



トーゴーの日シンポジウム 2022

異分野融合を志向した糖鎖科学 ポータルのデータ拡充と品質向上

木下聖子

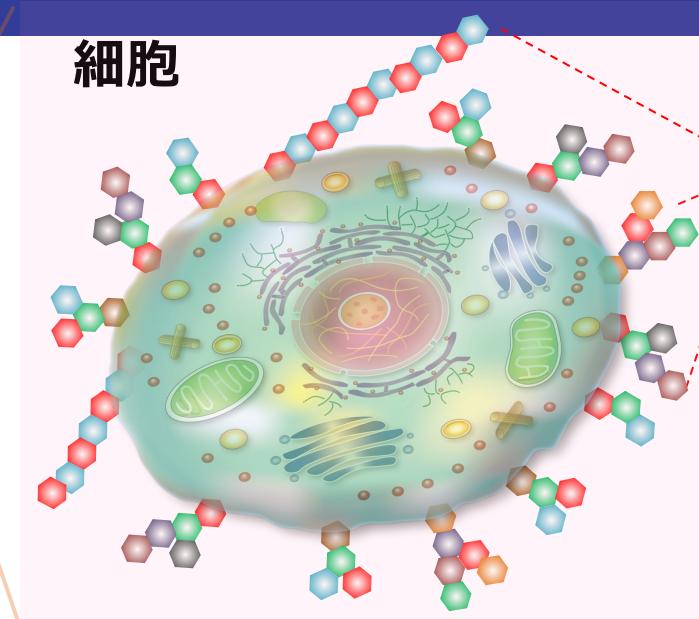
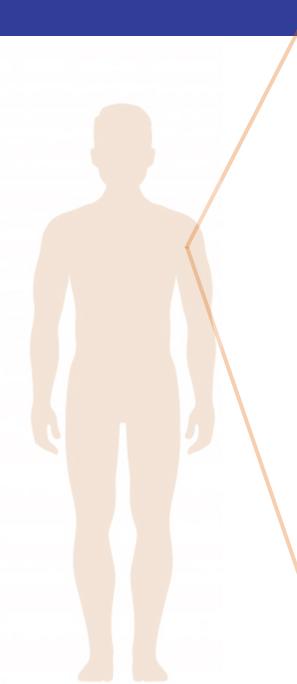
創価大学 糖鎖生命システム融合研究所 副所長

2022年10月5日

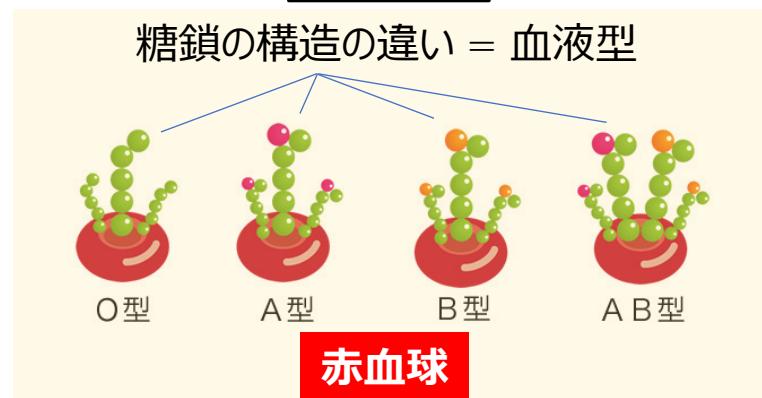
SOKA University

Discover your potential

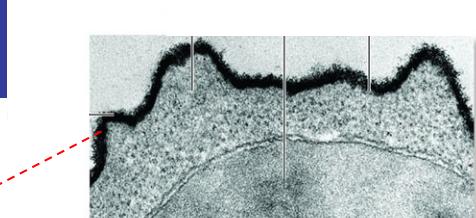
糖鎖の生物学的役割



血液型



糖鎖が細胞の**品質**を決める

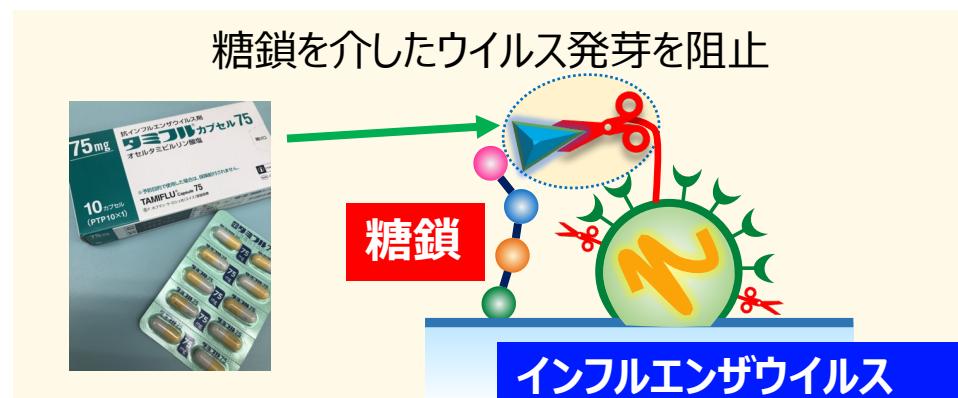


【糖鎖】

全細胞を覆いつくす生体分子

- ・ 細胞の個性を決定
- ・ 認知症・がん・感染症・老化などに関与する
- ・ 糖鎖研究は日本が世界をリード

タミフル



糖鎖を**標的**とした医薬品



The GlyCosmos Glycomics Portal

- Submissions (Repositories)
 - GlyTouCan (glycans)
 - GlycoPOST (raw MS data)
 - UniCarb-DR (annotated glycomics data)
 - GlyComb (glycoconjugates; currently only glycopeptides)
- Resources
 - Glycomes
 - Glycans
 - Glycoconjugates
 - Glycogenes
 - Diseases
 - Pathways
 - etc.
- Tools
- Standards

<https://glycosmos.org>

Submissions

- GlyTouCan
Glycan Structure Repository
- GlyComb (beta)
Glycoconjugate Repository
- GlycoPOST
Glycomic MS Repository
- UniCarb-DR
Glycomic MS Repository

Resources

- Glycogenes
- Glycoproteins
- Lectins
- Glycolipids
- Glycans
- Pathways
- Diseases
- Organisms

All Resources

- Genes / Proteins / Lipids
- Glycans / Glycoconjugates
- Glycomes
- Pathways / Interactions / Diseases / Organisms

Tools

- SugarDrawer
- GlycanBuilder
- Glycan Converters
- GlycoMaple
- GALAXY ↗
- MCAW ↗
- GlycoSim ↗

Search Tools

- Glycan Search
- Publication Search
- Cross Search
- Programmatic Access

Welcome to GlyCosmos!!

The GlyCosmos Portal is a Web portal aiming to integrate the glycosciences with the life sciences. It consists of Standards, Repositories and Data Resources, providing information about genes, proteins, lipids, pathways and diseases.

[Learn More](#) [Release Notes](#)

Cross Search

Keyword [Search](#)

Glycan Search

- | | |
|---|---------------------------------------|
| Search by text | Search by species |
| Search by graphic | Search by mass |
| GNOME Structure Browser | Search by composition |

Publication Search

[GlyCosmos PubAnnotation](#)

Data Resources

Main Data Resources

Overview Figure

- Glycogenes Integrated list of glycan-related genes, including glycosyltransferases, hydrolases, etc.
- Glycoproteins Integrated list of glycoproteins extracted from UniProt and annotated with glycosylation data from GlyGen and GlyConnect. For each entry, information such as glycosylation site, glycans, diseases, 3D structures, and pathway information are available.
- Lectins Protein entries annotated as carbohydrate-binding in UniProt. Glycosylation site information, along with glycan-binding patterns are also integrated where available.
- Glycolipids Glycolipid entries from the LIPID MAPS Structure Database (LMSD).
- Glycans The list of validated glycans extracted from GlyTouCan, updated weekly.
- Pathways Pathways from Reactome containing glycoproteins as annotated in UniProt. Search by pathway name, species, and protein name.
- Diseases List of diseases involving glycan related genes. The information of each database of Glyco-Disease Genes Database (GDGDB), DisGeNET, and Alliance of Genome Resources is integrated into one list.
- Organisms List of all species in GlyCosmos Resources.

[Release Statistics](#)

[Download](#)

News

Tweets by @GlyCosmos

GlyCosmos
@GlyCosmos

GlyCosmos Portal beta release has just been updated! Please check it out and send any feedback this week. This version will be released to production on August 8th!
[beta.glycosmos.org](#)

[Heart](#) [Reply](#)

Aug 1, 2022

GlyCosmos Retweeted

C14CB research group
@C14CB

RT: IBSIB: RT @GlycomicsExpsy: Very pleased to announce the release of a new GlySpace Alliance website! Find out more on our @IBSIB collaboration with @GlyCosmos and @gly_gen and our #glycoinformatics backyard 🌱🧬

[Heart](#) [Reply](#)

Jul 20, 2022

GlyCosmos Retweeted

Iain Wilson
@IainWilson298866

Abstract doodling extended for #inlambon

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GlyCosmos Pathways

GlyCosmos Pathways

Pathways from Reactome containing glycoproteins as annotated in UniProt.

Search by pathway name, species, and protein name.

Select Organism

- [Bos taurus](#)
- [Caenorhabditis elegans](#)
- [Canis familiaris](#)
- [Danio rerio](#)
- [Dictyostelium discoideum](#)
- [Drosophila melanogaster](#)
- [Escherichia coli](#)
- [Gallus gallus](#)
- [Homo sapiens](#)
- [Mus musculus](#)
- [Plasmodium falciparum](#)
- [Rattus norvegicus](#)
- [Saccharomyces cerevisiae](#)
- [Schizosaccharomyces pombe](#)
- [Sus scrofa](#)
- [Xenopus tropicalis](#)

Database	Last Updated
Reactome	June 7, 2021 (Version 76)
UniProt	June 7, 2021

▼Search all pathways

Keratan sulfate biosynthesis

Keratan sulfate degradation

Keratan sulfate/keratin metabolism

Tree of Keratan sulfate degradation

Show Tree

Click on the button below to select the tree you wish to view. In the pathway map tree, click on the circle to open/close the sub-pathway, and click on a pathway name highlighted in light blue to see a detailed pathway map.

Bos taurus	Caenorhabditis elegans	Canis familiaris
Danio rerio	Dictyostelium discoideum	Drosophila melanogaster
Gallus gallus	Homo sapiens	Mus musculus
Rattus norvegicus	Sus scrofa	

【Pathways】

Reactome

→Pathways related to glycoproteins



GlyCosmos Pathways

R-HSA-2022857

Pathway Name: Keratan sulfate catabolism
Species: Homo sapiens

Glycosylation Sites

#	Position	Description	PubMed ID	Glycan
1	26	N-linked (GlcNAc...) asparagine		
2	247	N-linked (GlcNAc...) asparagine	22128166 24737316	G05724UK
3	464	N-linked (GlcNAc...) asparagine	16263699 19159218 22128166 24737316	G05724UK G06110VR G10773YW G11870QZ G11911BT G20210JR G23294PN

BGAL

UniProtID ProteinName
[P16278](#) Beta-galactosidase
[Q6UWU2](#) Beta-galactosidase-1-like protein

Pathway Reactor

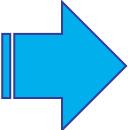
It

Lectin Frontier DataBase (LfDB)

Top 3 high affinity glycans and the actual measurement ($V-V_0$) values by an automated frontal affinity chromatography with fluorescence detection from [LfDB](#).

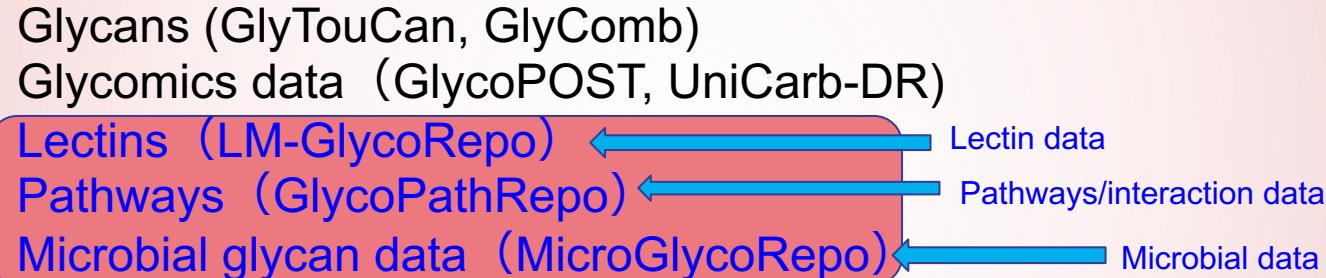
GlyTouCan	$V-V_0$
G65070LF	76.458
G67280SN	35.628
G55601IV	13.412
UniProtID ProteinName	
O60938 Keratanase	
P16112 Aggrecan core protein	
P20774 Mimecan	
P51884 Lumican	
P51888 Prolargin	
Q06828 Fibromodulin	

The new GlyCosmos project



Repository expansion

MIRAGE
WIBACE

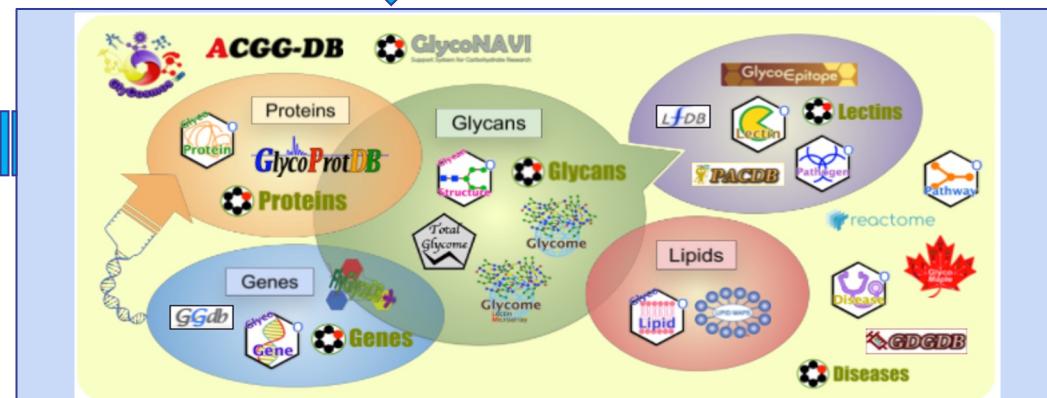


Easier access to data for understanding glycan function!



- Semi-automatic curation system
- Annotation jamborees

Data Resource expansion



All linked in the Semantic Web

LM-GlycomeAtlas Ver 2.0

- Web tool to visualize laser microdissection-assisted lectin microarray analyses data using 45 lectins
 - high-throughput and in-depth glycomic profiling of formalin-fixed paraffin-embedded mouse tissue sections
- Ver 2.0:
 - nine normal mice tissues (234 profiling data) → 14 tissues from normal and diseased (451 profiling data)



LM-GlycomeAtlas ?

LM-GlycomeAtlas is a web tool visualizing the data from Lectin Array analyses by the Kuno Laboratory at AIST.

Reference	Release Date
Ver. 1.0	August 15, 2019
Ver. 2.0	December 7, 2020

LM-GlycomeAtlas v2.0 is a web tool visualizing the data from Lectin Microarray analyses using 45 lectins by the [Kuno Laboratory](#) at AIST.

This work was supported by a project for utilizing glycans in the development of innovative drug key technology for discovering and diagnosis from the Japan Agency for

ACS Publications
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RETURN TO ISSUE < PREV TECHNICAL NOTE NEXT >

LM-GlycomeAtlas Ver. 2.0: An Integrated Visualization for Lectin Microarray-based Mouse Tissue Glycome Mapping Data with Lectin Histochemistry

Chiaki Nagai-Okatani*, Xia Zou, Noriaki Fujita, Isami Sogabe, Kouiti Arakawa, Misugi Nagai, Kiyohiko Angata, Yan Zhang, Kiyoko F. Aoki-Kinoshita, and Atsushi Kuno*

Cite this: *J. Proteome Res.* 2021, 20, 4, 2069–2075 Article Views Altmetric Citations Share Add to Export

Publication Date: March 4, 2021 <https://doi.org/10.1021/acs.jproteome.0c00907>

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Collaboration with Dr. Kuno at AIST

LM-GlycomeAtlas Ver 2.0

- Web tool to visualize laser microdissection-assisted lectin microarray analyses data using 45 lectins
 - high-throughput and in-depth glycomic profiling of formalin-fixed paraffin-embedded mouse tissue sections
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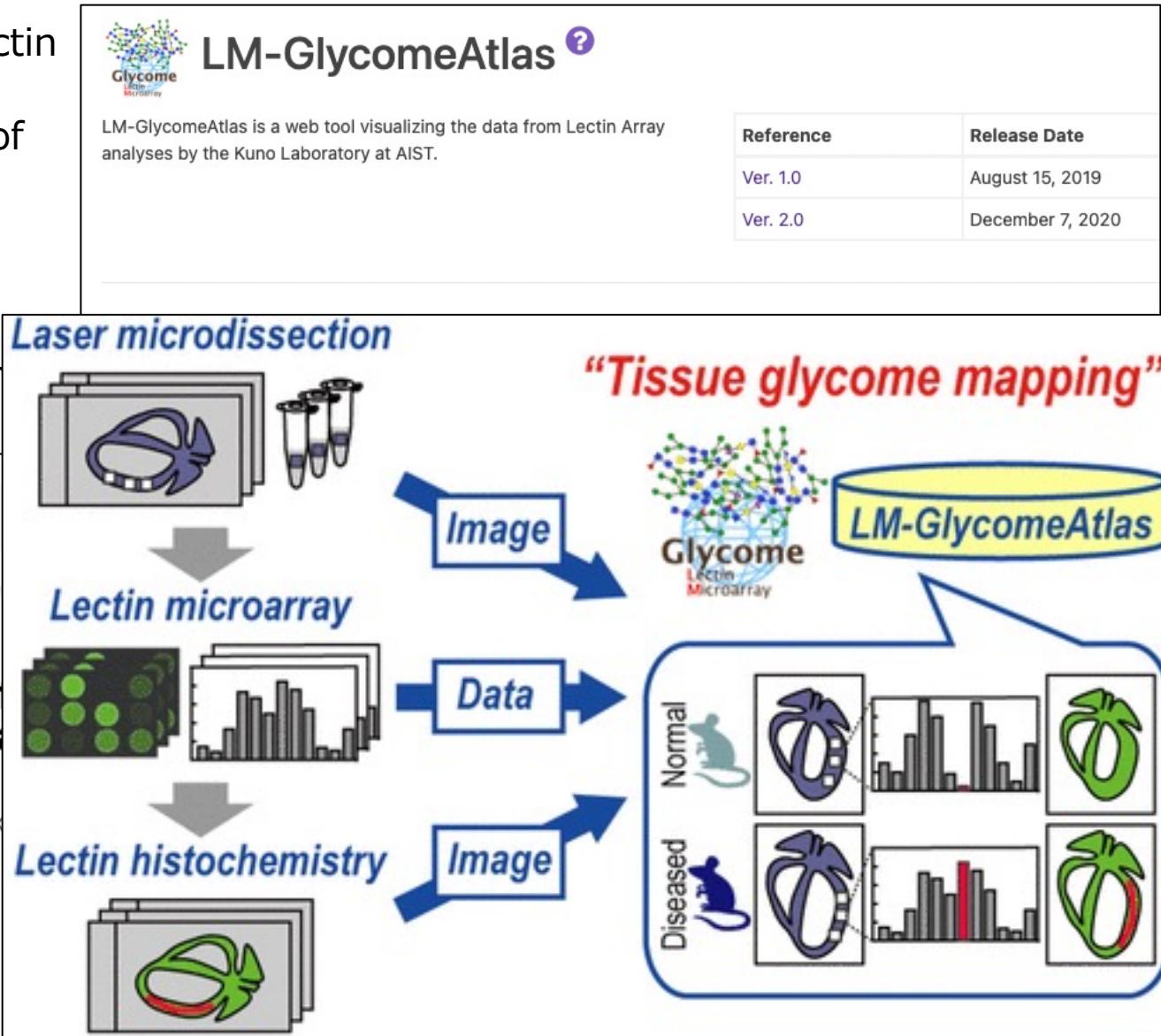
Chiaki Nagai-Okatani*, Xia Zou, Noriaki Fujita, Isami Sogabe, Kouiti Arakawa, Misugi Nagai, Kiyohiko Kiyoko F. Aoki-Kinoshita, and Atsushi Kuno*

Cite this: *J. Proteome Res.* 2021, 20, 4, 2069–2075 Article Views 294 Altmetric 2 Citations - LEARN ABOUT THESE METRICS

Publication Date: March 4, 2021 <https://doi.org/10.1021/acs.jproteome.0c00907>

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- [Campylobacter](#)
- [Cryptococcus](#)
- [Mycobacterium](#)

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- [DrawGlycan-SNFG](#)

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Welcome to MicroGlycoDB!!

MicroGlycoDB is a new database of glycan-related information in microorganisms using the **Semantic Web** technologies, in order to elucidate various biological processes that occur in vivo in these organisms.

[Learn More](#)

Organisms

Please click each icon.

- *Bifidobacterium*
 - *Bifidobacterium bifidum*
 - *Bifidobacterium longum*
- *Campylobacter*
 - *Campylobacter jejuni*
- *Cryptococcus*
 - *Cryptococcus neoformans*
- *Mycobacterium*
 - *Mycobacterium abscessus*
 - *Mycobacterium tuberculosis*

[Downloads](#)

創価大学国際共同研究費

- リール大学
- 米国ジョージア大学

微生物における糖鎖関係
データベースMicroGlycoDB

<https://microglycodb.test.glycosmos.org/>

現在論文執筆中

Campylobacter jejuni

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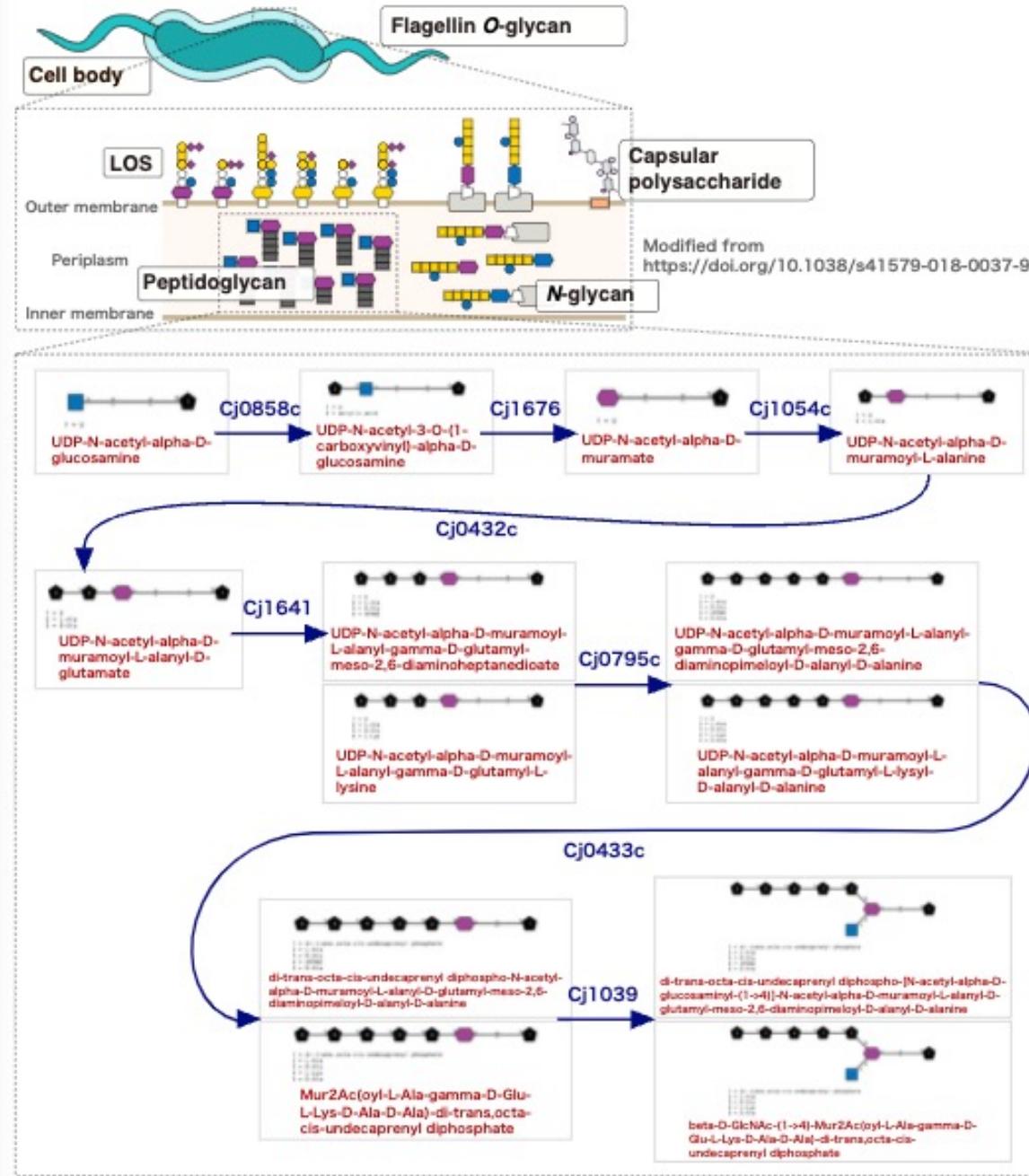
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[Genes](#) [Glycans](#)
[All data](#) [LOS](#) [Flagellin O-glycan](#) [N-glycan](#) [Capsular polysaccharide](#) [Peptidoglycan](#)

Gene ID	Gene No.	Gene Name	NOTES - phase variation etc
microglycodb_gene_00186	Cj1039	<i>murG</i>	UDP-diphospho-muramoylpentapeptide beta-N-acetylglucosaminyltransferase, leads to the formation of Lipid II
microglycodb_gene_00187	Cj1676	<i>murB</i>	Catalyzes the reduction of UDP N-acetylglucosamine enolpyruvate to form UDP-N-acetylmuramate in peptidoglycan biosynthesis
microglycodb_gene_00188	Cj1054c	<i>murC</i>	Catalyzes the formation of UDP-N-acetyl muramoyl-L-alanine from UDP-N-acetyl muramate and L-alanine in peptidoglycan synthesis
microglycodb_gene_00189	Cj0432c	<i>murD</i>	DP-N-acetyl muramoylalanine-D-glutamate ligase
microglycodb_gene_00190	Cj0433c	<i>mraY</i>	First step of the lipid cycle reactions in the biosynthesis of the cell wall peptidoglycan, leads to the formation of Lipid I
microglycodb_gene_00191	Cj0858c	<i>murA</i>	Enolpyruvyl to UDP-N-acetylglucosamine as a component of cell wall formation
microglycodb_gene_00192	Cj1641	<i>murE</i>	Involved in cell wall formation; peptidoglycan synthesis; cytoplasmic enzyme; catalyzes the addition of meso-diaminopimelic acid to the nucleotide precursor UDP-N-acetyl muramoyl-L-alanyl-D-glutamate
microglycodb_gene_00193	Cj0795c	<i>mufF</i>	UDP-N-acetyl muramoyl-tripeptide
microglycodb_gene_00194	Cj0798c	<i>ddl</i>	D-alanine-D-alanine ligase
microglycodb_gene_00195	Cj1652c	<i>murl</i>	Converts L-glutamate to D-glutamate, a component of peptidoglycan
			Cell division / peptidoglycan biosynthesis

GlycoMaple

糖鎖関連遺伝子を合成パスウェイ上に発現量を反映させて、糖鎖構造の合成を可視化するツール



Glycogene Expression Pathway Viewer

Please input .csv file (Gene ID, TPM value). Do you need [sample files](#)?

Data last updated: April 1, 2020

Choose File No file chosen

Submit

Complex: Min

Overlap: Ave

If two or more tabs are open in the diagram, two datasets can be compared using the Compare button below.

Compare

HPA(cell):

A-431

HPA(tissue):

adipose tissue

Unclear

1

4

None

4

20

x < 0.1

20

100

0.1 ≤ x < 1

100

100

100 ≤ x

100

100

LLO biosynthesis and OST

N-glycan processing and branching

Complex capping N-glycans/O-glycans/GSLs

Biosynthesis of GPI-APs

Biosynthesis of mucin-type O-glycans

Biosynthesis of O-Fuc/O-Glc/Col-Gal/O-GlcNAc/C-Man

Biosynthesis of O-Man

Biosynthesis of GAG

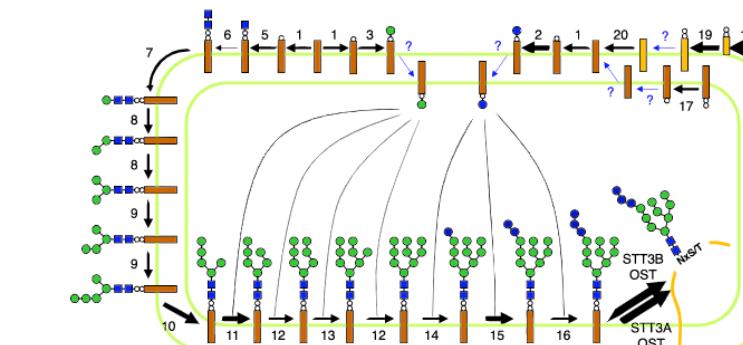
Biosynthesis of Heparan sulfate (HS)

Biosynthesis of Chondroitin sulfate (CS) and dermatan sulfate (DS)

Biosynthesis of Keratan sulfate (KS)

Biosynthesis of

default A-431



Download Image Legend

Glycogene Expression Pathway Viewer

 Please input .csv file (Gene ID, TPM value). Do you need [sample](#) files?

 No file chosen

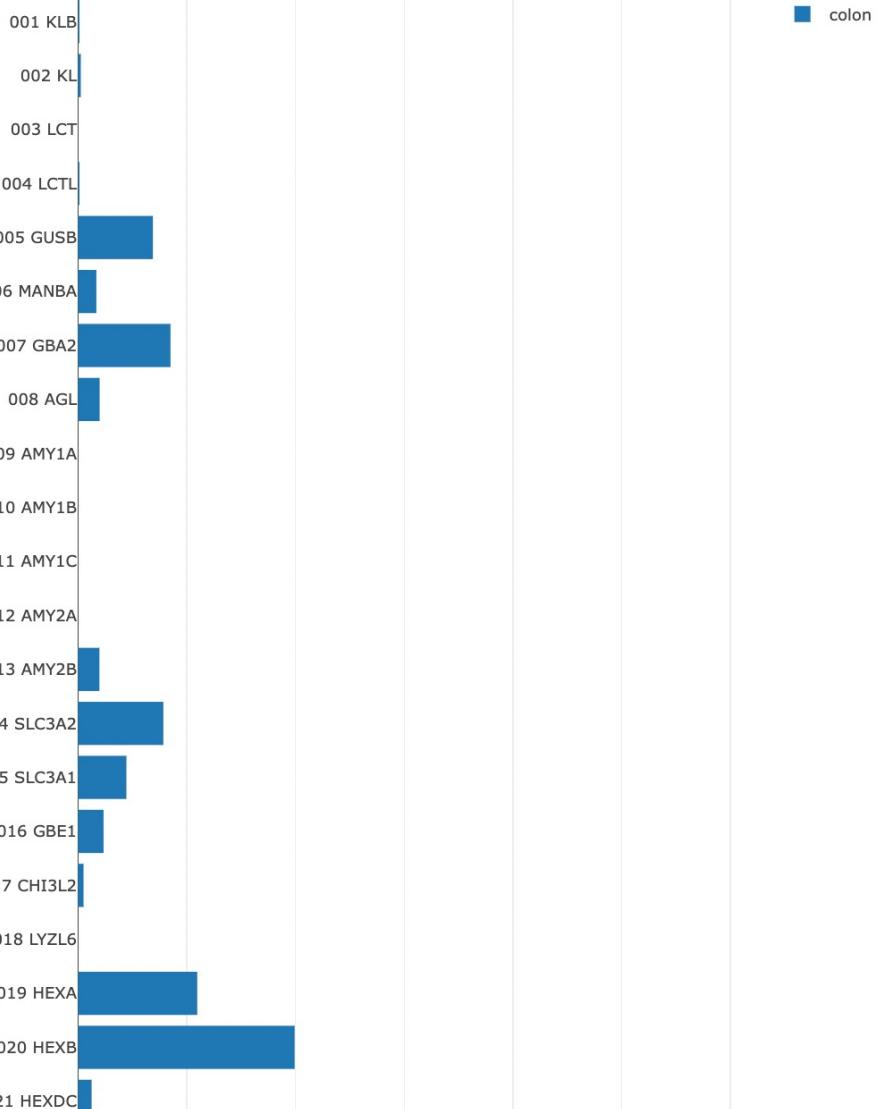
 Complex:

 Overlap:

If two or more tabs are open in the diagram, two datasets can be compared using the Compare button below.

Glycosylhydrolase

Carbohydrate Binding Module

 colon


Glycan Pathway Repository (糖鎖関連パスウェイ)



Pathway information Input

Basic Information of Glycosylation Pathway

Title

Description

Pathway Category [Select](#)

Pathway Category

- classic metabolic pathway
- signaling pathway
- regulatory pathway
- disease pathway
- drug pathway

Pathway ontology

NCBI Taxon

Brenda tissue ontology

Cell ontology

Species

Tissue [Select](#)

Cell Type

Backbone [Select abinding Backbone](#)

Related Disease [Select a related disease](#)

[Save New Pathway](#)

[Pathway List](#)

Tissue List

- animal
- organism form
- plant
- other source
- fungus



Reaction Information Input

Add of New Reaction

Reaction Number

2

Reactant Glycan

GlyToucan ID

G58161NS
IUPACcondensed
IUPACextened
Linear code

Enzyme

Type enzyme name(e.g. transferase)

[EC enzyme](#)

Sugar Nucleotide

Type your Sugar Nucleotide(e.g. Glucose)

Product Glycan [GlyToucan ID](#)

[Text of Glycan](#)

Cellular Localization

Type your cellular localization(e.g. Golgi)

[Cellular location](#)

[Close](#)

[Create](#)

[UniProt protein](#)

[Disease ontology](#)

➤ Glycan Pathway Repository: Uploaded results

- Confirmation of input reaction steps

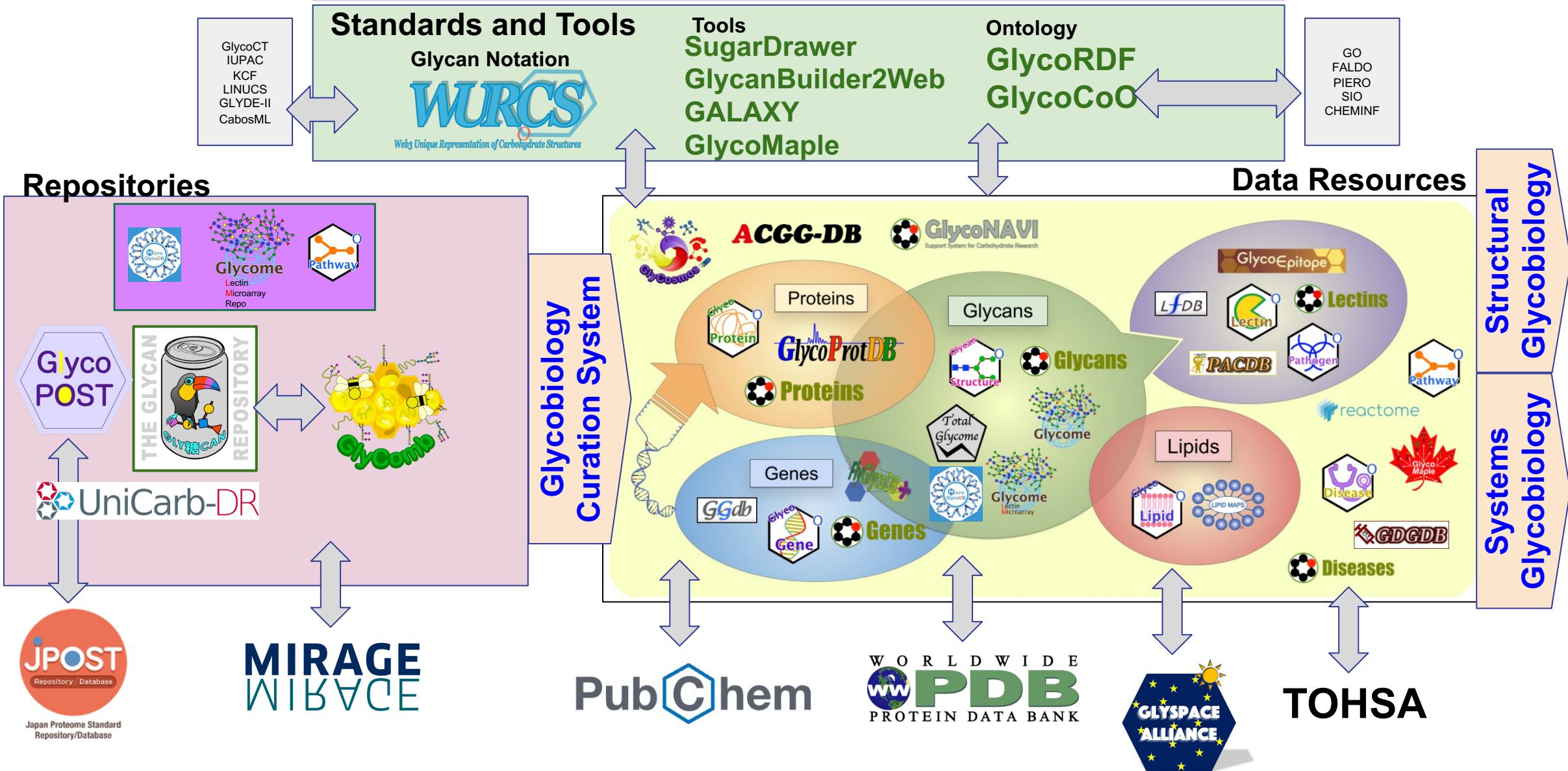
Reaction Table

RXN ID	Reactant	Enzyme	Sugar Nucleotide	Product	Cell Location	Action
1		rhamnogalacturonan I rhamnosyltransferase	L-Rhamnose		cytosol	
2		rhamnogalacturonan I rhamnosyltransferase	L-Rhamnose		cytosol	
3		rhamnogalacturonan I rhamnosyltransferase	L-Rhamnose		cytosol	
4		protein O-mannose b-1,4-N-acetylglucosaminyltransferase	D-Mannosamine		cytosol	

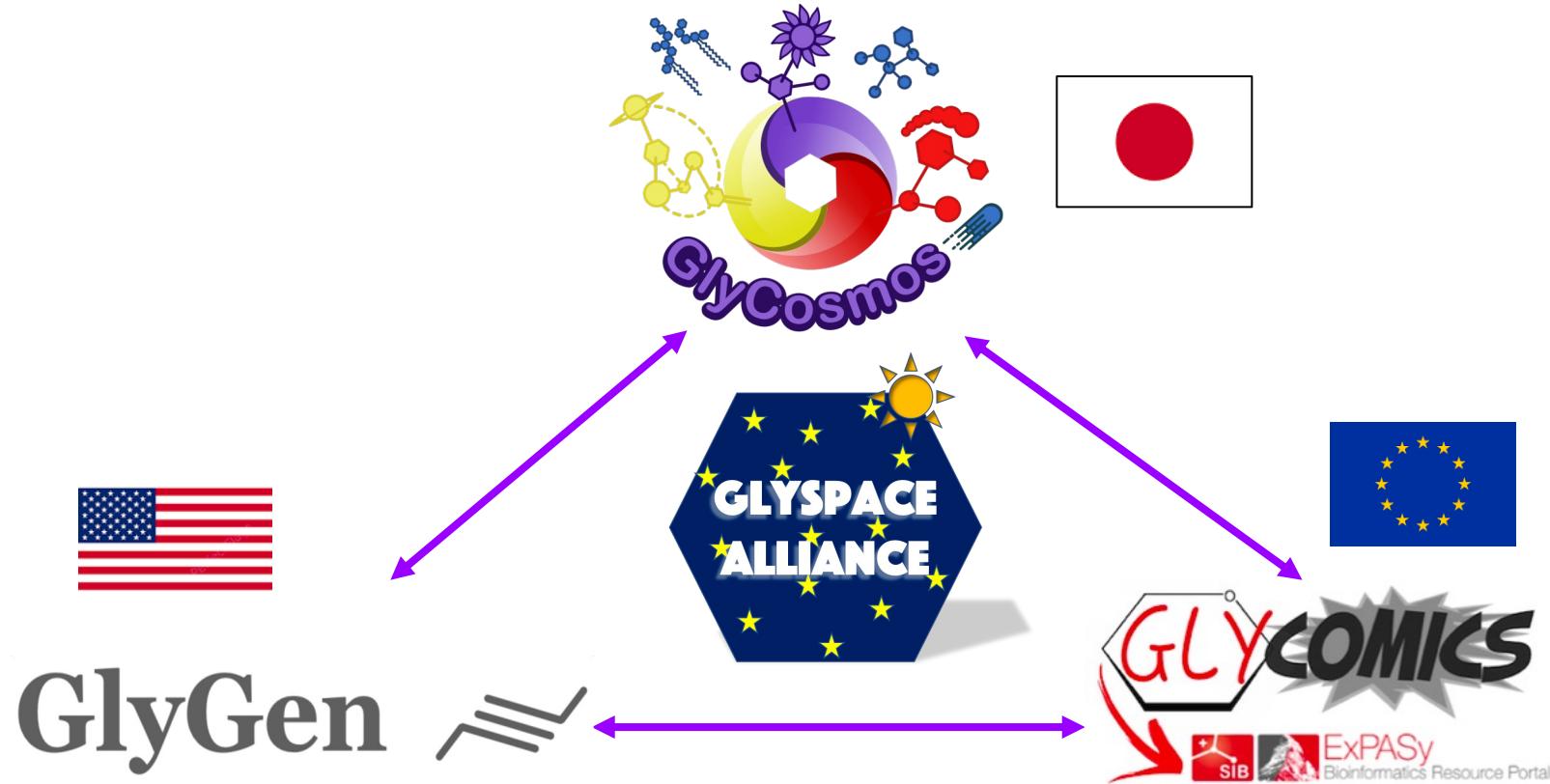
The visualized pathway information

Upload

GlyCosmos Portal



GlySpace Alliance



MIRAGEとの連携

- MIRAGE: Minimum Information Required for a Glycomics Experiment
- MIRAGE Recommendations:
 - GlyTouCan, GlycoPOST, UniCarb-DR, LM-GlycomeAtlas
- MIRAGE Ontologyの開発
 - <https://gitlab.com/m708/mirage-ontologies>
 - 質量分析メタデータのためのボキャブラリーの整理・管理

HOME BACKGROUND AIMS GUIDELINES EXAMPLES PEOPLE PUBLICATIONS MEETINGS CONTACT

PROJECTS > MIRAGE > RECOMMENDATIONS

MIRAGE RECOMMENDATIONS

As a platform for discussing and advancing glycomics, MIRAGE is paving the way for a number of related projects that include the development of software tools and repositories as well as the support of the use of an agreed nomenclature for the graphical representation of glycan structures. In order to promote these achievements, the MIRAGE Commission recommends the community to refer to these projects when glycan data are published and/or deposited.

REPOSITORIES AND DATABASES

Data	MIRAGE Guidelines	Repository	Database
Glycans	Sample Preparation	GlyTouCan	GlyTouCan MonosaccharideDB Carbohydrate Structure DB (CSDB)
MS data	Mass Spectrometric Analysis	GlycoPOST (raw data) UniCarb-DR (glycan annotations)	UniCarbDB
Glycan array data	Glycan Microarray Analysis	GlyGen microarray Imperial College Microarray Portal	CarbArrayART
Liquid chromatography data	Liquid Chromatography Analysis		GlycoStore
NMR data	NMR Glycan Recognition NMR Glycan Structures		NMRShiftDB
Lectin array data	Lectin Microarray Analysis (in preparation)		LM-GlycomeAtlas

GLYTOUCAN

GlyTouCan is the international glycan structure repository, developed and maintained at the Department of Bioinformatics, Faculty of Engineering, Soka University, Japan under the leadership of Prof. Kiyoko Aoki-Kinoshita.

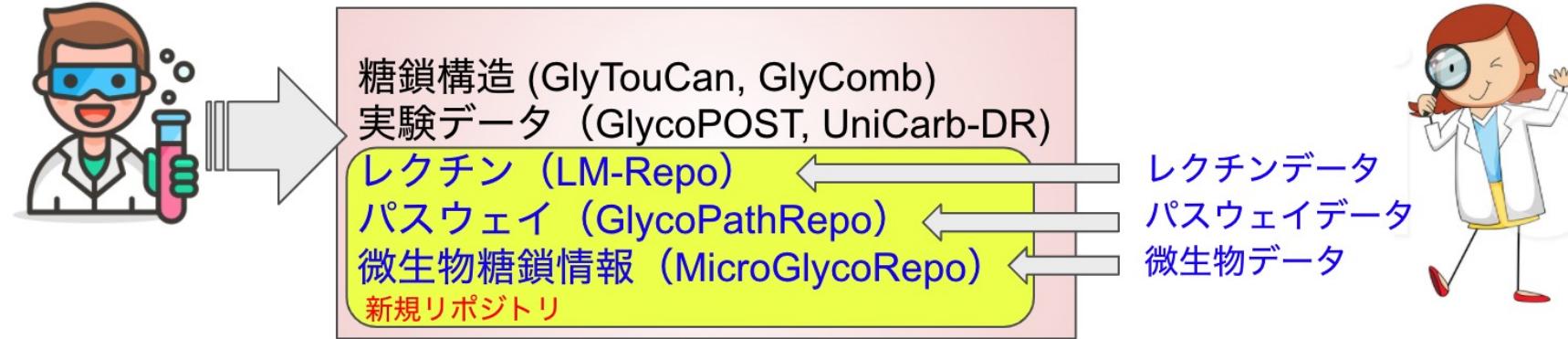
GlyTouCan is a freely available, uncurated registry for glycan structures that assigns globally unique accession numbers to any glycan independent of the level of information provided by the experimental method used to identify the structure(s).



まとめ

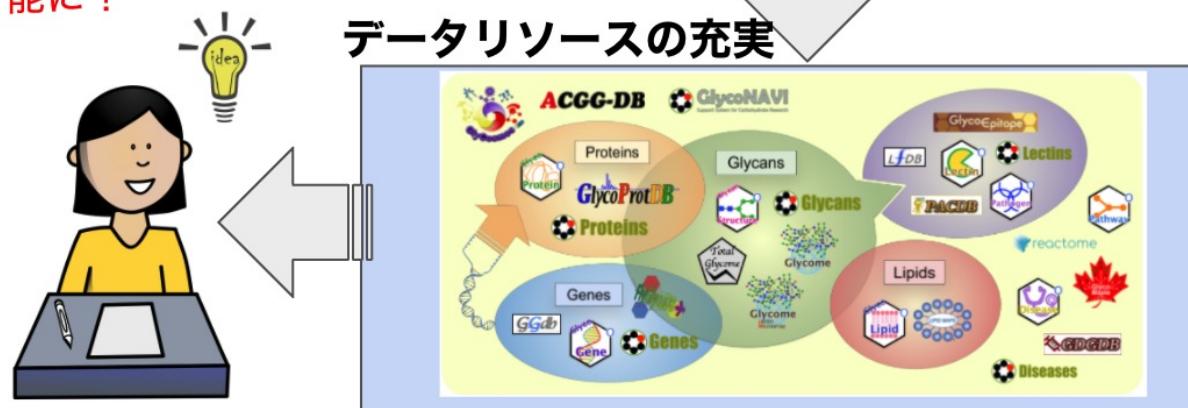


リポジトリの充実・整理統合 MIRAGE



より容易な糖鎖機能解明を
可能に！

- ・キュレーションシステム
- ・ジャンボリー開催
- リポジトリデータの半自動統合化システム



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(Former members:)
Miyuki Kikuchi
Isami Sogabe
Thukaa Kuoka
Sachiko Akase
Kotarou Hayashi
Takafumi Ogura
Hiromi Nagamatsu
Sakura Kiyama
Nozomi Hatanaka
Eiji Amagasa
Ran Fukazawa(Intern)
Ryuho Kumashiro

AIST

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Niigata University

Shujiro Okuda
Yu Watanabe
Akira Seno

The Noguchi Institute

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Haruko Kitakaze

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Morihisa Fujita
Yifan Huang
Weize Kong





SOKA University