



# How Data are Retrieved, Entered, and Organized

[www.iedb.org](http://www.iedb.org)

Presented by: Randi Vita, M.D. Lead Ontology and Quality Manager

# IEDB Scope

- Infectious Diseases, Allergy, Autoimmunity, Transplant
  - HIV, cancer, etc. only curated as structural data or when presented with above subjects as per NIH/NIAID
- Published literature and direct submissions
- Experimentally confirmed, no predictions, no reviews
- Negative data and supplemental data included
- Binding of an adaptive immune receptor to an epitope (T cell, B cell, MHC binding, MHC ligand elution)
- Must be epitope-specific
  - All tested antigens are curated for epitope-specific receptors

# Minimal Criteria for Epitope Inclusion

- Linear peptide <50 amino acids in length
- Tested as an immunogen or an antigen
- Discontinuous residues shown to be important in recognition
- Non-peptidic epitopes <5,000 Daltons
- Minimal information required (sequence, outcome, host, etc.)

# Literature Curation Process

## PubMed / PDB

- Complex query
- Bi-weekly

**240K retrieved**

## Classifier

- Content based categories
- Retrained annually

**151K epitope related**

### Infectious Disease

48,376 refs

### Autoimmunity

19,299 refs

### Transplantation

13,988 refs

### Allergy

9,220 refs

### Other

60,508

## Abstract Review

- Manual scan
- Confirmation of classification

**44K likely curatable**

## Manual Curation

- Assigned to curators
- Peer review

**21K curated**

### Infectious Disease

11,263 refs

### Autoimmunity

5,144 refs

### Allergy

1,646 refs

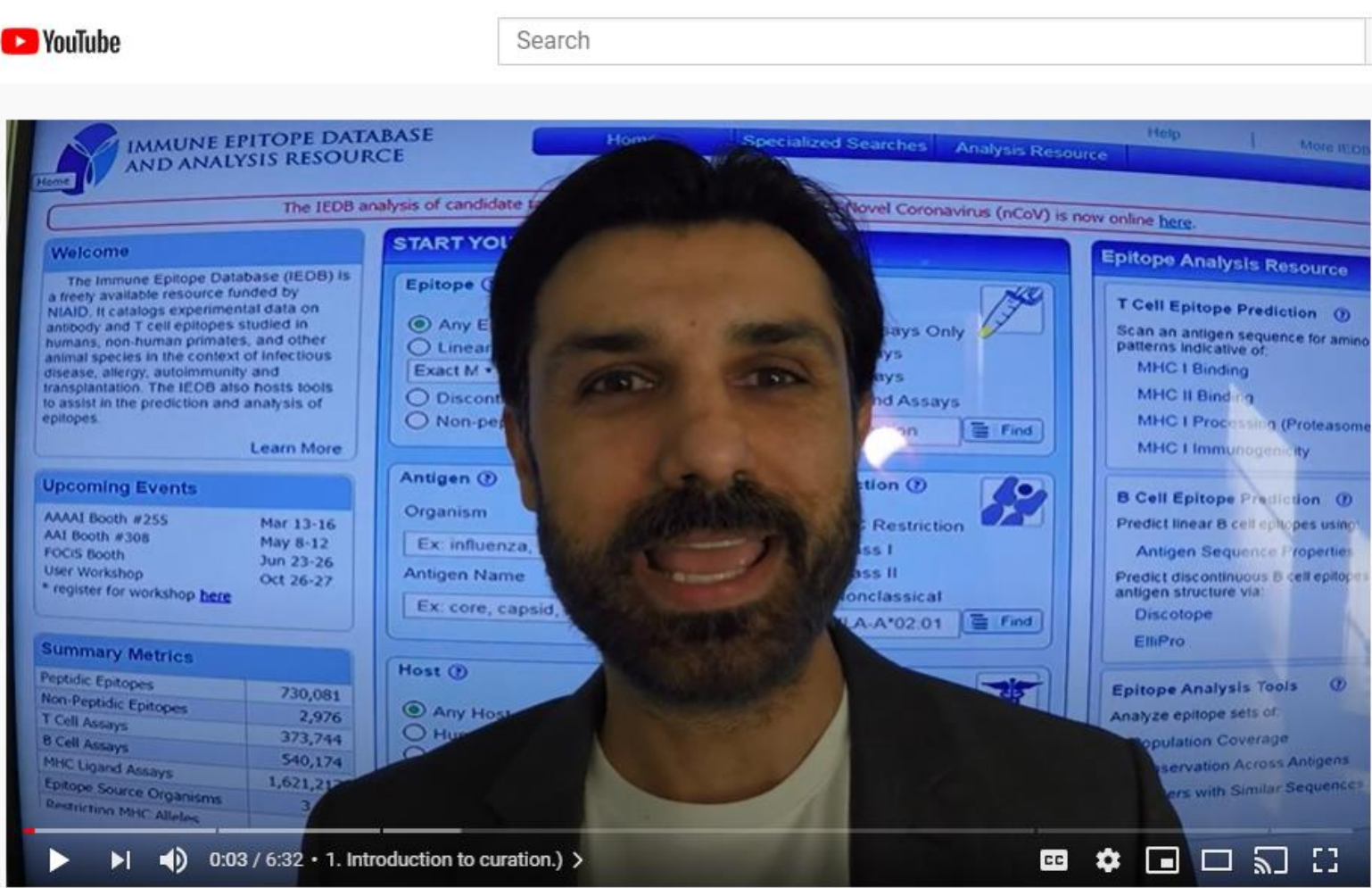
### Transplantation

846 refs

### Other

2,331 refs

# Literature Curation Process: Video



The video shows a man with a beard and dark hair, wearing a dark suit jacket over a white shirt, speaking directly to the camera. He is positioned in front of a computer monitor displaying the Immune Epitope Database (IEDB) website. The website has a blue header with navigation links: Home, Specialized Searches, Analysis Resource, Help, and More IEDB. A search bar is visible at the top right. The main content area includes a 'Welcome' section, 'Upcoming Events' (listing AAAI Booth #255, AAI Booth #308, FOCIS Booth, and User Workshop), 'Summary Metrics' (listing Peptidic Epitopes: 730,081, Non-Peptidic Epitopes: 2,976, T Cell Assays: 373,744, B Cell Assays: 540,174, MHC Ligand Assays: 1,621,217, Epitope Source Organisms: 3, and Restriction MHC Alleles), and 'START YOUR SEARCH' options for Epitope (Any Epitope, Linear, Discontinuous, Non-peptide) and Antigen (Organism, Antigen Name, Host). The video player interface at the bottom shows a play button, a progress bar at 0:03 / 6:32, and the title '1. Introduction to curation.) >'. Below the video, the title 'IEDB Curation Process Summary' is displayed, along with '61 views • Jun 17, 2020' and interaction icons for likes (2), comments (0), share, save, and a menu.

YouTube

Search

IMMUNE EPITOPE DATABASE AND ANALYSIS RESOURCE

Home Specialized Searches Analysis Resource Help More IEDB

The IEDB analysis of candidate epitopes for the novel Coronavirus (nCoV) is now online [here](#).

Welcome

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Learn More

Upcoming Events

AAAAI Booth #255	Mar 13-16
AAI Booth #308	May 8-12
FOCIS Booth	Jun 23-26
User Workshop	Oct 26-27

\* register for workshop [here](#)

Summary Metrics

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B Cell Assays	540,174
MHC Ligand Assays	1,621,217
Epitope Source Organisms	3
Restriction MHC Alleles	

START YOUR SEARCH

Epitope

Any Epitope

Linear

Discontinuous

Non-peptide

Exact Match

Find

Antigen

Organism

Ex: influenza, HIV

Antigen Name

Ex: core, capsid, HA-A\*02.01

Find

Host

Any Host

Human

Non-human

Find

Epitope Analysis Resource

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Scan an antigen sequence for amino acid patterns indicative of:

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Analyze epitope sets of:

- Population Coverage
- Conservation Across Antigens
- Antigens with Similar Sequences

0:03 / 6:32 • 1. Introduction to curation.) >

IEDB Curation Process Summary

61 views • Jun 17, 2020

2 0 SHARE SAVE

<https://youtu.be/GG6r1Vx8xBq>

# Consistency and Quality Control Measures

- Manually curated by a team of PhD-level scientists with specific expertise
- Formal curation guidelines and peer review  
Curation Manual: [http://curationwiki.iedb.org/wiki/index.php/Main\\_Page](http://curationwiki.iedb.org/wiki/index.php/Main_Page)
- External immunological experts
- Built in validation in the curation application

# Data Submissions

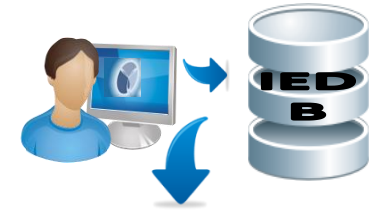
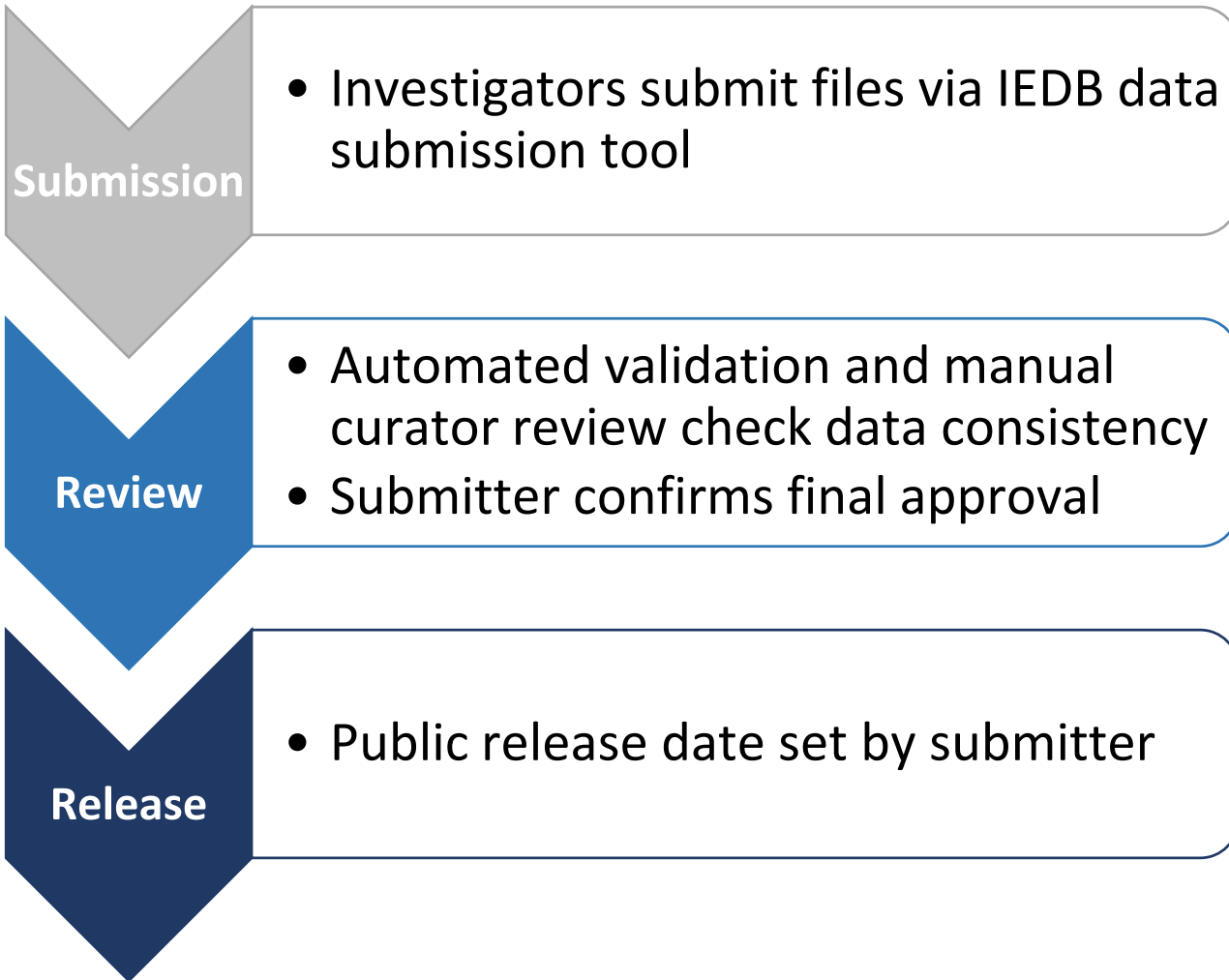
- Primarily sourced through NIAID Epitope Discovery contracts
- Data deposition is open to the general research community on a case-by-case basis

As of October, 2020:

- Data from **306 submissions** is publicly available & **96 submissions** are in process or on-hold
- Submitted data comprises **28% of epitopes**

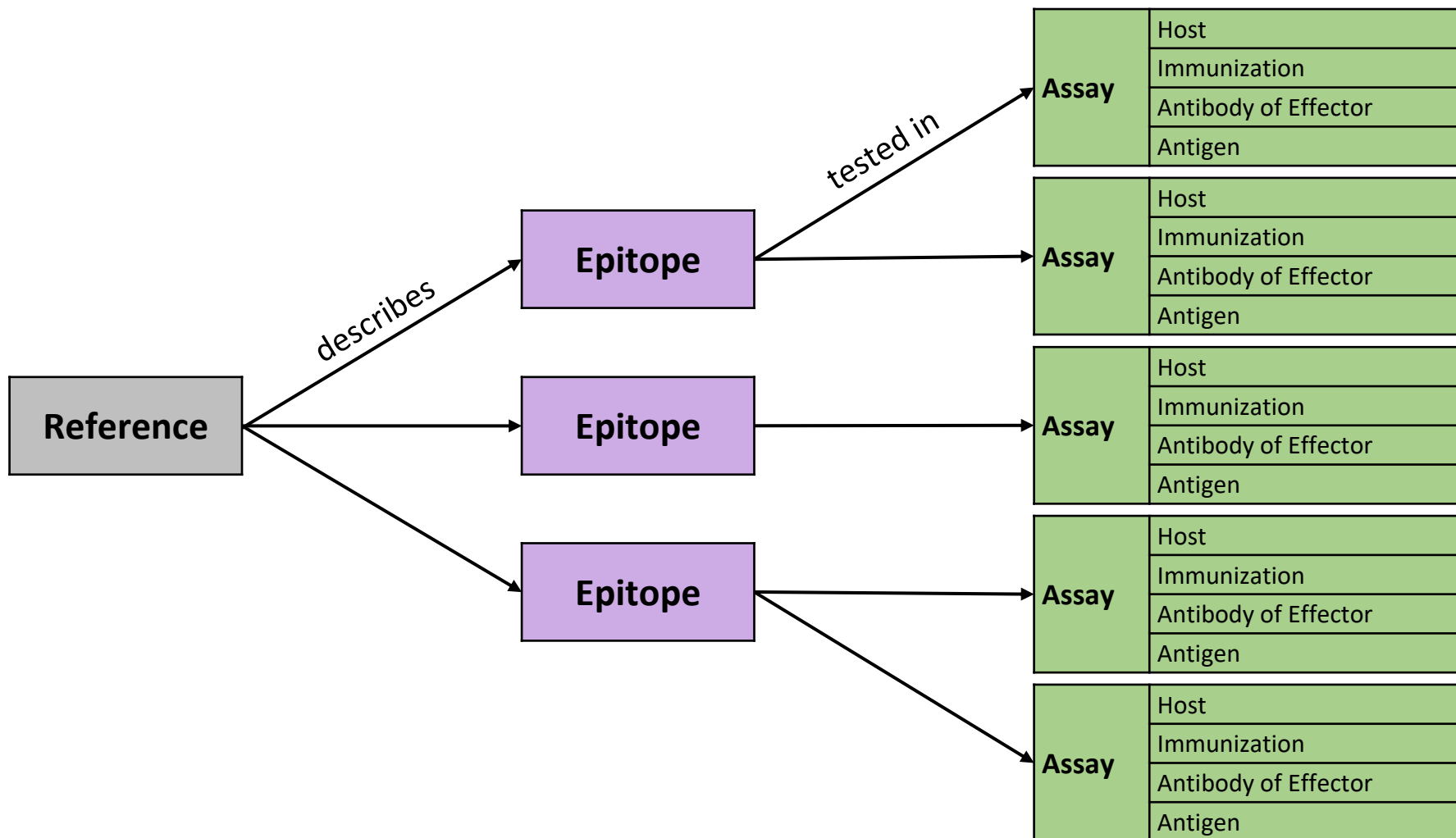
Inquire by contacting: [nblazeska@lji.org](mailto:nblazeska@lji.org) or [support@iedb.org](mailto:support@iedb.org)!

# Direct Submission Process





# Data Structure: A Database of Experiments

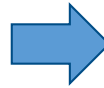


# Collaborations with Ontologies

- Provides standardized nomenclature, definitions, synonyms, and hierarchical relationships
- Makes curation easier → Finders
- Enhances user experience → Finders
- Ensures consistency and accuracy
- Finds errors
- Facilitates interoperability

# External Resources and Ontologies

<b>Peptidic Epitope</b>	Amino acid sequence
	Protein source
	Organism source



Human herpesvirus 5 (HHV-5)  
 NCBI  
 taxon:10359

**ORGANISM FINDER**

Current Selection(s) Reset Apply

**Search By**

Name:

Organism ID:

Clear Search

**Browse by Tree (Click to Select)**

- Human herpesvirus 1
- Human herpesvirus 2
- Human herpesvirus 4 (Epstein Barr virus)
- Human herpesvirus 5 (Human cytomegalovirus)
- Human herpesvirus 5 (strain RV798)
- Human herpesvirus 5 TB40
- Human herpesvirus 5 strain AD169
- Human herpesvirus 5 strain Merlin
- Human herpesvirus 5 strain Toledo

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**Search Results (Click to Select)**

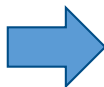
6 Records Found Page 1 of 2 5 Per Page

Organism Name	Synonyms	Organism ID
Cucumber mosaic virus (cucumber mosaic cucumovirus)	Cucumber mosaic virus, cucumber mosaic cucumovirus, cucumber mosaic virus CMV, cucumber mosaic cucumovirus CMV, cucumber mosaic virus, CMV, CMV	12305
Lymphocytic choriomeningitis mammarenavirus	Lymphocytic choriomeningitis mammarenavirus, Lymphocytic choriomeningitis virus, lymphocytic choriomeningitis virus LCMV, LCMV	11623
Murid betaherpesvirus 1 (Murine cytomegalovirus)	Murine cytomegalovirus, Murid betaherpesvirus 1, murine herpesvirus 1, murine cytomegalovirus MCMV, murine cytomegalovirus (MCMV), Murid herpesvirus 1, Mouse cytomegalovirus 1	10366
Human herpesvirus 5 (Human cytomegalovirus)	herpes virus 5,CMV,HHV5,HSV-5,HSV5, Human cytomegalovirus, Human betaherpesvirus 5, human herpesvirus type 5, Human herpesvirus 5, HHV-5	10359
Rhesus cytomegalovirus strain 68-1 (Rhesus cytomegalovirus (strain 68-1) (RhCMV))	Rhesus cytomegalovirus strain 68-1, Rhesus cytomegalovirus (strain 68-1) (RhCMV), Rhesus cytomegalovirus (strain 68-1)	103930

6 Records Found Page 1 of 2 5 Per Page

# External Resources and Ontologies

<b>Peptidic Epitope</b>	Amino acid sequence
	Protein source
	Organism source



PKYVKQNTLKLAT  
 hemagglutinin HA1  
 GenBank/UniProt  
 GI:AAL62329.1—UniProt:Q8V285

**MOLECULE FINDER**

Current Selection(s) Reset Apply

**Search By**

Name:

Molecule ID:

Source Organism:  Finder

Search

**Browse by Tree (Click to Select)**

- [-] Bacteriophage (RNA) protein
- [-] Influenza virus protein
  - [-] Influenza A virus protein
    - [-] Hemagglutinin
      - signal peptide (1-17)
      - mature protein (18-565)
      - Hemagglutinin HA1 chain (18-342)
      - Hemagglutinin HA2 chain (344-565)
      - Matrix protein 1

**Search Results (Click to Select)**

53 Records Found Page 1 of 11 5 Per Page

Molecule Name	Synonyms	Database ID	Organism Name
Influenza A virus protein	influenza A, Influenza A virus, Human Influenza A Virus, Influenza virus type A, FLUAV	IEDB [11320]	Influenza A virus
Influenza B virus (Influenza virus type B) protein	Influenza B virus, Influenza virus type B, FLUBV	IEDB [11520]	Influenza B virus (Influenza virus type B)
Influenza C virus (Influenza C viruses) protein	Influenza C viruses, Influenza C virus, Influenza virus type C, FLUCV	IEDB [11552]	Influenza C virus (Influenza C viruses)

# External Resources and Ontologies

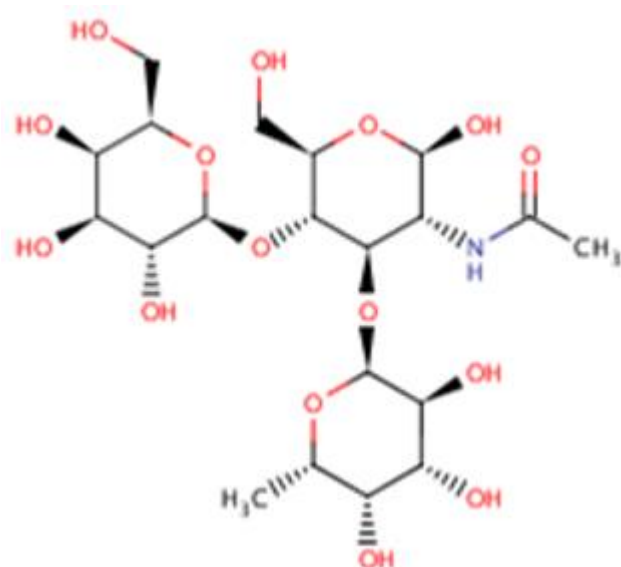
<b>Non-peptidic Epitope</b>	Structure name
	Source structure
	Organism source



$\alpha$ -L-Fucp-(1→3)-[ $\beta$ -D-Galp-(1→4)]- $\beta$ -D-GlcpNAc  
 CHEBI:59294  
 Lipopolysaccharide  
 CHEBI:16412



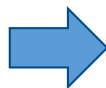
NCBI taxon:210  
 Helicobacter pylori



ChEBI Name	$\alpha$ -L-Fucp-(1→3)-[ $\beta$ -D-Galp-(1→4)]- $\beta$ -D-GlcpNAc
ChEBI ID	<b>CHEBI:59294</b>
ChEBI ASCII Name	alpha-L-Fucp-(1->3)-[beta-D-Galp-(1->4)]-beta-D-GlcpNAc
Definition	An $\alpha$ -L-Fucp-(1→3)-[ $\beta$ -D-Galp-(1→4)]-D-GlcpNAc where the glucosamine at the reducing end has $\beta$ -configuration at its anomeric centre. Commonly known as Lewis x trisaccharide or Le <sup>x</sup> .
Stars	☆☆☆ This entity has been manually annotated by the ChEBI Team.

# External Resources and Ontologies

<b>Immunization Process(es)</b>	Host
	Immunogen
	Administration
	Disease



Homo sapiens (human)  
NCBI  
taxon:9606



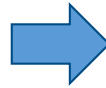
Peanut allergy  
DO  
DOID:4378



Metadata		Visualize
DOID	DOID:4378	
Name	peanut allergic reaction	
Definition	A food allergy that is an allergy or hypersensitivity to dietary substances from peanuts causing an overreaction of the immune system which in a small percentage of people may lead to severe physical symptoms. <a href="http://en.wikipedia.org/wiki/Allergy#Foods">http://en.wikipedia.org/wiki/Allergy#Foods</a>	
Synonyms	Allergy to peanuts (disorder) [EXACT] Peanut allergy [EXACT]	
Xrefs	<a href="#">MSH:D021183</a> SNOMEDCT_US_2015_03_01:213021008 SNOMEDCT_US_2015_03_01:91935009 UMLS_CUI:C0559470	
Relationships	is_a <a href="#">food allergy</a>	

# External Resources and Ontologies

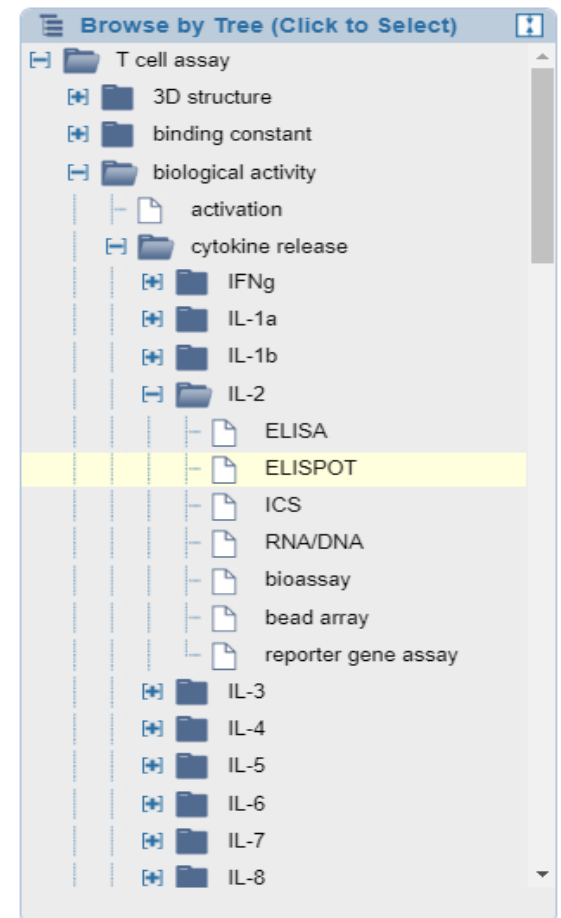
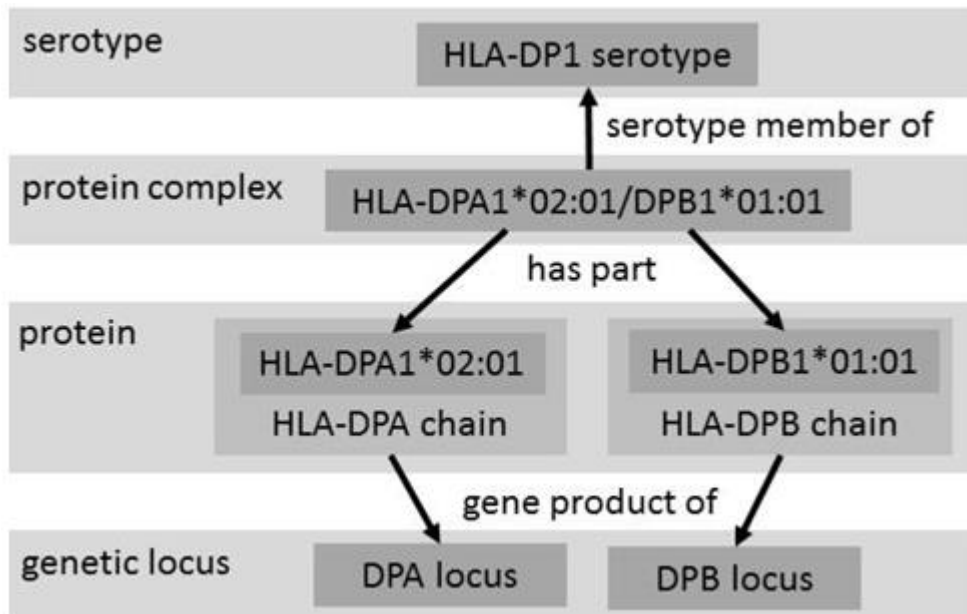
<b>Immunization Process(es)</b>	Host
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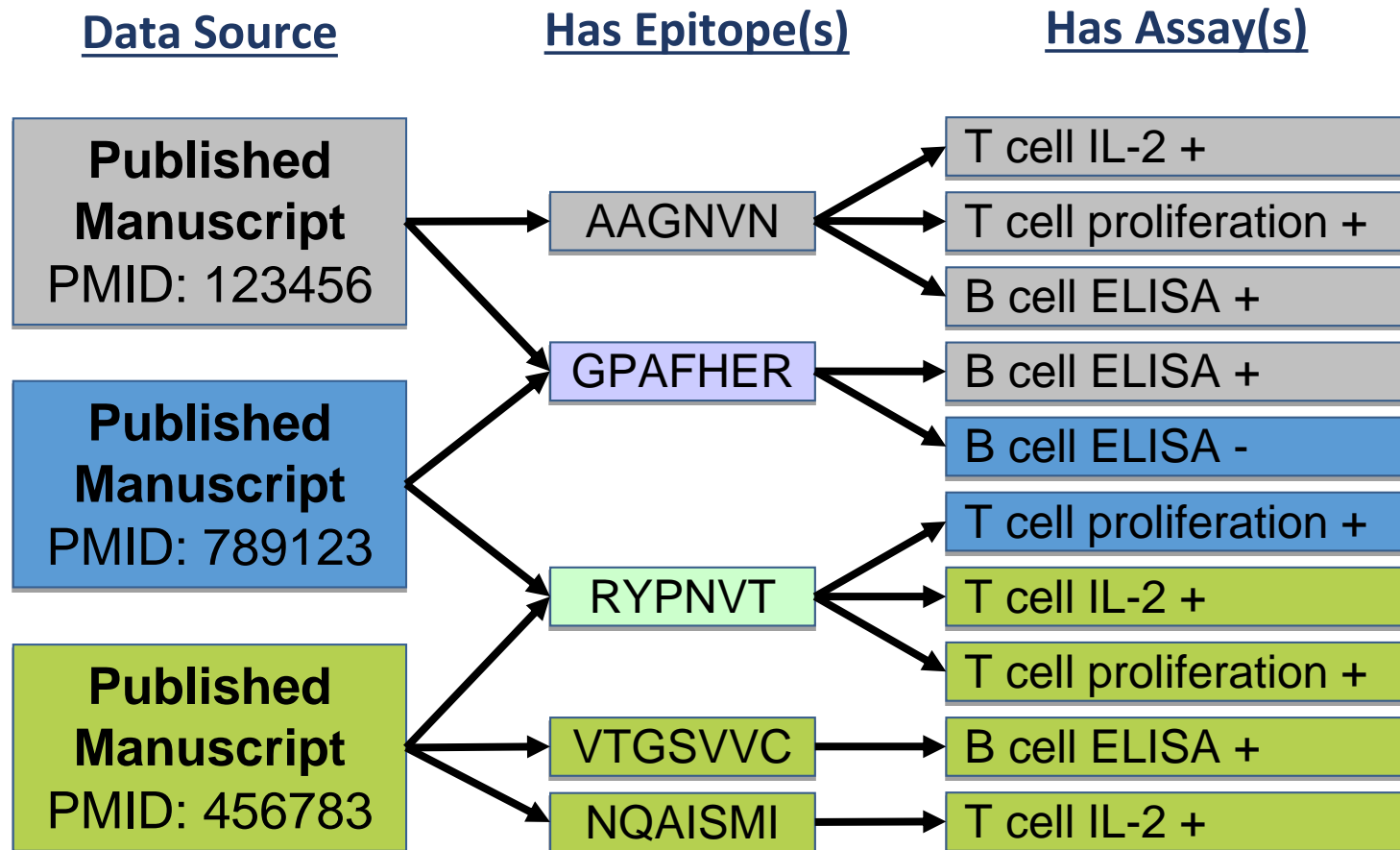
ELISA IL-2 release  
 OBI  
 OBI:1110152



MHC Restriction Ontology (MRO)



# Data Aggregation



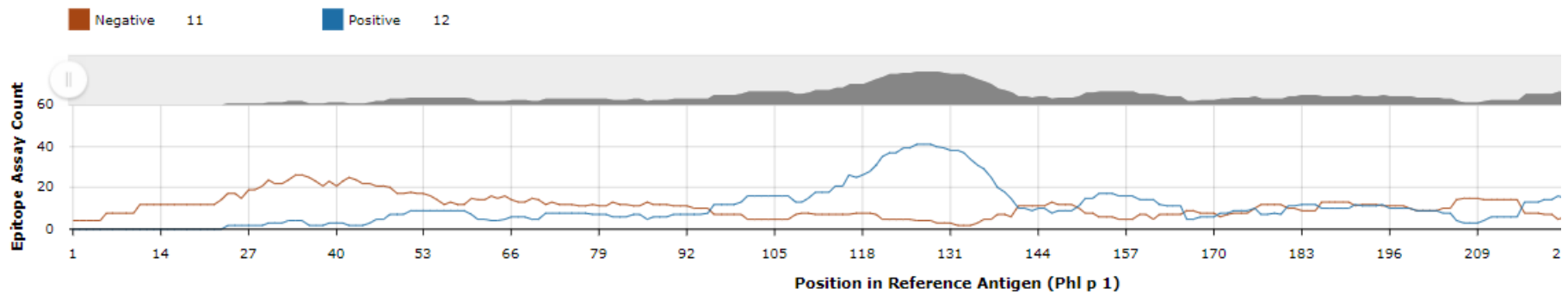


# Data Aggregation

## Phleum pratense (timothy grass) - Phl p 1

Pending Filters Positive Assays Only Organism: Phleum pratense (timothy grass) (ID:15957, timothy) Host: Homo sapiens (human) Disease Data: Allergic Disease

### Epitope Assay Counts [?](#)





### Welcome

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[Learn More](#)

### Upcoming Events

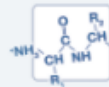
- An IEDB Case Study: TB Sept 3  
\* webinar recording [here](#)
- FOCIS Virtual Booth Oct 28-31
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### Summary Metrics

Peptidic Epitopes	971,496
Non-Peptidic Epitopes	3,051
T Cell Assays	383,184
B Cell Assays	549,059
MHC Ligand Assays	2,927,353
Epitope Source Organisms	3,974
Restricting MHC Alleles	860
References	21,564

### START YOUR SEARCH HERE ?

#### Epitope ?



- Any Epitopes
- Linear Epitope
- Discontinuous Epitopes
- Non-peptidic Epitopes

Exact M  Ex: SIINFEKL

#### Assay ?



- Positive Assays Only
- T Cell Assays
- B Cell Assays
- MHC Ligand Assays

Ex: neutralization

#### Antigen ?



Organism

Antigen Name

#### MHC Restriction ?



- Any MHC Restriction
- MHC Class I
- MHC Class II
- MHC Nonclassical

Ex: HLA-A\*02:01

#### Host ?



- Any Host
- Humans
- Mice
- Non-human Primates

Ex: dog, camel

#### Disease ?



- Any Disease
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Ex: asthma, diabetes

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Scan an antigen sequence for amino acid patterns indicative of:

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[Antigen Sequence Properties](#)

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- [ElliPro](#)

#### Epitope Analysis Tools ?

Analyze epitope sets of:

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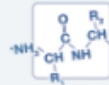
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- |                                              |           |
|----------------------------------------------|-----------|
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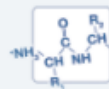
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Reset

Search

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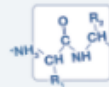
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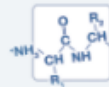
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- Any Disease
- Infectious Disease
- Allergic Disease
- Autoimmune Disease

Ex: asthma, diabet

## Epitope Analysis Resource

### T Cell Epitope Prediction ?

Scan an antigen sequence for amino acid patterns indicative of:

- MHC I Binding
- MHC II Binding
- MHC I Processing (Proteasome, TAP)
- MHC I Immunogenicity

### B Cell Epitope Prediction ?

Predict linear B cell epitopes using:

[Antigen Sequence Properties](#)

Predict discontinuous B cell epitopes using antigen structure via:

- [Discotope](#)
- [ElliPro](#)

### Epitope Analysis Tools ?

Analyze epitope sets of:

- [Population Coverage](#)
- [Conservation Across Antigens](#)
- [Clusters with Similar Sequences](#)

# Identifier Search

The screenshot shows the IEDB website interface. At the top left is the IEDB logo and the text "IMMUNE EPITOPE DATABASE AND ANALYSIS RESOURCE". Navigation tabs include "Home", "Specialized Searches", and "Analysis Resource". A dropdown menu under "Specialized Searches" is open, with "Identifier Search" highlighted by a red box and a red arrow. Other menu items include "Epitope Details", "T Cell Assay Details", "B Cell Assay Details", "MHC Assay Details", and "Browse by 3D Structure".

**Welcome**

The Immune Epitope Database (IEDB) is a freely available resource funded by NIAID. It catalogs experimental data on antibody and T cell epitopes studied in humans, non-human primates, and other animal species in the context of infectious disease, allergy, autoimmunity and transplantation. The IEDB also hosts tools to assist in the prediction and analysis of epitopes.

[Learn More](#)

**START YOUR SEARCH HERE**

**Epitope**

Any Epitopes  
 Linear Epitope  
 Discontinuous Epitopes  
 Non-peptidic Epitopes

Exact M

**Antigen**

Organism

Antigen Name

**MHC Restriction**

Any MHC Restriction  
 MHC Class I  
 MHC Class II  
 MHC Nonclassical

**Host**

Any Host  
 Humans  
 Mice  
 Non-human Primates

**Disease**

Any Disease  
 Infectious Disease  
 Allergic Disease  
 Autoimmune Disease

**Epitope Analysis Resource**

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Metric	Count
Peptidic Epitopes	971,496
Non-Peptidic Epitopes	3,051
T Cell Assays	383,184
B Cell Assays	549,059
MHC Ligand Assays	2,927,353
Epitope Source Organisms	3,974
Restricting MHC Alleles	860
References	21,564

# Identifier Search

**IDENTIFIER SEARCH**

**IEDB Identifiers**

Epitope ID

Reference ID

Submission ID

Assay ID

**External Identifiers**

PubMed ID

PDB ID

ChEBI ID

**Search**

*A quick way to retrieve data by using an identifier*

**Unique identifiers created by IEDB**

**Unique identifiers from other resources**





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[Learn More](#)

Upcoming Events

- An IEDB Case Study: TB Sept 3  
\* webinar recording [here](#)
- FOCIS Virtual Booth Oct 28-31
- User Workshop Nov 5-6  
\* register for workshop [here](#)

Summary Metrics

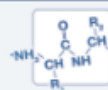
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START YOUR SEARCH HERE ?

Epitope ?

- Any Epitopes
- Linear Epitope
- Discontinuous Epitopes
- Non-peptidic Epitopes

Exact M  Ex: SIINFEKL



Assay ?

- Positive Assays
- T Cell Assays
- B Cell Assays
- MHC Ligand Assays

Ex: neutralization

Antigen ?

Organism

Antigen Name



MHC Restriction ?

- Any MHC Restriction
- MHC Class I
- MHC Class II
- MHC Nonclassical
- Ex: HLA-A\*02:01



Host ?

- Any Host
- Humans
- Mice
- Non-human Primates
- Ex: dog, camel



Disease ?

- Any Disease
- Infectious Disease
- Allergic Disease
- Autoimmune Disease
- Ex: asthma, diabetes



Analysis Resource

Epitope Prediction ?

- Antigen sequence for amino acid predictive of:
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Epitope Analysis Tools ?

- Analyze epitope sets of:
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Support

Help Request

Provide Feedback

Video Tutorials

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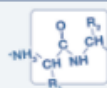
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**START YOUR SEARCH HERE ?**

**Epitope ?**

- Any Epitopes
  - Linear Epitope
  - Discontinuous Epitopes
  - Non-peptidic Epitopes
- Exact M



**Assay ?**

- Positive Assays Only
  - T Cell Assays
  - B Cell Assays
  - MHC Ligand Assays
- Ex: neutralization



**Antigen ?**

Organism

Antigen Name



**MHC Restriction ?**

- Any MHC Restriction
  - MHC Class I
  - MHC Class II
  - MHC Nonclassical
- Ex: HLA-A\*02:01



**Host ?**

- Any Host
  - Humans
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- Ex: dog, camel



**Disease ?**

- Any Disease
  - Infectious Disease
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- Ex: asthma, diabetes



Reset

Search

**Resource**

**T Cell Epitope Prediction ?**

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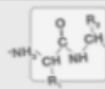
Welcome

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START YOUR SEARCH HERE ?

Epitope ?

- Any Epitopes
- Linear Epitope



Assay ?

- Positive Assays Only
- T Cell Assays



T Cell Epitope Prediction ?

Scan an antigen sequence for amino acid patterns indicative of:  
MHC I Binding



## Tutorials and Reference Materials

*Includes links to video tutorials.*

- ★ 2019 IEDB User Workshop Presentations
- ★ IEDB User Documentation Release 3
- 2018 IEDB User Workshop Presentations
- Browse by Source Organism (IEDB 3.0)
- Browse by MHC Allele (IEDB 3.0)
- Molecule Finder (IEDB 3.0)
- Allele Finder (IEDB 3.0)
- Home Page Search (IEDB 3.0)
- Understanding Search Results (IEDB 3.0)
- Diseases in IEDB 3.0

# More Exports

The screenshot shows the IEDB website interface. At the top, there is a navigation bar with 'Home', 'Specialized Searches', and 'Analysis Resource'. A 'Help' dropdown menu is open, showing 'More IEDB' with a sub-menu containing 'Database Export', 'Meta-Analyses', 'Citing the IEDB', 'Release Notes', and 'Links'. A red arrow points to 'Database Export'. Below the navigation bar is the IEDB logo and the text 'IMMUNE EPITOPE DATABASE AND ANALYSIS RESOURCE'. The main content area is divided into several sections: 'Welcome', 'Upcoming Events', 'Summary Metrics', 'START YOUR SEARCH HERE', 'Epitope Analysis Tools', and 'T Cell Epitope Prediction'. The 'START YOUR SEARCH HERE' section contains filters for Epitope, Assay, Antigen, MHC Restriction, Host, and Disease. The 'Summary Metrics' table is as follows:

Metric	Count
Peptidic Epitopes	971,496
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Restricting MHC Alleles	860
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# More Exports

[http://www.iedb.org/database\\_export\\_v3](http://www.iedb.org/database_export_v3)

XML Database Export	
<a href="#">Complete Database Export</a>	323MB
<a href="#">iedbAccessionList.zip</a>	49kB
<a href="#">MhcAlleleNameList.zip</a>	34kB
<a href="#">OrganismList.zip</a>	35MB
<a href="#">AssayTypeList.zip</a>	5kB
<a href="#">GeoLocList.zip</a>	3kB

IEDB Schema	
<a href="#">Curation.xsd (Primary IEDB schema)</a>	48kB
<a href="#">CurationSimpleTypes.xsd</a>	303kB
<a href="#">iedbAccessionList.xsd</a>	909B
<a href="#">MhcAlleleNameList.xsd</a>	1kB
<a href="#">OrganismList.xsd</a>	751B
<a href="#">AssayTypeList.xsd</a>	771B
<a href="#">GeoLocList.xsd</a>	642B

MySQL Database Export	
<a href="#">SQL Statement Export</a>	379MB
<a href="#">MyISAM Binary Export</a>	819MB

Physical Entity Relationship Diagram	
<a href="#">iedb_public_erd.pdf</a>	31kB

CSV Metric Exports	
<a href="#">epitope_full_v3.zip</a>	65MB
<a href="#">antigen_full_v3.zip</a>	2MB
<a href="#">tcell_full_v3.zip</a>	28MB
<a href="#">bcell_full_v3.zip</a>	36MB
<a href="#">mhc_ligand_full (single_file.zip) (multi_file.zip)</a>	168MB
<a href="#">reference_full_v3.zip</a>	12MB
<a href="#">receptor_full_v3.zip</a>	5MB
<a href="#">iedb_3d_full.zip</a>	3MB

Stable ID Exports	
<a href="#">Linkout IDs Compact</a>	21MB
<a href="#">Linkout IDs Full</a>	40MB
<a href="#">ChEBI to Epitope ID Maps</a>	158kB
<a href="#">PDB to Epitope ID Maps</a>	51kB
<a href="#">Epitope ID to Linear Seg Maps</a>	11MB

# Receptor\_full Export

- Receptor\_full contains exports of all antibody and T cell sequences in the IEDB
- Provides nucleotide and protein full length sequences
- Includes CDR1, 2, and 3 sequences
- Includes gene usage
- Listed by each epitope that they were shown to recognize

# iedb\_3d\_full Export

- iedb\_3d\_full contains exports of all 3D structures in the IEDB
- Antibody, MHC, and T cell are in separate spreadsheets
- Provides structural details on receptor-Antigen interactions (inter-molecular contacts)
- Include PDB IDs and resolutions of complexes, PDB chain IDs of antibody, TCR, MHC, and antigen chains
- Includes full length receptor and antigen sequences
- Can be combined with receptor export to get information on CDRs and VDJ gene usage



# After the Break

- **How to query the data in the IEDB**
- **Your submitted questions**



# But first...

