

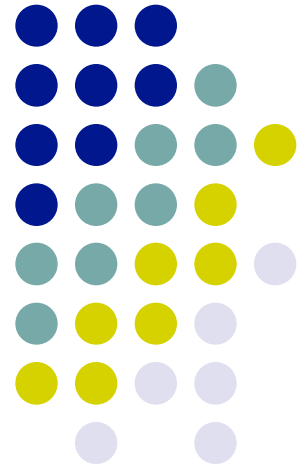
# GNOme – A glycan naming and subsumption ontology

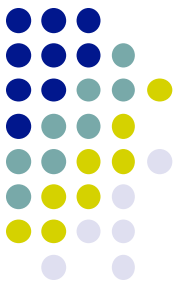


Nathan Edwards

Department of Biochemistry and  
Molecular & Cellular Biology

Georgetown University Medical Center

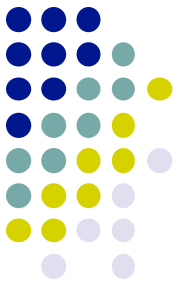




# About me...

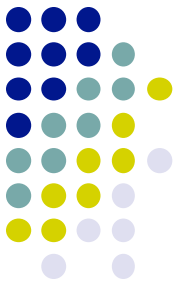
- Celera Genomics + Applied Biosystems
  - Proteomics pipelines, peptide identification software, informatics of new MS technologies
- NCI Clinical Proteomics Tumor Analysis Consortium (CPTAC Phases I,II,III):
  - Novel peptides using genomic/transcripts data
  - Data Coordinating Center (DCC/Portal)
  - Common Data Analysis Pipeline (AWS/Galaxy)
- Intact glycopeptide MS/MS / SWATH tools
  - w/ Rado Goldman (also Georgetown)

# Glycans are complex molecules

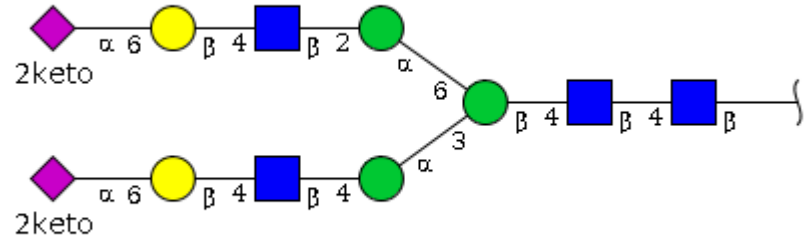


- Difficult to completely characterize
  - Mass spectrometry, etc.
- Partial characterization is common
  - Prior (biological) knowledge can fill in some gaps
  - Sample manipulation (glycosidases, etc.), too...
- Difficult to describe extent of characterization
  - Complex “sequence” formats precisely describe known and missing details
- Accessions provide a stable identifier
  - Link to explicit sequence formats

# Glycan Structure Descriptions



GlyTouCan: G39764AC  
 PubChem: SID252281000  
 GlycomeDb: 9088



Neu5Ac(a2-6)Gal(b1-4)GlcNAc(b1-4)Man(a1-3)[Neu5Ac(a2-6)Gal(b1-4)GlcNAc(b1-2)Man(a1-6)]Man(b1-4)GlcNAc(b1-4)GlcNAc(b1-

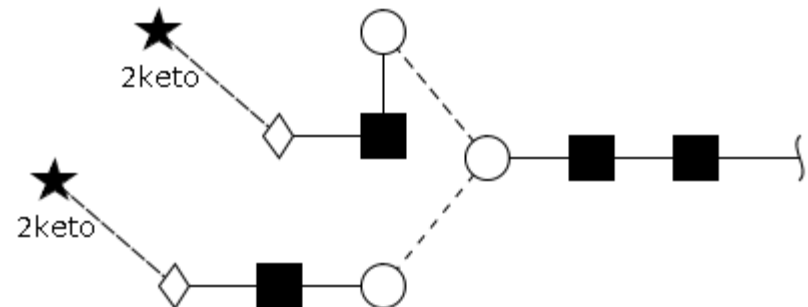
WURCS=2.0/5,11,10/[a2122h-1b\_1-5\_2\*NCC/3=O][a1122h-1b\_1-5][a1122h-1a\_1-5][a2112h-1b\_1-5][Aad21122h-2a\_2-6\_5\*NCC/3=O]/1-1-2-3-1-4-5-3-1-4-5/a4-b1\_b4-c1\_c3-d1\_c6-h1\_d4-e1\_e4-f1\_f6-g2\_h2-i1\_i4-j1\_j6-k2

RES

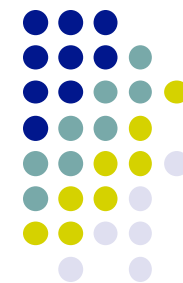
1b:b-dglc-HEX-1:5  
 2s:n-acetyl  
 3b:b-dglc-HEX-1:5  
 4s:n-acetyl  
 5b:b-dman-HEX-1:5  
 6b:a-dman-HEX-1:5  
 7b:b-dglc-HEX-1:5  
 8s:n-acetyl  
 9b:b-dgal-HEX-1:5  
 10b:a-dgro-dgal-NON-2:6|1:a|2:keto|3:d  
 11s:n-acetyl  
 12b:a-dman-HEX-1:5  
 13b:b-dglc-HEX-1:5  
 14s:n-acetyl  
 15b:b-dgal-HEX-1:5  
 16b:a-dgro-dgal-NON-2:6|1:a|2:keto|3:d  
 17s:n-acetyl

LIN

1:1d(2+1)2n  
 2:1o(4+1)3d  
 3:3d(2+1)4n  
 4:3o(4+1)5d  
 5:5o(3+1)6d  
 6:6o(4+1)7d  
 7:7d(2+1)8n  
 8:7o(4+1)9d  
 9:9o(6+2)10d  
 10:10d(5+1)11n  
 11:5o(6+1)12d  
 12:12o(2+1)13d  
 13:13d(2+1)14n  
 14:13o(4+1)15d  
 15:15o(6+2)16d  
 16:16d(5+1)17n



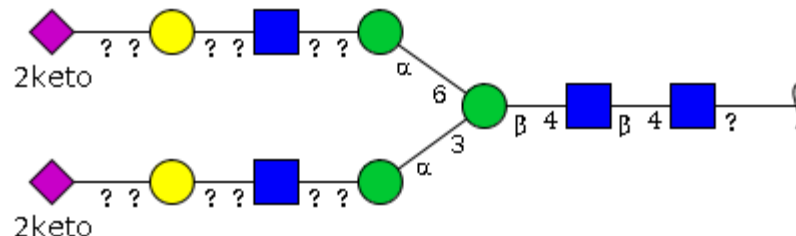
# Glycan (Partial) Structure Descriptions



GlyTouCan: G27817LK

UniCarbKB: 4923

GlycomeDb: 39722



Neu5Ac(?2-?)Gal(?1-?)GlcNAc(?1-?)Man(a1-3)[Neu5Ac(?2-?)Gal(?1-?)GlcNAc(?1-?)Man(a1-6)]Man(b1-4)GlcNAc(b1-4)GlcNAc(?1-

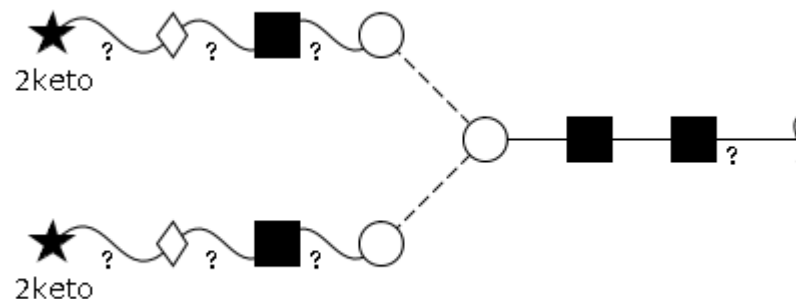
WURCS=2.0/6,11,10/[a2122h-1x\_1-5\_2\*NCC/3=O][a2122h-1b\_1-5\_2\*NCC/3=O][a1122h-1b\_1-5][a1122h-1a\_1-5][a2112h-1x\_1-5]  
[Aad21122h-2x\_2-6\_5\*NCC/3=O]/1-2-3-4-1-5-6-4-1-5-6/a4-b1\_b4-c1\_c3-d1\_c6-h1\_d?-e1\_e?-f1\_f?-g2\_h?-i1\_i?-j1\_j?-k2

RES

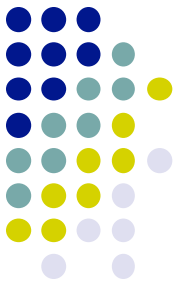
- 1b:x-dglc-HEX-1:5
- 2s:n-acetyl
- 3b:b-dglc-HEX-1:5
- 4s:n-acetyl
- 5b:b-dman-HEX-1:5
- 6b:a-dman-HEX-1:5
- 7b:x-dglc-HEX-1:5
- 8b:x-dgal-HEX-1:5
- 9b:x-dgro-dgal-NON-2:6|1:a|2:keto|3:d
- 10s:n-acetyl
- 11s:n-acetyl
- 12b:a-dman-HEX-1:5
- 13b:x-dglc-HEX-1:5
- 14b:x-dgal-HEX-1:5
- 15b:x-dgro-dgal-NON-2:6|1:a|2:keto|3:d
- 16s:n-acetyl
- 17s:n-acetyl

LIN

- 1:1d(2+1)2n
- 2:1o(4+1)3d
- 3:3d(2+1)4n
- 4:3o(4+1)5d
- 5:5o(3+1)6d
- 6:6o(-1+1)7d
- 7:7o(-1+1)8d
- 8:8o(-1+2)9d
- 9:9d(5+1)10n
- 10:7d(2+1)11n
- 11:5o(6+1)12d
- 12:12o(-1+1)13d
- 13:13o(-1+1)14d
- 14:14o(-1+2)15d
- 15:15d(5+1)16n
- 16:13d(2+1)17n



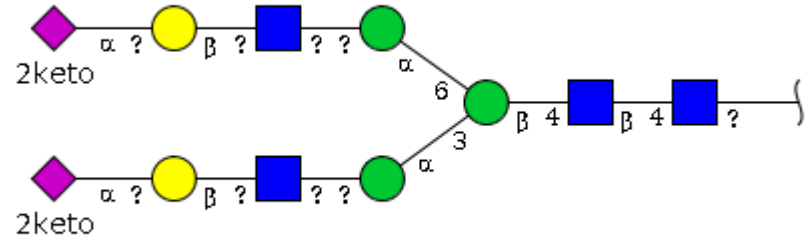
# Glycan (Partial) Structure Descriptions



GlyTouCan: G97545TB

UniCarbKB: 4227

GlycomeDb: 39610



Neu5Ac(a2-?)Gal(b1-?)GlcNAc(?1-?)Man(a1-3)[Neu5Ac(a2-?)Gal(b1-?)GlcNAc(?1-?)Man(a1-6)]Man(b1-4)GlcNAc(b1-4)GlcNAc(?1-

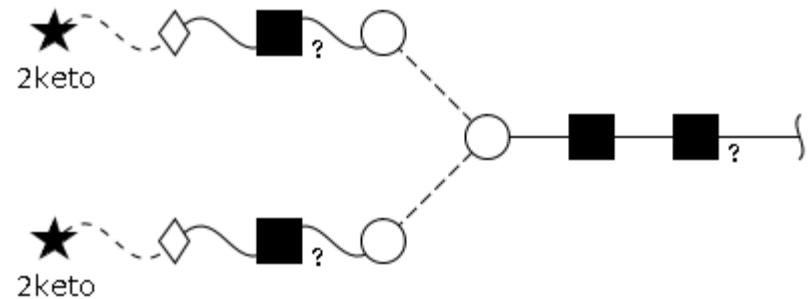
WURCS=2.0/6,11,10/[a2122h-1x\_1-5\_2\*NCC/3=O][a2122h-1b\_1-5\_2\*NCC/3=O][a1122h-1b\_1-5][a1122h-1a\_1-5][a2112h-1b\_1-5]  
[Aad21122h-2a\_2-6\_5\*NCC/3=O]/1-2-3-4-1-5-6-4-1-5-6/a4-b1\_b4-c1\_c3-d1\_c6-h1\_d?-e1\_e?-f1\_f?-g2\_h?-i1\_i?-j1\_j?-k2

RES

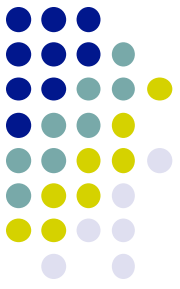
- 1b:x-dglc-HEX-1:5
- 2s:n-acetyl
- 3b:b-dglc-HEX-1:5
- 4s:n-acetyl
- 5b:b-dman-HEX-1:5
- 6b:a-dman-HEX-1:5
- 7b:x-dglc-HEX-1:5
- 8b:b-dgal-HEX-1:5
- 9b:a-dgro-dgal-NON-2:6|1:a|2:keto|3:d
- 10s:n-acetyl
- 11s:n-acetyl
- 12b:a-dman-HEX-1:5
- 13b:x-dglc-HEX-1:5
- 14b:b-dgal-HEX-1:5
- 15b:a-dgro-dgal-NON-2:6|1:a|2:keto|3:d
- 16s:n-acetyl
- 17s:n-acetyl

LIN

- 1:1d(2+1)2n
- 2:1o(4+1)3d
- 3:3d(2+1)4n
- 4:3o(4+1)5d
- 5:5o(3+1)6d
- 6:6o(-1+1)7d
- 7:7o(-1+1)8d
- 8:8o(-1+2)9d
- 9:9d(5+1)10n
- 10:7d(2+1)11n
- 11:5o(6+1)12d
- 12:12o(-1+1)13d
- 13:13o(-1+1)14d
- 14:14o(-1+2)15d
- 15:15d(5+1)16n
- 16:13d(2+1)17n

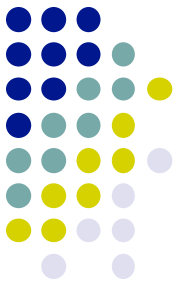


# Glycans are complex molecules



- Manuscripts and tools often use a short-hand
  - Monosaccharide composition
    - 4 GlcNAc, 3 Man, 2 Gal, 2 Neu5Ac (4-3-2-2-0)
    - 4 HexNAc, 5 Hex, 2 Neu5Ac (4-5-2-0)
  - Words (!)
    - Bi-antennary di-sialated complex N-glycan
  - Abbreviations
    - A2G2S2, 2A2SA, ....
  - Pictures
- Linking with accessions is difficult...

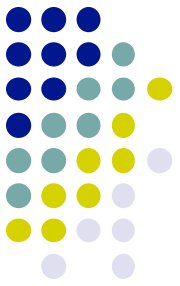
# Finding GlyTouCan Structure Descriptions



- 49 GlyTouCan glycans by composition
- 68 GlyTouCan glycans by mol. weight
- 95 GlyTouCan glycans by int. mol wt



# Finding GlyTouCan Structure Descriptions



Glycan Repository

Secure | <https://glytoucan.org/Structures>

Registration Search View All Preferences Sign in Accession Number

Number of Glycans: 133 [Reset all conditions](#)

**Current status**

- Motif
- Monosaccharide
- Mass range 2222~2223
- Linked DB

List WURCS GlycoCT Sort Date Entered Down 1 2 ... 7 >

**Accession Number** [G80123ZU](#)

Calculated Monoisotopic Mass 2222.783

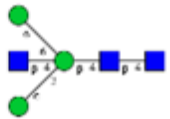
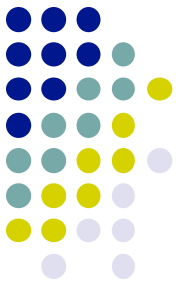
Contribution time Tue, 31 Oct 2017 22:21:52 GMT

**Accession Number** [G34449FW](#)

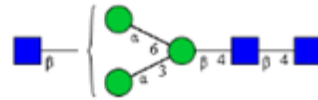
Calculated Monoisotopic Mass 2222.783

Contribution time Tue, 31 Oct 2017 22:20:29 GMT

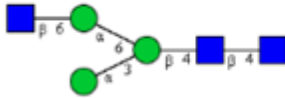
# Glycan (Partial) Structure Subsumption



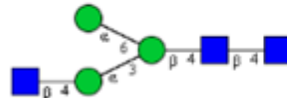
1027+



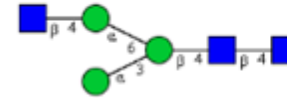
29010\*



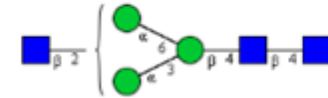
2493+



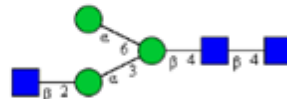
8188+



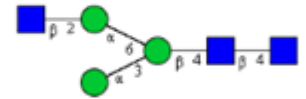
10083+



28973\*

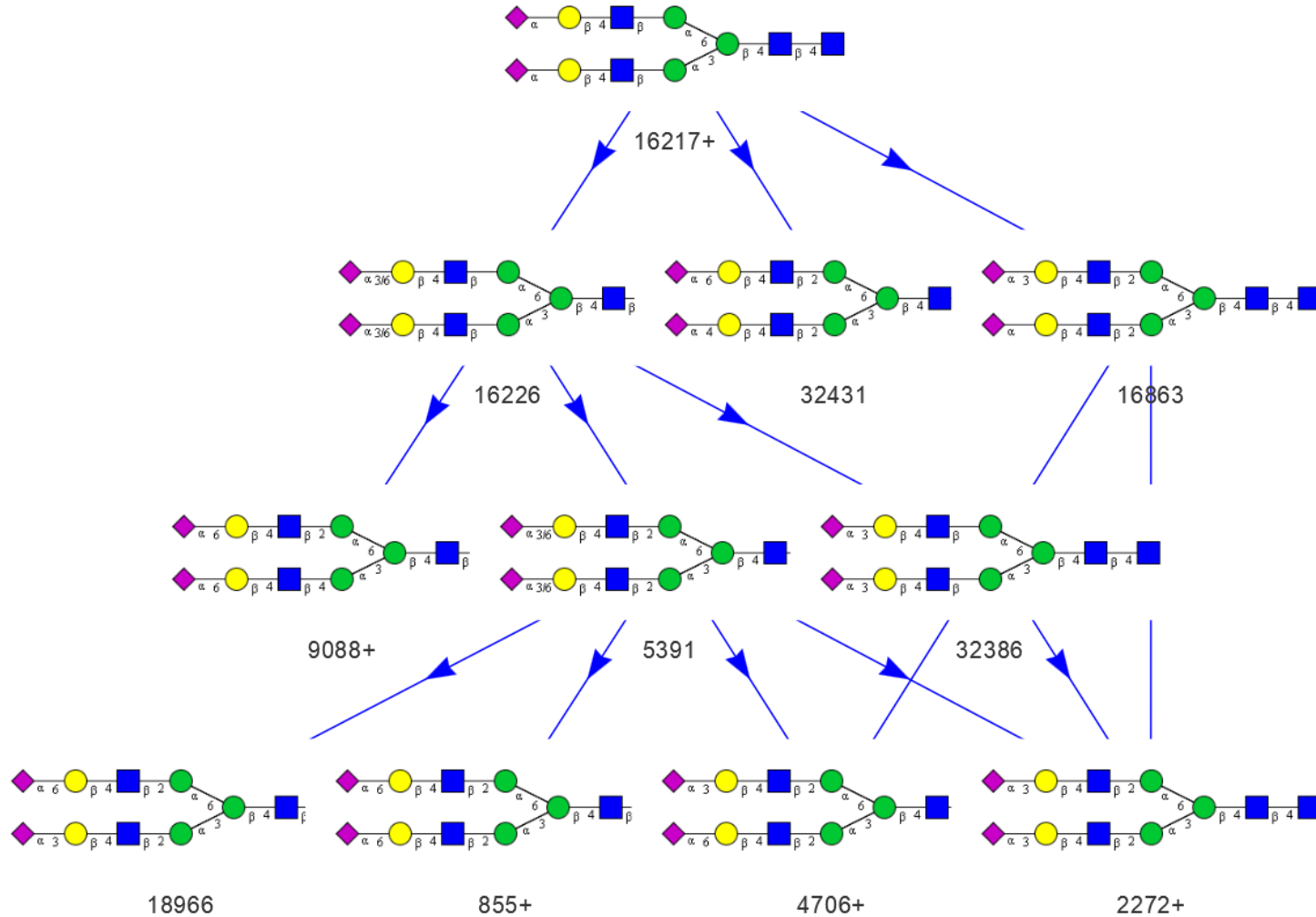
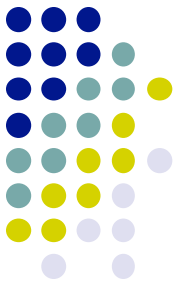


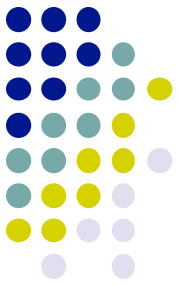
1014+



1013+

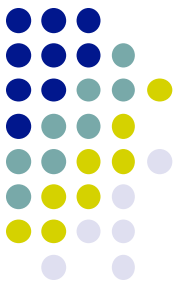
# Glycan (Partial) Structure Subsumption





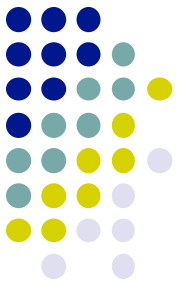
# GlyGen Glycans

- Glycans from GlyTouCan
  - Primary accessions
  - Complete WURCS coverage - GlycoCT partial
  - Species/Motif annotations
- Glycans from UniCarbKB
  - Connection to UniProt proteins (vital!)
  - Species / Protein-based species annotations
  - Accessions linked from GlyTouCan



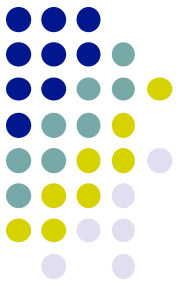
# GlyGen Glycans (Year 1)

- Require human and mouse glycans, but...
  - Species annotations are sparse
- Data-resources do not annotate consistent (partial) structure descriptions
  - Human curators extract structure descriptions from manuscripts inconsistently,
  - Different resources see different manuscripts
- Human Glycans:
  - GlyTouCan: 2261; UniCarbKB: 1854 (1471);
  - In common: 486



# GlyGen Glycans

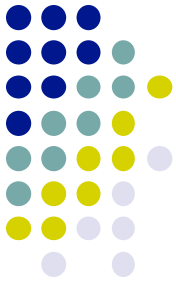
- Which compositions, topologies are human?
  - Use subsumption relationships to propagate annotation
  - Semantics: ...at least one glycan structure...
- Merged human annotation:
  - (Partial?) Structures: 3455 ( +621)
  - Topologies: 1720 (+1707)
  - Compositions: 0 (+1062)



# GlyGen Glycoenzymes

- Glycosylation enzyme annotations
  - ID mapping: GlycO → GlycomeDb → GlyTouCan
- GlycO “tree” of potential structures
  - w/ species specific glycotransferase annotations
  - Glycan monosaccharide indexing
  
- Will York, Alison Nairn, Kelley Moremen (CCRC)

# GlyGen Glycan Data Integration



SMW × +

edwardslab.bmcb.georgetown.edu/smw/Main\_Page

Edwardsnj Talk Preferences Watchlist Contributions Log out

Main page Discussion Read Edit View history More Search SMW

## Main Page

### Summary

<b>BaseCompositions</b>	834
<b>Compositions</b>	1132
<b>Topologies</b>	2915
<b>Saccharides</b>	8585
<b>All</b>	13466

### Annotation

Saccharides	GlyTouCan	UniCarbKB	UniCarb-DB	GlycO	Subsumption	Any
Human	2224	1364	31		802	3455
Mouse	345	238	3		346	817
N-Linked	2905				1237	3058
O-Linked	944				390	1032
Human Enzyme				0		0
Mouse Enzyme				583		583
Human Substrate		838				838
Mouse Substrate		85				85

Topologies	GlyTouCan	UniCarbKB	UniCarb-DB	GlycO	Subsumption	Any
Human	3	11	0		1717	1720
Mouse	2	2	0		391	393

**Contents** [\[hide\]](#)

- 1 Summary
- 2 Annotation
- 3 Human N-Linked Glycans
- 4 Mouse N-Linked Glycans
- 5 Other N-Linked Glycans
- 6 Human O-Linked Glycans
- 7 Mouse O-Linked Glycans
- 8 Other O-Linked Glycans
- 9 Human Misc. Glycans
- 10 Mouse Misc. Glycans
- 11 Other Misc. Glycans

Main page

Recent changes

Random page

Help

Tools

What links here

Related changes

Upload file

Special pages

Printable version

Permanent link

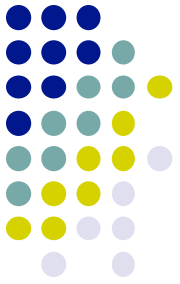
Page information

Browse properties

Windows taskbar: 9:19 AM



# GlyGen Glycan Data Integration



G35370OW - SMW

edwardslab.bmcb.georgetown.edu/smw/G35370OW

Edwardsnj Talk Preferences Watchlist Contributions Log out

Page Discussion Read Edit with form Edit View history More Search SMW

## G35370OW

**Contents [hide]**

- 1 Identifiers
- 2 Type
- 3 Motif
- 4 Organism
- 5 Enzyme
- 6 Substrate
- 7 Groups
- 8 Relationships
- 9 Sequence

### Identifiers

<b>GlyTouCan</b>	G35370OW
<b>UniCarbKB</b>	7102
<b>GlycomeDB</b>	40175

### Type

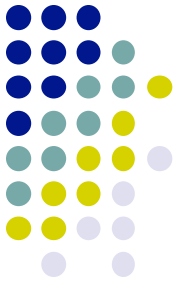
**Type** Saccharide

### Motif

**N-Linked** Subsumption

### Organism

# GlyGen Glycan Data Integration



G353700W - SMW

edwardslab.bmcb.georgetown.edu/smw/G353700W

Permanent link  
Page information  
Browse properties

### Identifiers

<b>GlyTouCan</b>	G353700W
<b>UniCarbKB</b>	7102
<b>GlycomeDB</b>	40175

### Type

**Type** Saccharide

### Motif

**N-Linked** Subsumption

### Organism

**Human** Subsumption, UniCarbKB, UniCarbKB-Protein

### Enzyme

### Substrate

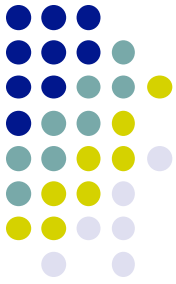
**Human** P04114 (UniCarbKB)

### Groups

<b>Molecular Weight</b>	1599.5656228 (17 Saccharides)
<b>Base Composition</b>	G28541PG (17 Saccharides)
<b>Composition</b>	G55719HL (7 Saccharides)
<b>Topology</b>	G95951LZ (6 Saccharides)

Relationships  
9 Sequence

# GlyGen Glycan Data Integration



G353700W - SMW

edwardslab.bmcb.georgetown.edu/smw/G353700W

### Groups

<b>Molecular Weight</b>	1599.5656228 (17 Saccharides)
<b>Base Composition</b>	G28541PG (17 Saccharides)
<b>Composition</b>	G55719HL (7 Saccharides)
<b>Topology</b>	G95951LZ (6 Saccharides)

### Relationships

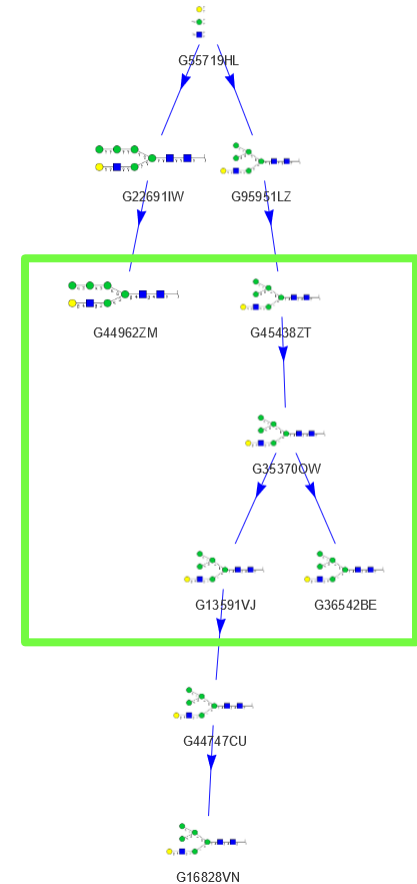
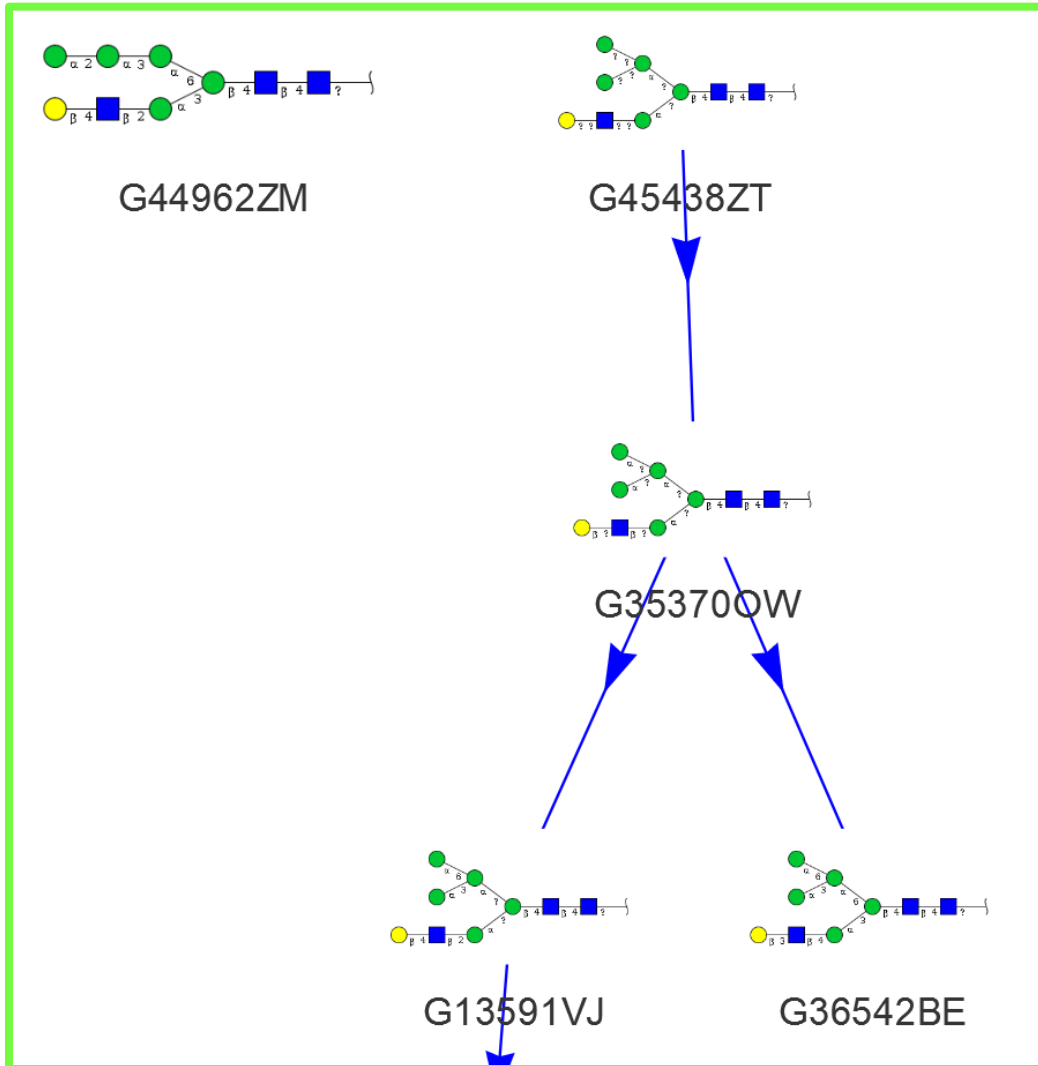
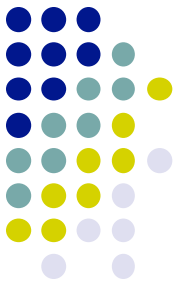
<b>Subsumed By</b>	G45438ZT
<b>Subsumes</b>	G13591VJ, G36542BE

[Explore](#)

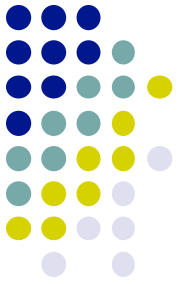
### Sequence

<b>IUPAC Condensed</b>	Gal (b1-?) GlcNAc (b1-?) Man (a1-?) [Man (a1-?) [Man (a1-?) ]Man (a1-?) ]Man (b1-4) GlcNAc (b1-4) GlcNAc (?1-
<b>IUPAC</b>	[beta-L-Galp- (1->) -beta-D-GlcpNAc- (1->) -alpha-L-Manp- (1->) - [alpha-L-Manp- (1->) -alpha-L-Manp- (1->) -alpha-L-Manp- (1->) ]-beta-L-Manp- (1->4) ]-beta-D-GlcpNAc- (1->4) -?-D-GlcpNAc (1->
<b>WURCS</b>	WURCS=2.0/5,9,8/[a2122h-1x_1-5_2*NCC/3=0][a2122h-1b_1-5_2*NCC/3=0][a1122h-1b_1-5][a1122h-1a_1-5][a2112h-1b_1-5]/1-2-3-4-2-5-4-4-4/a4-b1_b4-c1_c?-d1_c?-g1_d?-e1_e?-f1_g?-h1_g?-i1
<b>RES</b>	RES 1b:x-dg1c-HEX-1:5 2s:n-acetyl 3b:b-d1-1-5

# Explore subsumption relationships



# GlyGen Glycan Data Integration



G82312JY - SMW

SVG glycan

edwardslab.bmcb.georgetown.edu

edwardslab.bmcb.georgetown.edu/smw/G82312JY

Edwardsnj Talk Preferences Watchlist Contributions Log out

Page Discussion Read Edit with form Edit View history More Search SMW

## G82312JY

**Identifiers**

<b>GlyTouCan</b>	G82312JY
<b>PubChem</b>	SID252282805
<b>GlycomeDB</b>	13652
<b>Glyco</b>	GOG357

**Type**

Type Saccharide

**Motif**

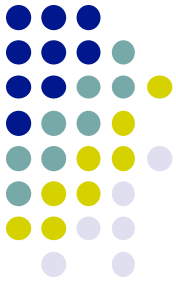
N-Linked GlyTouCan

**Organism**

**Contents [hide]**

- 1 Identifiers
- 2 Type
- 3 Motif
- 4 Organism
- 5 Enzyme
- 6 Substrate
- 7 Groups
- 8 Relationships
- 9 Sequence

# GlyGen Glycan Data Integration



G82312JY - SMW

SVG glycan | edwardslab.bmcb.georgetown.edu

edwardslab.bmcb.georgetown.edu/smw/G82312JY

Organism

Enzyme

**Mouse** Alg1 (208211, GlycO), Alg13 (67574, GlycO), Alg14 (66789, GlycO), Alg2 (56737, GlycO), Fut8 (53618, GlycO), Glt28d2 (320302, GlycO), Mgat1 (17308, GlycO), Mgat2 (217664, GlycO)

[Explore...](#)

Substrate

Groups

<b>Molecular Weight</b>	1665.6238064 (25 Saccharides)
<b>Base Composition</b>	G88725PI (25 Saccharides)
<b>Composition</b>	G29913WR (8 Saccharides)
<b>Topology</b>	G63253XC (6 Saccharides)

Relationships

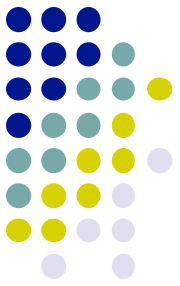
**Subsumed By** G98855LF

[Explore](#)

Sequence

<b>IUPAC Condensed</b>	G1cNAc (b1-2) Man (a1-3) [GalNAc (b1-4) G1cNAc (b1-2) Man (a1-6) ]Man (b1-4) G1cNAc (b1-4) [Fuc (a1-6) ]G1cNAc (b1-
<b>IUPAC</b>	[alpha-D-Fucp- (1->6) ]-[beta-L-GalpNAc- (1->4) ]-beta-D-GlcpNAc- (1->2) ]-alpha-L-Manp- (1->6) ]-beta-D-GlcpNAc- (1->2) ]-alpha-L-Manp- (1->3) ]-beta-L-Manp- (1->4) ]-beta-D-GlcpNAc- (1->4) ]-beta-D-GlcpNAc (1-]-

# Explore Glycoenzymes



G82312JY - SMW SVG glycan edwardslab.bmcb.georgetown.edu

glycomics.ccr.c.uga.edu/ggtest/gui/svgGlycans.html?GOG357

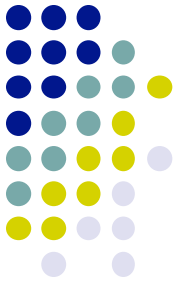
**GOG357**

**Residue properties:**

Name: GlcpNAc  
Anomeric Configuration:  $\beta$   
Absolute Configuration: D  
Glyco ID: N5  
[http://glycomics.ccr.c.uga.edu/ontologies/Glyco#N-glycan\\_b-D-GlcpNAc\\_5](http://glycomics.ccr.c.uga.edu/ontologies/Glyco#N-glycan_b-D-GlcpNAc_5)  
[PubChem Record](#)  
Enzyme: [NM\\_146035](#)

Enter URL for JSON file describing the glycan:

# Semantic Media-Wiki



G82312JY

edwardslab.bmc.gorgetown.edu/smw/Special:Browse:/G82312JY

90% Search

Main page  
Recent changes  
Random page  
Help

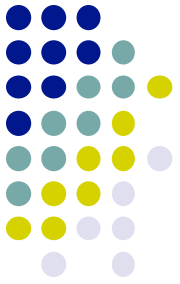
Tools  
Upload file  
Special pages  
Printable version

## G82312JY

<b>Accession</b>	G82312JY + 🔍
<b>Has BaseComposition</b>	G88725PI + ⚪
<b>Has Composition</b>	G29913WR + ⚪
<b>Has GlyYouCan Accession</b>	G82312JY + 🔍
<b>Has GlyYouCan Type</b>	Saccharide + 🔍
<b>Has Glyco ID</b>	GOG357 + 🔍
<b>Has GlycoCT</b>	true + 🔍
<b>Has GlycomeDB ID</b>	13652 + 🔍
<b>Has Image</b>	true + 🔍
<b>Has Molecular Weight</b>	1,665.624 + 🔍
<b>Has Pubchem SID</b>	SID252282805 + 🔍
<b>Has Topology</b>	G63253XC + ⚪
<b>Human</b>	false + 🔍
<b>ImageCRC</b>	1484706336 + 🔍
<b>ImageHeight</b>	160 + 🔍
<b>ImageRedundancy</b>	1 + 🔍
<b>ImageWidth</b>	394 + 🔍
<b>IsFullySpecified</b>	true + 🔍
<b>IsLeaf</b>	true + 🔍
<b>Mouse</b>	false + 🔍
<b>MouseEnzyme</b>	Alg1 (208211, GlycO) + 🔍, Alg13 (67574, GlycO) + 🔍, Alg14 (66789, GlycO) + 🔍, Alg2 (56737, GlycO) + 🔍, Fut8 (53618, GlycO) + 🔍, Glit28d2 (320302, GlycO) + 🔍, Mgat1 (17308, GlycO) + 🔍, Mgat2 (217664, GlycO) + 🔍
<b>NLinked</b>	true + 🔍

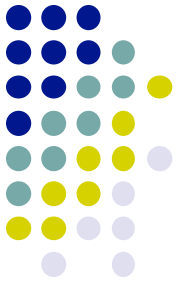


# Semantic Media-Wiki



```
edwardslab.bmcg.georgetown.edu X +
edwardslab.bmcg.georgetown.edu/smw/index.php?title=Special:ExportRDF/G82312JY&sym 90% Search
This XML file does not appear to have any style information associated with it. The document tree is shown below.
- <rdf:RDF>
- <owl:Ontology rdf:about="http://edwardslab.bmcg.georgetown.edu/smw/Special:ExportRDF/G82312JY">
  <swivt:creationDate rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">2018-03-04T16:48:07-08:00</swivt:creationDate>
  <owl:imports rdf:resource="http://semantic-mediawiki.org/swivt/1.0"/>
</owl:Ontology>
- <swivt:Subject rdf:about="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY">
  <rdf:type rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/Category-3AGlycan"/>
  <rdfs:label>G82312JY</rdfs:label>
  <rdfs:isDefinedBy rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:ExportRDF/G82312JY"/>
  <swivt:page rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/G82312JY"/>
  <swivt:wikiNamespace rdf:datatype="http://www.w3.org/2001/XMLSchema#integer">0</swivt:wikiNamespace>
  <swivt:wikiPageContentLanguage rdf:datatype="http://www.w3.org/2001/XMLSchema#string">en</swivt:wikiPageContentLanguage>
  <property:Accession rdf:datatype="http://www.w3.org/2001/XMLSchema#string">G82312JY</property:Accession>
  <property:Has_BaseComposition rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G88725PI"/>
  <property:Has_Composition rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G29913WR"/>
  <property:Has_GlyTouCan_Accession rdf:datatype="http://www.w3.org/2001/XMLSchema#string">G82312JY</property:Has_GlyTouCan_Accession>
  <skos:exactMatch rdf:resource="https://glytoucan.org/Structures/Glycans/G82312JY"/>
  <skos:exactMatch rdf:resource="https://pubchem.ncbi.nlm.nih.gov/substance/SID252282805"/>
  <property:Has_GlyTouCan_Type rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Saccharide</property:Has_GlyTouCan_Type>
  <property:Has_Glyco_ID rdf:datatype="http://www.w3.org/2001/XMLSchema#string">GOG357</property:Has_Glyco_ID>
  <property:Has_GlycoCT rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">true</property:Has_GlycoCT>
  <property:Has_GlycomeDB_ID rdf:datatype="http://www.w3.org/2001/XMLSchema#string">13652</property:Has_GlycomeDB_ID>
  <property:Has_Image rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">true</property:Has_Image>
  <property:Has_Molecular_Weight rdf:datatype="http://www.w3.org/2001/XMLSchema#double">1665.6238064</property:Has_Molecular_Weight>
  <property:Has_Pubchem_SID rdf:datatype="http://www.w3.org/2001/XMLSchema#string">SID252282805</property:Has_Pubchem_SID>
  <property:Has_Topology rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G63253XC"/>
  <property:Human rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">false</property:Human>
  <property:ImageCRC rdf:datatype="http://www.w3.org/2001/XMLSchema#string">1484706336</property:ImageCRC>
  <property:ImageHeight rdf:datatype="http://www.w3.org/2001/XMLSchema#double">160</property:ImageHeight>
  <property:ImageRedundancy rdf:datatype="http://www.w3.org/2001/XMLSchema#double">1</property:ImageRedundancy>
  <property:ImageWidth rdf:datatype="http://www.w3.org/2001/XMLSchema#double">394</property:ImageWidth>
  <property:IsFullySpecified rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">true</property:IsFullySpecified>
  <property:IsLeaf rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">true</property:IsLeaf>
  <property:Mouse rdf:datatype="http://www.w3.org/2001/XMLSchema#boolean">false</property:Mouse>
  <property:MouseEnzyme rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY-23_62fb3df7f7ea255bfa10a92d27f8e2d8"/>
  <property:MouseEnzyme rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY-23_a6200c3150e26f92d3d99cb04ad305c7"/>
  <property:MouseEnzyme rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY-23_149e9a9754d5e5247d933fa2d17d096"/>
  <property:MouseEnzyme rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY-23_8e117b5108318b158d62b4b19ed3b0e4"/>
  <property:MouseEnzyme rdf:resource="http://edwardslab.bmcg.georgetown.edu/smw/Special:URIResolver/G82312JY-23_8e79ach540710e0baa7607181a1467e"/>
```

# GlyGen Glycan Data Integration



SMW × +

edwardslab.bmcb.georgetown.edu/smw/Main\_Page

Edwardsnj Talk Preferences Watchlist Contributions Log out

Main page Discussion Read Edit View history More Search SMW

## Main Page

### Summary

<b>BaseCompositions</b>	834
<b>Compositions</b>	1132
<b>Topologies</b>	2915
<b>Saccharides</b>	8585
<b>All</b>	13466

### Annotation

Saccharides	GlyTouCan	UniCarbKB	UniCarb-DB	GlycO	Subsumption	Any
Human	2224	1364	31		802	3455
Mouse	345	238	3		346	817
N-Linked	2905				1237	3058
O-Linked	944				390	1032
Human Enzyme				0		0
Mouse Enzyme				583		583
Human Substrate		838				838
Mouse Substrate		85				85

Topologies	GlyTouCan	UniCarbKB	UniCarb-DB	GlycO	Subsumption	Any
Human	3	11	0		1717	1720
Mouse	2	2	0		391	393

**Contents** [\[hide\]](#)

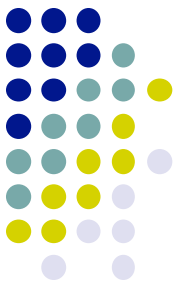
- 1 Summary
- 2 Annotation
- 3 Human N-Linked Glycans
- 4 Mouse N-Linked Glycans
- 5 Other N-Linked Glycans
- 6 Human O-Linked Glycans
- 7 Mouse O-Linked Glycans
- 8 Other O-Linked Glycans
- 9 Human Misc. Glycans
- 10 Mouse Misc. Glycans
- 11 Other Misc. Glycans

Main page Recent changes Random page Help

Tools

- What links here
- Related changes
- Upload file
- Special pages
- Printable version
- Permanent link
- Page information
- Browse properties

Windows Taskbar: 9:19 AM

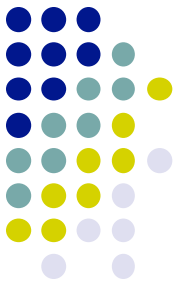


# GNOme

- Glycan Naming (and Subsumption) Ontology
- Pre-compute GlyTouCan subsumption relationships
  - Publish as OBO Foundry Ontology
- Ontologies good for structured terms
- Name/identifier resolution
  - Human terminology, synonyms, ID mapping

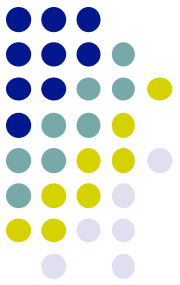


# GNOme



- Provide browsing tools for interactive glycan (partial) structure description discovery
  - Help humans navigate glycan descriptions
- Well defined (partial) structure levels
- Glycan annotation propagation and inference





# Acknowledgments

- GlyGen Glycoscience Portal Team
  - Will York (CCRC), Rene Ranzinger (CCRC, Glycome-DB), Raja Mazumder (GWU)
  - Kiyoko F Aoki-Kinoshita (GlyTouCan)
  - Matthew Campbell (UniCarbKB)
- NIH Common Fund: U01 - GlyGen