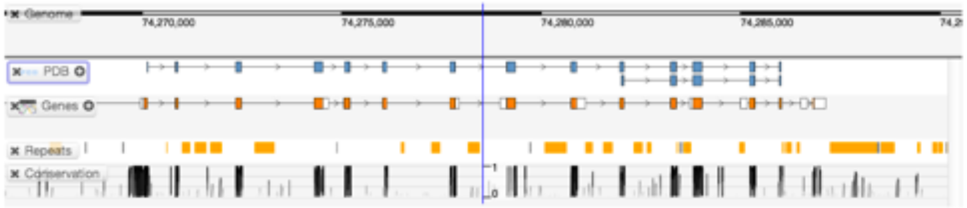
Method	P02008
Location	16:203890-204095
Links	HBZ
Note	Human zeta-2 beta-2-s hemoglobin
RCSB Structure Summary	3W4U
Protein Feature View	P02008
Image	
About:	The PDB track gives a graphical summary of the region of a gene for which an experimentally obtained protein structure is available from the Protein Data Bank.

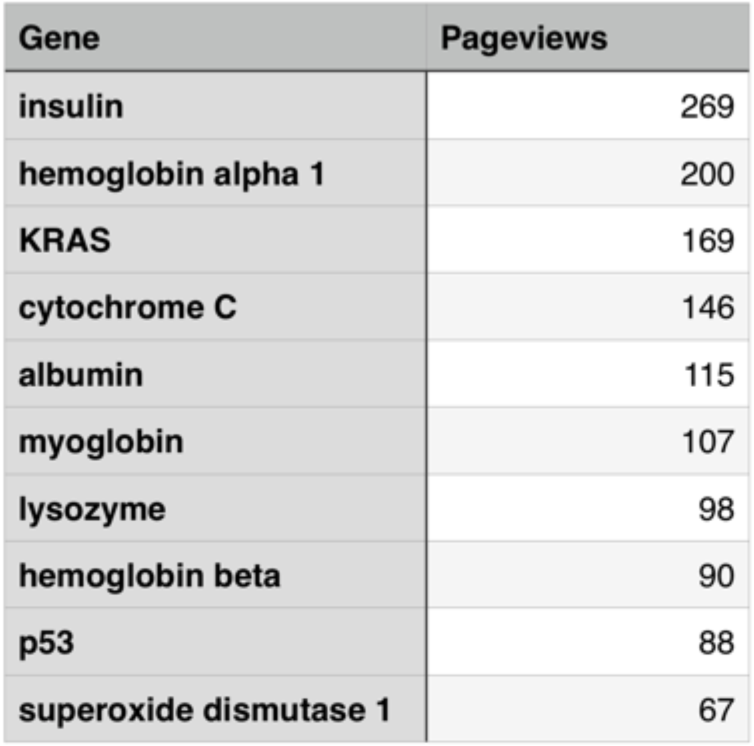
Live Demo of Gene View

- Explaining page layout
- Viewing genomic context
- Scrolling along the length of a gene or a structure
- Zooming in on particular segments

Gene View → Good Initial Uptake




Genome
74,270,000
74,275,000
74,280,000
74,285,000
PDB
Genes
Repeats
Conservation

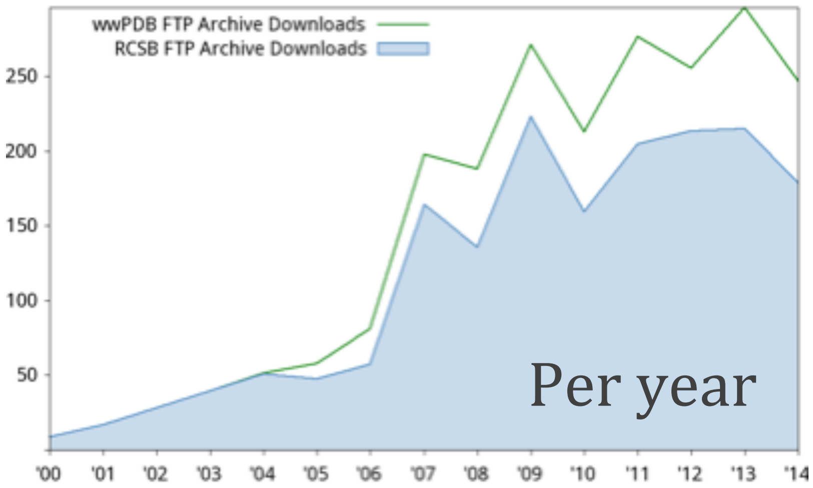


Gene	Pageviews
insulin	269
hemoglobin alpha 1	200
KRAS	169
cytochrome C	146
albumin	115
myoglobin	107
lysozyme	98
hemoglobin beta	90
p53	88
superoxide dismutase 1	67

Assessing Impact

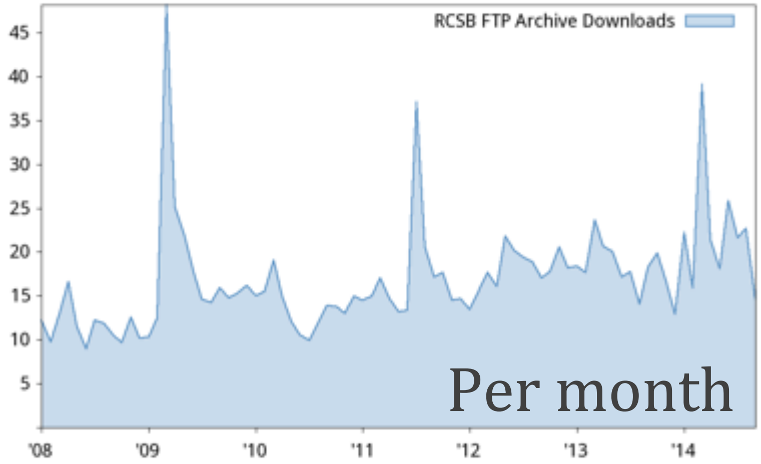
- Usage Metrics
- User Demographics
- Growth Areas
- Growth Opportunities
- Infrastructure Improvements

Overall FTP and Web Service Usage



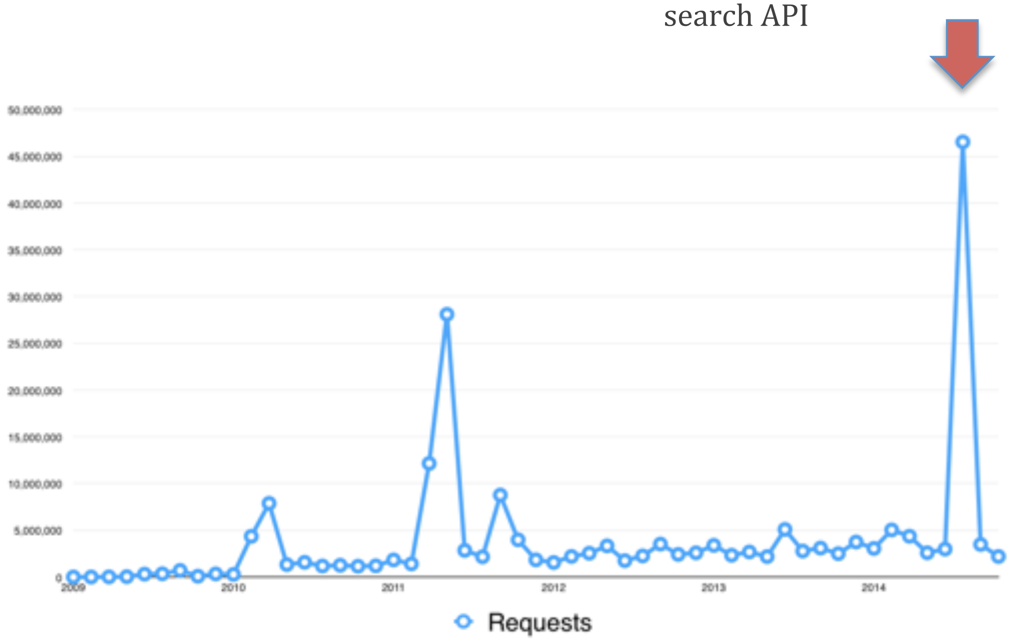
Per year

FTP downloads



Per month

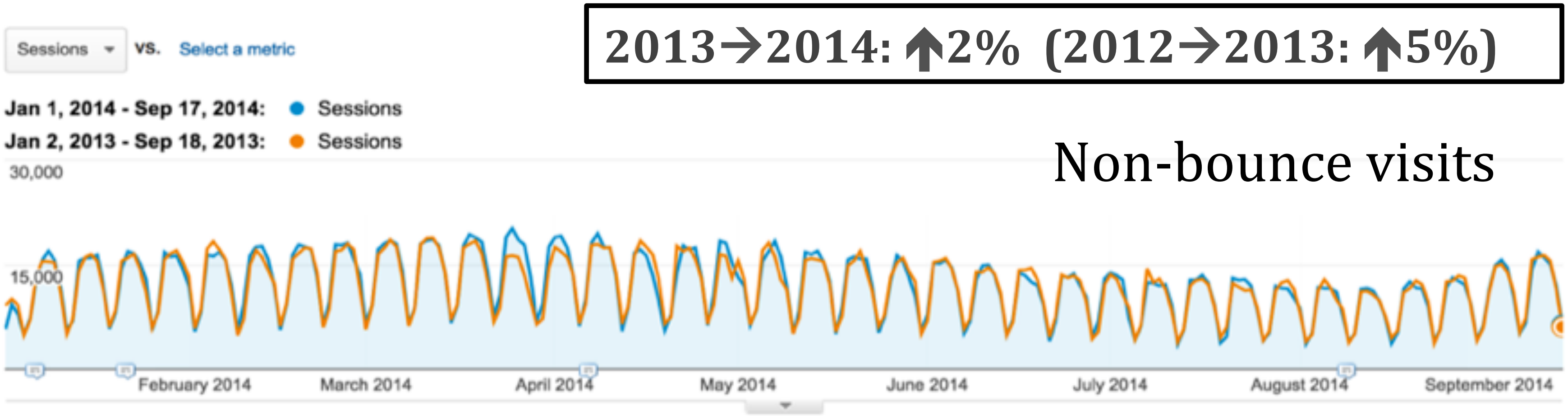
Argonne National Lab search API



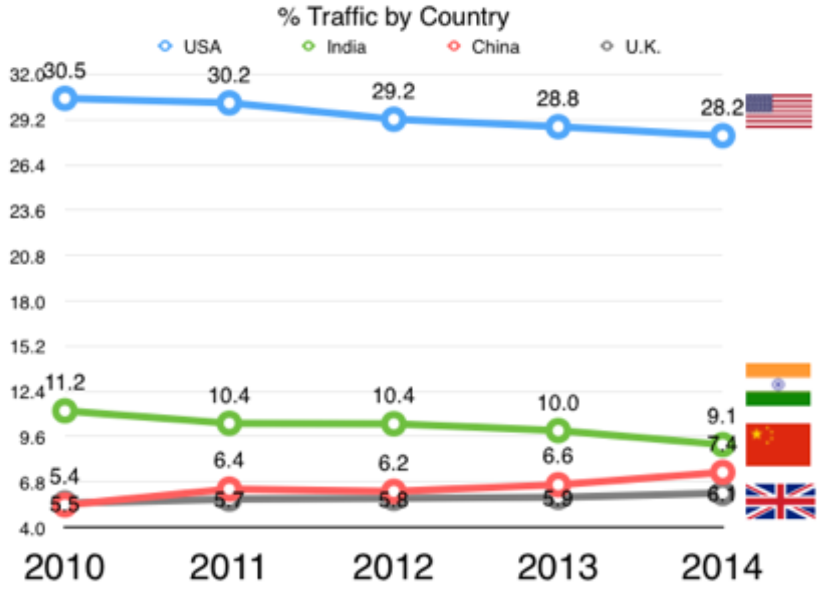
RESTful Web Services

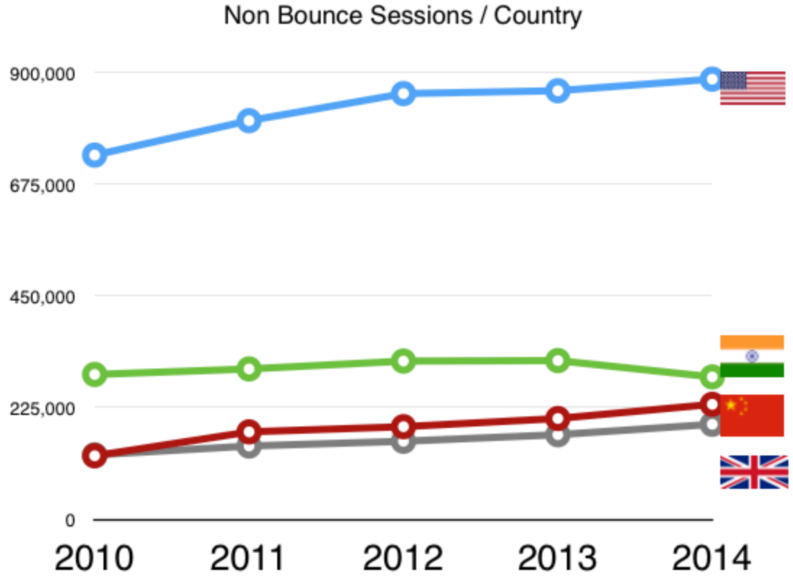
Overall Website Usage

2013→2014: ↑2% (2012→2013: ↑5%)

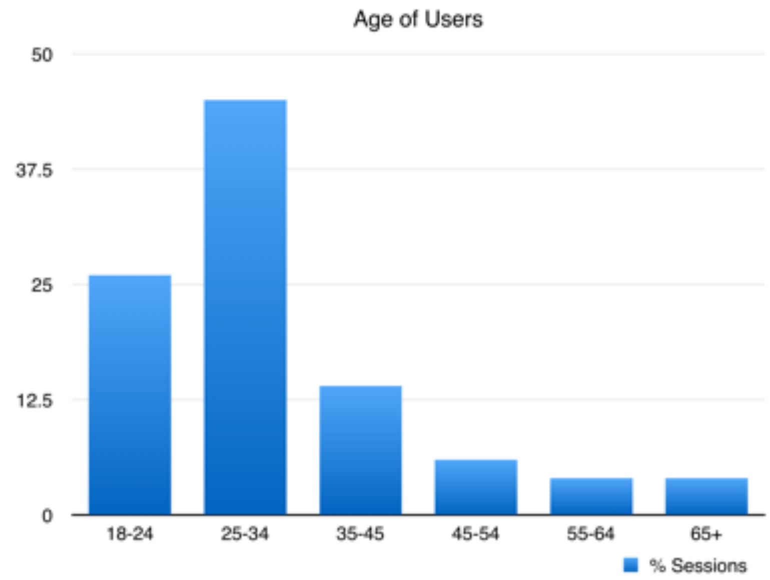

Sessions
VS.
Select a metric
Jan 1, 2014 - Sep 17, 2014: ● Sessions
Jan 2, 2013 - Sep 18, 2013: ● Sessions
30,000
15,000
February 2014
March 2014
April 2014
May 2014
June 2014
July 2014
August 2014
September 2014

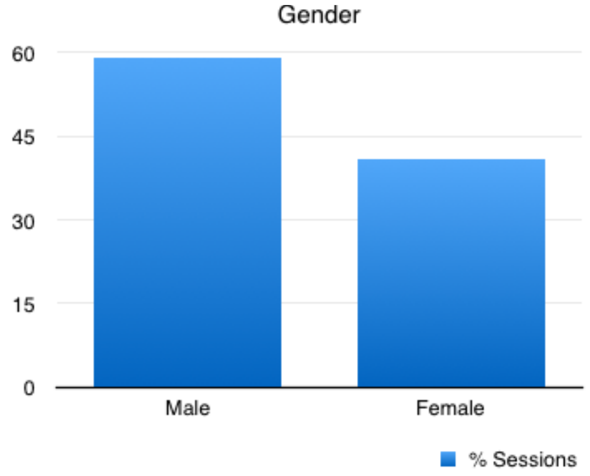
Non-bounce visits





Available User Demographics





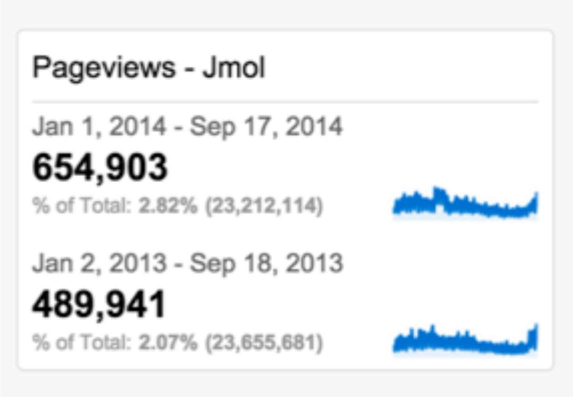
Age of Users

Age	% Sessions
18-24	26
25-34	45
35-45	14
45-54	6
55-64	4
65+	4

Gender

Gender	% Sessions
Male	59
Female	41

Growth Area: Jmol



Pageviews - Jmol

Jan 1, 2014 - Sep 17, 2014

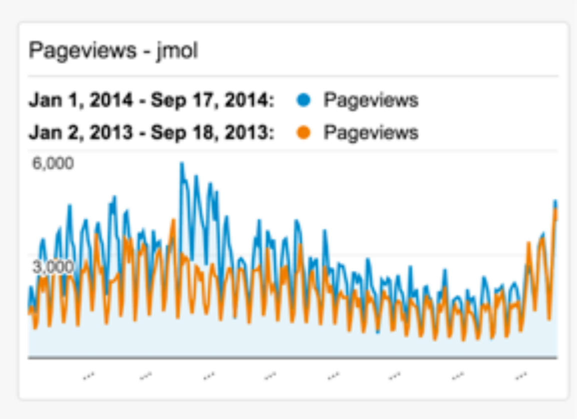
654,903

% of Total: 2.82% (23,212,114)

Jan 2, 2013 - Sep 18, 2013

489,941

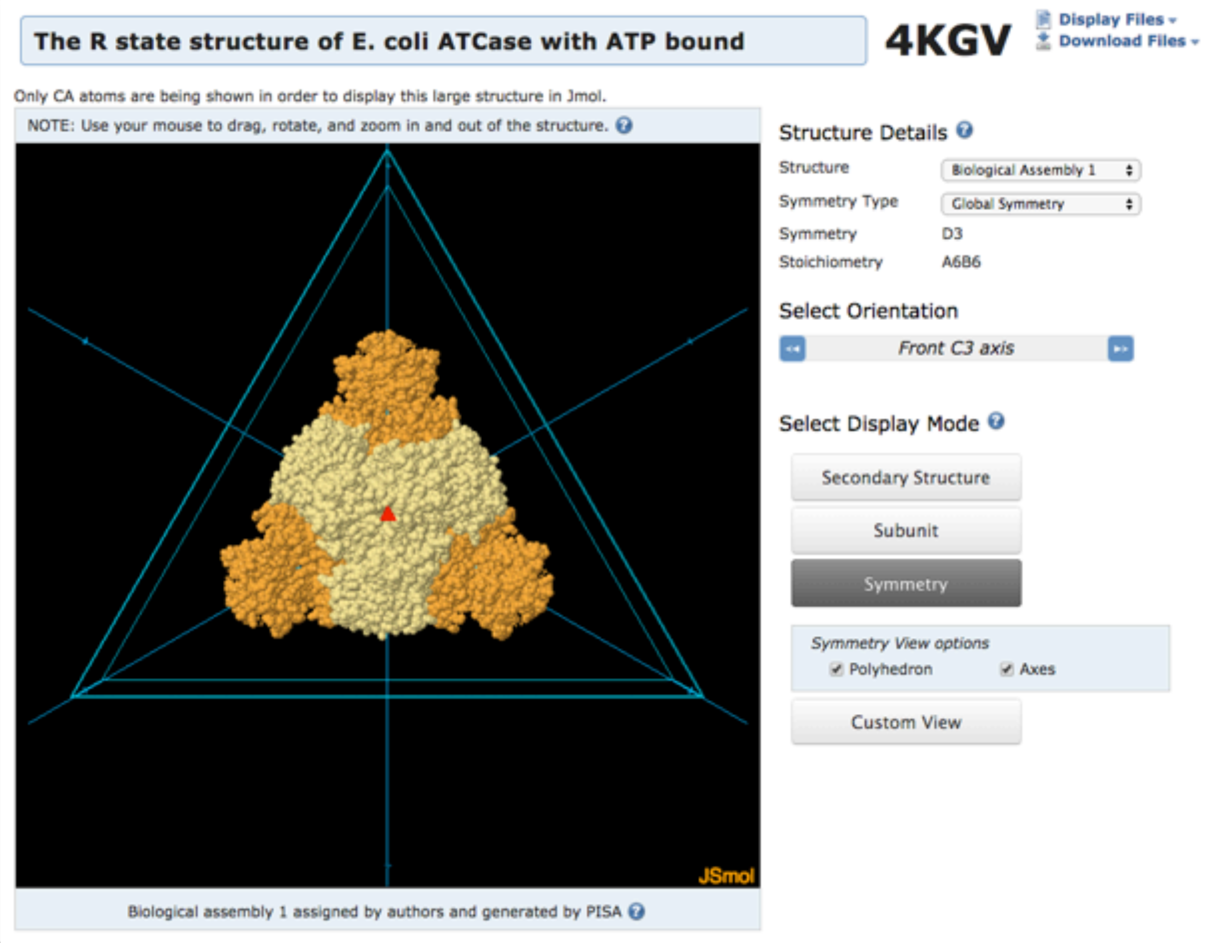
% of Total: 2.07% (23,655,681)



Pageviews - jmol

Jan 1, 2014 - Sep 17, 2014: ● Pageviews

Jan 2, 2013 - Sep 18, 2013: ● Pageviews



The R state structure of E. coli ATCase with ATP bound

4KGV

Display Files
Download Files

Only CA atoms are being shown in order to display this large structure in Jmol.

NOTE: Use your mouse to drag, rotate, and zoom in and out of the structure.

Structure Details

Structure	Biological Assembly 1
Symmetry Type	Global Symmetry
Symmetry	D3
Stoichiometry	A6B6

Select Orientation

Front C3 axis

Select Display Mode

Secondary Structure
Subunit
Symmetry

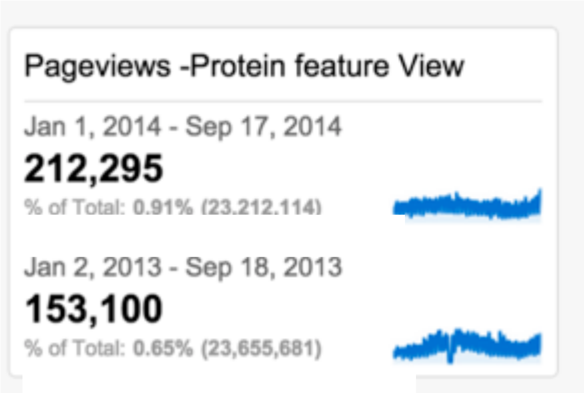
Symmetry View options

☑ Polyhedron ☑ Axes

Custom View
JSmol

Biological assembly 1 assigned by authors and generated by PISA

Growth Area: Protein Feature View



Pageviews -Protein feature View

Jan 1, 2014 - Sep 17, 2014

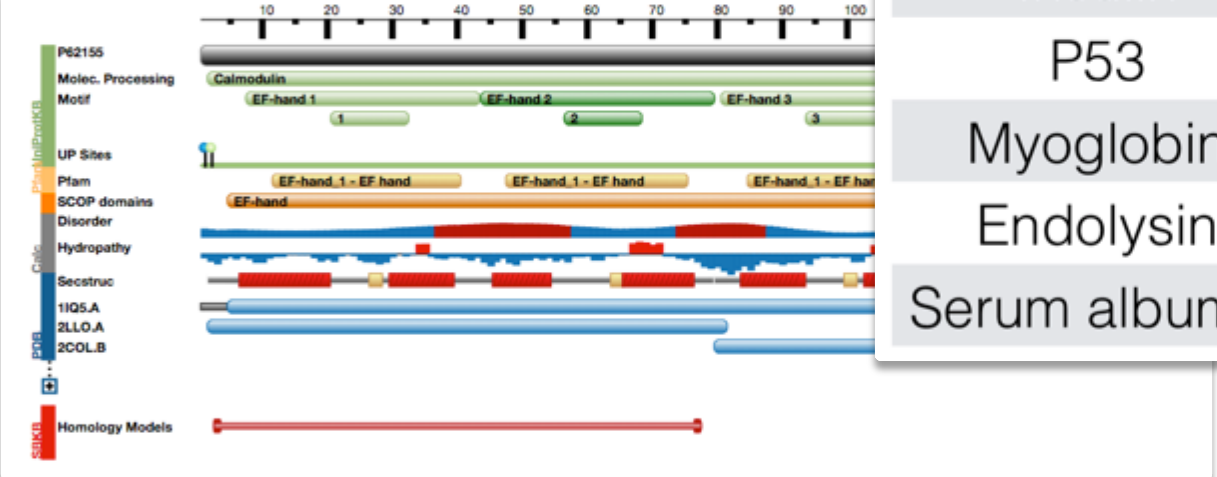
212,295

% of Total: 0.91% (23,212,114)

Jan 2, 2013 - Sep 18, 2013

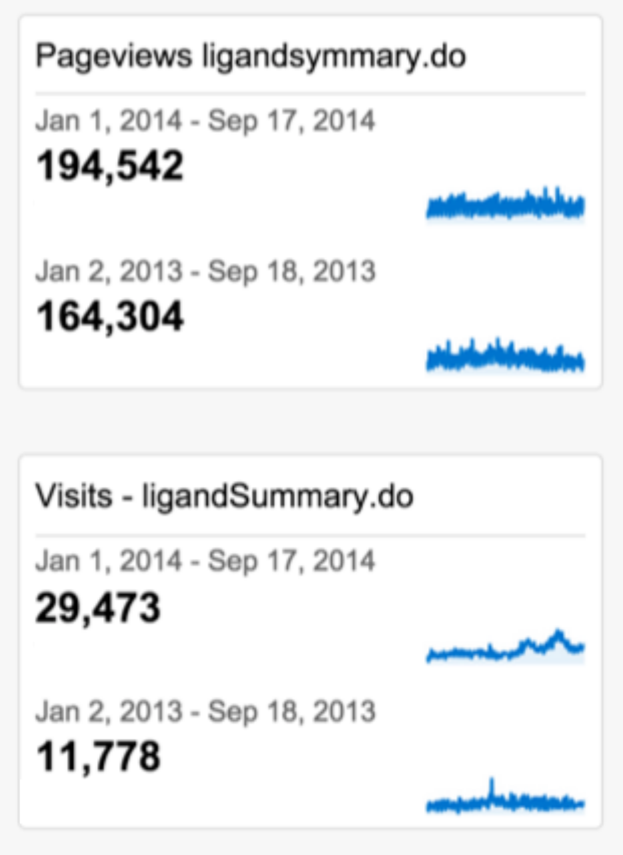
153,100

% of Total: 0.65% (23,655,681)


10
20
30
40
50
60
70
80
90
100
UniProtKB
P62155
Molec. Processing
Motif
UP Sites
Pfam
SCOP domains
Disorder
Hydropathy
Calc
Secstruc
PDB
1IQ5.A
2LLO.A
2COL.B
SBKB
Homology Models
Calmodulin
EF-hand 1
EF-hand 2
EF-hand 3
1
2
3
EF-hand_1 - EF hand
EF-hand_1 - EF hand
EF-hand_1 - EF har
EF-hand

Name	Pageviews
Calmodulin	1010
Lysozyme C	859
Hemoglobin	856
GFP	700
Insulin	625
P53	534
Myoglobin	485
Endolysin	484
Serum albumin	448

Growth Area: Ligand Summary



Pageviews ligandsymmary.do

Jan 1, 2014 - Sep 17, 2014

194,542

Jan 2, 2013 - Sep 18, 2013

164,304

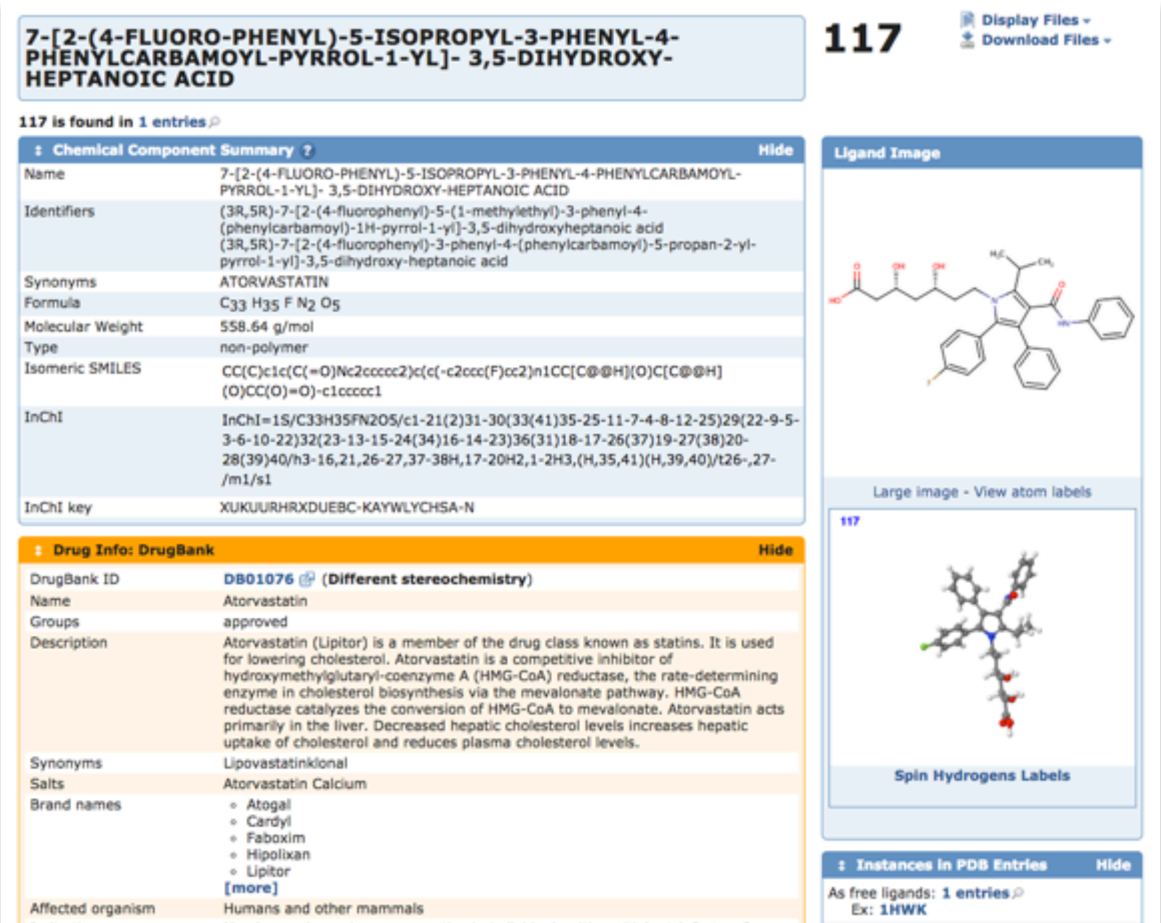
Visits - ligandSummary.do

Jan 1, 2014 - Sep 17, 2014

29,473

Jan 2, 2013 - Sep 18, 2013

11,778



7-[2-(4-FLUORO-PHENYL)-5-ISOPROPYL-3-PHENYL-4-PHENYLCARBAMOYL-PYRROL-1-YL]- 3,5-DIHYDROXY-HEPTANOIC ACID

117

117 is found in 1 entries

Chemical Component Summary

Name	7-[2-(4-FLUORO-PHENYL)-5-ISOPROPYL-3-PHENYL-4-PHENYLCARBAMOYL-PYRROL-1-YL]- 3,5-DIHYDROXY-HEPTANOIC ACID
Identifiers	(3R,5R)-7-[2-(4-fluorophenyl)-5-(1-methylethyl)-3-phenyl-4-(phenylcarbamoyl)-1H-pyrrol-1-yl]-3,5-dihydroxyheptanoic acid (3R,5R)-7-[2-(4-fluorophenyl)-3-phenyl-4-(phenylcarbamoyl)-5-propan-2-yl-pyrrol-1-yl]-3,5-dihydroxy-heptanoic acid
Synonyms	ATORVASTATIN
Formula	$C_{33} H_{35} F N_2 O_5$
Molecular Weight	558.64 g/mol
Type	non-polymer
Isomeric SMILES	CC(C)c1c(C(=O)Nc2ccccc2)c(c(-c2ccc(F)cc2)n1CC[C@@H](O)C[C@@H](O)CC(O)=O)-c1ccccc1
InChI	InChI=1S/C33H35FN2O5/c1-21(2)31-30(33(41)35-25-11-7-4-8-12-25)29(22-9-5-3-6-10-22)32(23-13-15-24(34)16-14-23)36(31)18-17-26(37)19-27(38)20-28(39)40/h3-16,21,26-27,37-38H,17-20H2,1-2H3,(H,35,41)(H,39,40)/t26-,27-/m1/s1
InChI key	XUKUURHRXDUEBC-KAYWLYCHSA-N

Drug Info: DrugBank

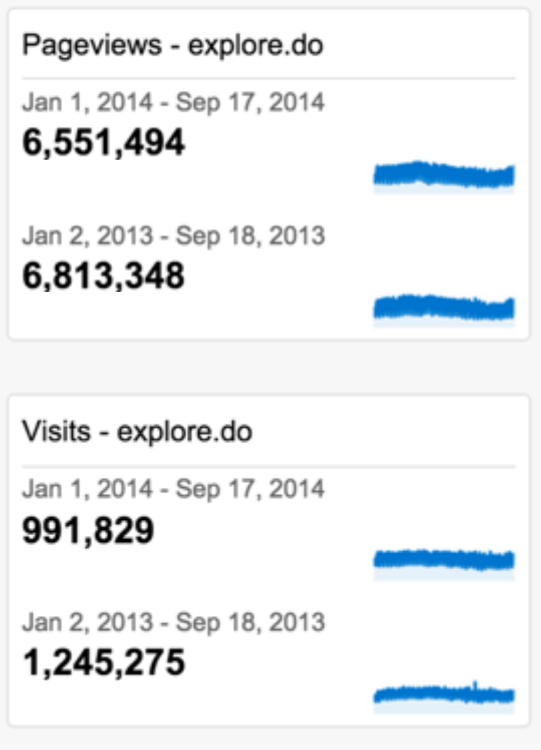
DrugBank ID	DB01076 **(Different stereochemistry)**
Name	Atorvastatin
Groups	approved
Description	Atorvastatin (Lipitor) is a member of the drug class known as statins. It is used for lowering cholesterol. Atorvastatin is a competitive inhibitor of hydroxymethylglutaryl-coenzyme A (HMG-CoA) reductase, the rate-determining enzyme in cholesterol biosynthesis via the mevalonate pathway. HMG-CoA reductase catalyzes the conversion of HMG-CoA to mevalonate. Atorvastatin acts primarily in the liver. Decreased hepatic cholesterol levels increases hepatic uptake of cholesterol and reduces plasma cholesterol levels.
Synonyms	Lipovastatinklonal
Salts	Atorvastatin Calcium
Brand names	Atogal Cardyl Faboxim Hipolixan Lipitor [more]
Affected organism	Humans and other mammals
Indication	May be used as primary prevention in individuals with multiple risk factors for

Instances in PDB Entries

As free ligands: **1 entries**
Ex: **1HWK**

Opportunity: Structure Summary

- 2014 Structure Summary Pageviews slightly down from 2013
- Plans Forward:
  - Improve searching to ↑ traffic
  - Monitor impact



Pageviews - explore.do

Jan 1, 2014 - Sep 17, 2014

6,551,494

Jan 2, 2013 - Sep 18, 2013

6,813,348

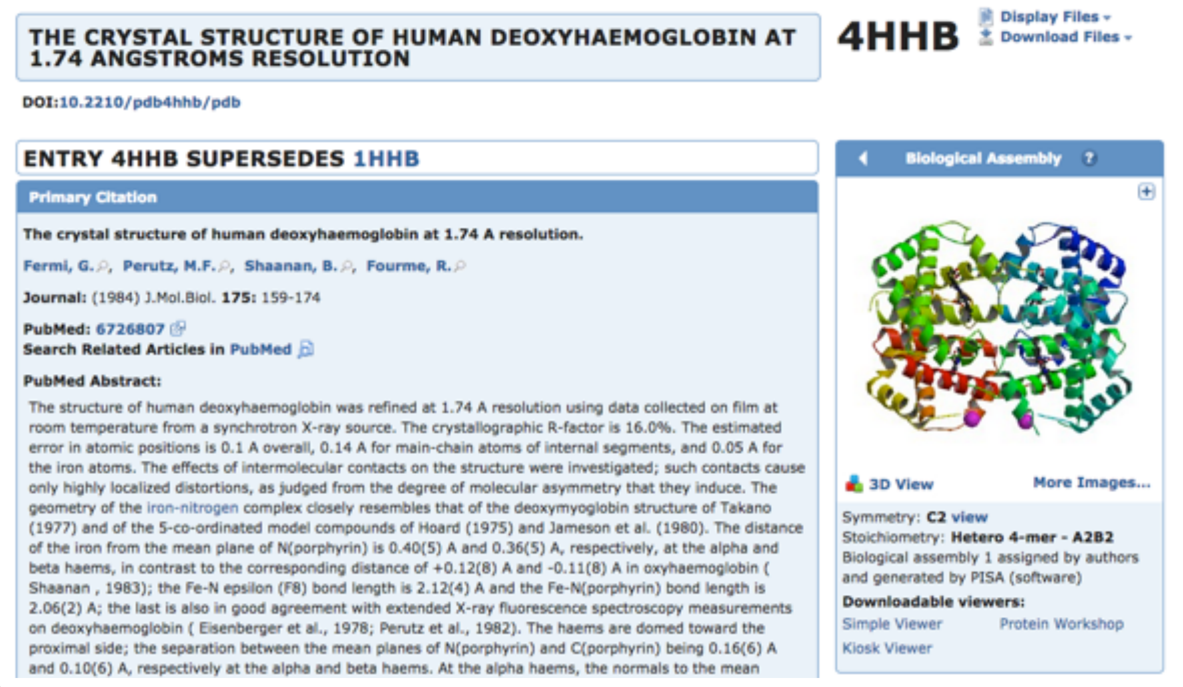
Visits - explore.do

Jan 1, 2014 - Sep 17, 2014

991,829

Jan 2, 2013 - Sep 18, 2013

1,245,275



THE CRYSTAL STRUCTURE OF HUMAN DEOXYHAEMOGLOBIN AT 1.74 ANGSTROMS RESOLUTION

4HHB

DOI: 10.2210/pdb4hhb/pdb

ENTRY 4HHB SUPERSEDES 1HHB

Primary Citation

The crystal structure of human deoxyhaemoglobin at 1.74 A resolution.

Fermi, G., Perutz, M.F., Shaanan, B., Fourme, R.

Journal: (1984) J.Mol.Biol. **175:** 159-174

PubMed: 6726807

Search Related Articles in PubMed

PubMed Abstract:

The structure of human deoxyhaemoglobin was refined at 1.74 A resolution using data collected on film at room temperature from a synchrotron X-ray source. The crystallographic R-factor is 16.0%. The estimated error in atomic positions is 0.1 A overall, 0.14 A for main-chain atoms of internal segments, and 0.05 A for the iron atoms. The effects of intermolecular contacts on the structure were investigated; such contacts cause only highly localized distortions, as judged from the degree of molecular asymmetry that they induce. The geometry of the iron-nitrogen complex closely resembles that of the deoxymyoglobin structure of Takano (1977) and of the 5-co-ordinated model compounds of Hoard (1975) and Jameson et al. (1980). The distance of the iron from the mean plane of N(porphyrin) is 0.40(5) A and 0.36(5) A, respectively, at the alpha and beta haems, in contrast to the corresponding distance of +0.12(8) A and -0.11(8) A in oxyhaemoglobin (Shaanan , 1983); the Fe-N epsilon (F8) bond length is 2.12(4) A and the Fe-N(porphyrin) bond length is 2.06(2) A; the last is also in good agreement with extended X-ray fluorescence spectroscopy measurements on deoxyhaemoglobin (Eisenberger et al., 1978; Perutz et al., 1982). The haems are domed toward the proximal side; the separation between the mean planes of N(porphyrin) and C(porphyrin) being 0.16(6) A and 0.10(6) A, respectively at the alpha and beta haems. At the alpha haems, the normals to the mean

Symmetry: **C2** view

Stoichiometry: **Hetero 4-mer - A2B2**

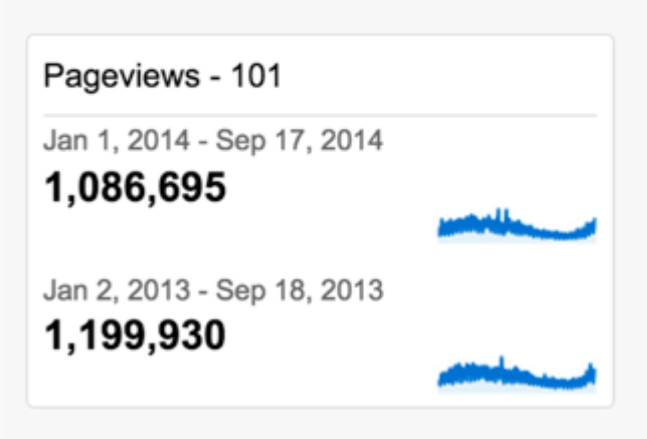
Biological assembly 1 assigned by authors and generated by PISA (software)

Downloadable viewers:

Simple Viewer Protein Workshop

Kiosk Viewer

Opportunity: PDB-101



Pageviews - 101

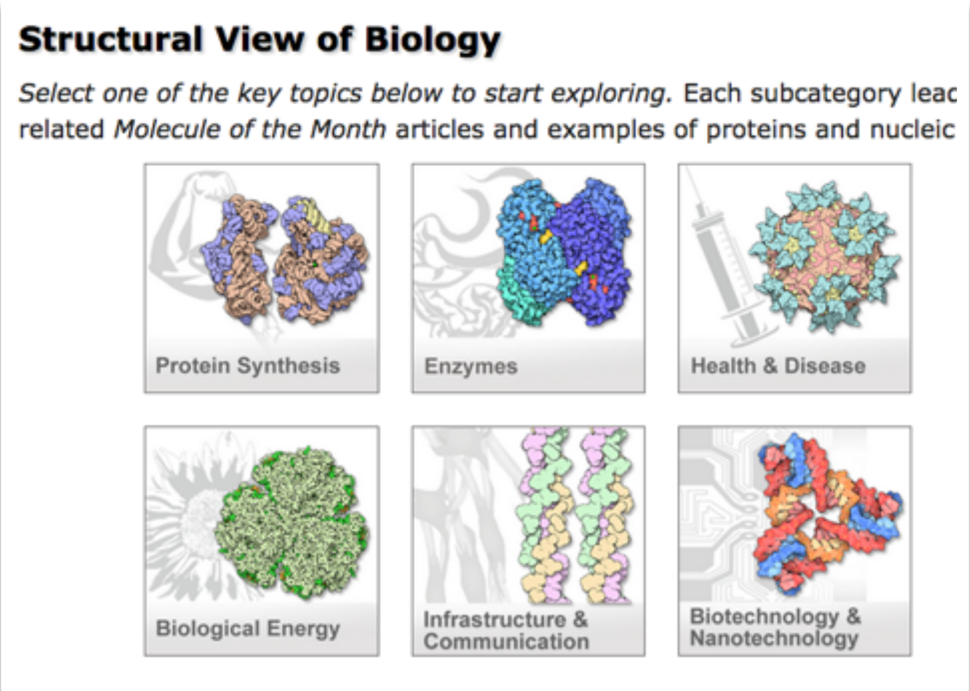
Jan 1, 2014 - Sep 17, 2014

1,086,695

Jan 2, 2013 - Sep 18, 2013

1,199,930

- 2014 page views slightly down from 2013
- Plans Forward
  - Reposition to ↑ traffic
  - Redesign to enhance usability
  - Monitor impact



Structural View of Biology

Select one of the key topics below to start exploring. Each subcategory leac related *Molecule of the Month* articles and examples of proteins and nucleic

Protein Synthesis
Enzymes
Health & Disease
Biological Energy
Infrastructure & Communication
Biotechnology & Nanotechnology

Continuous Integration Software Development Process

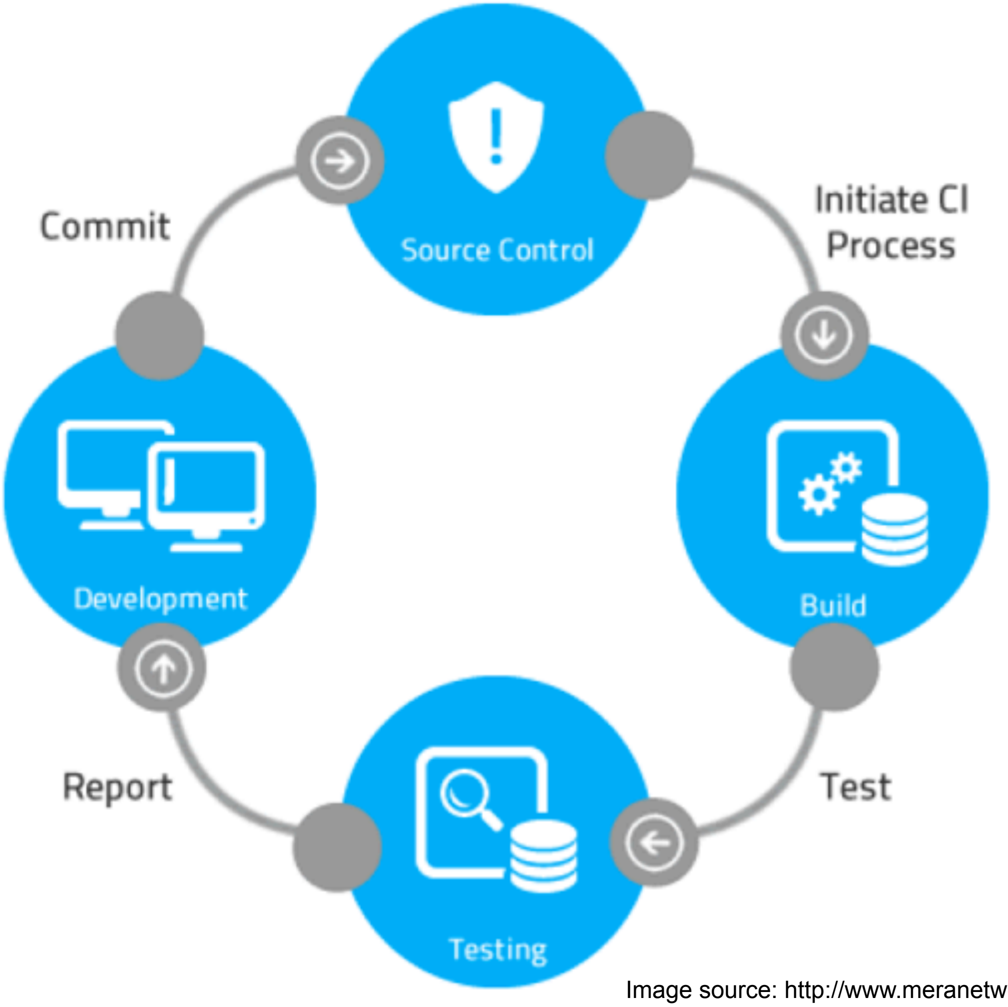
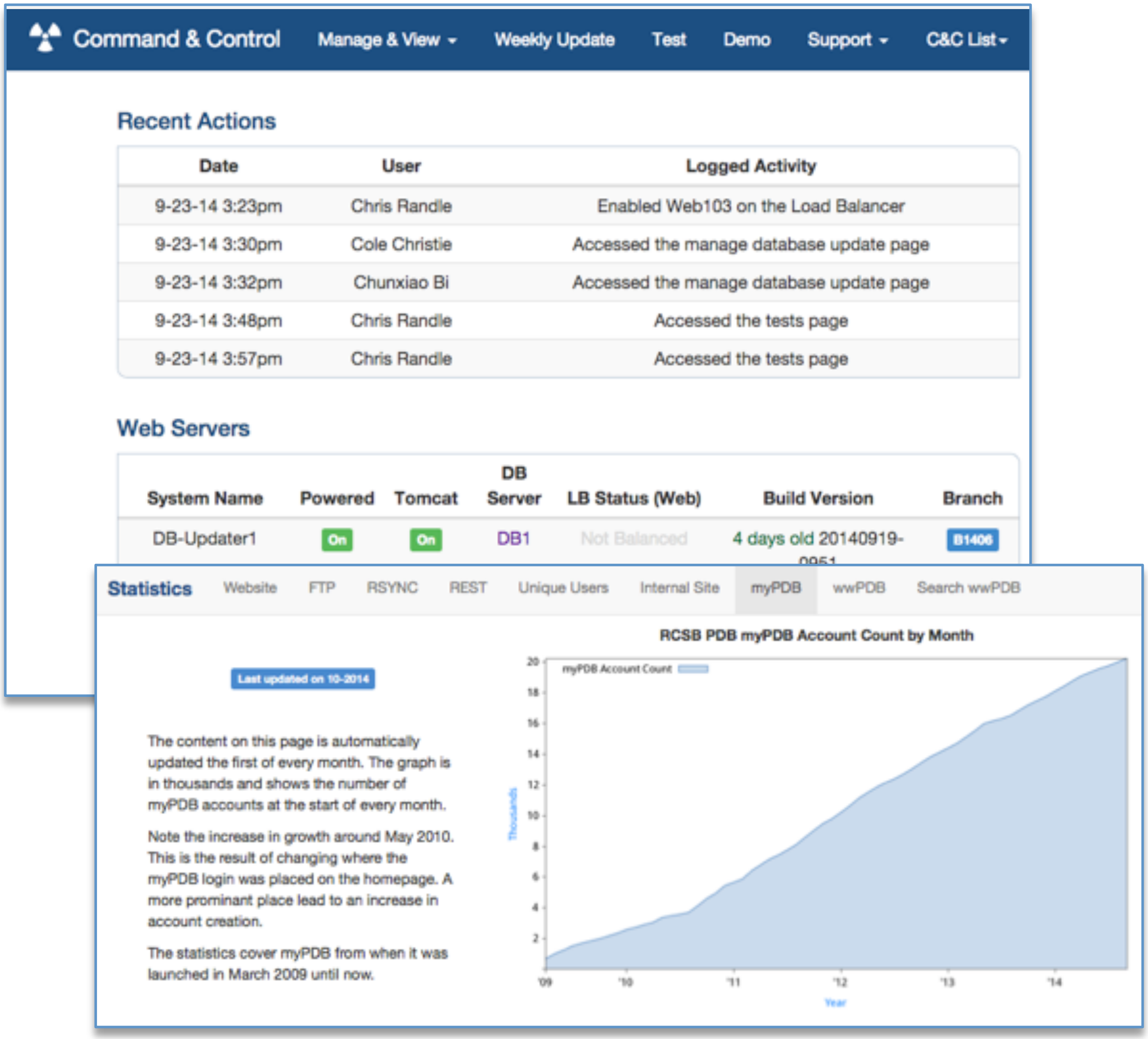

Source Control
Initiate CI Process
Build
Test
Testing
Report
Development
Commit

Image source: http://www.meranetworks.com/services/processes/integration

Automation Improvements

- Weekly update
- Software deployments
- Monitoring of services
- Additional usage statistics


Command & Control
Manage & View
Weekly Update
Test
Demo
Support
C&C List

Recent Actions

Date	User	Logged Activity
9-23-14 3:23pm	Chris Randle	Enabled Web103 on the Load Balancer
9-23-14 3:30pm	Cole Christie	Accessed the manage database update page
9-23-14 3:32pm	Chunxiao Bi	Accessed the manage database update page
9-23-14 3:48pm	Chris Randle	Accessed the tests page
9-23-14 3:57pm	Chris Randle	Accessed the tests page

Web Servers

System Name	Powered	Tomcat	DB Server	LB Status (Web)	Build Version	Branch
DB-Updater1	On	On	DB1	Not Balanced	4 days old 20140919-0951	B1406

Statistics
Website
FTP
RSYNC
REST
Unique Users
Internal Site
myPDB
wwPDB
Search wwPDB

Last updated on 10-2014

The content on this page is automatically updated the first of every month. The graph is in thousands and shows the number of myPDB accounts at the start of every month.

Note the increase in growth around May 2010. This is the result of changing where the myPDB login was placed on the homepage. A more prominant place lead to an increase in account creation.

The statistics cover myPDB from when it was launched in March 2009 until now.

RCSB PDB myPDB Account Count by Month
myPDB Account Count
Thousands
20
18
16
14
12
10
8
6
4
2
'09
'10
'11
'12
'13
'14
Year

Plans for 2014/2015

2014

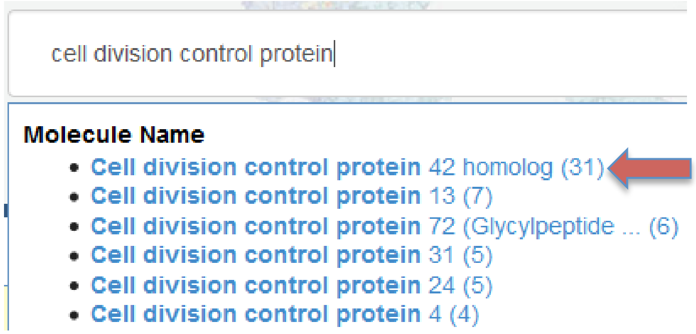
- Deploy redesigned RCSB PDB website (Phase 1)
- Support large structures deployment (December 10th)

2015

- Scientific projects
  - Expand synonym search using sequence clusters (Q1 2015)
  - Visualization
    - Validation data (geometry, e-density)
    - Membrane protein orientation
  - Structure mapping
    - Protein Kinase, GPCR, and Nuclear Hormone Receptor phylogenetic trees
    - Signal transduction pathways
- Technical projects
  - Website redesign Phase 2, including PDB-101
  - Improve scalability of backend calculations and data integration
  - Quantify PDB impact through citation network analysis

Molecule Name Searching Limitations

- Based on UniProt annotation
  - Consistent and unambiguous naming: www.uniprot.org/docs/nameprot
  - Search suggestion

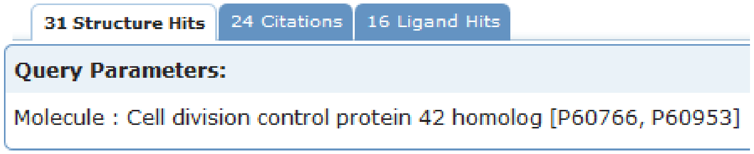


cell division control protein

Molecule Name

- **Cell division control protein** 42 homolog (31)
- **Cell division control protein** 13 (7)
- **Cell division control protein** 72 (Glycylpeptide ... (6)
- **Cell division control protein** 31 (5)
- **Cell division control protein** 24 (5)
- **Cell division control protein** 4 (4)

  - Select *Cell division control protein 42 homolog*
    - 1. Find all UniProt entries with a matching name -> P60766, P60953



Query Parameters:

Molecule : Cell division control protein 42 homolog [P60766, P60953]

    - 2. Retrieve all structures with UniProt IDs: P60766, P60953

- Limitation: Searches using Depositor-assigned protein name
  - GTP-BINDING RHO-LIKE PROTEIN (Biologists love synonyms!)
  - Some typographical inconsistencies and errors inevitable

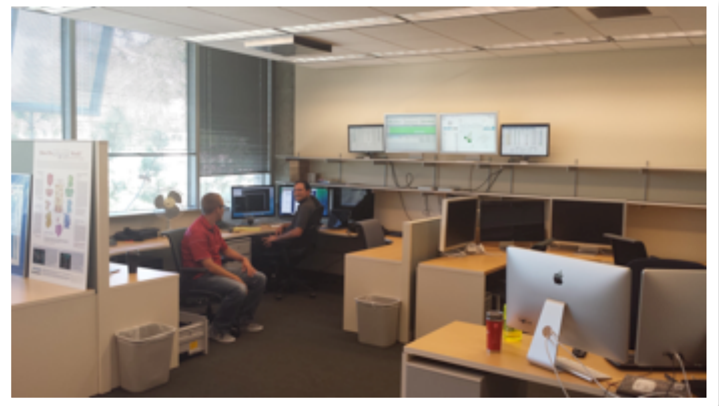
Sequence-based Synonym Searching

- Search for *GTP-BINDING RHO-LIKE PROTEIN* ➔ 1 hit
- Archive contains multiple names for the same protein
    - Example: 90% Sequence Identity Cluster (31 entries, 13 synonyms)
        - Cell division control protein 42 homolog (UniProt name)
        - cell division cycle 42 isoform 1
        - PROTEIN (GTP BINDING PROTEIN (G25K))
        - PROTEIN (GTP BINDING PROTEIN)
        - G25K GTP-binding protein, placental isoform
        - CDC42 HOMOLOG
        - Human Cell Division Cycle 42 (CDC42)
        - GTP-BINDING PROTEIN
        - G25K GTP-BINDING PROTEIN
        - CDC42HS
        - CDC42HS-GDP
        - G25K GTP-BINDING PROTEIN, PLACENTAL ISOFORM (GP),
        - PROTEIN (CDC42 HOMOLOG)
        - GTP-BINDING RHO-LIKE PROTEIN (protein name used for text search)
- These proteins can be found by current text search, but results will be incomplete due to inconsistent and partial annotation
- Not practical to remediate protein names for >100,000 entries
- **Our approach: Attribute all names to all members of each high sequence identity cluster to improve accuracy of text-based searching**

New Office Space at UCSD

- Moved to larger space at 2nd floor of Skaggs School of Pharmacy and Pharmaceutical Sciences

- Provides room for additional staff, students, and postdocs



RCSB PDB UCSD Team

Job Openings at UC San Diego

- Senior Java Web Developer
- Senior Scientist